Morgan

HAM RADIO TODAY

AN ARGUS SPECIALIST PUBLICATION

August '84

99p

ANTARCTIC DXING from VP8ANT

The Cut Price Quad

Scanning Receivers Investigated

High Performance 2m GaAsFET Preamplifier by John Matthews, G3WZT

HAM RADIO TODAY CONTENTS

VOLUME TWO NO. 8 AUGUST 1984

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Interested in vintage wireless sets? Tim Wander tells of a historic occasion

REVIEWS

RADIO TODAY

'Unlicensed' Possession Of Transmitting Equipment

A Law report in the edition of *The Times* dated 28 March 1984 carried the title "Proof of unlicensed use not necessary". This related to the case of 'D' (a Minor) v Yates in the Divisional Court. Basically, the judgment was that "....the offence of using apparatus for wireless telegraphy without a licence, contrary to section 1(1) of the Wireless Telegraphy Act 1949, was commited *where the set was available for use at any time and it was unnecessary to prove that the set had been used or that the defendant intended to use it"*.

To quote further from the Law report, "...The Queen's Bench Divisional Court so held and dismissed the defendant's appeal from the dismissal by Manchester Crown Court... of her appeal against conviction of an offence that between 13 November 1982 and 20 November 1982 the defendant did use a Superstar 360 CB transceiver without a licence, contrary to section 1(1). The crown court, having considered the evidence, was not sure that the defendant had operated the set between 13 and 20 November but *was sure that during that period she kept the set readily available for operation and intended to use it if the occasion arose.* The sole issue was whether in order to establish an offence under the section of having 'used' an apparatus it was necessary for the prosecution to establish that the set was switched on and transmitting and receiving during those dates".

"The crown court concluded that that was not the proper meaning of "use" in that section, and that it would be virtually impossible to obtain a conviction if the operator had to be apprehended at the time the set was switched on".

"Even without reference to the defendant's state of mind, that is, her intention to use the set in the future, *the offence had been established by the fact that the set was available for immediate use at any time."*

Lord Justice Kerr further said that the word "use" should be given a broad and sensible interpretation of being available for use. *It was going too far to require proof that the set was being used at the time.*

Leave to appeal to the House of Lords has apparently been refused. The Divisional Court decision in this case therefore has some very far-reaching consequences insofar as illegal operation on amateur frequencies, and any others for that matter, is concerned. It appears that a prosecution for unlicensed use can succeed without it being necessary for the prosecution to show that the equipment in question was switched on and transmitting or receiving: in other words, that the offence was established by reason of the equipment being available for immediate use at any time. This is very different from the opinion given to the RSGB at various times by the Home Office and the DTI that it is not possible to bring a successful prosecution under the Wireless Telegraphy Act because proof of transmission was necessary.

Given that the RSGB and the amateur radio fraternity as a whole is well aware of the very serious problems presented by the illegal use of radio transmitters, which continue to manifest themselves both in amateur bands and elsewhere, the consequences of this judgment give some grounds for hope that a solution may become available.

Apparently the RSGB has written to the DTI to make some points with respect to this case, and there appears to be a case for cautious optimism that it may at last be possible to tackle the apparently insuperable problem of illicit operation from a more productive angle.

There is another cause for optimism insofar as the Telecommunications Bill has now completed its passage through Parliament, receiving the Royal Assent on 12 April 1984, and has become law: the actual effects of this remain to be seen: it will now become possible for the authorities to take meaningful action against many of the abuses which have caused problems for radio amateurs in recent years. **(This item from RSGB Council Letter, May 1984).**

UOSAT-2 Back In Action

UOSAT-2, Surrey University's second scientific and educational spacecraft, has begun transmitting data after having been silent for over ten weeks. It responded to commands from the Surrey Command Station at 1105 hrs UTC on Monday 14 May, and is now transmitting telemetry data on its main data beacon on 145.825MHz.

Designed and built at the University of Surrey in the record time of only five months, UOSAT-2 was given a flawless launch from California by NASA on 1 March. During its first few orbits, the spacecraft operated perfectly, transmitting a strong signal of telemetry data and responding to a complex series of commands. It then ceased transmitting on command from the primary on-board computer. Up to that point, the telemetry indicated that the condition of the spacecraft after launch was very good.

Problems arose on the morning after launch, when UOSAT-2 did not respond to repeated commands from the Surrey Command Station. Then began a long series of checks to establish what the cause of the trouble might be, made all the more difficult by the fact that according to the telemetry — the equivalent of the readings and switch positions on the instrument panel of an aircraft — there was nothing wrong at all. At the same time, daily attempts were made to gain command of the spacecraft, but with no success.

Major progress was made on the 12th May in the international effort to recover the spacecraft. Radio amateurs at the Stanford Research Institute, California, using a very sensitive outstation in Greenland, picked up faint signals on 1.2 GHz. These signals indicated that the command receivers of UOSAT-2 were switched on. (Television detector vans use a similar principle!) This important discovery confirmed not only that the spacecraft was still operating, but also that it was in its predicted orbit.

Armed with this encouraging information, Neville Bean and Roger Peel, research officers of the UOSAT Project Team in the University's Department of Electronic and Electrical Engineering, made a further routine attempt on Monday 14 May, to command the spacecraft. Attempts using the 144 MHz receiver were unsuccessful, but, on the next orbit, commands using the

438MHz receiver resulted in the main data beacon being powered up. *The signals from the beacon are as strong as they were on the evening of the launch, and can be received on the simplest of narrowband VHF receivers, in the same way as the signals from UOSAT-1.*

Telemetry data is now being transmitted continually on 145.825MHz, and receiving stations around the world are picking it up and passing it to the Surrey Command Team, to supplement the data they are receiving from the spacecraft. Early analysis of the telemetry indicates that UOSAT-2 is in good shape, with a battery voltage of 14.6 volts and temperatures of zero to minus five degrees C, as expected.

It appears that there may be an intermittent fault in the command receiving system, but it will probably take many weeks of analysis to trace the problem and to see if it can be cured or avoided in the future. Not until then will the spacecraft, at present in a stable spin, be manoeuvred into its permanent orbiting attitude with the TV camera pointing to earth; the checking of the various scientific and educational experiments on board will then begin.

Because UOSAT-2 is in a higher orbit that UOSAT-1 — 435 miles compared with 330 miles — its orbit characteristics are much less affected by changes in the density of the ionosphere. Its orbit times are within ten seconds of those predicted from the early orbits. The Surrey University UOSAT Information Service is providing news and reference orbits on Guildford (0483) 61202. Enquirers experiencing delay in getting through on this number are asked to be patient and remember that the answering machine is dealing with a continual stream of calls from many parts of the world.

HRT at the NEC

(Four Go Mad in Edgebaston)

The HRT team relaxing before the Sunday morning onslaught at the RSGB Amateur Radio Convention

At 9 p.m. on 28th April, the HRT team, supplimented by 'Hobby Electronics' Ad. Manager Jo James, stumbled somewhat sleepily into Hall 3a of the NEC in Birmingham for the first day of the RSGB Amateur Convention.

Setting up the stand was swiftly completed as the crowds poured in. Fortified only by cartons of chips and coffee, the day took off with a bang. Entry into the exhibition proved much swifter than last year and the waiting crowd of about 2000 was inside the hall in a matter of minutes.

Little time was left to the Editor to visit lectures and haggle in the Fleamarket as he desired, due to the extremely enthusiastic crowd who thronged the stand to buy magazines, subscriptions, ask (usually) sensible questions and generally shoot the breeze. Quite a few old acquaintances were renewed also.

Taking a fish and chip break and a stroll around, I was particularly impressed by the 'G-QRP Club' stand which, among other goodies, offered a QRP transmitter which was built right in front of the purchasers eyes in minutes — effectively showing how simple QRP construction can be.

BNOS Electronics were displaying a rather natty 70cm 50W linear/pre-amp, apparently on show for the first time. All the name British manufacturers were there and quite a few had interesting things 'in the pipeline', of which I will let readers have details as soon as I can. Johnny Melvin, G3LIV, dropped by the stand (remember his RTTY interface for the BBC 'B' Computer, reviewed in February '84 HRT) with news of an interface he has developed to run SSTV with the BBC 'B'. This will shortly be the subject of an in-depth review in HRT — if the price of SSTV has frightened you off the mode, look out for this.

By 5 p.m. on Saturday, we had sold all the pre-publication issues of July HRT we had been able to get hold of. Ideas of ringing the Circulation Director at his home in Kent, and asking him to drive to the printers and then to the NEC were hatched. We decided to keep our jobs however...

Even on Saturday night we (G6LPZ) couldn't leave Amateur Radio alone. On a visit to BBC's Pebble Mill, a vehicle with the legend 'G4CBQ — 160m rules' (or something similar) was spotted in the car park. Ten minutes and a visit to the bar later, we were being shown around G2BBC/G6BBC, the Pebble Mill club station. This was followed by a swift Indian meal, after which we foolishly strayed into the convention hotel bar...

Sunday was pretty much as per Saturday regarding the exhibition attendance. Despite the lack of June issues we were very busy — as was every stand that I saw.

After the announcement of the winner of our subscription draw (winning a 7 ele 2m yagi donated by MET antennas and 'The CQ Centre') we wearily packed the stand, counted the money (!) and prepared for the trek southwards with the knowledge that over 10,000 visitors had walked past, if not visited (I must say it felt like it) our stand.

Well, we'll be back next year, maybe even with Fay Clark of Arrow Electronics brightly coloured table cloths (for which thanks) again. Thanks for dropping by and we'll see you then.
73 de G3ZZD, G4NXV, G6LPZ and Jo James.

WPO Communications Latest

WPO *Communications* are now making many of their designs available as ready built and aligned PCB modules, leaving only the external components to be wired in by the constructor. As an example, the popular DSB80 and 160 series QRP transceivers can now be purchased as ready built and aligned modules. Also available will be their range of PLL Synthesised VFO's, including a new 2 metre design, and their 2 metre FM Transceiver, plus 6 metre converter. This new service "will meet the requirements of those people who want to have some element of home construction in their station, but lack

the confidence to build from kits."

Also, they announce the re-introduction of their *Talking Frequency Meter* for the visually handicapped amateur. This is designed to assist Blind amateurs in determining their transmit frequency, although the unit can be used for any of the applications a normal frequency counter could be put to, including frequency readout under difficult operating conditions. It covers 500kHz to 150MHz (minimum) in two ranges, with a resolution of 100Hz between 500kHz and 40MHz, and 1kHz between 20MHz and 150MHz.

Speech is of good quality "from a unique circuit," through its own built in speaker, and the meter features either manual or automatic repeat operation, with selectable 2, 4 or 6 digit groups of figures spoken. The new unit has improved sensitivity at HF, and reverse polarity plus input protection. It operates from a 12V external supply and is supplied ready built and tested.

Priced at £179 including VAT and Post, further information on the Talking Meter, and ready built modules can be obtained on Hassocks (07918) 6149, or by post to 20, Farnham Avenue, Hassocks, West Sussex BN6 8NS.

Ex-Editor Attempts To Pass The RAE!

Former Editor of HRT (now Consultant Editor) Dave Bradshaw recently sat the May RAE examination in an attempt to gain his licence. He writes "Although I started my electronics career as an SWL, I wasn't actively involved in radio when I took on the editorship of HRT at short notice, so I was relieved to eventually get the chance of becoming less of a fraud, albeit as Consultant Editor. However, deciding to sit the May RAE, I was dismayed at the lack of quality of the examination.

"I think I can claim to have a reasonable knowledge of electronics, as I've taught it to 'A' level and to undergraduate students of physics, and I have been Editor of HRT's sister publication, ETI, for two years; however, some of the questions on the RAE had me completely flummoxed, either because all the multi-choice options given seemed wrong (!) (reducing the examinees takes to trying to choose the least wrong answer) or more than one option was correct."

"A good example of the latter case was provided by the very last question on the paper. I have to try to recall this from memory because you are not allowed to take the question paper out of the room (is this for fear of ridicule on the part of the City of Guilds Institute who set the examination?). The question went roughly as follows: in an oscilloscope tube, plates X2 and Y2 are earthed; how do you connect the X1 and Y1 plates to determine by the trapezoidal method the depth of modulation of a transmitter's output? i) X1 to timebase, Y1 to Tx O/P; ii) X1 to audio I/P, Y1 to Tx O/P; iii) X1 to Tx O/P, Y1 to audio I/P; iv) X1 to Tx O/P, Y1 to timebase. Of course, both ii) and iii) will work!

"Let me say at once that I am a strong believer in multiple-choice examinations, as I think that examinations with written answers can be as much a test of a candidate's English and handwriting as much as the subject under test. Additionally, a well-designed multiple choice exam can test a far wider range of knowledge than a written examination. However, by my reckoning, around 10% of the questions of this examination were unacceptably poor."

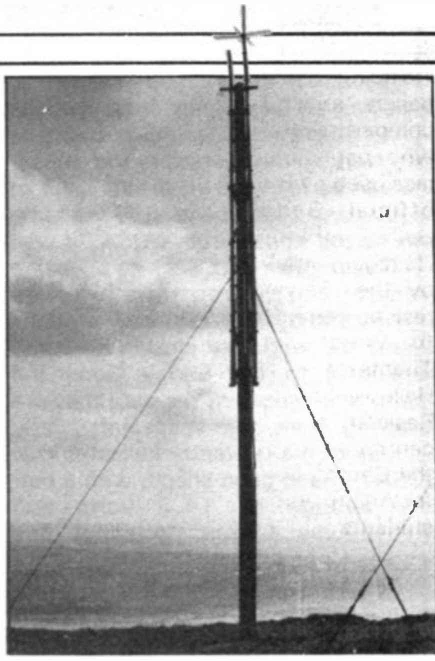
"Whether I pass or fail, let me put on record now that I do not think my ability — or the abilities of the other candidates sitting the examination with me — has been fairly tested."

Cheap SSTV With The BBC 'B'

There is a growing interest in ham radio circles towards the reception of SLOW SCAN TELEVISION using computers. A new unit designed by G3LIV and G8UEE for the BBC 'B' Computer allows ham radio video transmissions to be displayed on a compatible monitor or TV receiver and is complete with software. The BBC computer was chosen because of the high level of ownership in ham radio and short wave circles.

Many transmissions can be copied from countries all over the world using this system. The unit offered has facility within the software to receive pictures from both 50Hz and 60Hz countries.

The rear of the hardware has a 20 pin IDC connector which mates directly with the BBC computers' I/O port. This cable carries all digital and power rails to and from the computer.



The Orkney-Caithness Repeater Group was formally constituted in April 1984. Shown above is their GB30C repeater, near Kirwall. (Ken Doughty)

The tape containing the program has also SSTV video pictures and test signals recorded on the reverse side. This will allow the setting up of the converter, as well as allowing the owner to become familiar in using the equipment. Up until now, SSTV has only possible with the use of very expensive scan converters costing many hundreds of pounds, or the old fashioned long persistance CRT design. The cost of the PC board with program on tape, with full constructions for building are £17.50. A fully boxed and tested unit with program at £93.00.

Any further information can be obtained from John Melvin, G3LIV at 2 Salters Court, Gosforth, Newcastle Upon Tyne, Tyne and Wear. Please enclose SAE. *This interface will be reviewed in a forthcoming HRT.*

Go See Some 'Spy Sets'

At 12 noon on Tuesday 8 May (VE Day) Mrs. Odette Hallowes GC opened **Resistance**, a major exhibition which examines the nature of European resistance to Nazi Germany and the various forms it took between 1939 and 1945, at the Imperial War Museum, London SE1. This will run to 21st April 1985.

The exhibits on display include a phial of heavy water and wreckage from an aircraft which crashed during the first unsuccessful attempt in the Norsk heavy water plant in Norway in November 1942; **wireless sets** and **transmitters**; secret agents' equipment including a handbag containing false papers, a pistol and a hidden message compartment carried by a woman agent who parachuted into France; escape aids used by RAF aircrew; a copy of the official Gestapo report on the assassination of the SS leader Reinhard Heydrich; intelligence data assembled by the 'Service Clarence', a Belgian resistance circuit; and material relating to Wing Commander F.F.E. Yeo-Thomas, the 'White Rabbit' and Odette Hallowes, both of whom worked for the Resistance, survived internment in concentration camps and were awarded the George Cross. Admission is £1.50 for Adults and 80p Children, OAPs and students.

L to R. Kevin, EI740, Aidan, EI3EG, John EI5FC, Helen, EI646, Tom, EI6BA and Finbar, EIICS, members of Cork Radio Club who recently hosted the AGM of the Irish Radio Transmitters Society in Cork. (Photo by Mike, EI9FE)

RAYNET Changes

The operation of the Radio Amateur Emergency Network (RAYNET) will be affected by changes to the Amateur Radio Licence which will come into effect on June 8 1984.

Announcing the alterations to the licence Mr. Kenneth Baker MP, Minister of State for Industry and Information Technology, said in reply to a Parliamentary Question from Mr. Neil Thorne MP (Ilford South) today:

"My Department has recently agreed with the Radio Society of Great Britain to increase the present limit which applies to RAYNET group exercises and changes will be made to the Amateur Radio Licence to come into effect on June 8 1984. From this date, any exercise relating to disaster relief operations conducted by one of the user services (ie the British Red Cross Society, the St. John Ambulance Brigade, the County Emergency Planning Officer or any police force in the UK) will be without limit. Participation in other operations conducted by a user service will be subject to a maximum of 4 exercises in any one calendar month and an overriding limit of 12 in any calendar year."

"An additional change to the licence is being made to enable an amateur station to be operated during any disaster relief operation in the presence of and under the direct supervision of the licensee, by a representative nominated by the user service conducting the operation."

1 The change in the licence will be as follows:

Clause 1(1)(c): The current rules applying to RAYNET exercises introduced in January 1983 on a trial basis will now be formally constituted in the licence and additional freedom will be given by removing all restrictions to those exercises which are associated with disaster relief operations. The new limits apply only to the charity walk, county show, and marathon type of events giving RAYNET groups greater flexibility in their choice of event.

Clause 1(2)(c): Provision is being made for the use of an amateur station by someone nominated by the user service during a disaster relief operation when the use is supervised by the licensee. This would, for example, enable a doctor working in conjunction with the St John Ambulance Brigade (one of the user services listed in the licence) to operate the station himself rather than through the intermediary of the licensee.

Repeater Latest — 23cm and 28MHz Proposals

23cm Repeaters. Although a number of these units are licensed, it appears that only the Brighton and Bristol units are operational. The results seem to be at great variance, the Brighton group reporting outstanding penetration and range, the Bristol group appearing to be disappointed with results.

These units are Beacon/Repeaters, and employ horizontal polarisation. The RMG are unwilling to accept any further applications for 23cm licences until at least half of the existing 'franchises' are operational.

Recently, the DTI have licensed five in-band TV repeaters on 24cm. The Leicester unit is reported operational using AM Video. The maximum erp allowed has been restricted by the DTI to 35W and this is disappointingly low; normal UHF TV repeaters using such powers are only expected to have a range of a few kilometres. A unit at Worthing is expected to be operational using FM Video and it will be interesting to compare results.

Future Developments. 3 repeater Groups have enquired about the possibility of Microwave input to existing repeaters. The RMG have said that they were willing to accept any proposal and were looking for a good receiver specification, particularly with respect to useable sensitivity.

A group in Cornwall has apparently proposed an FM 29 MHz repeater, along with five other groups in England (as reported in last months HRT). The RMG are discussing the proposals with the HF Committee who have indicated, perhaps surprisingly, that they would favourably consider any complete proposals. A frequency plan has been discussed based on 10KHz channel spacing as follows:

29.540 MHz Input 1
29.550 MHz Simplex
29.560 MHz Input 2
29.580 MHz Input 3
29.640 MHz Output 1
29.660 MHz Output 2
29.680 MHz Output 3

Although the recent IARU conference in Sicily came out against 28 MHz repeaters in Region 1, the doors are apparently not shut and this proposal may well be reconsidered.

The Stockland Hill Repeater Group are working towards a single site 28 MHz repeater (all, or nearly all, of the American repeaters are dual site to get good transmit/receive separation). They hope to achieve this by the use of a receiver with a block filter, high level diode ring mixer, running at +17 dBm, 21.4 MHz crystal and the local oscillator running high. A letter of intent and a proposal for the RMG is also being developed. Anybody (repeater groups?) who is interested in developing practical 28 MHz repeaters is invited to contact Roger Jones, G3YMK, on 0404 86 468.

GB3SF is a 2m pilot carrier SSB repeater recently licensed for Sheffield University. This is being built as a student project and problems have been encountered with receiver stability. It is hoped that the repeater will be operational this summer. **(Axe Vale ARC).**

RADIO Tomorrow

2 Jul	Horndean DRC: *On the Air Cheaply by G2DZT*	
	Leighton Linslade RC: ring PRO	
	Stourbridge ARS: Informal	
	Leighton Linslade ARS: *Tools for the Radio Amateur by AB Engineering Ltd*	
	Todmorden DARS: Radio Treasure Hunt	
	Braintree DARS: *Power Supplies by G3PEN*	
3 Jul	Bury RS: Surplus Equipment Sale	
	Vale of White Horse ARS: AGM	
4 Jul	S. Bristol ARC: Lecture by the RSGB	
	Fareham DARC: *Brewing ATUs by G4GBZ*	
	Wirral DARC: Barbeque at Heswall	
	Fylde ARS: Blackpool Airport Radio and Radar Visit	
	Cheshunt DARC: Equipment Evening	
	Wirral ARS: Surplus Sale	
	Nene Valley RC: Natter Night	
	Lincoln SWC: CW/RAE	
6 Jul	Axe Vale RC: Visit to Stockland Hill TV Transmitter	
	S. Manchester: VHF NFD Preparations	
	Sutton and Cheam RS: ring PRO for details	
	Haverhill DARS: 2m Foxhunt	
	Harrow RS: *Basic Microwaves*	
	Maltby ARS: Visit to IBA transmitter at Emley Moor	
	Dunstable Downs RC: ring PRO	
	Medway ARTS: Ham Radio Film Night	
7 Jul	Hastings ERC: Summer Barbeque	
7-8 Jul	**VHF NATIONAL FIELD DAY**	
9 Jul	Exeter ARS: *Static and Chips by G3RSJ*	
	Stratford Upon Avon DRS: *Homebrewing Tips*	
	Leighton Linslade RC: Quiz at Milton Keynes DRC in Newport Pagnell	
10 Jul	Mid-Warwickshire ARS: St. John's Ambulance	
	Wakefield DRS: ring PRO	
	Bury RS: Visit to IBA transmitter at Emley Moor	
	Wakefield DRS: 2m Foxhunt with Pontefract ARS	
	Basingstoke ARC: Contact G4OAC for details	
	Verulam ARC: HF Wire Antennas by Louis Varney, G5RV	
11 Jul	S. Bristol ARC: 70 cm night with G4EIA	
	Farnborough (Hants) DRS: Talk by G3IEE	
	Cheshunt DARC: Natter Nite	
	Nene Valley RC: Tube Sale with G4MEO	
	Lincoln SWC: *End of the Vulcan by G8VGF* (Pulp Sci-fi featuring Mr. Spock?! — Ed)	
12 Jul	To be arranged	
	Edgeware DARS: Outside Visit (TBA)	
	Bury RS: ring PRO	
13 Jul	S. Manchester RC: *The Beginning of the Universe by G4ROM*	
	Maltby ARS: Barge Trip — ring PRO	
14 Jul	Harrow RS: Informal	
15 Jul	RSGB Low Power Field Day	
	Sussex Mobile Rally at the Racecourse, Brighton. Undercover Exhibition Area. Free Parking. Excellent Catering. Facilities and free minibus rides to the seaside for all the family. Huge Bring and Buy stall plus trade stands. Open 1030-1700. Admission £1, children and disabled free. Talk-in S22 and 80m.	
	Glenrothes DARC: *Antarctica by ex-VP8AQA.*	
	Dunstable Downs RC: DF Hunt on 160m and 2m	
	Wirral DARC: DF Hunt	
16 Jul	Leighton Linslade RC: *Lightning and EMP Protection by George Jessop, G6JP*	
	Stourbridge ARS: A Look at the Club's Artifacts	
	Braintree DARS: *Nuclear Power by the CEGB*	
17 Jul	Biggin Hill ARS: *QRP by G4BUE*	
	Fylde ARS: Discussion of Blackpool Airport Visit	
	Midland ARS: Amateur TV	
18 Jul	S. Bristol ARC: Computer Night with G1DBH	
	Fareham DARC: *QRP from St. Kilda by G3WLY*	
	Wirral DARC: D & W	
	Cheshunt DARC: Visit — ring PRO	
	Wirrall ARS: *Computers in Amateur Radio*	
	Nene Valley RC: Lecture from Crime Prevention Officer	
	Lincoln SWC: CW/RAE/Hamfest Preparation	
20 Jul	Sutton and Cheam RS: *German Wartime Radio Equipment by G3IEE*	
	Haverhill DARS: Club Aerials	
	Harrow RS: Airborne Radio	
	Dunstable Downs RC: GB3TV Repeater Demonstration	
	Medway ARTS: *Improving your 2m DX by Ken Willis, G8VR*	
	S. Manchester ARS: Radio Clinic — bring your sick projects!	
21 Jul	**Radio and Electronics Fair held by West Kent ARS at Royal Victoria Hall, Southborough, Kent. 1030-1700. Computers, Video Games and AMATEUR RADIO. Car Parking. Talk-in. 60 + Trade Stands.**	
	Located on the London Road between Tonbridge and Tunbridge Wells. Info Dave Green 0892 28275	
22 Jul	**Anglian Mobile Rally, Stanway School, Colchester.**	
	Open 1000-1700. Talk-in plus usual goodies. Info G3YAJ 0206 393938	
	Home Counties Mobile Rally at McMichael Sports and Social Club, Sefton Park, Bells Hill, Stoke Poges, Bucks. Doors open 1100. Trade stands, fleamarket, demonstrations, including radio controlled models, and a real ale tent! Talk-in S22 and SU8.	
23 Jul	Stratford Upon Avon DRC: Construction Evening	
24 Jul	Mid Warwickshire ARS: Fox Hunt and Barbeque	
	Wakefield DRS: Pitch and Putt at Holmsfield Park	

25 Jul	S. Bristol ARC: HF Night with G4TXW Fareham DARC: On air/natter Wirral DARC: DF Hunt for G8PMF Award Farnborough ARS: Club Station Work-in Nene Valley RC: Natter Night	
26 Jul	Edgeware DARS: Informal	
27 Jul	Harrow RS: Informal S. Manchester RC: *Microprocessor Design by G8TYY of Manchester University*	
1 Aug	Wirral DARC: D & W S. Bristol ARC: Lecture — ring PRO for details Wirral ARS: ring PRO Lincoln SWC: RAE night	
3 Aug	Axe Vale ARC: 2m Foxhunt Haverhill DARS: Mobile Suppression Medway ARTS: *Satellite Working by G8XLH* S. Manchester RC: 160m DF Contest	
4-5 Aug	RSGB 432 MHz Low Power and SWL	
5 Aug	Woburn Mobile Rally S. Manchester RSGB 160m DF Qualifier	
6 Aug	Horndean DRC: *Car Ignition Suppression by Lucas Engineering* Leighton Linslade RC: ring PRO Braintree DARS: 'Live' Operating night	
7 Aug	Wakefield DRS: On the air/natter night	
8 Aug	S. Bristol ARC: Pocket Phone rally with G4SDR Farnborough (Hants) DRS: TBA Lincoln SWC: On-air	
9 Aug	Southgate ARC: Demonstration of Equipment and Social Evening	
10 Aug	S. Manchester RC: *QRO Miscellany by G2HW*	
12 Aug	Wirral DARC: DF Hunt	
13 Aug	Exeter ARS: Construction Evening	
14 Aug	Mid Warwickshire ARS: Town and County Festival Planning Bury RS: Fox Hunt Basingstoke RS: Contact G4OAC for details	
17 Aug	Medway ARTS: Demonstration of Satellite Working by G8XLH S. Manchester RC: TBA	
19 Aug	Glenrothes DARC: Forward Planning Discussion RSGB 1296/2320 MHz Contest **RAIBC/FRARS Hamfest at Flight Refuelling Social Club, Merley, Wimborne, Dorset. Parking, trade stands, camping and caravaning facilities. Fun for all the family, including model railway rides and barbeque refreshment. Bring and Buy. Talk-in. Info Bob Burrows 0202 762828**	

East Kent ARS regret that they have been forced to cancel their Mobile Rally. All booking fees will be refunded.

20 Aug	Braintree DARS: *Computers and Amateur Radio by G8NPF and G6CHJ*
21 Aug	Biggin Hill ARC: *Construction Techniques by G4VTD* Wakefield DRS: Pitch and Putt Competition Halifax DARS: *Radio Calderdale by David Keitch* Midland ARS: Discussion night
22 Aug	Wirral DARC: Junk Sale S. Bristol ARC: End of Club VHF DX Contest Farnborough RS: TBA Lincoln SWC: Homebrewing with G8ZCD
23 Aug	Edgeware DARS: SSB FD Briefing
24 Aug	S. Manchester RC: ring PRO
26 Aug	**RSGB ROPOCCO 2** **Preston ARS Mobile Rally at Lancaster University.** **Free Parking. Admission 50p plus free prize draw.** **Cafe and Bar. Trade stands plus RSGB bookstall. Grand Bring and Buy. Rally stands 11 a.m. Talk-in on S22 and 70cm. Info G3DWQ 0772 53820**
28 Aug	Mid Warwickshire ARS: HF on air night
29 Aug	Wirral DARC: D & W S. Bristol ARC: QRO Activity night Lincoln SWC: RAE night Medway ARTS: Talk and demonstration by KW Electronics S. Manchester RC: ring PRO
1-2 Sept	**SSB FIELD DAY** RSGB 144MHz Trophy and SWL Contest

Will Club Secretaries please note that the deadline for the October segment of *Radio Tomorrow* (covering radio activities from 3rd September-2nd November '84 is 27th July.

Contacts

Axe Vale ARC	Roger Jones	Upottery 468
Barking RES	R. Woodberry	01-594 4009
Braintree RS	Alan Moore	0304 822738
Bury RS	Bryan Tydesley	0282 24254
Chichester DARC	C. Bryan	0243 789587
Cambridge DARC	David Wilcock	0954 50597
Dunstable Downs RC	Phill Morris	Dunstable 607623
Exeter ARS	Roger Tipper	0392 68065
East Kent RS	Stuart Alexander	0227 68913
Edgeware DARS	John Cobley	30 64342
Fylde RS	PRO	Lytham 737680
Halifax DARS	DL Moss	0422 202306
Hastings ERC	Dave Shirley	0424 420608
Haverhill DARS	Rob Proctor	0787 281359
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Medway ARTS	Andy Wallis	0634 363960
Mid Ulster ARC	DF Campbell	0762 42620
Preston ARS	George Earnshaw	0772 718175
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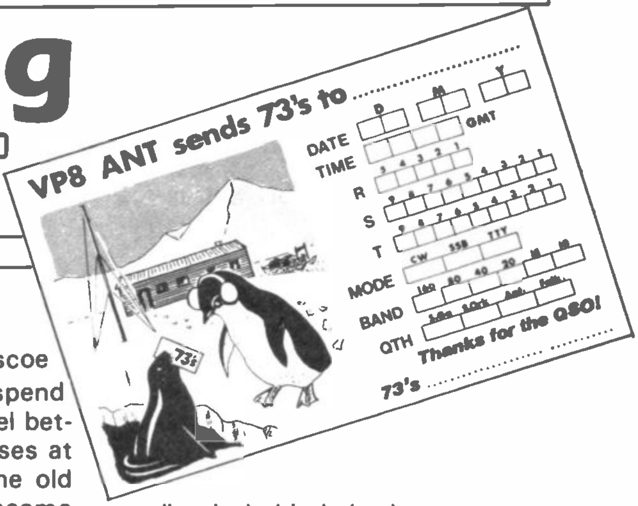
S. Lakeland ARS	Dave Warburton	Ulverston 54982
S. Manchester ARC	Dave Holland	061 973 1837
Stourbridge ARS	Malcolm Davies	038482 4019
Southdown ARS	P. Henly	0323 763123
Vale of White Horse ARS	Ian White	Abingdon 31559

Antarctic DXing from VP8ANT



Richard Newstead, G3CWI, answered one of those advertisements for work overseas that you sometimes see in daily papers and found himself in the Antarctic as VP8ANT.

