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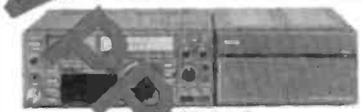

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HAM RADIO TODAY

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Unfortunately, due to lack of space, part 2 of the Simple Sender for 6m has had to be held over until next month.

Thanet El

ICOM ICOM

IC-3200E Dual-band

A new exciting set is the ICOM IC-3200E FM Dual-band transceiver (144-430/440 MHz).

The IC-3200E employs a function key for low-priority operations to simplify the front panel. LCD display is easy to read in bright places, showing frequency, VFO A/B, memory channel duplex mode and S/RF meter information.

Other features include a 10 channel memory able to store operating frequencies, Simplex or Duplex. A memory lock-out function allows the memory scan to skip programmed channels when not required. The IC-3200E has a built-in duplexer and can operate on one antenna for both VHF and UHF. Options include: IC-PS45 DC. power supply, HS-15 mobile mic, SM6 and SM8 desk mics, SP-10 external speaker and UT-23 speech synthesizer.

IC-735, The Complete HF Radio

This new HF transceiver from ICOM is compact enough to make mobile or portable use a possibility. The IC-735 covers all Amateur frequencies from 1.8MHz to 30MHz including the three new bands 10, 18 and 24MHz. Modes include SSB, CW, AM and FM, all circuits are solid-state and output is approximately 100 watts.

Tuning ranges from 100kHz to 30MHz, made continuous by using a high-side IF and a CPU control system. RTTY operation is also possible. Dynamic range is 105dB with a 70.451 MHz first IF circuit. The direct feed mixer rejects spurious response and gives higher sensitivity and wider dynamic range. Pass-band tuning and a sharp IF notch filter provide clear reception even under duress. Preamp is 10dB and attenuator 20dB.

The new IC-735 from ICOM is easy to operate and versatile, it has various scanning functions, comprehensive LCD and 12 memories. Computer remote control is possible via the RS-232C jack.

Options include: the AT-150 automatic antenna tuner and shown here the PS-55 AC power supply and SM-8 desk mic.

Please contact Thanet Electronics or your local ICOM dealer for even more information on this latest HF transceiver – the IC-735.

Attention All Amateurs

If you are thinking of buying an ICOM product call us. Just pick up the 'phone and dial 0800-521145, our FREE Linkline telephone service for Amateur Sales Enquiries.

Polite Notice: this service is strictly for Amateurs and we regret that NO dealer or other enquiries will be processed via this special free link. Thank you.

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ICOM ICOM

IC-290D/290E

290D is the state of the art 2 meter mobile, it has 5 memories and VFO's to store your favourite repeaters and a priority channel to check your most important frequency automatically. Programmable offsets are included for odd repeater splits, tuning is 5KHz or 1KHz. 25KHz option.

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

You can scan the whole band between VFO's/scan memories and VFO's. Adjustable scan rate 144 to 146 MHz, remote tuning with IC-HM10 and HM11 microphones. Digital frequency display, Hi/Low power switch. Optional Nicad battery system allows retention of memory.

Authorised Icom dealers in the UK

Alyntronics, Newcastle, 0632-761002.
Amateur Radio Exchange, London (Ealing), 01-992 5765.
Amcomm, London (S. Harrow), 01-422 9585.
A.R.E. Comms, Earlestown, Merseyside, 09252-29881.
Arrow Electronics Ltd., Chelmsford, Essex, 0245-381673/26.
Beamrite, Cardiff, 0222-486884.
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Bredhurst Electronics Ltd., W. Sussex, 0444-400786.
Dressler (UK) Ltd., London (Leyton), 01-558 0854.
D.W. Electronics, Widnes, Cheshire, 051-420 2559.
Hobbytronics, Knutsford, Cheshire, 0565-4040. Until 10pm daily.
Poole Logic, Poole, Dorset, 0202 683093.
Photo Acoustics Ltd., Buckinghamshire, 0908-610625.
Radcomm Electronics, Co. Cork, Ireland, 01035321-632725.
Radio Shack Ltd., London NW6, 01-624 7174.
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Tyrone Amateur Electronics, Co. Tyrone, N. Ireland, 0662-2043.
Reg Ward & Co. Ltd., S.W. England, 0279-34918.
Waters & Stanton Electronics, Hockley, Essex, 0702-206835.

Listed here are just some of the authorised dealers who can demonstrate ICOM equipment all year round. This list covers most areas of the U.K., but if you have difficulty finding a dealer near you, contact Thanet Electronics and we will be able to help you.

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IC-271 & 471

ICOM can introduce you to a whole new world via the world-communications satellite OSCAR. Did you know that you can Tx to OSCAR on the 430-440 MHz IC-471 and Rx on the 2m IC-271.

By making simple modifications, you can track the VFO's of the Rx and Tx either normally or reverse. This is unique to these ICOM rigs and therefore very useful for OSCAR 10 communications. Digital A.F.C. can also be provided for UOSAT etc. This will give automatic tracking of the receiver with digital readout of the doppler shift. The easy modifications needed to give you this unique communications opportunity are published in the December '84 issue of OSCAR NEWS. Back issues of OSCAR NEWS can be obtained from AMSAT (UK), LONDON E12 5EQ.

This range includes the IC-271E-25W, 271H-100W and the 70cm versions IC-471E-25W and 471H-75W r.f. output. The 271E has an optional switchable front-end pre-amp. The 271H can use the pre-amp AG-25, with the 471E and 471H using the AG35 mast-head pre-amp. Other options include internal switch-mode PSU's: the 271E and 471E use the PS25 and the 271H and 471H use the PS35.

Also available are the SM6 desk microphone and a speech synthesizer that announces the displayed frequency, what more could you ask for?

Contact us regarding <u>50MHz</u> equipment for new issued band!

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COMPETITION

Win a MICROWAVE MODULE 28 to 144MHz Transverter!

One of the cheapest ways of getting onto another band is with a transverter and your present transceiver. This month's competition offers you the chance of winning a 28 to 144MHz linear transverter provided by Microwave Modules of Liverpool. The MMT144/28 retails at £109.95 and allows all mode operation on 2m with an output power of 10W.

The questions (aaaaarg!!!)

1. The company, Microwave Modules Ltd, was formed in which year?
A 1968 B 1969 C 1971

2. Which famous annual horse race is held on the course near their Liverpool factory?
D The Derby E The St Leger
F The Grand National

3. The 1691MHz weather satellite system, sold by Microwave Modules receives weather pictures from
G Meteosat H Oscar 6 I RS

4. To amplify in a linear mode, a transistor amplifier runs in class
J 'A' K 'AB' L 'AB1' M 'C'

5. A linear amplifier is so designed to only amplify which modes of operation?
N AM and FM
O AM,FM,SSB and CW
P SSB and CW

6. When using the MMT144/28, and with your transceiver on 28.250MHz which frequency would you actually be working on?
Q 146.0250MHz R 145.25MHz
S 144.250MHz

The MMT 144/28 features:

★ **Very low noise RF amplifier stages;**

★ **Rugged PA transistors;**

★ **Highly stable oscillators;**

★ **Automatic RF VOX switching with hard wiring facility.**

Complete fully and carefully. Post to MM Transverter Competition, Ham Radio Today, 1 Golden Square, London W1R 3AB. Closing date 2nd December, 1985. Don't forget to follow the advice in the How To Enter section, including writing your choice of the answers on the back of the envelope!

NAME . . . .

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YOUR CHOICE OF QUESTION ANSWERS eg A, D, G etc . . . .

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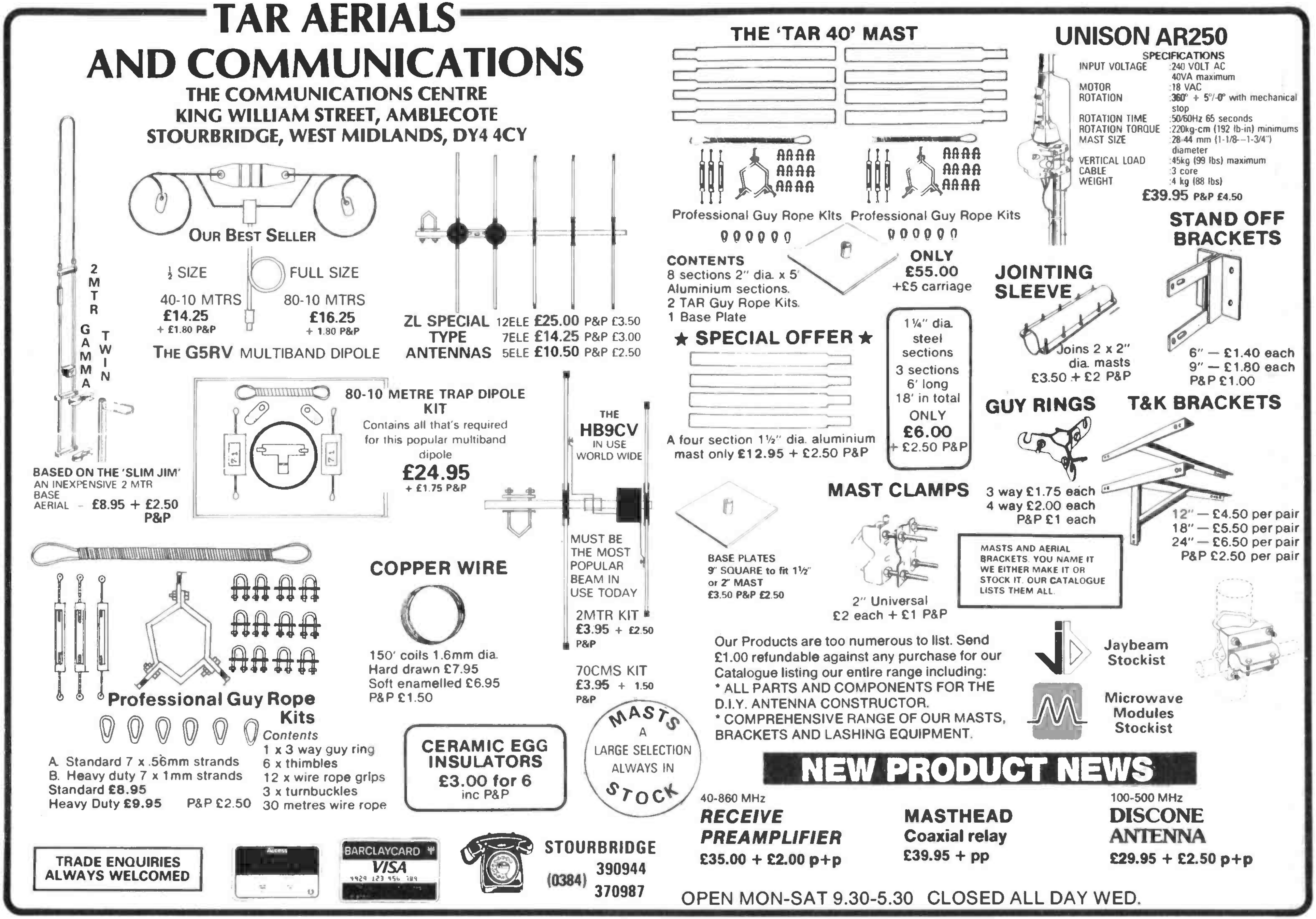
How To Enter

Look at the list of questions above and with your knowledge and judgement, choose the correct answer from those provided. Write the letters relating to your answers, in sequence, on the coupon below and on the back of the envelope. Send your entry to MM Transverter Competition, Ham Radio Today, 1 Golden Square, London W1R 3AB. The closing date for the competition is first post on Monday 2nd December.

IMPORTANT: complete the coupon fully and carefully. All the correct entries will be placed in a suitable receptacle and the winning entry drawn out by the infamous assistant editor. You may enter as many times as you like, but each entry must be on an official coupon — not a copy — and sealed in a separate envelope.

The Rules

Entries will not be accepted from employees of Argus Specialist Publications Ltd, Microwave Modules Ltd or Garden City Press. The restriction also applies to employees families and agents of the companies. The 'How To Enter' section forms part of the rules.



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ROTATION TIME :50/60Hz 65 seconds
ROTATION TORQUE :220kg-cm (192 lb-in) minimums
MAST SIZE :28-44 mm (1-1/8–1-3/4") diameter
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LETTERS

AN ALTERNATIVE MORSE TEST

Sir, The RSGB claim to favour, in principle, the introduction of novice licensing for radio amateurs, and its attitude towards experiments appears healthy (the use of CW by class B operators, the proposed 'intermediate' class between A and B). On the air, many regrets have been voiced by established CW operators that some new class A licensees have a poor knowledge of "shorthand" operating procedures, abbreviations and even Q codes. This is partly due to the morse test being in plain text only. Secondly, there are people who suffer from neurological, psychological and stress related conditions which make test situations difficult.

My suggestion involves the continuation of the current experimental class B use of CW. As an alternative to the morse test, an operator could be asked to furnish verifiable documentary evidence — QSL cards? — of a certain number of CW contacts (50? 75? 100?) at readability 5, with class A operators. This will encourage actual QSOs rather than on air practice sessions and will ensure operating experience. The odd mistake will not have such a devastating effect as in the formal test. I think the formal test should still remain for operators who wish to go straight onto class A.

Perhaps the RSGB would like to consider promoting this idea?

Paul Thompson, G6 MEN.

This suggestion has a few problems in its present form, particularly its openess to abuse. Furthermore, some would say that it would lower the overall standard of CW operation as amateurs would no longer have to reach the 12 words per minute requirement or maintain quality. What do you think?

A FOUND G7 CALLSIGN

Sir, On reading the article 'The Mystery of the Missing G7s' in October HRT, and noting the request for examples of G7 callsigns, I am able to supply you with one.

Between 1975 and 1979, I attended Northern Counties Radio School, Preston, Lancashire. This was a privately owned college for the training of Merchant Navy Radio Officers of the type mentioned in the article. It was equipped with all the necessary Marconi HF, VHF and radar equipment for passing the Maritime Radio General Certificate. The callsign the college was issued was G7 SE which we had to use when operating any of the equipment, CW or phone for training purposes — into a dummy load of course. One dummy load I remember consisted of 2/3 of a 1 kW electric bar which radiated quite well at HF!

Unfortunately, I don't know how long ago the establishment opened, or how long it had been issued with G7 SE, but I understand that the college closed in 1980 or 1981.

I L Liston-Smith, G4 JQT.

If there are any other ex G7 or G9 callsign users reading, we would be very interested in hearing from you. . .

REAL ALE AND AMATEUR RADIO

Sir, I was disturbed to read the rather paranoid letter in your August issue from Mr Slack, G3 GFE, regarding amateur radio and its so called links with alcohol.

As another contributor has observed, it was obviously the product of an overworked imagination. If he thinks his fellow amateurs are all raving drunks, I would suggest that he pay a visit to his local rugby club. Not that he would entertain such a depraved notion for a moment I suppose.

As a member of both CAMRA (the Campaign For Real Ale) and the RSGB and a founder member of the real ale division of the Leeds DARS, I strongly object to the idea that amateur radio is a hobby unfit for children because of people like myself who enjoy a few pints of honest English ale (the finest in the world and a tradition unto itself). My wife and children would certainly be most offended by such sentiments.

My friends and I combine our radio activities and our social drinking without rolling about on the floor of the shack or becoming incoherent on the air. I must say that we are becoming a little concerned that large doses of obscene RF from the local 2 m repeater may be having an adverse effect on the tight, creamy head that we in Yorkshire expect on our pint, but that is to digress.

If you should be in our area, Mr Slack, call CQ on 144.625 MHz locally known as RANET (Real Ale Net). I can assure you that you will be treated with the utmost civility — but not perhaps seriously.

Derek Wrathall, G4 XQU.

BEWARE! '290's CAN DAMAGE YOUR HEALTH

Sir, Whilst working a local station using my FT290, I noticed the signal strength dropping off. As I went through the usual checks — ie antenna going round, plugs fallen out, etc — I put my hand on the '290 and it was very hot. I pulled out all the cables and decided the only energy source for that amount of heat was the NiCad pack.

On opening the bottom cover, I saw that the battery compartment had melted and the NiCads were too hot to touch. After prising them out with a screwdriver and throwing them into the garden (they explode if too hot), I let the rig cool down, chiselled the gooey plastic mess out the box and found all the systems still worked!

Why did this happen after three years use? After a recent contest, the DC input lead did not find its way back to the shack. Another plug was purchased and lead made up. This plug had a larger centre contact than the '290 12 V input plug but my rig worked well so all seemed well. Not so! The internal battery is switched out of circuit when inserting this plug and the sloppy fit prevented proper action of this switch, resulting in the NiCads being left connected across the shack 13.8 V, 10 amp PSU. Overcharging created this very dangerous situation.

The moral of this tale is that when replacing the 12 volt input plug, make sure it's the correct size. The FT790 and FT690 are also liable to suffer from this form of maltreatment.

J C Darby, G4 TVC.

Please address correspondence to:
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RADIO TODAY

The WINNERS of our competition for two Waters and Stanton power meters are J Davey of Farnborough and N Grant of London whose choice was ADILNQ

CONGRATULATIONS!

THE RSGB: A NEED FOR REORGANISATION

It has been clear for some time that all is not well within the RSGB. Past and present Council Members have contributed to the enclosed Extraordinary Meeting Agenda because they believe that it is time that appropriate action is taken. The proposed Agenda is complex of necessity. Please study it carefully, the point being that only Agenda items may be discussed at an EGM.

Does This Mean War?

There are moves afoot for an extraordinary general meeting of the Radio Society of Great Britain (RSGB). The call for an EGM has come from past and present Council members Ingemar 'Smudge' Lundegard, G3GJW, and Geoff Smith, G4AJJ, along with Peter Crosland, G6JNS, who between them, have drawn up an agenda based on, what they describe as, the need for reorganisation of the RSGB.

The agenda, which they are circulating along with forms for proxy votes, consists of a variety of proposals including one to limit individual members service on Council, committees and other offices to six years. Another proposal involves changes to the election system particularly candidates statements, selection of President and Vice President and supervision of elections by the Electoral Reform Society.

If the agenda is approved, Council minutes would become available to all members on request. The largest single change proposed is the setting up of a separate, wholly owned subsidiary company which will produce all the publications including Radio Communication and handle sales and advertising. Finally, a supervisory committee would be set up to oversee that decisions taken by the membership at any EGM are carried out.

This is a detailed document which requires careful consideration as many of its proposals are very wide reaching. The organisers hope to hold the EGM after the AGM on 7th December although if this is not possible in early January. Copies of the proposed agenda, forms and covering address are available from G4AJJ, G6JNS or G3GJW all of whom are QTHR.

Help For Visually Handicapped

WPO Communications have announced the introduction of a Mk II version of their Audiobridge designed as an operating aid for the visually handicapped radio amateur. The instrument comprises a frequency independent power and SWR meter for use over 1.8-30MHz at RF powers of up to 400W PEP. It also has a voltage controlled audio oscillator driven by the forward or reflected rectified voltage from the metering circuits. This enables the unsighted operator to adjust his transmitter for optimum power output and best SWR by audio means only.

The unit is battery driven (PP3) and has only two operating controls making operation easy. The unit can be left in circuit at all times, is supplied ready built and tested and priced at £48 inc VAT and post.

WPO also produce a talking frequency meter which is designed to assist unsighted amateurs in determining their transmit frequency, although the unit can be used just like a normal frequency counter, including frequency readout under difficult operating conditions. It covers 500kHz to 150MHz (minimum) in two ranges, with a resolution of 100Hz between 500kHz and 30MHz, and 1kHz between 30MHz and 150MHz.

Speech is of good quality from a unique circuit and through its own built in speaker. The meter features either manual or automatic repeat operation, with selectable 2, 4 or 6 digit groups of figures spoken. The unit has high sensitivity at HF, and reverse polarity plus input protection. It operates from a 12V external supply and is supplied ready built and tested. It costs £179 including VAT and post.

Further information on the Audiobridge and Talking Meter can be obtained on Hassocks (07918) 6149, or by post to 20 Farnham Avenue, Hassocks, West Sussex BN6 8NS.

New Products From ICS

ICS Electronics of Arundel have announced two new products to their range and look like expanding it still further. They have just been appointed UK distributors to Alinco International of Japan, who manufacture handheld and mobile transceivers. The first product now available is the new ALM203E, 2m 3W output handheld which has a pushbutton keypad instead of the rather limited thumb wheel frequency input. It also provides what is claimed to be "all the most wanted features needed for pleasurable 2m operation" which includes a built in 'S' meter.

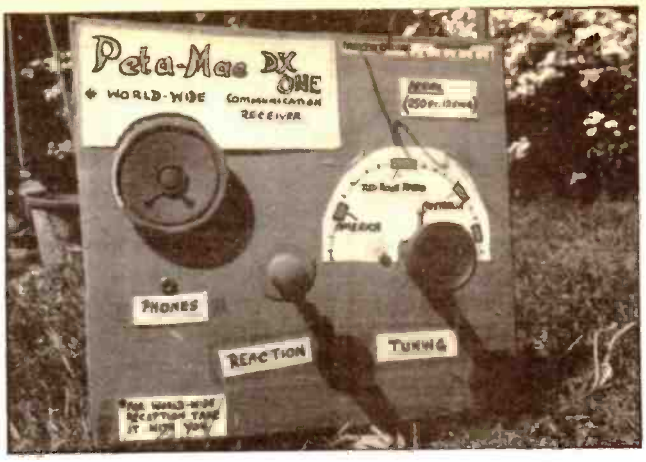
The transceiver costs £209 (inc VAT) which includes a NiCad pack and certain accessories.

The second product recently introduced is a continuation of their successful range of software for the radio amateur. Designed for the BBC 'B', this program allows data or Teletext compatible colour graphics images to be transmitted to other similar stations. Your transceiver can either be connected directly to the computer or, apparently for improved performance, via a radio modem.

The program, called ASCOM 1, comes supplied with your callsign and location on an EPROM and has the now common features of split screen, type ahead buffer and status line. There is also the (at present illegal if used) mailbox facility. The program comes with 'comprehensive documentation' at a price of £39 (inc VAT).

Contact ICS for more details of these products at PO Box 2, Arundel, West Sussex (phone 024 365 590).

Latest Design In Communication Receiver?



At a recent construction contest held by Fylde ARS, the above solid state communication receiver built by Chairman Peter MacKrell, G3AEP, was entered. In explaining its construction he said, "the wiring was of the (more or less) direct type on the long grain rice carton chassis (not critical), with many component leads twisted together (saving solder), but employing a high quality coil former retrieved after the puppy had finished filming its latest commercial".

Peter went on to point out that best all round reception would be obtained using a 250', preferably vertical, antenna. The full vision dial has stations clearly marked but the actual wavelength could be measured on the linear scale provided by dipping the aerial lead in iron filings which would, naturally, 'bunch up' on very strong signals.

Even though it did work (well, more or less), Peter decided to withdraw the entry since he had presented the trophy to the club and did not want the judges to be accused of near nepotism. However, we look forward to the next construction contest on the 3rd December and what other ideas are presented.

BBC Drives 757!

Many of the major manufacturing companies of amateur radio equipment are adding data input sockets to their equipment. To enable these to be driven by a home micro', the purchaser usually has to buy the optional interface, if available, which can be expensive. Furthermore, at the moment, very little software is available to program the computer to drive the rig.

However, we have received details of an interface and software available for a BBC 'B' computer and the Yaesu FT757GX transceiver. Produced by G3LIV and G8UEE, the program apparently allows complete control of the transceiver with 'many extra facilities' thrown in. The cursors, for example, control the selection of a variety of frequency steps from 10Hz to 1MHz. The program can also enable checking of 300 station frequencies in a matter of seconds.

The program is available on disc at £9.50 and will soon be available on ROM priced at £12.00. The interface will cost about £25. It is also planned to have programs for the FRG9600, FRG8800, FT980 and some of the Trio range of rigs. Further details can be obtained from G3LIV at 2 Salters Court, Gosforth, Newcastle upon Tyne NE3 5BH.

AMATEUR RADIO LICENSING

1 Background

1.1 The Department of Trade and Industry, Radio Regulatory Division (RRD) (based in Waterloo Bridge House, London) has many functions. It co-ordinates UK interests and participates on behalf of the UK in all international negotiations on the use and allocation of radio frequencies and on the technical and operating standards for radiocommunication services. It formulates policy governing the planning and allocation of frequencies to all radio services in the UK. It licences non-Crown users of radio, formulates equipment performance specifications and the technical criteria to be observed under the Wireless Telegraphy Acts in order to minimise problems of interference in the use of radio. It is responsible for the enforcement of the WT Acts.

1.2 The RRD is headed by an Under Secretary, and comprises three

Government Document Spells It Out

The Department of Trade and Industry have just produced a document which could eliminate the 'mystery and suspense' surrounding the licensing procedure. Called 'Amateur Radio Licensing', the booklet details the structure and functions of the various government bodies involved with amateur radio, including the Radio Regulatory Division and the Radio Amateur Licensing Unit based at the Post Office HQ in Chesterfield.

Of particular interest to enthusiasts who have ever tried dealing with the RSGB and the DTI, is the section covering the liaison between the department and the Society. However, the booklet also describes the involvement the department has in world issues. It is especially keen to point up the commitment to morse code despite its decline in maritime use.

The booklet is available free from the Radio Regulatory Division, Waterloo Bridge House, Waterloo Road, London SE1 8UA. Unlike most government documents it is very readable and will, I think, remove most of the confusion and frustration enthusiasts suffer when dealing with the 'authorities'.

More 'Handy-Talkies'

Hi Tec Worldwide Ltd have just announced their appointment as Kenpro distributors to the UK for a new range of handheld transceivers. Two models are currently available, the KT200E for 2m and the KT400E for 70cm. A new computerised version is also on the drawing board and is planned for the end of the year.

Kenpro are well known for their quality and Hi Tech have adopted a policy of very competitive prices and direct factory spares back up. For information, brochures, specs etc contact Hi Tec on 021 421 6001.

Go Anywhere Receiver

Philips have introduced a little brother to the D2999 mentioned in last month's Radio Today. Called the D2935, it weighs 2.45kg and can work off batteries or mains – anywhere they claim. It has a simple digital display and a push button keypad as well as the usual tuning knob for getting the frequency you want. There are nine memories for storing your 'favourite stations' and the receiver covers 150kHz to 30MHz continuously plus VHF FM and the full range of marine bands.

The D2935 costs £169 and is available from larger stockists of Philips products.

The G2DYM balun matches the unbalanced output of your transmitter, or the input to a receiver, to a balanced 75 ohm feeder. It also incorporates a change over switch to swap from a dipole or trapped dipole to a Marconi 'T' for 160m, medium and long wave reception. The balun covers 1.5MHz to 30MHz and can cope with up to 500 watts PEP on SSB or CW. The unit costs £19.50 and is available from G2DYM, Uplowman, Tiverton, Devon.

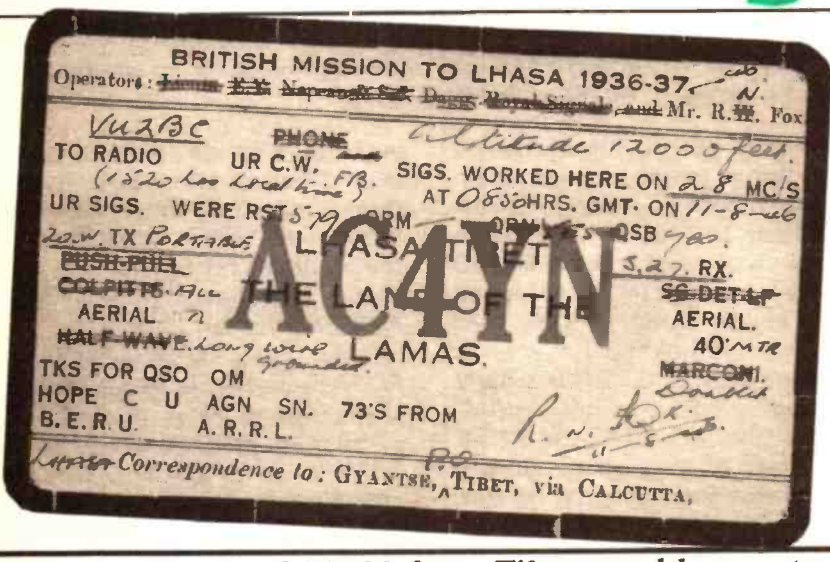
Thanet Move To New HQ

Thanet Electronics, sole importers of Icom equipment, recently opened the doors of their new premises at Sea Street, Herne Bay, to the public. The new £50,000 premises houses the administrative side of the company and a research and development section as well as the test side of things.

Thanet have been supplying some very important people recently including the Royal Yacht Britannia, and the the sailing ship Zebu, which is currently sailing around the world as part of Operation Raleigh. Thanet also sponsored three radios for the ill fated Virgin Atlantic Challenger which sank just short of breaking the record for crossing the Atlantic in the shortest time.

The company started life 10 years ago when Dave Stockley and Paul Nicholson got together because of their interest in amateur radio. Having written to several Japanese companies they received a reply from Icom Inc. who said they had "no friends in England". Initially, with the £7000 capital from savings, they worked from home but by ploughing back the profits, they were able to set up their permanent base in a shop at Beltinge. They now have a turnover of £3m a year and employ 20 people.

Radio Yesterday



At an altitude of 12000 feet, Tibet would seem to have distinct advantages for the radio amateur. Yet as John Heys, G3BDQ, discovers, only a handful of amateurs have ever operated from AC4...

The country of Tibet conjures up many images. For many years access was forbidden to Westerners, except for a short spell in the 1930s and 40s when the remote mountainous state was open to a measure of development. Then the incursion of China once more effectively sealed off the country. When still a schoolboy, I was impressed by the film 'Lost Horizon' which suggested that perfection and timelessness could be found in the lost valley of Shangrila in Tibet.

Since June 1974, Tibet has been a part of China and perusal of any good atlas produced between 1900 and 1914 shows that even then Tibet was considered to be part of the Imperial Chinese Empire. However, following a military invasion, British influence grew with the Governments of the inter war years maintaining an important mission in Lhasa, the capital city. Tibet covers 1400 miles east-west, 600 miles north-south and so was seen as a useful buffer against possible enemies (eg Russia) in the north.

CQ AC4

In January 1946, I was fortunate to spend a few weeks in Kashmir (with all expenses paid by HM Government). During that memorable visit, I actually reached a point no more than 150 miles from the Tibetan border and saw real Tibetan traders with their slow moving, heavily laden yaks on the mountain passes. Although the post war scramble for DX was not so hectic as now, the competition was still fierce. Everyone seemed to be striving to put CQ zone 23 and especially Tibet 'into the bag'. I must confess that I never once heard a transmission from Tibet during that time and it now looks as if very few European amateurs actually had QSOs with AC4 (Tibet) or AC3 (Sikkim). Now, of course, Tibet is no longer on the DXCC Country list which makes past QSOs even more interesting.

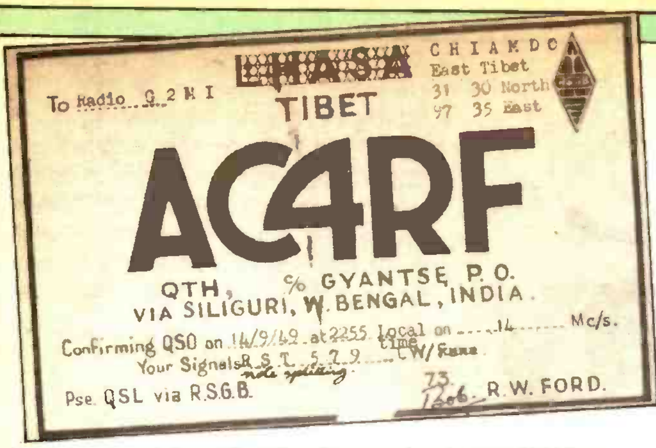
My hunger for rare and unusual QSL cards to grace my large collection led me to search for Tibetan examples. A few years ago I wrote to Lt Col (Retd) Sir Evan Y Nepean Bt, G5YN, who had previously spent some years attached to the British Mission in Lhasa and had operated from there as AC4YN. Sir Evan naturally wished to hold on to the few original QSLs in his possession, but kindly let me have photo-copies of these cards.

