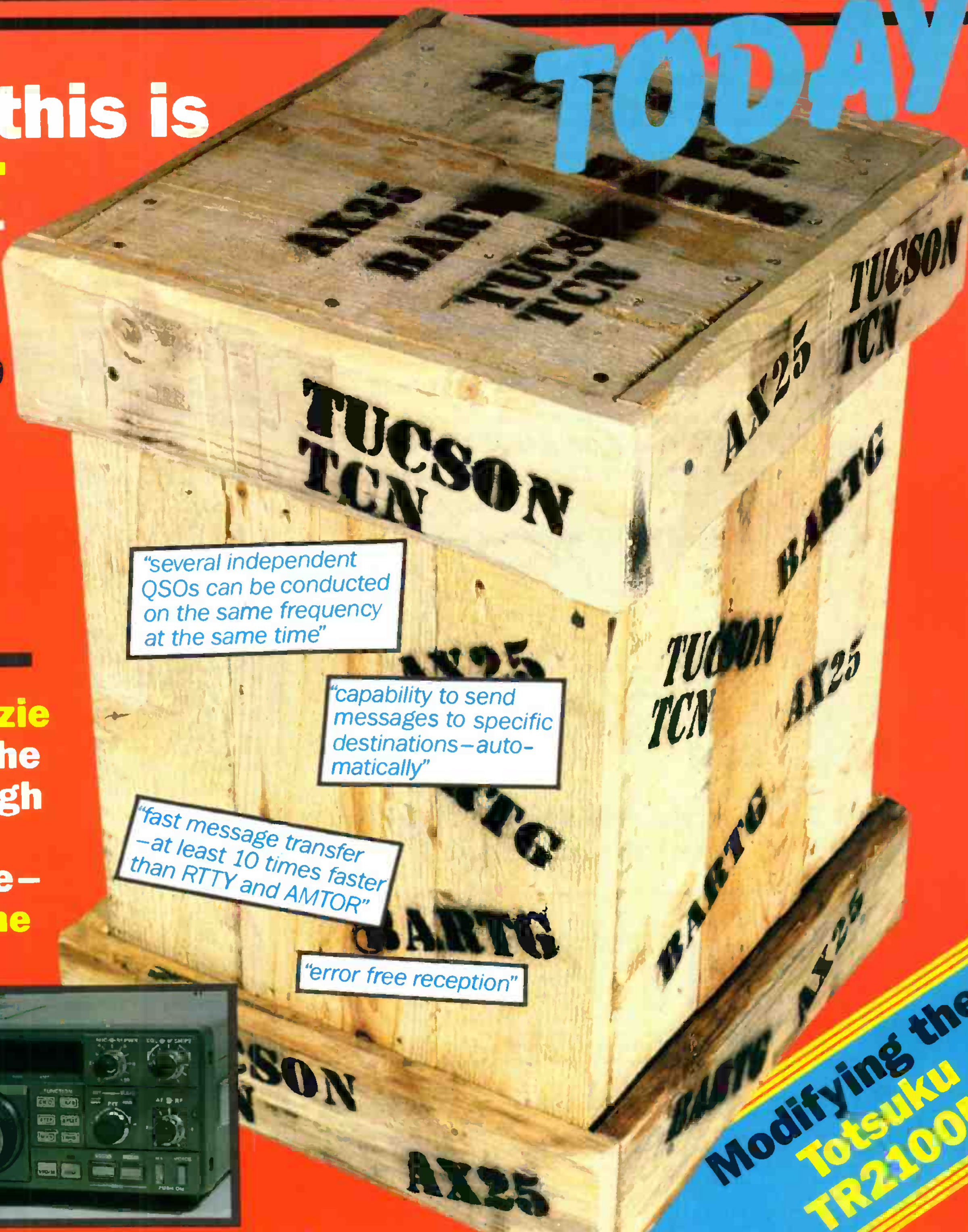
HAM RADIO TODAY

AN ARGUS SPECIALIST PUBLICATION

February 1985

99p



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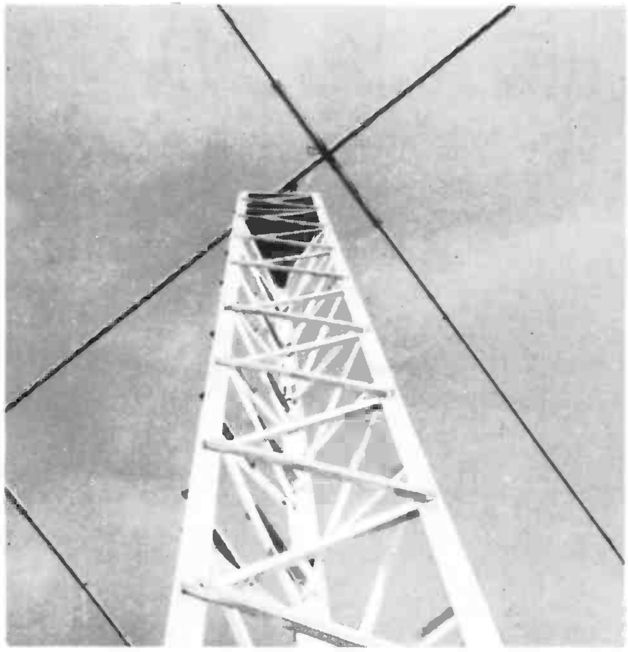

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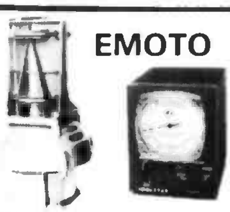

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Steve Ireland, G3ZZD
Editorial Assistant
Julie Darby, G1CKF
Group Editor
Dave Bradshaw, G1HRT
Advertisement Manager
Dave Gadsden, G4NXV
Classified Sales Executive
Jason Inskip
Chairman
Jim Connell

Designed by:
MM Design & Print
Published by:
Argus Specialist Publications Ltd.,
1,Golden Square,
London W1R 3AB.
Telephone: 01-437 0626
Distributed by:
SM Distribution Ltd.
Printed by.
The Garden City Press Ltd.
Subscription Rate
UK £14.50
O/Seas Sur: £16.00
USA Sur: $21.00
O/Seas Air: £31.00
Ham Radio Today,
Subscriptions Dept,
Infonet Ltd,
Times House,
179 The Marlowes,
Hemel Hempstead,
Herts HP1 1BB
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LETTERS

MORE TRAINING NEEDED

Sir, I have read with great interest the comments of Ian Abel, G3ZHI, on the subject of an amateur radio novice licence. The ideas he proposes (ie those of Letters September '84 *HRT*) seem reasonable and attractive as a basis for such a licence.

I was licensed about 18 months ago with the callsign I have now and, as soon as I could, I went to my local emporium and bought the largest and best 'black box' I could afford. I have since discovered that the 3 years of short-wave listening and the RAE were not much help in keeping me afloat. The actual operation of transmitting I found to be, very different to what I expected. All this rather lengthy info does have a point however, namely that my initial experiences suggested to me that I was very much a novice when I started, irrespective of the level of the RAE and the quantity of my previous listening experience. I am now a seasoned 'black box' operator and I have just realised that my interest in the hobby has begun to wane.

My solution is to embark on a constructional project (one selected from the vast library of the Rev. Dobbs). I have once again stumbled up against limited knowledge on my own behalf and have had to resort to calling on the help of my friends and masters, who have more experience in such matters. My conclusion is a simple, the present system has all the characteristics of producing radio amateurs of minimum [real?] qualifications (such as me). The creation of a novice licence may be detrimental to the hobby after all, in that a novice will only be taken by the examination system to the point that I have reached!

Why not then, at the same time as introducing a novice licence, also introduce an advanced level examination to encourage even further the 'apprenticeship' in the hobby. The present licence would then be reduced to the level of a 'technical' or mid-range qualification, with the novice licence serving as an introduction and the advanced licence providing a greater knowledge of electronics in particular and perhaps even a faster speed in morse than the present 12wpm. Thus we will have created a tuition system very similar to that used in the USA and other countries.

I wonder what the readers of *HRT* think of these ideas and perhaps they would like to propose a few details. I believe an examination and tuition system should provide as much for its students as possible, but the present system did not meet my requirements and I wonder if a novice licence is sufficient in itself to improve matters.

Sid Collings, G4SGI

The square brackets indicate added editorial.

TOO HOT UNDER THE COLLAR?

Sir, I would like to thank *'Ham Radio Today'* for publishing the truth about the 'Amateur Radio Novice Licence Campaign' and the novice licence issue. While Radcom, the organ of the RSGB, publishes lies and misinformation in order to manipulate its membership it is good that persons like myself can get the truth across. Despite what people read in Radcom, the RSGB now have a proposal for a novice licence which they are soon to present to the DTI. The sooner the RSGB starts being open and honest with its membership and the wider amateur community, the better it will be for the hobby's future. For too long the RSGB have sought to manipulate the community and it's time it stopped.

Ian Abel, G3ZHI

Frankly, Ian, some of the above is, to say the least, well OTT. I support the idea of a novice licence along the lines in my answer to you in 'Letters' September — CW only, say, on 3.56 and 28 MHz with a power input of 10W, which is not that different from the ARNLC proposal. The letter from Sid Collings, above, admirably makes the case for the introduction of an element of self training in our hobby, if it is not to stagnate.

The introduction of a novice licence of any kind is bound to raise controversy. I appreciate that you probably have suffered for your persistence in some quarters, but to accuse the RSGB of publishing "lies and misinformation in order to manipulate its membership" is tactless, inflamatory, scabrous and extremely unlikely to win you any new allies to ARNLC.

"DO YOU DRIVE FOR A LIVING?"

Sir, I wonder if it would be possible for you to publish this letter in order to establish the viability of an Association for Professional Drivers within the world of amateur radio.

I personally spend a good deal of my time on the road and encounter a large number of amateurs who are, like myself, HGV Drivers or otherwise employed in service or sales related fields.

The idea of forming some kind of association was not, I must admit, wholly my own. It started some weeks ago when in QSO with a small group of mainly HGV drivers through the Motherwell repeater GB3CS. Another station suggested that we form our own club for 'Truckers', not a term I relish, but it started the seed of an idea.

A few weeks later when in QSO through the Barnsley repeater GB3NA, again with a group of mostly HGV drivers, the idea of a giant repeater for HGV's was joked about. I promptly passed on the idea of our own association.

The idea was received with an enthusiasm I did not expect, the only change to the original idea being the inclusion of 'all' professional drivers ie anyone who spends his, or her, working hours at the wheel.

The outcome of this discussion is this letter, in order to feel the ground as it were. Although it is not intended to be too formal in structure any idea etc from any amateurs interested in such an association would be most welcome. Initially write c/o
PO Box 122,
Earls Barton,
Northampton NN6 0DE.
(Please enclose SAE)

Martyn Thompson, G1KIH

THE OLD 5m BAND

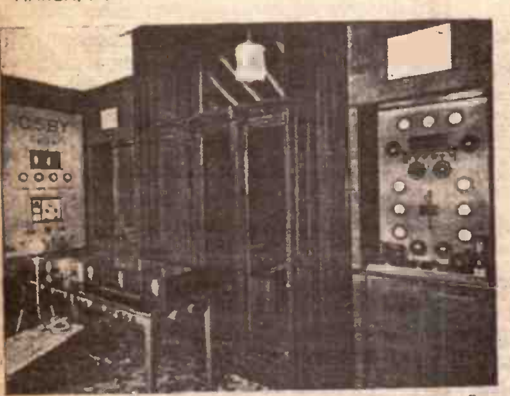
Sir, I was very interested in G3BDQ's nostalgic trip to the golden age of 'Ham Radio'. As a youngster in the thirties I built and experimented with circuits in the 30-150 MHz range. The 'superegen's' were very effective

MARCH, 1937

TELEVISION AND SHORT-WAVE WORLD

A 5-metre Record

This account of G5BY's recent activity on 5 metres will supply the answer to those U.S. amateur stations who have been wondering just what has happened to G5BY on 10 and 20 metres. This station is owned and operated by Hilton L. O'Heffernan, of Croydon.