''Radio operators wanted by British Antarctic Survey for Antarctic duty''. The advertisement was a tempting prospect. My major interests for many years had been contesting (with GB4ANT among others) and 160 metre DXing. Antarctica seemed to offer enormous potential for both kinds of operating — and where else could I be paid for doing my hobby? Certainly there would never be a better opportunity to visit such an interesting part of the world and put it on the DXCC map, so I soon had an application in the post.

Six months later, on a warm September morning in 1981, I was boarding the Royal Research Ship John Biscoe, bound for a 2 year tour of duty on Adelaide Island off the west coast of the Antarctic Peninsula. Not only Antarctic but Antarctica for DXCC purposes, I mused with pleasure.

The voyage south was a leisurely affair. Part of my luggage was an FT101, antenna wire, and three ''Jalbert'' parafoil kites — providing the potential for a bit of shipborne DXing. Unfortunately I was unable to get permission to transmit from the ship, but did do some listening with a long wire hung off one of the kites. Not surprisingly I developed something of a reputation for being eccentrically keen on radio!

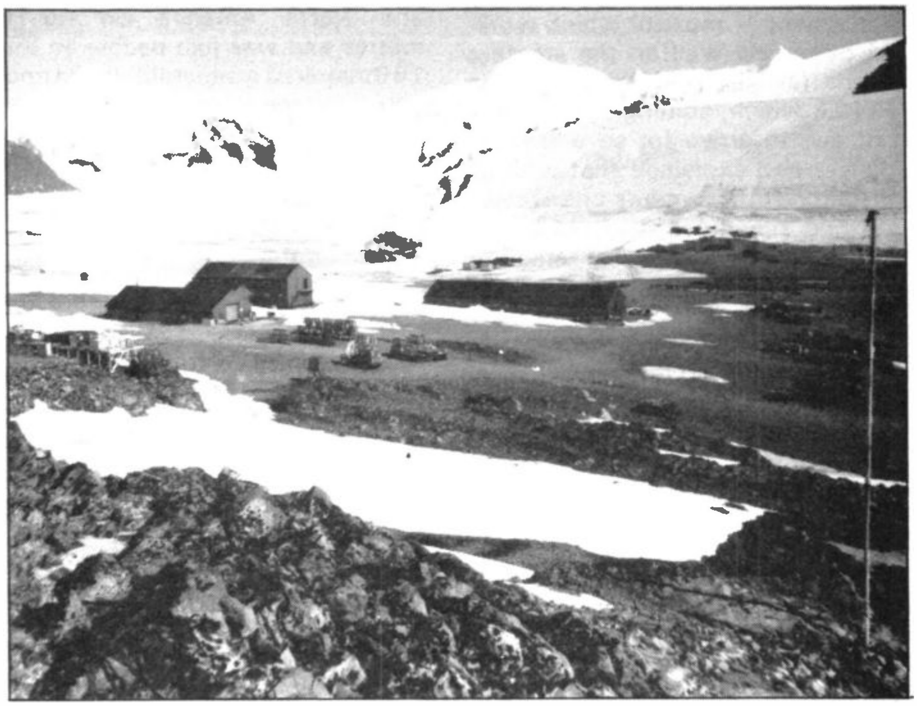
The ship called in for a few days at Rio de Janeiro, and passed tantalisingly close to the Peter & Paul Rocks which, a full year before the visit by WA2MOE, N4BQW & K8CW, were still on many peoples 'wanted' lists. The captain was reluctant to go for a landing because of possible uncharted reefs, and I didn't have a PY0 Licence anyway so even a short operation would have been out of the question.

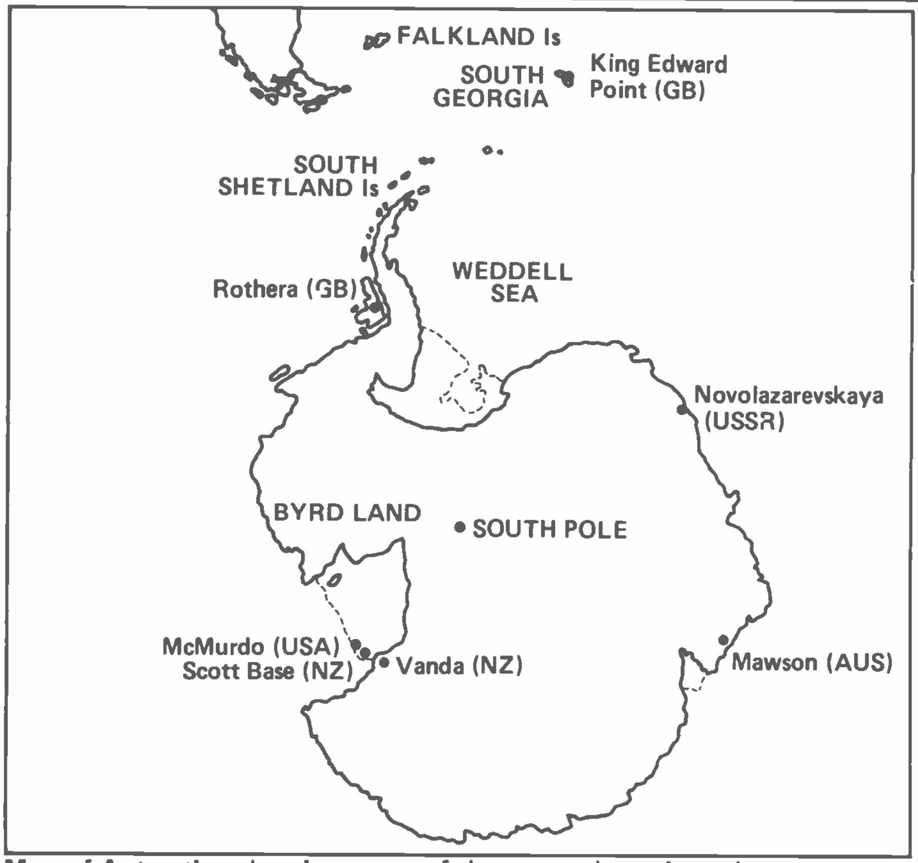
After Rio, the John Biscoe headed for South Georgia to spend a week transporting personnel between the two permanent bases at Bird Island and Grytviken (the old whaling station, soon to become rather better known), and the summer field camps. As South Georgia is a fairly rare location, I was anxious to get on the air as soon as possible and, one afternoon, Brian Stanswood, VP8AEN, the radio operator at Grytviken gave me the run of his shack.

The equipment at South Georgia was rather antiquated and I had to use valve gear made by Racal, some of which dated from World War 2. The receiver didn't even have an SSB filter. The aerials were dipoles at about 90 feet. Immediately behind the base, mountains to the north rose to several thousand feet but even so, conditions seemed about average with both the USA and Europe audible. However, 2 hours of frantic CQing on 15 & 20 metres yielded only 12 QSOs and I began to wonder whether coming south had been such a good idea after all!

Port Stanley provided a brief interlude of civilization (but no QSOs) before the ship headed south across the Drake Passage and into the ice. After a brief visit to Esperanza, the Argentine base at the northern end of the Antarctic Peninsula near to Dundee Is (the QTH of LU9ZI in 1982), the final leg of the journey was accomplished by plane from a snow airship near Palmer Station to Rothera Base on Adelaide Island. Although

Rothera Base, Adelaide Island...in Antarctica





Map of Antarctica showing some of the research stations that are situated there — including Rothera

there was a strict weight limit in the aircraft, preventing me bringing the FT101, I was able to smuggle in my electronic keyer.

Settling In

Andy Hawkins VP8QI, the outgoing radio man at Rothera introduced me to the commercial equipment — most of which worked extremely well on the amateur bands (allaying worries about the FT101 which, coming by sea, was not due to arrive for several months) — and explained that with all the aircraft movements and watchkeeping scheduled, I would be far too busy to make any amateur QSOs. Well, God must be a DXer because, within a few days of my arrival, a freak storm had totally wrecked both aircraft on the base and I had plenty of time for the more important aspects of radio!

Mercifully, the station (Racal again) was much more modern than that at South Georgia. The equipment I used on the amateur bands consisted of a fully synthesised transmitter running 1KW from 1.5-25 MHz (but only about 70 W on 28 MHz where the PA would not 'dip' correctly), and a separate synthesised receiver. One of my first soldering jobs was to reconnect the CW facility. British bases seldom use CW and it had been disconnected during installation at Rothera — good job I'd brought a keyer.

The station's main antenna, a V beam firing at Port Stanley, seemed to work extremely well to Europe and North America on 40-10 metres and was just usable on 80. 160 required a separate dipole and, although the only available mast was a mere 15 feet high, its location on a rocky point 120 feet above the sea was some compensation. Within a few days I'd worked into America and the UK on 160m.

Antarctica is much rarer on CW than SSB and the CW pile-ups on all bands were enormous. The first CQ on 40m produced a wall of callers for 30kHz, but, with QSO rates peaking at 180 per hour, things soon became manageable again. I found the maximum QSO rate was achieved by sending at between 30 and 35 wpm. Faster than that and people had trouble copying, slower and I got bored.

On Watch

I was soon introduced to one of the chores of life in Antarctica — night fire-watch. Because of the enormous threat posed by fire, most bases maintain a patrol throughout the night. When it was my turn, I would set the keyer calling CQ continuously on 160, go once around the base, work the resulting pile-up, set the keyer going, etc.. If my return was significantly delayed, there were rarely any callers — they had either given up or fallen asleep waiting for the "K"!

The long summer days produced excellent conditions on all bands with particularly healthy pile-ups on 15 & 20 around 0000z. Even 160 continued to produce DX QSOs for an hour or two each night (apart from a 2 week gap around the summer solstice) and I was able to enter the CQ WW 160 CW contest — at a time of the year when the sun was only below the horizon for a few minutes each day, making over 70 QSOs into the USA & Europe. As the summer passed and the days became shorter, I began to

G3CWI answering a typical load of VP8ANT QSLs

One of the two BAS Twin Otters, that kept VP8ANT off the amateur bands in the second summer

look forward to some interesting LF openings, but world politics intruded in dramatic fashion.

Towards the end of March, my QSL manager, G3ZAY, mentioned in one of our twice-weekly QSL handling schedules that a diplomatic storm was brewing over an Argentine landing on South Georgia. Within a very few days the Falklands had been invaded, VP8s on remote farms were broadcasting status reports, and I had an open radio circuit to VP8AEN at Grytviken where Argentine troops were expected imminently. The rest of the story is well known, VP8AEN and the other BAS personnel were repatriated by Argentine forces, Brian later joining me at Rothera, and amateur radio activity from South Georgia came to a halt. I, too, kept a low profile on the amateur bands while the fighting was going on, but a number of Gs who continued to show up for my normal schedules were often called by VP8s with news from occupied parts of the Falklands. One very weak station, claiming to be in Port Stanley, even reported to one of the Gs the extent of bomb damage to the airport after an air raid!

The Second Year

Returning to the bands in August 1982, the pile-ups were as big as ever and the QSO total continued to mount until two new aircraft were flown in at the start of October. Fortune did not favour me a second time, and the ensuing summer season was every bit as busy as the previous one had promised to be. I did, however, make a couple of QSOs from the air while flying to a summer field camp at Fossil Bluff.

This period saw the second visit to the Antarctic of Willy de Roos (VK9XR/MM) in his yacht "Williwaw". Willy put in an appearance at the British base of Faraday, some 200 miles north of Rothera, and was considering a visit to Peter the 1st island (a separate DXCC country if someone ever manages to operate from there) but the presence of pack ice, and problems with his radar, caused him eventually to abandon the plan. Willy is well known in amateur and yachting circles for his circumnavigation of North and South America in 1977 via the north-west passage and Antarctica, and has described the journey in his book "North-West Passage".

It was not until mid-March and the departure of the aircraft and transient summer field-workers that serious amateur radio could again be contemplated. While the weather was still reasonably good, I put up a new dipole at 50 feet for 160m and also one for 80m, a band I had neglected the previous year.

Another urgent task was to install a new VP8ADE 10 metre beacon as my first act on arrival the previous year had been to switch off the old, valve based, unit. In an advanced state of decay, it had been radiating 'hash' over most of the HF spectrum. Hearing of its demise, Pye Telecom had donated a solid state car telephone Tx, modified to run about 10W on 10 metres. BAS had shipped out and it now needed to be installed in an insulated enclosure (housing an MF homing beacon for aircraft), on top of Rothera Point. Transferring the memory keyer from the old unit proved to be a simple task and the beacon was soon QRV, though lack of a suitable mast meant that the antenna could only be raised about 5 feet off the ground. Reports from Europe soon indicated that all was well and the signal was getting out.

Conditions during the Antarctic winter were disappointing. HF openings were brief and infrequent for the two months either side of mid-winter (June 22nd), and although numerous stations in the northern hemisphere were weakly audible on 160 and 80, their local summer noise levels prevented them hearing me for most of the time. 40 metres was the best band and was open 24 hours a day, but did not yield a very high QSO rate because the best openings were to central Asia at around 0300 their time! At one stage my main activity was sending SWL reports to participants in various 'county hunter' type nets on 160. Needless to say, they were all astounded that their local QSOs were being monitored in the Antarctic!

A number of opportunities arose to go on field trips in the vicinity of the base and I usually managed to pack a small 10W synthesised transceiver onto the sledge. QSOs were very few and far between, using CW and a long wire only a few feet above the snow, but several Gs were worked. My tent-mates questioned my sanity on a number of occasions when it took 15 minutes to complete an exchange of name, QTH and report. Despite several requests from G3ZAY to fix a whip antenna behind one of the dog teams, no 'dog sledge mobile' photograph was taken!

Towards the end of September conditions began to pick up, but so did the work load. The final activity took place on 160 in the CQ WW SSB contest when a number of operators got a surprise multiplier. Bet not many had a VP8 slot on their check-sheets for the band!

The Return Journey

The first leg was again by air to the 'strip near Palmer Station where the RRS Biscoe was waiting. A short courteousy call at Palmer was made, and the radio shack visited. A 7 day period at Deception Island in the South Shetland group enabled me to make 365 QSOs on 20m SSB before returning to the UK via Port Stanley, and commercial flights from Punta Arenas (Chile) to London.

During two years in the Antarctic, the VP8ANT QSO total was 40,838 including 526 QSOs on 1.8MHz.

Please mention Ham Radio Today when replying to adverts

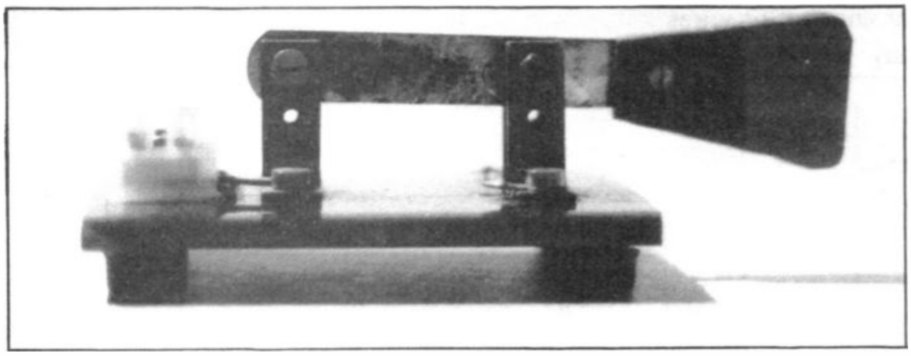
An El-Bug Paddle for Pennies

Commercial keyer paddles can be expensive. Louis Varney, G5RV/CX5RV, had the solution.

A typical manufactured El-bug paddle can cost quite a lot of money, but with a few hand tools and a little patience you can make the paddle described in this article for literally pennies in one evening. It has an excellent action and 'feel' and looks good on the operating desk at CX5RV.

You will need the following materials:

Base plate — 1 piece of plastic sheet * 90 × 60 × 5 mm.



Paddle handle — 1 piece of similar plastic sheet 40 × 30 × 5 mm.
Paddle blade — 1 piece of standard hacksaw blade 75 mm long.
Paddle support brackets — 2.
Paddle contact brackets — 2.
5 — 4 BA cheese or round head brass screws 10 mm long.
5 — 4 BA nuts and spring washers.
2 — 6 BA round head brass screws 10 mm long (for dot and dash contacts).
4 — 6 BA nuts (to lock dot/dash contact screws in position).
4 — Brass L brackets.
4 — small rubber feet (fixed to underside of the base plate by self-tapping screws or adhesive).
1 — 3 way miniature plastic connector block.
2 — 6 BA cheese head brass screws with nuts (to fix connector block to base plate).
1 — 6 BA countersunk head brass screw 10 mm with nut (to fix paddle to blade).
3 — 4 BA solder tags (fitted under the heads of the 4 BA screws holding the paddle blade and dot/dash contact brackets).

* Note. The plastic sheet can be bought cheaply (or given away) as "off-cuts". I used scarlet Melamine.

Construction

First, mark out and cut the plastic base plate with a hacksaw and carefully file to the required rectangle. Mark out and drill the bracket fixing holes, the holes for the connector block and the connecting wires as shown in **Fig.1**. If you drill and tap the fixing holes, you can dispense with the nuts and washers on the underside of the base plate. Next, cut out the paddle handle, file to shape and cut a slit with a fine (miniature) hacksaw to a depth of 15 mm at the narrow end into which the paddle blade will be a push-fit, but secured with a 6 BA countersunk head screw and nut. Drill the 6 BA clear hole "D" in Fig.1. and countersink one side. Now, take an old standard hacksaw blade, mark off 75 mm from the rounded end (with hole), fix firmly in a vice and snap off the unwanted portion of the blade. If possible, grind off teeth. Then, at 62 mm from the centre of the hole, heat a small area to red-heat over a gas flame and allow to cool. Insert the square end of the blade into the slit in the paddle and mark position of the paddle 6 BA fixing screw. Remove paddle and drill blade with a No.33 drill to take the paddle fixing screw. Re-assemble paddle on the blade and fix with the 6 BA screw and nut. If care is taken to heat only a small area of the blade to red heat before drilling, the remainder of the hacksaw blade will retain its springiness. See **Fig.2**. Make the four brackets, using suitable brass strip about 1.5 mm thick. See **Fig.3**. for details.

Fix the 3-way terminal block, the two paddle blade support brackets and the two dot/dash contact brackets to the base plate using the appropriate 6 BA and 4 BA brass screws. Cut off surplus length of all screws under blade with fine emery cloth. Fit paddle blade to its support brackets with a 4 BA screw, lock washer and nut. Fit dot/dash brackets with 6 BA screws (dot/dash contacts), nuts, and lock nuts. Connect paddle blade support brackets to inner terminal of connector block and the dot and dash contacts to the outer terminals. Fit the four rubber feet to the underside of the base plate.

Adjustment

Insert a standard postcard (or QSL card) between the dot contact screw and the side of the paddle blade, adjust the 6 BA screw until the end just touches the postcard and tighten the 6 BA fixing nuts on each side of the contact bracket. Repeat the operation for the dash contact screw and nuts.

NOTE. Because the paddle is designed for use with an electronic keyer circuit, the dot and dash contacts are making and breaking a current of micro-amperes in a high resistance circuit. Thus, provided that the contacts and paddle blade are cleaned occasionally, there is no need to use silver or platinum contacts. The paddle has been in daily use for several months without the need to re-adjust or clean the contacts or the paddle blade.

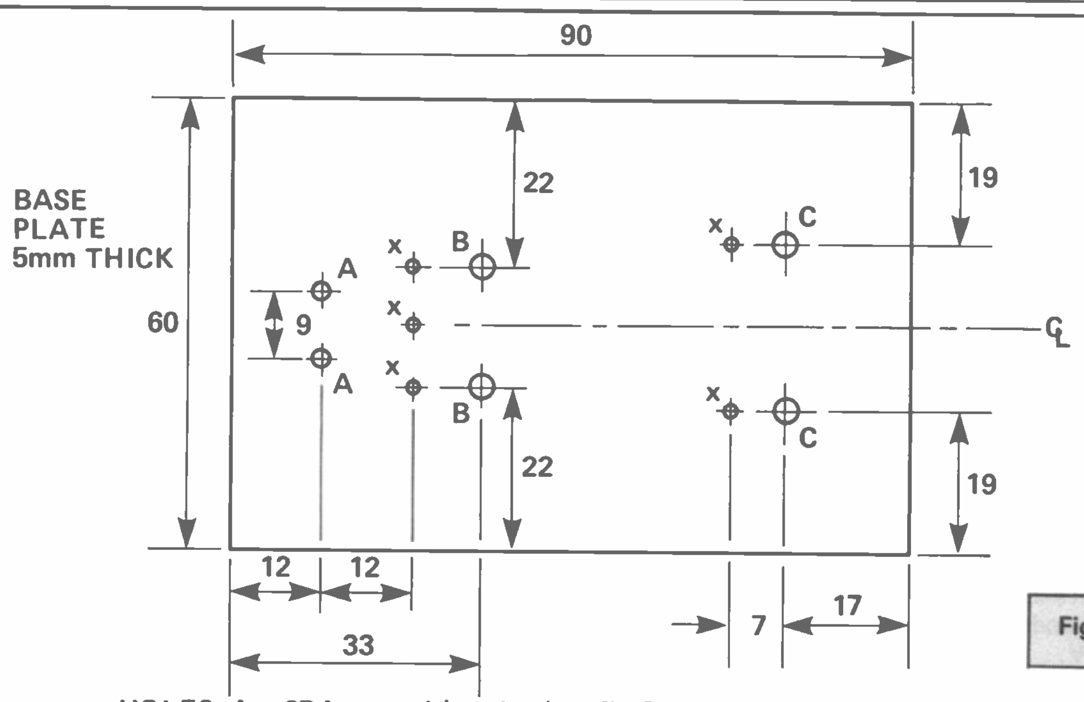


Fig.1

HOLES A = 6BA tapped (or clear) to fix 3 way connector block
B = 4BA tapped (or clear) to fix paddle brackets
C = 4BA tapped (or clear) to fix dot & dash contacts brackets
x = Holes for connecting wires

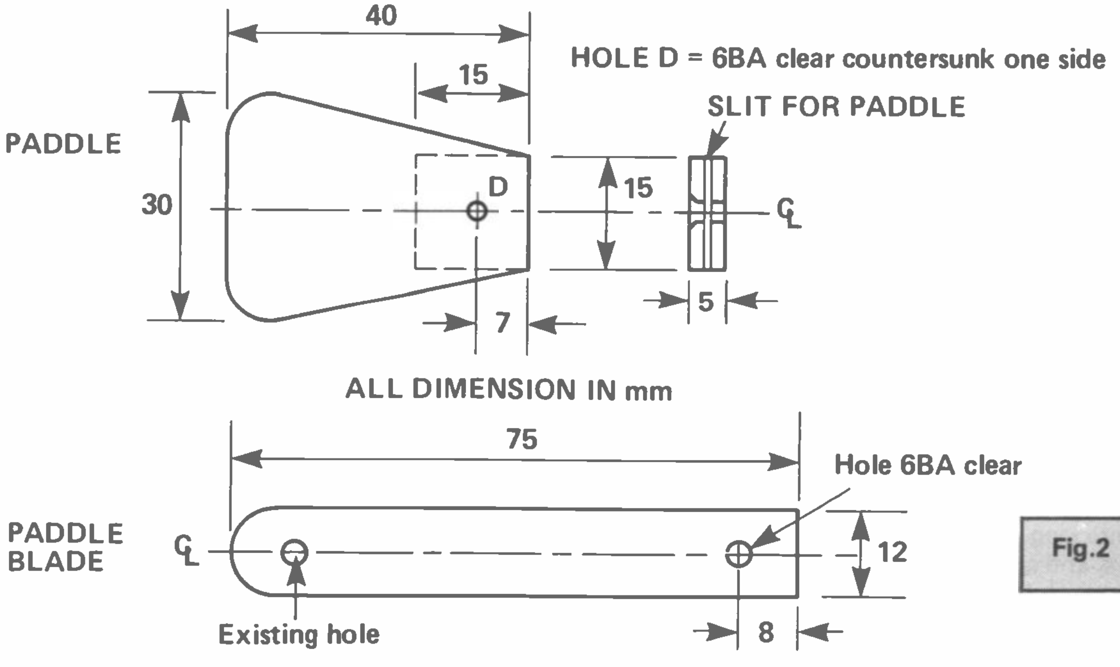


Fig.2

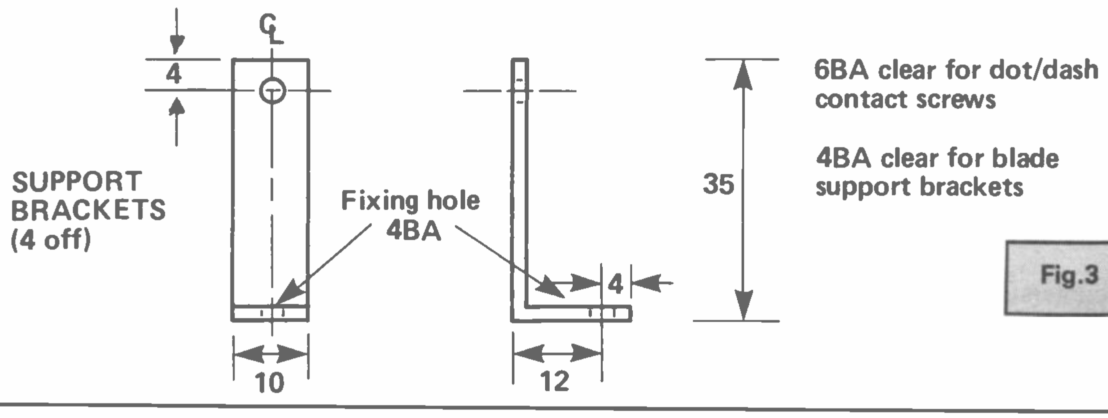


Fig.3

A Superior Morse Trainer

Find most morse trainers boring? This BASIC program from Dr Alan Shattock, G4RTP/E17EH, brings in some useful novelty.

The ideal morse tutor programme should be able to take you from the complete beginner stage to test-speed and then beyond to actual CW QSO words. These add realism and relieve boredom! Most published morse tutors fall short of this ideal, particularly in the early stages and very few go on to generate common CW words. This programme, written on the ZX Spectrum (16 or 48K), but adaptable to other computers since it is entirely in BASIC, is designed to be used at any stage of learning — from the absolute beginner to the very advanced.

In this programme, the beginner would start with the letters from A — E first at any selected speed with normal, medium or long gaps selected between characters. Fifty characters are sent and listened to — either through the internal speaker or, if that is too deafening for the family, through headphones plugged into either of the tape in/out jacks on the Spectrum. After the gap, each character is printed onto the screen and your receiving accuracy may be checked. You then move on to the letters H — L and so on, through the alphabet. Similarly, numbers may be received on their own or mixed in with letters. All modes have a repeat request after 50 characters.

A major complaint about morse tutors is that a stream of random letters are not like 'real' CW transmissions, and indeed they are not. This is where the programme comes into its own: You can select 'words' to be sent to you. The ones in this programme are the more common QSO words used in the average CW contact. They are selected at random from a data file of 44 words. Receiving these words will give much more feel of 'rhythm' and purpose to the learning process. Indeed, if you get fed-up with the words listed, you can delete these and put in your own selection!

How the Program Works

The dits and dahs are stored as "s" and "l" in a data file in Line 9000, dimensioned by Line 105. Similarly, the words are stored in Line 9200, dimensioned by Line 117. The option of setting the gap, o, between characters to normal, medium or large is skipped by Lines 178 and 179 if the speed selected, s, is more than 15 wpm. (It is assumed that if you have reached 15 wpm you should no longer wish to increase the gap since 'rhythm' will be lost).

The programme starts sending morse at Line 215 where the speed factor, s, is set up. The character is 'called' by a random number in Lines 510-528. The dit or dah length is set by 'd' in Lines 540-560, unless a space is found when the programme jumps to Lines 590 or 700, which are loops to generate the required gap between dits, dahs or spaces between characters. The character sent is then printed on to the screen by Line 710. Word generation is similarly carried out starting at Line 1000.

After 50 characters or words are sent, Lines 816 and 1600 offer you the option of a repeat of more at the same selected setting. If you answer 'no' the programme returns you to the speed request.

If you wish to change the words stored, then you may do so by deleting some or all and putting in a total of 44 of your own words up to five letters each. If you wish to increase the number of letters per word, then change the "5" in Line 117 to the number of letters in the longest word you wish to put in. The number of words, set at 44 here, may be changed also in Line 117, but you *must* put in the correct total number of words in Line 9200 and also in Line 1040 after RND*.

When saving the programme type SAVE "wordmorse" Line 100 and the programme will auto-start after LOADing.

Assuming five characters to be a word, the speed has been calibrated as accurately as possible when 12 wpm is selected. Speeds far removed from this are nevertheless not far wrong, but, with BASIC language, do not expect it to be smooth beyond about 24 wpm!

For masochists only, it is easy to make this programme imitate the bad morse sending that one hears so frequently in real life. You can do this by RNDing 'd' within minor limits so that some dits are a bit long and some dahs are a bit short: This is highly amusing and works well! For those who do not wish to type in the listing a limited number of tapes are available from the author at £3.50 including postage at Hillside, Bohernabreena, Co. Dublin, Eire.