AC4YN On The Air

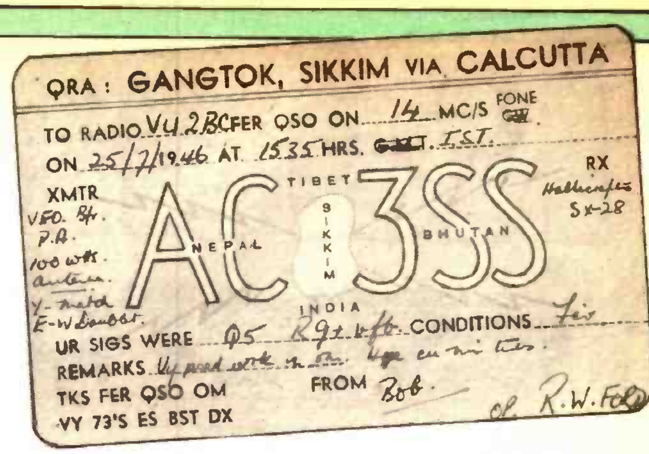
AC4YN had three operators before WW2 and they were named as Lt E Y Nepean and S J Dagg, both in the Royal Signals, and also Mr R N Fox on the station's QSL card. During the years 1936-37 their transmitter was just a simple self-excited push-pull Colpitts oscillator coupled to a half wave antenna on the 14MHz band. The receiver was a three valve 'straight' using a screened grid RF amplifier, a detector and one stage of AF amplification and it used a 40' long Marconi aerial.

All correspondence with AC4YN had to be directed to Gyantse, Tibet, via Calcutta. Amongst the QSL cards received at AC4YN was a listener report from AA licence holder T S White, 2DPX, then living in Mansfield, who gave AC4YN R5 and S3 to 4 on June 9th 1938. Rather optimistically 2DPX wrote "... Ere hpe have full call soon es hpe QSO. Watsa?..." I hope he made it! In December 1936 VK6JE worked AC4YN and a few months earlier the Chinese station XU8HR had made contact from Hangchow. In 1937, VK2BA was worked from Tibet and written on his card was "... Vy psed to wrk my first AC4. pse QSLL om..."

I feel sure that Sir Evan Nepean will not mind me giving a few details from his QSL cards. The earliest card I have was sent from 'British 5YN' to G5UF in 1928 when 5YN was living in Winchester. A card sent to Arthur Milne, G2MI, in 1949 names the operator as Major E Y Nepean, R. Signals. Later cards from 1961 to the present indicate that G5YN had by then risen to become Lt Col



A very rare card from Bob Ford operating as AC4RF from Chiamdo near the Chinese border in September 1949. He was later captured and imprisoned by the Chinese for spying.



A July 1946 card to VU2BC from Bob Ford operating as AC3SS in Gangtok, Sikkim.

(Retd) and a Baronet. The later cards also indicate that Sir Evan had formerly held the calls VU2YN, VUQ, AC4YN, VS1YN, LA9YO and DL2YN! He remains very active and may sometimes be found on 80m SSB.

Other Operators

Very little is known about what is probably the first amateur radio operation from Tibet. The operator can only be identified as Mr Moore (no first names) who was with the Lamb expedition to Northern Tibet in 1932. The callsign used by Moore was AC4UU and the expedition leader was Harold D Lamb, a noted American explorer of Asia.

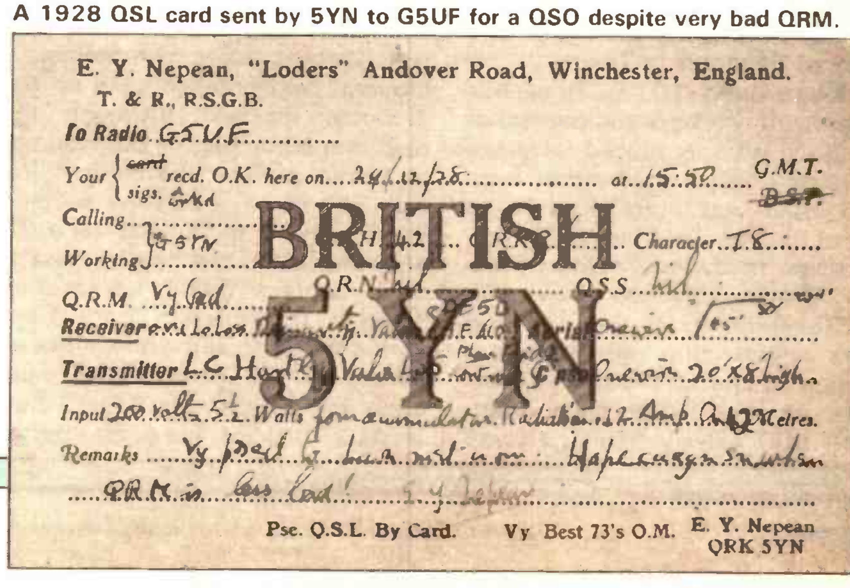
Mr R N (Reg) Fox of AC4YN fame continued operating the station up to and for a short period after WW2. Also in Tibet, and worked often by Fox was a missionary located in Choni who held the call AC4JS, but this station was not known to be active after the war. Reg Fox was still using up the old AC4YN pre-war QSL cards during 1946 when he worked VU2BC on 28 and 14MHz; by then the transmitter was a portable rig using a 6L6 valve running at 20 watts from a battery supply. His receiver was a Hallicrafters S27. At an altitude of 12,000 feet Reg surely had a good 'take-off'! Another Lhasa station was AC4NC, Mr N Chakravarti ('Chak'), who was at the Indian Mission from 1948. 'Chak' had previously been operating for two years as AC3NC from the now non-existent state of Sikkim.

In 1946, R W (Bob) Ford was working as AC3SS at Gangtok in Sikkim and in 1948, he moved to Tibet where he was licensed as AC4RF and set up his station in Lhasa. Bob is famous for his amazing two month journey in 1949 from Lhasa to Chiamdo in eastern Tibet, a distance of more than 360 miles over some of the most rugged terrain in the world. A QSL card from Bob Ford when he was at Chiamdo, sent to G2MI, is clearly endorsed in red typescript CHIAMDO East Tibet, 31 30 North, 97 35 East'. Some of the stations worked while he was there thought he was actually in China, because their maps showed Chiamdo to be across the border. However, my own 1905 map clearly shows Chiamdo as being about 30 miles into Tibet. Bob explained to doubters that the Tibetans didn't draw maps but the Chinese did! At that time, the inhabitants of Chiamdo were Tibetan, spoke Tibetan language and were governed from Lhasa. Later in October 1950 when China occupied Tibet, Bob Ford was captured and later charged with spying and 'spreading separatist propaganda' by suggesting that Chiamdo was in Tibet! Bob was released in 1955 and he returned safely to England.

Between 1950 and 1953 there was no amateur radio operation from Tibet, but in 1953 AC4NC, Chak, operated from the Indian Mission in Lhasa. Chak informed the world via his rig that Reg was a 'silent key' having died in India. Another Indian operator, Deb Shankar Seal, VU2AC, established AC4AX in the Indian Consulate, Lhasa during most of 1958 and 1959 and was usually found on 14MHz AM phone. The last amateur operation from Tibet took place in 1964 an 'under-cover' exercise during the hours of darkness by DX-peditioner Gus Browning. Gus slipped across the border into Tibet from Bhutan for a one night stand using the call AC5A/AC4, the whole operation being strictly illegal and a very risky undertaking.

The final annexation of Tibet by China was in 1974 and it put an end to amateur radio operation from that country. Hopefully, the awakening interest in amateur radio and the setting up of a few stations in China in recent times, may one day result in future operations from that part of the country which was once Tibet, the 'Land of the Llamas' and the 'Roof of the World'!

A 1928 QSL card sent by 5YN to G5UF for a QSO despite very bad QRM.



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MICRO NET

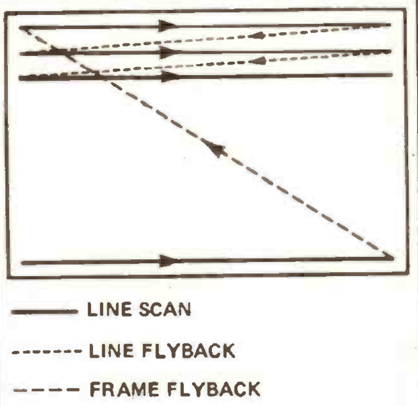
Visicode, TV's version of Basicode looks like offering the ATV and computer buffs another outlet for their transmissions. Dave Bobbett, G4IRQ, explains the new system and reviews the latest datacoms chip for the Beeb.

This month we'll be taking a look at how TV's new version of the Visicode system works and investigating a new ROM chip for the BBC which offers ASCII TTY with a choice of special file transfer facilities over the radio. But first, a mention of the planned changes to the Radio Investigation Service (RIS) which is run by the Department of Trade and Industry.

RIS Faces Charges!

There are plans afoot to 'rationalise' this service by increasing staffing levels, producing a more helpful leaflet on interference for the general public and introducing a fee for investigating interference problems. At first sight this may sound like good news for radio amateurs as the number of official complaints is bound to drop when people discover that they will face a £20 to £25 bill before the RIS will show up. But it also means that many of the poorer groups will not be able to afford an entire week's income just to have an interference problem looked at. One service for the poor and another for the better off?

The second point concerns the delicate subject of relations between radio amateurs and their neighbours. If you are unfortunate enough to live next door to the sort of people who think that radio waves poison their goldfish, will you be expected to pay for the RIS to come and tell them that their telly is at fault? Or, if you won't oblige, will 'next door' decide that a pair of wire clippers would be a better long-term investment than the fee?



(a)

Fig.1 Detail of TV screen scan sequence.

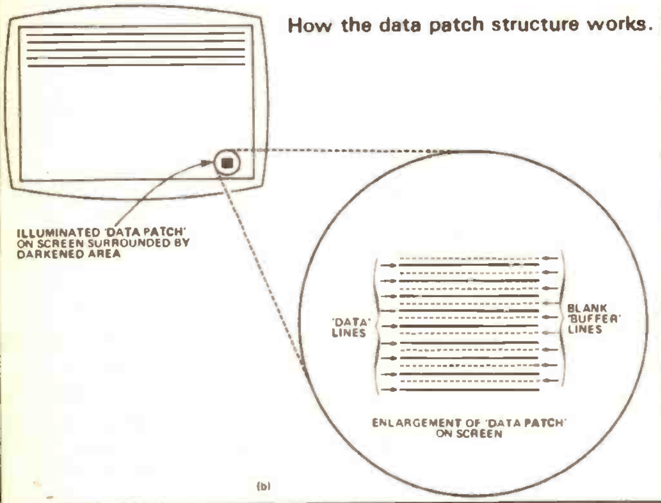
Visicode Mk II

A recent development by Thames Television has resulted in what could be described as the TV sequel to the radio-based Basicode system. The new version was developed in order to overcome the slow data transfer rate inherent in the design of the previous system. It will probably be some time before amateur TV enthusiasts get started on their own version it might be of interest to quickly look at how it works.

The earlier system worked by a glorified 'flashing-a-torch' method, whereby a small block on the screen was alternately lit and unlit so as to 'flash' a TTY type code which represented the data. With the new rather ingenious system, however, the entire block is not switched wholly on or off as a single unit. Instead each one of its individual lines are switched in order to transmit the data.

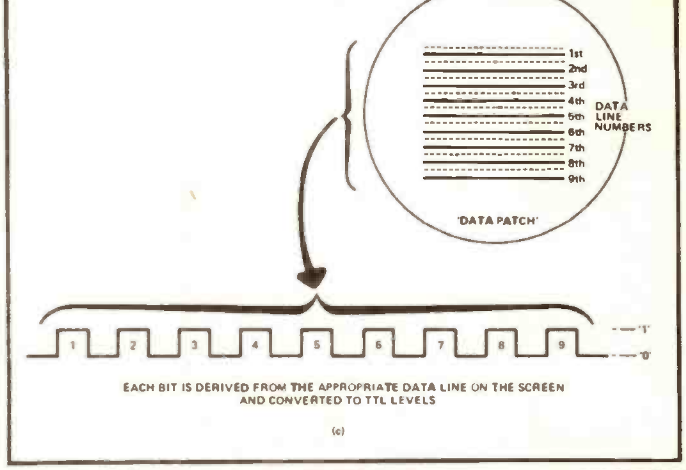
The result is a dramatic improvement in data speed. Whereas the old system could send one data bit every 1/25th of a second (ie every time the screen was scanned), the new system can send an entire byte of data with each scan, giving a speed improvement of about nine or ten. For most people a TV picture is not seen to be flickering due to the persistence of vision but of course there is a finite delay between one line and the next being drawn on the screen. As a result, if you consider a small section of 10 lines, each of them will be 'drawn' in quick succession with a time delay between them. So if the topmost line in the block represents the first (start) bit of a data byte and the line below being the second bit, the binary code can be 'shown' for an entire byte in eight, nine or ten lines depending upon the specific code being employed.

How the data patch structure works.



(b)

The output from the Visicode interface.

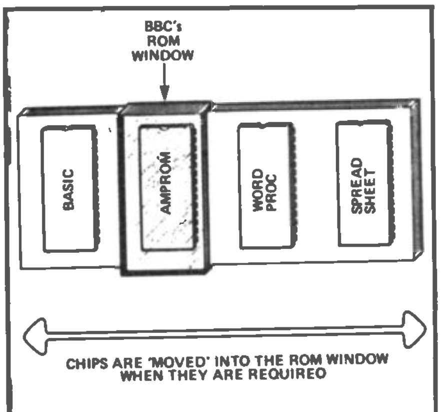


(c)

In order to read this information from the screen, a fast photo-transistor, followed by suitable amplification stages, is used to drive a flip-flop type integrated circuit. This IC can then drive the input port of most home computers and from here it is simply a question of writing suitable software to translate the code.

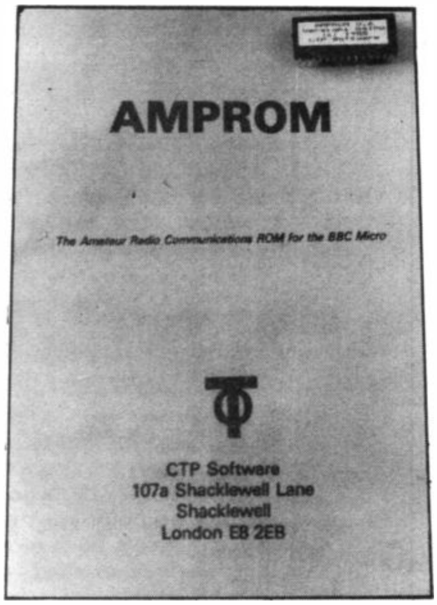
Fig.1 shows the scheme, in diagram form, and also illustrates how unlit lines can be interspersed between the real data lines so as to help overcome the problems associated with the persistance of the TV screen's phosphor coating. The great advantage with this system is that as long as the number of lines required does not result in the 'block' being larger than the optical field of the photo-transistor, virtually any code can be used. This is made use of by allowing 'control' codes to be transmitted in addition to normal character codes. Thus enabling both text and programs to be transmitted and using the host computer to watch for data which has been 'labelled' as being specifically intended for that particular type of machine.

Most of the popular micros such as the Amstrad 464, BBC, Commodore 64 and Sinclair Spectrum (48K only) are supported at the time of writing and there are plans to add others to the list in the near future. The interfaces are



(a)

Fig.2 How the BBC micro's sideways ROM system works.



The manual for the Amprom package.

available in either kit or ready built form from Magenta Electronics. Further details can be found in the box but generally kits cost around £7 with ready built units being £2 or £3 dearer.

New Datacoms Package for BBC

A new datacoms package designed for the BBC micro and specifically intended for use in amateur radio has been produced by CTP Software of London. Unfortunately, the review copy arrived too late for inclusion in the recent Software Index but at least that gives us a chance to take a closer look at it.

The new program incorporates many of the features found in the earlier 'Beebcom' package and combines these with a number of extra facilities. The program was supplied in the form of a ROM chip ready to be plugged into the machine and was accompanied by a handy sized 24 page instruction manual. A tape version is also available but it cannot be loaded into the machine like a normal piece of tape software as it is intended for those BBC owners who have a 'Sideways RAM' facility fitted to their machines. Bearing in mind the often confusing terminology used in the micro industry it would probably be a good idea if I briefly explained exactly what sideways RAM actually is before going any further.

The BBC machine uses ROM (Read Only Memory) chips to store the machine code needed for languages such as Basic or word processors like View. When the user wants to write a Basic program, the appropriate chip (containing Basic) is switched on by the software and the other ROM chips are switched off. The machine code is thus made available within a 'window' in the micro's memory. The other packages can similarly be switched on when required and their code would then appear within the same window (see **Fig.2**), replacing whatever code was there previously.

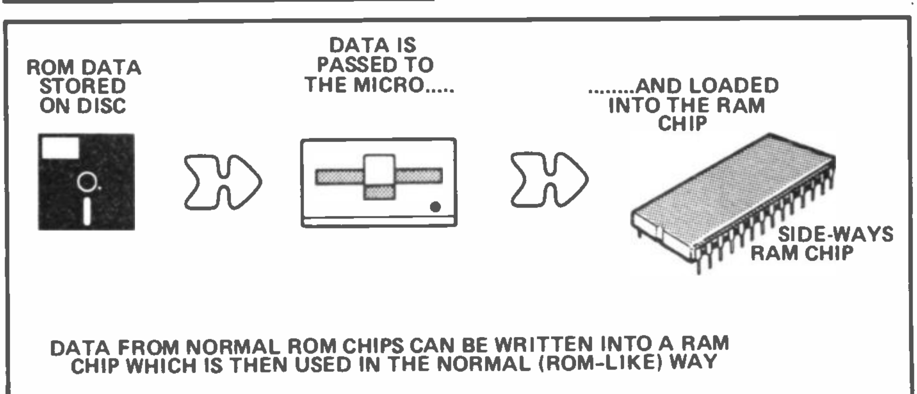
This all works well until you run out of sockets for the extra chips — with only three 'spares' in the standard machine that doesn't take very long! One solution is simply to place a RAM (Random Access Memory) type chip in the window position. This can be read in just the same way as a ROM chip but it has the added advantage of being able to have data written into it too. With this system, the machine code which is normally fixed permanently inside a ROM can be stored on disc or tape instead and then simply loaded into the RAM chip when required. As far as the machine is concerned the end result is the same and you don't have to spend half your life digging about inside your pride and joy with a screwdriver! The sideways RAM technique is the one adopted by CTP Software and as such there should be no difference whatever in the final performance of the package.

Amprom Facilities

Amprom offers the user a choice of three different 'modes' of communication namely:

i) Real time transmit/receive of ASCII data at either 300 or 1200 baud using c.u.t.s. tones.
ii) Direct memory-to-memory file transfer with error checking.
iii) Direct disc-to-disc file transfer with error checking.

The first option works in a very similar manner to normal RTTY, using the cassette port output tones to modulate the transmitter and also using it to decide incoming tones. However, it is pointed out in the manual that the 1200 baud rate should be seen very much as an experimental speed — after



(b)

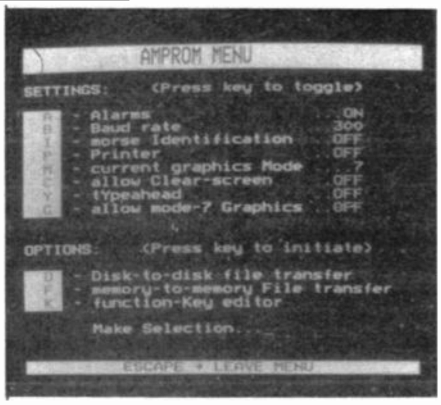
Using sideways RAM instead of sideways ROM.

all the BBC cassette port was not designed to be a radio modem!

Whilst the first option gives the user what could be described as a 'chat mode' which would be compatible with any other 300 baud ASCII system using the 2400/1200Hz c.u.t.s. tones, the two remaining options are machine specific. It is possible to transmit a user-defined section of the BBC's RAM directly from one machine to another and do so with error detection and correction by means of an ARQ type of operation.

What happens is that the section of memory to be transferred is sent as a series of data blocks, if the first block is not received correctly it is retransmitted until either it does arrive intact or the sending machine aborts the transmission. When a poor signal path is encountered, subsequent blocks are reduced in size so as to increase the chances of uncorrupted reception and reduce the time delay before the sending station realises that errors have occurred.

The third option is essentially the same idea, except that it offers the possibility of transferring files which are stored on disc instead of files which are stored in memory. The procedures are the same but the machines involved must be fitted with a disc drive system. The program is really designed to make use of the BBC's display Mode 7, a Teletext look-alike which is by far the most frugal user of the machines 32k of RAM. The manual does say that it is possible to use any of the seven display modes available, but at the cost of loosing the prompt line at the bottom of the screen. This is rather a shame because if the BBC's Mode 7 (Teletext) screen-jitter drives you up the wall you must decide whether you want a stable



The menu for the Amprom package.

screen *or* prompts to tell you what's going on — you can't have both. For the majority of users this won't be a problem but it is worth bearing in mind — most people will consider the savings in terms of usable RAM to be worthwhile.

The Verdict

Each Amprom program comes specially 'customised' with your callsign. Should you need to change it, this can be done by CTP Software for a £1 handling charge. The integral callsign is not just an anti-copying device, it is put to use by providing the option of an automatic CW identification at the end of each transmission or every 10 minutes, whichever is the more frequent. The ID comes up in the form of a 12 wpm 'side-tone' morse signal which can also be heard from the computer's loudspeaker — a nice touch and one which keep those awfully nice people at DTI happy too!

Page one of the manual states that: ". . . Amprom has no effect on the normal operation of the BBC." But the review copy of the Amprom program (Version 0.6) was found to contain two 'bugs'. The chip interfered with the normal operation of the machine even when it was not selected. The first, and most important, problem was that the chip interacted with one of the disc commands. When you want to prevent over-recording of a file on a disc you can do so by issuing the command *ACCESS * . * L, which is shortened to *A. * . * L. However, the *A. part of the command would select the Amprom chip whether you wanted it or not. It was most disconcerting to find Amprom leap onto the screen uninvited when in the middle of a disc editing session! The second problem was that the Amprom chip (again whilst inactive) disabled the parallel printer port. This could be 'fixed' by sending the command *FX3,0 (which sets the machine back to normal) but this sort of interaction shouldn't happen.

Overall then, assuming that the two bugs found in Version 0.6 are fixed, Amprom could offer the solution to a group of Beeb equipped amateurs wishing to exchange (*non-copyright*!) programs over the air and who also indulge in the odd ASCII TTY session. Quite a reasonable package with a better than average manual and it's encouraging to see that sideways RAM users are also being catered for. All the usual details can be found in the address box.

Address Box

Amprom prices (including VAT and p and p):
£8 for Sideways RAM compatible tape,
£18 for ROM chip.

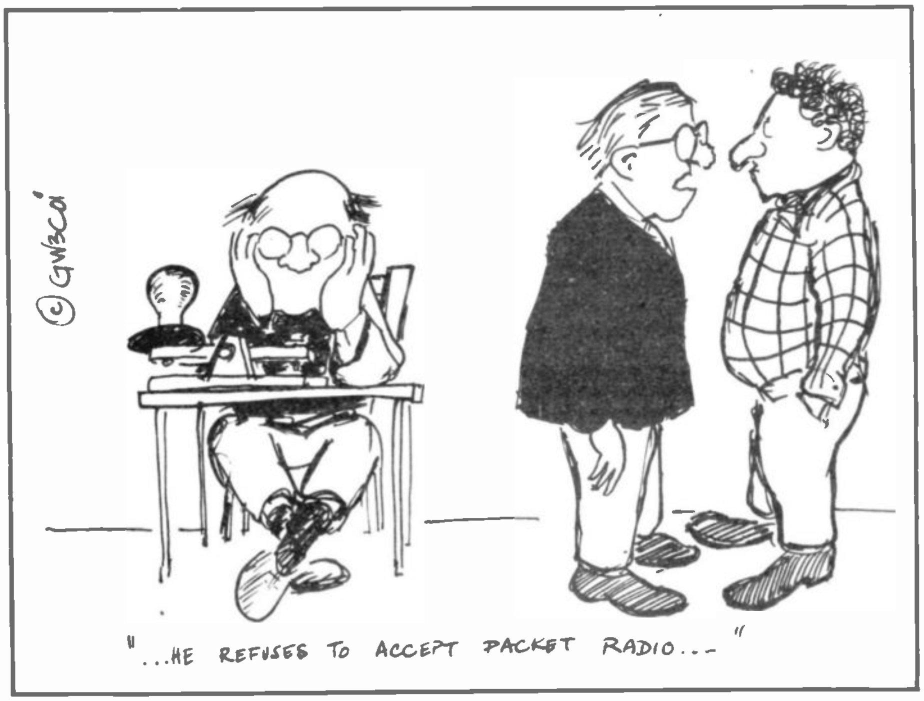
Available from:
CTP Software Ltd.,
107a Shacklewell Lane,
Shacklewell,
London E8 2EB

Visicode Interfaces

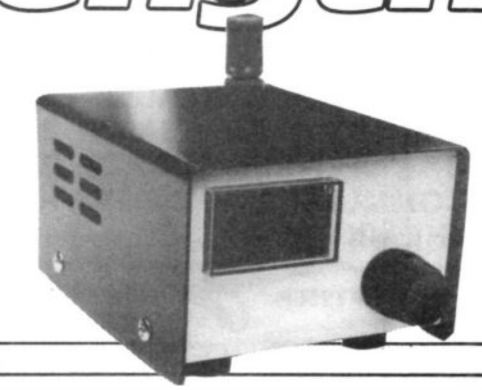
Micro	Kit	Built
Amstrad 464	7.56	9.40
BBC Micro	5.92	7.80
Commodore C64	6.04	7.70
Spectrum 48k	11.48	14.58

Prices include both VAT and a p and p charge of 60p.

Available from:
Magenta Electronics Ltd.,
135 Hunter Street,
Burton-on-Trent,
Staffs DE14 2ST
Tel: (0203) 65435



A Field Strength Meter For Beginners



Many new (and not so new!) radio amateurs are reluctant to try their hand at home construction. They believe that such work is complicated and difficult to complete — and that the final result is unlikely to work properly!

This is, of course, a possibility if first projects are too ambitious. There are, however, simple circuits which can be made up, with almost certain success, which can be easily corrected should anything go wrong, and which will give the budding constructor confidence to progress to something a little more challenging. Furthermore, this project requires two basic skills — soldering and elementary metalwork. You can undertake both on the kitchen table if workshop facilities are unavailable. Follow the hints and even a complete novice can obtain satisfactory results.

Monitor Your Signals

A useful first project is a field strength meter. This is an ultra simple, non-tuned, radio receiver, driving a panel meter to give a visual indication of relative signal strength at all amateur radio frequencies up to, and including, 144MHz. A ready calibrated, inexpensive, meter is used, together with other components needing minimum work for assembly. Mounted in a ready-painted case, this results in a smart unit to grace any operating station, and for which several uses can be found.

The Metal Bashing Bit

The basic tools needed are a hand-drill, with twist drills, a small centre punch, a hammer, an engineer's 6", 2nd cut (ie light to medium), hand file with one safe (uncut) edge, and a screwdriver. If you have access to a DIY power drill on a bench stand this will greatly assist the work, but is not essential.

Build yourself a very simple radio receiver that gives you a visual indication of your relative signal strength. By Tony Smith, G4FAI.

The recommended case measures 80 x 50 x 100mm, although the depth of the case is not vital. The front panel requires a rectangular hole, 37 x 22mm, and one further hole for the sensitivity control. **Fig.2** gives all dimensions which should be marked out on the panel in pencil. Only two holes are required, one on the top of the case, for the antenna socket, and one on the floor of the case, for a terminal block, **Fig.3**.

Having marked out the panel, place it on a piece of wood on the edge of a table and go round the inner rectangle lightly tapping the centre punch with a hammer to mark the points for drilling. Do not hammer too hard or the panel will be distorted. Mark the three other drilling points at the same time.

The indentations made serve as an anchoring point for the drill when starting drilling. It is helpful to drill a smaller hole at first, and then to enlarge it with the correct size drill. If drilling on a table, a wooden base underneath the panel will prevent the drill going through and damaging the table top.

When all holes are drilled, the small amount of metal between each hole can be gently broken with the end of a screwdriver, again with the wooden base for support. The resulting hole is now carefully filed out to the line previously marked on the panel. A novice should take great care over this. File gently and slowly, especially in the corners. Use the safe edge to ensure that when working on one line nothing is filed from the other line forming a corner.

Support the panel by hand to avoid distortion. Offer up the meter to the hole frequently to ensure that not too much metal is filed

How It Works

RF power from the transmitter is picked up by the antenna and rectified to DC by germanium diodes D1 and D2. Potentiometer VR1 controls the DC reaching the meter M1, which enables the meter to react to greater or lesser levels of radiation energy as required. C1 is a decoupling capacitor, minimising the effect of RF on the meter.

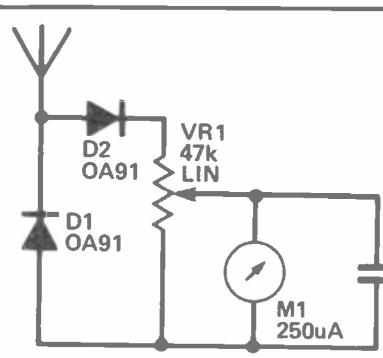
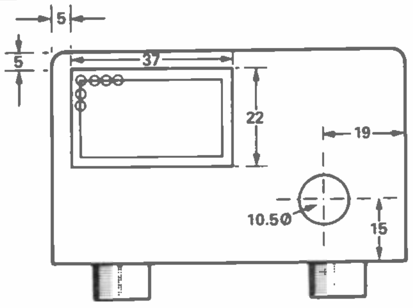


Fig. 1 Circuit diagram.



ALL DIMENSIONS IN mm

Fig. 2 Drilling details for the front panel. The hole for the meter can be made by drilling a series of holes along an inner line which is at least the radius of the drill to be used away from the outer rectangle. Take the surplus metal away with a hand file.

away. Always use a handle on the file to prevent the tang (the sharp bit) digging into the hand or wrist.

The hole for the potentiometer is the only other one not entirely straightforward. Drilling the size required sometimes results in "snatching" as the drill breaks through the thin metal. A better approach is to drill a 6.5mm (¼") hole and carefully enlarge it with a tapered reamer to the size required. This is a useful tool, not too expensive, and well worth having for future projects. When a hole has been drilled it usually leaves a 'burr' on its edges. This can be removed with a larger size drill simply held in the hand. 'Countersink' drills will also perform this function.

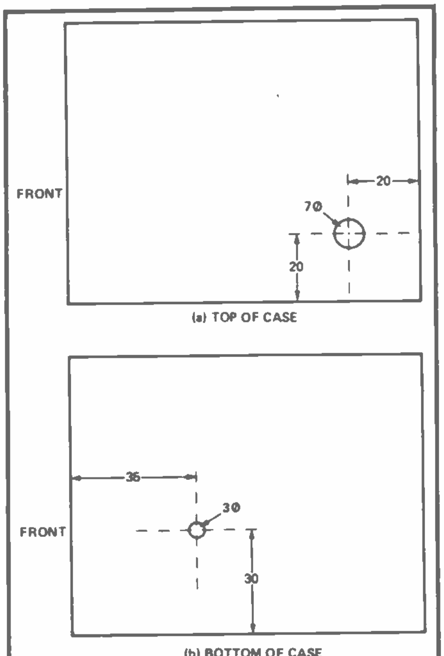


Fig. 3 Drilling details as viewed from above.

In all metalwork, try to avoid bending or scratching any surface on the outside of the case, to ensure the unit has a good final appearance. Finally, to enhance the unit's appearance, and to cover any slight damage to the case, the exterior of the front and rear panels, and base, can be covered with sticky back plastic or paint.

Fitting The Components

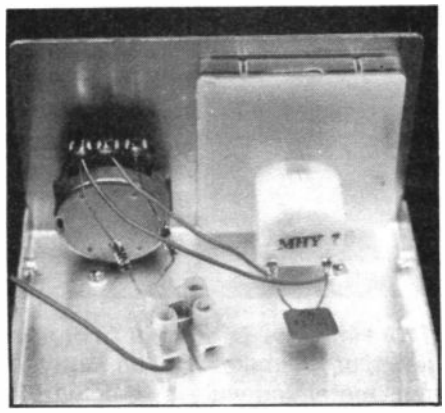
The meter is mounted from behind the front panel and is glued in place. The potentiometer is placed as shown in Fig.4. The component block is bolted to the floor of the case, and the antenna socket mounted on the top. The small components are located as shown and soldered in place.