Left to right. 500-watt modulator and control panel for all transmitters. On table, monitor, frequency meter, 5 metre receiver, 160, 80, 40, 20 metre receiver, 10 metre receiver. The transmitter on the right is the 250 watt 80, 40, and 20 meter crystal controlled arrangement with 100 per cent. modulation on phone. Above this transmitter is the first British WAC—for phone certificate, while the trophy in the window is G5BY's most treasured possession, the A.R.R.L., 1929 Award for the world's best amateur station.

IN our February issue we mentioned very briefly how G5BY had been heard in America by the amateur

For some considerable time has been experimenting with controlled equipment on 5

25-mmfd. variable condenser in this circuit controls the

receivers and I picked up a bit of DX on 56 MHz in the way of police transmissions and the occasional French 'ham' with dipole or W8JK antennas. I graduated to more sophisticated superhet circuits using acorn valve oscillators and incorporating a few of my own idea.

Unofficially I built and used a Tx roughly on the lines of G5BY's to good effect. It might be of interest to readers to see the rig '3BDQ mentions built by G5BY — Hilton L O'Heffernan who was (and *is* apparently) an exceptionally gifted and clever radio man.

Enclosed therefore are extracts from Television and SW World from March 1937.

Trevor Owen

MORE FM CHANNELS ON 2m

Sir, Recently I was 'evicted' from three different frequencies, when trying to conduct a 2 metre FM simplex conversation, on the grounds that I was contravening the recommendations of the band plan. As there were many QSOs taking place at the time, due to not being able to find a place to chat, the QSO was abandoned. This episode set me thinking.

I have attached a schedule to illustrate my conclusions, but to summarise this, it would appear that, if you assume strict adherence to the recommended band plan, then, in the 144 MHz section, there are 8 FM frequencies 100% usable (based on 25 kHz separations). In the 145 MHz section (ignoring repeater in & out frequencies, and also S20), there are a further 12 simplex FM frequencies available (assuming the RTTY people only use their calling channel!) Whilst I appreciate that I am perhaps contriving the worst possible circumstances, nevertheless, there are still only 20 'legal' channels available (to two 'fixed' stations).

Having discussed this on the air with various stations, the two general comments, once the correctness of my allegations are proved, are, 'What about 70 cms?', or, 'What about SSB?' . . .

. . . I wonder if there are three possible solutions. The first is less strict adherence to the recommendations of the band plans ('ANARCHY ON THE AIRWAVES' screams RadCom!), which, whilst a small answer, seems to go against the whole 'gentlemanly' spirit of amateur radio, and seem to be a backward step. The second possibility, is, I feel, perhaps more worthy of thought, and that is a reduction of the FM channelising to, perhaps, 12.5 kHz channel separation, with of course, a reduction of the deviation to an appropriate level. As it seems to me that 2 metres is basically a 'black box' band, I believe that the majority of Japanese rigs are fairly easily modifiable to achieve this. The final possibility, and this I am sure will be the most controversial, is a slight restructuring of the bandplan frequency allocation of SSB & CW. According to my calculations, there are the equivalent of 15 × 25 kHz chunks allocated to SSB & CW — both among the most economic users of the frequencies. By — perhaps — amending the recommendations to say, 144.175-144.375 then this would open up more space for FM operation on 144 MHz.

I must admit that I am aware that the above discussion proposals seem to be verging on sacriledge, but with the ever increasing usage of 2m spectrum, perhaps now is the time to plan for the future.

Bryan Ewing, G6UBB

P.S. I am (also) a keen practitioner of 2m SSB DXing — which is my main 2m interest.

Due to the lack of space Bryan's letter has been regrettably shortened.

Certainly, around London, 12.5 kHz channel spacing is getting to be an absolute necessity. Most fairly recently made 'black boxes' can be easily adapted for 12.5 kHz, indeed many already have the facility at the touch of a button. I have recently noticed that there are many people already using 12.5 kHz spacing within Greater London. If the band plan doesn't change soon, 12.5 kHz channelling is likely to happen anyway. . .

POSSIBLE MISMATCH

Sir, the other day I went into a local CB shop. There were three people in the shop. One was behind the counter, one was a customer, and the third repaired rigs etc for the ship. A CB radio was on in the shop, and upon hearing several voices at the same time from the rig, the 'repairman' stated "that's bleedover". 'Bleedover' appears to encompass a number of receiver problems including blocking, and, in this case, cross modulation.

The customer agreed, and then went on to say that a particular CB in the shop was "a good rig, but you have to whop the crystals out." Translated, this means that to achieve an improvement in receiver performance, the ceramic 1st IF filter should be replaced by a cyrstal filter. Normal CBers gibberish, you may conclude, but the aspect that caused me concern is that the customer had gone into the shop to purchase some sort of adaptor to connect his 2m whip to his CB aerial mag mount. If this incident is not a good argument for making the Class B more difficult to get then, I don't know what is.

Incidentally, I am not a radio ham, **I am a CBer**, but I can see 2m going the same way as 27 MHz.

P J Snaden

Please address correspondence to:
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RADIO TODAY

Compact Vertical With WARC Bands

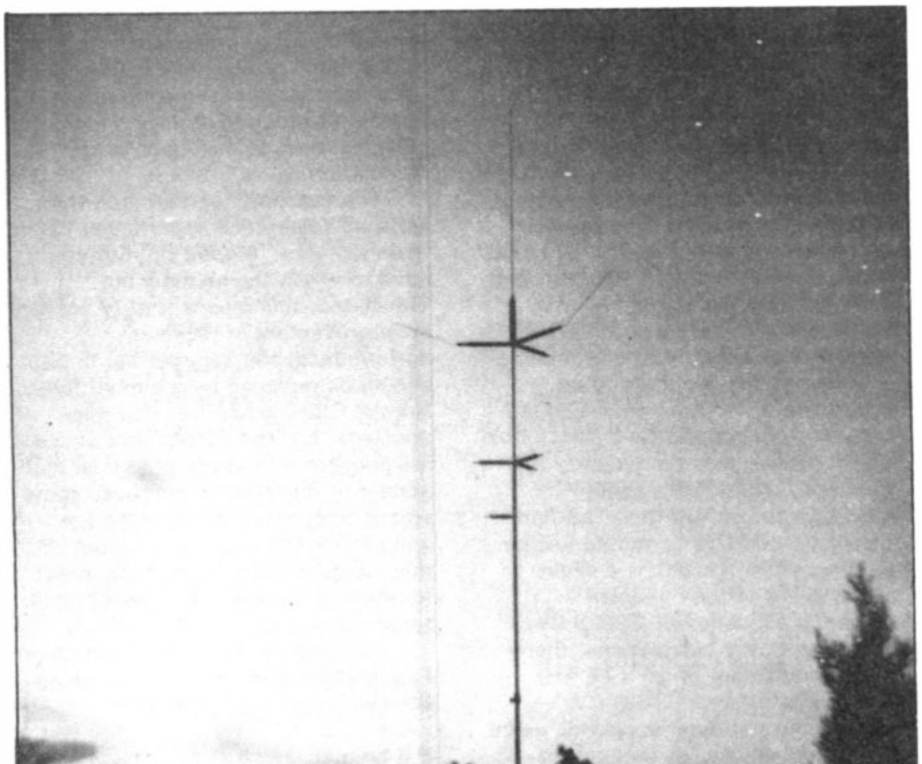
'G Whip' antennas have been around for some 14 years, manufacturing antennas for both commercial and amateur applications, with sales of mobile antennas totalling over 11,000 worldwide. The brainchild of Frank Pardy, GW3DZJ, 'G-Whips' can be found on vehicles, base installations — including, apparently, Embassies — all around the world and throughout the HF spectrum of 2-30 MHz. One of Frank's proudest achievements has been the sale of quite a number of antennas to Japan. Back when the Editor was first licensed and 160m mobile was king, *the* Topband antenna to have was a 'G-Whip'.

'G-Whip' have recently launched a new compact base antenna for all bands 80-10m *including the WARC bands, 30, 12, and 17m.* Using a combination of top loading and LC type traps, the antenna provides a vertical electrical quarter wave radiator on each band and has a maximum height of some fifteen feet. The antenna is designed to be mounted at ground level upon its mounting/earthing stake and with the accessible short length is said to be very easy to tune. Frank recommends that the lawn be slit slightly to allow the burying of additional earth wires, although it is claimed that "effective DX communication is normal with the minimal arrangement supplied". (By the way, the Editor has tried the aforementioned lawn slitting and this is not as drastic as it sounds — into a slit made with a spade a radial or two is dropped and, after a gentle walk along the line of the slit, nothing may be seen of the surgery, even by the most observant XYL/OM).

The G8-100 is coaxial fed with 50 ohm cable direct from the transceiver. On the whole, apparently, "there is no need for an Aerial Tuning Unit." On 80m, the narrow bandwidth of the (physically) very short antenna can be improved with an ATU. G-Whip are believed to be developing an 'add-on' to permit ATU-less operation in, say, the CW portion as well as the phone. Other bands, it seems "should not prove to be a problem" in this respect, the antenna providing "considerable coverage within the bands".

Power rating of the antenna is 100W PEP or 75W CW. For the SWL who is interested in broadcast band listening, additional traps may be provided for these bands — at an extra costs.

Further details are available from 'G-Whip' Products, 4 Bryn Coed, St. Asaph, Clwyd.



Across The Pond on 2m — Can It Be Done?

by David Green, G4OTV

Back in October 1983, some of the members of the West Kent Amateur Radio Society began feeling that it would be an interesting project to organise a radio dxpedition to take place in the summer of 1985. The club is an active one based in the Royal borough of Tunbridge Wells in Kent and has been well known for being in the forefront of amateur radio activity in the area since 1948.

Once the initial dxpedition idea had been put forward, a group of interested members got together to decide on a destination and a major objective for the expedition to achieve. Turning first to possible destinations, a number were considered including Andorra (members had been there twice before), the Balearic Islands (DX in a bikini?), Luxembourg (too easy), the Faroe Islands (too expensive), Liechtenstein, San Marino and the Aran Islands (off the west coast of Ireland). The final choice was in favour of the Aran Islands for two reasons.

Firstly it had been suggested that the club might consider a very major, once in a lifetime, dxpedition to somewhere terribly exotic in about ten years time and the 1985 expedition could be seen as a training ground for that. The Aran Islands consist of a group of three islands, the largest of which is Inishmore where it is hoped to establish a camp at the ruins of the fort of Dun Aengus. There are no roll on/roll off ferries to the island and the group will have to lug all its equipment (about one ton) up to the castle by the 'arm-strong' method!

The second and most compelling reason for choosing the Aran Islands was. . . The Brainwave. This came from an old hand at expeditions and 2m DX enthusiast, Roger, G4BIA, whilst thinking about expedition objectives and this was that we should attempt to make the first ever direct transatlantic QSO on 2 metres.

The next parish to the west of Inishmore is in North America, although the distance between the two is a few thousand miles! That's the gap which the group will be attempting to bridge in August 1985 with a formidable collection of equipment, propagation permitting.

The expedition will take place over a two week period commencing on August 17th, with skeds being arranged both with the USA and Canada. For the first week, the group will operate from Inishmore. If no successful cross-pond QSO takes place then the group will move back to the Irish mainland to try again the second week from a high site in the mountains of Galway.

So, far, hundreds of man (and woman) hours have gone into the research and organisation of this expedition — with much more still to do in order to give the group the best possible chance of meeting their stated objective. More information will be provided over the next few months.