G4RTP/EI7EH Morse Trainer: Summary of features

1. Nine sending modes: Common CW QSO words; letter groups A-E, F-J, K-O, P-U, V-Z; all letters; numbers only, letters and numbers mixed.
2. Speed and gap user selectable.
3. Characters or words printed to screen after sending for user check.
4. Repeat after 50 characters or return to change speed.

```
 50 REM This programme is the c
opyright of Alan G. Shattock, EI
7EH/G4RTP.  If you copy it pleas
e send one pound to a charity of
 your choice; thank you."
 100 CLS : BORDER 6: PAPER 1: IN
K 7
 105 DIM a$(43,5)
 110 FOR a=1 TO 43: READ a$(a):
NEXT a
 117 DIM w$(44,5)
 118 FOR w=1 TO 44: READ w$(w):
NEXT w
 120 PRINT AT 4,5;"RANDOM MORSE
AND WORD"
 125 PRINT AT 6,11;"GENERATOR"
 130 PRINT AT 10,13; BY"
 140 PRINT AT 14,2;"Alan G. Shat
tock,EI7EH/G4RTP"
 145 PRINT AT 20,5;"Press any ke
y to start"
 150 IF INKEY$="" THEN  GO TO 15
0
 155 CLS
 160 PRINT AT 4,2;"Please enter
the speed you"
 170 PRINT AT 6,1;"would like me
 to send the morse at,     (in w.
p.m). Best between 4-25wpm"
 175 INPUT s
 176 CLS
 178 IF s>19 THEN  LET o=0: GO T
O 200
 179 IF s>15 THEN  LET o=1: GO T
O 200
 180 PRINT AT 9,1;"Woud you like
 normal, medium or larger  gaps
betwen letters -    Gaps variabl
e for speeds up to 15 wpm.   Ent
er n, m or l"
 185 LET i$=INKEY$: IF i$<"l" OR
 i$>"n" THEN  GO TO 185
 187 LET o=1
 188 IF s<8 THEN  LET o=3
 190 IF i$="m" THEN  LET o=4
 192 IF i$="l" THEN  LET o=6
 195 CLS
 200 PRINT AT 4,2;"Would you lik
e  (l)letters": PRINT AT 6,18;"(
n)numbers": PRINT AT 8,18;"(b)bo
th": PRINT AT 10,18;"(w)words"
 201 PRINT AT 12,2;"or would you
 like groups of     letters:": P
RINT AT 14,10;"A - E (a)": PRINT
 AT 15,10;"F - J (f)": PRINT AT
16,10;"K - O (k)": PRINT AT 17,1
0;"P - U (p)": PRINT AT 18,10;"V
 - Z (v)"
 202 INPUT b$: IF b$="w" THEN  G
O TO 1000
 203 LET C=5: LET f=1: IF b$="b"
 THEN  LET C=43
 204 IF b$="a" THEN  LET f=18
 205 IF b$="f" THEN  LET f=23
 206 IF b$="k" THEN  LET f=28
 207 IF b$="p" THEN  LET f=33: L
ET C=6
 208 IF b$="v" THEN  LET f=39
 209 IF b$="n" THEN  LET C=10
 210 IF b$="l" THEN  LET C=26: L
ET f=17
 211 IF b$<>"b" AND b$<>"l" AND
b$<>"n" AND b$<>"w" AND b$<>"a"
AND b$<>"f" AND b$<>"k" AND b$<>
"p" AND b$<>"v" THEN  GO TO 202
 212 CLS
 213 PRINT "50 Characters will b
e sent.     Press BREAK to stop
CONT to continue."
 214 PRINT
 215 LET s=1/s
 500 FOR v=1 TO 50
 510 LET x=INT (RND*C)+f
 520 IF x>10 AND x<18 THEN  GO T
O 510
 528 LET n$=a$(x)
 540 FOR z=1 TO LEN n$: LET d=0
 550 IF n$(z)="s" THEN  LET d=s:
 BEEP d,16: GO TO 590
 560 IF n$(z)="l" THEN  LET d=3*
s: BEEP d,16: GO TO 590
 570 IF d=0 THEN  GO TO 700
 590 FOR p=1 TO 30*s: NEXT p
 600 NEXT z
 700 FOR t=1 TO 200*s*o: NEXT t
 710 PRINT CHR$ (x+47);" ";: NEX
T v
 810 PRINT
 815 PRINT
 816 PRINT "Do you want a repeat
? (y/n)"
 817 IF INKEY$="y" THEN  GO TO 5
00
 818 IF INKEY$<>"n" THEN  GO TO
817
 900 GO TO 155
1000 CLS : PRINT "50 words will
be sent. Press BREAK to stop and
 CONT to continue."
1001 PRINT : PRINT
1010 IF s>20 THEN  LET s=s*1.5
1020 LET s=1.2/s
1030 FOR v=1 TO 50
1040 LET x=INT (RND*44)+1
1042 LET t$=w$(x)
1044 FOR t=1 TO LEN t$
1046 LET y=CODE t$(t)-47
1047 IF CODE t$(t)=32 THEN  GO T
O 1540
1050 LET n$=a$(y)
1060 FOR z=1 TO LEN n$
1070 IF n$(z)="s" THEN  LET d=s:
 BEEP d,16: GO TO 1160
1080 IF n$(z)="l" THEN  LET d=3*
s: BEEP d,16
1160 FOR p=1 TO 10*s*o: NEXT p:
NEXT z
1180 FOR u=1 TO 40*s*o: NEXT u:
NEXT t
1540 PRINT w$(x);" ";
1550 PAUSE 40*o*s+2: NEXT v
1600 PRINT : PRINT : PRINT "woul
d you like more words at the sam
e speed? (y/n)"
1650 INPUT d$: IF d$="y" THEN  G
O TO 1030
1660 IF d$<>"y" AND d$<>"n" THEN
  GO TO 1650
1670 CLS : GO TO 170
9000 DATA "lllll","sllll","sslll
","sssll","ssssl","sssss","lssss
","llsss","lllss","lllls","*","*
","*","*","*","*","*","sl","lsss
","lsls","lss","s","ssls","lls",
"ssss","ss","slll","lsl","slss",
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9200 DATA "QUAD","THERE","THAT",
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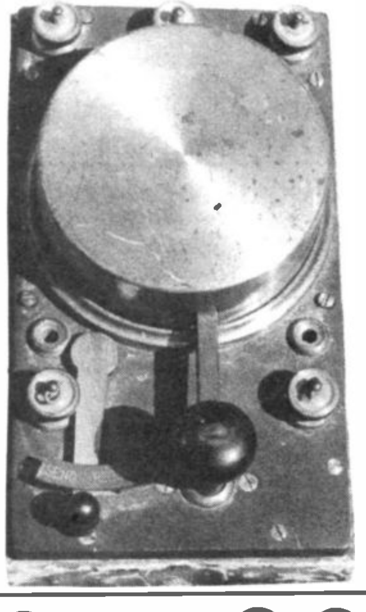

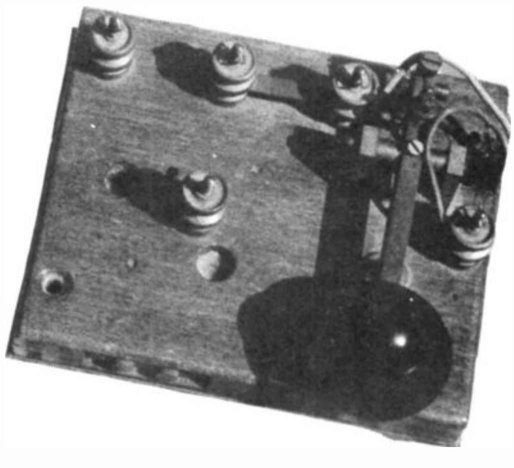

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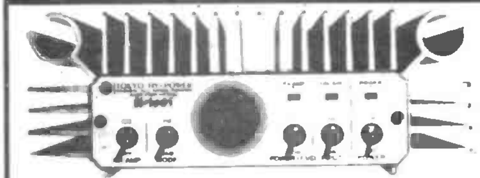

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NEWCOMERS FORUM

By Tony Bailey, G3WPO

This month Tony Bailey, G3WPO, talks about the 'GDO', that most basic and versatile piece of RF test gear.

At some period in your time as Radio Amateur, you will come across the need for some test equipment. Be it a simple voltmeter, GDO, wavemeter, or even something so complex as a Spectrum Analyser, you will also need to know how to use it. While using a GDO (Grid Dip Oscillator) may apparently be obvious, there are a number of 'practicalities' which make it easier to use, and can help to explain why it sometimes refuses to work when you think it should.

The abbreviation 'GDO' is something of a misnomer these days. This originally correct description has stayed with us in the face of changing technology and probably will for evermore. The first designs were of course valve types (you know, those 7 or 9 legged encapsulated room heaters), and relied on the fact that if you couple an oscillator circuit to another resonant circuit (at the *same frequency* as the oscillator) then the second circuit will absorb energy from the first — discernable by monitoring the current into the grid of the oscillator valve, which will dip when this happens. Hence the term.

Nowadays, Dip Meters are more than likely to be found using semiconductor devices, such as FETs, MOSFETs, and even Tunnel Diodes. Thus the term 'grid' is obsolete and should be 'gate' or whatever. However, the principle is the same and a similar decrease in oscillatory current is still monitored in some way or other. One other spin-off of the modern type is that the power level from the oscillator is generally much lower, and thus less likely to damage the circuit under test by too high a level of RF energy coupled in to it.

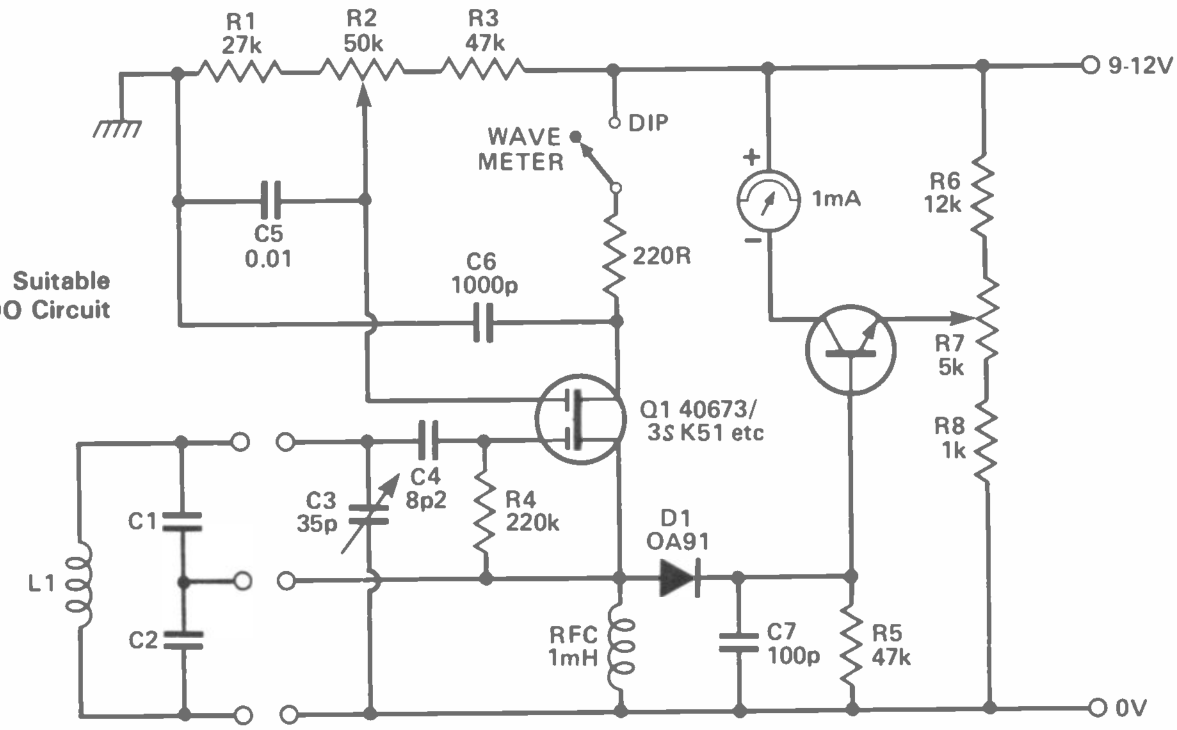


Fig.1 Suitable GDO Circuit

FREQ	C1	C2	L1(TURNS)
2.3–4	15	15	71½
3.4–5.1	33	10	39½
4.8–8	10	33	25½
7.9–13	10	33	14½
12.8–21.2	10	33	6½
21–34	10	33	4½
34–60	10	33	2½

C1 AND C2 ARE SILVER MICA TYPES
L1 IS 1" dia CLOSE WOUND ON SUITABLE FORMER
R7 SETS METER DEFLECTION
R2 SETS SENSITIVITY

A circuit is given for your interest (**Fig.1**) — it does work! The device may be simply calibrated by listening for the output on a suitable receiver and calibrating from the receiver dial or digital readout.

Must Be Resonant

The first thing to remember is that the dip oscillator will only work with a resonant circuit, as non-resonant circuits won't absorb any RF energy at a specific frequency to operate the device. It doesn't particularly matter whether the circuit is a coil and capacitance, or a tuned line (which will also possess inductance and capacitance), as long as it has sufficient 'Q' (remember, Q is a measure of the 'goodness' of the inductance) so that the dip meter can detect the absorption of RF energy. A poor Q coil will either give no dip or a very poor broad one.

With a normal air spaced coil or similar inductor, the coupling is usually inductive, and the best dip will be obtained when the axis of the two coils are *in the same plane*, as would be the case when you are trying to get maximum coupling between any two such coils in a normal circuit. One important point to remember is not to overcouple the two coils. Beginners often go for a spectacular dip, with the meter crashing down to its stop, but this is also very inaccurate! The most accurate reading will be when you get enough dip to read clearly, and no more.

You may also be able to get a dip reading via capacitive coupling — this often happens when one end of the coil is not connected to ground, and the coupling orientation is less than critical. This is also the way to couple into cavity resonators ('cavities') or even look at the resonant frequency of a length of coaxial cable.

Trouble With Toroids

One problem area is that of the toroidal core. Because of the self-shielding effect of the magnetic field on a toroidally wound core, it is often almost impossible to get a reading as there is so little coupling. It sometimes helps if the windings have a decent gap in them, as this provides a slight magnetic discontinuity for coupling into. A better way is to use an *external coupling loop* to the dip meter — actually parting the winding will change the resonant frequency anyway as you will be changing the distributed capacitance around the winding.

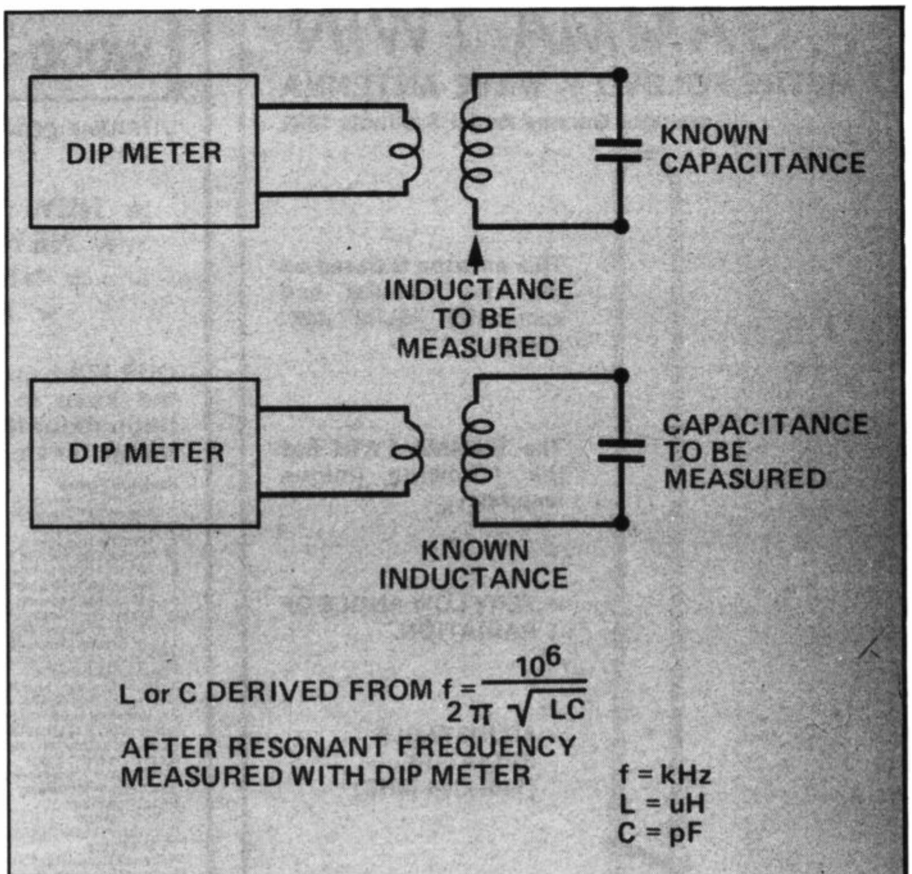


Fig.2 Measuring capacitance and inductance with a GDO

The dip oscillator can also be used to measure inductance and capacitance if you want it to, with the aid of some standards for comparison against. **Fig.2** shows how this is done. For amateur work the accuracy of the results is quite adequate and saves the construction or purchase of a more sophisticated measuring equipment.

Wavemeters

The Absorption Wavemeter is another popular instrument, and one which everyone should have, if only to meet the terms of their Licence! It is simply a calibrated tuned circuit with a means of showing when it is absorbing RF energy from another circuit to which it is coupled, such as a transmitter or oscillator. The usual indicator is a meter or low power light bulb, although there have been designs published which use an LED. The calibration accuracy is never very good, and their primary use is to prove that you are generating a signal in the correct band, rather than at an indicated frequency. Detection of harmonics and frequencies of multiplier chains are other primary uses.

The only problem with aborption devices is that they tend to be inaccurate as noted above, especially if insensitive — the circuit has to absorb a lot of energy from the circuit being monitored to get a reading and can thus affect its frequency. The most sensitive meter movement available (say, 50uA) needs to be used for best results.

On VHF

As the frequency gets higher, the more normal air wound coil becomes simply a loop, and this will be the case with most wavemeters for VHF you will come across. There are quite a few commercial versions available if you don't fancy building one yourself.

A 2m GaAsFET mast head pre-amplifier

For the majority of serious 2m operators, imported transceivers with typical noise figures of 4-6 dB are inadequate. When co-axial feeder and relay losses are included, performance will be degraded by an additional 2-3 dB, assuming a typical feeder run of 100 feet in UR67. There are of course ways to overcome feeder loss and improve the overall system noise figure is to place a low noise amplifier at the mast head.

Assuming that the gain of the pre-amplifier is sufficiently greater than the feeder loss, the system noise figure will be effectively set by the pre-amplifier input stage. For

If you are seriously interested in 2m DX, meteor scatter or tropospheric working, then this high performance pre-amplifier from John Matthews, G3WZT, is for you.

improve the noise figure of the receiver, but this involves modifying the input stage to overcome deficiencies in the original design. To many people this is not an acceptable solution as the re-sale value of the equipment may be reduced and warranties on new equipment made invalid. However good the receiver performance, feed losses must be made insignificant if good system noise figures are required.

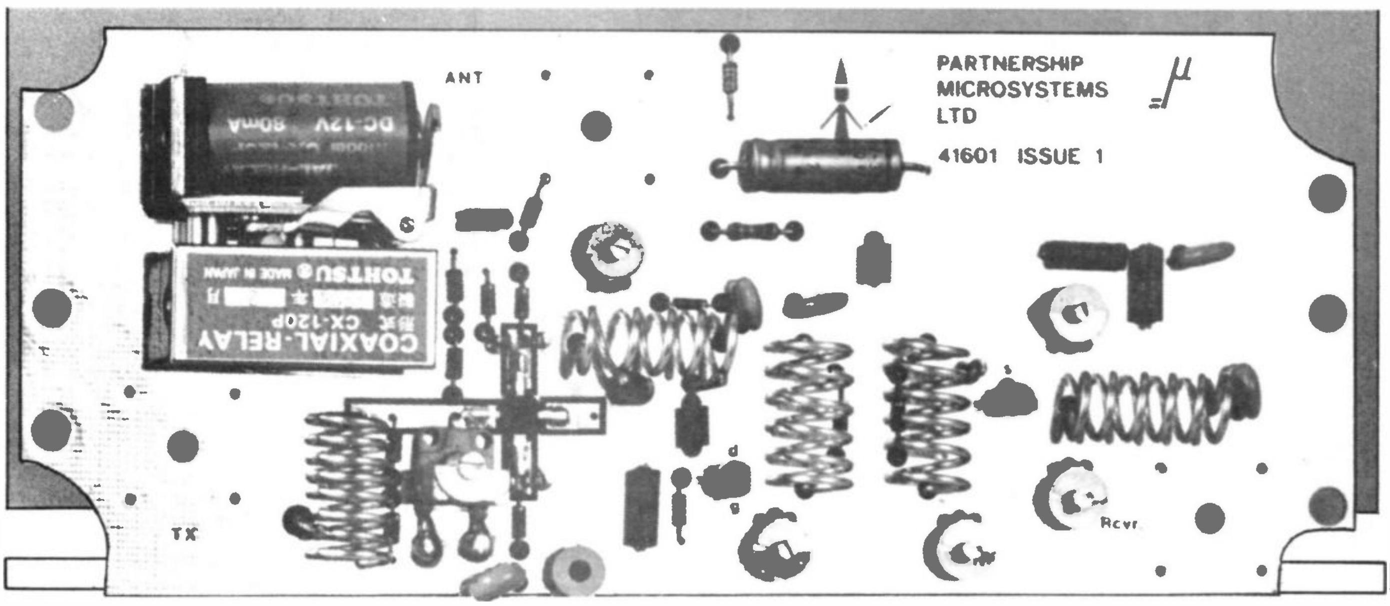
The most effective way to

example, a receiver with a 5 dB noise figure connected to co-axial feeder with 2 dB loss represents a noise figure of 7 dB at the antenna end of the feeder. If the installation is altered to include a mast head pre-amplifier with a gain of 12 dB and a noise figure of 1 dB, the overall noise figure will be reduced to 1.75 dB. If the pre-amplifier gain is increased a further 4dB to 16dB, the overall noise figure would be reduced to 1.3 dB.

Although this gives the impression of being the ideal solution to poor receiver sensitivity, other factors are involved which will reduce the strong signal handling capability of the receiver connected to the output of the pre-amplifier.

Strong Signal Problems

When additional gain is used in front of the main receiver, spurious products generated by in-band signals will be degraded by *at least* the gain of the pre-amplifier. On the other hand, if narrow pass band response and good stop band performance are achieved in the pre-amplifier, products generated by unwanted out-of-band signals will be significantly attenuated. The reduction of *in-band* strong signal handling capabilities on the receiver is the price paid for improved system noise figure. If excessive gain is placed before the receiver, the increased level of spurious products may more than cancel out the improvement in sensitivity due to better noise figure. Exactly how much gain may usefully be



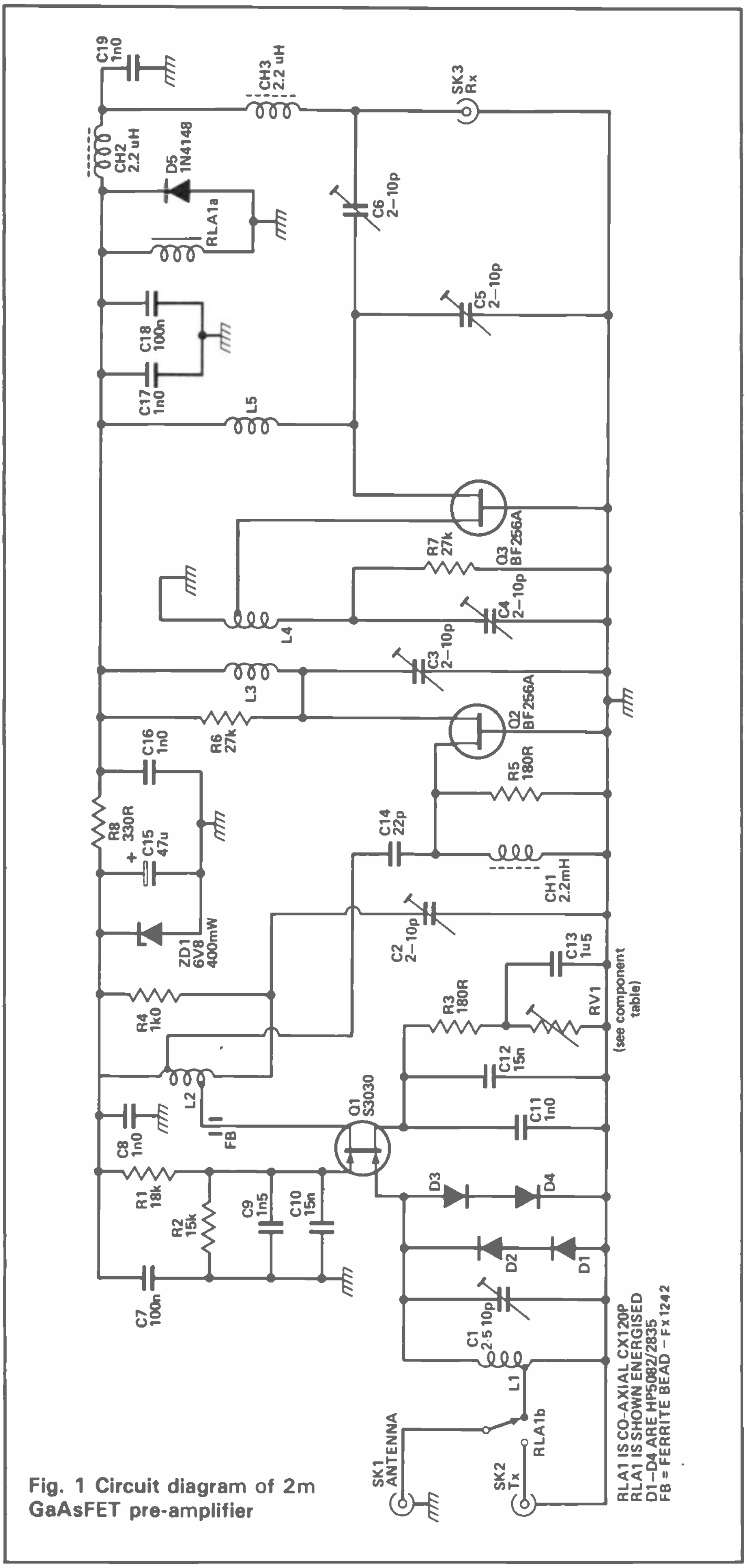


Fig. 1 Circuit diagram of 2m GaAsFET pre-amplifier

employed will depend on circumstances. An EME group working at 3 am or an expedition to The Empty Quarter of the Sahara might well be able to put an extra 30 dB of gain in front of the receiver without any problems. Conversely, a station working on top of the South Downs during VHF NFD might not be able to use any extra gain (in fact, a 6 dB attenuator would probably be more appropriate!).

Even when the useable gain is known, there is still the variable of feeder loss, since required pre-amplifier gain = useable gain + feeder loss. The solution here is to design a pre-amplifier which has more than enough gain and then to place a variable attenuator in the shack. The operator can then choose the best compromise between noise and receiver overload, setting the attenuator to the best position for his receiver, his cable loss and the current band conditions.

Signal Handling

On the subject of strong signal handling, four more points must be made.

1. The pre-amplifier should have large signal handling charactersitics *at least* as good as the receiver that it is feeding.
2. It has been pointed out before that for ordinary terrestrial working on 2m, there is little point in striving for system noise figures better than 2 dB. It is often concluded from this that there is no point in trying for pre-amp noise figures better than 2 dB. *Not so;* for a given receiver noise figure, and a given required system noise figure, a lower noise pre-amp will need less gain before the receiver.
e.g. Suppose Rx NF = 4 dB, and required system NF = 2 dB. A pre-amp of NF = 1.9 dB would need a gain of 16 dB, but a pre-amp of NF = 1 dB would need a gain of only 6.6 dB.
3. The pre-amplifier must have excellent stop band performance, to prevent strong out-of-band signals mixing to produce spurious signals within the passband.
4. A point that is sometimes overlooked is the need for good electromagnetic shielding. There is little point designing and producing an amplifier with good out-of-band

tion is required when the linear amplifier is not in use.

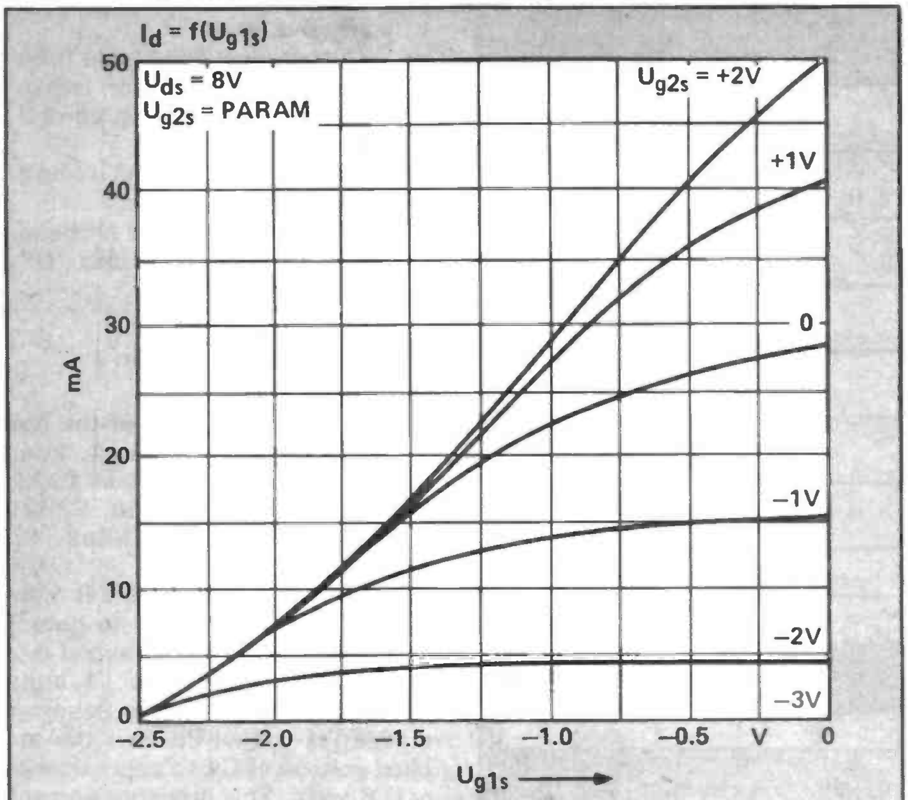


Fig. 2 Characteristics of the S3030 GaAs Schottky MES FET

PTT Choice

There are two methods which may be used to operate the Tx/Rx switching, these being RF sensing and hard switched changeover. Although RF sensing is very convenient in so far as no separate PTT line is required between transceiver and pre-amp, it does have the annoying trait of continuously chattering relays when used on CW or SSB. The problem may be reduced by increasing the hang-time of the sensing/switching circuitry, but there is then an excessive delay when switching from Tx to Rx.

By far the best method is hard switched changeover. It caters for all modulation modes and can be made fail-safe. It is strongly recommended unless there is no alternative to RF sensing, eg in the case of those transceivers that have no facility for switching external units unless minor modifications are made.

performance and then fitting it into a plastic enclosure which may be located within a hostile RF environment.

Most published and manufactured designs of mast head pre-amplifier use only one (the existing) co-axial cable for common transmit and receive signals. The major drawback is that two expensive co-axial relays are required at the mast head to switch the input and output of the pre-amp. Both relays must be capable of carrying the full transmitted power. Apart from introducing additional loss in the transmit path, this almost doubles the current that must be fed to the mast head and increases the probability of failure. Reliability is most important in a unit which is to be mounted at the mast head, since servicing will be inconvenient, and may require the hire of ladders or scaffolding towers.

In this design, an extra co-axial cable is run from the mast head to carry the received signal. It also carries the operating voltage for the pre-amp and a fail-safe hard switched changeover between transmit and receive.

At first sight this might seem a retrograde step, but it should be remembered that almost any cheap cable can be used, due to the high gain of the pre-amp. Additionally, this design makes it easy to include an operator adjustable attenuator in the receive path without using yet another pair of co-ax relays, and no relays are required in the linear amplifier unless a feed-through op-

Sequential Switching

Although co-axial relays are designed to switch RF current, the life expectancy of the contacts will be severely reduced due to burning

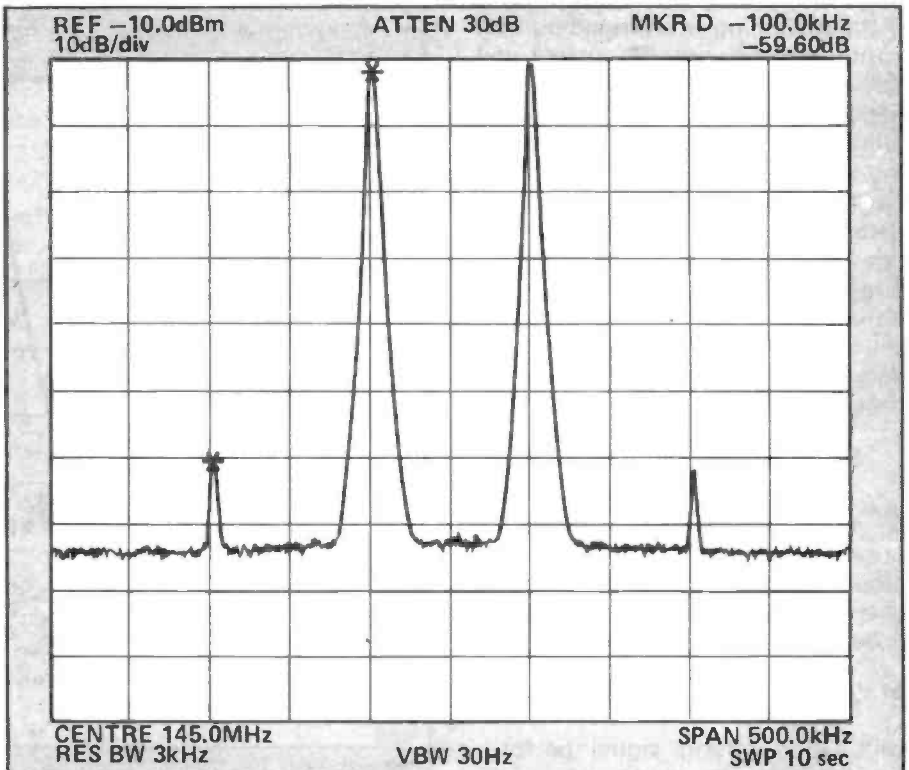


Fig. 3 3rd order intermodulation products of pre-amp (input power − 36dBm each tone)

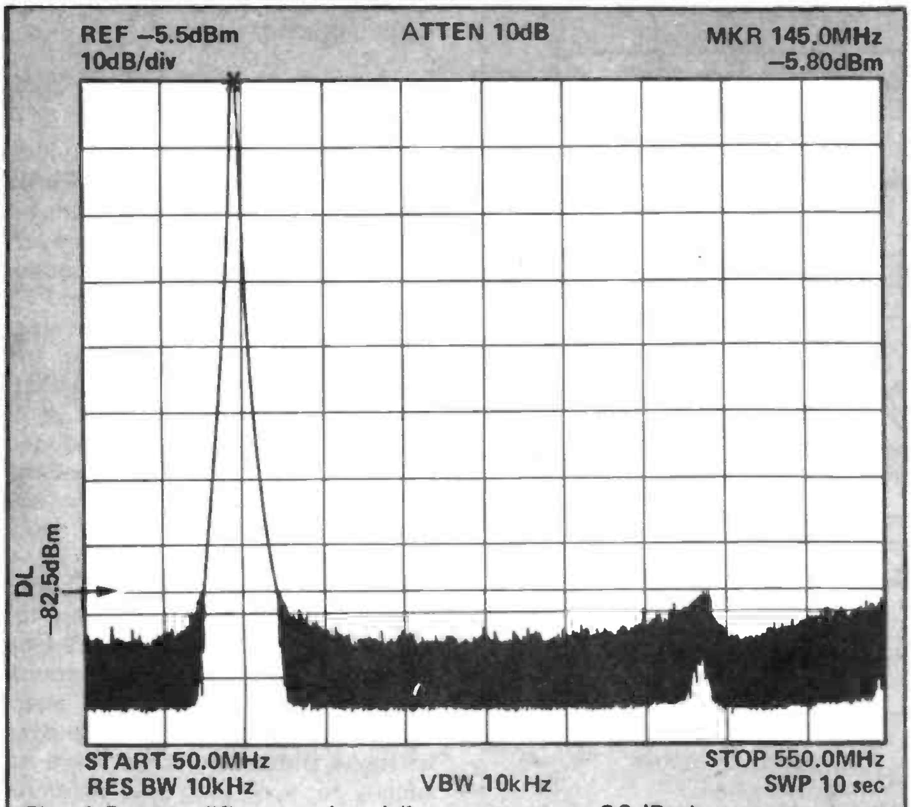


Fig. 4 Pre-amplifier stop band (input power — 30dBm)

when using high power levels. This effect may be reduced to some extent by 'over engineering' and providing larger contact area, but this results in a significant increase in cost without over coming other problems associated with systems that are not sequentially switched. If the switching is arranged so that contacts only *carry* RF current and do not switch it, the carrying capacity and reliability of the relay will be greatly increased. When using sensitive pre-amps, it is essential to ensure that RF power is not generated until the changeover relay is connected to the antenna, and that RF power has decayed before the relay disconnects from the antenna. Properly designed sequential switching can meet all these criteria.

Design Considerations

All the features mentioned previously are included in the pre-amplifier described here. They are listed below not in any particular order.

a) Low noise GaAsFET input stage.
b) Good strong signal performance.
c) Excellent passband and stopband performance.
d) Single co-axial relay at mast head.
e) Separate receiver output with common supply and PTT.
f) Sufficient gain to cater for long cable runs using inexpensive co-ax.
g) Output level adjustable from the operating position (when used with matching control unit).
h) Sequentially switched changeover system.
i) Electromagnetically shielded enclosure with low loss "N" type connectors.

Circuit Description

The circuit diagram of the pre-amplifier is shown in **Fig.1**. Input transistor Q1 is a low noise GaAs-Schottky MESFET, type S3030 manufactured by Texas Instruments.

The input tuned circuit consisting of L1, C1 is fed to gate 1 with the antenna input tapped into the low impedance end of L1. Input protection is provided by Schottky diodes D1-D4 which limit the applied voltage at G1 to approximately 0.6 volts. This prevents damage to the GaAsFET when high power is used (due to the limited isolation of any co-axial relay), or by static from charged rain, etc. This is essential, since the S3030 does not have gate protection. Although the fitting of protection diodes ensures safety of the input device, they do introduce small losses. The

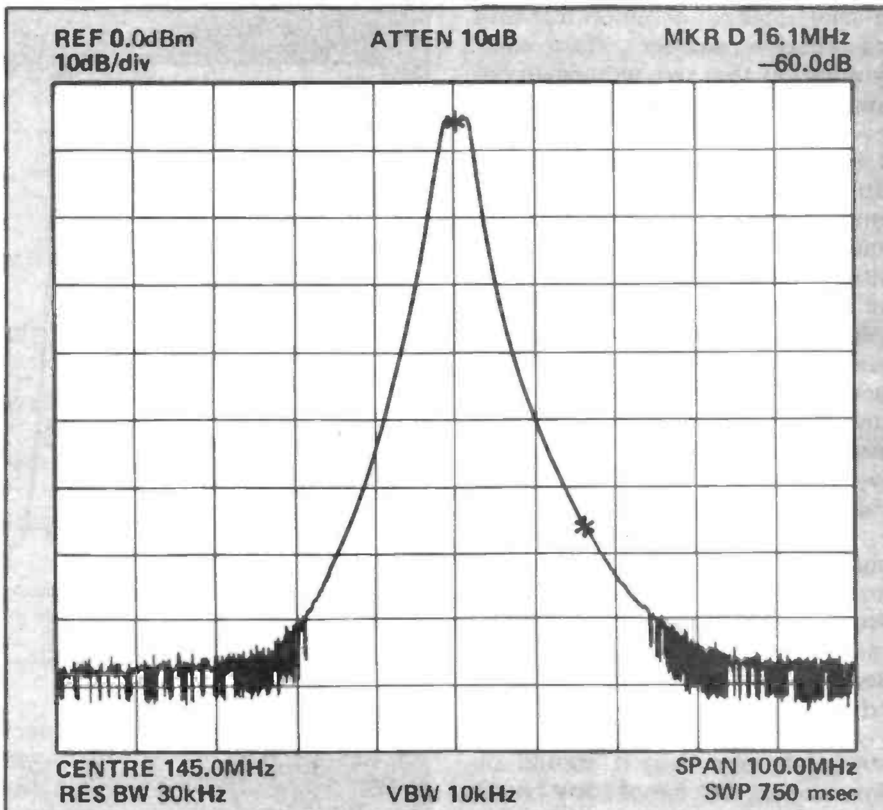


Fig. 5 Pre-amplifier pass/stop band

effect of these addtional unwanted losses is to reduce the achievable noise figure by a small amount (perhaps 0.3 dB), but this is considered a small price to pay for the protection given.

In order to minimise input circuit losses, C1 should be air-spaced and L1 wound with silver-plated copper wire. At a recommended drain current of 10 mA, the gate 1 — source voltage should be — 1.8 V. This is obtained by self-bias resistors R3 & RV1 with drain current set at 10 mA by RV1. Wideband decoupling is provided by using chip capacitors for C11 & C12; these are soldered directly onto the ground plane of the PCB. Gate 2 voltage is supplied from the potential divider network R1, R2 and holds g2 at approximately +2V with respect to source. Inspection of Fig 2 shows that for an appreciable change of drain current, g2-s voltage needs to be negative. For this reason, conventional means of setting drain current by varying the positive voltage on g2 are invalid. Ceramic chip capacitors C9, C10 provide wideband decoupling for g2 and are mounted directly to the ground plane.

Intermodulation

In order to improve intermodulation performance, the drain voltage swing of Q1 is limited by tapping towards the low impedance end of the output tuned circuit L2, C2.

R4 further reduces the overall drain impedance and provides heavy damping of the circuit. This arrangement reduced the available gain and will also reduce the noise figure by a small amount due to the gain limiting action of the output circuit of Q1; this must be weighed against the improved intermodulation performance. The filtering required to achieve good passband/stopband characteristics reduces the gain still more, so that further amplification is needed. Typical third order intermodulation products are shown in Fig.3.