All electronic projects involve soldering to some degree and, by observing basic requirements, there is no reason why a beginner should not do this successfully. An electric soldering iron with a small bit is required. Strip the insulation off the wire and after heating this should be tinned by melting a little multi-core onto the wire. Keep clean between joints by wiping with a damp cloth.

An iron holder is a useful accessory, providing a safe and obvious place to put the hot iron when not in use. Some models have a sponge insert which, when dampened, replaces the cloth for cleaning. All surfaces to be soldered should be clean, dry, and free of corrosion. The leads of components can be cleaned with a fine emery paper if necessary.

The hot iron should be placed against both surfaces to be joined *before* solder is applied. Solder is then placed against the heated surfaces and allowed to run round the joint. The application of heat should be as short as possible to avoid damaging components. As little solder as possible, consistent with a good joint, should be used. Components should not be moved whilst the molten solder is hardening, as this will result in a "dry joint", unsatisfactory both electrically and mechanically. The hardened joint should have a shiny surface. If it does not, re-apply heat and a further small quantity of solder. Clip off the leads projecting from the joints with side-cutters.

The antenna is made from a



length of material, about 360mm, cut from a wire coat hanger, as supplied by dry-cleaning shops. One end is tinned, ie coated with solder, and soldered into a 4mm plug. Some form of coloured bead, or similar, is placed on the extremity as a safety measure. A 6mm plastic rawlplug was used in the prototype.

A 150mm length of insulated flexible wire is soldered to the tag underneath the antenna socket. The other end is tinned to prevent fraying and secured in the terminal block just prior to placing the cover on the case for final assembly.

Testing And Problems

Place the unit near a transmitter, with the sensitivity control set midway. Activate the transmitter and adjust sensitivity to provide mid-scale deflection of the field strength meter during transmission. Additional sensitivity can be achieved by placing the meter nearer the source of radiation, or by connecting a length of wire to the terminal post on top of the case.

There is little to go wrong in this circuit. If the meter fails to register, diodes may be damaged by heat, or incorrectly wired in.

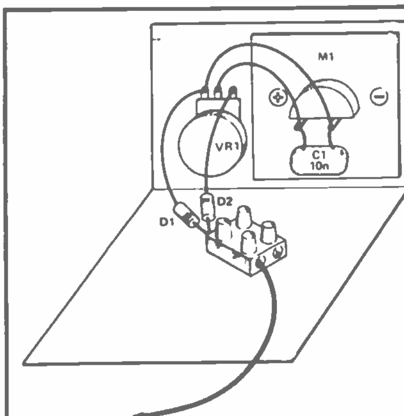
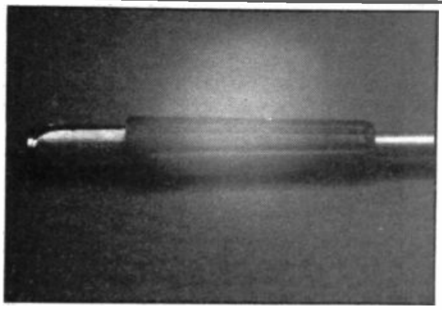


Fig. 4 How the meter is wired up.



There may be poor solder connections, or the meter may be faulty. If the meter moves in the wrong direction, the diodes are the wrong way round, or the wires to the meter are wrongly connected.

What It Can Do

The unit provides a relative indication of the presence of RF energy. It does not measure actual power, and does not discriminate between wanted and unwanted emissions. In daily use, it monitors the level of transmitted power from the station. If the normal reading is known, any change indicates a variation of output requiring investigation.

In tuning up or adjusting various sections of a transmitter, or antenna circuit, observation of the meter assists in obtaining maximum radiated power. When RF is present in the shack, or in equipment, the unit can "sniff out" where the problem is greatest as a first step in dealing with it.

Components List

RESISTOR

VR1	47k lin

CAPACITOR

C1	10n ceramic

SEMICONDUCTORS

D1,2	OA91, germanium

Metal case, 80 x 50 x 100mm (with feet and screws); moving coil meter calibrated for signal strength 0-5, 250uA (Maplin LB80B); insulated terminal post with 4mm top socket (for the antenna socket); 4mm plug for the antenna; coat hanger (the antenna wire); knob for VR1; terminal block; 6BA x ½" nut and bolt; some insulated connecting wire.

In setting up antennas, tests made several wavelengths away will confirm that a signal is radiated, and give an indication of the radiation pattern. In this case a longer pick-up antenna may be needed, in the same polarisation as the transmitting antenna.

Made as suggested, the beginner will have a useful piece of equipment he/she can be proud of. Having tasted success, other units, of greater sophistication and performance, will undoubtedly follow.

Buying Guide

Most of these items can be bought from electronic component stockists such as Cirkit (0992 444111) or Maplin (0702 552911) both of whose catalogues can be bought from larger newsagents. The latter is recommended for the case and the meter which cost £1.60 and £1.95 respectively. The total cost of the unit would be about £7, although you may be able to buy many of the components cheaper at amateur radio rallies.

Addendum

Power Meter Add-on For SSB Signals (November '85)

Unfortunately the company named as makers of this unit have not been in business for over a year. However, GW Morse Keys of Rhyl, are producing and selling it and all enquiries and orders should be made out to them. They can be contacted at 4 Owen Close, Rhyl, Clywd (phone 0745 54763).

We apologise for any inconvenience caused.

Get Down To Earth

A good earth system is the key to efficiency when using vertical quarter wave antennas on the LF bands. John Heys, G3BDQ, explains why and describes some effective systems.

Old-time gardeners were reputed to have owed their success in growing prize-winning fruits or vegetables to their use of 'muck and magic'. This is a simple formula which also seems to embrace the thinking of many radio amateurs when they contemplate the laying down of an earth system!

Confirmed UHF/VHF addicts need read no further (unless of course they wish to add to their knowledge of antenna matters) for their antennas are normally well above ground in terms of wavelength and tend not to use the earth as part of the radiating system. Return earth currents will only be of academic interest even to those HF band operators who use horizontal 'Hertzian' antennas such as resonant dipoles, long wires, multi-element yagi or 'driven' beams, or the humble centre fed multi-banders fed with open wire line. Such operators however may one day wish to operate on the LF bands (7, 3.5 and 1.8 MHz) for which a good earth system is the key to efficiency.

Every amateur radio station must, of course, have a sound earth connection; if only to 'tie down' the equipment and prevent that all too common 'hot chassis' effect — particularly bothersome when using random length end fed wires as antennas. A good earth connection will also reduce the clicks and bangs which often emanate from domestic electrical appliances like thermostats. It may also reduce or even eliminate TVI, BCI or other RFI problems. Should there be a lightning strike in your vicinity, a good earth may protect some of your equipment from destruction; though a direct strike generally means 'curtains' for almost everything, operator included, no matter how good the earthing may be.

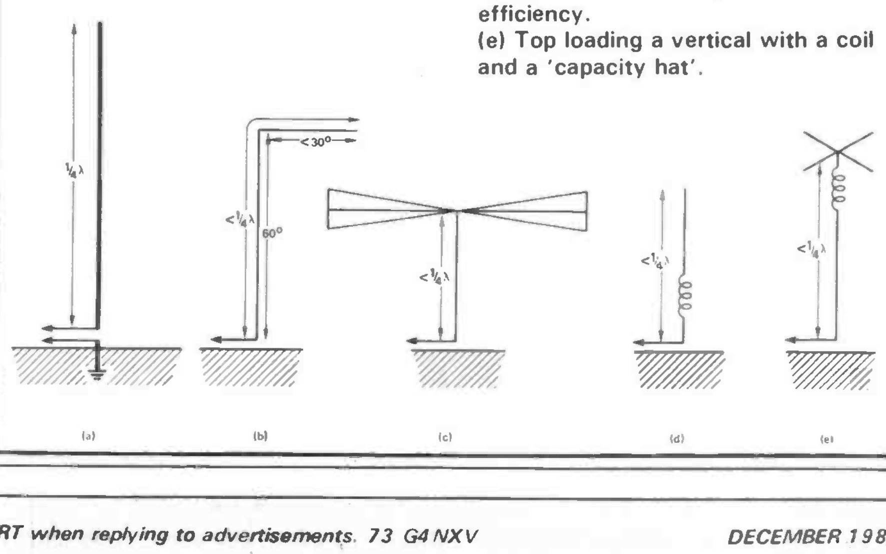
Marconi Antennas

A good low resistance 'ground' is essential for the satisfactory operation of Marconi type antennas. Some examples of the antennas within this category are illustrated in **Fig. 1**. Such antennas can be likened to a 'half dipole' where the missing dipole half is the earth. When operating, these antennas induce earth currents which return to the base of the antenna; the earth resistance limits these return RF currents so reducing radiating efficiency.

Marconi antennas include vertical quarter waves or similar shorter 'loaded' verticals, inverted 'L' types a quarter wavelength long or more and the inverted 'T'. They are all tuned to operate as resonant quarter wavelengths working against ground and they must have a good low resistance earth if they are to perform correctly. Although not strictly a Marconi type antenna even the once popular Windom or VS1AA antenna with a single wire feeder requires a good earth if it is to work well.

No one in their right minds would put up a half wave dipole which consisted of one normal leg made from copper wire with a low ohmic resistance and a second leg which was a length of thin high resistance conductor wire. Such a dipole would radiate just a small proportion of the power applied at its centre! This paradigm may help to illustrate the problem of earth or ground resistance which when high will bring down the effective transmitted power to very low levels. It has been estimated that a vertical quarter wave working against a very poor ground (such as

Fig. 1 (a) The basic quarter wave vertical antenna working against ground.
(b) A top loaded vertical about ¼ wavelength long arranged as an inverted 'L'. This type of antenna is very good when the total length is about ⅜ wavelength long.
(c) A 'T' antenna. The top loading sections are multi-wire to increase their capacity and there is virtually no radiation from them. The G5RV with feeders strapped is a 'T' antenna.
(d) Bottom loaded vertical. The coil's ohmic resistance brings down the efficiency.
(e) Top loading a vertical with a coil and a 'capacity hat'.



a single 3' earth rod) would only radiate 1 or 2% of the applied power!

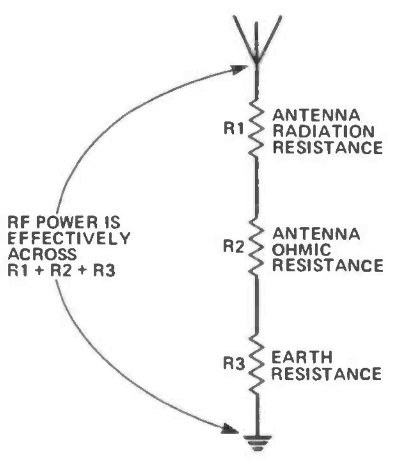
Earthing Equals Efficiency

A vertical quarter wave antenna or any other Marconi antenna system if tuned against *perfect* ground can perform with almost 100% efficiency. Such an earth system for the LF bands is beyond the reach of most amateurs but the judicious use of earthing plates, radials — buried or above ground — counterpoise wires or earth mats will allow radiation efficiencies in the order of 50-80%. Such efficiencies represent a loss of transmitted signal of 3dB or less which in real terms means half of one 'S' point. Prospective LF band users should therefore pay considerable attention to their earth systems.

Another all-important factor in the determination of radiation efficiency is the radiation resistance of the antenna. A full sized quarter wave vertical has a radiation resistance of around 36 ohms, but a short and top loaded 1/16 wave vertical will have a radiation resistance of only 5 ohms. Shorter loaded verticals will have even lower values of radiation resistance; for example, a top loaded 7 foot long antenna when used on 1.8MHz will have a radiation resistance of less than 0.3 ohms!

The radiation resistance is a critical factor if high efficiency is sought when using a Marconi type of antenna system, for this resistance, the actual ohmic resistance of the radiator and the ground resistance are all effectively in series (**Fig. 2**). For example, if the radiation resistance of a top loaded 1/10 wavelength vertical was 10 ohms and its ohmic resistance, including any loading coil, was 1 ohm; this together with an effective ground resistance of 1000 ohms would result in less than 1% of the applied RF power being radiated. Most of the power would be dissipated in heating up the soil surrounding the antenna!

Fig 2 The relationship between antenna radiation resistance, ohmic resistance and earth resistance. The aim is to have the radiation resistance much greater than the sum of the other two resistances.



To improve this antenna, the ground resistance must be greatly reduced. With effort and some expense it might be brought down to 5 ohms and this would raise the antenna efficiency to more than 60%. An increase in radiated power by a factor of 60 means an increase in signal strength of three 'S' points — the S2 signal becomes a readable S5!

Antenna Length and Radiation Resistance

It is more convenient to refer to antenna length in degrees rather than as fractions of a wavelength. A quarter wave antenna thus becomes a 90 degree antenna; 1/8 wave = 45 degrees; 1/20 wave = 18 degrees and so on. If antenna lengths in real linear terms are needed, it is quite easy to calculate such lengths using simple arithmetic. For example, a quarter wave (90 degrees) on 1.8MHz is about 126 feet so 1 degree represents a length of 1.4 feet.

The amateur who wants to put out a big signal on the LF bands has therefore to bring down his ground resistance to as low a value as possible and to use an antenna which has as high a radiation resistance as possible. 90 degree verticals are easily achievable on 7MHz; but on 3.5 and 1.8MHz they remain pipe dreams for most of us who have to get along with antenna supports no higher than 45 to 50 feet. Fortunately, even on 1.8MHz, where a 90 degree vertical is 126 feet long, it is still possible to top load much shorter verticals and still achieve a reasonable efficiency. Bottom loaded verticals must have a loading coil at the base which is where the maximum current and radiation is located — such coils have high ohmic resistance. Top loading often involves no more than having a top loading capacity and this contributes nothing to the ohmic resistance of the antenna. In this article therefore I shall disregard bottom loading designs although they are of course essential for mobile installations.

Assuming a *perfect* earth (show me one!) a top loaded, 36 degree vertical theroretically has an efficiency of about 60% of a 90 degree antenna. This represents a loss of only 2dB and it means that a 50 foot top loaded vertical antenna will give excellent results on top band. Even when the vertical section is brought down to 23 degrees, its efficiency only falls to 43% and will radiate signals just 3.6dB down on its big quarter wave brother! On the 1.8MHz band, a vertical just 32 feet long will be less than 1 S point down on the performance of a massive 126 footer.

Do not let yourself at this stage become over-excited by these figures for unfortunately they all relate to the use of the so called 'perfect' earth, and every earth the writer has come across has been far from perfect. The 23 degree antenna will have a radiation resistance of around 5.5 ohms, so a really low resistance ground system is vital for good performance. At this point it may be as well to remind readers that an efficient transmitting antenna is also an efficient antenna for receiving. On a good vertical it is possible to copy DX which simply does not seem to exist when using the proverbial 'bit of wire'.

Earth Resistance

It is difficult to dig out (sorry!) much information relating to earth resistance and its measurement but it is often much higher than we assume. An average moist loam (good garden soil) has a resistance of about 6000 ohms/cm^3. A metal plate having an area of 100 cm^2 in such soil will reduce this to about 60 ohms but only at a distance of 1cm from a similar plate. One metre away, the resistance rises to 6000 ohms again! It has been discovered by experiment (Messrs Doty, Trey and Mills, QST February 1983) that soil conductivity can vary by as much as 7.5:1 within less than 10 feet. Furthermore, there are considerable seasonal variations linked with changes in temperature and rainfall. It is just not good enough to rely upon Mother Earth to provide us with a ground system.

Sea water, of course, is not far removed from the 'perfect' earth and it is generally some 2500 times better than the soil found in city or town residential areas. Fresh water is only three times better than such soil and is surprisingly of little use as an earth. A stream running through your plot will do little to enhance your LF band signals, although having the water table near the surface of your garden will give you a better earth than that found by the unfortunate individual located up on chalk downs. Such an improvement is however at best just marginal.

So many of the amateurs that I meet say they have a good earthing arrangement. Further questioning however often reveals that they are using nothing more than a few earth rods hammered down four or five feet somewhere near the shack. This kind of earthing to be effective must present as great a surface area to the soil as possible. This would imply the use of large diameter rods — for a rod presents just one surface to the soil and a rod one inch in diameter five feet down will only have an effective surface area of about 180 sq. inches.

On the other hand an aluminium plate measuring 2ft x 2ft will have both of its faces touching the soil; each face having an area of 576 sq. inches! It is a good idea to invest in large metal (preferably aluminium) plates and arrange for them to be hammered down edgewise into your soil and all joined together with short thick wires. These wires connecting the plates must be of heavy gauge aluminium wire (sold by Tandy) and the use of aluminium nuts and bolts (as used for greenhouses) will limit electrolytic action and corrosion. Dissimilar metals in contact and in the presence of moisture and salts (as found in soil) will encourage electrolytic activity and actually make 'batteries' from earthing rods or plates.

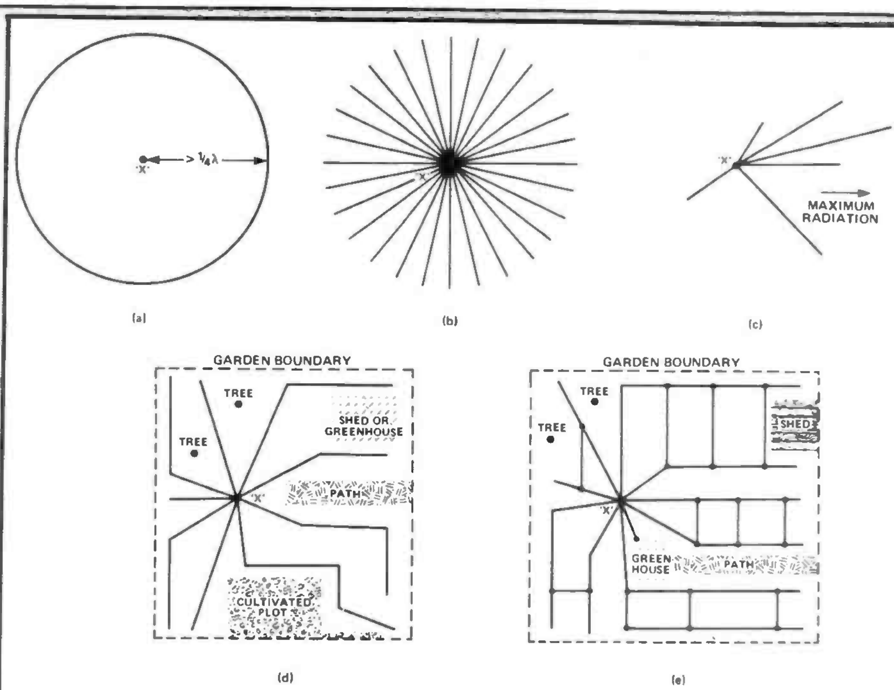


Fig. 3 (a) Plan view of a vertical antenna over a 'perfect' earth; in this instance a circular metal plate having a radius greater than ¼ wavelength.
(b) A 28 wire radial arrangement. If the radials are all longer than ¼ wavelength this would be an effective ground system.
(c) Six radials of differing lengths not equally spaced. This would result in a poor ground system and the maximum radiation in the direction of the most radial wires.
(d) A practical radial arrangement where the buried wires avoid garden plots, paths etc. This is a fair arrangement which would best be supplemented by a counterpoise running along and round the boundary of the garden.
(e) A similar arrangement but with the radials inter-connected in the form of a grid. This is a more effective system than (d).

Radials and Counterpoises

Buried radial wires which run out on or below the surface of the ground will help to reduce ground resistance. Such wires (Fig. 3) need not be cut to any particular length, but should preferably be longer than a ¼ wavelength and at least ⅛ wavelength long at the operating frequency.

They do not have to fan out radially, they can be arranged to fit into the available space. The writer has a long rectangular garden and his buried radials zig-zag around in many directions to avoid vegetable plots, paths and the like. Some were laid out on the ground before their 'burial' and had additional cross wires soldered to them making a kind of 'grid' or spider web arrangement. The edge of a spade is used to make slots just two or three inches deep for the wires. Insulated wires are the best for they retard corrosion and increase the effective life of the system. One authority has stated that when using vertical antennas between 22 and 90 degrees in length in conjunction with up to 15 buried wires, the ground resistance will lie between 5 and 30 ohms. Some fanatics have been known to have put down as many as 250 radials!

Counterpoise systems are very effective and are in fact better than buried radial wires, but they are difficult to set up in most urban situations. Who wants a garden festooned with a 'cat's cradle' of wires just three or four feet above the surface? Most amateurs certainly don't and their partners would probably walk out if such an arrangement was installed. A compromise but a less effective method involves the running of an assortment of wires all around one's property; by walls, hedges, fences etc. Such wires ought to be non-resonant at any frequency to be used and should all connect at the antenna base, from where additional stout earthing wire can be run back to the operating position. The problem which arises when similar wires are run into a hedge a few feet above the ground is avoiding them when the annual clipping season arrives. Twice this summer your's truly has had to run out his extended mains lead and solder up the ends of snipped counterpoise wires!

Earth Mats

It was amusing to read amongst several 'Specimen RAE Questions' recently, one relating to earth systems. One of the answers presented was that a good earth was ". . . . . an earth mat made from woven fibreglass". The use of the word 'mat' may mislead newcomers to the hobby — an earth mat is nothing more than a close mesh of conductor wires laid on the ground or buried just below the surface. The effectiveness of earth mats can be judged from the fact that all broadcast stations on LF employ huge mats made from thick copper conductors. These often cover acres of ground and can result in an almost 'perfect' earth.

Recently, G3BDQ has experimented with a small earth mat and by 'forking out' a few pounds for a roll of galvanised iron 'chicken wire' from the local DIY store has been able to discover the value or otherwise of this idea. The roll of 1.5 metre wide 10 metre long 1 inch mesh wire was laid on the lawn surface, after first giving the grass as close a cut as possible in this area. It was pegged down with home-brew 'U' shaped galvanised wires which were bent like the old-time hairpins. Four stout copper connecting wires were soldered at four points along one end of the mat as shown in **Fig. 4** and these were connected to the chief earth point adjacent to the foot of the vertical section of the antenna. By keeping the petrol mower (rotary) away from the mat area for a few weeks there was no damage to earth mat, lawn or mower when the first 'cut' was made. Two months later the mat had vanished! Eventually worm action will actually bury the earth mat. (Archaeologists use worm burial depths as a measure in calculating the age of dug up ancient artifacts.)

The earth mat has seemingly improved the antenna system and before the end of the grass growing season at least two more rolls of 'chicken wire' will be added to run away from the antenna base in different directions. If only one direction of 'run' is used for radials, earth mats or whatever, the maximum radiation will tend to be along the direction of such ground wires. This may sometimes be an advantage, but for all-round DX work an earth system must go out in all directions.

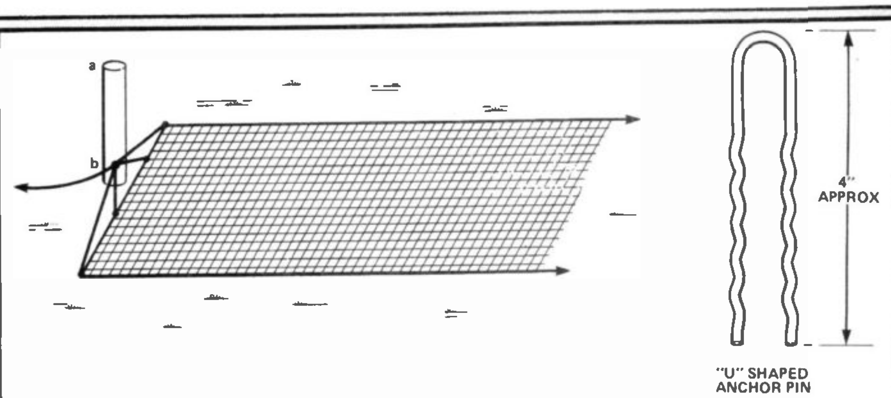


Fig. 4 A practical earth mat made with 'chicken wire'. Four stout wires connect the mat to point B on the earth post A. All the other station radials etc. would also connect to the earth post. The 'U' shaped anchor pins are made from 2mm galvanised iron wire and can be hammered in around the edges of the earth mat every foot or so. Some may also be used within the area of the mat. Such earth mats 'vanish' very quickly when laid on grass.

Multi-band Trapped Verticals

Antennas needing a good low resistance earth system have already been listed, and to this list must be added the commercially made trapped verticals. Without a really low resistance ground arrangement, such antennas perform miserably even when a quarter wave radials are set out. This may be the reason why similar antennas have gained such a poor reputation and why so many are offered second hand in the amateur magazines.

The writer has an 18AVT five band trapped vertical as a second or 'stand-by' antenna. Although it is badly screened by houses some twenty feet away and only positioned a foot or so above ground, its performance is only 1 to 2 S points down on the big 50 foot top loaded vertical main station antenna. This is due entirely to its being connected to the station ground system which is very extensive. Even with the best ground system, however, these antennas have a narrow bandwidth on 7 and especially 3.5MHz where only about 20kHz is really usable.

DX Working on LF

When arranging for a good earth system, one can never attain the ultimate and the addition of more and more buried or elevated wires will always improve things. Some of the top DX'ers on 1.8MHz have enormous ground systems. A swedish amateur uses 26km in total of buried radials and in the USA some amateurs can better this! A Californian station worked on 160 metres states on his QSL card that he has more than 30 miles of earth wires! There will be the factor of diminishing returns and it is doubtful whether signal levels from a station with 3 miles of radials would become noticeably stronger were he to double the extent of his earthing arrangements. Perhaps it might be better to rent or buy an old 'tub' and anchor the station a mile or so out to sea!

Wherever you may live and however small your garden plot seems to be, your earthing arrangements can be improved. The low angles of radiation needed for long distance communication on the LF bands can only be realised by the use of vertically polarised radiation from a Marconi type antenna — unless of course you happen to have a few 200 foot masts available to allow you to string up some top band dipoles! DX *has* been worked with dipoles only 50 feet above ground but at this height (lower than ⅛ wavelength) much of the power is being radiated almost vertically.

RADIO Tomorrow

Your at-a-glance guide to what's happening around the clubs, on the air and in general radio-wise.

1 Nov	W Kent ARS: club expedition video and slide show. Coventry ARS: film show. Radio Society of Harrow: *Astronomy for Amateurs by G4ZES.* Clifton ARS: club meeting. Maltby ARS: amateur radio open forum. Maidstone YMCA Sportscentre ARS: natter night. Ayr Amateur Radio Group: At home to visitors. The meeting place is Wellington Leisure Centre, Wellington Square, Ayr.
4 Nov	Horndean DARC: *Constructional Techniques by G4JXO.* Basingstoke ARC: Constructors Competition. Alyn and Deeside ARS: Bonfire and Bar-be-cue d & w. Braintree DARS: informal. Worcester DARC: *AMSAT by G4BBR.* Chester DRS: Quiz at Ellesmere Port Club. Derwentside ARC: meets every Monday at Consett Association Football Club, Bellevue Park, Consett starting at 7.30pm. Welwyn Hatfield ARC: informal night workshop. Southdown ARS: *Weather Satellites by G8FCD.* Todmorden DARS: *BT Talk.* Morecambe Bay ARS: Morse Class.
5 Nov	E Lancashire ARC: home construction night. Dartford Heath DFC: pre hunt meeting. Bury RS: informal. Chichester DARC: club meeting. Wolverhampton ARS: natter night and night on the air. Rugby ATS: Fireworks and bar-be-cue.
6 Nov	Wirral ARS: Chairman's night. Exmouth ARC: meeting. Fareham DARC: *Circular Polarisation for VHF/UHF by G6XHB.* Telford DARS: *Microwaves by G8MWR.* Mirfield RC: meets every Wednesday at the Community Centre, Yockleton Rd, Birmingham. White Rose ARS: natter night.
7 Nov	Preston ARS: *Trains by Anthony Stevenson.* Meirion ARS: *'Eye of the Wind' Maritime venture by Rod James of Fairbourne.* Shefford DARS: *UOSAT update by G4PSO.* Abergavenny and Nevill Hall ARC: meets every Thursday. Pontefract DARS: Computer evening.
8 Nov	Bromsgrove DARC: meeting. Coventry ARS: sausage and mash supper. Radio Society of Harrow: activity night on top band. Clifton ARS: club meeting. Dunstable Downs RC: *Receiver Design by G3OSS.* Maltby ARS: *Smoke Detectors by G4BVV.* Maidstone YMCA Sportscentre ARS: *Conversion of CB rigs to 10m by G4XRH.*
10 Nov	Dartford Heath DFC: DF hunt.
11 Nov	Morecambe Bay ARS: *RTTY Mailbox by G1GRP. The club meets in the Cauken Luneside Engineering Company, Mill Lane, Halton near Lancaster at 7.30pm.*
12 Nov	Reading DARC: *Smith Charts and the Radio Amateur by G3RZP.* Worksop ARS: *Ham Radio in the early days by G3AUZ.* Bury RS: Bert Donn, G3XSN, regional rep of RSGB. Dorking DRS: informal, at Star and Garter Hotel. Chester DRS: *Radio Astronomy by Dr Spencer from Jodrell Bank.* Wolverhampton ARS: discussion night.
13 Nov	Three Counties ARC: *Victorian Micro Waves by Badger, G3SSI.* Fareham DARC: natter night on the air. Farnborough DRS: AGM. Telford DARS: *Medium wave DXing by G6PZZ.* White Rose ARS: *Technical Topics for Beginners G3TDZ.*
14 Nov	Shefford DARS: *Static — The Shocking Truth, G6RHL.* Pontefract DARS: 2m antenna project.
15 Nov	Radio Society of Harrow: *BBC World Service by a Spokesman.* Clifton ARS: club meeting. Maltby ARS: Three in a row — lectures. Maidstone YMCA Sportscentre ARS: natter night. Ayr ARG: *Computer Use by GM4HCO.*
16 Nov	Crawley ARC: junk sale/bring and buy.
18 Nov	Alyn and Deeside ARS: D and W. Welwyn Hatfield ARC: projects evening. Todmorden DARS: chat night. Morecambe Bay ARS: morse class. Braintree DARS: junk sale.
19 Nov	Midland ARS: surplus sale. Chester DRS: *RAYNET and CARES.*

Wolverhampton ARS: *Aerial Circus and Secret Listeners videos.*
Biggin Hill ARC: *The work of the RIS.*
Bury RS: informal.

20 Nov Wirral ARS: debate.
Exmouth ARC: meeting.
Fareham DARC: *A Commercial Receiver by G4ITF.*
Worcester DARC: informal.
Kingston DARS: meeting at 3 Berrylands Road, Surbiton.
Telford DARS: *Sweden by G3IMP and activity night — project 90 by G6XUF.*
White Rose ARS: natter night.

21 Nov Preston ARS: *Motor Sport by G4PLB.*
Shefford DARS: natter night.
Chichester DARC: meeting.

22 Nov Radio Society of Harrow: activity night.
Clifton ARS: club meeting.
Maltby ARS: video.
Maidstone YMCA Sportscentre ARS: junk sale.
Pontefract DARS: Celidh and supper.

24 Nov Wolverhampton ARS: 144MHz DF hunt.
Carmarthen ARS: rally at St Peter's Civic Hall, Nott Square, Carmarthen 10.30 till 5.00pm. Usual trade and specialist stands. Talk in on S22. Free parking. Further details: GW3GUE. 026 783 460.

25 Nov Morecambe Bay ARS: *RTTY.*

26 Nov E Lancashire ARC: informal.
Reading DARC: constructional contest.
Worksop ARS: memorial cup night.
Chester DRS: meeting.
Wolverhampton ARS: night on the air.
Bury RS: informal.
Dorking DRS: junk sale.
Verulam ARS: *Digital Filters by G8FUL.*

27 Nov Three Counties ARC: *Amateur Radio Awards by Mike Matthews G3JFF.*
Fareham DARC: natter night on the air.
Farnborough DRS: Chairman's evening.
White Rose ARS: *W5LFL Shuttle Mission video.*

28 Nov Greater Peterborough ARC: *Electromagnetic compatibility by G3HCQ.*
Shefford DARS: *Software Protection by G8PTP.*

29 Nov W Kent ARS: meeting.
Radio Society of Harrow: junk sale.
Clifton ARS: club meeting.
Maltby ARS: *Meteor Scatter by G6OYL.*
Maidstone YMCA Sportscentre ARS: natter night.
Ayr ARG: *Fables and Fancies GM4RSJ.*

2 Dec Basingstoke ARC: Christmas Social.
Alyn and Deeside ARS: D and W.
Worcester DARC: *Resonance by G3LBS.*
Derwentside ARC: meets every Monday from 7.30pm at the Consett Association Football Club, Bellevue Park, Consett.
Welwyn Hatfield ARC: AGM.
Southdown ARS: *Proposed ATV repeater for E Sussex.*
Todmorden DARS: Christmas Social.
Morecambe Bay ARS: morse class.
Braintree DARS: informal.