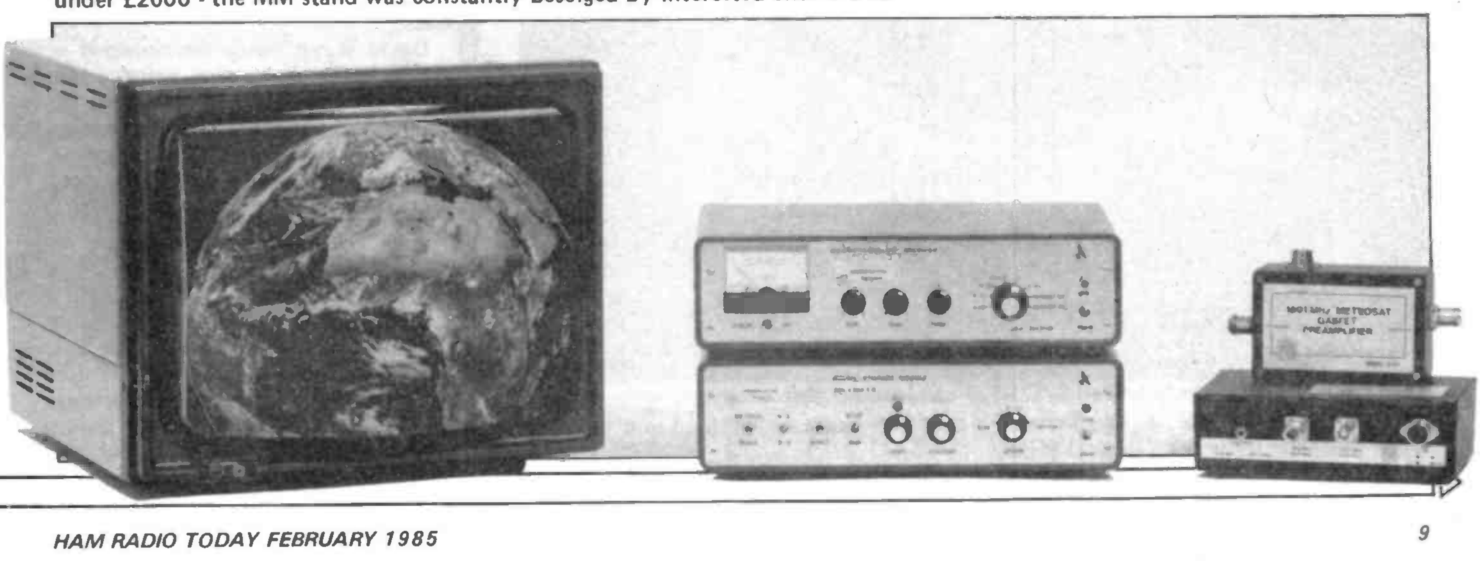
Don't Be Overcharged!

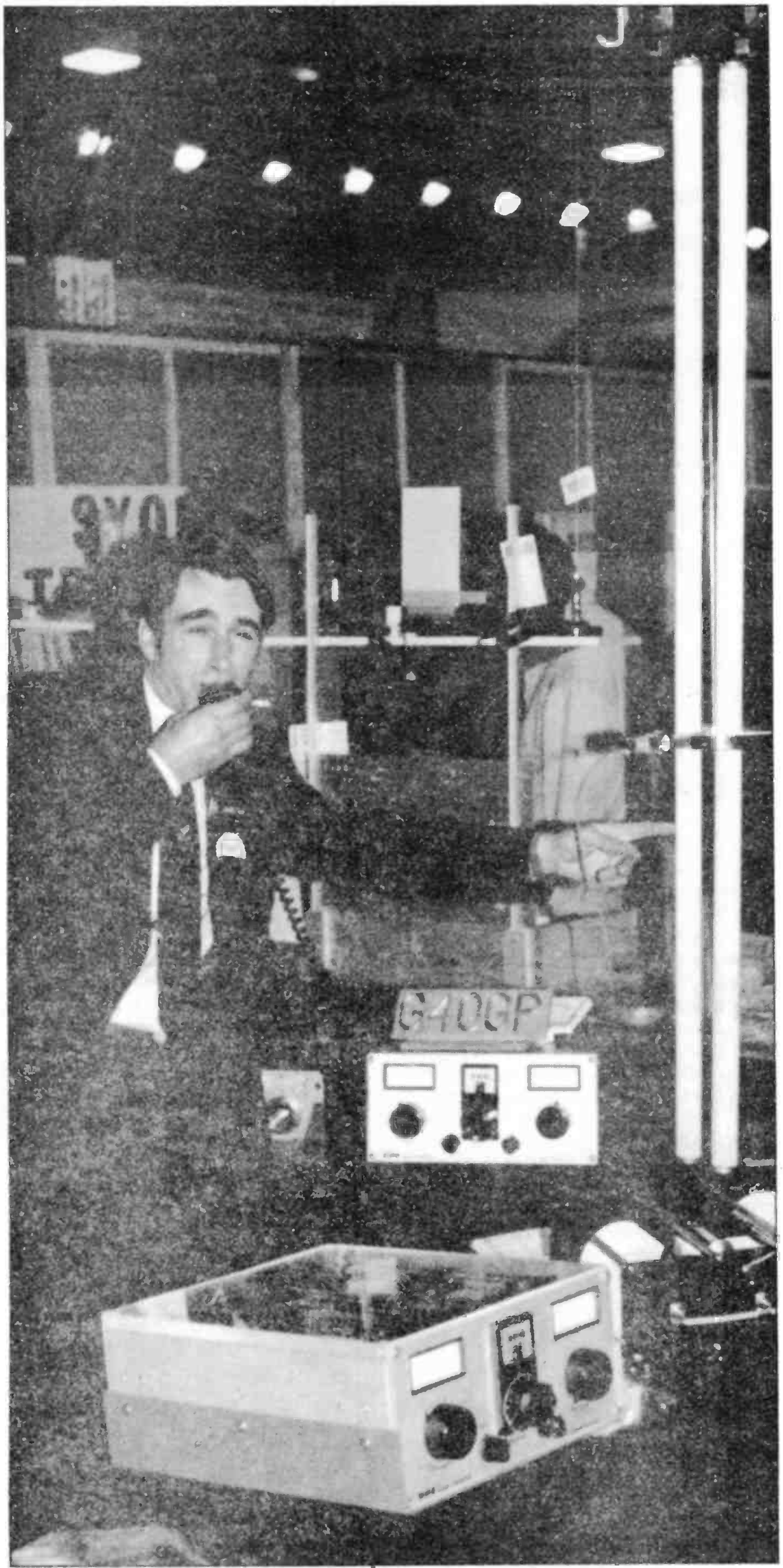
To quote the press release "Batteries need never fail as a result of overcharging". Why is this, you may well ask. Well, S&W Battery Charging Systems have now developed a plug-in module that may be fitted to any battery charger in order to adjust the output according to the needs of the battery. The controller will allow full charge to be delivered into a flat battery, but then the voltage rises, the charging current "will reduce to a safe level". The battery may therefore be left on charge without fear of overcharge and subsequent destruction of the battery. A unit of this kind is essential, when recharging the new re-combination sealed lead acid cells — which, if they do not have venting facilities, may explode if overcharged!

The new 10 Amp version of the module is totally encapsulated and tamper proof. It is available in fixed or adjustable voltage mode for use on various types of cells.

More information is available from S&W Battery Charging Systems Ltd, Nailsea Trading Estate, Southfield Road, Nailsea, Bristol, BS19 1JL. (0272 855161)

On show at the recent Leicester Amateur Radio Exhibition was Microwaves Modules 'Meteosat' Receiver which was constantly displaying satellite pictures. Although, apparently, a little out of the price range of the average amateur - the complete system including 32 segment antenna, GaAsFET pre-amp, digital frame store and 14" colour monitor costs a little under £2000 - the MM stand was constantly beseiged by interested enthusiasts.





As a demonstration that the Tau SPC 3000 can load up absolutely any antenna, Tony Johnson, G4OGP, of Tau Systems is seen here using a coat stand as a 160m antenna (!) at the Leicester show.

Have You Worked All Wakefield?

Along with the international and national award schemes described in Ian Poole's article this month, we have had notice of the (more modest?) North Wakefield RC award. To qualify, G stations must collect 50 points, non G stations collecting 20 points.

The points can be obtained from confirmed contacts with the club callsigns — G4NOK, G6WRS, and GB2NWR, each worth 10 points. A member's callsign is worth 5 points with international members VK4BRC (Ray), VK4VMB (Sherri), A4XYQ (Jim), and 2 PA stations (callsigns not yet known) names Tom and Kees, each of which is worth 10 points.

All contacts should have been made after August 1984. Send an extract of your log with the date, mode, band and time of the contacts to claim your award, (plus £1 or 5 IRC's). Further details from the Awards Manager, John Muzyka, G4RCG, QTHR.

Walk On The Wild Side

David Rickwood's, G6UDM, three peaks walk in 30 hours, mentioned in 'Radio Today' in October 1984 *HRT*, was something of a survival test. Using a FT290 with a 13 ele Tonna, he managed 14 QSOs from the top of Snowdon. However, having set up the station on Scafell Pike, there was a thunderstorm and the three intrepid climbers decided to depart sharply.

On reaching the summit of Ben Nevis within the 30 hour time limit, the three lads found the temperature had dropped to −6 degrees and there was a foot of snow on the ground. The GM6UDM station was, therefore, abandoned!

David is not easily discouraged — there are plans in the pipeline for another survival test on an island off Scotland, with only the barest of essentials and a transceiver for company. This is likely to take place in the next summer.

Repeater News

The Milton Keynes 70cms repeater suffered some storm damage during October. Bob, G6KMM, found the

1985 heralds the first ever Lady president of the Radio Society of Great Britain. Joan Heathershaw, G4CHH, is captured here 'off duty' at ELHOEX 84, giving the 'Bring and Buy' a quick once over. Photo by G4NJP.

antenna mast had come away from the top support. Although the coax ensured that the antennas were not lost; the Jay beam colinear receiver antenna was damaged but the Antennae Specialists Tx colinear luckily remained relatively unscathed. Some repairs were carried out on the spot and the repeater is apparently functioning fairly well. **(G8GIK)**

The South Coast RTTY Repeater Group needs support in the way of membership. Its aim is "to encourage the use of RTTY and link amateur stations in Sussex by a 70cms repeater." They are presently in the early stages of the procedure and have already carried out tests from a possible site in Truleigh Hill.

Anyone wanting more information, should write to G6VKM, PO Box 161, Portslade, Brighton, BN4 1LW, who also welcomes any comments.

STOP PRESS!

Class B Licensees May Use Morse

Mr John Butcher, MP, Parliamentary Under Secretary of State for Industry, announced, on the 7th December, that, as a result of discussions between the DTI and the RSGB, holders of the Amateur Radio Licence (B) who wish to use Morse code in their radio contacts may do so for an experimental period of one year.

The experiment will start on 1 April 1985 and last until 31 March 1986. Any Class B licensees interested in participating in the experiment should request a letter of variation to their licence to permit them to transmit Morse code from their station address. Requests should be sent to the Secretary, RSGB, Alma House, Cranborne Road, Potters Bar, Herts, EN6 3JW. Applicants should enclose two first class stamps to cover costs and postage. There is no selection process. All applicants who hold a current amateur amateur radio licence (B) will receive a letter of variation and a copy of a leaflet called 'Guidelines for Class B Licensees using Morse'.

It is hoped that the experiment will encourage Class B licensees to practise the sending and receiving of Morse in preparation for the amateur Morse test and help them to see its advantages as a mode of transmission.

Did You Know . . . (I)

An amateur station, GB4DIS, is being set up on the research vessel RRS Discovery and will operate from the South Atlantic and Weddell Sea between 12th February and 12th April. Using the suffixes/MM and /MA, staff members who are also amateurs will (hopefully) create 'pile-ups' on 14 MHz and 21 MHz using SSB and CW.