Output from the first stage is coupled via blocking capacitor C14 to the low input impedance of the common gate JFET amplifier. Q2. This stage, a BF256A, is operated with Vg-s at 0V, providing a quiescent drain current of about 5mA.

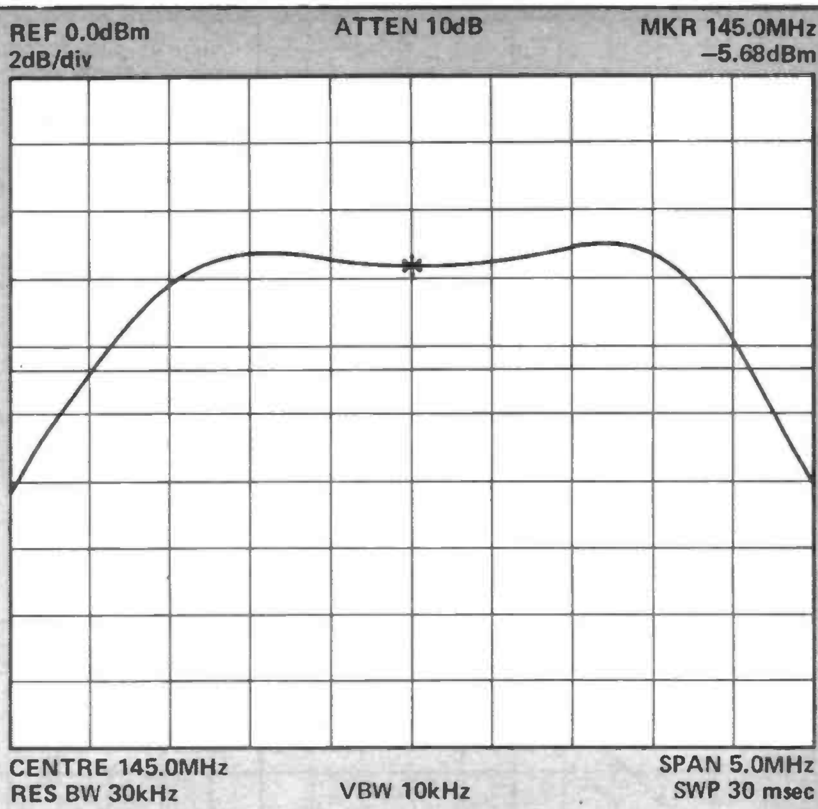
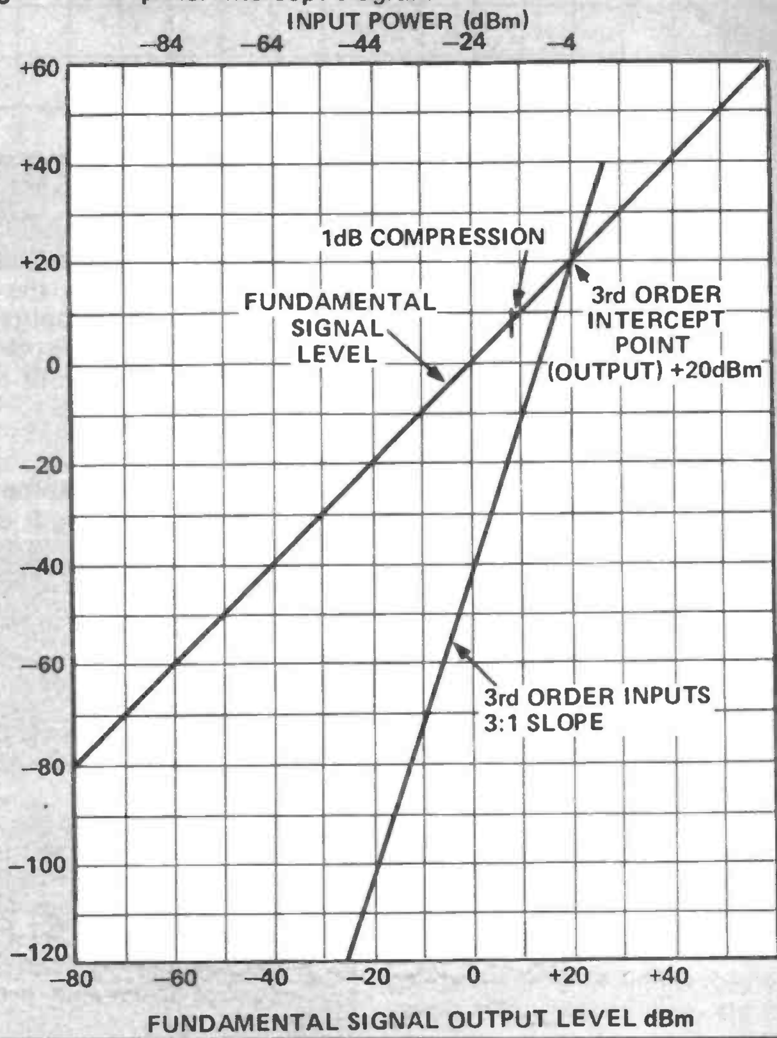


Fig. 6 Pre-amplifier – 3dB points (input power – 30dBm)

Fig. 7 Pre-amplifier intercept diagram



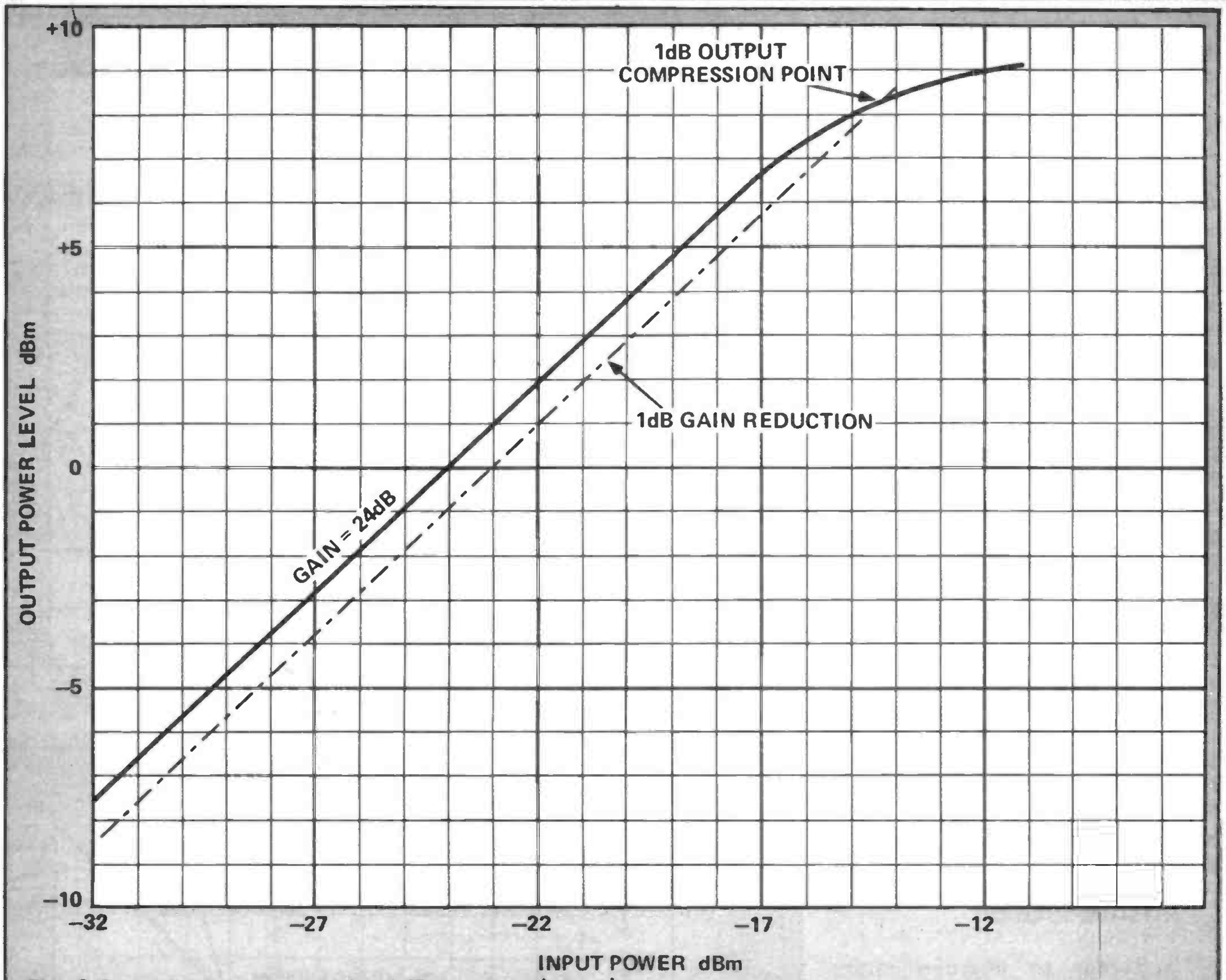


Fig. 8 Pre-amplifier output/Input 1dB compression point

The output lead comprising L3, C3, R6, forms part of the bandpass coupled tuned circuit which, in conjunction with L4, C4, R7, feeds the second common gate amplifier Q3. Biasing arrangements for this stage are identical to those of the preceeding stage. Output tuning is by means of L5, C5, with output matching adjusted by C6.

Using two low gain common gate amplifiers following the input stage allows excellent passband and stop band performance while maintaining adequate gain. Plots of stopband attenuation and passband ripple are shown in **Figs. 4,5, and 6**.

Supply for the pre-amplifier is fed along the receive signal co-axial cable and is isolated from the signal by CH2, CH3, C19, on receive. When the transmit PTT is operated the DC is removed and RL de-energised, connecting the transmitter to the aerial system. This gives a fail safe system which automatically switches the aerial system to the transmitter/receiver if a failure should occur or if the control unit is switched off.

Construction

Details of the component layout are shown in **Fig.9** and require little further explanation. There are however, several points which may aid construction and avoid disappointment due to component failure during soldering operations.

First solder in all resistors followed by fixed value capacitors, except chip types C9-C12. Next,

Measured Performance

Noise figure (including relay & input connector losses	**1.4 dB**
3 dB bandwidth	**4 MHz**
60 dB bandwidth	**30 MHz**
Stopband attenuation (1-500 MHz)	**77 dB**
Passband ripple (144-146 MHz)	**0.5 dB**
Gain	**24 dB**
3rd order intercept point (output)	**20 dBm**
1 dB compression point (output)	**8 dBm**
1 dB compression point (input)	**-15 dBm**

Graphs showing 3rd order intercept values and input/output 1 dB compression points are shown in figures 7 & 8.
When sequentially switched, the unit will handle 350W RMS continuous or 600W PEP, provided that the antenna VSWR is no worse than 1.2:1.

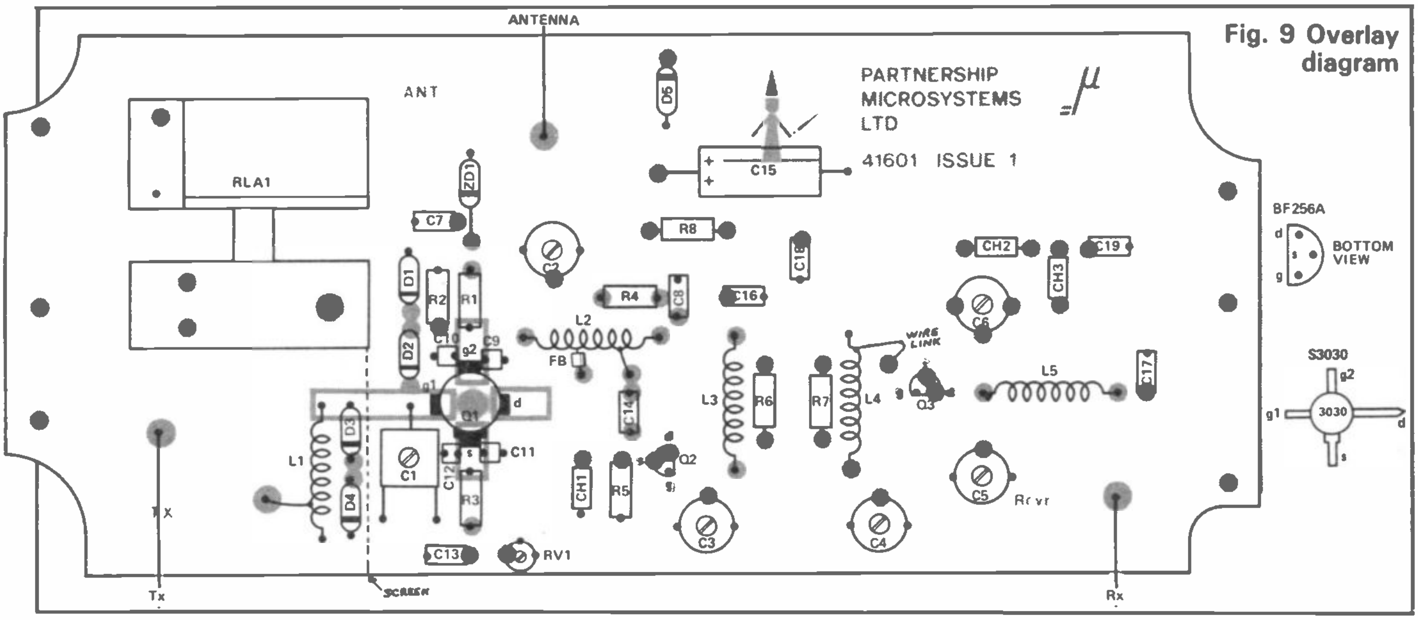


Fig. 9 Overlay diagram

fit inductors L1-L5 and the respective taps, the axes of L3 and L4 must be parallel and 15mm apart. Use a minimum of heat consistent with good joints.

Referring to Fig. 9, cut and fit the copper screen using 0.3mm material. A small cutaway should be made for gate 1 of Q1. The height of the screen is not critical but should be cut so that it is approximately the same height as the top surface of the co-axial relay RLA1. Now fit the remaining passive components including the co-axial relay. Place the chip capacitors in the positions indicated, hold with a small spatula and solder to the gate and source pads on the top side of the PCB using a minimum of solder and heat. Solder the other ends of the capacitors to the ground plane surface taking care to use a minimum of heat consistent with good joints.

Fit Q2 and Q3 keeping the lead lengths as short as possible. Next, make up the co-axial input/output leads as follows:-

Cut 3 lengths of UR43, each 25cm long. Remove 20mm of the outer insulation from one end of each. Cut back the braid leaving 8mm and sparingly tin, taking care not to melt the inner dielectric material. Using 0.15mm copper foil, cut 3 pieces 20mm by 9mm; roll one piece around each of the cable braids and solder. Finally, using a sharp knife, remove the inner insulation flush with the bottom of the copper sleeve. For clarity, the dimensions of the above are also shown in **Fig. 10**. When assembled, solder the three cable inners to the PCB, making sure that the copper sleeves are flush with the ground plane, then solder the copper sleeves to the ground plane. Cut the leads to the required length and fit the chasis mounting 'N' connectors to the cables. Do not mount the connectors onto the box at this stage.

The final step is to solder in the GaAsFET Q1. Great care should be taken when soldering this device in as it can be easily destroyed by static charges or mains leakage unless some simple precautions are taken. Pick up the device by the source using tweezers and cut the longest (drain) lead to the same length as the remaining leads. Lay the device onto the pads provided on top of the PCB with the identification marks uppermost. Heat the soldering iron and remove from the mains supply. Using a spatula to hold the device in position, solder each lead in turn. Use the minimum heat consistent with good joints. Re-heat the iron if necessary but be sure to always remove from the supply before using.

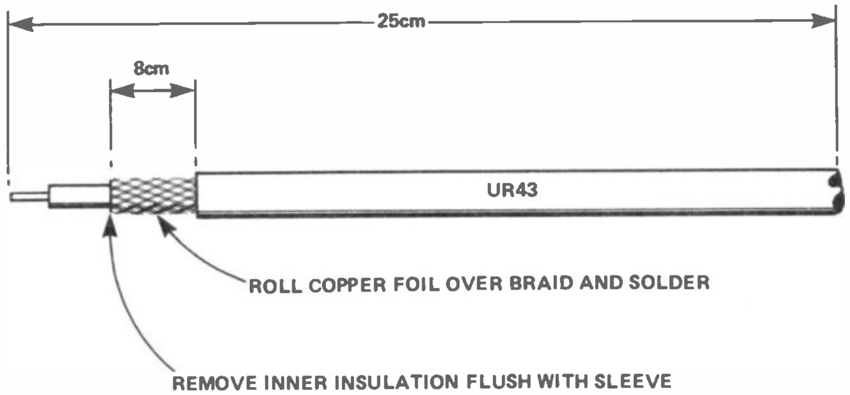


Fig. 10 Details of coaxial terminations to PCB

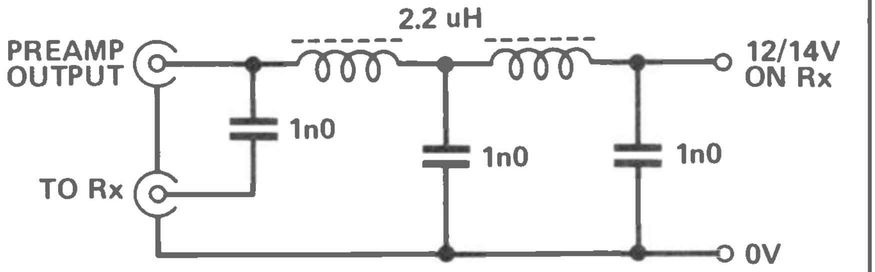
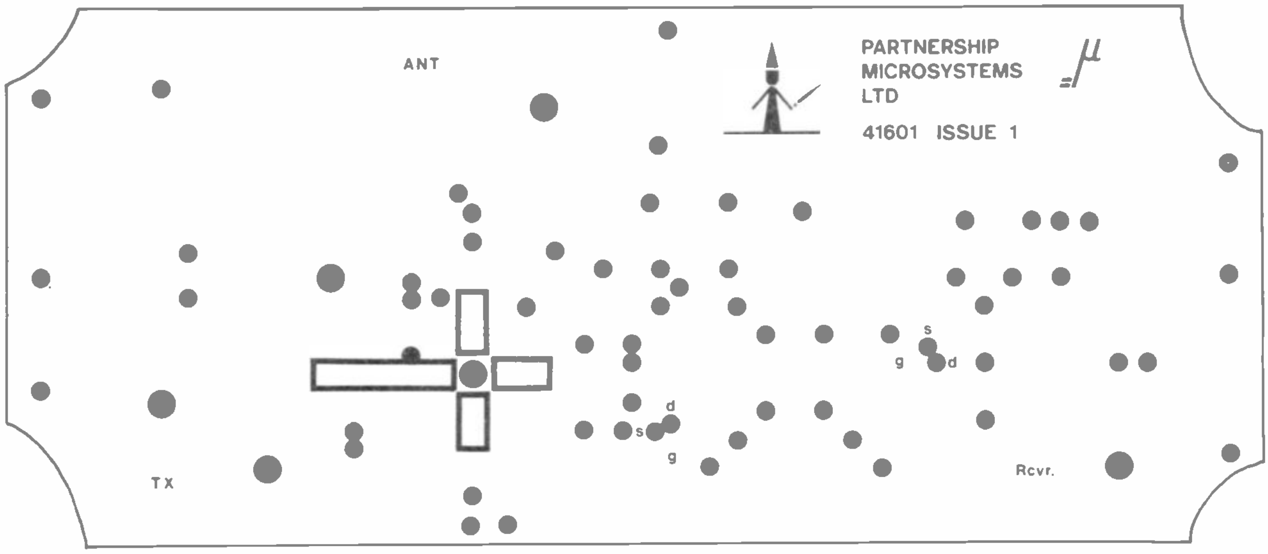
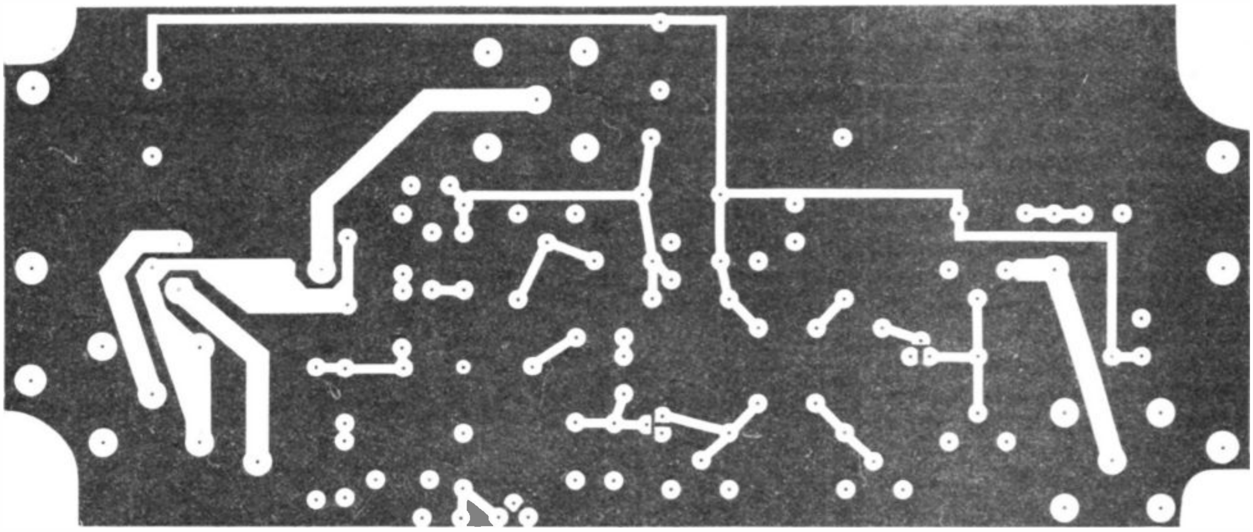


Fig. 11 Simple power interface

Top



PCB track layouts-WILL CONSTRUCTORS PLEASE NOTE THAT ETCHED AREAS ARE SHOWN IN BLACK



Bottom

As power for the unit is fed via the co-axial cable it will be necessary to make a simple interface unit to supply 12-14V to the Rx output socket. The unit shown in **Fig.11** can be built on a small PCB with 'flying' co-axial leads.

Set Quiescent Current

Connect interface to pre-amplifier and apply 12-14V where indicated. Relay RL should energise. Fit a 50 ohm dummy load to the aerial input socket (SK1) and monitor the voltage across R3 (180R); adjust RV1 for 1.25 volts.

RF Alignment

It should be emphasised that although perfectly adequate results will be achieved by aligning this unit using simple methods, *the performance figures quoted will only be met by employing swept alignment techniques* to achieve the desired bandwidth. For those who neither have nor can borrow this facility proceed as follows.

Inject a signal at 144.20 MHz and tune C1, C2 for maximum reading on the receiver S-meter, making sure to reduce the input signal to the minimum needed as the gain increases. Alter the signal input to 145.0 MHz and peak C3, C4 for maximum gain. Finally adjust C5, C6 for maximum gain at 145.80 MHz. If a signal generator is not available, alignment may be carried out using a 100 KHz marker generator. This should be fed via a variable 50 ohm attenuator and must have sufficient output at 145 MHz to allow at least 10 dB attenuation to be used at all times. If facilities are available, C1 and the input tap on L1 may be adjusted for optimum noise figure, but make sure the precautions earlier concerning the handling of GaAsFETs are adhered to.

When the unit is aligned, undo

Component Listing

R1	18K
R2	15K
R3	180R
R4	1K
R5	180R
R6,7	27K
R8	330R
RV1	Cermet ¼" round (RS 184-451)All resistors 0.125W, 10%, body length not greater than 6mm.
C1	1.5-10p air spaced variable.
C2-C6	Min. polypropylene trimmer 2-10pF (RS 125-648)
C7,18	100n 50V ceramic 0.2" pitch
C8,13, 16,- 17,19	1n 50V ceramic 0.2" pitch
C9,11	1n5 ceramic chip (PM)
C10,12	15n ceramic chip (PM)
C14	22pF ceramic 0.2" pitch
C15	47uF 25V tubular electrolytic
D1-4	Schottky diode HP5082-2835 (PM)
D5	1N4148
ZD1	6V8 400mW Zener diode
Q1	S3030 (PM)
Q2,3	BF256A
RL	Co-ax relay CX120P (AM 46-90120)
CH1-3	2.2uH moulded RF choke
L1	8t tapped at 1¼t
L2	5t tapped at 3/4t and 3 3/4t
L3,5	6t
L4	6t tapped at 1 3/4t

All inductors wound to 17mm length, ¼" ID, in 18 SWG silver plated wire (AM 03-05018)

Also required:

SK1-3	Type 'N' chassis mounting with rear cable entry, either Amphenol 36250 or Radiall R 161 256; sealed die-cast enclosure (RS 507-056) and PCB (PM 41601)
	Suppliers:-
AM	Ambit International Ltd. Ring 0277-230909.
PM	Partnership Microsystems Ltd. See ad. in this months HRT.
RS	RS Components Ltd. RS supply to the trade only, but many amateurs have access . . .

the gland-nuts on the three 'N' type connectors, and separate the shells from the rest of the connector. Fit the PCB using 6 off M4x6 brass pan-head screws. Mount the shells onto the box using M3x12 brass screws (not c/sunk) with washers under the heads. The flange must be outside the box, and sealing compound should be used between the flange and the box and under the washers. Re-assemble the connectors. Check alignment.

Installing The Unit

Mounting methods will depend on the mast and antenna system. If possible the unit should be mounted with its long axis horizontal, and the Rx socket facing downwards. Make sure to install the antenna cable with a drip-loop.

The box specified is hose proof to IP65, and 'N' type connectors are reasonably waterproof; for long term protection the unit can be given a coat of Bitumastic paint. This should cover the whole of the box and the connectors and the first few inches of cable.

Components

The PCB details are given in **Figs. 12 and 13.** The prototypes were made from 1/16th inch double-sided glass fibre board to BS 9000; all holes are plated-through with the exception of the 6mm hole in which the GaAsFET sits. If a non-plated-though board is used, all components should be soldered on both sides of the board and all spare holes should be pinned through; RV1 will need to be stood off the board so it can be soldered both sides, also, don't overlook the coil connections on RL. Ready-made plated-through PCBs are available if required. Suppliers for these, and other components not widely available, are suggested in the component list, plus stock numbers if any.

Control Unit

A following article will describe a suitable control and interface unit to work with this pre-amplifier. It will include the following features:

Internal mains driven PSU
Attenuator variable up to 30 dB
Sequential switching of pre-amp and PTT to power amplifier
Fail safe in the event of switch-off or power fail
PA Inhibit-protects against any single component-failure

Conclusions

The performance figures shown for the prototype amplifier are the actual measured values and have no corrections made to them for measurement uncertainties. No 'specmanship' has been entered into in presenting these values and it is hoped that the plots included in this article confirm this in a readily understandable format. When mounted as intended, at the masthead, this pre-amplifier will give more than adequate performance for *any* propagation mode.

16-Bit Stereo on the 70cm band

The University of Surrey Radio Society and G3OSS went digital stereophonic on 70cm. Keith Davies, G6VCQ, and Simon Whittle, G6EZL, report.

On the basis of promising signal strengths obtained at the University club station G8AHK during crossband 2m/70cm QSO's with G3OSS during previous months it was suggested, by the latter, that an experimental link be organised for the sending of high-definition audio signals over the 31-mile path. This was a follow-up to experiments made previously by G3OSS in which a similar link had been set up over a considerably smaller distance in the London area.

Such a link is of interest, not because it is a new thing in radio communications as a whole, but rather because it is new to the Amateur radio field. (The BBC, for example, have for a long time now been sending stereo radio signals to transmitters as far afield as Wrotham and Manchester in digital form from their microwave transmitter site at Swain's Lane in London, with obvious benefits to listeners over the previous landline distribution still employed in less fortunate parts of the country . . .)

Line Up

The system to be used involved a digital encoder (SONY PCM F1) whose output was a PAL format video waveform, fed to a converter which transmitted this waveform in the ATV end of the 70cm band, in this case via a 70cms linear to give the required power at the sending end of the link.

The beauty of the system was that, since the output of the digitial encoder is already in TV-video format, the rest of the equipment required is basically exactly the same as that required for traditional ATV transmission, and therefore fairly easy to obtain.

In fact the digital encoder's video output gives rise to some rather entertaining video effects on the screen of a monitor set, in the shape of constantly fluctuating vertical bars, which display some quite hypnotic standing wave patterns at times, though in this particular case the video "side-show" was of little importance in comparison with the achievment of the aim of the experiment viz. the establishing of a reliable 16-bit digitial audio link. For any station monitoring the ATV signal, the rather unique pictures were obviously interspersed with the requisite sending of G3OSS' callsign in the usual familiar manner, perhaps rather a relief to those who wondered what their receiving equipment was doing to this rather unusual 'testcard'!

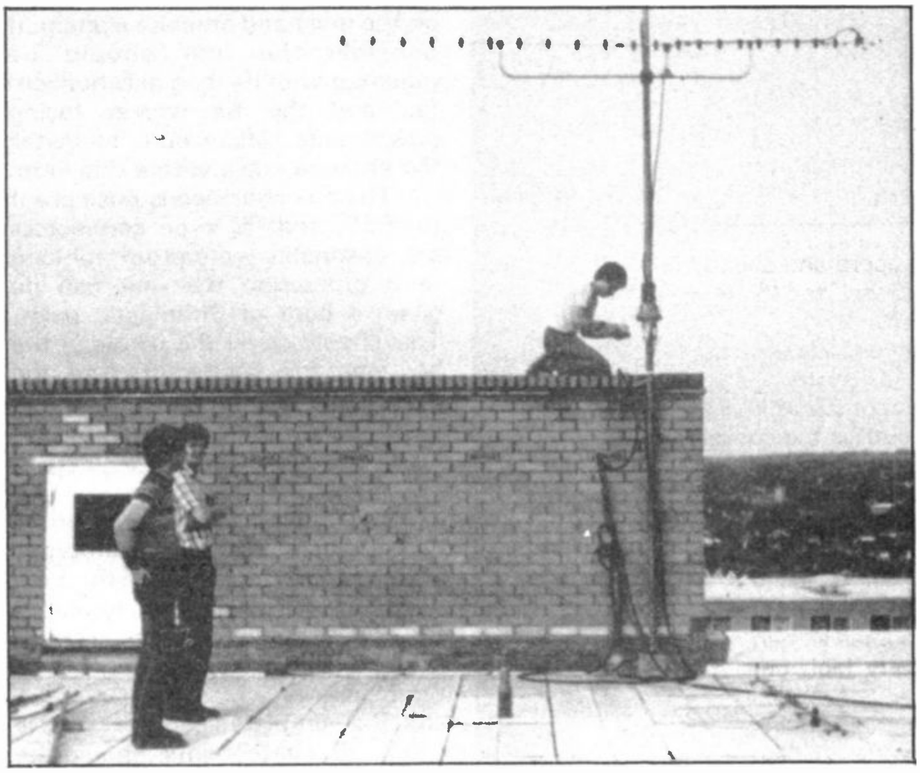
For the collective amusement of those involved at the receiving end, colour pictures of those helping at the London end were also sent after the initial part of the experiment had been successfully completed. This part of the morning's activities will be covered in a little more depth later.

Down To Basics

Having described the ideas behind the experimental link it would be helpful at this point to have a look at the fundamental principles of digital audio, and its advantages, to understand why its use gives us the potential for such high-quality sound in the first place. Basically a digital audio encoder samples the incoming audio waveform many times a second and compares each of a large number of discrete stored values, each of which is represented by a binary code.

The number of discrete values depends upon the system; an n-bit system will have 2^n levels — hence

Which way's North? Adjustment to G8AHK 88ele multibeam



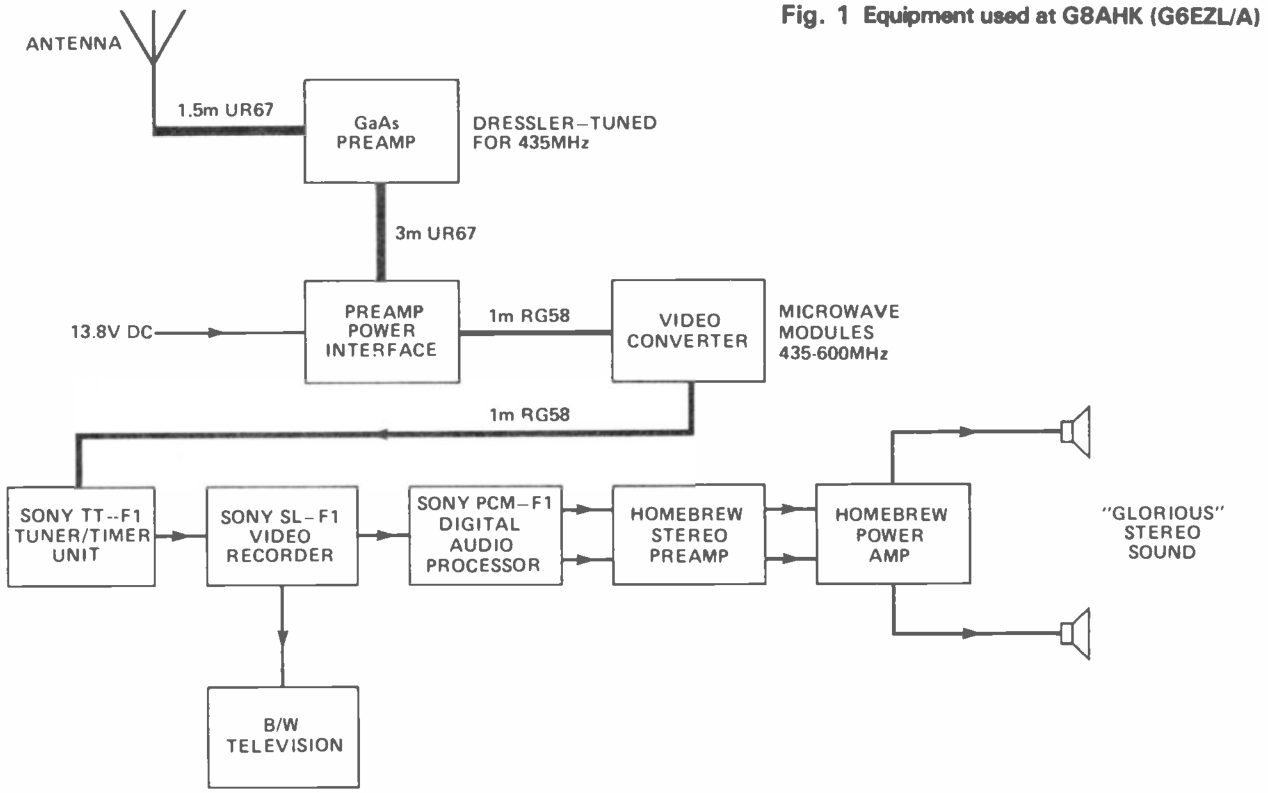
the 16-bit system used here has 65536 discrete values with which the input is compared. The binary number representing the step to which the input is closest is fed out as part of the output of the encoder, and this in fact occurs approx 44,000 times a second on both channels, along with various error codes, time codes and like which result in an encoder output bandwidth of some 2MHz. This happens to be some what in excess of the input bandwidth (!), but this is the price to be paid for the high fidelity results. Of course, to benefit from the system we need to record and decode this digital output signal, and this is when the TV aspect comes in; the natural choice for the economic recording of signal of such bandwidth (instrumentation recorders and the like are definitely out!) is the common or garden video recorder as used by so many households in the land for recording "Dallas" and the like! . . . This method of recording fits the bill exactly in its ability to cope with the wide bandwidth. (The video recorder that comes as part of the F1 package is a very high quality portable machine, which is very versatile in its own right). Having recorded the video signal we then need to decode it and it is here that the F1 serves a dual function — it is both an encoder and decoder. For the experimental link then we needed two F1 machines, the one at our end being very kindly lent by Mike Hatch, a student on the Tonmeister course at the University. To summarise the advantages of digital recording over analogue:

a.) There is negligible wow and flutter
b.) Absolute distortion is extremely low
c.) Analogue modulation-noise problems are absent
d.) Frequency-response is extremely flat
e.) Phase jitter and amplitude instability are absent
f.) Dynamic range is extremely wide (96dB or so in the case pf the F1)

Into Action

Having completed the installation of the 88-element multibeam at well gone midnight on the previous day, we rose on the morning of the tests at the unearthly hour of 7.30 (students don't like getting up in the morning!) and proceeded to assemble the necessary equipment in the shack, waking up most of campus in the process. The shack bore a more than passing resemblance, to quote G3OSS, to a "spaghetti factory", since we were using, in addition to 2m and 70cms gear, a video recorder, PCM adaptor, TV set and a hi-fi system! Using talkback on 2m we aligned our beams whilst watching the G3OSS testcard — the picture quality was good but not as good as had been expected — however we decided that there was probably enough signal for the PCM-F1 to stand a fair chance of decoding the transmissions. By now there were about 8 of us crammed into the shack, all waiting expectantly for Angus to begin sending the output from the F1 system. When he did, all we heard was a lot of clicks and pops interspersed with very brief snatches of a 1 KHz tone. Our first reaction was one of disappointment, but as we persevered with fine adjustment of the equipment at our end e.g. careful optimisation of the beam heading etc., the tone suddenly appeared rather more steadily, though at first with a few 'dropouts' now and then. Eventually, with a bit more '"tweaking", we reached a point where the link was fully operational. This fact was relayed to Angus, who then replaced the tone with his own dulcet tones thus enabling us to hear him in glorious stereo! We were soon

Fig. 1 Equipment used at G8AHK (G6EZL/A)



made aware of one of the main features of digital systems: the fact that there is a very sharp threshold between perfect, error free communication and a completely useless system. With our setup optimised, we were just above this threshold, but any slight disruption such as an occasional aircraft going overhead destroyed the link completely. To test how near this threshold we actually were, we bypassed the masthead preamp and found that this took us below that threshold. Once we had agreed that the link was sufficiently reliable, G3OSS proceeded to send us various recordings that had been made on the F1 — this was, in fact, of a steam train passing very close by at a very high speed *(Ouch! — Editor)* and a recording made by another Surrey student of a fireworks display on November 5th — both of which stretch the dynamic range of the F1 to its limit. It is interesting to note that the link quality was so good that we managed to detect a slight hum-loop problem on Angus' microphone connection which was producing 100Hz hum *at about 80dB below peak level!*

So much for Breakfast Television!

The sheer quality of the link was seen to be even more impressive when a high-quality cassette copy was later made of the mornings event from the video recording made at the time — a very noticeable decrease in the dynamic range and overall sound quality was quite obvious to all those who had heard the quality of the original received signals.

not an easy task since the Amateur Licence specifies that transmissions "should not be of an entertainment nature"!

While those helping at the London end located the relevant video tapes, we were treated to an entertaining live colour presentation of what was going on at that end of the link — it was apparently time for a mid-morning celebratory snack with coffee and Belgian buns, enough to make us very envious, since we'd failed to make similar preparations.

Eventually, however, it was time to return to the serious business of the morning and Angus proceeded to send us a recording made by himself

Noise Problems

The link demanded a very sensitive receive system and it was thought worthwhile including some of the basics of noise theory and its limiting effect on communication systems. It can be shown that the noise power available from an ordinary resistor as purchased from your local component emporium is given by Na = KTB where K = Boltzmanns constant, T = Absolute temperature, B = Bandwidth. The conclusion from this is that a humble (ideal) resistor, lying on a bench has a voltage across it of NaKTBR! If this resistor is placed across the input of an amplifier, then the output of the amplifier will be the amplified resistor noise plus the noise generated by the amplifier. This amplifier with our resistor on its input will generate a total noise power of KTB x Nf. Nf is the 'noise factor' of the amplifier which translated (!) is the noise power gain of the amplifier. We can reduce the noise by either reducing the bandwidth, lowering the temperature of using an amplifier with a lower noise figure. The bandwidth can't really be reduced easily (PCM needs around 2MHz bandwidth minimum), liquid nitrogen cooling is rather impractical (although it is used in some applications!) — so the solution is to use a 'quieter' amplifier with e.g. a GASFET in it. Another way of gaining an increase in the signal-to-noise ratio is to mount the preamp at the masthead — this helps because if there is, say, 3dB *signal* loss in the feeder between the antenna and the receiver then the result will be a noticeable better signal-to-noise ratio at the input to the receiver than if no preamp is used. By placing our low noise preamp at the masthead our gain is where our signal-to-noise ratio will be at its *maximum* — before attenuation of the signal by the cable and more 'noise' being by the conversion processes of the receiver to audio frequency. Complete receive system is shown in **Fig.1**. The masthead preamp fed a Microwave Modules ATV coverter which converts 70 cms TV pictures to UHF Channel 36. It can be seen then, that most of the equipment used is, as suggested in the introduction, fairly standard amateur radio equipment, and thus readily available.