3 Dec E Lancashire ARC: AGM.
Dartford Heath DFC: pre hunt meeting.
Chichester DARC: meeting.
Bury RS: informal.
Wolverhampton ARS: junk and surplus sale.

Rugby ATS: *Leicestershire Repeater Group talk.*

4 Dec Wirral ARS: Christmas party.
Exmouth ARC: meeting.
Fareham DARC: *Video and Electronics by G4XJF.*
Telford DARS: natter night.
White Rose ARS: junk sale.

5 Dec Preston ARS: *Talk by G3KCC.*
Meirion ARS: Christmas dinner at the Dolserau Hall Hotel, Dolgellau.
Shefford DARS: junk sale.
Abergavenny and Nevill Hall ARC: meets every Thursday.

6 Dec W Kent ARS: club annual dinner.
Radio Society of Harrow: activity night on 80m.
Maltby ARS: computer night.
Maidstone YMCA Sportscentre ARS: construction contest.
Clifton ARS: meeting.

7 Dec Three Counties ARC: Christmas party.

8 Dec Dartford Heath DFC: DF hunt.

9 Dec Morecambe Bay ARS: Visit to police Wireless Workshop at Hutton.

10 Dec Chester DRS: construction contest.
Reading DARC: AGM.
Dorking DRS: informal.
Worksop ARS: club quiz night.
Bury RS: AGM.
Wolverhampton ARS: committee meeting.

11 Dec Three Counties ARC: quiz night.
Fareham DARC: natter night on the air.
Farnborough DRS: Christmas social.
Telford DARS: Club Project — Building a GDO.
White Rose ARS: AFS briefing.

12 Dec Shefford DARS: constructor's contest.
Greater Peterborough ARC: social evening venue to be announced.

13 Dec W Kent ARS: meeting.
Radio Society of Harrow: *Radio and Computing.*

Maltby ARS: Christmas junk sale.
Maidstone YMCA Sportscentre ARS: natter night.
Ayr ARG: RSGB video films.
Clifton ARS: meeting.

16 Dec Alyn and Deeside ARS: Christmas party.
Welwyn Hatfield ARC: informal/workshop night.
Todmorden DARS: chat night.
Morecambe Bay ARS: hot pot supper.
Braintree DARS: Christmas party.

17 Dec Chester DRS: Christmas party.
Dartford Heath DFC: EGM.
Reading DARC: Christmas social evening.
Biggin Hill ARC: junk sale.
Bury RS: informal.
Wolverhampton ARS: social evening.
Rugby ATS: Christmas meeting.

18 Dec Wirral ARS: no meeting.
Hastings ERC: Christmas social.
Exmouth ARC: meeting.
Fareham DARC: *The GDO and its Use by G4ITF.*
Kingston DARS: meeting at Alfriston, 3 Berrylands Rd, Surbiton.
Telford DARS: club project.
White Rose ARS: natter night.

19 Dec Shefford DRS: social evening.
Chichester DARC: Annual Christmas social evening.

20 Dec Worksop ARS: Christmas disco.
Radio Society of Harrow: Grand Christmas social.
Maltby ARS: social.
Telford DARS: Christmas social.
Maidstone YMCA Sportscentre ARS: social evening.
Clifton ARS: meeting.

28 Dec Shefford DARS: Chairman's social evening and presentation of awards.

Will club secretaries please note that the deadline for the February segment of Radio Tomorrow (covering radio activities from 1st January 1986 to 1st March 1986) is 23rd November.

Contacts

Abergavenny & NH ARC	GW4XQH	0873 4655
Alyn and Deeside ARS	GW4RKX	0244 660066
Axe Vale ARC	Bob	029 74 5282
Ayr ARG	GM3THI	Ayr 42313
Barking RES	R. Woodberry	01 594 4009
Bath DARC	G4UMN	Frome 63939
Basingstoke ARC	Dave	07356 5185
Biggin Hill ARC	G0AMP	0689 57848
Braintree RS	G6CJA	0376 45058
Brighton DARS	Peter	0273 607737
Bristol ARC	G4YOC	Bitton 4116
Bury RS	G1PKO	061 764 5018
Cambridge DARC	D. Wilcox	0954 50597
Cheshunt DARC	Roger Frisby	0992 464795
Chester DRS	Alan	0244 40055
Chichester DARC	C. Bryan	0243 789587
Clifton ARS	RA Hinton	01 301 1864
Coventry ARS	R. Tew	0203 73999
Dartford Heath DFC	Pete	0322 84467
Denby Dale DARS	G3SDY	0484 602905
Derwentside ARC	G1AAJ	0207 520477
Donegal ARC	EI3BOB	074 57155
Droitwich DARC	G4HFP	0299 33818
Dudley ARC	John	0384 278300
Dunstable Downs RC	Phill Morris	0582 607623
East Kent RS	Stuart	0227 68913
East Lancashire ARC	Stuart	0254 887385
Edgware DARS	John	01 306 4342
Exeter ARS	Roger Tipper	0392 68065
Fareham DARC	Brian	0329 234904
Farnborough DRS	Mr Taylor	0252 837581
Fylde RS	PRO	0253 737680
Galashiels DARS	GM3DAR	0896 56027
G. Peterborough ARC	Frank	0733 231848
Halifax DARS	D Moss	0422 202306
Harrow RS	Dave Atkins	0923 779942
Hastings ERC	Dave Shirley	0424 420608
Haverhill DARS	Rob Proctor	0787 281359
Hornsea ARC	Norman	0262 73635
Horsham ARC	Pete Head	0403 64580
Inverness ARC	Brian	0463 242463
Kidderminster DARS	Tony	0562 751584
Kingston DARS	G3ODH	Epsom 26005
Leighton Linslade RC	Pete Brazier	052 523 270
Loughborough ARC	Philip	0509 412043
Loughton DARS	G6FWT	01-508 7190
Maidenhead DARC	John	0628 28463
Maidstone YMCA S/C ARS	G4AYD	0622 29462
Maltby ARS	Ian Abel	0709 814911
Medway ARTS	Tony	0634 363960
Midland ARS	G8BHE	021382 0086
Mid Sussex ARS	G1FRF	0791 82937
Mid Ulster ARC	DF Campbell	0762 42620
Mid Warwickshire ARS	G4TIL	Southam 4765
Morecambe Bay ARS	G3PER	Heysham 52659
N. Cornwall RS	J. West	0288 4916
N. Staffs ARS	G6MLI	0782 332657
N. Wakefield RC	S. Thompson	0532 536633
Newbury DARS	G3VOW	0635 43048
Oswestry DARC	Brian	0691 831023
Pontefract DARS	G0AAO	0977 43101
Preston ARS	George	0772 718175
Reading DARC	Chris	Reading 471761
Rhyl DARC	GW1AKT	Nantglyn 469
Shefford DRS	G4PSO	Hitchin 57946
S. Bristol ARS	Len Baker	0272 834282
S. Lakeland ARS	Dave	0229 54982
S. Manchester ARC	Dave Holland	061 973 1837
Southdown ARS	P. Henly	0323 763123
Stockton DARS	John Walker	0642 582578
Stowmarket DARS	M. Goodrum	0449 676288
St. Helens DARC	A. Riley	051 430 9227
Swale ARC	B. Hancock	0795 873147
Telford DARS	Tom Crosbie	0952 597506
Three Counties ARC	R. Hodgson	0428 77368
Tiverton (SW) RC	G. Draper	03634 235
Todmorden DARS	Mr Gamble	070 681 2494
V White Horse ARS	Ian White	Abingdon 31559
Verulam ARC	Secretary	St Albans 59318
WACRAL	G5NPM	0795 873147
Wakefield DRS	G8PBE	0924 378727
Welland Valley ARS	J. Day	0858 32109
Welwyn Hatfield ARC	Dave	07073 26138
West Kent ARS	B. Guinnessy	0892 32877
Westmorland RS	G. Chapman	0539 28491
White Rose ARS	G4YEK	0423 884481
Willenhall ARS	G4LWI	0902 782036
Wirral ARS	Cedric	051 625 7311
Wirral DARC	Gerry Scott	051 630 1393
Wolverhampton ARS	Keith	0902 24870
Worcester DARC	D. Batchelor	0905 641733
Worthing DARC	Roy	0903 208752
308 ARC (Surbiton)	Dave Davis	01 399 5487

Have Fun On Fone!

To win the HRT/Verulam 2m/160m phone contest, you need brains not QRO. There are suitable prizes to be won and fun to be had, says G3ZZD.

If you are a regular reader of HRT, you may have seen details of our 'Straight Key Evening' that took place back in May. We promised then we would sponsor a phone contest along similar lines, with operation skill rather than brute force the essential commodity, and plenty of fun to be had by all.

For the DX or contest phone operator seeking the maximum amount of 'punch' and readability from their signal, the use of some form of speech processing device has become almost essential. These fall into two categories: RF or AF processing, referring to whether the processing is carried out at the same (voices) frequencies (AF) or at a higher frequency (RF). Without going into the complexities — well covered in an article by Richard Lamont, G4DYA, in September '83 HRT — both have 'fors' and 'againsts'.

Processed 'P's and 'Q's?

RF processing in general requires a good quality crystal filter in the processor and reasonably complex circuitry and, in consequence, is expensive in comparison with AF processing. AF processors, often using a single VOGAD (voice operated gain adjusting device), are easy to build but are often poorly adjusted and used partly because of their apparent simplicity. The possible improvement in signal strength and 'talk power' with AF processing is less than with the RF type and increased signal strength is often at the expense of readability. Most of us active on the air have had at least one embarrassing contact when the other station proudly puts their new AF processor in circuit and promptly disappears in a welter of distortion!

In the last year, a new processing device has come onto the market from Heil, the company formed by American professional

sound engineer Bob Heil, K9EID, who has been sound manager for such diverse people as Billy Graham and The Who.

The Heil Theory

Heil and his engineers reportedly spent two years analysing SSB signals on the 160, 80, 40 and 20m bands, with audio spectrum analysing equipment. According to an article in *'Radiosporting'* magazine by Bob Heil in April, they discovered that "almost 70% of SSB signals on the air today have very little, if any, audio response above 1800Hz. Most of these have a huge peak of +10 to 12dB at 500Hz and lower that ends up giving an audio response with a slight rise at the top for that added punch and clarity so vital to cutting through pileups".

THE HRT/VERULAM "CLUBS" CONTEST 1985 RULES.

WHEN:

Section 1: 2000gmt-0000gmt Saturday 16th November, 1985.
Section 2: 0900gmt-1300gmt Sunday 24th November, 1985.

ELIGIBLE ENTRANTS:

The contest is open to all licensed amateurs and short wave listeners. Portable, mobile and fixed stations may take part.

CONTACTS:

SSB, AM or CW.
Section 1: 1900-1990 kHz.
Section 2: 144.150-144.400 MHz.
Exchange: RS, serial number (commencing 001), name of your club (if any)* and "club station"(only if you are operating with the Club's callsign.)
* Members of more than one club should use the name of one club throughout. A club name should be as brief as possible — eg Ainsdale, not Ainsdale and District Radio Society.

SCORING:

3 points per contact.
A bonus of 5 points for the first member worked from each new club.
A bonus of 50 points for contact with the Verulam Club Station G3VER.
A bonus of 25 points for any station using their club callsign.

LOGS:

Logs must include GMT, callsign of station worked, RS/serial number sent, RS/serial number received, club name received, (if any), bonus (eg 5, 25, or 50), and points claimed (eg 3).

Heil believes that conventional audio processors "do very little to that frequency response curve" and add distortion because many produce very high outputs which over-load the microphone preamps of SSB transceivers. His response was to produce a 'microphone equaliser', the Heil EQ300 based upon studio engineering techniques, that could be adjusted with a variety of microphones and transceivers, to give the ideal response mentioned above.

Heil thought that not only was talk power being lost through poor use of audio bandwidth — most SSB transceiver filters are at least 21kHz wide — and poor audio quality, but that good audio quality could sometimes beat sheer brute RF power in a pile up. In the article in 'Radiosporting', Heil details how an EQ300 equalised 100W competed and even beat a 2kW unequalised station in DX pileups, from side by side locations and identical antennas. When one DX station was asked why he answered the equalised station first, he is reported to have replied "I could understand what you said better than any other signal on the frequency."

The Prizes

Whetted your appetite to try one? If you'd like to go along to Amcomm Services in Northolt Road, South Harrow, UK importer of Heil products, they'll be delighted to show the Heil EQ300 off to you. Like the idea, but are short of cash? You can always win one in our contest!

We thought that offering some 'hifi' quality accessories would be a nice touch in a fone contest and the Heil equipment seemed mouth-watering and eminently suitable to the editor. Thanks to the generosity of Alec, G5VS, owner of Amcomm Services, we not only have an EQ300 microphone equaliser to give away to the winner of the 2m section but a superb Heil HM5 desk microphone worth £60 for the winner of the 160m section — you, too, can sound like Alvar Liddell.

Anyone sending in an entry to the address below will be eligible for a prize draw for the Rolls Royce of hand microphones, the Heil MM5, worth £37.

Whether you're a club station or single operator station, you can enter the contest. If you're the former, when participating in the contest you should indicate this (see the rules) for you are worth 25 points to other stations. This is where brains not brawn comes in — club stations are worth five times the points of a single operator and well worth the time spent seeking them out!

We are not excluding SWL members from all this generosity either. The winning entrant will receive a memento bundle of goodies from the HRT offices.

Read the rules nearby carefully and we hope to see you on the air. Good luck!

ENTRIES:

It would be appreciated if entrants could use standard RSGB contest logsheets, but any similar format will be acceptable. Each entry must contain a cover sheet stating the station address, the entrants address (if different), equipment used, and a signed declaration that the rules and spirit of the contest and the terms of the entrants licence conditions were observed.

Entries should be addressed to:

Mrs H. Claytonsmith, G4JKS.
115 Marshalwick Lane,
St. Albans,
Herts., AL1 4UU.
Tel. St Albans (0727) 59318.

and postmarked not later than 9th December, together with an SAE if results required by post.

SWL ENTRIES:

Scoring will be the same as for the transmitting section, but the following differences should be noted:

a. Only contacts made by stations taking part in the transmitting sections of the contest will count for points.

b. Logs must include GMT, callsign of station heard, report, serial number and club name sent by station heard, callsign of station being worked and points claimed. A particular station must only appear once in the "station heard" column.

AWARDS:

Specially endorsed certificates in addition to the aforesaid prizes (see nearby) will be awarded to the top 3 individual entries, and to the leading club station entry in each contest section. There will also be a certificate for the leading Verulam contestant.

A Cheap 25' Telescopic Wooden Tower

Bottom Section

1. Clamp together two 12' lengths of timber (strings) and measuring every 6" from the bottom along a centre line, drill a ¼" hole through both pieces of timber. Remember that the holes must be kept in line to accept the 23 dowel rods.
2. Lay the two timbers parallel on the ground ensuring they are approximately 5 ⅝" apart. Insert, screw and glue the top and bottom ¼" dowels. Measuring 19" from the bottom, screw and glue the first 5 ⅝" spacer into position on the face of the timbers. Measure from the top of this spacer a further 19" and screw and glue the next spacer into position. Repeat for the remaining four spacers.
3. Insert, screw and glue the remaining 21 dowels.
4. Make the steel or aluminium guides for the head of the bottom section as shown in insets A or B. These should then be screwed to the head as per the plan view (inset C).
5. Measure 2'9" down from the head and drill a ¼" hole through each timber in line with each other. This is to take the 7" by ¼" dia threaded steel rod which is the support for the top (extending) section. Insert the rod and secure with washers and nuts.

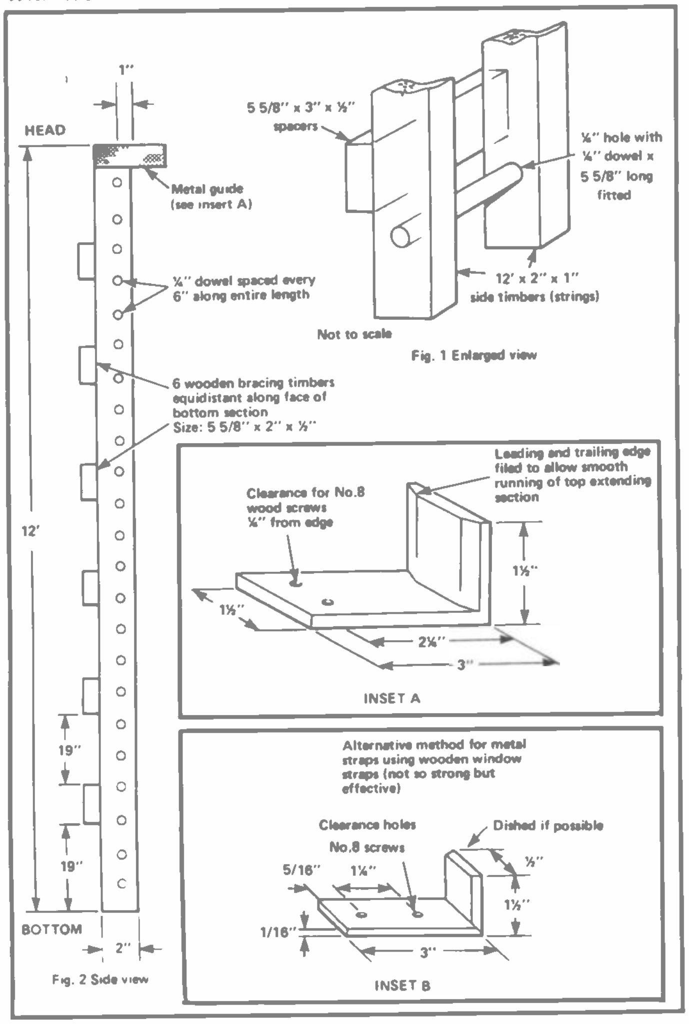


Fig. 2 Side view

Fig. 1 Enlarged view

INSET A

INSET B

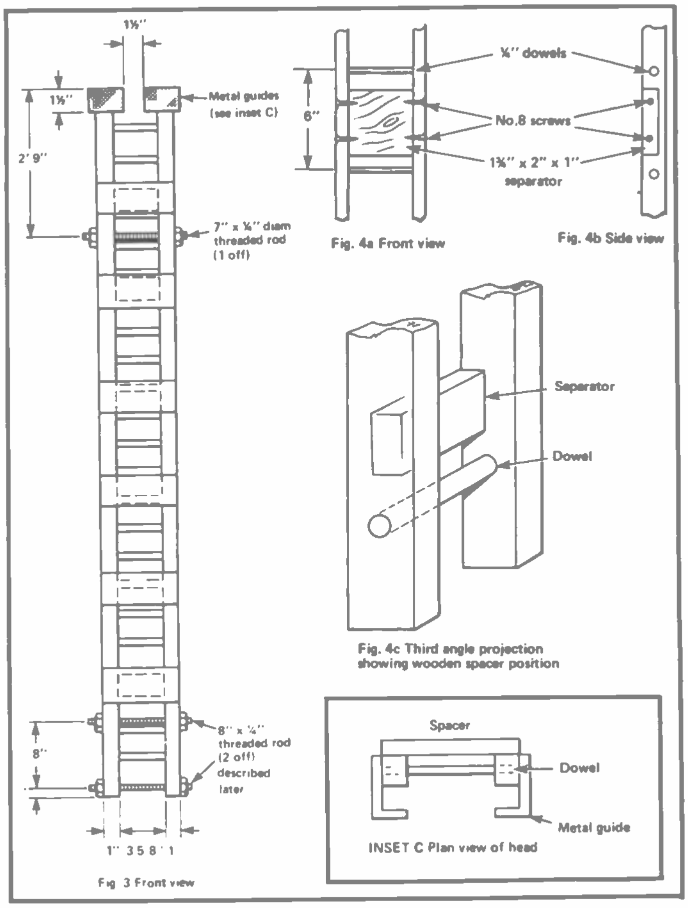


Fig 3 Front view

Fig. 4a Front view

Fig. 4b Side view

Fig. 4c Third angle projection showing wooden spacer position

INSET C Plan view of head

Top Section

1. Repeat instruction 1 above.
2. Insert, screw and glue all 23 dowels.
3. Taking two 1 ¾" separators, place them below the first dowel. Glue and screw into position. Note that unlike the bottom section (where the spacers are fixed to the face of the timbers) the separators go between the timbers.
4. Taking three more separators insert them above the top most dowel. Glue and screw into position (the top one will protrude about ⅛"). These are for securing the wooden pole to the structure, which will be fitted after fitting the two sections together.
5. Insert and fix on separator 6' from the bottom and the remaining two 3' either side of this centre one.
6. Construct the metal shoe as in insets D or E and secure it to the two separators at the bottom.

Putting It Together

1. Place the head of the top section through the metal guides at the head of the bottom section, ensuring that the metal support shoe is the correct way round (see Fig.5).
2. Screw a wooden pole between 5' and 8' long to the head of the top section.
3. Screw an eyelet at the top of the pole for your aerial wire and thread a pulley rope so that the aerial can be raised when the tower is erected.

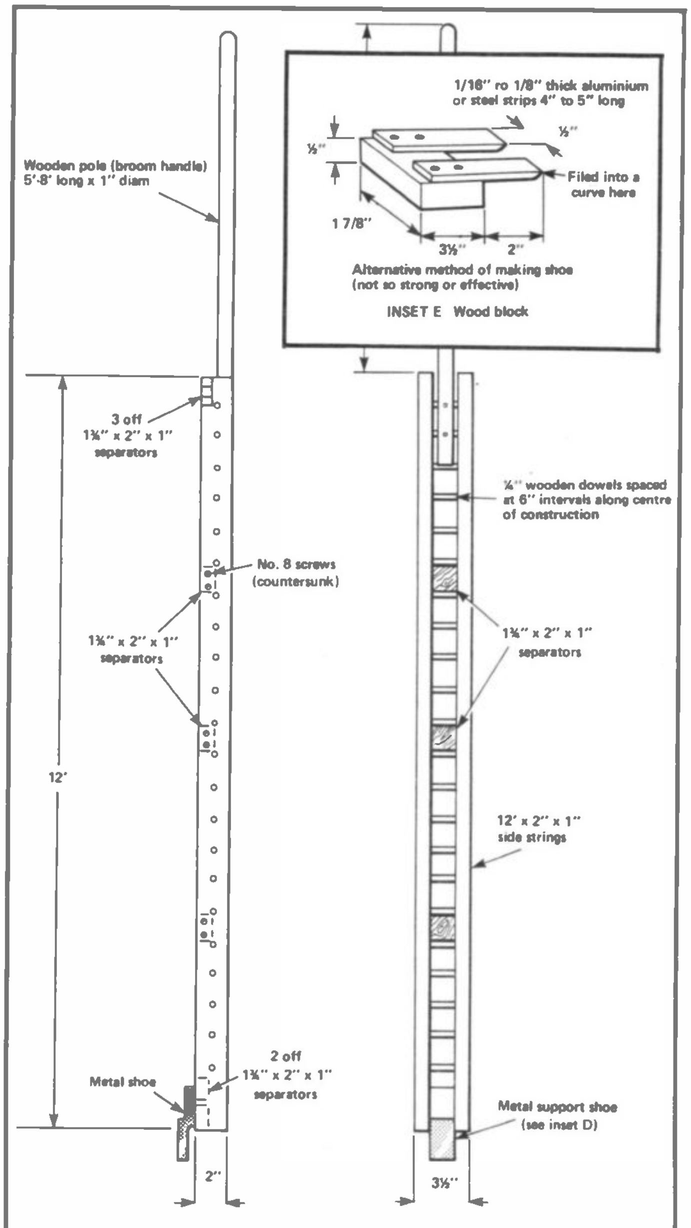
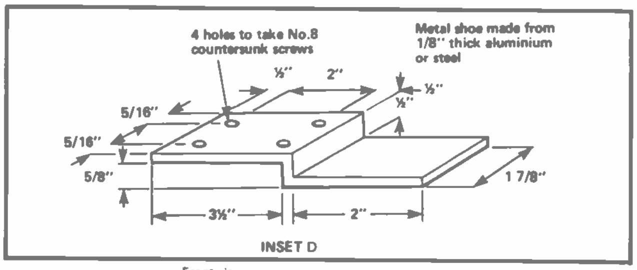


Fig. 5 Side view

Fig. 6 Front view



INSET D

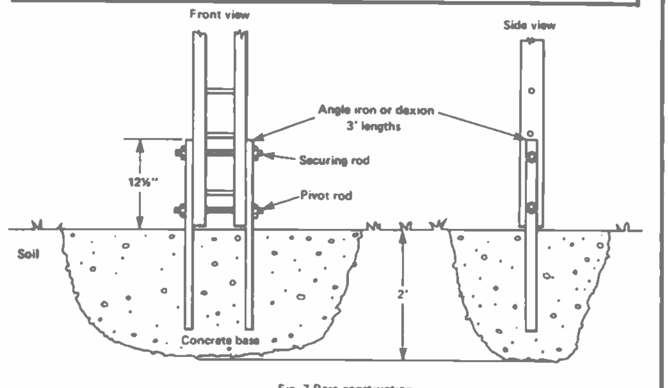


Fig. 7 Base construction

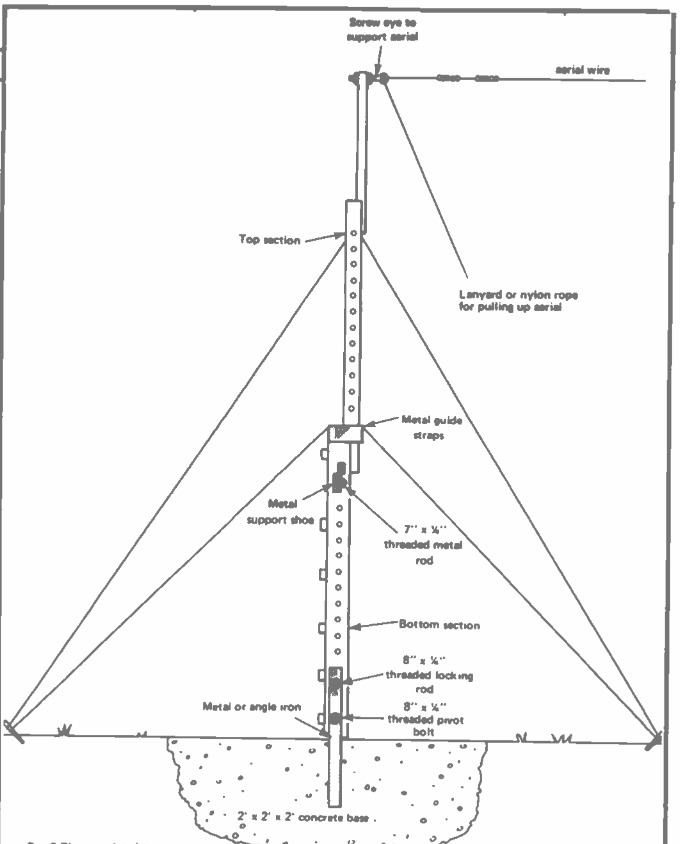


Fig 8 The completed tower

Erecting The Tower

1. Taking two 3' angle iron, drill ¼" holes 2" and 10" from the top. The bottom hole will be the pivotal point, the top is for securing to the vertical position. The pieces should be firmly set 5⅝" apart into a 2' concrete base, ensuring that 12½" is protruding.
2. Drill a ¼" hole 2" from the bottom in both timbers, then measure exactly 10" up and drill two more holes. Note these holes must coincide with those in the angle iron!
3. After allowing time for the concrete to set, with the angle iron in position, place the tower between the irons and insert the pivot rod into position. Raise the tower into vertical position and insert the securing rod. Don't forget to secure the guy ropes.
4. Raise the aerial and good DXing.

PARTS LIST

TIMBER all available from builders merchants.
4 off 12' × 2" × 1" strings
6 off 5⅝" 3" × ½" spacers
8 off 1¾" × 2" × 1" separators
23 off 5⅝" long × ¼" dia dowel rod
23 off 3⅝" long × ¼" dia dowel rod

SCREWED ROD available from model engineers suppliers.
1 off 7" long × ¼" dia Whit, BSF, or 6 mm
2 off 8" long × ¼" dia Whit, BSF, or 6 mm
8 nuts 8 washers

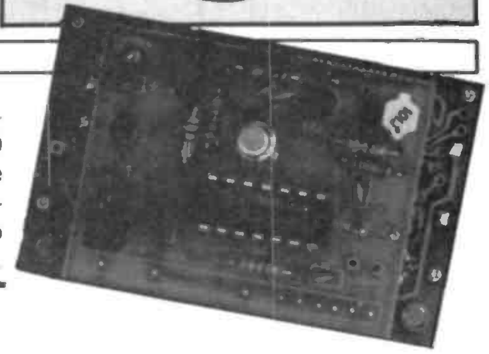
STEEL OR ALUMINIUM PIECES available from scrap metal merchants.
2 off 3 ft long 1/16" or ⅛" thick angle iron or dexion frame
1 off 1½" wide × 1/16" thick aluminium or steel for shoe
2 off 1½" wide 1/16" or ⅛" thick aluminium or steel for 'L' shaped guide straps
Pieces of tin or aluminium for timber end grain protection.

WOOD SCREWS
Approximately 3½ dozen 1½" long counter-sunk No.8 screws (plated steel preferably or brass).

MISCELLANEOUS
guy ropes (nylon clothes line); halyard (thin nylon rope); large screwed eyelet; wood glue and wood preservative.

Meet the MICRON!

Part 5



MICRON DISPLAY

The Micron Display kit is purpose designed to enable the basic Micron transceiver to be converted to having a full frequency LCD digital readout (display to 1kHz) on all bands. This may also be used with any direct conversion receiver or transmitter where the VFO or xtal frequency is at signal frequency. It requires approximately 50mV of RF drive and contains its own regulator and signal conditioning circuits. The display mounts on the front panel of the Micron case, just above the main tuning knob.

In part 5 Tony Bailey, G3WPO, and Frank Ogden, G4JST, describe this six band, CW rig's display and SWR/power metering and offer an ATU design not only for Micron, but for any QRP rig — matching most unbalanced antennas to 50 ohms.

How It Works

Signals from one of the Micron VCO buffer stages are further buffered by Q1, a J-FET, and passed to Q2 (2N2369A). This stage amplifies and raises the voltage level of the incoming signal to a level suitable for driving IC1, a 74LS90 divide-by-ten IC.

The need to do this division is caused by the FC177 digital display module, a complete frequency counter in its own right, having a maximum upper frequency limit of 4MHz. Although 160 and 80m frequencies could be displayed with this unit to a resolution of 100Hz, we also require to display frequencies up to 29MHz. Thus, after division by 10, the maximum frequency presented to the module is 2.9MHz, well inside its limit. This enables the display to show the frequency to a resolution of 1kHz.

IC2 provides a regulated 5V supply for all stages of the circuit from the incoming +12 to 14V supply of the Micron.

Construction

The method of construction for this module is similar to that of the main Micron board, except that the board is single sided. All components mount on the side screened with component positions. *Note that you should keep at least 9 pieces of the leads cut off of resistor ends after soldering — these will be required to attach the display to this PCB.*

1. Insert and solder 1mm PCB connection pins from the underside, through the holes marked 'IN', and the adjacent earth hole, and the two holes marked 'LAMP'.

2. Insert and solder IC1-2, C7-1 (reverse order), RFC1-2, R1-6 and Q1-2.

3. Cut off all leads close to the PCB on the underside.

4. Cut 9 of the excess resistor lead trimmings to 15mm in length. Insert one through each of the holes within the marked rectangle at the front of the PCB, such that the main length of the leads project *from the track side*, and the other

Components List — Display

RESISTORS	
R1	100k 5% Carbon Film
R2	150R 5% Carbon Film
R3	68R 5% Carbon Film
R4	10k 5% Carbon Film
R5	1k 5% Carbon Film
R6	3k3 5% Carbon Film
CAPACITORS	
C1,3,4	1n Ceramic Disc
C2	10n Ceramic Disc
C5	100n Ceramic Disc
C6,7	0.47uF Tantalum Bead
SEMICONDUCTORS	
Q1	J310
Q2	2N2369A or BSX20
IC1	74LS90N
IC2	78L05
Display	PCIM 177 Digital Display
RF CHOKES	
RFC1	100uH TOKO type 7BA or BS
RFC2	1mH TOKO type 7BA or BS
MISCELLANEOUS	
Connecting wire; 1 length RG174A/U coax; 1 length Red wire and PCB.	