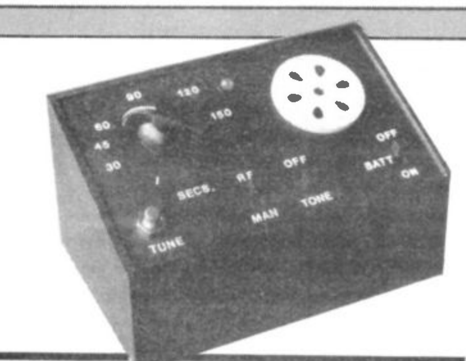
Although the greetings-messages facility will not be available, a special QSL card will confirm contact. Further information from Dr. CW Fay, NERC, Research Vessel Services, No. 1 Dock, Barry, South Glamorgan CF6 6UZ.

Did You Know . . . (II)

British Telecom's research labs at Martlesham Heath near Ipswich have come up with a first of interest to microwave buffs. They have developed several 'terminals' to be used for a local network at 29 GHz — which they claim is the highest frequency used to date for civil communications.

A Carrier-Operated Tone Access Generator and Repeater Timer.

The unit described is an RF-activated device which delivers an audible tone for repeater access at the start of transmission followed (after a chosen interval) by a second 'bleep' giving warning of time-out. The first tone is picked up by the microphone and activates the repeater. A switch inhibits this access bleep when not required —



This useful little unit enables 'hands off' repeater access, indicates when the local repeater is about to time you out and provides a useful AF source around the shack. By Edward Nield, GW3ARP.

when the device becomes purely a timer. A further push switch (SW3) gives a continuous tone for initial tuning purposes. A jack socket may be wired in parallel with this so the unit can be used as a morse practice oscillator. Putting the front panel mounted switch (SW2) to manual — providing the 'timer only/toneburst' switch is switched to toneburst — will provide a toneburst immediately, followed later by the timer generated burst of tone. Putting the toneburst to the 'timer only' position the initial toneburst is removed and we get a bleep only when the timer period is up. A panel mounted LED provides a simultaneous visual period of burst operation.

The device is therefore at least dual-functional: the tone-burst is useful to those amateurs whose rigs are not equipped with one, and also to those whose equipment is of the type which requires a button to be pressed on the rig itself — these are not always easy to reach or find, especially when 'mobile' at night! At the ending of a 'transmit' period (whether shorter or longer than the time-out period) the timer circuitry automatically resets, to give the full period on the next transmission.

The precise frequency of the tone (1750 Hz) can be adjusted by R4. If a frequency meter is available, the push-button switch SW3 will give a continuous tone to facilitate adjustment of the tone. The duration of the tone may be varied by R3 up to about 750mS (some repeaters dislike too short a tone-burst).

Volume can be set by R5 to a suitable level (enough to illuminate the LED, perhaps).

Circuit Operation

The circuit consists of an RF sensor, two monostable MVBs, one astable MVB, one inverter gate and a single-transistor output-stage.

1. The Sensor Stage

This consists of a pair of transistors connected in the 'super-alpha' or darlington mode, giving a high degree of gain approximating to the product of their individual gains. These act as a DC amplifier which converts the RF across the tuned circuit L1, C1, into a negative-going voltage at the base of Q1. This stage has a variable positive bias applied to it by the network R1, R5 and R6. In the absence of a signal, this is set so as to bias Q2 into a degree of conductance such that its collector voltage falls to almost zero. A very small amount of RF pick-up is enough to

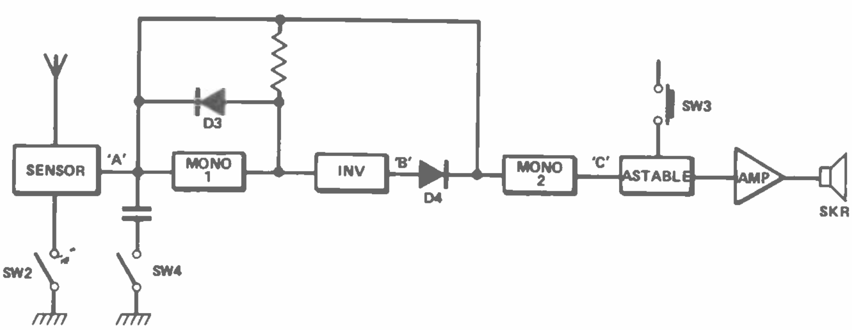
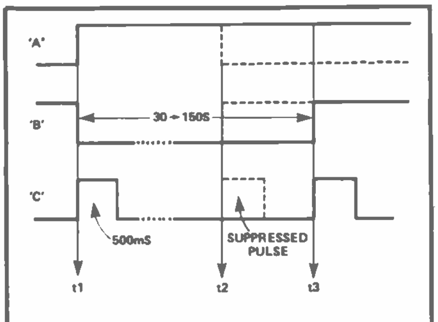


Fig.1 Block diagram of the COTAG&RT

reverse the situation, cutting off Q2 and causing its collector to rise to almost full battery voltage. This positive voltage is used to activate the logic circuits.

The period of operation of the timer is set by VR2. This may be simply calibrated by timing the periods between bursts with a wristwatch. The period may be



Logic waveforms

varied from a few seconds to nearly three minutes.

2. Logic Circuits

The block diagram **Fig. 1** will help in following the working of these circuits. Consider first what happens when a carrier is (a) switched on and (b) switched off before the end of a time-out period and (c) switched off after the time-out period has elapsed.

(a) Carrier 'ON' (t1)

1. Sensor o/p swings positive. 'A'

2. Mono. 1 (30-150 secs.) and Mono 2 (500mS) fired simultaneously.

3. Astable (1750Hz) is 'enabled' by the output pulse at 'C' and a tone is produced in the speaker.

4. At the same time, a negative going pulse at 'B' is stopped by D4 from reaching Mono 2.

5. At the end of time-out (t3) a positive going pulse at 'B' enables Mono 2 for a second time (via D4) to give warning 'time-out' tone.

(b) Carrier stopped before end of 'time-out'. (t2)

1. Sensor o/p swings negative and Mono 1 disabled as D3 conducts. A positive going pulse occurs at 'B'.

2. This pulse is prevented from firing Mono 2 as it is neutralised at pin 8 by the negative voltage swing from the sensor o/p at 'A'. Thus, no false 'time-out' pulse occurs. (Note: timing period always begins afresh since Mono 1 has been reset to original state.)

(c) Carrier stopped after time-out period.

1. Mono 1 has completed its cycle and so no more triggering pulses are produced.

2. Mono 2 disabled as O/P from TR2 falls to zero.

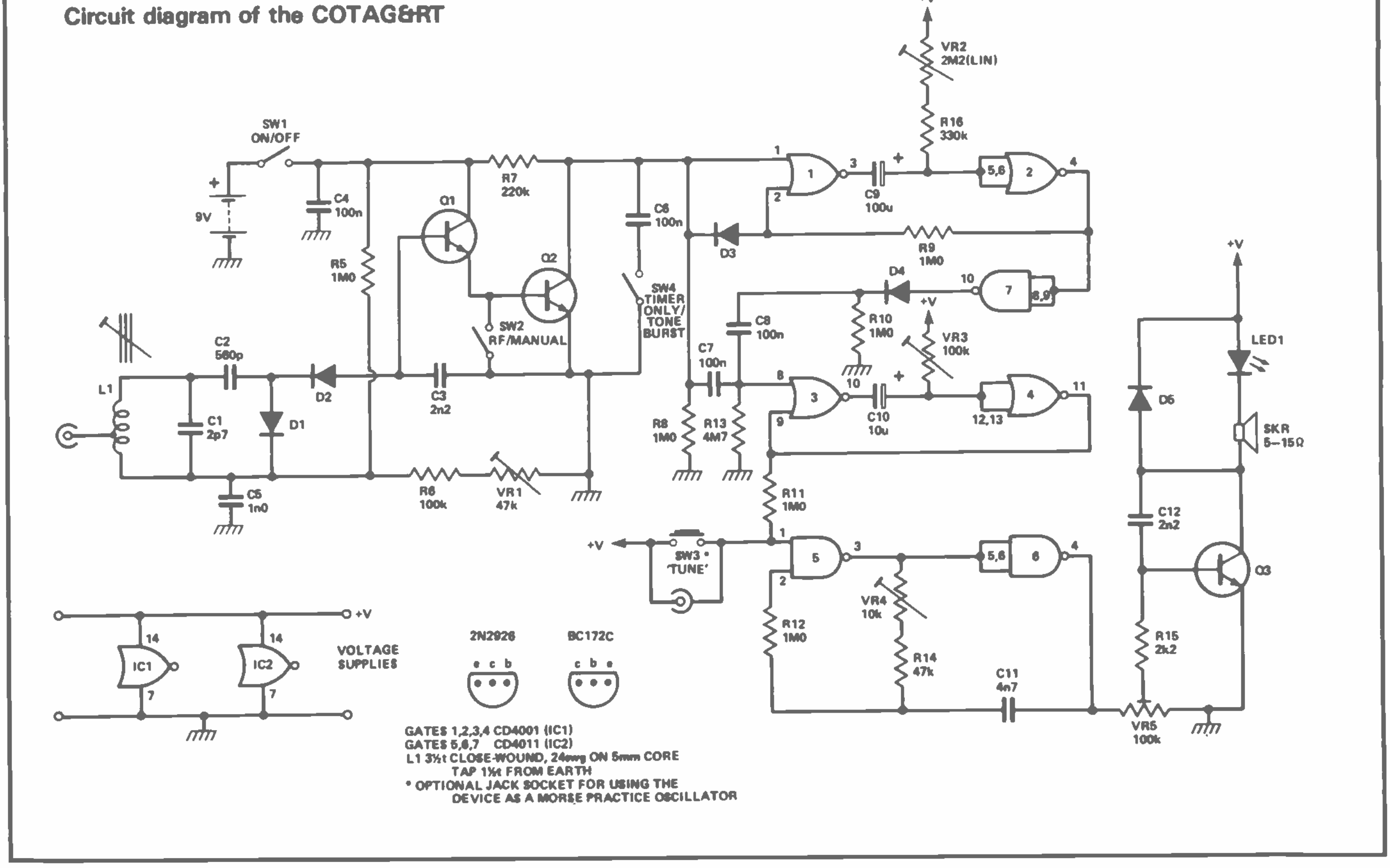
'Timer Only' Operation

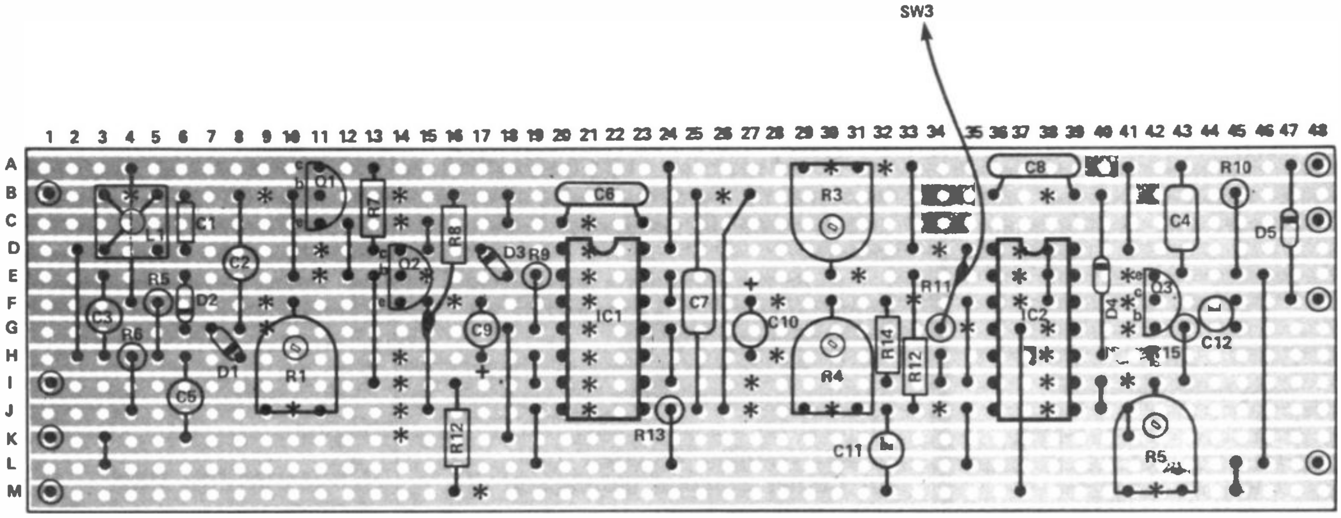
Closing SW4 inhibits the access tone and converts unit into a simple timer. C6, between Q2 collector and earth, rounds off the sharp front of the positive voltage swing. Whilst this leaves Mono 1 unaffected, Mono 2 is no longer triggered, due to the effect of the RC network at its input gate. The time-out functon is, of course, unaffected.