To conclude, then, it remains for us to add a word of thanks to all those who helped out at both ends — Simon Roberts G8UQX, David Hall G6JCH, Andrew Harding, and all those previously mentioned, in particular Mike Hatch for entrusting his treasured F1 system into our eager hands (!). Finally we would like to feel that this article will, in some way encourage further experimentation in this field by many other Amateurs, who we trust will find such experimentation as fascinating and rewarding as we did.

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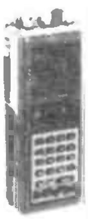

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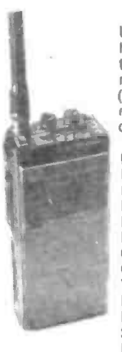

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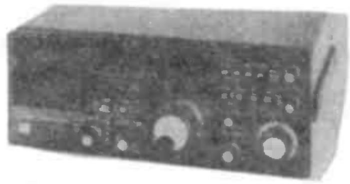

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Some crafty and practical suggestions on utilising this evergreen antenna from wily young Harry Leeming, G3LLL.

HCJB came into being over 40 years ago when it was decided that the site 10,000' above sea level on the Andes in Ecuador was an ideal place to build a missionary radio station; ideal, except for the one problem that had not been forseen! The driven dipole element in a beam antenna has very high voltage at its ends, particularly if driven by a high power broadcast transmitter. In the case of HCJB, in the rarefied damp evening air of Ecuador, this voltage was just too much and a corona discharge struck up at the tips of the dipole if anything other than very low power was run. Quite apart from causing local interference, this discharge was melting and destroying the beam, and so something had to be done.

The project seemed somewhat hopeless; the transmitter, buildings and all the money spent would be wasted unless the problem could be solved, but how do you stop an antenna having high voltage at its ends? The answer, literally, to their prayers was the Quad Antenna, developed by station engineer W9LZX/HC1JB, an antenna without any 'ends'. The Quad solved the corona problem and also seemed to give HCJB a signal which was out of proportion to its cost and simplicity. Results were so encouraging that W9LZX made one for his own use on the 20-metre amateur band and obtained outstanding results. From this unusual beginning, by magazine articles and word of mouth, the details spread so that the Quad and its derivatives such as the Delta Loop have achieved supremacy as the number one do-it-yourself HF band beam.

Quad Workings Simply

In **Fig. 1A** we see two horizontal dipoles stacked one above the other. Vertical stacking gives a few dbs gain with no increase in horizontal directivity; the beam being squashed down vertically so that more signal goes to the horizon and less goes up and down. The active part of the half-wave dipole is the centre high current section, and so to save space, the ends can be folded as per **Fig. 1B** giving some reduction in performance. There would be little point in actually constructing an antenna system as per Fig. 1B as points A & B and also C & D are in phase and have the same voltage on them so that they do not need insulating from each other. Once they are connected together, as in **Fig. 1C**, the top feed point is no longer needed as energising the lower "dipole" also energises the upper one, and this how the classic quad loop is formed.

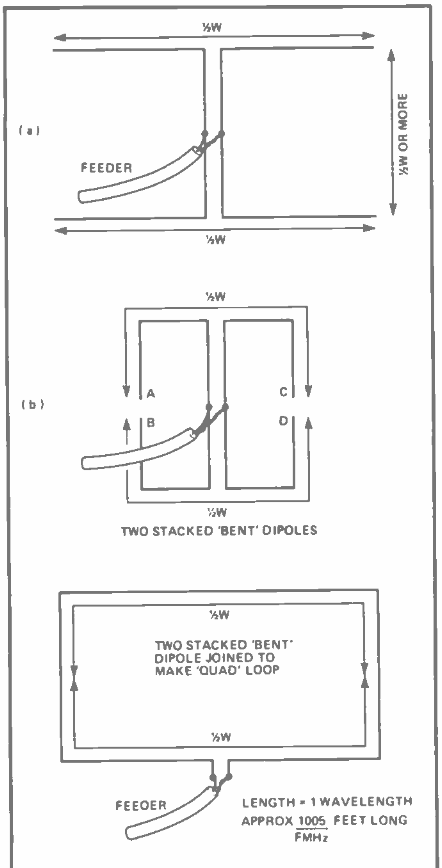


Fig. 1 Evolution of a Quad loop

Forming A Beam

The obvious partner for Quad driven element is a quad reflector so that the classic two-element Quad, as developed by W9LZX and HCJB, is shown in **Fig. 2**. For mechanical simplicity and ease of adjustment the reflector and driven elements are usually made the same size, the small stub being adjusted to resonate the parasitic element lower in frequency than the driven element. While the gain of a two-element Quad is about the same of that of a good three-element mono-band Yagi, many operators claim that at low heights or in poor locations it out performs the Yagi. Measuring the DX gain of an antenna is extremely difficult but two factors possibly do give the quad and delta-loop types of construction a definite advantage over the Yagi.

1. Being, in the main, a do-it-yourself antenna (there are commercial versions available as you will have noticed) and having only two elements it is relatively simple to adjust on site for correct resonance and front-to-back ratio, *and so ensure the best results every time.* (Most commercial Yagis are simply erected by operators who 'hope for the best').

2. The Quad type of construction seems to be less susceptible to being upset by nearby structures, and probably its lack of voltage 'ends' and the loop type of construction gives it some kind of 'insulation' from nearby objects. Certainly on the two-meter band, four or six element Quads are much to be preferred to Yagi beams if one is forced to install them in the confined space of a loft and not in the clear, out of doors.

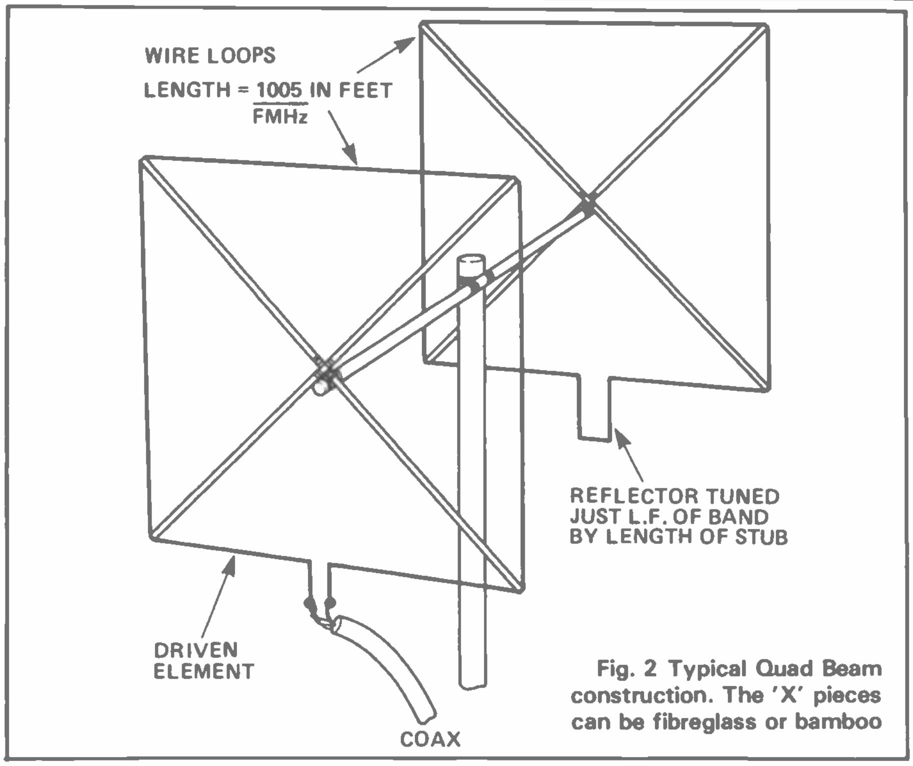


Fig. 2 Typical Quad Beam construction. The 'X' pieces can be fibreglass or bamboo

The exact shape of a Quad element does not seem to matter much, provided that the formula length of wire in feet equals 1005/F(MHz) is not taken too literally, and the possibility of adjustment of a few per cent is allowed for either way. Squares, diamonds, circles and triangles all seem to give good results, but, of late, the latter, which for some reason has been re-christened the delta loop, has become very popular.

Impedance Matching

The impedance of a full wave Quad loop is somewhat over 100 ohms and, whilst it can be fed by 75ohm co-axial cable with a passable SWR, using 50 ohm coax gives an SWR of just over two to one. A good match to 50 ohm coax can be made using a matching section of 75 ohm coax if one is an SWR fanatic! — but unfortunately, where a two element Quad beam is concerned, the presence of a correctly spaced reflector element brings the impedance down to around the 50 ohm mark, without any matching devices being needed, and so keeps everyone happy.

Cheap, Non-Rotatable

Some years' ago the writer moved QTH and wanted to try the 20 metre band with a high performance, low cost beam. After much head scratching and splinter removal, the system shown in Fig. 3 was devised and erected. As will be seen, this uses the delta loop type of Quad construction with the point of the triangle at the top, whereas most designs of delta loop seem to prefer the triangle to be inverted. The theory of operation of a single delta loop element is shown in Fig. 4 where it will be seen that, once again, the effect is as of two stacked two element Yagi beams.

The design of the first delta loop beam was based on what was available, the reason for the four foot spacing at the top being that there was a convenient FM broadcast antenna with this length at the top of the mast already pointing at the right direction. The shape was tailored to fit in the available space, one end of the loops being supported by a concrete lamp standard which the local authority have thoughtfully placed in front of my home. The spacing of the loops should, according to most sources, be in the region of eight to ten feet, but in my particular installation, with the top fixed at four feet, around six feet at the bottom was found to give the best gain and front-to-back ratio, plus a low SWR, using 50 ohm feeder. The loop lengths shown are only very approximate, as they are affected by the proximity of the roof and the exact shape of the triangle. Normal practice with Yagi beams is to resonate the reflector 5% lower in frequency than the driven element, but for some reason this does not seem to work out with delta loops or Quads. After much trial and error the best results across the 20 metre band were obtained by resonating the driven element at around 14.2 MHz, and the reflector at about 13.8-13.9 MHz.

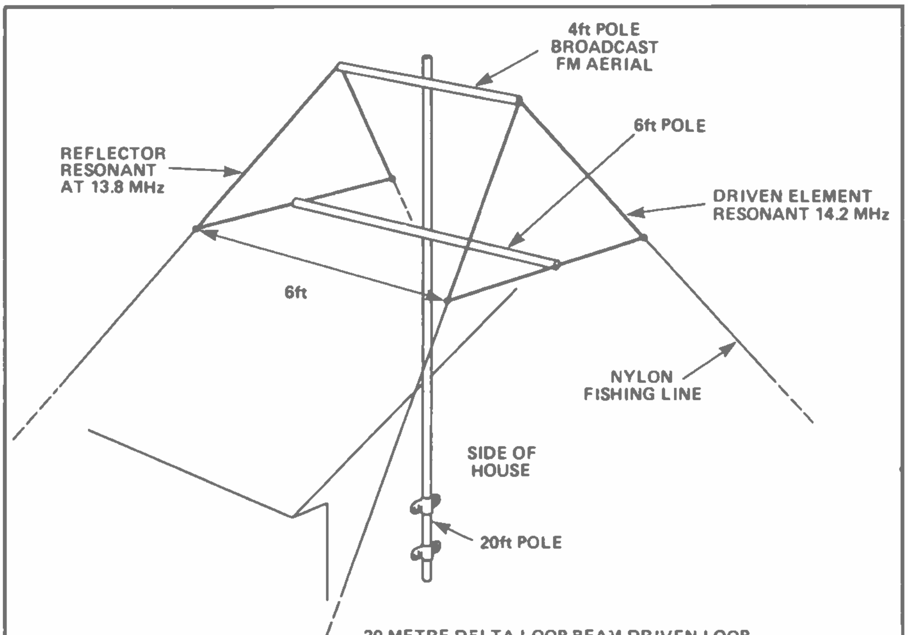


Fig. 3 The G3LLL 20m Cut-Price Delta Beam

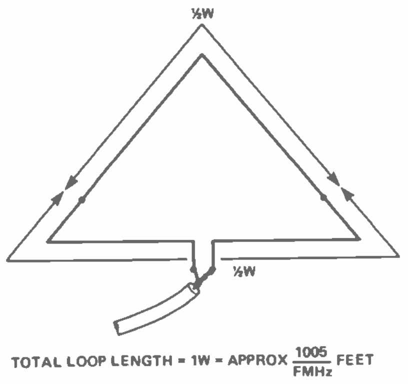


Fig. 4 Delta Loop Operation

The beam was, of course, not rotatable but was fixed on the United States as, at that time, I was much enjoying myself boosting my ego by talking to American users, of my FT101 RF Clipper! The theoretical gain of a Quad/Delta loop type aerial is something in the region of 7 db over a dipole (5 times power gain), but the actual 'DX gain' can be more than this. Compared with a multiband 108' W3DZZ type trap dipole, the gain on receiving States-side signals was anything from one to four S points. Interestingly, this seemed to vary considerably with band conditions and the biggest gain of the delta loop over the trap dipole occured under 'long skip' conditions, presumably due to its lower angle of radiation. Certainly on transmit, by comparison with other stations, the impression was gained that the results bettered that of the 20 metre section of typical tri-band beams. The 20 metre delta loop was thrown up experimentally in 1977 when 15 and 10 metres were in the doldrums, but in the following years when these bands opened up, naturally I wanted to add them, so that eventually my delta loop sprang new loops and at the final building looked like Fig. 5.

Easy To Tune

Once again, the dimensions are only approximate but, if you do fancy duplicating the idea, it is quite easy to 'tune up', as is the 20 metre version, using a dip meter. After the aerial system has been assembled, do not connect the coaxial cable but complete all six loops leaving a 1" diameter single turn coil in the centre of the driven elements and on the ends of the reflector stubs. Having done this check the elements individually with a battery powered 'grid dip oscillator' (check the calibration of the dip meter with an accurate receiver before use, and then place it an inch or so from the one turn coils. Use as loose a coupling as possible for the best accuracy) and adjust the loop or stub lengths so that the resonance comes at about 14.2, 21.2 and 28.5 MHz on the driven elements, and 100 or 200 kHz outside the LF ends of the bands on the reflectors. Make sure the loops are in their final shape and position when you do this, and try and keep clear of the wires so as not to detune them with your body capacity.

Once the loops are correctly tuned individually, remove the one turn coils from the driven elements, and connect the coaxial feeder. As shown in the drawing, a simple balun-type arrangement can be made by wrapping the coax as many times as possible around a ferrite core, made of, say, a couple of FX1588 type rings. Any reasonable sized ferrite core will do. Just underneath the joining point, and this is quite effective in stopping RF going down the outside of the coaxial feeder. The delta loop beam once it is completed should perform excellently and a check of the SWR should show this to be below 1.5-1 in the centres of the bands, and not much bigger at the edges. If necessary, the driven elements can be pruned so that minimum SWR falls in the centre of the bands, but if it is below 2-1 it is probably best to leave well alone. Once the feeder has been connected , re-check the resonant frequency of the reflector elements with the dip meter just to be sure.

Cheap and Bi-directional

An interesting variation of the above system is to feed one or all of the "reflectors" with a length of

Fig. 5 G3LLL Delta Beam variant for 20,15 and 10m

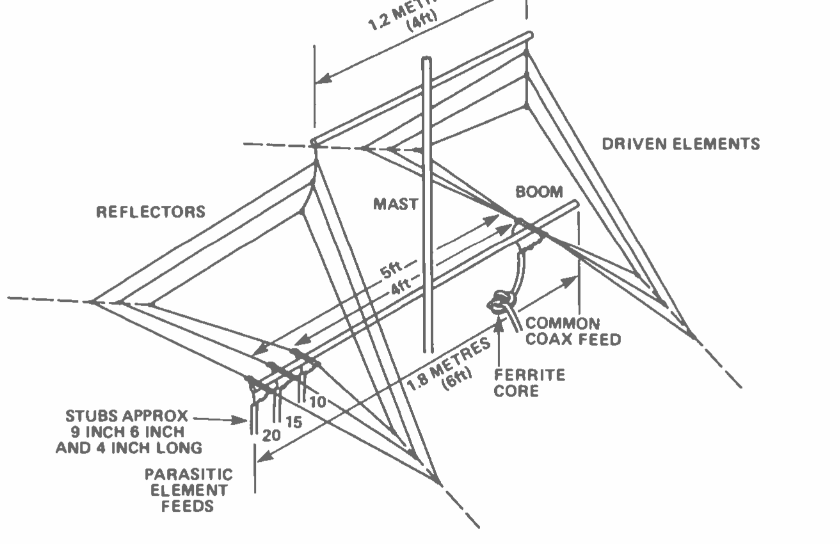
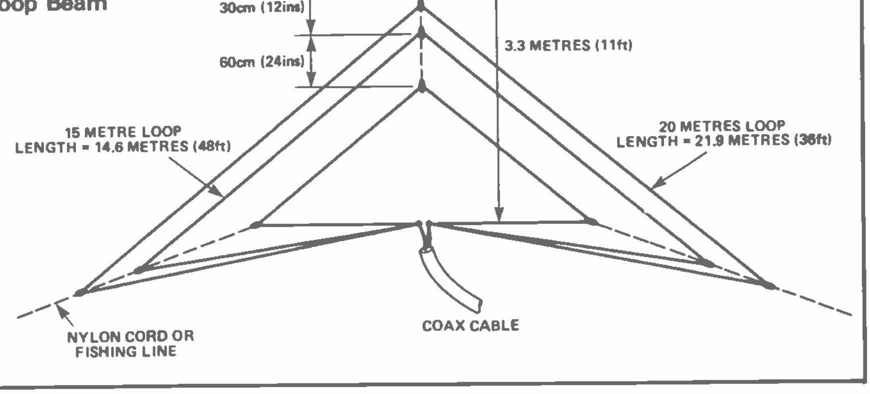
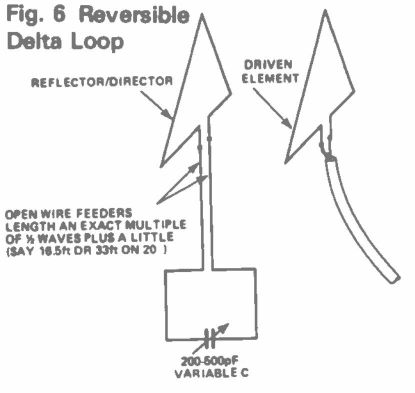


Fig. 5b Dimensions for 20, 15 and 10m Delta Loop Beam



open wire feeder that is an exact multiple on half wave lengths long on the design frequency of the antenna (see **Fig. 6**). Doing this brings control of the resonant frequency of the parasitic element into the shack, and, once again, this frequency can be checked by connecting a one turn loop to the end of the open wire feeder and using the dip meter. The feeder can be shortened or lengthened until the resonance is just LF of the band in question. Once this has been achieved, remove the one turn loop and put a 500 pf variable capacitor in its place and "hey presto", a *reversible* delta loop beam. With the capacitor set at maximum, the parasitic element is tuned as a reflector and operation is normal, but, set it near minimum, and the element is tuned as a director and the beam is reversed. In practice, the capacitor is set for the strongest signal on receive in the direction desired with the assurance that the transmitted signal will then go in that direction. Results are best in the reflector mode, but it is certainly a useful modification to the idea.

Fig. 6 Reversible Delta Loop



Short of Space

Even a single delta loop will give a good account of itself, and when fed with open wire feeders can be used on more than one band (see **Fig. 6**). A closed loop is a very quiet aerial and signals which would be buried in noise on a vertical come in "clean and green" on the delta. As the delta loop does not seem to pick up much noise from nearby electrical sources, it is reasonable to assume that it will not pump too much RF into local electronic equipment, and while there is no such thing as a TVI proof aerial, Quads and Delta loops do seem to help in this way.

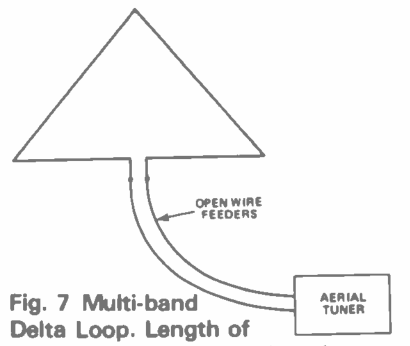


Fig. 7 Multi-band Delta Loop. Length of Loop approx. one wavelength at lowest frequency

Go Quad!

A few hours' work and you may produce a bigger signal States side than the guy down the road who has spent £500 with a dealer on a rotor and a multi-element beam. To the writer achieving results like that are the real thrill of amateur radio.

As a dealer/radio amateur, I don't know which gives me the greatest pleasure; taking the £500 or generating the biggest signal!!!

Got a Pink Ticket?

Lying on the front door mat was an official Governmental envelope and inside it was a heavy frown — the purpose of which was to warn it's amateur radio recipient that he had transgressed. He had been heard working duplex — nothing wrong about that — but he had also been heard to allow to pass through his microphone the voice and, more importantly, the person he was working — and there is quite a lot wrong about *that.* The recipient of the letter (let us call him Party 1) had been on 145MHz. Party 2 had been on 433MHz.

When Party 2's voice and *callsign* became discernible back on 145MHz through Party 1's microphone, that was obviously quite wrong, for he wasn't transmitting on 145MHz: he was using 433MHz and being retransmitted.

Sundry other transgressions, some of them quite mild, are detected regularly by the Amateur Radio Service monitoring system. And an official letter containing that heavy frown may result. This is commonly known as a 'Pink Ticket', a colloquialism from the other side of the Atlantic where a letter in shocking pink is the normal means by which Authority tells the errant ham "You have transgressed".

Jack Hum, G5UM, offers a few thoughts on transgressing radio-wise.

Very few British hams receive warning notices of the kind described for the very good reason that the great majority of them do their homework well before activating their transmitters for the first time. A list of possible 'sins' is given in the accompanying panel. It is by no means exhaustive.

Before going farther, let us finish that story about the UK ham who got a "pink ticket" simply because he didn't do his duplex properly.

Cross-Banding

There are two hazards about the process of operating duplex — or 'cross-band,' as it is popularly known. One of them is the danger of inadvertantly allowing the other person's callsign to be heard on a band he/she is not using, as already described above. The other is the continual occupation of frequencies which other operators might wish to use. A simplex QSO, that is co-channel operation, needs only one frequency whilst a duplex, split frequency operation, needs two.

The answers to these hazards are self evident. If Party 2 wears headphones whilst engaging in a duplex contact, there will be no chance that emissions from Party 1 will be heard through his microphone.

But herein lies a frustrating ambiguity, and it is this: each party will wish to know how his transmission sounds at the other end. He can only find out if he hears his voice coming through. What to do? Why, simply ask your QSO-partner to give a counting check "one to nine" so that he may hear his voice through *your* microphone and assess for himself the quality of his own signal. Tell him beforehand not to utter his own callsign while counting.

This procedure is particularly rewarding to operators making their first essays on to bands not used previously. Many people new to 70cm, for instance, are able to appraise its potentialities more effectively if they can actually hear what they sound like at a distance. Time and again, in the writer's experience, users of 433MHz are amazed at the band's penetrative power simply because they are given the opportunity — via duplex — to hear the evidence of their own signals. Without this opportunity, they might have remained in that erroneous state of scepticism about 'Seventy' which seems to afflict so many people.

In-Banding

Duplex does not necessarily mean cross-band. It can be conducted in-band if desired by the participants — but non-participants may well tend to disapprove of this hogging of *two* frequencies in the same band. So may Authority.

Where to go, then, when conducting duplex contacts? For preference, do it cross-band rather than in-band. This procedure is more economical of our precious frequency space. And this irritates fewer random 'listeners'(!): they hear only *one* frequency being occupied continuously within a given band, and not two.

When you operate duplex from 2m, choose a frequency below 145MHz to clear those congested S-channels above 145MHz (in practice, this means below 144.9MHz to avoid the beacon area). As for the other end of the link choose a frequency in the 70cm band well away from the commonly used SU-channels, which is very, very easy: 'Seventy' is an enormous band that offers something like fifty FM simplex channels at 25kHz spacing. What, you don't have a transceiver that covers them all? Then perhaps it's time you bought one from an HRT advertiser to bring yourself up to date.

Having chosen appropriate frequencies for the duplex operation, there is still one important consideration to remember, if you are to avoid getting that Pink Ticket. This is simply: Observe the Fifteen Minute Rule! You can read all about it in Clause 9 (2) of your Licence. Yes, you have remembered it now, haven't you: that one about giving the callsign at intervals of fifteen minutes. When you propose to do so, tell your duplex party to switch off while you give your identification. Then your callsign will definitely not get out on the wrong band, as has been emphasised above.

Just a final-final about the technique of duplex operation: never, but never engage in a cross-band set-up involving a band you are not licensed to use. If a Class B operator attempts to cross-band into, say, 4 metres he is inviting trouble and a Pink Ticket. His voice should never be heard on a band for which he is not licensed.

Self Policing

It is commonly averred that the Amateur Service is self policing, that a station with a 'dirty' signal will soon be politely told about this by his fellows.

Very true: but there is always the chance that the 'dirty' signal, if capable of incommoding its neighbours on a ham-band, may be also causing interference on non-amateur frequencies. Then the licencee is in real trouble. One man's splatter could be another man's air crash. A re-read of the two clauses of Paragraph 4 of The Amateur Licence would not come amiss in this context and may well stave off the evil day when Paragraph 11 ("Station to close down") is invoked, the ultimate sanction, to be applied only for the severest irregularities.

There is much else in The Licence that calls for a quiet re-read to help dredge from the subconscious all that information which was given during the RAE course. It is all too easy in the excitement of "getting the ticket" to put The Licence away in a drawer forlorn and forgotten — until a Pink Ticket arrives unexpectedly through the letterbox one morning. It is no excuse after the event to say "But I never knew. . .".

Postpone that day for good by re-studying your ticket to transmit and engaging the brain before pressing the transmit switch.

YOU ARE INVITING A PINK TICKET IF —

- * you fail to announce your callsign whenever you change frequency.
- * you let another station's callsign come through your microphone on to a band he is not transmitting on when working DUPLEX.
- * you emit 'Splatter'.
- * you use any of the frequencies forbidden in The Schedule to The Licence.
- * you are unable to give an extract of your log to the nearest minute and kHz if required by Authority (Radio Regulatory Division, GPO and DTI etc).
- * you utter obscenities or expletives (strangely, some people do).
- * you utter (very) facetious phonetics for your callsign.
- * you fail to state your location when operating "Stroke A"

There are many others. They are all in The Licence. Read it!

YOU WON'T GET A PINK TICKET IF —

- * you operate the wrong mode in the wrong place, eg, FM in the SSB area or SSB in the repeater area; but you will antagonise your fellow operators.
- * you hog a repeater (you won't be thought much of by others waiting to use it).