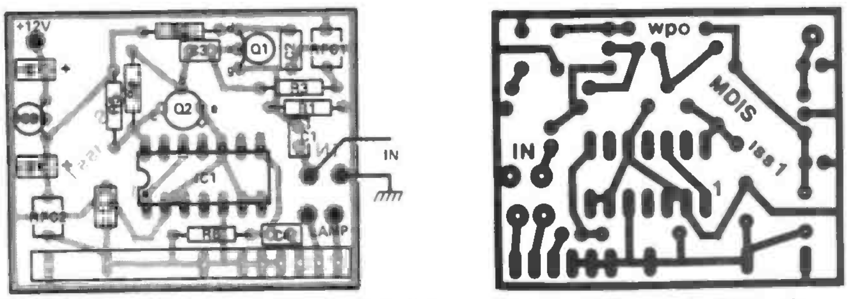


Fig.1 PCB component overlay and foil pattern for the Micron display unit.

ends are level with the top surface of the PCB. Solder each in place as you go on the track side.

5. Take a 19cm length of red wire, strip 5mm off each end and solder one end to the point marked '+12V'.

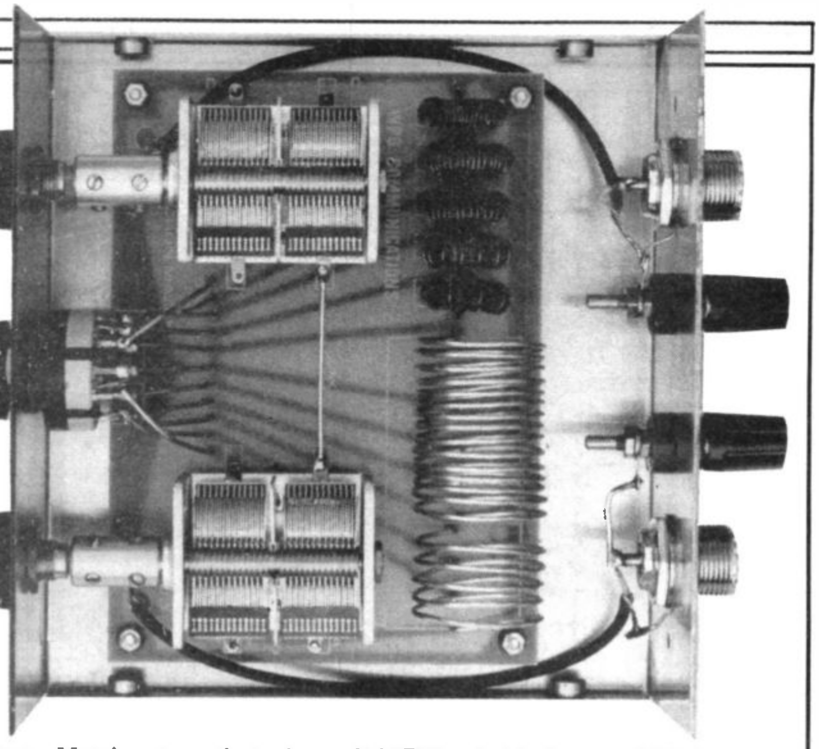
6. Remove the display from its packaging and, slide it over the projecting wires (track side of display facing track side of display PCB) such that the positions of the holes on the display PCB match those on the actual display. Make sure both boards are parallel with each other and that the crystal on the display is just clear of the rear of the display PCB. Solder each wire at the front of the display module (these holes are through-plated to the other side of the display and need not be soldered on both sides) and remove excess wires.

This completes the construction of the display. There is no alignment involved, but you can check operation by either connecting to the Micron (point Q on Micron 'to IN' on display PCB) via the coaxial cable supplied (the negative PSU connection is made via the braid of the coaxial cable), or, if you have a signal generator, using this to drive the display. Besides the frequency, the words 'SW' and 'MHz' should appear on the display.

If there is no reading at all (display reads '00'), then check that +5V is present on the output of IC2, and that the general voltage checks are OK. The current consumption of the module should be around 30mA at 12V. Intermittent and non-stable reading may be caused by insufficient RF voltage reaching the display module or IC2. This is most likely due to a fault in the buffer (Q1 or amplifier Q2) stages.

LAMP: The internal lamp may be illuminated by connecting a 330R resistor (not in the components list) from one of the 'LAMP' pins to the +12V supply, and the other lamp pin to the input EARTH pin. Total current consumption will then be about 55mA.

The PCB for the Micron display is available from WPO Communications for £3.10 and a complete display kit is also available for £33.56.



The Micron Match automatic tuning unit (ATU) suitable for any QRP rig

The *Micron* ATU and SWR/power metering kit is designed as an integral part of the *Micron* case and when used with the custom case (to be described in a later part) mounts behind the holes already provided at the top right of the front panel. It is inserted between the output of the PA stage and the antenna socket — making the transceiver truly portable — and is capable of matching most unbalanced antennas to the 50 ohms required by the PA output stage.

It incorporates metering functions, which with the custom scale for the 'S' meter allows measurement of SWR and power output accurately from 200mW to 15W, with a frequency independent detection circuit. Besides use with this transceiver, *it can also be used with any QRP rig as an outboard ATU, with or without the metering unit.*

The T Match Circuit

There are a number of variations of the basic T match type of ATU circuit, popularised as the 'Transmatch'. The chosen variation has high pass characteristics, partly as this allows a much wider range of impedance matches from a smaller total inductance, but also to assist rejection of out of band signals lower than the wanted frequency. The latter assists rejection of broadcast stations on the 80m band and also 160m if used with another rig.

The input variable capacitor C1/2 is the tuning control along with the variable switched inductor L1-L7 for the matching circuit. The capacitor is in fact a single dual-gang type, with the common stator insulated from earth. The inductor is made up from seven separate coils: two air spaced L1 and L2 both with a number of taps, and a further five wound on Amidon dust iron cores. By means of the front panel 12 position switch, the total inductance in use can be varied, with unwanted coils shorted out. C3 is the loading control and is normally set at the maximum capacity which will allow a low VSWR to be achieved. This setting gives minimum losses in the circuit.

The Matching Unit is capable of handling 20W of RF, except under very high mismatch conditions into a high antenna impedance then the capacitors may arc over. As tuning should always be carried out at low power first, this will not actually cause any problems.

The Meters

To achieve a flat power versus frequency response a classic current transformer type of detector unit has been used for the metering circuit. This gives a flat response from 1.8-28MHz and allows a calibrated meter to be used for power measurement. The minimum

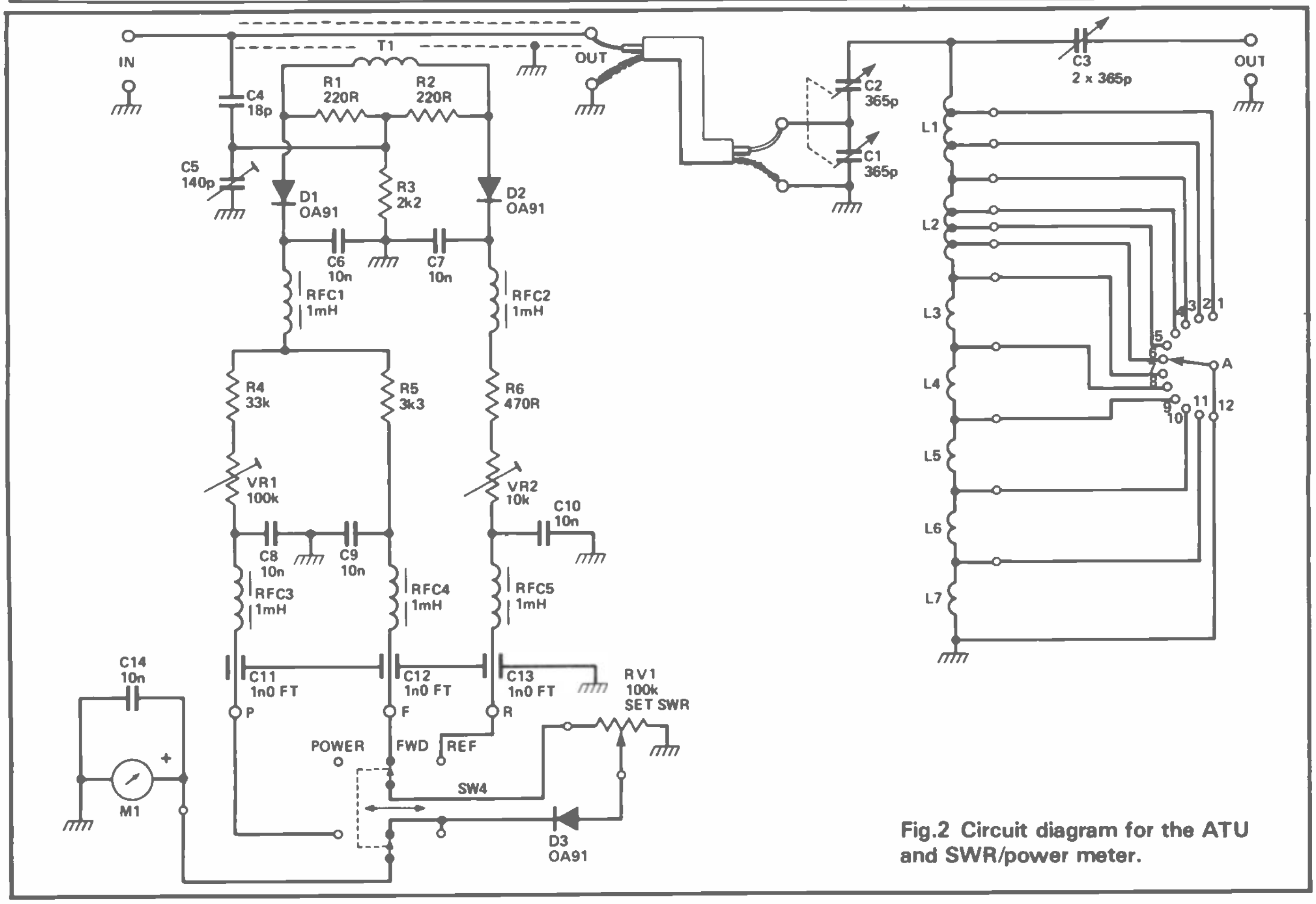


Fig.2 Circuit diagram for the ATU and SWR/power meter.

power measureable is set by the detector diodes, which need to develop at least 600mV across them to be in their linear region. In this design this is 300mW of RF although the meter still reads reasonably accurately down to 200mW. It must, of course, be looking into a matched 50 ohms for correct indication.

The primary of the current transformer, T1, is a single turn made from a piece of coaxial cable passing straight through the centre of a ferrite core. Only one end of the braid is earthed as an electrostatic shield, which improves the null on reflected power. The secondary consists of 15 turns of insulated wire wound round the outside of the core. Incidentally, decreasing the number of turns, increases the output voltage but 15 turns is the minimum required for correct operation on 80m. A centre tapped 440 ohm resistor network (R1/2) provides the load for the transformer secondary.

A voltage is produced at each end of the secondary winding, both of equal amplitude but 180 degrees out of phase with each other. A small proportion of the RF voltage present on the line arranged by C5 to be half the secondary voltage under matched conditions — is sampled and fed back to the centre tap. This results in the out of phase voltage at one end of the winding (V ref) being cancelled and the in phase voltage being doubled. Diodes D1 and D2 and associated components form peak detectors providing two DC voltage outputs proportional to the RF voltages present on the line.

For the actual metering, the forward VSWR voltage is fed direct to the meter via R5, with a value sufficient to give FSD at around 200mW of RF output. RV1 front panel control, SWR Set, allows the meter deflection to be set for higher powers. The reflected voltage is selectable via SW4 and initial calibration is by VR1, set against a known SWR or accurate SWR meter.

As the current transformer has a flat voltage/frequency response over the range of interest, it is possible to use the forward voltage output, under matched conditions, to measure power on the meter. VR2 allows calibration against an external power meter such that the meter reads 15W for FSD. With the meter used, this means that mid scale is approximately 2W, giving a useful scale expansion — the lowest accurate calibration will be around 400mW. A new scale of the meter is provided and is calibrated with S points, watts and SWR scales.

The front panel switch for selecting the meter indication is wired so that the SWR Set control does not affect the power scale reading.

Construction of the ATU

The ATU proper is built on a single sided PCB which mounts inside a U-shaped aluminium enclosure. This acts both as a screen and as a support for the unit and allows it to be mounted against the front panel. As both the variable capacitor stators have to be insulated from ground, the spindles are brought out through the front panel via nylon shafts to the control knobs. L1 and L2 are 25mm (inside diameter) air wound coils, each with several taps. The other inductors are individual switch selectable coils wound on

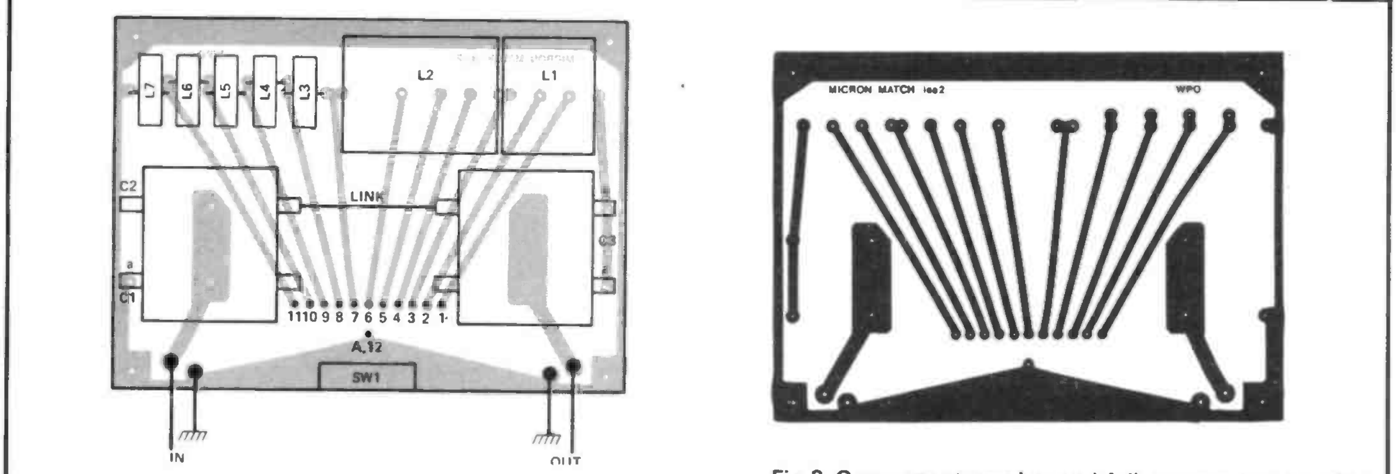


Fig.3 Component overlay and foil pattern for the ATU.

Amidon dust iron cores.

The metering and detector circuits are built on a second PCB, mounted in a diecast box. This is screwed to the outside rear of the ATU support bracket with all outputs using feedthrough capacitors. An internal brass screen separates the RF and DC parts of the circuit.

The ATU board is built first and starts with the inductors. There are four sizes of wire supplied with the kit, which should be separate into decreasing sizes. The tinned copper wire should be straightened before winding by running it over a pencil in both directions.

1. Take a 49cm length of 18swg tinned copper wire and wind 5 turns around a 25mm or 1" diameter (+/– 1mm) former — the coil will spring out to about 29mm (inside diameter) afterwards. Bend each end down at right angles and trim the bent leads to 10mm.

2. Take a 137cm length of the same wire and wind 15 turns, bending and trimming the ends to 10mm as before.

3. Take a 16cm length of 0.8mm diameter enamelled copper wire and wind 6 turns — defined as 6 wires visible around the outside of the core — onto a T68-2 core (coloured red). Trim the leads to 10mm and strip off 8mm of insulation. Insert this coil, L3, into the board so that the base of the core is resting against the PCB and solder into place. Trim the excess leads off to within 1mm of the PCB.

4. L4 is made in the same way as L3 but with 23cm of 0.8mm enamelled copper wire, wound for 11 turns. L5 is the same but with 52cm of 0.56mm enamelled copper wire wound for 25 turns. 73cm of the same wire as L5 is used for the 36 turns for L6 and a 100cm length of 0.4mm enamelled copper wire is wound 50 times for L7.

5. Cut 5 pieces of 18swg tinned copper wire each 10mm long. Insert one into each of the two holes between the ends of L1's marked position, such that 5mm projects above the PCB, and solder each into place. Repeat this with the remaining three pieces of wire between the ends of L2.

6. Insert L2 into the PCB until the lower part of the winding just touches the wires and solder the end leads into place. Adjust the winding spacings so that the sixth turn from the end nearest L3 is just over the left projecting wire. Carefully solder the bottom of this turn to the wire — taking care not to bridge adjacent turns. Then solder the bottom of the tenth turn to the next piece of wire and the thirteenth turn to the remaining wire on the right.

7. Similarly insert L1 into place and solder the end leads. Solder the taps at one and three turns from the right. Check that none of the turns are shorting at any point on the two air spaced windings and adjust the winding spacing equally throughout using a pencil run between the windings.

The two variable capacitors are now mounted. Before mounting these, carefully reduce the spindle on each to 8mm in length by cutting with a hacksaw — *be very careful* not to let any swarf get between the plates of the capacitors!

8. Take two 4BA 9mm long bolts and insert from the underside of the PCB through the mounting holes of C1/C2. Hold in place and drop a 4BA 6mm long clearance spacer over each bolt. Position one of the variable capacitors over the bolts with the spindle facing away from the inductors and carefully tighten each bolt into the threaded holes on the capacitor underside. Tighten up firmly.

9. Take three 18mm lengths of 18swg tinned copper wire and use each to solder a link from each of the three tags on the capacitors over the holes marked 'a' on the PCB, to these holes — two on C3 and one on C1.

10. Take a 4.5cm length of the same wire and use this to solder a link between the two inside rear tags of the capacitors where shown.

11. Next, cut 12 lengths of 18swg tinned copper wire each 5.5cm long. Solder one into each of the series of holes numbered 1-11 ensure about 1mm of wire projects from the underside of the PCB before soldering. Solder the remaining wire into the hole marked A,12. The unit so far assembled now has to be mounted in the support bracket for the remainder of the assembly.

12. Reduce the spindle length of the 12 way switch down to 8mm. Unscrew the fixing nut and remove together with the washer and place to one side. Also remove and discard the position stop behind the washer (this may already have

been removed).

13. Take a 19cm length of miniature coaxial cable and strip the ends (10mm braid, 5mm insulation). Pigtail the braids and then solder one end directly into the 'IN' holes on the PCB. Take another length 31cm long, strip and pigtail and solder this to the 'OUT' holes. Remove all excess leads on the underside of the PCB back to within 1mm of the PCB.

14. Take the support bracket and insert four 12mm long 6BA round head bolts from the underside through each of the four holes on the base. The front right hand bolt should have a solder tag placed under its head before insertion (place the bracket on a bench afterwards so that the bolts don't fall out). Drop a 6BA 6mm long clearance spacer over each bolt. Then slip the PCB over the bolts (spindles facing the 3 large holes) and tighten into place using 6BA lockwashers and nuts.

15. Pass the switch bush through the centre hole on the front and tighten into place with the lockwasher and nut so that the terminal marked '12' is at top centre, Bend the lead from the A,12 hole back between terminals 5 and 6 (it must not touch them) then against the centre 'A' terminal and on up against the top '12' terminal. Solder 'A' and '12' and clip off the excess.

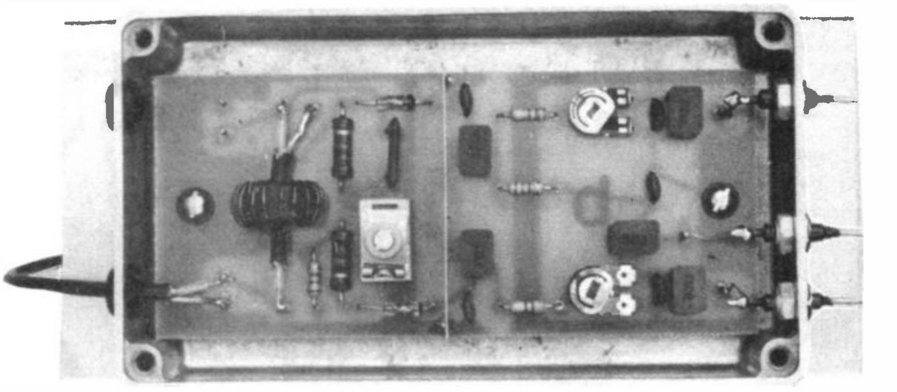
16. Next, solder lead 6 to terminal 6, cutting off the excess. Continue with 7,8,9,10 and 11 in the same way, making sure that the outer leads are bent clear of the others as you go along. Then continue with leads 5 to 1 in the same way.

Assembling the Metering PCB

This completes assembly of the ATU for the present — next the Metering PCB is assembled.

1. Insert and solder 1mm connection pins into the 12 holes shown with larger black circles on the layout.

2. Insert and solder R1-R6.



The SWR/power meter unit, screwed to the rear of the ATU chassis.

3. Insert and solder C4, C5 (the end with the 'shoulder' should face the edge of the PCB) and C6-C10.

4. Insert and solder VR1 and VR2, and RFC1-RFC5.

5. Insert and solder D1 and D2 observing their polarity — be careful when bending the leads as the glass bodies are fragile.

6. Take a 40cm length of 0.56mm dia enamelled copper wire and wind 15 turns (as counted by the number of turns visible on the outside of the core) onto the ferrite core. Trim the leads to 10mm, strip off the insulation to within 2mm of the core, insert so that the core is resting against the PCB and solder into place. Distribute the turns evenly over 270 degrees of the core.

7. Strip and tin a 36mm length of miniature coaxial cable as shown in the drawing. Insert through the core and solder into place.

8. Fix the brass screen into place across the centre of the PCB using the pins at each end to solder against.

9. There are a number of holes to be drilled in the diecast box. Place the PCB centrally inside the box and accurately mark the positions of the mounting holes on the inside of the base. Drill these out to 3mm (1/8") diameter. Using the drawings, drill the remainder of the holes on the shorter ends (three for the screw-in feedthroughs, and two for the grommets).

10. Place two 6BA bolts 12mm long with lockwashers on, through the PCB mounting holes from the topside. Place another lockwasher on each on the underside and screw on two 6BA nuts to each bolt and tighten.

11. Place the PCB inside the box with the transformer facing the end with two holes. Temporarily screw on nuts on the base to hold the board in place.

12. Using a small screwdriver, lever the two grommets into place. Insert the three feedthrough capacitors onto the other holes so that the fixing nuts will be on the inside, and tighten up.

13. Using short offcuts of wire, link the feedthroughs to the appropriate pins.

14. Remove the nuts from the underside of the box and mount the box on the rear of the bracket with the feedthroughs to the right hand side, using a lockwasher and nut to hold it in place.

Aligning the Meters

The metering unit should now be aligned. You will require either an accurate SWR meter to compare the SWR function for calibration or you use known 1 or 2 watt carbon composition resistors to make a load giving a known VSWR. The Power function will require an accurate power meter in series with the unit for calibration.

1. Using a short length of coaxial cable, connect the output of the metering box (the top pair of pins) to the calibration bridge, and the other end of the bridge to a 50ohm dummy load.

2. Disconnect the coaxial link on the *Micron* board from point AW

(below left of IC6 — the other end goes to the Ant terminals), thus removing the relative power metering circuit.

3. Connect the free end of this coaxial cable to the lower pair of terminals on the metering board, via the grommet.

4. The SWR section is set up first. For the following temporary connections use the lengths of wire shown (these will be required later for permanent connections). Temporarily connect a 23cm black lead from the Meter +ve terminal to the wiper (centre) tag of the SWR Set pot, RV1 (100k) via an OA91 diode (See **Fig.5**). Make the connection between the chassis of the ATU bracket and the *Micron* chassis or PCB earth foil.

5. Temporarily link the top (clockwise) end of the pot to pin F on the metering board using a 27cm length of green wire and the other pot tag to ground.

6. Turn the pot fully anticlockwise and apply power to the *Micron* (tuned to the 14MHz band), then go to transmit. Set the power output on the calibration bridge to about 5W. Turn up the SWR Set pot for FSD. Reconnect the top of the pot to the R pin on the metering board.

7. Adjust C5 for minimum reading. Turn up the Drive control for maximum output and the SWR Set pot fully clockwise. Readjust C5 carefully for the minimum reading obtainable.

8. Reconnect the SWR pot to pin F. Set the output to about 5W and adjust the SWR pot for exactly FSD on the meter without touching any of the controls, reverse the coaxial connections to the metering PCB and reconnect the SWR pot to pin

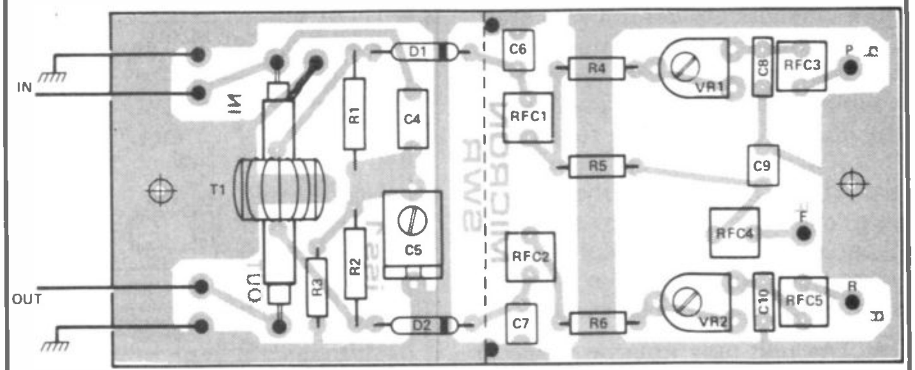
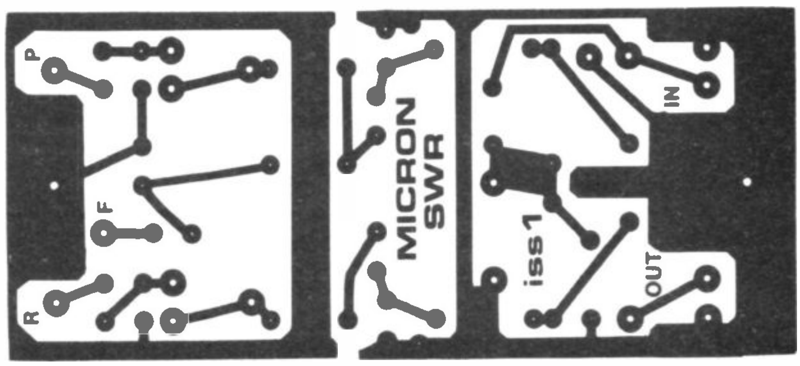


Fig.5 The component overlay and foil pattern for the SWR and power meter.



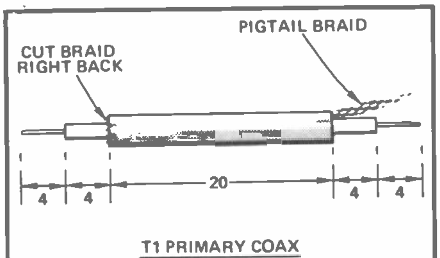


Fig.4 Detail of how to strip T1's primary coax.

R. Turn on again and adjust VR2 so that the meter again reads exactly FSD. Reconnect the coaxial connections the correct way round. This completes adjustment of the SWR metering.

9. To calibrate the Power function, disconnect the SWR pot and diode from circuit and reconnect the meter +ve directly to pin P on the metering board. Run the *Micron* into a 50 ohm dummy load on 14MHz at exactly 5W output on the calibration power meter. Adjust VR1 so that the *Micron* meter scale reads exactly 5W.

10. Remove the temporary coaxial connections to the metering board. Take the shorter length of coaxial cable coming from the ATU proper, pass it through the top grommet and solder to the top pair of pins. Replace the lid on the metering box.

ATU Installation

The ATU may now be installed in the *Micron* case. If you are building the complete *Micron*, it is easier to fit the ATU as the first job when the front panel is free of the case and has no other fitments made to it.

11. Take the two solid aluminium couplings and screw onto the two variable capacitors so that the rear of the couplings are 1mm clear of the capacitor bodies.

12. Cut two lengths of 1/4" nylon rod to 32mm each (you can use plastic pot spindles if no rod is to hand). Insert just through the ATU bracket front panel hole and slip one of the fixing nuts from a 1/4" brass bush over the rod from the inside of the bracket. Push the rod into the aluminium coupler and tighten up the grub screws. Repeat with the other capacitors.

13. Remove the nut and lockwasher from the 12 way switch. Offer the ATU unit up to the front panel and push the switch bush through. Loosely fix this in place with the lockwasher and nut. Insert the bushes through from the front with a fibre washer just behind the flat face, over the rods and tighten

up using the nuts already over the rods, while making sure that the fibre washers are centrally located. Check that the rear of the bushes are just clear of the aluminium couplers adjusting the position of the coupler if necessary to achieve this. Firmly tighten up the switch and fit the knobs with the lines in appropriate positions. The capacitor settings should read '0' when fully anticlockwise and the switch '0' fully anticlockwise.

14. The unit may now be wired in place as shown in **Fig.5**. As noted earlier, you will find it easier to wire up the switch and SWR Set pot with the front panel free of the rest of the case — the instructions for the case assume that the ATU will be fitted first. When wiring up, fit the SWR pot first with a nut screwed hard up against its body before inserting it and then fit a plain washer and nut on the outside — the tags should face upwards on the panel. Wire the earthed tag on the solder tag fitted to the base of the support bracket.

15. Also to the solder tag, connect a 7cm and a 6cm length of black wire. The shorter length is soldered to another solder tag held on the stud just above the bandswitch hole. The remaining length is used to connect to the *Micron* PCB just to the right of L1 after the panel is fitted to the chassis. This will ensure earth continuity between the ATU/front panel/chassis/PCB.

16. Use the shortest piece of wire from the pot to the tag as a loop through which the three wires going to the metering box pass. These wires should run straight up from the slide switch, round, through the loop, then on up and over the rear lower edge of the support bracket to the feedthroughs to avoid fouling the bandswitch and lid. D3 is inserted directly in the wiring with sleeving over each lead. C11 is soldered directly across the meter – ve/ + ve terminals.

Using The ATU

After a while, you will get used to the settings for various bands and antennas and can keep a note of these for rapid tuning. Until then the following procedure should be used for tuning up.