Construction And Adjustment

The unit was built on Veroboard and a layout is given in **Fig. 2**. SW1, SW2 & SW4 are slider switches (SPST) whilst SW3 is a 'push to make' type. The speaker is an 8 ohm unit of 1½" diameter, and the whole equipment can be housed in a case made from any material. The pick-up aerial may be either a rigid wire about 18" long, or simply a similar length of flexible wire with its end placed near the Tx output coax. With this latter

Circuit diagram of the COTAG&RT





CUTS IN VEROBOARD TRACKS ✱
A 30, 32
B 4, 9, 14, 26, 38
C 14, 21
D 11, 21, 34, 37
E 11, 15, 21, 31, 37, 41
F 9, 16, 21, 28, 33, 37, 41
G 9, 21, 35, 38, 41
H 14, 21, 28, 38,
I 14, 21, 27, 38, 41
J 10, 14, 21, 27, 30, 34, 38
K 14
L –
M 17, 42

EXTERNAL CONNECTIONS AND SUITABLE TEST POINTS ⊕
B 1 RF Input
I 1 'Test' SW2
K 1 'Test' SW2
M 1 Timer pot R2
A 48 9V+ SW1
C 48 Tone inhibit SW4
F 48 Speaker
L 48 0V
D 35 'Tune' SW3 (from R11 lead)

COMPONENT FUNCTION
R1 Bias
R2 –
R3 Tone duration
R4 Tone frequency
R5 Volume
IC1 4001
IC2 4011

Overlay diagram

method, 0.5W of RF easily operates the alarm. L1 is very broadly tunable (a DC millivoltmeter placed across C3, whilst the Tx is on, gives anything up to 750mV) and may be 'peaked' by the slug. The unit works whether the coil is in tune or not!

R1, the bias setting, is best adjusted by connecting a millivoltmeter at the collector of Q2 and (in the absence of a carrier) adjusting R1 to give about 100mV. Too high a setting and nothing works — too low, and sensitivity is sacrificed.

Battery Economy

It is worth noting that the sensor stage cannot consume more than about 40uA, ie, when Q2 is fully conductive, as the 220K collector load limits it to this figure. The logic circuits consume practically nothing, and in practice, the whole unit takes about 70uA in its quiescent state. Taking into account the increased current flowing during the output pulses (which varies according to the setting of R5) the average current is little more than 100uA. Bad news for makers of PP3's!

In practice, with the unit sitting on the table alongside the rig, a quite moderate bleep is enough for access purposes when the operator is sitting back relaxed. There is no need to hold the microphone close to the unit, or — of course — any further need to reach for the access button!

COMPONENTS LISTING

Resistors

VR1	47k horiz preset
VR2	2.2M lin pot
VR3,5	100k horiz preset
VR4	10k horiz preset
R6	100k
R7	220k
R8,9,10,11, 12	1M
R13	4.7M
R14	47k
R15	2.2k

All fixed resistors 0.25W 5% carbon film

Capacitors

C1	2.7p
C2	560p
C3,12	2.2n
C4,6,7,8	100n
C5	1n
C9	100u electrolytic 10V
C10	10u electrolytic 10V
C11	4.7n polystyrene

All capacitors miniature ceramic unless otherwise stated.

Inductors

L1	3½ turns 24 swg on a 5mm core, tapped 1½ turns from earthy end

Semiconductors

Q1,2	BC172C
Q3	2N2926
D1,2	AA113
D3,4,5	1N4148
IC1	CD4001
IC2	CD4011
LED1	yellow panel mounting

Also required: 3 SPDT slide switches (SW1,2,4) push to make switch (SW4), 2 14-pin DIL sockets, 'wander plug' socket, knob, speaker 1½" dia 8 ohm (Cirkit), PP3 connector.

MICRO' NET

This month sees Micro Net being written in the wilds of northwest Scotland. In this part of the world, the only radio activity, apart from that which drifts north on the tide from Sellafields (nee Windscale), is on 2m via GB3HI on the Isle of Mull. It is a pleasant change to be able to have a chat on the local 'box' without the usual 'it's-my-repeater-and-I'll-do-what-I-want-to' syndrome, which is all too often the case down South. However, it must be said that there are considerable problems with VHF working in an area populated by so many hills. You can never be sure that all of your over has been received intact, so mobile stations frequently end up having to repeat themselves through the repeater! This incidence of having to repeat the same piece of a message over and over until it is received correctly neatly leads us on to the underlying principle of this month's micro computing and radio topic, which concerns a relatively new and very exciting field of activity for micro/radio users — packet radio.

'Packet Radio' is a new and exciting mode of data communications in which there is much interest in both amateur and professional spheres. Keeping the jargon to an absolute minimum, Dave Bobbett, G4IRQ, explains what the fuss is all about.

Technish Spoken Here?

I don't know if you can remember back to the days when you first came across amateur radio, but if you can then you will undoubtedly recall your first encounter with ham 'procedures'. Speaking personally, I could never remember which callsign belonged to which station and, after a hefty dose of Q codes, I would scurry off to the broadcast bands where they spoke English at least for some of the time! Now whilst it is true to say that both my, and other peoples, headaches could have been eased if only people had used 'normal' language, there are situations where 'technish' has to be used, if only because there are no suitable words in everyday English which are capable of conveying what we wish to say.

There is no better example of the necessity for the use of specialist words than in computing but unfortunately this dialect of 'technish' all too often puts the newcomer off; whilst the ideas within individual 'building blocks' are usually fairly simple in themselves, you need an awful lot of such blocks before you can make up a useful 'picture' of the subject. Not only this, but 9 times out of 10, a simple, introductory article starts off at a reasonable pace, only to leap ahead of the reader after the first few paragraphs. No sooner have you just got to grips with the difference between 'Read Only Memory' and 'Random Access Memory' than you are plunged into bits, bytes, nybbles and memory paging — it's enough to make you take up basket-weaving! It is with an avoidance of 'technish' in mind that I will be looking at packet radio.

Down To 'Packets'

So far in 'Micro Net' we have looked at the use of computers and radio from both the 'supportive' point of view — that is to say where micros have been used as 'super-calculators' for satellite prediction etc and also, vice versa, where radio has been used as a *medium* for exchanging Basicode programs. Indeed, one of the original objectives of this series was to provide more in the way of Basicode routines so as to popularise the system further. However, the pace at which innovation takes place in computer-related fields is such that more important developments have been covered from time to time.

Although the name 'packet radio' may be unfortunately more reminiscent of dried soup than anything else (just add half a pint of boiling water and stir for an instant FT290R . . .) the system does offer a significant advance in terms of the facilities available to the user compared to other current forms of keyboard communications.

Essentially packet radio could be described as being a high-speed error-free radio teletypewriter (RTTY) system, in which information typed into a terminal unit at one station can be conveyed to a distant receiving station where it will be 're-consitituted' in the form of a totally uncorrupted copy of the original message. The 'packet' part of the name does not, incidentally, stem from the message being re-constituted! — it is derived from the fact that the message is split up into small 'sections' or 'packets', each of which is transmitted, one at a time from one station to the other. Fig. 1 illustrates the general idea, although I should mention that in practice each 'packet' would contain considerably more than just one word! As well as consisting of a larger chunk of the message, each packet also incorporates other pieces of information which allow the receiving terminal to check whether any errors have occurred during the transmission process — if such an error is found then the receiving terminal asks for that particular packet to be sent once again. The clever part about this 'dialogue' which takes place between the two terminals is that it is totally automatic, even switching from transmit to receive is taken care of for the user.

Before we go further into the capabilities of packet radio it might be interesting to take a brief look at its origins, as this is a classic case of the technology developed by one field being adopted by another for different purposes. Understanding some of the pro-

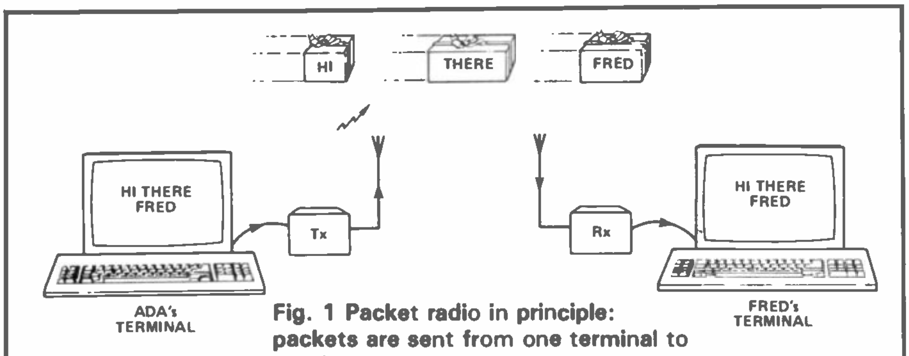


Fig. 1 Packet radio in principle: packets are sent from one terminal to another.

blems which the system was designed to solve will also further our understanding of how some of its properties came about.

Origin Of The Species

Over the past few years, there has been a continuing improvement in the cost vs capability of computer equipment, especially in the context of the 'home micro' market. Only a (relatively) short time ago, the Sinclair ZX80 computer broke the magic £100 price barrier and in the space of 5 years or so, the facilities which can be brought for about the same price have expanded tremendously — so much so that the stage is now rapidly being reached where the division between the 'home' and 'business' micro will cease to exist.

Despite all this, computer systems are still not 'cheap' as such and it makes financial nonsense for expensive items of hardware such as hard-discs, printers etc to be duplicated unnecessarily. So as to allow computers to talk to each other and enable them to have access to other hardware, a communications system was developed by computer engineers. The system enabled, for example, a large central computer to support a number of individual terminals by a method of 'time-multiplexing' — which is 'technish' for a process where a main computer switches its attention to, and follows the instructions of each terminal in sequence. Due to the high speeds at which such computers work, the process would be 'invisible' to the users. **Fig.2** shows the sort of layout such a system may have with all four terminals connected 'in parallel', as it were, to the main computer.

Because 'everything' is connected to 'everything' else, it follows that the information going between terminal 'A' and the main computer has to be coded in such a way that (a) the main computer knows which terminal sent the data and (b) any results derived from working on terminal A's data can be sent back to the correct terminal. The packet system of data communication was developed specifically to deal with such a situation and essentially works on the principle that each packet of data contains details of not only where the packet came from but also what its destination should be. Each terminal sends off its own uniquely labelled packets to the main computer, and the computer returns the results in similar packets with the correct terminals 'name' attached. If a packet is being sent to terminal 'D', then all the other terminals will ignore it because it is not 'addressed' to them.

You will have noticed that the single cable connecting all the equipment together is able to carry packets going in either direction without problems — and with more 'intelligent' terminals, it would be possible to dispense with the 'main computer' part of **Fig.2** and get the terminals to talk to each other directly. Hopefully, things are falling into place at this stage; we can replace the cable with a ham bands receiver (plus a little extra software) and the terminals can be thousands of kilometers apart — as long as there is a radio propagation path between them we are in business. Just as is the case with its cable counterpart, packet radio means that a number of terminals can share the same frequency — a packet which is intended for one specific terminal is heard, but ignored, by all the others.