- * you fail to announce your location if you are not in The Callbook: someone somewhere might like to know where you are.
- * when you use telegraphy and you send faster than the other chap's speed: you are wasting his time and yours, you incur repeats and his wrath and you might discourage him from using the mode.

The Ritman Wireless Auction

In this 'Radio Today' special, Tim Wander, G6GUX, member of the British Vintage Wireless Society, reports on the first major sale of vintage wireless equipment in Britain.

The first ever major sale of vintage wireless equipment in this country tool place at Christie's South Kensington branch on March 1st, 1984 at 2.00pm. The sale consisted of 180 lots, part of a collection that had been built up by Dutch businessman, Mr Tony Ritman over the past eight years; apparently after an early interest in historic radio had been rekindled when he found a crystal set at a junk market. The collection had then been wrapped up and placed in store in a barn, as an investment to gather interest. It is perhaps sad that no restoration attempts had been made at this stage on many of the sets, as some had deteriorated quite badly. The collection was available for viewing on the morning of the sale and on the two previous days, and created a lot of media interest. During the morning of the sale, BBC's 'Sixty minutes' team came along and filmed a preview, directed through the more interesting items by the Director and subsequent auctioneer, Christopher Proudfoot.

In every field of collecting there will always be differences in exactly what interests the collectors concerned. The television people showed most interest in the two televisions in the sale. Lot 100 was an original Baird televisor, obviously very rare, but also in very poor condition due to external corrosion, and Lot 35, a pre-war vision only Ekco, type TA201 with a 7 inch screen.

My own interst was aroused by the collection of First World War Equipment, which is somewhat rare on today's market, and represents an epoch in the design and development of wireless. The earliest lot in the sale was lot 179, a telegraph sender and receiver, incorporating a print-out mechanism that used paper tape, while the 'cut-off' date for the latest (!) piece of equipment was around 1930.

The other category many people collect under could be termed 'attractive', and unless a set is particularly interesting it is unlikely to be added to a personal collection or even to have survived, if it is ugly. There were several sets that caught the eye, Lot 78, an Atwater Kent 4 valve breadboard receiver, lot 68, a Pye 830, and lots 12 and 107, a Cosmos Radiophone and an AJS 7 valve receiver. Although the latter two are of no great historical interest, I simply liked the look of them.

The lots consisted mainly of receivers, but, as a testament to the days when narrow signals were unheard of (the last big 2m contest ??) lot 110 was an interesting spark gap transmitter and receiver. This incorporated a crystal detector, morse key and spark gap unit built into a wooden case with the patent date 1907.

Let Bidding Commence!

By auction time there had been quite surprisingly large turnout, all the seats were taken half an hour before kick off time, with around 1509 people attending overall. As you would expect, Christie's handled the whole event very professionally and auctioneer Chris Proudfoot pronounced the last of the lots sold in under two hours.

Before the sale there had been some disquiet about the fact that estimated prices in the back of the catalogue seemed in many cases very high, especially considering the condition of the pieces concerned. But in the end prices reached were for the most part sensible, with one or two bargains offsetting the one or two lots where bidders enthusiasm possibly got the better of them. Crystal sets were very popular, attracting much high speed bidding to reach healthy, (on average £100) and in one case ridiculous prices.

Other prices ranged from £5.00 for a paper maché horn speaker, to £2,400 for the televisor; the Ecko TV reached £85.00, the AJS 4 valve receiver reached £300, the spark gap Tx/Rx £180, the Atwater Kent Set £450. The Cosmos radiophone fetched £260, the telegraphy unit £1,600 and the First World War equipment between £100 and £300 per set. There were also a few single valves in the sale, an unmarked White (capital W) valve fetched £100, and a box of valves comprising two Cossor P type bright emitters, an Edison R type, a Marconi Osram DEP type and five other period valves fetched £130.

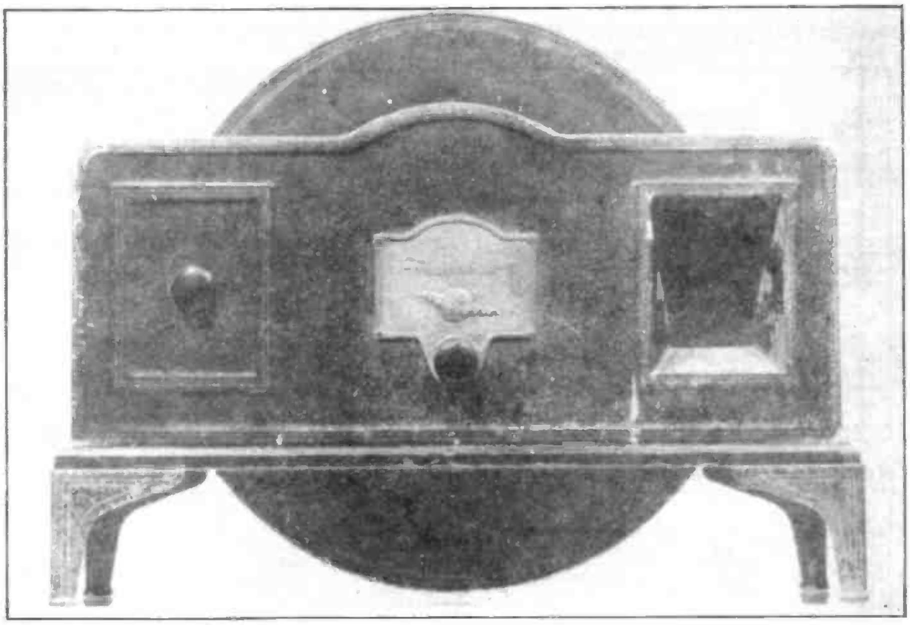
Foreign Interest

Many of the pieces offered for sale were in fact continental in origin, and bidders for these consisted mainly of foreign collectors and dealers. Prices in the main were not that high, possibly questioning the wisdom of bringing the collection acros the channel, but for those of us wishing to add a French valve set or two to our collections the chance was there.

It seemed rather sad at the end of their auction to see the collection split up and carried out, literally, to the four corners of the world. The Baird televisor went to an Australian museum who can hopefully handle the restoration, while other pieces went to a German museum, America, and selected pieces to members of the British Vintage Wireless Society.

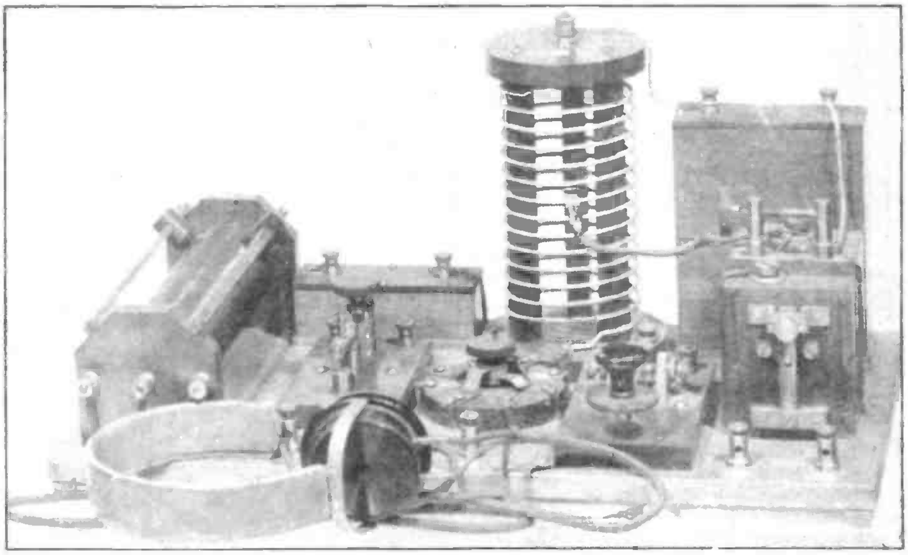
Overall the sale raised £18,274, but VAT was charged at 15% on top of the bid price, something that may have come as a nasty shock to the big spenders. Christie's have indicated their willingness to hold other sales of this type if a suitable collecton became available, although wireless lots do occur from time to time in their regular mechanical music sales. Overall the sale held no real surprises, reinforcing the prevailing view of the flat state of the vintage wireless market at the moment. But a pleasant day out was had by all; to talk about vintage wireless, watch an expert auctioneer in action and enjoy the sight of other people spending their money was very satisfying.

Cosmos Radiophone TRF Receiver (£250)

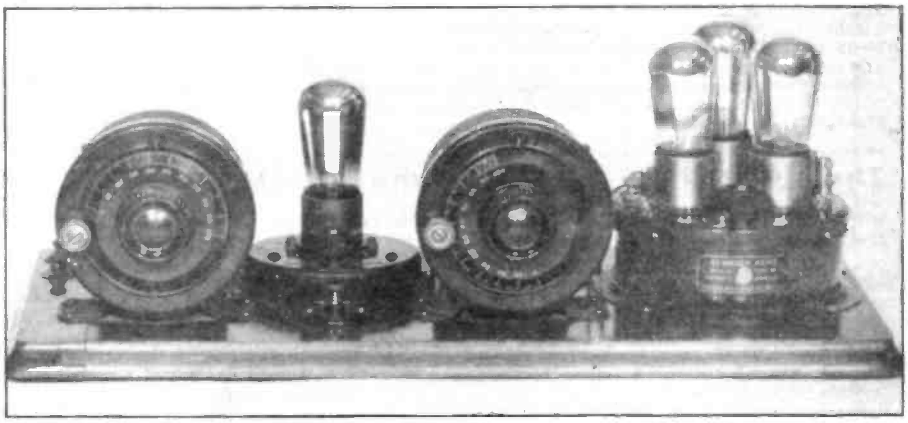


Baird Televisor with 4 x 3 inch screen (£2400)

AJS 4 valve Rx with 3 valve amplifier (£300)



Spark Gap Tx/Rx with sliding tuning coil from 1908 (£180)



American Atwater Kent 'Breadboard' Rx (The components could bought individually and are all mounted on bakelite) which fetched £450

A Look at SCANNING RECEIVERS

Scanning receivers — what do they do exactly? To whom are they useful? Tony Bailey, G3WPO, takes a philosophical look at several currently available 'scanners'.

Once upon a time, when transistors, chips, keypads and such things were mere twinkles in the eye of some scientist, the only way to find a radio station was to take hold of the tuning knob on your receiver, wind it round until you found a station, listened to it and then decided whether you wanted to continue listening to it. If not, the process carried on until you either found something you wanted to listen to, or your arm got tired and you gave up and went to bed.

Like the advent of washing machines, modern technology has removed all this drudgery from monitoring the bands, and, so the adverts tell us, we don't have a complete station unless we possess some form of scanning monitor receiver. With the aid of these devices, you can monitor anything from around 150kHz up to 500MHz and above automatically. Or can you?

In fact, do these automatic boxes actually help or are they just another symptom of a solution looking for a problem to apply itself to?

This review looks at several of these receivers, from a broad selection on the market, and we will be discussing their pro's and con's, and whether they actually do the job they are intended for, primarily from the Short Wave Listeners point of view.

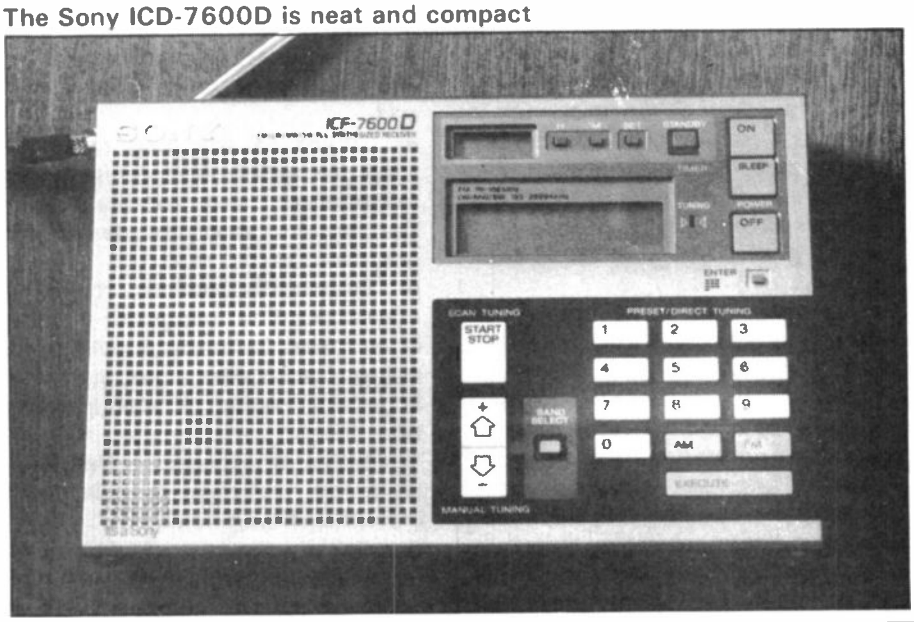
Who Needs Them?

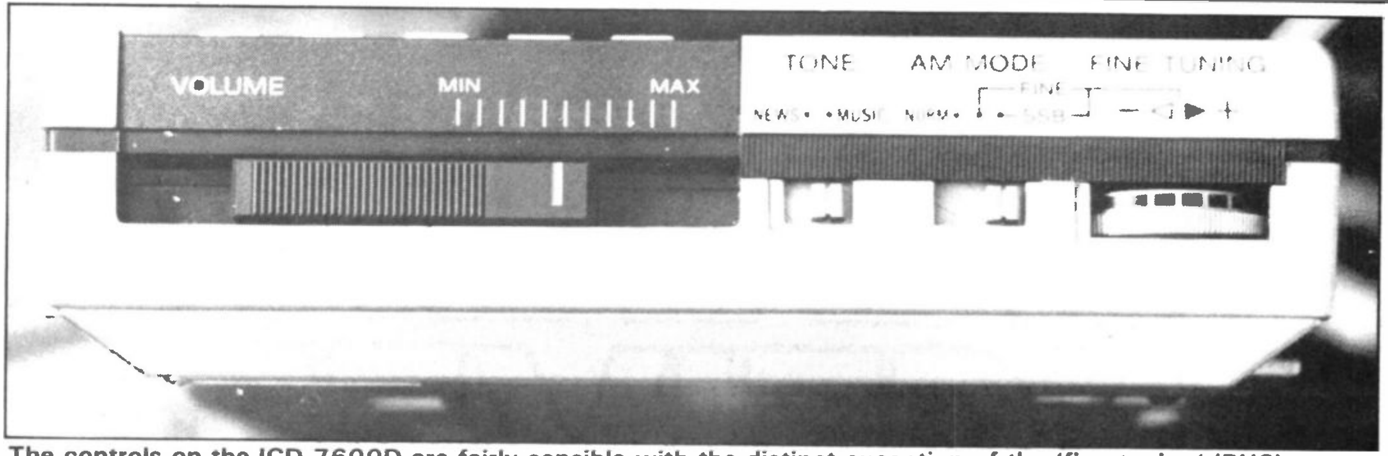
I get the impression that the majority of Scanning receiver users are those who have interests in the VHF/UHF spectrum — not surprisingly, because the very great majority of such receivers available are for these bands! HF orientated stations are probably less likely to want one of these receivers — it depends on the operator of the station involved, and especially the mode he is working with. Scanning is fine for seeking FM and AM stations, but rather less suitable for SSB or CW.

The problem is of course that the receiver doesn't know when to stop scanning when it finds an SSB or CW signal — it has no reference to tune in correctly against. With FM and AM, there is a nice steady reference carrier, and even if the scanning stops slightly off frequency, possibly because the rig is scanning in steps smaller than the channel spacing on the band in question, it isn't usually too much of a disaster — the bandwidth of the receiver is normally such that you can still decipher the modulation well enough to identify the station.

There is possibly only one exception to the above and that is with some computer controllable rigs — in particular one of the Heathkit range. With this, it is feasible to actually scan to a CW station, check via the controlling program whether it is a wanted sta-

The Sony ICD-7600D is neat and compact





The controls on the ICD-7600D are fairly sensible with the distinct exception of the 'fine tuning' (RHS)

tion, and if so, the rig can go ahead and work it for you. A bit outside our present but indicative of the way our technology is going. As an addenda, the Pie-In-The-Sky idea of the rig actually writing out the QSL for you is probably not at all far fetched these days.

So, we are left with scanning as primarily an aid for AM and FM monitoring. Now, many transceivers for the VHF and UHF bands have scanning facilities already built in. Some will scan the whole band in question, or between two programmed frequency limits, or a number of memory channels. You can also get a 'Priority' channel — which will be checked every so often independent of what else is being received/scanned. You can normally also choose to stop the scan on either an empty or busy channel and also miss channels of your choice should they be occupied but not of interest (such as the localRepeater occupied by two stations boring everyone listening). The conclusion must be that dedicated scanning receivers are used/needed by SWLs interested in Broadcast or other non-amateur frequencies, or by amateurs who have a need to monitor VHF/UHF amateur channels, but don't have scanning facilities built in to their rigs.

There is one other point — if you monitor any frequencies other than those covered by licences you have then you are breaking the law. *You are covered for reception of Broadcasting stations and licenced Amateur Stations anyway under normal Law,* but 99% of people will not be legally able to listen to anything else. However, this doesn't seem to stop anyone listening to anything going, such as the police, air traffic, ambulance, PMR, etc etc, if they can receive it. It is rather unlikely that you will be prosecuted for this, though — you have to be caught first. Leaving the shack window open with the volume up loud on local police transmissions is not recommended.

Needs

What should you want/expect from a scanning receiver? This will depend of course on individual needs, but I would suggest that the following would not be untypical for a general specification.

1. Coverage of all desired frequencies in one receiver.
2. Minimum number of antennas needed for the frequencies covered.
3. Adequate sensitivity, bearing in mind the frequencies you require to receive and type of antennas to be used (If the receiver is fairly insensitive, a large antenna may be needed!)
4. Lack of image response when wide spectrum coverages are planned.
5. Choice of scanning rates and steps — which is suitable for the frequencies and modes/channel spacings in use on the desired frequencies.
6. Selectable facilities for either continuously staying on a signal once found, or automatically continuing to scan after a predetermined adjustable period of 'stable' reception.
7. Choice of continuous frequency coverage, or programmable set of individual frequencies.
8. 12V operation for portable/mobile use as well as base with memory power back-up facilities.

Through the years, all of these facilities have appeared in various receivers, but not always at the same time.

The SONY ICD7600D

The first of the receivers reviewed here is sightly unusual in that it isn't a VHF/UHF type. It is actually a generally available consumer market receiver, the SONY ICD7600D (or the ICF2002 as it is sometimes marked), but which has interest for the amateur/SWL because of its Short Wave coverage and facilities for CW/SSB reception, and to BC SWLs due to its AM general coverage facilities.

A few years ago, the contents of this small package would not have been dreamt of. In one small box, sixe 180 x 117 x 31mm (plus telescopic aerial) you get the following facilities (and extras) for your money:

a) General coverage 153kHz-29.999MHz & 76-108MHz
b) Manual or scanning facilities by keypad entry
c) Digital LCD display/clock/alarm/snooze
d) Backup memory battery
e) AM/FM/SSB/CW reception facilities
f) Carrying case/mains adaptor/instruction manual and comprehensive frequency chart.

There are a number of controls — on the main front face are the LCD display, Power on/off-Sleep (for the alarm) buttons (all buttons are soft-contact 'soundless' types), plus a selection of further buttons for frequency selection. Without going into the exact method of each type of frequency selection, you have a choice of either direct, preset (10 channels) scan or manual tuning on all bands.

In addition there is a Band Select function — this will take you directly to any of the main broadcast bands; that is FM, LW, MW (522-1611kHz), and SW (split into 75, 60, 49, 41, 31, 25, 21, 19, 16 & 13 Metre bands). It is possible to scan each of these bands from one end to the other, then start again; or, to manually step through them, or directly set a frequency within them. You can, of course, also tune to any frequency between 1615 and 29995kHz if you want to. While scanning, the receiver will stop on any station for a maximum of 1.5 seconds, then carry on stepping, unless stopped manually. Incidentally, the step rates are 0.1MHz for FM, 3kHz for LW, 9kHz (or 10kHz by changing an internal switch) and 5kHz for SW.

For the SWL interested in a general coverage receiver for Broadcast work the Sony represents an almost ideal little purchase. The Rx is *synthesised* general coverage, although the 'steps', as just descibed, suit BC station channel spacing. There is however, an interpolation oscillator control sitting on the side of the case — this enables you to 'fill-in' the gaps missed by the synthesised coverage. This control is very useful for trying to remove heterodynes etc, when listening to BC stations but is primarily for SSB/CW tuning on the SW ranges, of which more anon.

The sensitivity and selectivity is adequate for AM reception, although strong adjacent channel transmitters did tend to cause some problems — this is not really objectionable when using the internal antenna. On an external tuned antenna, the situation is somewhat worse and the built-in switched attenuator was required on many occasions. Stability of the receiver is, of course, no problem.

SSB/CW

For general SWL monitoring of the short wave bands (both amateur and other) the SSB/CW facilities are adequate, although this particular sample did unfortunately suffer from distinct 'pulling' of the interpolation oscillator when the AGC was in action. This is not uncommon in cheaper sets with BFOs but it seems to me a design omission from Sony in this case. It is not so bad as to prevent copy, but does make CW signals sound as though they all should be given RST589C reports. I'm not sure anyone would want to use this receiver for serious amateur radio listening — the fine tuning control for SSB/CW is a very small edge pot on one side of the case and trying to adjust this accurately gets more than a little tedious very quickly. Selectivity leaves a lot to be desired as it is no different from the AM mode, but considering the size and price of the set I don't suppose you can really complain too much.

Technical Info

It's a shame that no circuit diagram or other technical information was provided with the set — this is, in fact, common or so it seems; *none* of the three receivers described here had any form of circuit supplied with them. This is possibly to be expected with a general consumer market product (a technical manual is probably available from Sony), but not with amateur market rigs — we *do* expect such information, especially after forking out several hundred pounds.

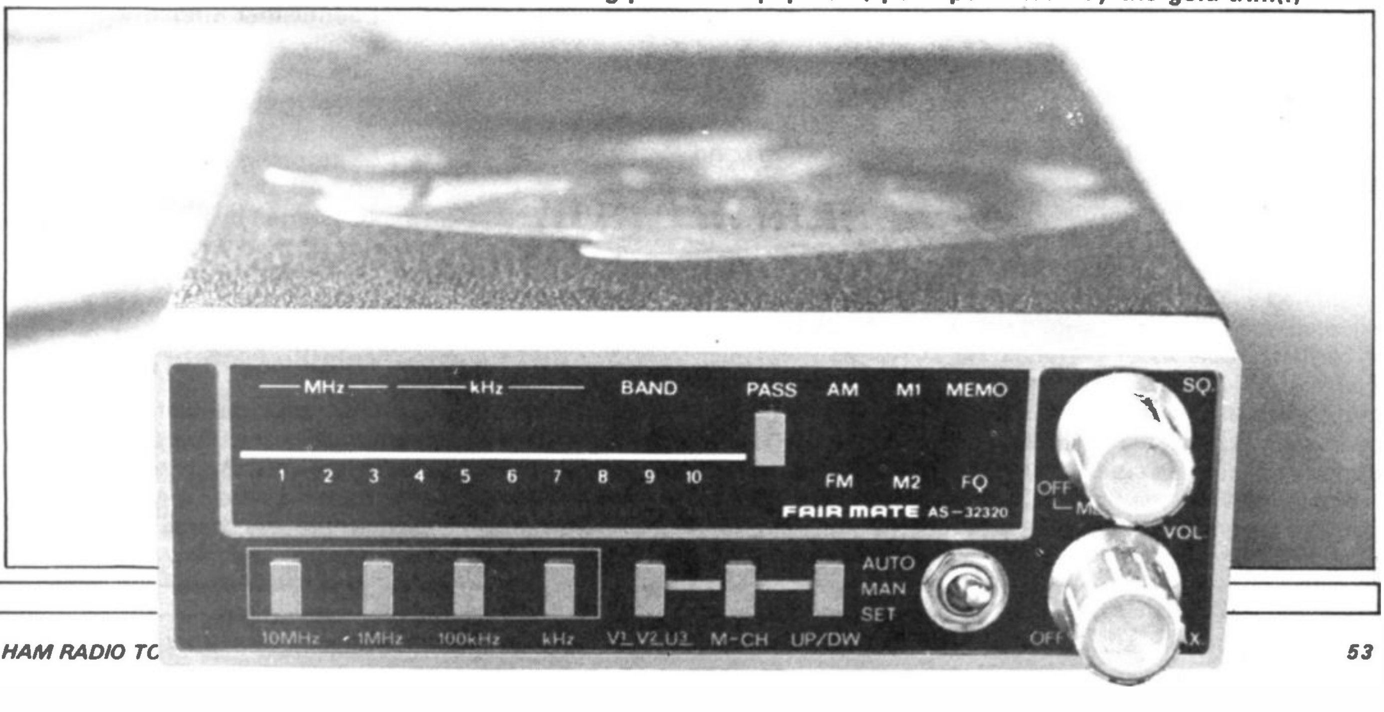
You will be pleased to know that the following important piece of technical information is given in the manual of the Sony "NEWS Tone setting is for listening to the news & MUSIC Tone setting is for listening to music".

FAIRMATE AS-32320

For VHF/UHF Monitoring, the Fairmate AS-32320 is on offer, and appears to be a fairly popular item around the retailers. For some obscure reason, the makers have decided to finish it off in gold — knobs, trims and buttons — which I find particularly out-of-keeping in the shack. Maybe they intended it to be around in the lounge where it might look a little more in keeping? . . .

This rig is basically a synthesised mobile or base station receiver covering 110-161.995MHz and 296-367.9875MHz. Within this frequency range you will find the VHF Air Band, Police, various BBC transmissions, the 2 metre amateur band, and other assorted services, such as ambulance, taxis etc. Up at

The Fairmate AS-32320 is a workmanlike looking piece of equipment, perhaps marred by the gold trim(!)



The AOR2001, arguably the best known of the scanner receivers

UHF, the UHF Military airband appears to be the main target . . .

Both AM and FM are copyable, together with two sets of 10 programmable memories, and scanning of either 'bands' or 'memoiies' with lock-out facility. In the VHF section, the step rate is 5kHz, and at UHF, 12.5kHz. Frequency readout is via a rather small LED display.

The front panel has a fair number of buttons and knobs in addition to the frequency readout. Along the bottom are the frequency select buttons and three for band select, together with an up/down step selection button. A three position toggle switch controls Auto or manual tuning plus a third position — SET, but the purpose of this isn't explained. The normal volume/ squelch controls are provided, plus a further three slide switches for AM/FM, M1/M2 (the two memory banks) and a MEMory or FREQuency switch. Under the main display are a set of figures labelled 1-10 to indicate which memory channel you are set to if this facility is in use.

With the wide frequency coverage, two aerial sockets are provided (S0239), one for the VHF and one for UHF.

I make no apologies for observing that the frequncy setting process on this receiver is chronically slow and painful. It involves the use of no less than 5 separate buttons (all small) and some of these will have to be pressed more than once to get to the desired frequency. To quote the operating instructions-

"To select a frequency — e.g. 121.225

a. Select band 1 as in note 9 (the Rx has three band start frequencies 110, 136 and 296MHz).

b. Press button marked 10MHz — once

c. Press button marked 1MHz — once

d. Press button marked 100kHz — twice

e. Press button marked kHz — five times

Hence, if you want to, say, get to 139.975 you could prod away over twenty times. Actually, using the loaf, you could go to 140MHz, then, step down 25kHz by using the 'up-down' button, but it does illustrate a point — scanner receivers are meant to take the hard work out of tuning . . .

The display is one of those very small types that used to be used in a lot of the early LED calculators, very small digits, not easy to see unless you are looking directly at them.

Shoving frequencies into the memories is not too much of a task once you have memorised (sorry . . .) how to do it. With a choice of twenty in total (but only 10 scannable at a time) these do offer a useful way of scanning around which is rather better than scanning whole frequency bands for a few frequencies.

If you do want to scan the entire bands you can, but there is a problem. You can start at any frequency you dial up and the rig will happily step away at either 5 or 12.5kHz (depending on whether VHF or UHF), up or down in frequency. The problem is that once it finds an occupied channel, the Fairmate stops forever, or until the signal goes away. Now unless my QTH is abnormal (which I don't believe it is) there are an awful lot of carriers around which don't go away and don't carry any information (or just bleep at you). They also effectively occupy more than 5kHz worth of space. That is, of course, because the rigs IF bandwidth is greater than the step rate. Hence, if you want to get past a plain carrier/unwanted station, you have to step *several times* to bypass it.

Having got passed one plain carrier, the scanner promptly stops again on another plain carrier. I must admit that after 5 minutes of continually re-starting the scan, I gave up and went on to memory scanning. It also has a nasty habit (but then it doesn't know any better) of stopping off-tune on an FM station. All this could have been simply avoided by having step rates which matched the channel spacing band for the band/receive mode.

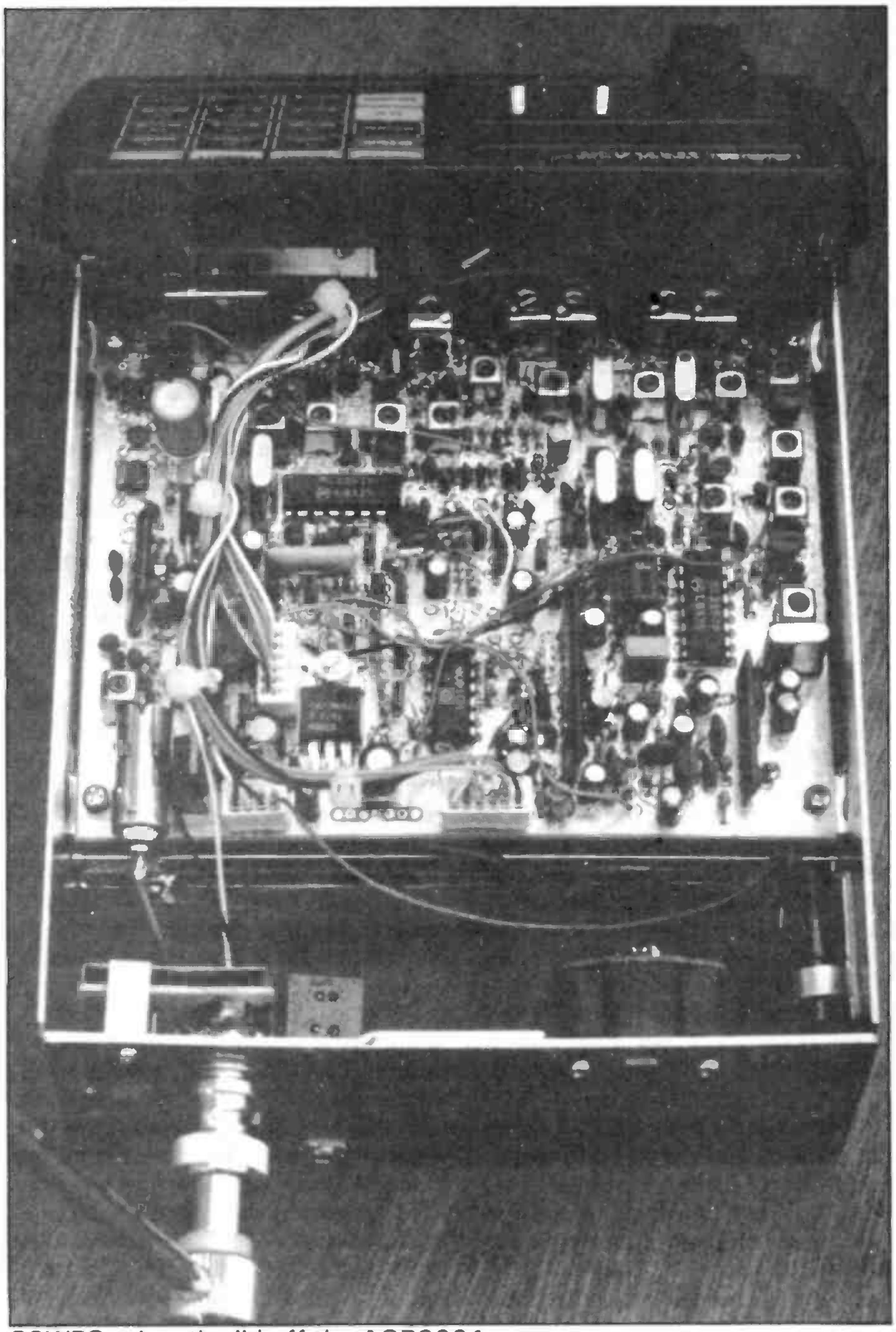
Volatile Memory