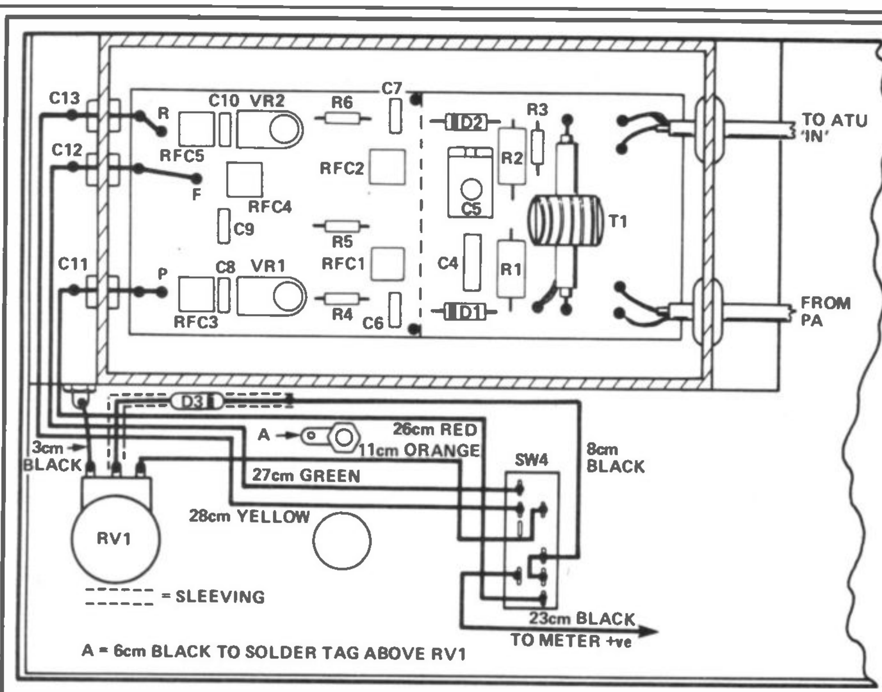
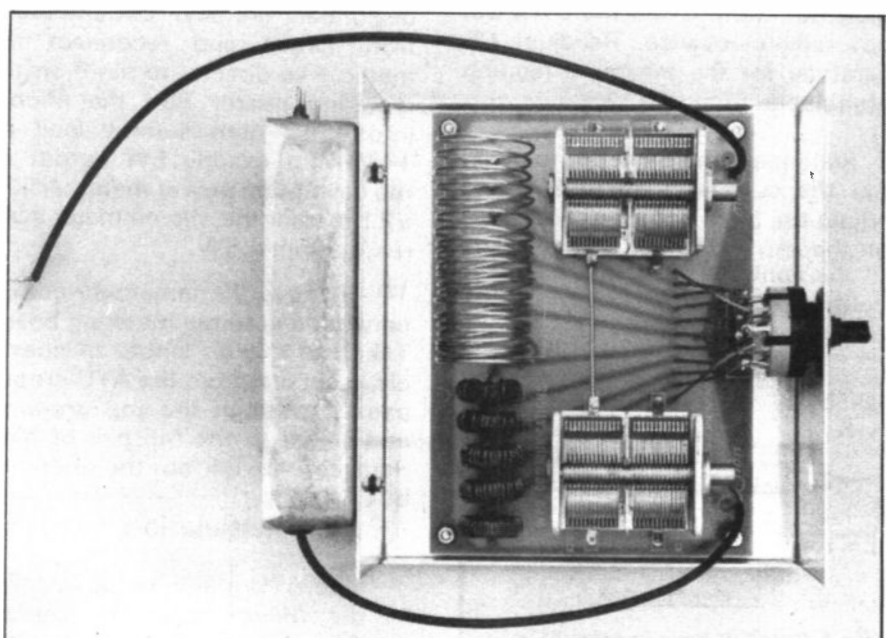


Fig.5 Wiring up the meter.

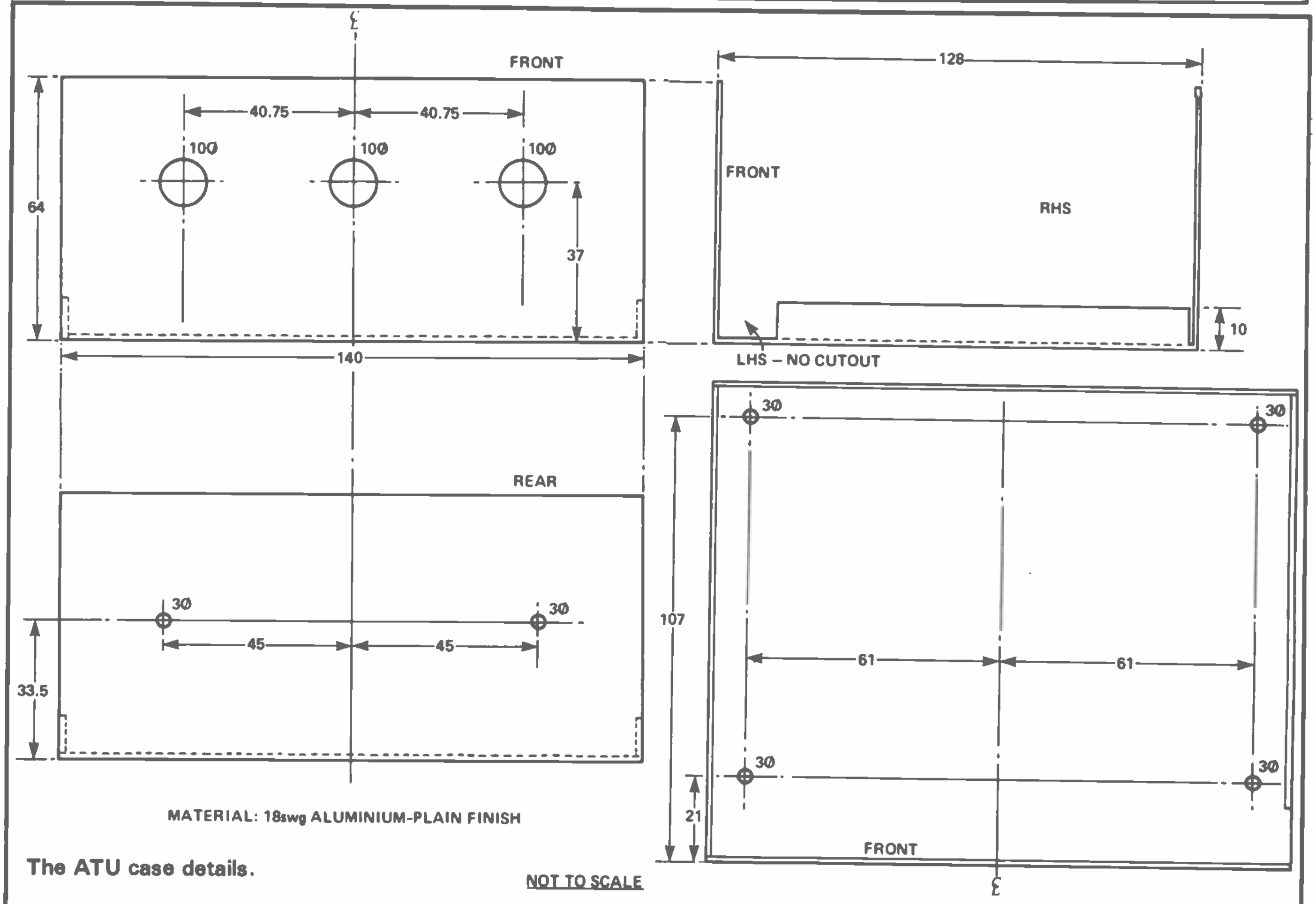
1. Set the *Micron* to the frequency required. Set the matching unit Inductance switch to '0' and Tune and Antenna controls to 5. Rotate the Inductance control for a peak in a received signal.

2. Turn the SWR Set pot to full clockwise travel, the Drive control fully anticlockwise (minimum output) and the Meter switch to FWD.

3. Go to transmit and turn up the Drive until the meter reads FSD. Switch to REF. Turn the Indicator one way or the other switch until you get the meter reading at its lowest (this may only be a small drop). Then adjust the Tune and Antenna alternately for minimum reading on the meter, periodically readjusting the meter for FSD in the FWD position. If you cannot achieve a satisfactory match (better than 1.5:1) try another switch setting one away from the existing setting. Note that minimum loss through the matching network oc-



The complete ATU and metering unit.



The ATU case details.

curs with the Antenna control as far clockwise as possible consistent with a match. If you get a match with two different settings of the Inductor switch, use the one which results in the Antenna control having a higher reading.

As the matching unit uses a series of stepped inductors, it is possible that you may find it difficult to achieve a match with some aerials on particular frequencies due to the inductance steps not being quite correct. If this occurs and you use the antenna regularly, it is possible to change the taps on the air spaced coils, or add or remove turns from the toroid inductors as required. The highest value inductor, L7, is unlikely to be required in most cases.

Kits

A kit of parts for this unit is available from WPO Communications for £37.00 inc. Also available is a modified version of the ATU itself with its own aluminium case and connectors etc that can be used as a stand alone ATU and costs £39.95 inc.

Component List

FIXED VALUE RESISTORS

R1,2	220R 0.5W
R3	2k2
R4	33k
R5	3k3
R6	470R

All are 5% carbon film.

VARIABLE PRESET RESISTORS

VR1	100k 10mm dia preset
VR2	10k dia preset

VARIABLE PANEL MOUNT RESISTORS

RV1	100k ALPS Linear pot

FIXED CAPACITORS

C4	18pF silver mica
C6,7,8,9,10,14	10n ceramic disc
C11,12,13	1n bolt in feedthrough

VARIABLE PRESET CAPACITORS

C5	140pF max mica trimmer

VARIABLE CAPACITORS

C1,2,3	365pF max dual gang Jackson type 0

SEMICONDUCTORS

D1,2,3	OA91

RF CHOKES

RFC1,2,3,4,5	1mH Toko

INDUCTORS

T1	Secondary 15 turns 0.56mm en Cu wire wound on Fair-Rite core type 59-61001101 primary is coaxial cable
L1-L7	see text

SWITCHES

SW4	DPCO slide
SW5	Lorlyn 1 pole 12 way

Miscellaneous: a diecast box RS type 509-939; Micron SWR PCB; Micron match PCB; 5 off Amidon T68-2 cores; 2 ¼" panel bushes; a nylon rod ¼" outside dia; 2 fibre washers (10mm inside dia; 16mm outside dia); 2 off ¼" aluminium couplings; an ATU support bracket; 2 small grommets; a brass screen 44 by 18mm; 12 off 1mm PCB connection pins; 4 off 4BA RH 9mm bolt; 4 off 4BA clearance spacer ¼"; 6 off 6BA RH 12mm bolt; 10 off 6BA shakeproof washer; 4 off 6BA clearance spacer ¼"; a 6BA solder tag; 18swg tinned copper wire; 0.8mm dia en cu wire; 0.56mm dia en cu wire; 0.4mm dia en cu wire; miniature coaxial cable; red, orange, yellow, black and green connecting wire; a length of sleeving.

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A large, colourful wall poster providing an at-a-glance guide to where that exotic 'CQ' is coming from.

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PROJECTS

AN 80W 2m SSB LINEAR AMPLIFIER

A CHEAP AND SIMPLE 2m TO 10m CONVERTER
which can be adapted to listen to 15m too!

REVIEWS

THE TRIO TS830S: THE ULTIMATE IN SELECTIVITY?
Tony Bailey, G3WPO, assesses this contesters rig and optional filters.

THE ICOM IC02E – MORE THAN JUST A 'HANDIE TALKIE'?

PLUS

CLANDESTINE AMATEUR OPERATIONS IN THE MIDDLE EAST

ON SALE FROM FRIDAY 6th DECEMBER

REVIEW:

Icom IC735 HF Transceiver

Icom move into the mid priced compact HF transceiver market with the IC735. Does latest equal last word in hi tech? mused Tony Bailey, G3WPO.

The IC735 is Icom's latest addition to its range of HF transceivers, intended for the mobile and home station market. Oddly enough, it appears to be competing with their own IC745, as well as the Yaesu FT757 and Trio TS430S. As a mobile rig, the basic transceiver operates off 12V (at around 20 amps max) and does not thus contain an internal power supply. This makes it quite small, actual size is 94 x 241 x 239, or about half the volume of something like a FT101 or TS830S. It is still a mite too large to fit under the average car dashboard unless you use some form of made to measure mounting — Icom can supply a mobile mounting bracket at extra cost. The review sample was supplied in its basic form ie without optional CW filters and automatic ATU, but complete with the optional PS-55 AC power supply which can deliver the odd 20 amps demanded by the solid state PA.

Nice to see that Icom supply a microphone with the rig, so that you don't have to return to the dealer to buy one when you get home and find this 'optional' accessory isn't part of the station! But, it still comes with one of those wretched European plugs on the end of the mains lead which has to be cut off and replaced! Surely the sales of these rigs in the UK must be high enough for Icom, Yaesu and others to go to the expense of supplying a standard UK plug with the rig? I have a sneaking feeling that it may be illegal to supply the Euro plug especially as the standard colour coding information for rewiring the plug isn't supplied. Also *there is a hazard involved* — someone may be tempted to plug the two pin Euro plug into a standard UK mains socket. This can be done if you open the shutters on the earth part of the socket with a screwdriver. However, there is then no earth as these plugs have side wiper-contact earth strips which only work with the correct socket.

Having got that off my chest, the usual range of accessory leads are supplied with the rig, including a +12V power lead (nearly 9 feet long), various phono and other plugs for the accessories, spare fuses, and even a jack for the key. There is an optional electronic keyer available for the '735' which appears to use the well known Curtis chip.

What You Get

So, what do you get for the money? The IC735 covers all nine HF amateur bands on both receive and transmit (100W output), but also has general coverage receive facilities from 100kHz to 30MHz and this with no gaps! This continuous coverage is available because of the use of a very high first IF at 70.45MHz. This is then down converted to 9MHz and then 455kHz for all the modes available — as standard the IC735 comes with AM, CW, SSB and FM facilities plus AFSK transmit for RTTY fans. The standard filters supplied are 2.3kHz for SSB and CW (plus AM narrow), 6kHz for AM, and 15kHz for FM which are all at −6dB. A choice of two optional narrow CW filters can be had with one at 500Hz with a shape factor just over 3:1, and a narrower version at 250Hz with a shape factor of just over 4:1 and at 6/60dB. The installation instructions for these filters are clearly shown in the manual.

The AM narrow and CW/SSB filters can all be used with PBT (Pass Band Tuning). This enables you to continuously shift the centre frequency of one IF filter around compared with another and get rid of interference on either side of the wanted station by narrowing the passband. It does also function with the AM wide and FM filters but is not of much use as the shift is only 1.8kHz compared with the 6 and 15kHz bandwidths of these filters. A notch filter is also part of the QRM reduction line-up and operates at IF frequency.

Frequency control is via a stepped digital synthesiser with 10Hz steps giving the feel of an analogue tuning system with variable tuning rate per revolution of the main tuning dial. The method of getting to any specific frequency is a little strange but easily got used to after a couple of minutes. The IC735 doesn't have a band switch as such, but three buttons which determine what happens when you tune. For use on the amateur bands, the button marked 'HAM' is depressed. Then , as you rotate the main knob, the rig steps through the amateur bands in a continuous cycle until you arrive at the one you want. If the main dial is at 14.050MHz, then the steps are through 21.050, 24.550, 28.550, 29.550, then 1.550, 3.550, 7.050, 10.050, 14.050 and so on, leaving you to flip the button back out and tune to the wanted frequency.

Having got to the wanted band, you then have a choice of tuning rate via the 'kHz' button; when not depressed tuning is at 10Hz steps giving a 2.5kHz/rev rate — rather slow for SSB but good for CW with a narrow filter — when rotated slowly, and about 6kHz per rotation when tuned a little faster. With the button depressed, the tuning rate is 100kHz/rev which is really too fast for either SSB or CW. For general coverage use, a further 'MHz' button enables a 1MHz step rate or 9MHz/rev of the tuning knob.

Do We Have Lock?

One interesting observation is that on the fast tune rate, continuously tuning backwards and forwards one revolution fairly slowly always gave the same two frequency readings — as one might expect. However, tuning faster resulted in different readings each time with less change in kHz/rev than at the slower rate. It would appear that the synthesiser was loosing lock on faster rotations and spinning the knob very fast resulted in much less change than anticipated — seeming to confirm this phenomenon — not that it resulted in any actual problem.

One nice feature is that the tension of the main tuning knob can be adjusted via an under-the-case screw to suit your preference from loose spin to very tight.

The other feature automatically selected with the 'HAM' switch is that of sideband selection, so that LSB is enabled below 10MHz, and USB above. This can be overidden via the 'SSB' button which will swop between USB and LSB each time it is pushed. You will also notice a quiet relay click as you tune through wide frequency swings — these are the Tx output low pass filters being switched as appropriate with the Rx filters being electronically changed over.

There are two VFOs in the 735, labelled as 'A' and 'B', of course. Each is totally independent of the other and can be used on any frequency and mode — both these parameters are stored for the individual VFO and not lost on switching around. So, you can either operate both VFOs in the same band and use one to monitor a specific frequency while tuning around with the other (just like a memory) or have each on totally different bands and modes. Switching between the two is simply a matter of pushing the 'VFO' button once.

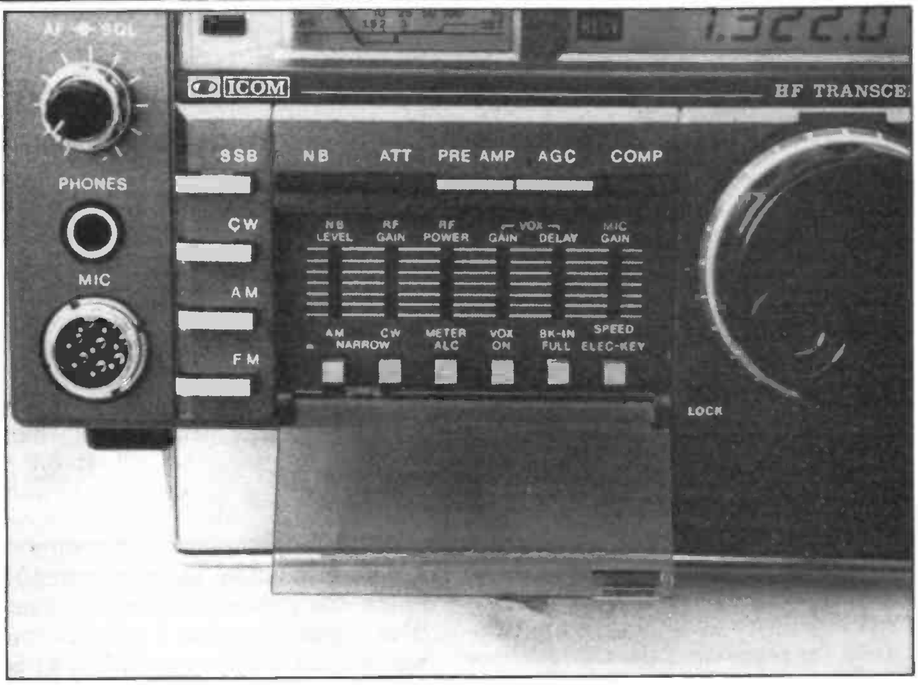
In addition, there are 12 memory channels available each storing frequency and mode. They all have the advantage that once you recall a memory (push 'MEMO'), you can instantly tune away from the memorised frequency and change mode without pushing any more buttons — on some rigs you have to transfer the memory to the dial before this is possible.

The memory channels are stepped via two 'M-CH' 'UP' and 'DOWN' buttons — the channel in use is continuously shown on the display and can be stepped while in VFO mode to the correct channel. Storage is by simply pressing the 'MW' button. In addition, you can recall a memory channel frequency direct to the dial by calling up the memory channel (which has no effect on the existing received frequency), then pressing 'M-VFO'. This operation can also be carried out while in memory mode in which case the displayed frequency doesn't change, but the VFO (whichever is selected of A or B) does then contain the memory frequency and can be selected later.

Scanning The Horizons

Needless to say, scanning facilities are provided with several options. You can scan the memory channels continuously but with two options. The first is a normal channel 1-12 scan stopping as soon as a signal is received (the all-mode squelch control has to be set to mute of course) and resuming after about 10 seconds if the signal is still there. You can alter an internal switch so that the scan is cancelled as soon as a signal is found.

The second is rather new but has appeared on rigs such as the FT757 — a mode scan where the logic will only scan those memory channels which contain the same



mode as the channel from which the scan was started. Useful for instance where your memory channels contain say both AM and FM and you only want to look at the FM ones, possibly on 29MHz. You can, of course, program SSB or CW into the memories for scanning but neither of these two modes are particularly suited to scanning unless you are purely looking for activity — say on 28MHz at the present state of the sunspot cycle or maybe 50MHz with a converter/transverter. However, it does work well in any mode and, for a change, the all-mode squelch is efficient, even on SSB providing the long time-constant AGC is selected.

The scanning speed is selectable, but only be delving inside the case — as it comes the speed is set to slow or about 1 channel per second. If you set it to fast then the speed is around channels per second.

As well as memory scan, you can also perform limited band scanning say to monitor the FM section of 29MHz, the satellite downlinks, or a section of the AM broadcast band. Memory channels 11 and 12 are used to store the relevant limits of the scan — it doesn't matter which way round as the scan will always start from the lower limit. Then a VFO is selected, the squelch muted and SCAN pressed to start a continuous cycle scan between the two programmed limits. Going to transmit, or moving the tuning knob will stop the scan, as will pressing SCAN again.

The supplied microphone, HM-12 comes with UP/DOWN buttons which can be used to perform many of the frequency moving functions, except for memory channel stepping. This can only be controlled via the front panel.

Many of these facilities are also stated to be available via a serial output from the rear of the transceiver. However, although the manual mentions this and that it is intended for RS-232 but is only a two pole connector, there is no further reference as to a suitable interface or how it operates.

One other facility to mention is that of matching the two VFO frequencies and modes by pressing the "A = B" button — useful for the next mentioned facility when used within the same band.

Splits

Not banana, but operating frequency ones, are possible by depression of the 'Split' button and with VFO A controls the receive frequency and B the transmit. It is even possible to split so that you can receive 14.050MHz CW and transmit 28.500MHz SSB if you feel like it!

Display

Like many of the newer rigs, the IC735 has a green backlit LCD display showing the operating frequency to 100Hz, plus other information. It can be read from quite wide angles and also shows the operating mode, memory channel continuously plus 'Memo' when in use, VFO A or B, and whether in receive or transmit (Xmit) — the receive annunciator is not lit when the squelch is muted.

RIT is provided through crystal pulling within the PLL loop but only moves things about 800Hz. About double or triple 800Hz is really necessary a lot of the time and the shift doesn't get shown on the display, although a red LED above the RIT knob does show that it is in use. No transmit RIT (XIT) is provided.

We have in fact only covered the controls on the right of the rig! Immediately to the left of the main tuning knob are a series of push buttons controlling noise blanker (more anon), attenuator (−20dB), pre-amp (+10dB), AGC (slow or fast recovery — there is no AGC off provided) and compressor. To the left of these are the four mode control buttons for CW, SSB, AM and FM, one momentary depression controlling each.

By these we have a small 'smoke finish' plastic cover which hinges down to reveal a number of miniature slide switches and a row of pushbuttons. Now, why this cover is there I do not know but the chances of it lasting very long are pretty remote! You will find that it has to be opened quite often by nature of the controls inside and, personally, I would remove it permanently (easily done) if the rig was mine, and especially when used mobile. The slide controls don't appear to be up to much mechanically and could suffer the same fate as the hinged panel!

The sliders control the noise blanker threshold, RF gain, RF power, VOX gain and delay, and the mic gain. The six pushbuttons are for AM wide/narrow filter, CW narrow filter (this was not fitted and the audio is muted when this is depressed), meter ALC or PO (power out), VOX on/off, CW BK-IN full or semi and speed for the optional keyer.

This leaves the AF and RF gain controls (concentric), a manual transmit button, phones socket a standard ¼" jack), power on/off and the meter. The latter shows 'S' units on receive plus RF power (in watts) or ALC, plus SWR on transmit.

Inconvenient SWR Meter!

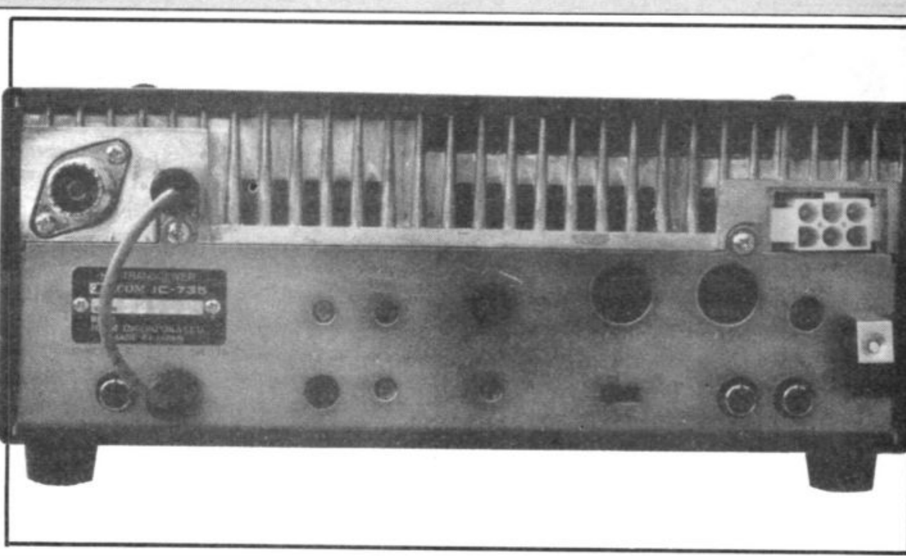
Here lies the strangest and most impractical choice of controls I have ever seen on a rig! Although the IC735 has an internal SWR metering system, its use seems to have been an afterthought, as though they found that they had run out of panel space after designing it in! To use this facility, you have to depress the meter switch button inside the cover to the PO position, then delve round the *back* of the rig for the meter switch and move this to the set position. You then run up a carrier and adjust the RF power control inside the panel for FSD on the meter. Then round the back again to change the switch to SWR so that you can take a reading. If you are actually trying to adjust the SWR via an ATU this becomes a right rigmarole. It's very strange that space couldn't be found for this switch on the front.

Round The Back

Actually, there are a few adjustments available under the case, for the receiver audio tone and CW sidetone level. As supplied, I found the treble a bit too overpowering especially on the internal speaker — the case is fairly small and doesn't leave a lot of room for the bass to develop. The audio was quite good though and far more available than you are actually likely to ever want (except for a demo station into an external speaker). You can also vary the intensity of the LCD illumination via a preset access hole on the left of the case.

On the rear apron are the usual selection of sockets and connectors. Standard antenna connection is via an SO239 socket. There is an output/input provided for an external receiver or fitting an external preamp in series with the receive path *after* the changeover relay. Also provided is a transverter output giving around 30mV o/p for upconverting to VHF or UHF — painfully low in level with about 20 — 30 times this being a much better choice.

Jacks for the key, external speaker, ALC (from a linear), 'Send' (earthed relay contacts on



transmit), and 'RS232' (see earlier) are fitted, plus two accessory connectors (T/R switching etc). Controls for presetting the Compressor level (set at 10dB at the factory) and the tone of the transmit audio circuits plus the AM carrier injection level (for 40W carrier) are also there. All that remains are the anti-VOX level control, Meter (already covered), and a ground terminal for an external earth.

Manual

The supplied operating manual is of good quality and presentation with lots of cross-references to other sections. Many illustrations are given, plus a full circuit and block diagram, with the text all in good English. It runs to some 46 pages plus circuits and should be able to answer all your questions except anything about the 'RS-232' interface and operation.

There is an internal Lithium battery which supplies back-up current for the memories etc. It is given a useful life of about 5 years and advises that an Icom dealer should replace it. It is possible, although not stated that this battery also keeps the memory information intact required for booting up the CPU. If this is the case, then failure would mean that a dealer would have to reprogram this information and hence the real reason for dealer replacement rather than by the operator?

Circuit

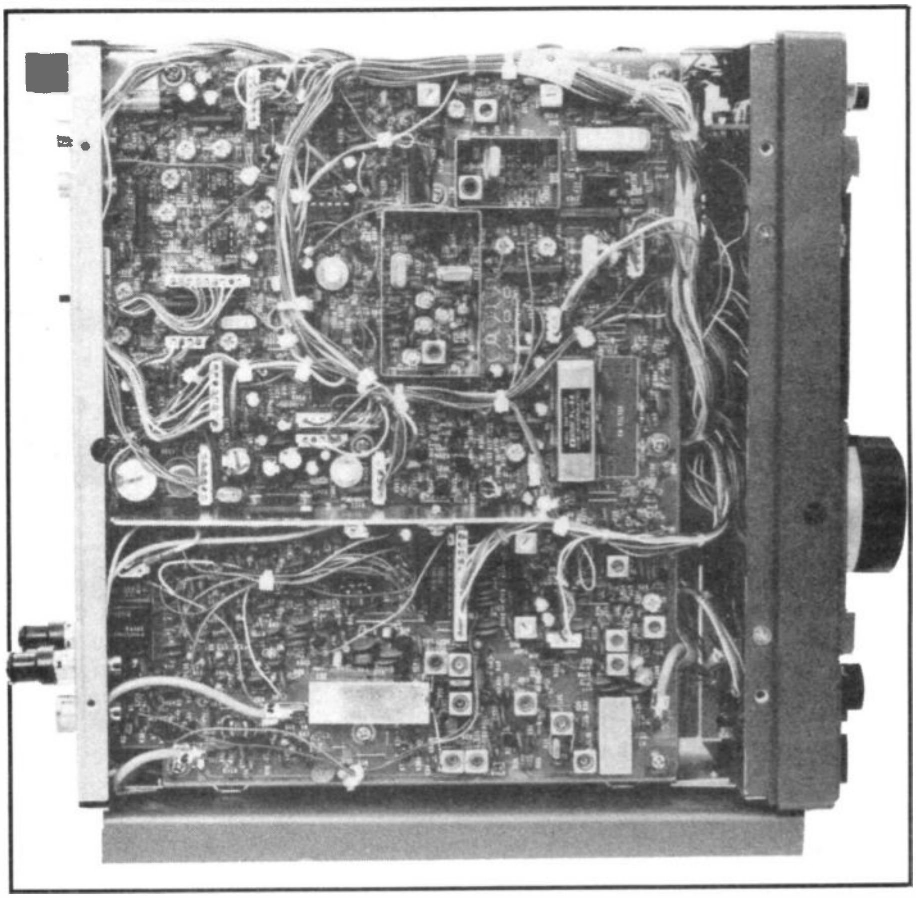
This is quite complex as one might expect but some salient points are worth mention. No RF stage as such is used in the 735 when the preamp is not in circuit. The signals go straight into a double balanced first mixer using a pair of 2SK125 JFETS. These are preceded by a bank of filters, diode switched depending on frequency (LPF for 0.1 — 1.6MHz) and bandpass above that (from a bank of six). The switchable preamp uses another pair of the same JFETS in push-pull. Signals then go straight into a 2 pole monolithic 70MHz roofing filter before more processing down through the remaining two IFs.

The optional CW narrow filter goes in at 9MHz which is also the frequency of the IF notch filter. For AM and FM, the 9MHz filters are replaced with an attenuator to preserve the signal loss in the filters and the selectivity for these modes achieved at 455kHz — both CW and SSB signals pass through a further 455kHz filter.

The transmit output stage uses a pair of 2SC2904's driven by a pair of 2SC3133's to yield the 100W rated output.

In Use

The IC735 was used with a full size G5RV or various dipoles, and a transmatch type ATU over a period of several weeks on both CW and SSB with no real problems of any sort. On SSB, received reports were complimentary even with the compressor in, although pushing its ratio up much higher than as supplied started getting a few adverse remarks from high signal strength contacts — not really surprising. The transmitted audio lacks base and was particularly noticed by



local stations but probably a useful feature for DX and mobile working. For best undistorted talk-power it was necessary to keep the ALC reading well up (but within its limits), and a useful feature was the RF power control which enabled a reduction down to about 8 watts to be achieved. The AGC time constant in slow for SSB use, seemed a little longer than usual, which is no bad thing as it does mean that AGC pumping is absent on strong signals.

The VOX was excellent and quiet with none of the need often felt to try to keep the VOX going by means of 'ahs and ums'. It was sensitive and difficult to detect in operation by the receiving station.

The lower limit of the RF output control does mean that it would not be suitable for the QRP enthusiast. Also, a blind operator would have difficulty in using the rig as reference points for frequency determination purposes are not present.

On CW, the 735 offers a choice of either semi-automatic operation (semi break-in) or full break-in and so will be of interest to the CW enthusiast. In semi break-in mode, found on virtually all transceivers these days, the key is depressed and the rig immediately goes to transmit, with the recovery to receive being determined by the VOX delay setting. With the 735 this could be varied from nearly full break-in at speeds up to about 20wpm, down to about 1 second delay. In this mode it was quite pleasant to use being fairly silent despite a relay being keyed, and a slight click from the audio circuits, but this is not obtrusive. It isn't as quiet though as say the TS930S or the KW Ten-Tec Corsair.

Full break-in was achieved up to about 35wpm — above this the receive path was lost between dots. The keying noises (relay, audio) were more obtrusive in this mode — all you should really hear is the sidetone and receive signals. However, this is probably acceptable to the majority of people, although possibly not to the CW addict. The sidetone itself was pleasant and sounded a good sinewave. Although the nominal level of this can be preset, the final volume is governed by the main volume control which is annoying.

The noise blanker (gated type at 9MHz IF frequency) gave fairly reasonable performance on ignition pulses — providing the interference level was sufficiently high enough above the wanted signal — and certainly improved readability under these conditions. On 'woodpeckers', again the performance was good, only failing with multiple signal types, which are the most difficult to blank with any system. I found the notch filter reasonably effective — the notch is quite wide and not particularly deep but it does serve a purpose under most heterodyne conditions.