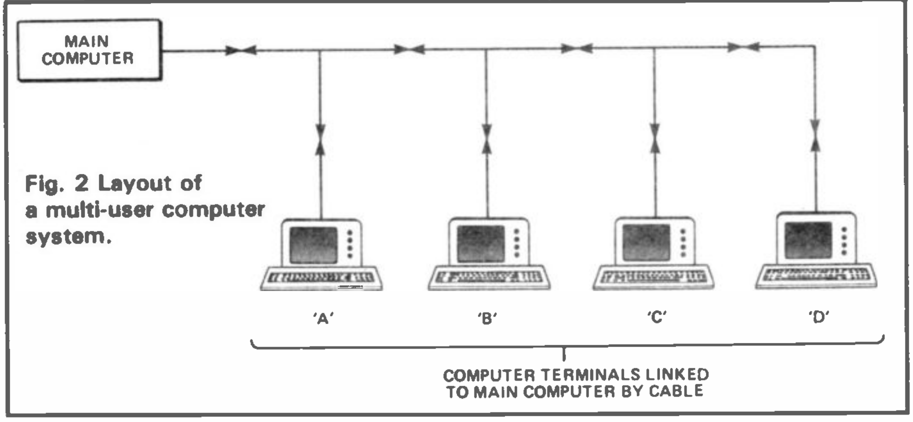


Fig. 2 Layout of a multi-user computer system.

From what has just been said, it may be seen that the terminal part of such a packet radio network would have to be quite a bit more sophisticated than just a keyboard and a VDU! Such a device, which goes under the grand title of 'Terminal Node Controller' (or TNC for short) — takes care of all the invisible 'housekeeping' necessary. A TNC consists of two main parts, each of which is dependant on the other; these are:-

i) The Hardware, which is needed to:
a) control transceiver switching.
b) generate and decode the codes used to convey the packets.
c) drive the VDU or printer.
d) accept keyboard input.
e) 'house' and support the software.

ii) The Software, which is required to:
a) 'listen' to a channel before transmission.
b) build packets into the appropriate format for transmission.
c) decode and error-check incoming packets.
d) ignore packets not addressed to that TNC.
e) respond to various fault and error conditions.

And, to coin a phrase much-loved by 'Tomorrow's World', "it's all done using a micro-processor."

At this point, you may be wondering what all the excitement is about if the whole packet radio system relies in the main upon the use of expensive imported equipment — see advertisements for currently available TNC's. However, it must be borne in mind that there is usually an alternative for solving any problem and packet radio is no exception. Looking at **Fig. 3**, we can see a block diagram of one end of a packet radio network which would consist of the transceiver, a tone generator and decoder unit, the heart of the system in the shape of the TNC, and some sort of 'dumb' (ie unintelligent) terminal which could be either a micro-computer or some sort of teletype device — in fact anything which had a keyboard for input and a screen or printer for output could be used.

Earlier in this article I mentioned the software component of a TNC unit. Given the ever-increasing capabilities of small computers it is clearly a feasible proposition to write a program which is capable of mimicking, or, as computer buffs would say, 'emulating' the

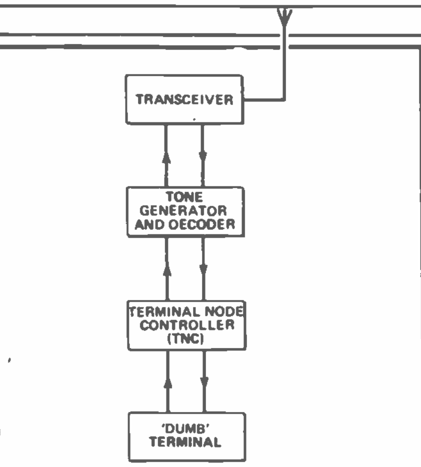


Fig. 3 Block diagram of packet radio components.

characteristics of a Terminal Node Controller's software. This is not to say that such a piece of software could be quickly scribbled down on the back of a beermat! Such programs are fairly large and would have to be developed taking into account the differing facilities offered by various micro-computers. For reasons of both speed of operation and compactness, the final versions would be written in machine code. Unfortunately, despite press stories of young software writer geniuses making their first million by their tenth birthday, expert machine-code writers are rather thin on the ground so I think we have to accept that there will be a time delay before 'TNC Emulator' programs are readily available.

When these programs do appear however, the outline of a micro-based version of a packet system would be along the lines of **Fig. 4** where the 'Dumb Terminal' function of the original layout would be combined with the 'TNC Emulator program' as part of the micro-computer itself. All that would be required then would be a tone generator

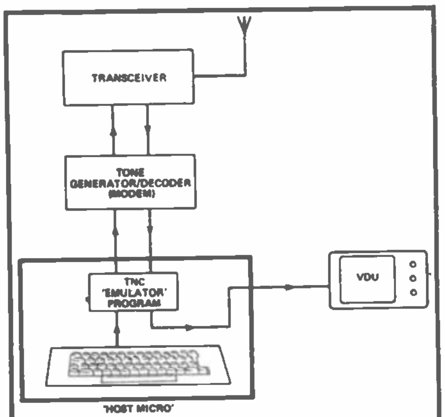


Fig. 4 A packet radio system using a micro-computer and an outboard modem.

and decoder unit to interface the transceiver and the computer. This would probably be the appropriate moment to take time-out and say a little about the tone generator/tone decoder part of the system.

A Word About Modems. . .

As you are probably aware, one of the fundamental characteristics of computer circuitry is that it can only ever be in one of two states at the same time, either ON (ie there is a positive voltage present) or OFF (where there is no voltage present). The result of this bi-state or 'binary' method of operation is that when a computer is connected to the outside world it is usually necessary to provide some kind of interface. For example, in the context of packet radio, it would be pointless to connect the computer output directly to the microphone socket — the transmitter is designed to accept audio tones and so the micro must provide these somehow. This is the role of the tone generator/tone decoder module; on transmit, it generates one of two tones — one tone to represent the ON condition and the other tone for OFF; on receive, the circuit is required to decode or demodulate the incoming tones into sequences of OFF and ON which the computer can 'understand'. This modulator/demodulator unit is usually known as a MODEM (MOdulator/DEModulator) and these days, thanks to the same miniaturisation that gives us cheaper computers, all these functions can be accommodated by one integrated circuit. Unfortunately there is a catch (you must admit it was starting to be a bit too easy!); just as there are a variety of 'standard' tones. America uses 'Bell' standard tones, Europe uses 'CCITT' tones — and they are not compatible. Readers who use the BT 'Prestel' system will also be able to add that set of tones to the list of different 'standards'.

Because packet radio (at the moment) relies on the use of such standards for conveying messages from A to B you may think that packet users will be stuck with links to the USA only or Europe only; here the uA7910 comes to the rescue. Whilst the single-chip modems which I mentioned earlier are very clever devices, the uA7910 is exceedingly clever because it is capable of dealing with all of the tone 'standards'. So, if you want to play packet radio with the States just switch the device to Bell tones, a contact with Europe? No problem, simply select CCITT tones instead. You can see from this that the use of a multi-standard modem chip such as the uA7910 overcomes the tone standard incompatibility problem.

Later on in this article we will be looking at some of the experimental packet systems currently being developed in the UK. Both systems use the BBC micro-computer but so as to reduce costs the cassette-interface of this machine is put to work in lieu of a modem. A point worth noting here is that the cassette system's tones differ from any of the standards which we've just looked at so compatibility problems could arise. **Fig. 5** outlines the simplicity of this approach and in fact, because the cassette interface and one of the machine's output sockets are electronically closely related, it should be quite easy to use the experimental programs with standard tones derived from a modem as in Fig. 4.

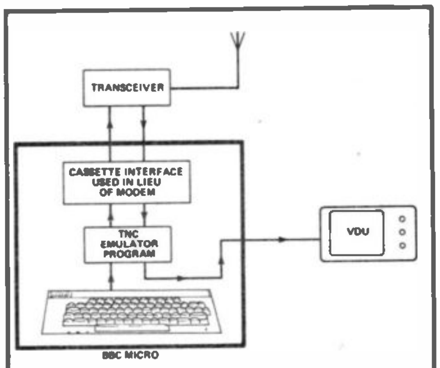


Fig. 5 Experimental packet system using BBC micro.

Maintaining Standards

In the previous section we looked at the problems associated with the variety of different tones which could be used to convey data, and there are also a number of other factors which must all be common to participating stations before a packet radio system will work; there are:-

i) the same tones (eg Bell or CCITT)
ii) the same transmission speed (eg 1200 baud)
iii) the same packet format (eg AX25)

Taking the second item on the list, most computer owners will find that their machines either offer a choice of transmit and receive speeds directly selectable from the BASIC language, or by accessing that part of the machine's operating system which either usually looks after loading and saving cassette programs, or that which specifically deals with the inputting and outputting of data. There will be some machines, usually the older (and therefore simpler) types which lack adequate data-handling facilities; but for the majority of users, it should be possible to set the speed of the data-handling circuitry to 1200 baud (which is about 120 characters per second), this being the speed required of a TNC Emulator program. Clearly, as long as all the stations are using the same speeds, there will not be a compatibility problem — in certain circumstances it may even be beneficial to use a slower signalling rate, but then there would be the risk of preventing stations which have less flexible systems from participating.

It is worth noting that, whilst 1200 baud should be seen as the de facto 'standard' transmission speed for use in packet radio, for a variety of reasons the experimental systems which I mentioned earlier have had to resort to the far lower speed of 300 baud. Owners of BBC machines will know that 1200 and 300 baud are the only two speeds available with the cassette — interface on this particular machine.

The third item on the list mentions packet format compatibility. I will be dealing with this aspect of the subject shortly; but suffice to say at this point in the discussion that each packet contains not only the data (ie the message or information) to be conveyed, but also various other items which the receiving station will expect to occur in a specific sequence. It is the actual order and context of such 'housekeeping' sections of the packet which constitute the format and are, as a result, extremely important — the format must be common to all packet radio stations in a net.

Making A Packet

In the previous section, we noted the importance of using the same parameters for all participating packet stations, and a cryptic reference was made to the 'AX25' packet format. Earlier in this article, I also mentioned that the need for packet systems grew out of the requirement of professional computer users for a 'communication system' between computers and peripherals, and also from computer system to computer system. As a consequence, various packet formats have been developed for industrial use; both 'one-off' specialist formats and international standard packet configurations have evolved. This veritable plethora of different standards does not (fortunately) pose a problem from the viewpoint of ham packet radio users; the 'pioneers' of this mode of communication had the good sense to adopt a widely-used industrial format called X25; hence we have Amateur X25 or AX25 *(This was fairly recently adopted by the ARRL and looks set to become the IARU standard — Ed.)*

So far, we have been talking about the format of the packet, ie the *sequence and components* which go to making up a usable, functional part of a packet system. However, if you take a look at books dealing with computer networks, you will find that they refer to certain popular *protocols* and not formats. This is because each individual packet is only a part of the whole system — so as to allow the whole thing to operate successfully, more is required than to simply say what sort of information appears where within the packets, which carry data about. Certain sets of rules must be incorporated into the system which, for example, define what action should be taken in the event of an error being detected in a received packet and there are many other rules governing the action taken by a piece of terminal equipment under various fault or error conditions.

To summarise then, a PROTOCOL *is a set of rules adhered to by the entire system which enables orderly communication to take place between any terminal unit (ie packet radio station) and another.* A protocol not only defines the FORMAT of the packets which are used to convey information around the system, but also delineates the precise actions which should be taken by terminal units in the event of various errors occurring.

STRUCTURE	START FLAG	ADDRESS FIELD	CONTROL FIELD	DATA FIELD	FCS	STOP FLAG
FUNCTION	START OF PACKET MARKER	TO:.................. FROM:............ ROUTE TO BE TAKEN	TYPE OF PACKET MESSAGE OR 'HOUSE-KEEPING' TYPE	MESSAGE	ERROR DETECTION	END OF PACKET MARKER

Fig. 6 Structure of a packet radio 'frame'.