The only problem with the memories is that there is no backup facility. Although the memories are kept if the (power) on/off switch on the panel is used to 'disconnect' the power, removing the primary power source from the scanner will destroy them. With twenty available, and I suspect the most user popular way of scanning with this receiver, re-programming them every time will get a bit boring. In use as a mobile rig, you can of course connect the receiver permanently to the battery to get this over, but then are you going to leave the rig on display in the car anyway?

In Use

Ignoring the rather 'intensive' manual attention needed when automatically scanning (except for memory scanning where lockout of unwanted channels is possible), the rigs performance is otherwise quite good. It needed around 0.3uV of signal for 10db quieting on FM across most of its coverage with a marginal drop-off at the top end, and seemed fairly happy in the presence of strong adjacent channel signals.

The performance of the Fairmate as far as image reception was concerned wasn't so good — with a wideband antenna connected, you could hear several signals on 2 metres which shouldn't have been there — these disappeared with a resonant 2 metre antenna. Audio quality was acceptable from its internal speaker. It comes complete with a mobile mount, and fused power lead. I didn't check inside but there are dire warnings about connecting the power lead the wrong way round so there is probably no internal reverse polarity protection.



G3WPO takes the lid off the AOR2001

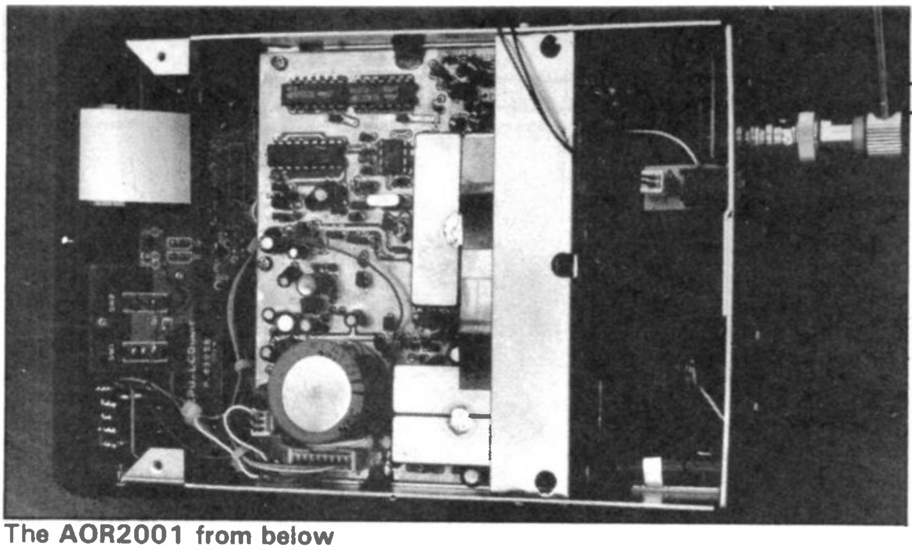
AOR 2001

The most expensive of this group of receivers, but this model possesses a very good reputation, and is not always easy to find ex-stock for this reason. It is billed in the adverts as the scanning receiver to beat all others hands down (until the next one comes along!), a statement which has not gone down well with retailers of other scanner receivers as witness the amateur press. An observation which can be made from the photographs nearby is that you don't appear to get a lot for your money when you look inside the rather unusually designed case — a case of overpackaging?

Coverage is from higher HF (25MHz — which allows it to monitor the FM amateur 29MHz stations as well as CB if you want) up to 550MHz, so you can listen to 70cm as well, but with only one antenna socket provided — the Fairmate does have an edge here. All fixed channel modes normally encountered are provided for — AM, and Wide/Narrow band FM for both Broadcast and Communications reception. No facilities exist for SSB or CW.

This coverage is continuous with no gaps unlike both the other receivers, and it is here that the 2001 has a distinct advantage by being a true general coverage receiver. Frequency selection is via a multi-purpose keypad, but in my eyes this is spoilt by the use of a *membrane* type pad. This is about as good as the ZX81 keypad, and you know how many firms have come out with alternatives for that! Unless you hit the button right in the centre nothing much happens. A pity, because otherwise the 2001 is an extremely nice machine.

Step frequencies are 5, 12.5, and 25kHz (all usable at any time) plus 20 memories and a 'Priority' function (this allows you to automatically check a particular



The **AOR2001 from below**

specified frequency every few seconds whatever else the receiver may be doing). Scanning can be 'up' or 'down', and there is a choice of two speeds. In addition to memory scanning, you can scan between any two specified frequencies.

The keypad mentioned earlier is quite complex and worth a look at. Many of the keys are dual function, and are colour coded to help the operator. Across the top are the SCAN, LOCKOUT, PRIORITY & CLOCK keys (yes the receiver has the inevitable clock which you can select instead of the frequency display). Along the left side are keys for SEARCH, MANUAL, UP, DOWN facilities, leaving the 0-9 and 'decimal point' and ENTER keys. These last set have alternative functions — low, high (for upper/lower scan frequency setting), CLOCK SET, 5, 12.5, 25kHz, FM narrow, FM wide, AM, (scan) SPEED, and DELAY (with this operative, the receiver makes a small delay after a carrier goes off before the scan recommences). Yes! the scan restarts when the carrier signal goes, so no more button pushing folks!

Beep, Beep

Another personal dislike (it doesn't affect the receiver operation at all) is the dreaded 'beep' which accompanies each keypad entry. Admittedly it does give a high beep when the entry is correct, and a low beep when it isn't (also the display reads 'Error') which is a help in the early days, but becomes tiresome after a while. There is a cure which involves removing the lid plus the use of a pair of wire cutters, but this was a review model after all . . .

The LCD display shows the frequency in the form 145.125.5MHz, plus the mode in use, and the memory channel number, or, alternatively, the time when in 'clock' mode. There is a light switch for illuminating the display should you be using the receiver in the dark.

In use the keypad entries are quite easy once you remember the order, and getting to a frequency or memory channel is a simple job. A nice touch is that the receiver remembers what the correct mode for the channel is in each memory, so you can happily scan away between AM air traffic, Broadcast WBFM, and NBFM amateur traffic if you want.

Once again there is no circuit diagram supplied. However, we do know that the 2001 uses a very high first IF, of the order of 750MHz, which accounts for the relatively few harmonics to be heard throughout the ranges, and has a remarkable lack of image responses across such a wide frequency range. There is a crystal around 47MHz whose harmonics can be heard very well, but this is where the second local oscillator is derived from so it can't really be avoided, except possibly by the use of a higher frequency crystal.

The receiver is fairly flat across its frequency coverage in terms of sensitivity, measuring an average 0.22uV for 10dB quieting, with best sensitivity around 150MHz (this may be intentional?). Audio quality is again good, but better on an external speaker. My only criticism would be on Wide Band FM, where even my un-musical ears could detect some distortion. This appeared to be dependant on the deviation level and could be due to a number of reasons — from the tuning behaviour, the IF bandwidth seemed rather narrow. A quick measurement indicated it to be about 110kHz rather than the 180kHz or so required (don't forget, commercial WBFM peak deviation is around 75kHz). An improvement could also be made by tuning away from the nominal station frequency indicating that the filter centre frequency wasn't the same as the IF. On AM and NBFM, the audio was perfectly acceptable.

On The Air

Except for the membrane keypad, operation was fairly simple, and it was nice not to have to keep fiddling with the rig to keep it scanning. The squelch control (concentric with the volume control) was nicely sensitive and didn't suffer from audio effects (ie the frequency that the noise sensitive circuitry was 'tuned' to was much higher than the audio range) — the Fairmate did have a slight problem here). As well as an external aerial, a telescopic antenna is supplied which plugs directly into the BNC socket on the gear — this worked quite well for local and semi-local signals.

Conclusions

Of the two VHF/UHF receivers, the AOR 2001 must get the accolade for its performance and facilities over the Fairmate, although you will pay over twice as much for this. It possesses all the features one desires for lack of operator intervention when automatically scanning, and had a superior RF performance. It is quite a lot larger than the Fairmate, and the latter would be easier to fit in a car, but is more dangerous to use due to the amount of knob pushing required.

The Sony HF/VHF receiver is not bad for the price and is really only spoilt by the LO pulling on CW and SSB. For a fairly cheap (in view of its facilities), portable monitor receiver you could do a lot worse. There is a similar receiver newly on the market form Uniden (the CR-2021) at a similar price which might be worth looking at.

Thanks to Amateur Radio exchange for the loan of equipment. The Sony 7600 is priced at £169, the Fairmate at £149, and the AOR 2001 at around £325.

An Introduction to FREQUENCY SYNTHESIS

The majority of HF and VHF equipment today uses some form of PLL frequency synthesis for frequency determination. Ian Poole, G3YWX, looks at the principles, 'pros and cons' of this oft controversial approach.

Frequency synthesisers can take many forms, with early versions usually using the principle of successive mixing where the output was generated by successively adding or subtracting various constituent frequencies. This method required the use of very effective filters to reduce spurious outputs from the synthesiser to a reasonable level. The use of these filters which sometimes had to be tuneable made this approach to frequency synthesis very expensive and often bulky.

The approach which has gained most popularity today is based around the phase-locked-loop. The rise in popularity of the phase-locked-loop or PLL method can be attributed to two main factors. Firstly the advent of integrated circuits, especially those which can be used at RF, has meant that it is possible to produce what is essentially a very sophisticated frequency generator, at a cost which will not make the overall equipment too expensive for at least some of us to afford. The other reason for the popularity of the PLL approach is the fact that the filters required using this method of synthesis are considerably less complicated than with the original synthesisers, and it is therefore easier to keep the level of spurious outputs to an acceptable level..

Phase-Locked-Loop

As the starting point for most synthesisers used today is the PLL, a basic explanation of PLL operation will be given before progressing onto a description of synthesiser techniques.

A block diagram of the basic loop is shown in **Fig.1**, and from this it can be seen that this consists essentially of a feedback loop. The operation of the loop is based around the phase of the incoming signal which is compared to the phase of an internal voltage controlled oscillator. An error voltage is then fed back to the control point of the oscillator to reduce the phase error. Eventually there comes a point where a *constant* phase difference exists and the loop is lock-

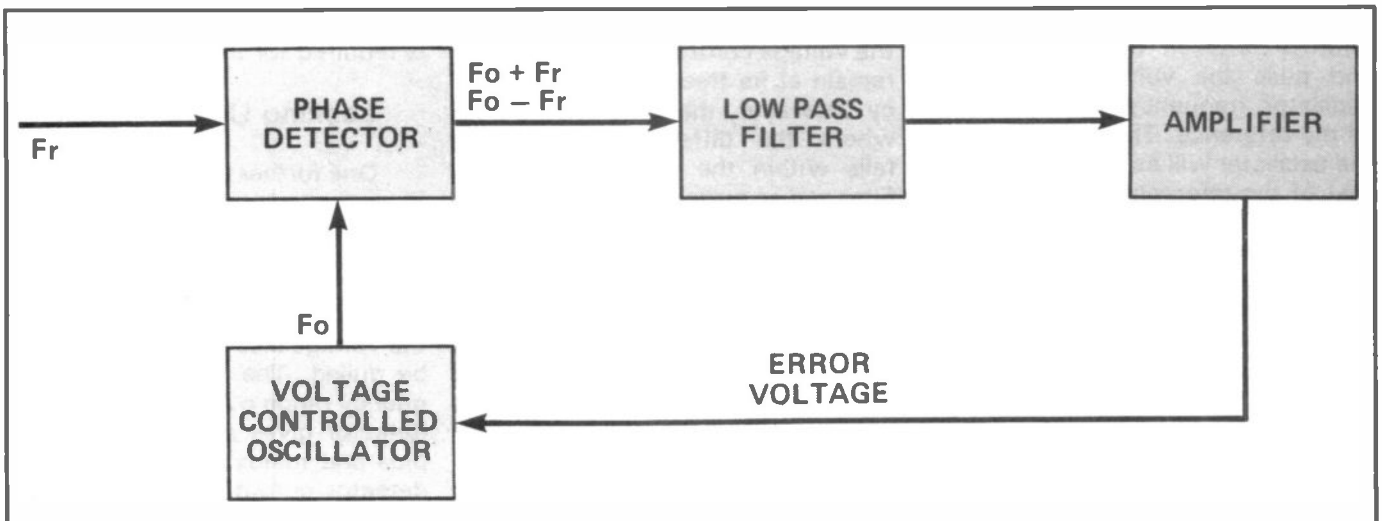


Fig. 1 Basic Phase Locked Loop

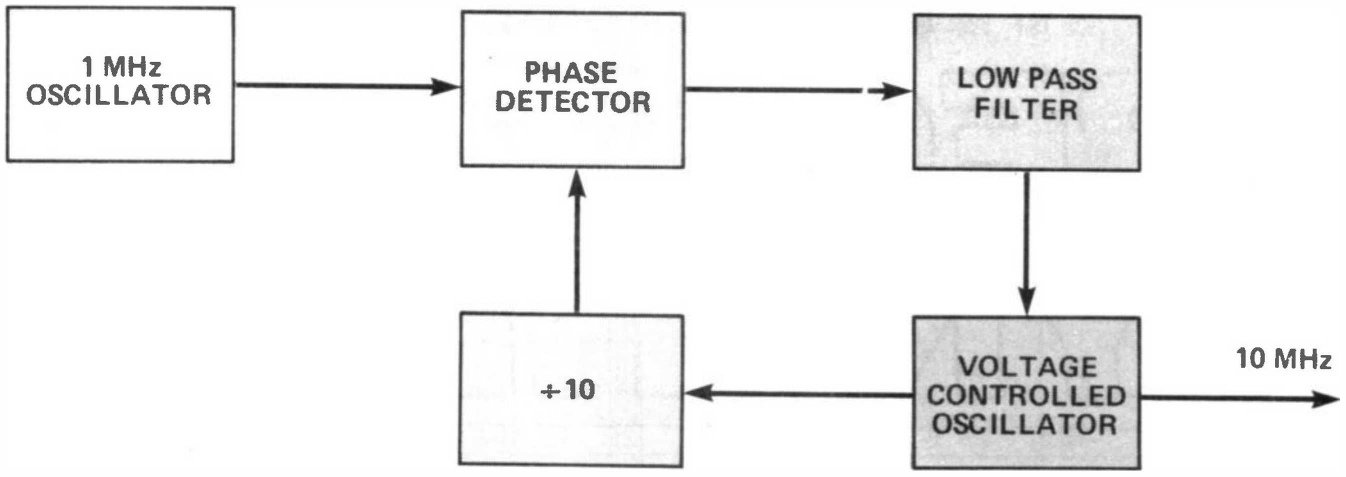


Fig. 2 Phase Locked Loop used as a multiplier

ed. As phase is the differential of frequency with respect to time this means that when the phase difference between the two signals is constant then the two frequencies are exactly the same.

Referring to **Fig.1** the phase detector compares phase of the incoming reference signal with that of the voltage controlled oscillator, and gives a signal which is proportioned to the phase difference between the two signals. This output does in fact contain the sum and difference frequencies Fo + Fr and Fo − Fr. As only the difference frequency is required, this signal is filtered through a low pass filter in order to just leave the phase difference signal. This can then be amplified, if required, and then applied to the control terminal of the voltage controlled oscillator. The sense of this signal is such that it tends to reduce the phase difference between the two signals and pulls the voltage controlled oscillator frequency towards that of the reference. The frequency of the oscillator will be pulled towards that of the reference until the loop has locked when the oscillator and reference frequencies will be exactly the same, but there will be a fixed but finite phase difference between them.

A Few Terms

When dealing with phase locked loops there are a few terms which are used to describe certain of their features. These can mostly be explained qualitatively. The first is the **capture range** of the loop. Consider the loop when no signal is applied to the reference input, it will have no error voltage applied to the oscillator control terminal and will oscillate at its free-running frequency. If a reference signal is then applied and slowly swept towards the free-running oscillator frequency, the phase detector will generate the sum and difference frequencies Fo + Fr. If the difference frequency, which will be the lower of the two, and the one which produces the error signal falls outside the passband of the low pass filter then the voltage controlled oscillator will remain at its free running frequency. However, there comes a point where the difference frequency falls within the passband of the two, and the one which produces the error signals falls outside the passband of the low pass filter then the voltage controlled oscillator will remain at its free running frequency. However, there comes a point where the difference frequency falls within the passband of the filter and an error voltage will be applied to the oscillator causing the loop to lock. The actual locking process is complicated and as it adds little to one's understanding of the loop it will not be explained any further. It can now be seen that the capture range of the loop is the frequency range over which the loop can gain acquisition and it is normally dependent on the characteristics of the filter.

There are various factors to be weighed up when determining the passband of the low pass filter. If the filter cut off frequency is made low, then there is less chance of any noise from the reference disturbing the loop as the noise products are more likely to be filtered out. In addition to this, the very fact that a filter is made very narrow means that the loop can effectively *store* a frequency. This will enable the loop to remain locked if for any reason the reference signal is temporarily lost. However, if acquisition is lost then it does make it more difficult to relock the loop as the capture range will have been reduced. In addition to this, the rate at which the reference signal will be able to change its frequency whilst the loop is locked will also be reduced as the low pass filter will filter out any fast changes. Therefore compromises have to be made dependent upon the specification which is required for the loop.

Locking Up

One further term worth explaining is the **lock range** or the range of frequencies over which the loop will remain locked. This is generally limited by two main factors. The first is the actual range over which the voltage controlled oscillator can be pulled. The second is the frequency range over which the phase detector gives an output between plus and minus 90°. If the phase detector output goes beyond 90° then the loop will lose acquisition.

The basic loop as it has been

described here may not seem to lend itself to many applications as it seems to generate a copy of a reference signal which already exists! However, by modifying the basic loop and adding a few extra functions it becomes a very versatile tool as a *basis* for frequency synthesisers.

PLL And Frequency Synthesis

There are two main approaches which can be used in a synthesiser based around a phase-locked-loop. The first approach lends itself ideally to channelised operation as the frequency is incremented in *discrete steps* and is often used in VHF FM transceivers. In this approach the phase-locked-loop has a programmable divider inserted into the loop, and by altering the *division ratio* the synthesised frequency is changed. Using this type of synthesiser it is very easy to have the frequency selected by computer or microprocessor because it is a very easy matter to control the divider, which will be a digital type device, using data — from a computer or processor. As this method relies heavily on digital techniques it is often referred to as a *digital* method of synthesis.

The other type of phase-locked-loop synthesiser is often referred to as an *analogue* type because it relies on analogue techniques to convert the loop into a synthesiser. Again various elements are introduced into the basic phase-locked-loop to achieve the required offsets. In this case, however, the required frequency is generated by introducing mixers into the loop. Using this method the output frequency can easily be made continuously variable, making it ideal for use in applications such as HF transceivers. A very good example of this type of synthesiser was described in the October 1983 issue of HRT as part of *Project Omega.*

Digital Synthesis

When using this approach to frequency synthesis the phase-locked-loop acts as a frequency multiplier where each multiple of the fundamental is selected by altering the division ratio of a divider placed in the loop. In order to understand how this is accomplished refer to **Fig.2**. Here a 1MHz oscillator is used as the reference. When the loop is locked the phase detector output will indicate that there is no phase change between both of it's inputs, or in other words the signals at both of it's inputs are at exactly the same frequency.

However the voltage controlled oscillator output has been divided by ten by the divider, and therefore the oscillator must be operating at ten times the comparison frequency or 10MHz. If the division ratio is then changed it can be seen that again the frequencies at both the inputs is 1MHz, but this time the output from the voltage controlled oscillator has only been divided by nine and therefore it must be operating at 9MHz.

From this example it can be seen that by incrementing the division ratio by one, the output of the voltage controlled oscillator 'steps' by a frequency equal to the input or reference frequency each time. In other words the comparison frequency is equal to the channel spacing. Normally the channel spacing on a practical system will be much smaller. For example on two metres it is 25KHz, and so the comparison frequency for a synthesiser to give this spacing would have to be 25KHz. In order to produce a reference signal of the required stability it is far more normal to have the reference oscillator at about 1MHz and divide the output by a fixed amount to produce the reference. Therefore the overall block diagram for a basic digital type phase-locked-loop synthesiser can be seen in **Fig.3**. To illustrate the example with a few figures, if a synthesiser were required to give an output at 24MHz to drive the RF strip of a transmitter for two metres, giving a channel spacing of 25KHz between 145 and 146MHz, then the actual output of the synthesiser would be required to be between 24.166 and 24.33MHz with a channel spacing of 4.166KHz. From this the fixed divider shown in Fig.3 will have to divide by 240 to give the correct

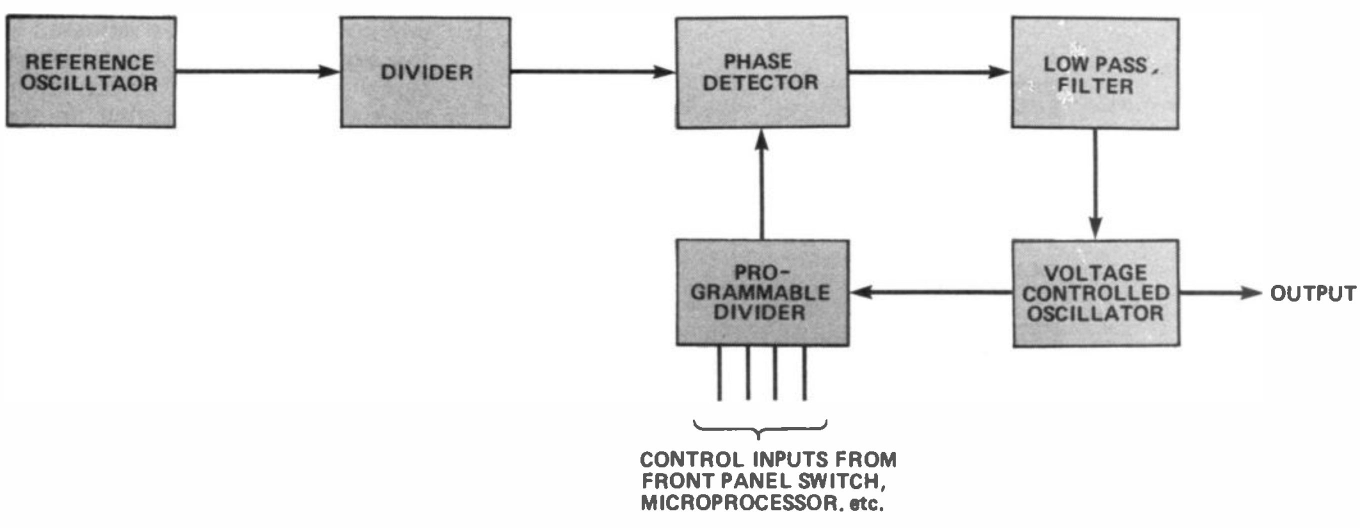


Fig. 3 Digital Phase Locked Loop Synthesiser

channel spacing, and the programmable divider will have to give division between 5800 and 5840.

Analogue PLL Synthesis

As mentioned before, the second method of frequency synthesis is based on using mixers to introduce offsets within the loop. Take as an example the block diagram shown in **Fig.4**. When the reference is set to 1MHz and the loop is locked, the output from the mixer must also be 1MHz. This 1MHz must be the frequency difference between the injected 'offset' frequency and the voltage controlled oscillator frequency. This means that the oscillator can be running at either 15MHz or 13MHz, and by judiciously ensuring that the oscillator can only run at one of these frequencies, the correct output will be ensured, in this case 15MHz. If the reference frequency is increased by, say, 1KHz then the comparison frequency will also increase by 1KHz and the voltage controlled oscillator frequency will correspondingly alter by 1KHz to keep the loop locked. Thus the output will now be 15.1MHz, and so on, for an infinitely variable selection of frequencies.

This method now produces a very elegant way of producing the local oscillator for an HF transceiver or similar piece of equipment. In practice the reference oscillator swing would be limited to say 500KHz, in this case from 1 to 1.5MHz, and this would determine the maximum frequency for phase comparison, which would be 1.5MHz. The low pass filter on the output of the mixer should then have a minimum cut-off frequency of 1.5MHz, but be capable of attenuating the mixer sum product in the region of 29MHz so that none of the sum frequency appears at the input of the phase comparator, allowing spurious outputs to be produced. The low pass filter at the output of the phase comparator should also be capable of attenuating the unwanted sum products. In both cases it is relatively easy to produce a filter of the required specification because it does not have to be variable. Also, it is far easier to design a low pass filter than a band pass filter or resonant tuned circuit which would be required by the double conversion mixing techniques which were very popular a few years ago.

The synthesiser can very easily be made to operate on a range of frequencies by changing the loop offset frequency. It will also be necessary in practice to change the voltage controlled oscillator free-running frequency by changing the oscillator tuned circuit.

This system has several advantages over the double conversion techniques. The two major ones are the simplified filter design, and, as a result of this, the spectral purity of the output is improved.

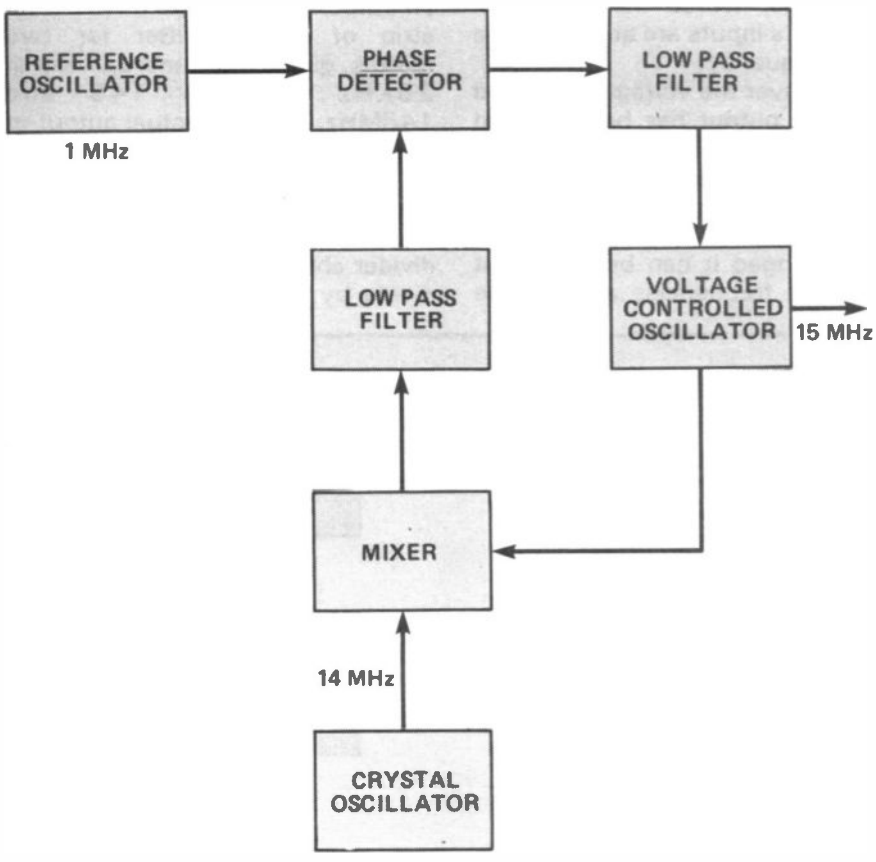


Fig. 4 Analogue Phase Locked Loop Synthesiser