Frequency stability is excellent and, of course, the rig is ready to go as soon as it is switched on — no PA finals to warm up. There are a number of sproggies scattered throughout the receive range but not too many, and the very great majority only 3dB or so above noise. The only ones that moved the internal 'S' meter were at 8.466 (S7), 9.010 (S2), 12.801 (S2) and 14.473 (S7) — nothing of any consequence in the amateur bands.

The receive filtering and general performance is as good as any for SSB and AM applications and the excellent dynamic range is evident in freedom from intermodulation products on the lower bands. However, any CW addict would almost certainly want to add one of the optional narrow filters. Although the bandwidth can be narrowed, via the PBT control, the minimum for CW using the SSB filter is about 800Hz and therefore not really adequate. There is some top cut introduced on CW receive which helps general CW reception, but I would like to have seen an IF shift facility as on the Trio TS830S. With both PBT and IF shift available, the receive side for CW could have been classified as excellent rather than very good. On FM, things are a bit too wide for 10kHz spacing used on HF FM, the fitted filter is more suited for 25kHz spacing. AM wasn't used on transmit but could be set up OK, and FM only for one contact on 10m with the received comment that the deviation sounded a little too much.

The preamp wasn't really needed, certainly on the lower bands, but was useful once or twice on 28MHz with weak signals. It works well showing that the noise contribution from the mixer is not the determining factor with sensitivity. Below 1.6MHz, the preamp doesn't function anyway.

Ergonomically, I didn't find the bank of sliders etc particularly good. but the rest of the layout is acceptable. I would have preferred the AF/RF controls on the right rather than the left. The plastic cover has already been mentioned!

Conclusions

Not a bad rig by any means, and, allowing for a few oddities, such as the SWR metering facilities, should prove a good seller. It performs very well, has an excellent dynamic range, is compact and has a number of useful facilities — all easily mastered. With the general coverage facilities it will prove especially popular for those with SWL leanings as well as normal chatting on the bands, DX and contest working, or even 10m FM. Its multimode facilities are, in the main, excellent and would also match well with transverters for the higher VHF and UHF bands, allowing for the rather low transverter drive level available. For those with CW leanings, one of the narrow filter additions would be highly desirable, and the break-in, although good is bettered in terms of quietness by at least the Corsair and TS930S.

Thanks to Thanet Electronics of Herne Bay for the loan of the rig, currently priced at £849, plus £169 for matching PSU.

Measurements

RF sensitivity SSB (for 10dB S/N+N) — preamp on — SSB filter

0.1MHz	0.85uV (No preamp)
1.8MHz	0.12uV
3.6MHz	0.11uV
7.05MHz	0.13uV
14.2MHz	0.11uV
21.2MHz	0.14uV
29MHz	0.15uV

Dynamic range, two tone 14.2MHz, SSB 100kHz spacing: 107dB

Power output on CW with about 13.8V

1.9MHz	110W
3.5MHz	105W
7.05MHz	105W
10.MHz	110W
14.2MHz	105W
18.4MHz	105W
21.2MHz	105W
24.8MHz	105W
28MHz	100W
29.7MHz	100W

'S' meter, on SSB 14.2MHz (relative dB increase per division)

S1	—
S2	2dB
S3	3dB
S4	2dB
S5	2dB
S6	4dB
S7	3dB
S8	4dB
S9	6dB
S9+10dB	10dB
S9+20dB	10dB
S9+40dB	17dB
S9+60dB	21dB

Attenuator: 1.8MHz −21dB; 14.2MHz −19dB; 29MHz −19dB.

Preamplifier: 1.8MHz +12dB; 14.2MHz +11dB; 29.0MHz +9dB.

Converting Ham Internationals To 10m

Roger Alban, GW3SPA, looks at this widely available range of CB rigs and explains how they can all be modified to 28MHz.

During the late 1970s, when the growth of CB use in America had outgrown the 40 channels available, a number of manufacturers decided to offer CB sets that were capable of operating on 80 channels and 120 channels. Although these sets did not meet the FCC specification, they found their way into the hands of the CB enthusiast.

One of the manufacturers, Ham International, has their headquarters based at Ghent, Belgium and are still manufacturing good quality 120 channel multimode transceivers intended for the CB market around the world. Ham International manufacture a number of different models all capable of operating on 120 channels offering AM, FM, and SSB modes of operation.

The CB manufacturers offered a variety of different models in an attempt to sell more sets. To date the author has tracked down seven 120 channel sets all manufactured by Ham International that either use the same PCB, or whose method of frequency generation is very similar. **Table 1** shows the relationship between eight sets manufactured by Ham International and the PCB numbers found on the sets. For example, the top of the range base station model, the Jumbo, uses the same main PCB as the Ham Major M360, and the Multimode II. Whereas the top of the range mobile model is the Concord II which uses the same PCB as the Trystar 747 mobile rig. The main differences between the various models seems to be the inclusion or exclusion of transmit course tuning. This enables the user to tune 5kHz either side of the frequency selected by the channel control switch.

Table 2 gives the manufacturers specification quoted for each model together with the different facilities offered. There is one main common bond between all these models, that is the way the sets working frequency is generated which also lends itself to being easily converted to the amateur 10m band.

The Band Oscillator

If the set is to be converted to operate 10m band, the value of the band crystal oscillator will need to be changed. To be able to calculate the required value of crystal, we need to derive some formula using simple arithmetic and a small amount of algebra. These are shown nearby in the box 'Calculating Band Oscillator Crystal Values'.

If you decide to stick with the possibilities of re-crystalling the set on the upper part of the 10m band using the three band crystal positions, as most people will, then the crystals you will require are high band 21.2525MHz, mid band 21.0525MHz, low band 20.8525MHz. The sets new operating frequencies are shown in **Table 3**.

Also remember that when ordering crystals, the specification must be fundamental crystals, operating at about 28 pF, +/− 20pp at 25°C. *If you happen to own a Multimode II, or a Jumbo, then the crystal frequencies must be half of the crystal frequencies*

CB MODEL	MAIN PCB No	PPL PCB No	XTAL OSC PCB No	SWR PCB No	ROGER BEEP PCB	NOTES
COLT 1600DX	PTBM125A4X	–	–	–	–	
HAM MAJOR M360	PTBM059C0X	PTSY016A0X	–	–	–	
MARCO CB-747	PTBM121D4X	–	PTOS110R0X	PTSR007A0X	–	
TRYSTAR 747	PTBM121D4X	–	PTOS110A0X	–	–	
MULTIMODE II	PTBM059C0X	PTOS006A0X	–	–	YES	BAND CHANGING XTALS AT ½ FREQ THEN MULTIPLY BY ½
CONCORDE II	PTBM121D4X	PTOS011A0X	–	PTSR021A0X	YES	
HIGH GAIN 2795	PTBM121D4X	–	PTOS011A0X	–	–	
JUMBO	PTBM059C0X	PTOS006A0X	–	PTSR017C0X	YES	BAND CHANGE XTALS AT ½ FREQ THEN MULTIPLY BY 2

Table 1 The PCB numbering system for the Ham International range of CBs.

	COLT1600DX	HAM MAJOR	MARCO CB747	TRYSTAR 747	MULTIMODE 2	CONCORD 2	HIGH GAIN	JUMBO
FREQ RANGE (MHz)	26.515-26.955							
LOW	26.965-27.405	26.965-27.405	26.965-27.405	26.965-27.405	26.965-27.405	26.965-27.405	26.965-27.405	26.965-27.405
MID	27.415-27.855	27.415-27.855	27.415-27.855	27.415-27.855	27.415-27.855	27.415-27.855	27.415-27.855	27.415-27.855
HIGH	27.865-28.305	27.865-28.305	27.865-28.305	27.865-28.305	27.865-28.305	27.865-28.305	27.865-28.305	27.865-27.305
EMISSION AM/FM/USB/LSB	YES	YES	YES	YES	YES	YES+CW	YES	YES
RX SENSITIVITY AM (uV at 10dB S/N)	1	0.7	1	1	0.7	0.7	0.7	0.7
RX SENSITIVITY FM (uV at 20dB S/N)	1	0.5	1	1	0.5	0.5	0.5	0.5
RX SENSITIVITY SSB (uV at 10dB S/N)	0.5	0.2	0.5	0.5	0.2	0.2	0.2	0.2
SKIRT SELECTIVITY AT 6dB DOWN	UNKNOWN	AM/FM 6kHz SSB 2kHz	AM/FM 5kHz SSB 2.2kHz	AM/FM 5kHz SSB2.2kHz	AM/FM 6kHz SSB 2kHz	AM/FM 6kHz SSB 2kHz	AM/FM6kHz SSB 2kHz	AM/FM 4kHz SSB 2kHz
AUDIO OUTPUT AT 10% dist INTO 8 OHMS (Watts)	2	3.5	2	2	3.5	3.5	3	3
FINE TUNE RANGE	+/-800Hz	NO	+/-800Hz	+/-800Hz	+/-800Hz	+/-800Hz	+/-800Hz	+/-800Hz
COARSE TUNE RANGE	+/-5kHz	+/-4kHz	NO	NO	+/-4.5kHz	+/-4.5kHz	+/-4.5kHz	+/-5kHz
SQUELCH RANGE (uV)	0.5-300	0.7-300	0.5-500	0.5-500	0.7-300	0.7-300	0.7-300	0.7-300
TX POWER SSB (PEP (W))	12	12	12	12	12	12	12	12
TX POWER AM(W)	7.5	4	7.5	4	4	4	7.5	4
TX POWER FM (W)	10	4	7.5	12	4	4	7.5	4
TX COARSE TUNE	+/-5kHz	NO	NO	NO	+/-4.5kHz	+/-4.5kHz	NO	+/−4.5kHz
NOISE BLANKER	YES	YES	YES	YES	YES	YES	YES	YES
AUTO NOISE LIMITER	YES	NO	NO	NO	NO	YES	NO	YES
RF GAIN CONTROL	YES	SWITCH	SWITCH	SWITCH	SWITCH	YES	YES	YES
FM DEVIATION+/-1.5kHz	YES	YES	YES	YES	YES	YES	YES	YES
SWR FACILITY	NO	NO	YES	NO	NO	YES	NO	YES

Table 2 The manufacturers spec for each model.

shown above because the oscillator frequency is doubled by the tuned circuit comprising T1 before being injected into the mixer.

Adjusting The Band Oscillator

For those of you contemplating this conversion, remember it is not just a straightforward exchange of band crystals, the set will need to be re-tuned. You will also require a frequency counter, oscilloscope, and a digital DC voltmeter. Before removing the old band crystals, select channel 30 on the high band and measure the DC voltage with a digital meter at test point 1 on the PTBM121D4X PCB, or test point 2 on the PTBM059C0X PCB. The voltage reading should be in the region of 1.33V.

Table 3 The new channel and frequency allocations.

CHANNEL	LOW	MID	HIGH
1	28·46	28·86	29·26
2	28·47	28·87	29·27
3	28·48	28·88	29·28
4	28·50	28·90	29·30
5	28·51	28·91	29·31
6	28·52	28·92	29·32
7	28·53	28·93	29·33
8	28·55	28·95	29·35
9	28·56	28·96	29·36
10	28·57	28·97	29·37
11	28·58	28·98	29·38
12	28·60	29·00	29·40
13	28·61	29·01	29·41
14	28·62	29·02	29·42
15	28·63	29·03	29·43
16	28·65	29·05	29·45
17	28·66	29·06	29·46
18	28·67	29·07	29·47
19	28·68	29·08	29·48
20	28·70	29·10	29·50
21	28·71	29·11	29·51
22	28·72	29·12	29·52
23	28·75	29·15	29·55
24	28·73	29·13	29·53
25	28·74	29·14	29·54
26	28·76	29·16	29·56
27	28·77	29·17	29·57
28	28·78	29·18	29·58
29	28·79	29·19	29·59
30	28·80	29·20	29·60
31	28·81	29·21	29·61
32	28·82	29·22	29·62
33	28·83	29·23	29·63
34	28·84	29·24	29·64
35	28·85	29·25	29·65
36	28·86	29·26	29·66
37	28·87	29·27	29·67
38	28·88	29·28	29·68
39	28·89	29·29	29·69
40	28·90	29·30	29·70

After taking this reading replace the old band crystals with the new and with a 10pF capacitor connected to terminal 1 on the oscillator board (PTOS011A0X PCB), measure the frequency and amplitude of the band crystal oscillator on each band. The frequency of the oscillator can be adjusted by altering the trimmers CT1, CT2, and CT3. The frequency measurement should be carried out on the AM/FM/USB mode. The core of T1 should be adjusted for maximum amplitude.

If you cannot obtain a sharp peak in tuning T1, you will have to replace the internal tuning capacitor of T1 for a 68 pF one to replace this, the transformer and the screen have to be completely removed from the PCB. The internal tuning capacitor will be found inside the base of the coil former and should be removed carefully. Replace the metal screen and resolder the transformer on to the PCB. The new 68pF tuning capacitor can be soldered across the coil of the transformer on the back of the PCB. When T1 has been successfully tuned, switch to LSB. Transistor Q2 should now conduct and the output frequency of the crystal oscillator should drop by 3kHz. If it doesn't, adjust CT4 until you obtain the correct frequency offset.

In the case of the band oscillator the following procedures will need to be followed. Connect a 10pF capacitor to the output of T1 and measure the amplitude and frequency of the crystal oscillator. The output presented at test point 4 was found to be quite low and insufficient to drive my digital frequency meter. With the set switched to FM/AM/USB mode, the frequency of the crystal oscillator can be adjusted by altering the trimmers CT2, CT3 and CT4.

With the set switched to the LSB mode, the frequency of the band crystals should drop by 1.5kHz. Remember that the crystal oscillator is operating at half the frequency of other models' band oscillator and it is doubled by the tuning circuit, T1. Therefore the frequency shift measured on LSB at the output of T1 will be 3kHz. If this is not so, then adjust trimmer CT5 until you achieve the required offset. Tune the core of T1 for maximum amplitude, again changing the value of the internal tuning capacitor if necessary.

The VCO

The remaining PLL circuitry is similar for all the models and modification work is, of course, the same. A DC voltage reading has been taken at test point 1 or 2 depending on the model you

Calculating New Band Crystal Oscillator Values

We know that the transmit/receive frequency for AM/FM/USB is derived from Fo, the frequency injected into the receiver first mixer minus 10.695MHz.

Thus:- Ftx = Fo – 10.695 . . . equation 1.

Fo is the output frequency of the band pass filter which is produced by additive mixing, adding together the frequencies of the VCO, Fvco and the frequency of the band crystal oscillator Fxtl.

Thus:- Fo = Fvco + Fxtl . . . equation 2.

If we now substitute equation 2 for Fo into equation 1, we obtain,

Ftx = Fvco + Fxtl – 10.695 . . . equation 3.

We also know that Fin, which is obtained from the output of the low pass filter, is derived by subtracting the frequency of the VCO from the frequency of the band select crystal oscillator.

Thus:- Fin = Fxtl – Fvco . . . equation 4.

Re-arranging equation 4, we obtain

Fvco = Fxtl – Fin . . . equation 5.

Substitute Fvco in equation 5, into equation 3 we obtain

Ftx = Fxtl – Fin + Fxtl – 10.695

Ftx = 2Fxtl – Fin – 10.695 . . . equation 6.

In equation 6, the only unknown quantity is Fxtl, which is the required frequency for the band select crystal. So if we re-arrange equation 6, we obtain the final equation

Fxtl = (Ftx + Fin + 10.695)/2

where Fxtl is the operating frequency of the band crystal oscillator,

Ftx is the transmit/receive frequency of the set and Fin is the input frequency to the programmable divider.

Let us test the formula. From a previous example, channel 30 on the high band corresponds to an operating frequency of 28.205MHz. From Table 4 we can see that the value of Fin for channel 30 will be 2.21MHz. If we know substitute the data into the formula, we obtain

Fxtl = (28.205 + 2.21 + 10.695)/2 = 20.555MHz

which is the frequency of the crystal used on the high band in the unmodified set.

We can now calculate the value of the crystal required to convert the set for use on the amateur 10m band. It is usual to select channel 30 on the high band to correspond with the calling frequency for 10m FM working ie 29.60MHz. Therefore the value of the crystal required will be

Fxtl = (29.60 + 2.21 + 10.695)/2 = 21.2525MHz.

It is also worth while considering re-crystalling the mid and low bands as well since all the models listed in Table 1 are multimode transceivers. However there is a problem. The VCO is so designed that it can only operate over three consecutive blocks of 40 channels. If for example you try to cover the CW portion of 10m as well as the FM portion, the VCO will be unable to provide the frequency sweep that will be required. The VCO tuned circuit, is encapsulated in a rectangular block of solid plastic covered by a green plastic skin, and does not therefore lend itself to easy modification. If you want to increase the operating bandwidth of the set, you will have to replace the green plastic blob with the circuit shown in Fig 2.

Table 4 Truth table of the programme lines for each channel.

CHANNEL	Fin (MHz)	÷N	P8	P7	P6	P5	P4	P3	P2	P1	P0	HEX ADDRESS	
1	2.55	255	0	1	1	1	1	1	1	1	1	F	F
2	2.54	254	0	1	1	1	1	1	1	1	0	F	E
3	2.53	253	0	1	1	1	1	1	1	0	1	F	D
4	2.51	251	0	1	1	1	1	1	0	1	1	F	B
5	2.50	250	0	1	1	1	1	1	0	1	0	F	A
6	2.49	249	0	1	1	1	1	1	0	0	1	F	9
7	2.48	248	0	1	1	1	1	1	0	0	0	F	8
8	2.46	246	0	1	1	1	1	0	1	1	0	F	6
9	2.45	245	0	1	1	1	1	0	1	0	1	F	5
10	2.44	244	0	1	1	1	1	0	1	0	0	F	4
11	2.43	243	0	1	1	1	1	0	0	1	1	F	3
12	2.41	241	0	1	1	1	1	0	0	0	1	F	1
13	2.40	240	0	1	1	1	1	0	0	0	0	F	0
14	2.39	239	0	1	1	1	0	1	1	1	1	E	F
15	2.38	238	0	1	1	1	0	1	1	1	0	E	E
16	2.36	236	0	1	1	1	0	1	1	0	0	E	C
17	2.35	235	0	1	1	1	0	1	0	1	1	E	B
18	2.34	234	0	1	1	1	0	1	0	1	0	E	A
19	2.33	233	0	1	1	1	0	1	0	0	1	E	9
20	2.31	231	0	1	1	1	0	0	1	1	1	E	7
21	2.30	230	0	1	1	1	0	0	1	1	0	E	6
22	2.29	229	0	1	1	1	0	0	1	0	1	E	5
23	2.26	226	0	1	1	1	0	0	0	1	0	E	2
24	2.28	228	0	1	1	1	0	0	1	0	0	E	4
25	2.27	227	0	1	1	1	0	0	0	1	1	E	3
26	2.25	225	0	1	1	1	0	0	0	0	1	E	1
27	2.24	224	0	1	1	1	0	0	0	0	0	E	0
28	2.23	223	0	1	1	0	1	1	1	1	1	D	F
29	2.22	222	0	1	1	0	1	1	1	1	0	D	E
30	2.21	221	0	1	1	0	1	1	1	0	1	D	D
31	2.20	220	0	1	1	0	1	1	1	0	0	D	C
32	2.19	219	0	1	1	0	1	1	0	1	1	D	B
33	2.18	218	0	1	1	0	1	1	0	1	0	D	A
34	2.17	217	0	1	1	0	1	1	0	0	1	D	9
35	2.16	216	0	1	1	0	1	1	0	0	0	D	8
36	2.15	215	0	1	1	0	1	0	1	1	1	D	7
37	2.14	214	0	1	1	0	1	0	1	1	0	D	6
38	2.13	213	0	1	1	0	1	0	1	0	1	D	5
39	2.12	212	0	1	1	0	1	0	1	0	0	D	4
40	2.11	211	0	1	1	0	1	0	0	1	1	D	3

are modifying. Reconnect the voltmeter to the test point and adjust the tuning core of the VCO until you obtain the previous reading of 1.33V.

If you are retaining the original VCO circuitry and using the set over only 40 channels, then the tuning core will have to be unscrewed by a few turns. When you have obtained the desired voltage reading the VCO should now be correctly tuned and the PLL loop functioning correctly.

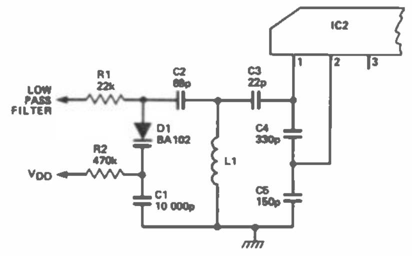
Modifying The VCO

If you choose to use the set on the three consecutive groups of 40 channels on 10m, then you will find that the existing VCO circuitry will not track the entire 120 channels. I found the VCO would only track over 114 channels on 10m. On the 11m CB band, the VCO was capable of tracking approximately 130 channels. The change in the L to C ratio is the prime cause for this tracking problem on 10m. The VCO voltage swing varied between approximately 1V up to 6V. It was therefore found necessary to remove the existing VCO tuned circuitry by unsoldering the five connections on the main PCB and replace it with the circuitry shown in **Fig 2**.

The circuit is constructed on Vero board of the same floor measurements as of the encapulated circuitry removed. The layout of the various components is shown in Fig. 3. The five connecting terminals are constructed out of stiff wire and soldered to the back of the Vero board. The coil is wound on a Toko coil former and surrounded by a pot core and screen can. The new circuit board should be installed in place of the encapsulated VCO and the five connecting terminals soldered to the main PCB.

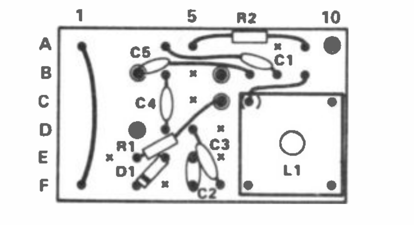
After installing the new VCO, reconnect the digital voltmeter to test point 1 (or test point 2) and adjust the tuning core of the VCO to obtain a voltage reading of 2.48 volts on the same channel as before. This should then correspond to approximately 5.12V on channel 1 on the low band.

It was found necessary to make a slight alteration to the low pass filter installed between the phase comparator and VCO. A 0.22 uF



L1 = 10 TURNS OF 36swg. WOUND ON TOKO COIL FORMER WITH POT CORE

Fig.2 The replacement VCO circuit.



× DENOTES CUT TRACK WITH TWIST DRILL

● DENOTES TERMINAL POST CONNECTING VCO TO THE MAIN PCB

Fig.3 The new VCO is built on veroboard (viewed from the component side).

tantalum bead electrolytic capacitor was placed in parallel across R1 to improve the stability of the loop. Although the new VCO circuit extends the operating frequency range of the set, additional modifications have to be made to the two band pass filters, and the transmitter tuned circuits which are not covered in this article.

Transmitter Tuning

The next step in the modification procedure is to tune the transmitter power amplifier and drive circuits. With a SWR meter and a 50 ohm dummy load connected to the aerial socket, key the transmitter on channel 60 on the mid band on AM or FM. At the output of the PLL mixer IC2, a band pass filter comprising of T2 and T3 selects the frequency Fvco plus Fxtl which is fed to the receiver first mixer and transmitter mixer IC3.

The tuning cores of T2 and T3 must be adjusted to give a peak in output transmitter power. You may find you can not tune T2 and T3 on the new frequency. In which case the internal fixed tuning capacitors in the base of the coil formers will have to be replaced with lower fixed value capacitors soldered to the printed circuit side of the PCB as previously described. I found I could tune T2 and T3 without altering the value of the fixed capacitors.

The next step is to tune the band pass filter, T4 and T5, at the output of the transmit mixer IC3. The fixed tuning capacitors here had to be replaced for 33pF capacitors soldered to the back of the PCB. The output of the band pass filter is fed to the base of transistor, Q7, which is an emitter follower. This feeds RF preamplifier, Q8, which is tuned by T6 and C47, a 47pF capacitor. If you are unable to tune the preamplifier you will need to change the value of C47 for a 33 pF capacitor.

The output of T4 feeds, via C49, the base of the RF driver transistor Q9. The value of C49 was selected by the set manufacturer when the set was initially tuned back in the factory. It may be necessary to change the value of C49, which is normally about 390pF, for a lower value. The RF driver is tuned by L7. Again you may find it necessary to change the value of C53 which is normally a 220pF capacitor for 150 pF. No difficulty was experienced in tuning the RF power transistor stage. Repeat the tuning exercise until you have obtained maximum output on channel 60 on the mid band.

After completing this stage of the tuning, compare the output power of channel 60 on the mid band with channel 1 on the low band and channel 40 on the high band. If the output power is not the same, then you will have to readjust the tuning cores of the band pass filters to obtain as near as possible a constant power output across the new operating frequency range of the set.

Receiver Tuning

Tune the set to channel 60 in the mid band, and inject a signal of 29.10MHz into the aerial socket. Adjust the tuning cores of the receiver RF amplifier T7, T8, and T9 with the noise blanker switched on. Reduce the level of the injected signal until it is just audible from the set's loudspeaker and again adjust the tuning cores of T7, T8, and T9 for maximum audio. If you do not have a suitable signal source, the receiver front end can be tuned from an off air signal generated by another amateur station. Finally, with the dummy load attached, monitor the transmit output signal on the amateur station main receiver. Tune the receiver either side of the carrier frequency by more than 10kHz and ensure no stray sidebands exist.

If the set has passed this test it is now ready to be used on the air. Remember, that the operating frequency generated by the channel change switch logic code does not necessarily change in 10kHz steps from one channel to the next. The new operating frequency relationship with channel number is shown in Table 3. The cost of the modification using three new crystals is approximately £20.

Cut Price Conversion

A cheaper method of converting these models to 10m would be to retain one of the crystals and modify the program code to adjust the programmable divide number N to suit the requirements. Using the 20.555MHz crystal and changing the program code the value of Fin on channel 40 on the high band can be found by manipulating the equation derived in 'Calculating New Band Oscillator Crystal Values'

Fxtl = (Ftx + Fin + 10.695)/2.

Then Fin = 2Fxtl − Ftx − 10.695.

On channel 40 we require the operating frequency of the set to be 29.7MHz. Therefore Ftx will be 29.7, and Ftxl will be the crystal frequency 20.555MHz.

Fin = 41.11 − 29.7 − 10.695 = 0.715MHz

This value of Fin makes the divide by N number for the programmable divider equal to 71.5. However, we must always have a whole number for the value of N. If we make the N equal to the nearest value of whole number, 72, how far do we need to pull the frequency of the 20.555MHz crystal to obtain the desired operating frequency of 29.7MHz? Using the formula

CHANNEL	P5	P4	P3	P2	P1	P0	BINARY NUMBER
CHAN 1	1	1	1	1	1	1	63
CHAN 30	0	1	1	1	0	1	29
CHAN 40	0	1	0	0	1	1	19

Table 5 Some switch logic codes for selecting channels 1, 30 and 40.

CHANNEL	P8	P7	P6	P5	P4	P3	P2	P1	P0	BINARY NUMBER
CHAN 1	0	0	1	1	1	0	0	1	1	115
CHAN 30	0	0	1	0	1	0	0	0	1	81
CHAN 40	0	0	1	0	0	0	1	1	1	71

Table 6 The required programme code for channels 1, 30 and 40 on the high band.

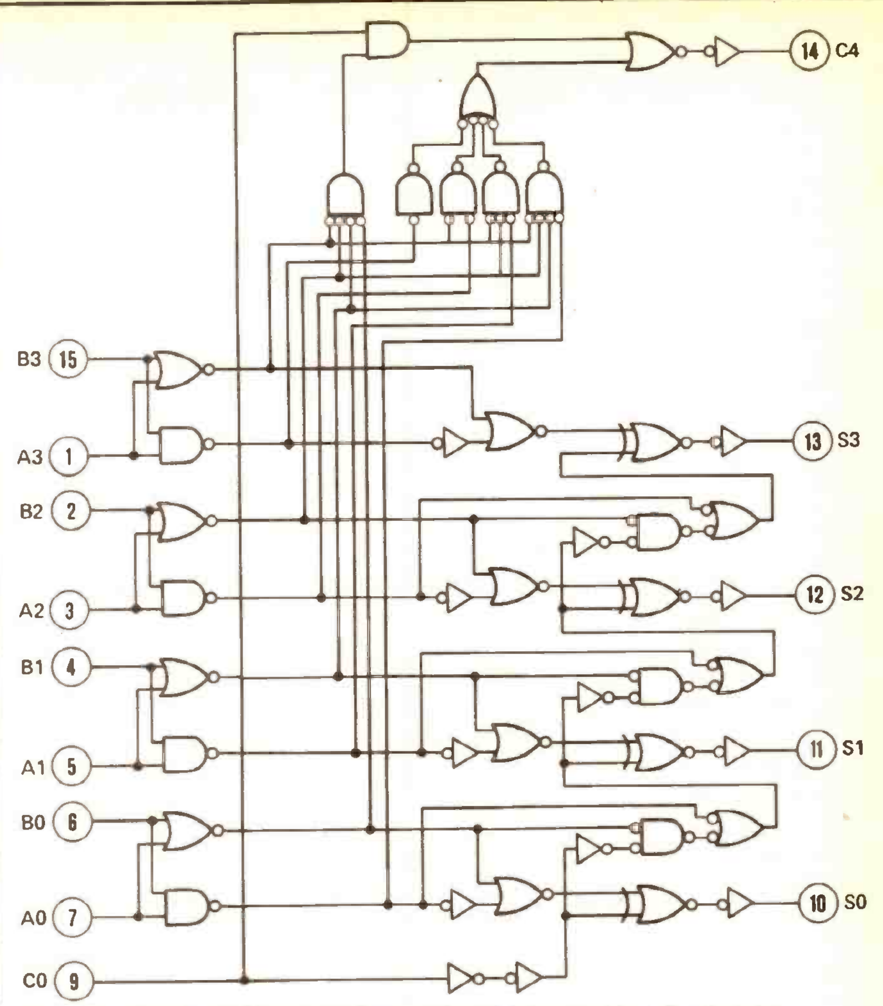


Fig.4 The circuit configuration for the 4008 binary adder IC. The pin out is shown on Fig.5.

to obtain the value of Fxtl, we obtain:-

Fxtl = (29.7 + 0.72 + 10.695)/2 = 20.5575MHz

I found it proved impossible for the existing crystal oscillator to increase the oscillator frequency by reducing the capacitance in series with the crystal.

If instead we make N = 71, then:-

Fxtl = (29.7 + 0.71 + 10.695)/2 = 20.5525MHz

The 20.555MHz crystal can be pulled down to 20.5525MHz on the PTOS011A0X PCB by removing the 33pF capacitor in parallel with the crystal trimming capacitor, and replacing it with a 150pF capacitor. In the case of the PTBM059C0X PCB, a 150pF capacitor must be connected in parallel with the crystal trimming capacitor CT4. Some difficulty was experienced in pulling the frequency of the 10.2775MHz crystal down, such that the output doubled frequency from the secondary of T1 was 20.5525MHz. You may have to replace the 10.2775MHz crystal with a 10.27625MHz crystal. But it is a very small price to pay!