Each packet (or frame) used in AX25 type packet systems consists of the portion of the message allocated to that particular frame, plus a number of other 'housekeeping' sections. **Fig. 6** shows the construction of one frame; moving across the diagram from left to right, the frame starts off with the 'start flag', the sole function of which is to act as a marker to indicate the beginning of the frame. Next comes the 'address field' which contains details of where the frame came from, what its destination happens to be, and, in the case of more complex packet radio systems, additional information concerning the route the packet should follow so as to reach its destination. The 'address field', to all intents and purposes, is the equivalent of the 'name and address' panel on an ordinary letter. The 'control field' deals with describing what sort of frame is being sent, that is to say either the frame is carrying a part of the message which the system is conveying, or it is a 'housekeeping' frame; perhaps confirming that a previous frame was received without error, or requesting a repeat of a faulty packet. There is quite a bit more going on inside the control field but, as this is intended to be an introductory article, the going details will only serve to cloud the issue! The 'data field' serves to carry the section of the message allocated to that particular packet, and, at the end of this field is the 'FCS' — a number which allows the receiving station to check that all of the earlier part of the packet has arrived without corruption. The FCS or 'Frame Check Sequence' works on the principle that if there has been corruption of the frame then the number held in the 'FCS' section (which has been calculated by the transmitting station) will be different from the number calculated by the receiving station.

As the same formula is used at both ends to calculate an 'FCS' value, any difference can *only* be caused by a faulty packet. In the case of packet radio, the receiving station will detect such an error and respond by sending a request back to the originating station asking for the last packet to be repeated — the faulty packet is ignored. Finally, the frames end is marked by the 'stop flag'. So as to make things clearer, the lower part of Fig. 6 summarises the functions assigned to each field in the packets. As can be seen from the diagram, there have to be quite a few 'extras' added to the original portion of message before it can be successfully conveyed as an 'error-checked' unit from one place to another.

Confused? Read On!

The bits and pieces which go into a frame of packet radio are complex, and explanations can put you off if you are not 'into' computing to that extent. For many people, the fun part of experimenting is to get on-the-air and start using the new technology, and perhaps learn about the 'nuts and bolts' of the system later on. In my view, this sort of approach is just as valid as any other, and so, for those readers who would rather plough through the intricacies of packet radio at a later stage, I shall simply comment on some of the advantages which are offered by this mode.

Firstly, there is the question of *speed*; because most packet radio systems operate at 1200 baud there is a significant gain simply in terms of the rate at which messages or data can be conveyed.

Secondly, there is the advantage of knowing that information obtained via packet system will not have been further corrupted en route from the sender to you. If your terminal detects a transmission error, it will automatically request a repeat of the suspect packet and even the fact that the repeated packet may arrive out of sequence doesn't matter because *your terminal* will sort the various packets into the correct order.

Thirdly, packet radio allows a number of stations to operate on the same frequency — because each packet is clearly 'addressed' your terminal will only pick out those which are addressed to you and so the system could be described as being 'frequency frugal'. When working on the same frequency like this, a packet radio system will be aware of 'collisions' or in 'phone terms 'doubling'. When this occurs, the risk of repeated 'doubling' is reduced by enabling the transmitting stations to wait for a random length of time before trying again. Because of this random waiting period, the chances of two stations 'trying again' at precisely the same moment are minimised.

Finally, due to the sophistication of the packet radio specification, there is the possibility of relaying a message in packet from, via repeater-type terminals, so as to connect stations which would otherwise be unable to communicate and with routing information as part of the packet. Although licence conditions currently prohibit this 'third-party-traffic' type of operation, it is technically feasible to evolve a digipeate system which could 'connect' Lands End to John O'Groats on, for example, 70cms!

Finally, because the timing of various aspects of the packet system can be altered to suit particular applications, the problems of systems such as AMTOR (which has to receive a confirmation of correct reception within a specific time) can be avoided.

All in all, packet radio is rather clever!

Here Is The News

As far as I'm aware (and please drop me a line if you know otherwise) there are currently two experimental packet radio systems being developed in the UK. Both are based on the BBC micro-computer, both make use of the machine's cassette interface (see Fig. 5) and so do not conform to the recommended standards outlines earlier.

The first 'Amateur Packet Radio Program' has been written by Peter Robinson (G6GIX) and Alan Jones (G8WJL) of the Cambridge University Computer Laboratory; the tones, speed and protocol are all derived from the BBC micro's own cassette interface which is run at 300 baud.

Despite this compatibility problem, the program really must be the ultimate 'minimum hardware' solution for anyone wanting to dabble in packet radio. The program is supplied on cassette and when it is run, there is an introductory screen which asks for the selection of various options — this completed, the second screen appears which is split into three areas; at the top there is an 'information window', showing which station is selected for reception of your data; beneath this is the middle 'data window', which gives information about all data traffic on the frequency; and, at the bottom, there is an area where you can assemble your own message for transmission.

G1AKQ	G1ARJ	G1ATY	G1AVI	G1AXO	G1BAP
G1BFV	G1BYY	G1CEO	G1DAV	G1ECE	G1EPO
G1FHY	G1GQJ				
G3AAJ	G3CDK	G3INN	G3KNJ	G3LDI	G3NKS
G3NRW	G3OJI	G3OUF	G3PLX	G3PMQ	G3RDG
G3RPE	G3RWL	G3RXP	G3TIK	G3TVV	G3TXH
G3UEC	G3UVQ	G3VMR	G3VOW	G3VPF	G3WRI
G3WXW	G3XJO	G3XKN	G3XTQ	G3YGF	G3YXZ
G4ASH	G4CGE	G4FKI	G4GPQ	G4HDK	G4IVV
G4JCP	G4KAL	G4KHW	G4KZT	G4LOU	G4LWA
G4MGC	G4NJU	G4NVC	G4OAX	G4OSN	G4PEY
G4PIC	G4PIL	G4PSO	G4RAA	G4RPL	G4RSP
G4SGO	G4SRF	G4SYY	G4TEC	G4THP	G4TIO
G4TRT	G4UKE	G4UME	G4VBY	G4VKX	G4VMR
G4VSZ	G4VWW	G4WRY	G4WTI	G4WWK	G4XGK
G5DS					
G6CUP	G6DKF	G6EIG	G6EKY	G6GIX	G6III
G6IKA	G6IPN	G6IXX	G6JAD	G6JEH	G6JTH
G6LUT	G6MGQ	G6NHU	G6OWN	G6PIQ	G6RPM
G6SWO	G6SXL	G6TCJ	G6THZ	G6TJT	G6TLI
G6TSF	G6TZS	G6XZA	G6YLJ	G6YYZ	
G8AGN	G8ATI	G8AYM	G8DSS	G8DZH	G8ELA
G8GIK	G8GQJ	G8HHA	G8ISI	G8KBV	G8KMV
G8NVK	G8NVW	G8ONH	G8PWC	G8QR	G8RIW
G8TMJ	G8VEL	G8VLL	G8WJL	G8XXV	
GI4JER	GI8SKR				
GM4ANB	GM4LVW	GM4RSJ	GM6HLG	GM6NAA	
GW6UTP					

BARTG packet register.

One nice touch about this program was the ability to choose which of up to 8 different stations was to receive your packet transmission. The only criticism I can make, which is not of the program itself, is that whilst it is reasonable to expect that licensed amateurs should know what they are doing, the notes which accompanied *the cassette did not mention the need for caution with regard to signal levels being fed into the transmitter and the level of AF output from the rig into the micro.*

Just for the record, the output from a BBC micro's cassette interface is 200mV peak-to-peak — if you exceed this level you stand a good chance of frying a few ICs in your 'Beeb'! At £2.50 for the cassette you'll not need a second mortgage and the authors are keen to receive user's reports — as usual see the address box for ordering details.

Whereas the program just mentioned uses only the relay inside the computer for transceiver switching, the other experimental packet radio program uses a small piece of hardware which could be best described as a 'data-VOX' unit. Whilst AMTEXT (as the program is a little confusingly known), developed by Paul Brown, G3WRI, does require a small amount of construction work it also allows for adjustment of the input level to a transmitter, which is a worthwhile facility given the 200mV p-p output from the BBC micro and the 20-50mV microphone input requirement of most rigs! The article covering the design objectives and program architecture was offered in 'RAMTOP' September '84, and this is well worth the read if you are the type who likes to get into the intricacies of program and hardware development. As for the AMTEXT program itself, that is also available from the RAMTOP address, price £2.50. *Please remember that the authors of these programs stress that they are experimental and will probably undergo changes in the process of being developed further.*

In Conclusion

It is relatively early days yet for packet radio; (I've yet to find another station near me to try out the 'Cambridge' program) but I think most readers will agree that it is very interesting mode which is destined to catch on, providing people are not put off its advantages by the complexity of the system. Certainly I'll be keeping an eye on the development of packet radio in 'Micro Net' from now on — watch this space! Also, on the subject of packet radio reading matter, DATACOM, the quarterly journal of the British Amateur Radio Teleprinter Group (BARTG), publish a packet radio news section in each issue and regularly update a list of members active or interested in the mode. RAMTOP publish packet news as it occurs.

Address Box

'Cambridge' Packet Radio Program
Price £2.50 on cassette from
RAMTOP
Great Billing Rectory,
Northampton,
NN3 4ED (see December 'Micro Net' for more details)

'AMTEXT' Packet Radio Program
Price £2.50 on cassette
RAMTOP address as above

BARTG (Membership Sec.),
John Beedie, G6MOK,
161 Tudor Road,
Hayes,
Middlesex.
UB3 2QG

Micro Net
Either G4IRQ, QTHR
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Ham Radio Today,
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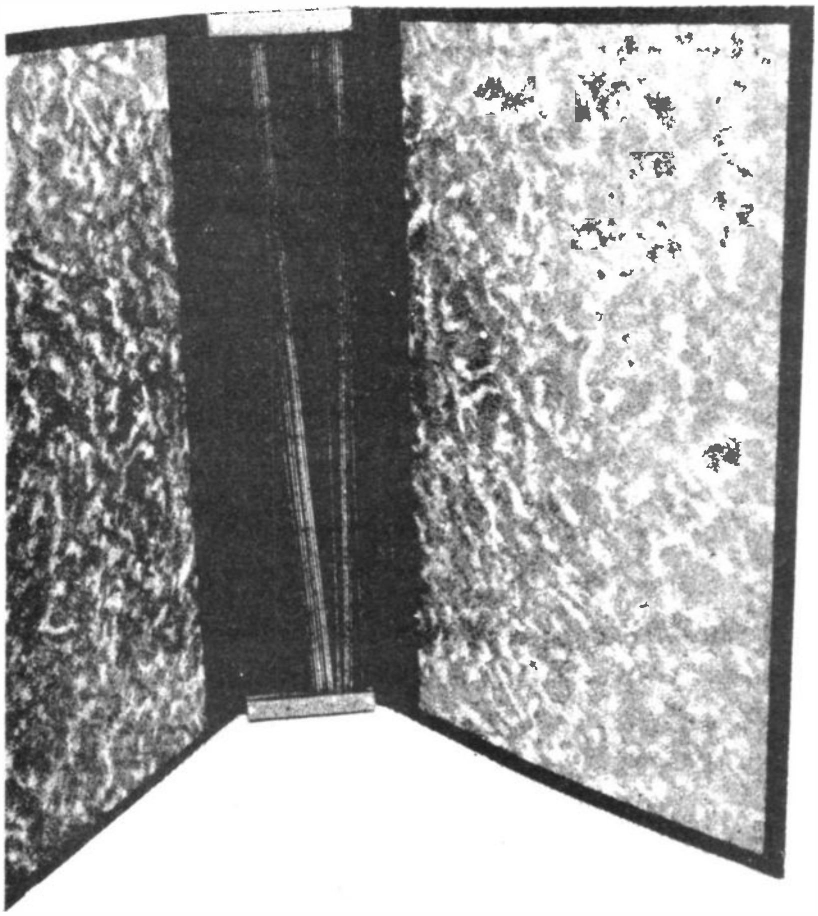

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WAVEMETERS Galore

What's the one piece of gear every radio amateur's got to have. Whether you've just taken the RAE or are perchance thinking about it we strongly advise you to read on...