Nasty Noises

Ever since synthesisers were first incorporated into amateur equipment there has been considerable controversy and discussion over their various merits and disadvantages. Whilst it can not be disputed that synthesisers offer very many advantages, probably the biggest and most talked about disadvantage is that of noise. It is this factor which is very often overlooked in much equipment. As a synthesiser has a wide noise spectrum, its noise performance will not necessarily be reflected in the signal-to-noise ratio of a single signal under laboratory test conditions, but in performance on the crowned bands which exist today.

The performance of synthesisers in terms of noise is normally expressed in terms of signal-to-noise ratio *at a certain offset from the signal frequency.* Also, the noise spectrum does not necessarily show a decrease in noise the further one measures the noise from the signal frequency. In fact, the system acts as a low pass filter for reference signal phase noise, as any components of phase noise further away from the reference signal frequency than the cutoff frequency of the loop filter will not appear at the control terminal of the voltage controlled oscillator. Accordingly these components cannot appear on the output of the loop oscillator. However the reverse is true for noise generated *within* the loop itself where most of the noise is generated either by amplifiers in the loop or the oscillator. Any elements of phase noise within the passband of the loop filter will tend to be counteracted, whereas any elements of noise appearing outside the cut-off of the low pass filter will not be corrected. Therefore it can be seen that the system will act as a low pass filter for reference signal noise and a high pass filter for voltage controlled oscillator and loop noise.

The noise generated by the system has to be minimised by careful design. This can be done by reducing the internally generated loop noise. The most obvious way is firstly to widen the loop low pass filter. Secondly, the overall loop gain can be reduced so that any noise generated at the input of the amplifier is kept to a minimum. Similarly the voltage controlled oscillator deviation can be reduced so that any noise will be minimised at the output. These criteria have to be balanced against other operational requirements — so that the overall design will meet the specification required of it.

If a synthesiser incorporated into a HF transceiver does have a poor noise performance it may well be possible to copy a weak signal on an *empty* band, but, if there is noise present at the mixer from the synthesiser and a strong signal a few kilohertz away from the required signal, it may well be swamped by noise generated from the mixing of the noise and the off-channel signal.

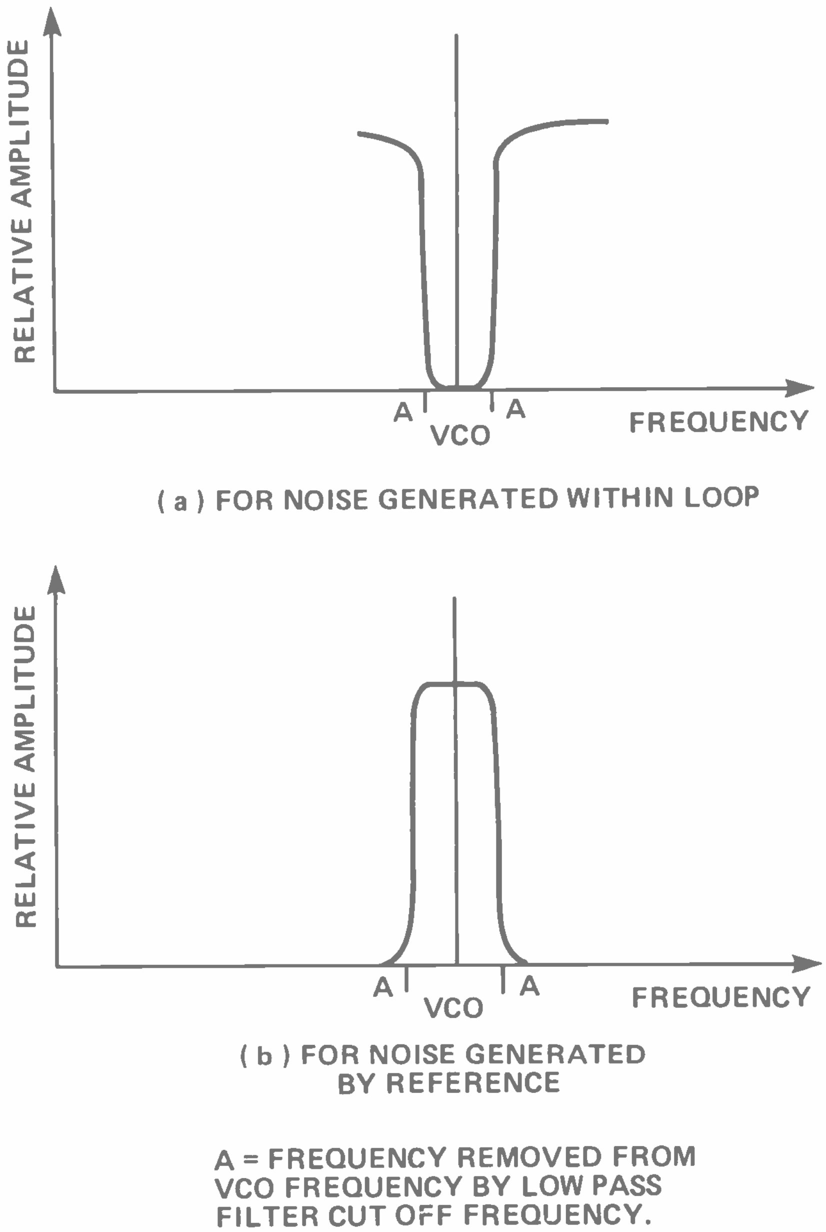


Fig. 5 Susceptability of Synthesiser to noise generated by reference and loop.

Final Thoughts

The explanations given here of the operation of synthesisers have been limited to either digital or analogue loops in their basic forms. However, in practice, synthesisers will often employ both principles within the same unit in order to tailor the synthesiser more exactly to suit particular requirements. In addition to this, many of the more sophisticated synthesisers will employ a multi-loop system to enable such parameters as noise, tracking rate etc., to be maintained at acceptable levels, whilst also enabling the system to operate at very high frequencies or over a large bandwidth.

Most of todays modern transceivers use synthesisers, and those which advertise memories, dual VFOs and so forth use digital techniques to accomplish this. The incremental steps in frequency are all but removed by reducing the channel spacing to around 10Hz or so. This means that the loop filter cut-off frequency has to be much less than twice the channel spacing to remove the phase detector's unwanted products. The off-channel noise generated by the synthesiser is thus bound to be higher than is really acceptable, and this is what most of the sometimes heated discussion in the magazines is really about.

Overall synthesisers can be very usefully and successfully employed in many applications — provided that when they are designed, the basic requirement of low noise is to the fore in the design parameters. This should not be sacrificed to enable the inclusion of a whole host of frills which are only used to enable the equipment to be advertised with more facilities than the next.

Converting 'Illegal' CB sets to 10m

Ten metres FM working has grown rapidly in popularity — as has the demand for readily convertible CB rigs. Basil Spencer explains how to convert 'illegal' CB multimode AM/FM/SSB rigs to 28MHz.

This article is intended to provide sufficient information for **suitably licenced amateurs** to take advantage of the readily available 'illegal' CB rigs by converting them to the 10m band. The demand and value of these sets has dropped very dramatically since the introduction of legal FM CB radio and a 40 channel AM set can be purchased for about £10-£15 or less, whilst a decent 120 channel multi-mode (AM/FM/SSB) rig can be picked up for £20-£50 in working order if you shop around carefully.

For the additional price of one crystal per 40 channels, these can be converted to cover 28.36 to 29.7MHz with very good performance making a neat mobile or base rig.

Phase Locked Loops

It is necessary to understand the principles of how Phase Locked Loops work. (*See G3YWX piece*) before any attempt is made to change the rig up to 10m, and this is therefore described in some detail, using the Ham International Concorde II as an example. IT MUST BE NOTED THAT ALTHOUGH THE BASIC PRINCIPLES OF THE PLL DO NOT CHANGE FROM ONE RIG TO THE NEXT, THE ACTUAL VCO, IF AND REFERENCE FREQUENCIES **DO VARY** AND THIS SHOULD BE KEPT IN MIND! The greatly simplified diagram of the PLL fitted to the Concorde II is shown in **Fig.1**, commencing at the area marked Voltage Controlled Oscillator (VCO). This varies its own internal frequency between 17.555MHz and 18.445MHz depending upon which channel and which band has been selected. The VCO also has two different outputs; one is running between 2.55MHz and 2.11MHz and feeds into the programmable Detector (Prog Det), this is shown by the dotted line. The second output is between 37.660MHz and 39.000MHz; both these outputs ae generated by mixing one of the

band crystals (X1,2,3) with the VCO frequency, eg: on channel 1 of the low band the VCO internal frequency is 17.555MHz and X1 is in circuit, mixing 20.105MHz with 17.555MHz produces the *sum* ie: 37.660MHz and the *difference* 2.55MHz, so using one mixer to get two outputs. The 2.55MHz is processed by the Prog Div and passed to the Phase Detector which compares this signal with a reference supplied by a 10.24MHz oscillator which is divided by 1024 to give 10kHz to the Phase Detector. If these two inputs to the Phase Detector are not the same phase, it gives a correcting DC voltage output back to the VCO (where it all started) until it is corrected and once the 'phase' of the 'loop' is correct the synthesizer 'locks', hence the name Phase Locked Loop. This basic principle also applies to a lot of 2m and HF gear, although it is slightly more complicated in these cases!

Now regard the output from the VCO in the 37.660MHz to 39.000MHz range: this is in fact the high local oscillator (LO) for the rig. If the first IF of 10.695MHz is subtracted from this the result is the Rx/Tx frequency; for example, suppose the rig is on channel 1 of the low band, the output from the VCO is 17.555MHz plus 20.105MHz, ie: 37.660MHZ take away 10.695 leaves 26.965MHz which is the American FCC channel Pretty clever stuff eh? but it does more than just that: the 10.695MHz first IF is generated by mixing the 10.24MHz crystal oscillator (already used in the 1024 Divider) with the second IF of 455KHz ie: 10.24MHz gives 10.695MHz!! It is this maximum use of the minimum number of components that ensured mass production of these rigs.

The Nitty Gritty

Now that the principles involved have been explained, the frequency numericals can be changed to algebraic form so the relationships between them will be crystal clear (ouch!!). After which, calculating where a given crystal will take a rig is easy and calculating what crystal is required to take the rig to a chosen spot is merely jiggling the formula around a little;

a = 17.555 to 18.445MHz (VCO Internal freq)
b = 20.105 or 20.330 or 20.555MHz (X1, 2 or 3)

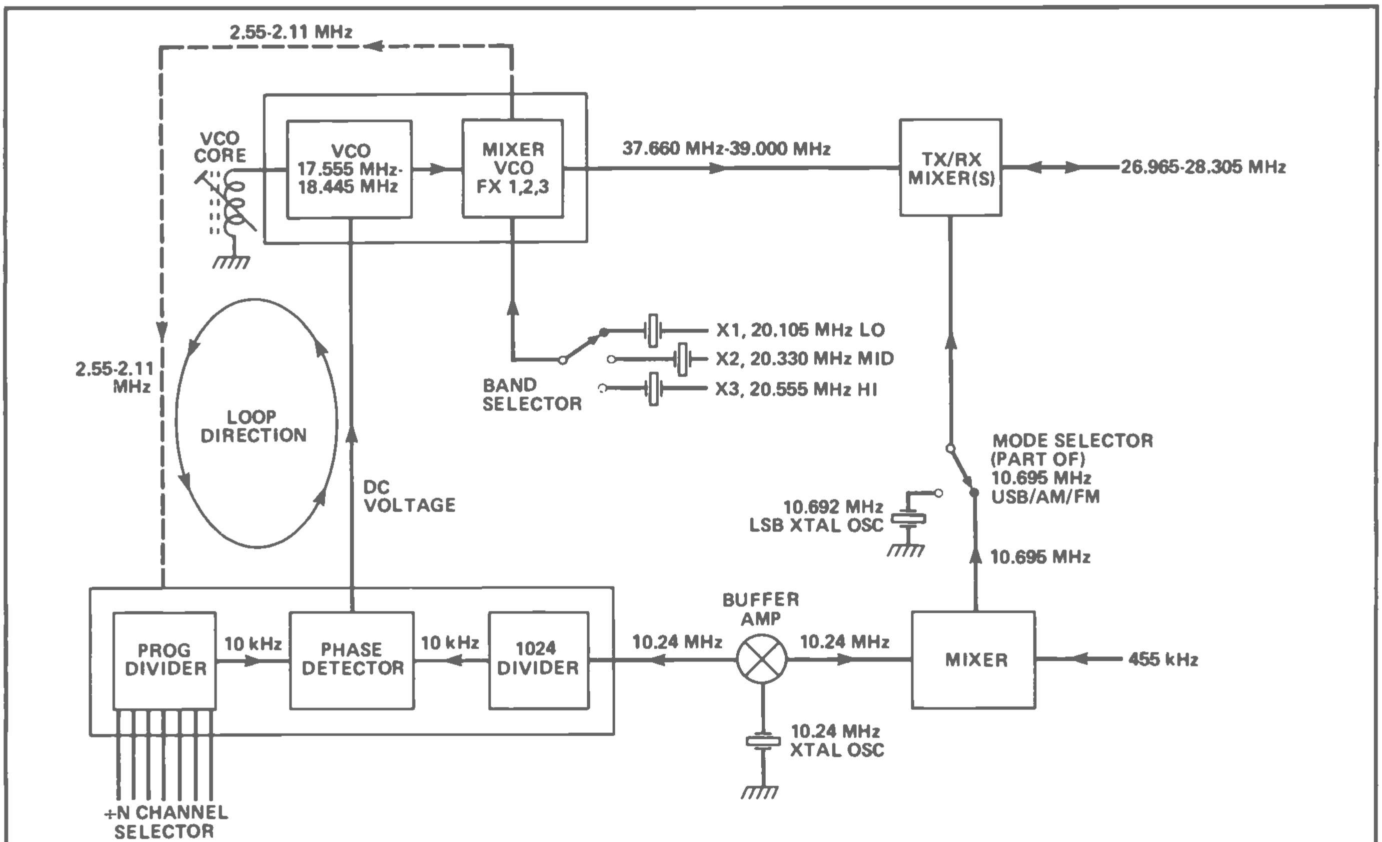


Fig.1 Simplified block diagram of Ham International "Concorde II" phase locked loop

c=10.695MHz (1st IF)
d=37.660 to 39,000MHz (high LO/VCO output)
e=2.55 to 2.11MHz (VCO output to Prog Div)
f=26.695 to 28.305MHz (Tx/Rx freq)

so from the above;
b−a=e eg:
20.105−17.555=2.55MHz
a+b=d eg:
17.555+20.105=37.660MHz
d−c=f eg:
37.660−10.695=27.695MHz

As the various relationships are examined, it becomes evident that the easiest way to get the TR frequency up is to increase the value of 'b', which is the band crystal. Therefore, to find out where a crystal in the junk box will take the rig, the formula is;

a+b−c=f eg:
17.555+20.625−10.695=
27.485MHz

and in this case it does not take the rig high enough. Suppose instead of looking into the junk box, a specific frequency is chosen for channel 1 of the low band, and the rest to follow going up in frequency? Say 28.36MHz is decided on and the formula is jiggled to tell you what crystal to order;

f+c−a=b eg:
28.36+10.695−17.555=
21.5 MHz

This time the crystal to do the trick is 21.5MHz; remember the top channel for the low band will be 440kHz higher, ie: 28.8MHz. Incidentally, the other two crystals for the mid and high band to compliment the 21.5MHz would be 21.725MHz and 21.95MHz giving the following coverage, 28.36MHz to 28.8MHz on low, 28.81MHz to 29.25MHz on mid and 29.26MHz to 29.7MHz on high.

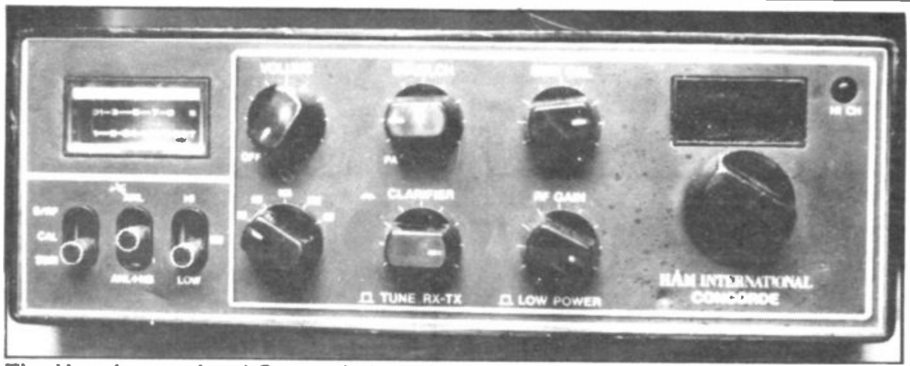
The channel spacing will be 10kHz, although the rig will sometimes 'hop' where a channel should be and miss it out. This is because these particular frequencies are not authorised for CB in the USA, which is where these rigs are supposed to be. These 'hops' occur between channels 3 and 4, 7 and 8, 11 and 12, 15 and 16 and this is also irrespective of the of the Tx/Rx frequency because the input from the VCO to the Prog Div is missing and prevents the PLL from locking up.

These FCC standard rigs also do a funny "hop, skip and jump" around channels 23, 24, 25 and 26 which goes, up 30kHz, back down 20kHz, up 10kHz and then up another 20kHz and back to normal. These channels are all there but in a funny order!! No, the author does not know why they do this!

Other Rigs. . . . .

Some rigs have an "FTZ Nr. . . ."stamped onto the case, which indicates it has been approved by the Bundespost for use in West Germany. This means in reality that it is a 40 channel American rig that has been limited to 12 channels and the RF power cut back to 0.5 W. A rig of this kind could be changed back and converted to 10m, but it probably is not worth it. However, a rig with an FCC approval stamp on it has been intended for the US or Canadian markets and could well be worth taking upstairs to 10m.

Some of the older CB radios having SSB fitted have three crystals per band!! These are usually about 11MHz and one is used for USB, one for LSB and one for AM — it can be a drag to pay out for an



The Ham International Concorde is perhaps the most readily available of the 'illegal' CB multimodes

extra 12 crystals! These triple the 11MHz up to 33MHz and subtract a funny IF of 7.8MHz to get the Tx/Rx frequency. Other rigs use 10MHz crystals and double them up to get the 20MHz needed for the PLL and then the rest is the same as the Concorde II. For one of these rigs thus divide 'b' in the algebra by 2.

Other rigs use 15MHz crystals either as the IF or doublers and then mixing and subtracting to get the right frequency. Some rigs unfortunately do not have external crystals at all; these have all the necessary bits and pieces *inside* the PLL chip, although some will respond to various methods of 'bullying' to go up to 10m. It should be noted that some CB rigs will not move one inch even if hit with a 16lb sledgehammer and these are the ones to avoid. A list of rigs that will go up to 10m, together with a list of the PLL chips that will or will not move, is included at the end of this article.

Odd rigs will move by changing the BCD (Binary Coded Decimal) inputs from the channel selector to the PLL chip. Effectively the 2.55 (3.30 in some rigs) has to be brought down and the rig moves up. Others will shift by swapping around diodes or working out a truth chart for the binary-adder chips, notably the Cobra 148GTL DX. This particular rig will also move by changing the 15MHz crystal.

A SSB rig will probably use only single conversion (10.695MHz or 7.8MHz) on single side-band but double conversion on AM and FM. Further, it actually uses a slightly lower 1st IF for LSB eg 10.692MHz, upper side-band is usually linked to the AM or FM carrier frequency. Finally on the theory side of these sets, make sure that the set is theoretically able to go 'upstairs' before purchasing — there are still a number of con/rip-off artists about!!

What To "Tweak"

Having obtained the set, calculated how the mixing and frequency output is to be reached and the necesary crystals arrived, here's what to do next. This is a generalisation and some poetic licence should be allowed for, although essentially these rigs are pretty much of a muchness.

1. Locate the crystals to be changed and remove the old ones and solder in the new ones.

2. Connect up an SWR bridge or Wattmeter, a dummy load and a power supply to the rig.

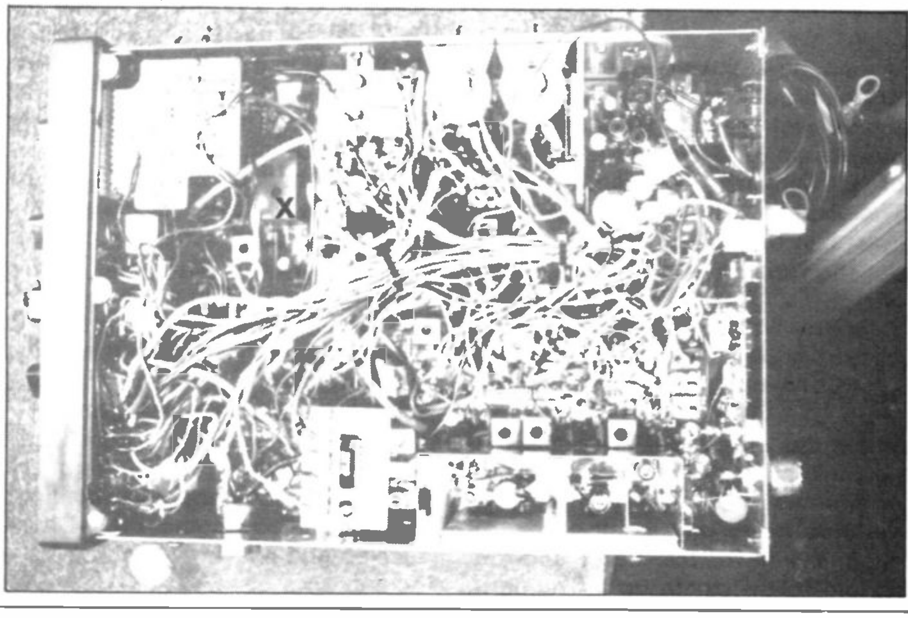
3. Locate the PLL chip, which is the chip the leads from the channel selector switch go to. Next, look for the VCO core; in Ham International rigs this is the size of a matchbox and green in colour. In the Stag, KWS and Electronica rigs, it is inside a small can near the screening metal on the left hand side, looking into the set from the front. Either way, if the PLL chip is found you will probably fall over the ferrite core on the way!

4. Once the VCO core has been found, put the rig onto FM and AM but not SSB and switch to Tx mode. If no reading is present on the SWR bridge or the rig's own meter, gently 'tweak' the ferrite core at the VCO until a reading appears; this will be when the PLL locks up. Once a reading is obtained then switch to the top channel on the high band and the bottom channel on the low band to make sure the PLL is still locked. If it is not, then continue to 'tweak' the core until the PLL does. At this stage the RF output will be quite low as the tuned circuits are not properly aligned.

5. With pencil and paper to hand, commence 'tweaking' (almost ∗)all the cores and coils starting at the aerial socket and work backwards from there. With the rig on the mid band and set to channel 20, keep the rig in Tx mode and aim for maximum output on the SWR bridge, keeping a note of the coils/cores which made no difference (these being the Rx cores!) ∗ **Do not 'tweak' the cores near to the SSB filter or the CFH455 filter or any of the IFs as these should be already set to the right spot!!**

6. Having tuned the rig for maximum Tx output, there should be

Underside of the Ham International "Concorde II". The position of the VCO core is indicated by X



about 4W on AM and FM and 12 PEP on SSB. If it does not give this, go through the previous procedure until it does. The upper and lower channels will give a little less RF out than the middle ones.

7. Connect up a signal generator set to 29.05MHz, which should be about channel 20 mid band on the CB, and 'tweak' the cores that made no difference on Tx. This Rx 'tweaking' should be easily accomplished using the rig's own S-meter; **again leave the coils near the IF's and filters well alone.**

8. Check Tx output on a digital frequency meter to make sure the rig has gone where predicted. The output of the rig should now be checked for harmonics and spurii with an absorbtion wavemeter (at least) or a spectrum analyser (at best!). *A simple 28MHz bandpass filter or a lowpass filter should be used at all times between the rig and the 50/75 ohm antenna system — these rigs are not noted for the purity of their spectral output!*

7. Connect a suitable antenna of 50-75 ohm impedance — say, a ½ wave dipole or a ¼ ground plane— and call CQ!

The Law, The Amateur and Illegal CB Sets.

This seems to be a funny mix of "the good, the bad and the ugly" although no hard and fast rules have been obtained by the author despite two letters to the DTI, one to HM Customs and Excise and an hour long conversation with the local British Telecom.

Two letters were sent to the Department of Trade and Industry, RALU at Waterloo Bridge House, Waterloo Road, London SE1 8UA in June and September 1983 asking for a firm answer to the question of converting illegal CB radios from the FCC frequencies onto the 10m amateur band for use in accordance with a Class 'A' amateur radio licence; to date no reply has been forthcoming and the author has therefore concluded that there are no objections from the DTI.

One letter was sent to HM Customs and Excise, Kent House Upper Ground, London SE1 9PS, their reply stated, ". . . . the conversion arrangements were introduced solely for owners of illegal CB radio's to have their sets converted to the legal specification MPT1320 and to register the conversion with Customs by paying £5 to cover VAT and duty. There are no such arrangements for conversion of sets to the amateur band . . . . . if you still wish to convert your set then you are advised that as the set will not bear the mark of conformity "CB 27/81" showing that the set conforms to MPT1320, then it may be subject to examination to confirm it does not operate on the illegal AM frequencies and also that all AM facilities have been removed. Once this has been established then the set ceases to be of interest to Customs . . . . ."

Who would actually examine the set on behalf of Customs is not clear and also the removal of AM facilities (as opposed to frequencies) is rather strange as although AM is outdated as a mode, it is nevertheless permitted by the Class 'A' licence. This raises the question of whether the letter from Customs overrides the modes permitted in a licence given by the DTI. There are two routes then; the first is to complete an "HM Customs and Excise Form CBR3" and pay Customs £5, informing them the rig has been converted to conform with MPT1320, ie: make it a legal CB radio. Of course there is no restriction on an amateur taking a legal CB up onto 10m and fitting anything to it, eg; SSB. The second route is to go directly to 10m, not pay Customs the £5 (as they don't ask for it except for conversion to legal FM CB) and accept the fact that at some stage someone on behalf of Customs may at some stage wish to examine the set.

Finally British Telecom: the author discussed the various aspects of CB, both legal FM and illegal CB, with the local interference official and it should be emphasised that the following precis does not necessarily reflect the policy of British Telecom. The official was against ANY form of Citizens' Band Radio Service, legal or illegal, as since the whole interest in CB arose he has had to deal with 200 or more cases of RFI weekly, both from FM sets and others, although the number of illegal sets has drop-

Rigs that will move.	Method.
Stalker 9-FDX	Change 15MHz crystals
Super Star 360FM	" " "
Cobra 148GTL DX	" " "
Cobra 146GTL	" " "
President AR-144	" " "
Realistic TRC 451	" " "
Sears 633.3810	" " "
Ham International UK	" " "
Ham International Multimode II	change 10MHz crystals
Ham International Concorde	" " "
Ham International Concorde II	change 20MHz crystals
Ham International Jumbo	change 10 or 20MHz crystals
Hy-Gain III, V	" " "
KWS 101, 1001	change crystals, possibly 11MHz
Stag 357	" " " "
Electronica 360	" " " "
Realistic TRC 459, TRC 480	change 17MHz crystals
Nato 2000	change crystals, freq. not known
Super Star 2000	" " " "
Tristar 777, 747	" " " "
Colt 1600, 1200DX	" " " "
Colt Excalibur 160, 1200	" " " "
Major M360, M588	" " " "

PLL chips that move

LC7113, MB8719, PLL02A, PLL03A, PLL08A, MC14506, REC86345, TC5080, TC5081, uPD858, uPD6861, uPD2814, uPD2816, uPD2824, LC7120, LC7130, LC7131, PB010AB.

PLL chips that will NOT move.

MB8733, LC7135, TC9106, TC9190, LC7136, LC7137, TC9116.

ped since FM was introduced. He stated as far as he was concerned, converting CB to the 10m band was not a good idea, even though it was pointed out that if the sets were converted and used on an authorised band by an authorised user this stopped one RFI problem and removed a pirate from an unauthorised band. In addition, he was highly suspicious of any amateur using such a set, even after conversion to 10m and stated he would, if possible, have the set confiscated, although exactly what authority a British Telecom official would have is not clear, presumably his statutory powers, whilst acting under the Secretary of State, in the role of his *normal* duties.

This may well change when the new Telecommunications Bill becomes law; however in conclusion, where there's a will there's a way!

Acknowledgements.

The author wishes to thank John Brown G4UVL for his assistance with this article, in particular the list of rigs and PLL chips.

The Electronica 360 multimode is a good bet for 10m conversion

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