Binary Code

The existing binary code produced by the channel switch can be obtained from **Table 4**. In the unconverted set, the program lines P0 – P5 are connected directly to the channel control switch, and program lines P6 and P7, are connected to Vdd which produces logic level 1. Program line P8 is grounded giving logic level 0. The actual binary value of the switch for each channel can be obtained from program lines P0-P5. **Table 5** shows the binary and logic levels for channels 1, 30, and 40. The binary value of the channel switch on channel 40 is 19. From the previous calculations we require a binary code of 71 with the crystal oscillator operating at

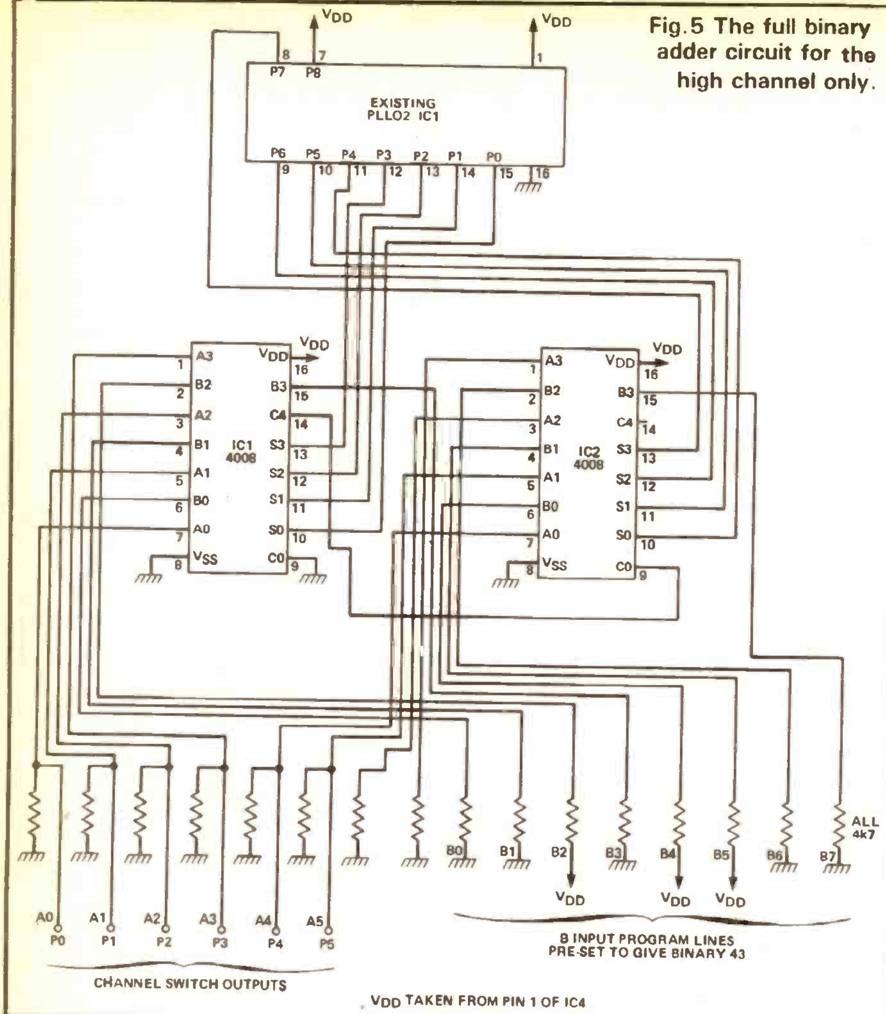


Fig.5 The full binary adder circuit for the high channel only.

How the Ham International Multimodes Work

PLL CIRCUIT

All the models listed in Table 1 use the same phase lock loop circuitry, which uses the PLLO2 chip to produce the various frequencies necessary for the set to operate on CB. The block diagram which is common to all the models is shown in Fig 1.

The PLL loop comprises of a reference crystal oscillator operating at 10.24MHz, which is fed to pin 3 of the PLL chip. Pin 3 is the input to a fixed frequency-divider, known as the 'divide by R' divider. This divides by a fixed number, 1024 to produce a 10kHz reference input to the phase comparator.

A sample of the output frequency produced by the PLL circuit is fed to pin 2 of the PLL chip. Pin 2 is the input to the programmable divider which divides the input frequency Fin by a number N. N is selected by a logic code produced by the channel switch. The output of the programmable divider is fed to the other input of the phase comparator where if compared with the reference 10kHz fed to the other input. The phase relationship between the two inputs to the phase comparator produces a DC voltage at pin 5 of the PLL chip which is fed to the VCO, via a low pass filter. Therefore the output voltage produced by the phase comparator, controls the output frequency of the VCO.

To produce the correct operating frequencies required for American CB, the VCO operates in the frequency range of 17.555MHz to 18.445MHz in the AM/FM/USB mode.

The technology used in the PLLO2 is quite old when compared with the technology available today. The maximum input frequency, Fin, to the programmable divider is limited to approximately 4.5MHz, because of the timing delays within the programmable divider. For the PLLO2 chip to be used in a circuit which generates frequencies suitable for CB, some form of prescaling or down mixing must be used to ensure that Fin remains below 4.5MHz. The circuit designer has opted for a very clever arrangement, where the output of the VCO is fed to a mixer which forms part of IC2, where the VCO frequency is mixed with the frequency of a crystal oscillator.

One of the predominant frequencies produced as a result of mixing comprise of the crystal oscillator frequency, minus the frequency of the VCO Fxtl – Fvco. This is the filtered out of the mixer by a low pass filter and fed to the input of the programmable divider — thus completing the loop. The other predominant frequency produced is Fxtl + Fvco obtained at the output of the mixer by a band pass filter comprising of T2 and T3. This frequency is fed to both the receiver first mixer Q22, and the transmitter mixer, IC3, where 10.695MHz is added, under transmit conditions on AM/FM/USB, to produce the final transmit frequency. This circuit configuration ensures that the VCO is operating at a frequency well below the operating frequency of the set and also ensures that Fin is kept below 4.5MHz.

THE PROGRAMMABLE DIVIDER

The value of the divide by N number is determined by the value of the binary logic code presented to the program code inputs P0 — P8, pins 7-15 on the PLLO1 chip. The PLLO2 chip is a CMOS device where logic level 1 can be represented by a positive voltage anywhere between +4V up to approximately 9V. The logic truth table for the PLLO2 chip is shown in Table 7. The range of divide by N numbers varies between 2 and 511, where all the logic inputs are at logic level 1. From Fig. 1 it can be seen that the channel switch is permanently connected to program line inputs P0 — P5, P6 and P7 is permanently connected to Vdd, logic level 1, and P8 is grounded to give logic level 0. The input codes together with the resulting value of Fin is given in Table 4.

For the loop to be locked, it is necessary for the frequency being sampled by both inputs to the phase comparator to be at the same frequency namely 10kHz. By altering the divide by N number the frequency being generated varies in 10kHz steps. Thus from Table 4, it can be seen that the value of Fin jumps in 10kHz steps when the logic codes are changed by the rotation of the channel select switch.

You will also observe from Table 4 that the frequency in a small number of channel positions will jump forwards or backwards by more than 10kHz. This is due to the F.C.C. specification which calls for some frequencies to be skipped altogether. For example, the set operating frequency jumps 20kHz between channels 3 and 4 and again between channels 7 and 8. The most confusing jump in frequency is that which occurs downwards between channels 23 and 24.

Rotating discs connected to a common central shaft in the channel switch produce the program logic code. These are made from double sided PCB which has been etched to provide the correct logic codes for each channel selected. The central wiper contact is connected to Vdd. Internal pull down resistors are provided within the PLLO2 chip to produce logic level 0 when the channel switch contact is open and the program line is disconnected from Vdd.

Additional rotating discs provide the correct code to drive the two seven segment LED displays — the visual indication of the channel number selected. It would be very difficult to alter the program codes to make the channel number relate correctly to operating frequency, or to change the logic

Table 7 The truth table for the PLLO2 chip.

SELECTION									DIVIDE BY N
P_8	P_7	P_6	P_5	P_4	P_3	P_2	P_1	P_0	
0	0	0	0	0	0	0	0	0	2
0	0	0	0	0	0	0	0	1	3
0	0	0	0	0	0	0	1	0	2
0	0	0	0	0	0	0	1	1	3
0	0	0	0	0	0	1	0	0	4
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
0	1	1	1	1	1	1	1	1	255
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
•	•	•	•	•	•	•	•	•	•
1	1	1	1	1	1	1	1	1	511

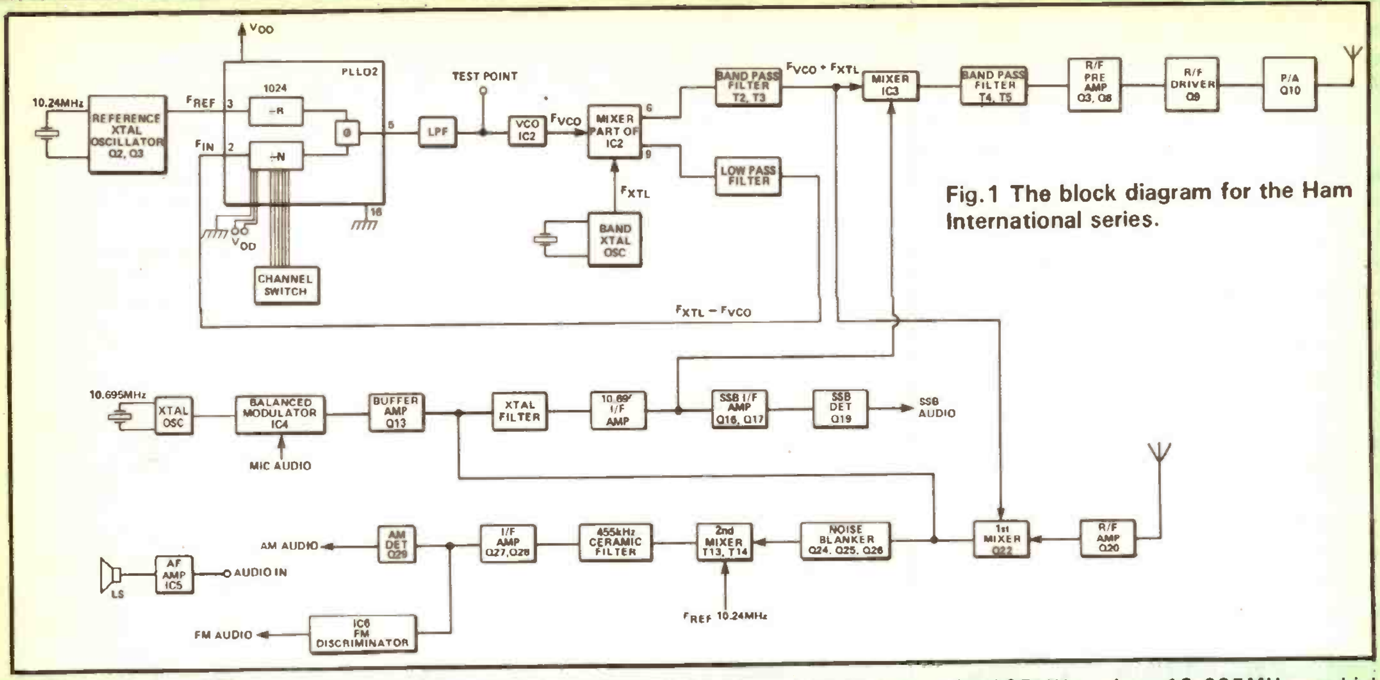


Fig.1 The block diagram for the Ham International series.

codes outright to alter the operating frequency say from 11m to 10m. One method of achieving this is to use an EPROM which will be discussed in the second part.

THE BANDS

Each band of 40 channels is selected by the down mixer crystal oscillator. This is sometimes refered to as the band crystal oscillator, whose frequency, Fxtl, is fed to a mixer which forms part of IC2. In the unconverted set, the three crystal frequencies for each group of 40 channels are 20.105MHz, 20.330MHz, and 20.555MHz for the PTBM121D4X PCB, and at half the frequency for the PTBM059COX PCB. The crystals operate in a fundamental mode with a capacity of about 28pF.

In the Multimode II and Jumbo models, the crystal oscillator circuit is different. The crystal oscillator is contained on PCB number PTOS006A0X and it oscillates at half the frequency. This is then doubled by a tuned circuit comprising T1 to arrive at the correct frequency to be injected into the mixer IC2.

LOOP FREQUENCIES

In the unconverted set, the VCO operates in the frequency range of 17.555 – 18.445MHz in the AM/FM/USB mode and 17.5535 – 18.4424MHz in the LSB mode. The additive products of mixing Fvco and Fxtl will produce frequencies operating in the range 37.66 – 39.0MHz in the AM/FM/USB mode and between 37.657 – 38.997MHz in the LSB mode.

A low pass filter selects the subtractive product of mixing and will appear in the frequency range from 2.55MHz down to 2.11MHz. The band crystal oscillator will oscillate at 20.105MHz on the low band, 20.330MHz on mid and 20.555MHz on high for the AM/FM/USB modes of operation. When the LSB mode of operation is selected, the crystal oscillator will operate at a frequency 3kHz lower. This is achieved by transistor Q2, which changes the capacitance in the crystal oscillator circuit. Remember the Multimode II and Jumbo models' crystal oscillators oscillate at half the frequency; so on LSB, the crystal will operate at 1.5kHz lower. This will turn out to be 3kHz lower when the frequency is doubled by T1.

SIDEBAND OSCILLATOR

The sideband crystal oscillator, Q11 or Q12 depending upon the model you have, will operate at 10.695MHz in AM/FM/USB mode, and 10.692MHz on LSB. The output Fvco + Fxtl of the band pass filter T2 and T3 is fed to the transmit mixer IC3. There it is mixed with the frequency generated by the sideband crystal oscillator to produce a transmit frequency in the 26.965 – 28.305MHz frequency range.

On SSB, double sideband modulation is produced at the output of the balanced modulator IC4 with the audio output signal from the microphone amplified by IC5. The output of the balanced mixer is fed to a crystal filter which has a pass band restricted to 3.5kHz. Thus allowing only one sideband to pass through depending upon the frequency of the sideband crystal oscillator.

THE RECEIVER

The receiver RF amplifier will amplify signals in the frequency range 29.965 – 28.305MHz. This amplified output from RF amplifier, Q20, is coupled through T9 to the receiver first mixer, Q22. Here the signal is mixed with the injected frequency derived from the output of the band pass filter T2 and T3. The injected frequency will always be 10.695MHz higher that the receiver frequency on AM/FM/USB and 10.692MHz on LSB to ensure that the signal is further amplified by the receiver first IF amplifier.

FREQUENCY GENERATION

To fully understand the principles behind the operating frequencies generation, it is useful to select an operating frequency and follow it through the block diagram shown in Fig.1. In the un-modified set operating on AM/FM/USB on channel 30 on the high band, the operating frequency will be 28.205MHz. The frequency at the output of the band pass filter T2, T3 will be 28.205MHz plus 10.695MHz, which equals 38.9MHz. The VCO will be operating at a frequency of 38.9MHz minus 20.555MHz a resultant 18.345MHz. The frequency output from the low pass filter will be 20.555MHz minus 18.345MHz equalling 2.21MHz – the input sampling frequency Fin which appears at the input to the programmable divide by N divider.

You will remember that for the loop to be locked both inputs to the phase comparator must be at the same frequency. The frequency, 10.24MHz, of the reference crystal oscillator is divided by the fixed value, 1024, the divide by N divider. This appears at one input of the phase comparator at a frequency of 10.24MHz divided by 1024 which equals 10kHz.

Therefore, it is essential that the frequency presented to the other input of the phase comparator must also be 10kHz for the loop to be locked. With an input frequency to the programmable divider of 2.21MHz, the value of the dividing number N will be 2.21MHz divided by 10kHz which gives a value of 221. The logic levels that must appear on the program lines to produce a divide by N number of 221 will correspond to the binary value of 221 obtained from Table 7.

To obtain a binary value of 221 it is required that program lines 2^7, 2^6, 2^4, 2^3, 2^2, and 2^0 should be at logic level 1, and the remaining logic lines should be at logic level 0. This will give a binary value of 128 plus 64 plus 16 plus 8 plus 4 plus 1, which equals 221. This logic bit pattern for channel 30 and the value of Fin agrees with the information shown in Table 4.

The operating frequency of the set can be altered by changing the value of N which in turn changes the value of the DC output from the phase comparator. This also controls the operating frequency of the VCO, which after mixing will affect the value of Fin – thus completing the closed loop. The operating frequency of the set can also be changed by altering the frequency of the band oscillator or down mixer crystal oscillator. With this series, different bands of 40 channels are selected by altering the crystal frequency of the band oscillator.

20.5525MHz. Therefore some gadget needs to be inserted between the channel change switch and the program lines to the PLL chip.

A cheap method of altering the program code is by using binary addition. To obtain the desired binary code of 71 for channel 40, we need to add a binary value of 52 to the channel switch code of 19. This binary value difference remains constant throughout the 40 channels. Therefore the binary values for channels 1, 30, and 40 together with the required logic levels is shown in **Table 6**.

Adding Gadget

Motorola have on the market an integrated circuit which costs about £1, which will do the job of adding two binary numbers together. It is a 4000 series CMOS type 4008, which is a four bit binary full of adder with two four bit data inputs — A_0 — A_3 and B_0 — B_3 — a carry input C_0, four sum outputs — S_3, and a carry output C_4. The type 4008 also incorporates full look ahead across 4 bits to generate the carry output C_4. This minimises the necessity for extensive look ahead and carry cascading circuits. The full circuit configuration and pin out functions are shown in **Fig. 4**.

To obtain the required binary number two 4008's will be required. The circuit diagram of the binary adder circuit is shown in **Fig 5**. The input program lines for both IC1 and IC2 are grounded through 4.7k ohm resistors to ensure that they are at logic level 0 when not being used. The logic outputs of the channel change switch are connected to A_0 — A_3 for IC1 and A_0 — A_1 for IC2. A_2 and A_3 of IC2 are not used and are therefore grounded through 4.7k ohm resistors to ensure that they remain at logic level 0.

The B inputs for both binary adder ICs are fed via 4.7k ohm resistors to either Vdd or ground to achieve the binary value of 52. The carry output of IC1 is connected to the carry input of IC2 to obtain full carry over between the two binary adder ICs. The carry input of IC1 is not used and is grounded to ensure that noise cannot trigger the input to give an incorrect output code. The carry output of IC2 is not used and pin 14 is left open circuited. The power consumption for the 4008 is less than 2 milliamps and therefore it is acceptable to use the same voltage rail which feeds the PLL02 chip.

Construction

The two binary adder IC's are mounted on a small piece of Vero board. It is wise to use IC holders and complete the soldering before inserting the two ICs to avoid possible damage. The resistors are also mounted on Vero board and ribbon cable was used to connect the Vero board, channel switch and PLL chip. The Vero board was mounted to the side of the metal chassis using a right angle bracket of the style used to mount the other sub PCBs.

In the second part, Roger will be dealing with the extended frequency range, the EPROM to be used, and the repeater shift.

Free Readers' ADS!

WANTED

WANTED Yaesu YK-901 keyboard also a late FRG7700M reasonable proce please. Phone Colchester 394336 (Essex).

WANTED for spares non working Hammarlund HQ180 Rx, with clock timer. Also matching speaker model S-200 for HQ180A Rx. Must be in good condition. 0875 52317.

WANTED Datong morse tutor. Exchange for realistic DX-100L 5-band general coverage receiver mint condition or sell £40 telephone 051 525 4196 G6PBJ.

WANTED Radcom and QST magazine reviews of Yaesu FT301 Tx/Rx and accessories. Expenses paid. Tel St Albans 39333.

WANTED for JR310 Trio, 19.955 MHz crystal and 10AZ narrow filter. Also any parts of chassis etc for JR310. Harmer, 9 Park Square East, Jaywick, Clacton, Essex.

WANTED Icom IC730 FM board. Must have fitting instructions etc or full circuit diagram and construction details — David G0AFP tel 0900 826461.

WANTED Practical Wireless 1930s 1960 Radio Constructor Bernard, book George Newnes, fair price paid. J Savage, 7 Weyhill Close, Park North, Swindon.

WANTED 3 element tri band beam and rotator must be good working order. Good price paid for right units. Phone 0647 52520.

WANTED Palm 2 or Palm 4 handheld transceiver or similar commercial equipment for V/UHF also lowband handheld, all must be complete. No silly prices please. Phone John 0280 702900.

WANTED Pye Cambridge service manual 70MHz/FM buy or borrow to make copy. Any information on convertion to 4 meters welcome. Phone Phil 0535 65262 or write to J.P. Barras, 26 Wimborne Drive, Keighley, W. Yorkshire BD21 2TR.

WANTED 6 meter or 4 meter convertor for Yaesu FR101 receiver. Tel Wrexham 262757.

WANTED 10M Rx/Tx must cover 28 and 29.99 MHz CW and SSB, commercial or home brew in good cond. Telephone Rodger GM3JOB 0294 215728.

WANTED power supply 5A or 10A. Must be in perfect working order. Write to: David Mitchell, Westfield, Rillington Fields, Scagglethorpe, Malton, North Yorkshire, YO17 8EB.

WANTED Schematic diagram for Marconi CR300 will accept original or photocopy. Any costs will be refunded. Please telephone 0783 488 995 (Sunderland).

WANTED HF (prefer scanning) all mode receiver. Also transceivers mobile and base suitable glider freq. 129.90 130.10 etc. Also scanning VHF receiver 25MHz to 550MHz (no breaks) cash awaits. Tel 085 886 452 late eves or Sundays.

WANTED service, alignment details plus circuit diagram for Trio 9R-59DS receiver original or photocopy. Name your price or expenses reimbursed. Phone Alan, Basildon (0268) 45573 after 6pm or write G1EBH QTHR.

MOBILE mount for FT290R wanted. G0ANF, Penzance 63084.

WANTED RTTY transceive program for Commodore C16, on cassette. Also copy of circuit diagram C16. G6KYT tel 0424 213479. 9 Collington Ave, Bexhill, East Sussex TN39 3PX.

WANTED urgently DSB 80,

must be well made. Please tel Don G0AMH (0323) 898515 QTHR.

WANTED Codar AT5 Tx. Heathkit DX40, DX60 and also FTDX 401 T/R. Send condition and price to Marris, 35 Kingswood House, Farnham Road, Slough, Berks, SL2 1DA.

WANTED FT101 ZD/AM/FM FT102 AM/FM also ATU 160-10 WARC must be good condition. Your price paid. Please ring John, L'Pool 051 480 4862.

WANTED to purchase or loan manuals or circuit diagrams of Cossor 1045K oscilloscope and Truvox amplifier TSA200 all letters answeres. T Truran, Fairview, Green Bottom, Chancewater, Truro TR4 8QQ Cornwall.

WANTED Bearcat or similar scanner 22D FB prefer not working, must be cheap. Tel (0772) 634194 before 8pm.

WANTED Trio R.1000 general coverage Rx or similar must have direct readout be in good condition. Will swap for cash. Phone 302 4204 anytime — 9am-9pm.

WANTED Yaesu FT-480R in vgc. N. Purkins, 32 Astral Road, Hessle, North Humberside HU13 9DD. Tel 0482 644122 after 6pm.

WANTED Murphy type 618 HF Tx AP 100333 and power unit AP 100336 also Marconi Elettra receiver — G4FUY QTHR. Phone Reading 733633.

WANTED service info or circuit diagram for advance timer counter type TC9Bm loan or purchase, all costs refunded. Also FREE GEC colour TV with I/output fault, must collect. Phone Mike Hadley (G4JXX) on 021 773 8139 after 6pm.

WANTED IC260A or E must be perfect condx and reasonably local to Kent area. Motorola NiCad packs (2) for HB h/helds. Info on Lunar 2M10-150P linear or lunar dealer in UK will defray expenses. For sale: 2 large variable capacitors (QRO ATU?) 2 transformers (Ferro-Mag) for 1-50V PSU offers. Mark, G4RGB Tel: Medway (0634) 30822. QTHR 1984/5 callbook.

WANTED info, circuits, manuals, etc for Ultra Electronics Tx/Rx type 3A4A83, 3 channel, believed low band AM. Also for Furzehill scope 1684D/2. All letters answered, costs refunded. Nick G6AJY 30 Aukland Road, Kingston, Surrey. Evenings 01 549 1983, day 01 7474 304/5.

WANTED in FB condition FT102 or 1012D with an ATU £300 ono for M7 FT757 and auto ATU and HDPSU rig 6 month old rest new G4WIE QTHR 01 987 2296 or 01 240 1277.

WANTED Solartron CD1740 oscilloscope mains power supply module or non working CD1740 with good PSU or info on the possible source of supply of a PSU. Please contact Alan G6LTN on 0945 860800 Wisbech, Cambs or try 144.300 evenings!

WANTED FRG-7700M must be late one, mint condition. Also Yaesu YK-901 keyboard. Phone Colchester 394336 Essex.

WANTED Yaesu FRG-7 or Lowe SRX-30 in good condition. Please write or phone, Peter Wood, 2 Yew Tree House, Queens Road, Crowborough, E. Sussex. Tel Crowborough (08926) 63061 (reverse charges).

WANTED Icom IC251E with or without muTek front end G3XKN Toddington, Bedfordshire 05255 2207.

WANTED transverter for 2mtr to fit FT707 Tx and Rx anything considered eg homebrew. Must be cheap and working. Tel Paul 01 961 4659.

WANTED FP707 PSU working or not but cheap. Paul 01 961 4659.

EDDYSTONE 940 would consider 840 in good condition. Also wanted old interesting morse keys or telegraphy equipment — old crystal sets and a bencher paddle. Could collect within 50 mile radius of London. G4PDT phone 01 952 9548.

WANTED Sony airband reciever if you can help me acquire one of these small radios please contact me: John Higgins, 30 Under Wood Road, Portishead, Nr Bristol, Avon BS20 8PS. Tel 845351 (0272).

TWO METRE rig wanted any condition acceptable, any type acceptable, any age acceptable. Will collect London area. Dave 729 6925.

WANTED: plug in units and information on Cossor CDU110 oscilloscope and information on microwave modules 28/144 transverter G3PTD 88 Sandy Lane, Stretford, Manchester.

WANTED to provide spare parts: old codar AT5 Txs and Heathkit RA1 Rxs. Condition not important as long as complete and not 'bashed in' metalwork. Details and price to Marris, 35 Kingswood House, Farnham Road, Slough, Berks SL2 1DA.

HELP impoverished SWL needs triple oil filled DC smoothing condensor for his cherished AR88LF. Present one has dumped its oil. Urgently requied for morse practice as test is already booked. Phone 0454 614178 (Bristol).

WANTED Sony ICF 2001 or ICF200D must be mint have oscilloscope solartron CD1220 with three plug ins big but beautiful. Exchange or sell also Russian oscilloscope C1-16 true dual beam both with manuals both cheap. Phone 0945 860475 ask for Alex.

WANTED FTV 707 frame or exchange for FTV107. For sale MML 432/20 linear with preamp £50. MMT 28/144 transverter, OK 10M FM — £45. Star 8480 RS232 printer £75. All vgc and ono. Dave G3ZOI QTHR Reading 332777.

WANTED Belcom LS102L also NATO 2000 phone 0283 221870. For sale Ham multi 2 £110. Hygain £90 phone 0283 221870.

WANTED valves: 'R' type to KT88, any quantity, output triodes specially wanted. All valve wireless, communications, audio equipment and crystal sets. Early quality value hi-fi amplifiers, tuners, turntables, speakers, pickups and heads, Deccola, Dynatron and similar radiograms, separates. Compact, transportable Military receivers, transceivers, spy-sets etc, American midget radio-sets, Ekco, Philips, Philco, Bakerlite radios and speakers. Please write: John Baker, 57 Birkenhead Street, London QC1H 8BB (01 833 3008).

I have a problem PSU manufactured by D Reinhardt Can anyone supply me with their address? Phone Geoff Bracknell 52601.

WANTED linear amp 80-10 FL2100, HA14, KW1000 or good home brew. Phone Barry Macklin, Basingstoke 0256 475466 daytime.

WANTED Yaesu FT200 information, reviews, accessories etc. Also wanted information etc on the 'Jupiter' 80/160m transmitter and June 1968 issue of 'The Radio Constructor' (or photocopy of article) SB Mattinson, 22 Churchill Crescent, Sonning Common, Reading RG4 9RX.

WANTED newcomer to SWL required general coverage receivers. Condition unimportant, working or otherwise. Look around the shack, see what you can spare. Reasonable prices offered. All letters answered. Mr Whylie, 5/4 Greendykes House, 14 Greendykes Road, Edinburgh EH16 4JJ.

WANTED Eddystone 888-A receiver. Condition immaterial but must be 'A' model and BFO must be OK. Tel G3VDL 02404 2268 (S. Bucks).

WANTED transverter from 2 meters to 70cms, also has anyone out there any info on the Grundig Sataliit 3400 HF receiver? Brian Barwick G1ESG 100 Westwood, Golcar, Huddersfield HD7 4JK telephone daytime 0274 663928

WANTED OAP requires secondhand Tx/Rx preferably valve job. Must be in first class condition. Prefer TS 520/30 or American gear. Have for sale KW Viceroy mark 111A. Working but needs attention £40 ono. Pryse 36 Hart Road, Byfleet, Surrey KT14 7NH (G3WXT).

HELP can anybody help with circuit for the Lafayette KT320 HE 30 or the drawing of the BFO circuit will pay all costs, have Marconi valve millivolt meter TF899 manual sell or WHY books valves circuits SAE for wants. 0622 61327.

WANTED Heathkit DX40, DX60, DX100, SB401, HW16, also Codar AT5 plus ACPU. Must be in good working condition. No rubbish. Please write to Marris, 35 Kingswood House, Farnham Road, Slough, Berks SL2 1DA.

WANTED linear amplifier Icom IC2KL or Trio TL922 East Grinstead (0342) 312374.

EXCHANGE

EXCHANGE Icom 255E 2M mobile rig for 2m hand held with charger. Phone Pete G1 HED 0705 455389 after 5.30pm.

EXCHANGE realistic DX400 brand new for communication rx. Must have manual tuning age porevents the uyse of keypad tuning or sell £130. Harvey 93 Lockend Road, Gartcosh, Nr Glasgow. Tel. Glenboig 872656 G96 8AB.

EXCHANGE Shimizu SSI05A, Trio TL120 linear (200w pep), Trio NC35s mike, MMT144/28 T'Verter and Reace 05F HF Freq counter for: Trio 430S or Yaesu FT757GX or 400W all band HF valve amplifier. Also have 10M allmode QRP transmitter/Receiver (28 to 29.795) 4W AM/FM 12W SSB and CW Has tape output socket and PA as well as freq counter socket and mike. Sell for £195 ono. Also offers for RT707 no mods. G4XPP, 10 Bowness Rd, Coniston Rk Estate, Timperley WA15 7YA.

EXCHANGE Sommerkamp FT277 HF transceiver plus microwave modules two-metre transverter for two-metre multi mode base station. I have new HF rig. Offers for Marine Six-channel VHF Transceiver installation. Phone evenings 0229 62932 or daytime 0229 20351 ext 5342.

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SWAP SR9 receiver c/w power supply and pre-amp for 2m hand-held transceiver. Approx valve £50. Mr Henshaw, 60 Bude Crescent, Stevenage.

RACAL wieghtlifters club. Seeks hardware! but seriously folks I'm looking for gear, MA79 Tx, Ta99 amp, Pu99 supply. Also MA144 ATU. Have some cash but would like to exchange gear. Please call with enquiries, Have allsorts. Eddie N. London. 01-445 0528.

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EXCHANGE Zenith EM SLR camera, light meter computer flash, Tripod X2 converter X3 converter + sundries, automatic slide projector, 3 slide magazines, Free standing screen. 4ft by 4ft for FT290R or Similar 2m multi mode. Phone Gerry Fakenham 701436. Norfolk.

EXCHANGEFujica SLR camera. 1.8 lens Pentax 105 M/M lens, Chinon 28mm lens, close-up lens, leather carrying cases. All mint. Little used for vhf or UHF rig or HF equipment, satisfaction. Both ways. Tel 0952 618972 Midlands area.

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YAESU FT1012D mk3, FM

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FOR SALE Bomber command communications receiver 18/7.5, 7.5/30, 3.0/7.5 MHz, 1500/600, 500/200, kHz £40. Another 18/7.5 7.5/3.0 MHz, 1500/600, 500/200, 200/70kHz £40 Beckenham Greater London tel 01 650 3686.

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KW204 excellent condition £90 only or consider part exchange HF transceiver also want help, anyone got spare osc moxer cans for B40? G3RNB Stan, Williton Lodge, Williton, Taunton TA4 4DL 0984 33115.

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FOR SALE Mullard high speed valve tester complete with cards and adaptors £25. collect from Mr Atkins, 17 Cherry Court, Longwood Gardens, Barkingside, Ilford, Essex.

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1. These advertisements are offered as a free service to readers who are not engaged in buying or selling the same equipment or services on a commercial basis. Readers who are should contact our advertising department who will be pleased to help.
2. Advertisements will be inserted as and when space becomes available.
3. The insertion of advertisements will be on a first-come, first-served basis, subject to condition (2). As a result, it will not be possible to guarantee the insertion of a particular advertisement into any particular issue of the magazine.
4. Readers should either write out their advertisement in BLOCK CAPITALS or type it, underlining any words that are to appear in **bold**.
5. The magazine cannot accept any responsibility for printers' errors in the advertisements; however, we will do our best to ensure that legibly written advertisements are reproduced correctly. In the event of a gross error, at the Editor's discretion, a corrected version of the advertisement will be printed (at the advertiser's request) at the earliest issue in which space is available.
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7. The magazine reserves the right to refuse to accept or to delete sections of advertisements where this is judged necessary.
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