In the haze of a post RAE results 'high', the last thing to cross the mind of the fledgeling radio amateur is often the purchase or construction of the one piece of equipment mandatory in both class 'A' and 'B' licences. The author is by no means innocent himself — after a 2m transmitter and converter had been borrowed from a friend, a design from the RSGB's Radio Communication handbook was hurriedly put together, more as a lucky afterthought than anything else.

I'm sure you know that I'm talking about an absorption wavemeter. Those two rather serious sounding words mask a very simple device indeed. Mine consisted of a tuned circuit, with a diode tapping onto the coil. The diode rectified the signal received by the tuned circuit, a 500pf capacitor gave a bit of 'smoothing' and the rectified RF then drove a 500uA meter from an ex-WD 19 set via a couple of RF chokes. What it all amounted to was a *calibrated* VHF crystal set.

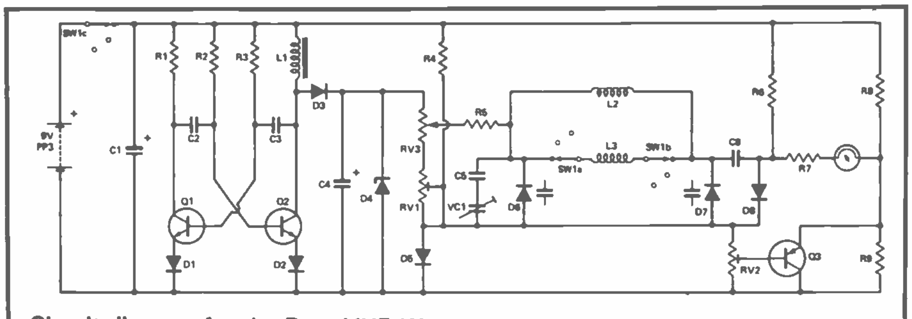
In those days most 2m stations used ex Gas Board, Fire Brigade, Police equipment like Pye Vanguards, Westminsters and Cambridges — all AM of course. Your wavemeter's prime usage then was helping to realign the multiplier stages of your particular surplus set to get this up on 'two' — 72 to 144MHz was the tricky bit — and finally checking you got a reasonable amount of RF on the band. My wavemeter covered from about 60 to 250MHz. You checked your 8MHz crystal was tripling to 24MHz on your main station receiver, and that the 24MHz was tripling to 72MHz with the wavemeter... and so on. After you had got the PA tuned to 144MHz, just before you made the first QSO, you would check that there was no second harmonic or third harmonic being produced — if your wavemeter went up that far, or you remembered to in the heat of the moment!

Those were innocent days and a very different situation than for the 2m operator today. For a start, there was little UHF television, 2m activity was about 5% of that today and 70cm was comparatively deserted. In other words, the purity of your transmitter output was, by virtue of this situation, probably less critical than it is today. That being said, 99.9% of PAs were valve and less awkward to get to produce a harmonic free output.

Current Situation

In these days of dense and almost entirely synthesised 'black box' solid-state operation on 2m, UHF TV and the vastly increased population on 70cm, the primary use of an absorption wavemeter in my eyes is for checking that RF output is only at 144, particularly not at 288 or 432MHz, or anywhere between these frequencies.

There are a number of VHF/UHF wavemeter designs in the Radio Communication Handbook



Circuit diagram for the Drae VHF Wavemeter.

and also in the RSGB's VHF/UHF manual. These fall in two main categories; the LC tuned circuit crystal set and the cavity wavemeter, usually used more at UHF. A basic version of the former type is very easy to construct and for those who want to at least build something of their own for VHF this is an ideal project. The designs I have seen for this basic version have one disadvantage though — they cannot easily cover from below 2m to above 70cm because the large variation necessary in the LC ratio to tune this range is generally too much for (reasonably priced) capacitors to perform with a simple fixed value coil.

For those with money to spare or a burning desire to get on the air as quickly as possible, there are some commercial designs which offer wide band coverage. I shall look at three of these, the first two falling into the LC category in this issue and a cavity wavemeter next month, space permitting.

Commercial Circuitry

The first two wavemeters up on trial are the Drae 'VHF Wavemeter' and the AKD 'VHF/UHF Absorption Wavemeter'. Both are British made, the former in Hampshire and the latter in Bucks, and cover roughly the same frequency range, approximately 130-450MHz. Thus fundamental, 2nd and 3rd harmonics of the 2m band are covered and, in addition, 70cm. Prices are also similar; the Drae currently retails at £27.50 and AKD at £24.95.

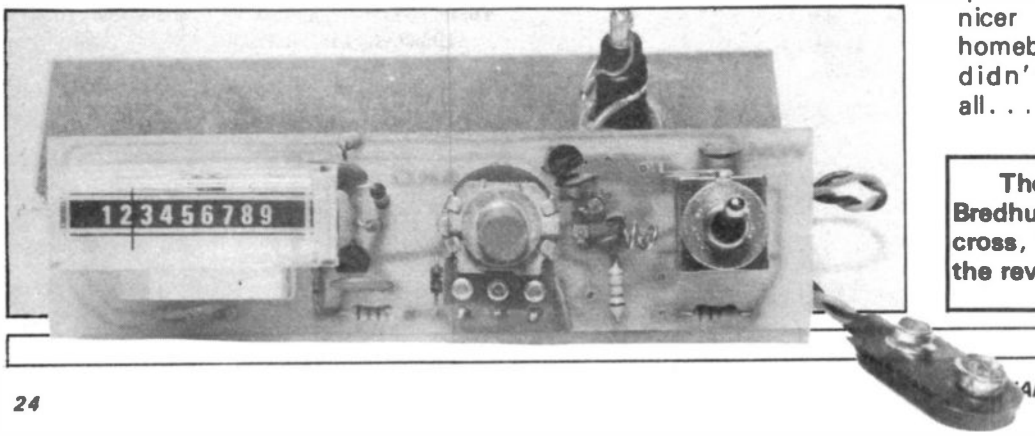
The Drae comes with a leaflet which both explains how to use the device and gives an, albeit rather garbled, description of how the device operates. A circuit diagram is also carefully given.

Now, what we have here is a rather more complex device than my homebrewed one from the RSGB handbook. The tuned circuit at the heart of the device is formed of two coils in parallel, the second one being switched into circuit to enable coverage of 200-450MHz. The capacitance is formed by two capacitors in series, one a 'trimmer' for calibration purposes, in parallel with a 'varicap' (variable capacitance) diode. The varicap is driven by a two transistor multivibrator running at about 100kHz, whose output is controlled by a variable potentiometer P1, thus varying the voltage across the varicap and the frequency of the wavemeter.

The detector, a Schottky diode, is biased for maximum sensitivity by R6 and the voltage with zero detected signal is 'backed off' by a preset potentiometer RV2 and Q3. As the detected voltage from the transmitter increases, Q3 cuts off reducing the sensitivity of the meter. This simple form of automatic gain control (AGC) gives the wavemeter a large dynamic range.

The AKD wavemeter is provided with a leaflet which unfortunately only gives operating instructions for the device. However, a perusal of the PCB of the wavemeter, leads me to believe that a similar kind of circuit is employed to the Drae. In the case of the AKD, though, a small external 'sensing' aerial is coupled to the detector circuitry in order to improve the sensitivity of the wavemeter.

The lid off the AKD VHF/UHF Absorption Wavemeter.



On Trial

My Trio 9130 2m transceiver was fired up into a 5 ele Yagi and both wavemeters tuned to 144MHz. The Drae was placed in close proximity to the antenna feeder as per the instruction leaflet and the AKD placed with aerial parallel to the feeder to assure maximum sensitivity. With the antenna in this position the AKD was extremely sensitive and could be overloaded with the 9130 giving 5W. A repositioning of the aerial soon cured this. The Drae also proved sensitive but is very dependent on being positioned very close to the feeder. On both wavemeters the meter needles just moved on 288 and (possibly) 432MHz. All it seems was well with my rig!

Conclusions

Both the AKD and Drae are solidly built and perform well. The quality of construction of the Drae is better than the AKD and it is, in these eyes, a little more rugged and better looking. I found the meter on the Drae easier to read from a variety of angles than the AKD. This can be useful when you have your nose deep in the innards of an old Pye Westminster or similar, that you are trying to tweak onto 'two'! That being said, the AKD is more sensitive than the Drae and costs a few quid less, too. Both of them are nicer and more useful than my homebrew one, but then, that didn't cost me much at all. . . **G3ZZD.**

The author would like to thank Bredhurst Electronics of Handcross, West Sussex, for providing the review samples.

SSTV Reception with the BBC 'B' and G3LIV/G8UEE Interface

'Slow scan' offers the possibility of world wide TV communication. During the early seventies, there was considerable interest in the mode which gradually tailed off due to the lack of constructional information and the horrendous price of commercial equipment. Well, SSTV is definitely back and this time without breaking the bank. Over to Ken Michaelson, G3RDG, in the studio...

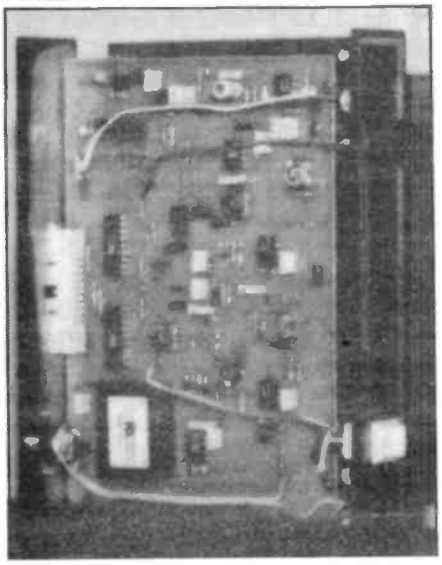
Johnny Melvin would seem to have done it again. Readers will remember the G3LIV RTTY interface for the BBC 'B' computer, which I reviewed last year. (HRT February 1984). Well, Johnny has, in my opinion, come up with another very useful accessory for the radio enthusiast with a 'Beeb'. He, together with G8UEE, has produced an interface which, when connected to the 'Beeb', allows the reception of Slow Scan Television (SSTV) pictures sent by amateurs all over the world.

Perhaps I should say, first of all, a little about 'slow scan'. Slow scan television, as the name suggests, is a TV system in which the speed of generation of a TV picture is comparatively 'slowed down' — compared to the conventional domestic British PAL system — so that it may be transmitted in a bandwidth of around 2.5kHz. This is so that it may be transmitted via a conventional amateur SSB transmitter or transceiver. Depending upon the line standard adopted, each SSTV picture (or rather, frame) takes between a little over 7 seconds to 32 seconds to form(!). This may seem agonisingly slow but with this method you can send pictures to Australia with ease — and without taking up the whole band. Don't forget, domestic TV takes up over 6MHz of bandwidth!

The transmission of SSTV pictures is achieved by modulating an SSB transmitter with an audio frequency corresponding to the light intensity at a particular point of the picture being received by a TV type camera. The audio range involved is approximately 2.5kHz and one of the advantages is that pictures can be thus recorded on a standard audio cassette recorder, and edited for replay or transmission at a later date. There are currently three 'standards' of frame and line in operation, and the latest one, 256 lines with a frame time of 32 seconds gives very good quality indeed. The program supplied with the G3LIV/G8UEE interface covers all three standards by using the key commands described later in this review.

Ergononically Speaking

The item I received for review was the complete boxed unit (programs and PCBs are also available separately), and comes enclosed in a silver-grey anodised box measuring 185mm wide × 155 mm deep × 42 mm high. The front panel is silk-screen printed and has a pleasing design of a wide black band across its width with the lettering in black on the border. The power switch is on the left with a green 'LED' indicator for 'on', and on the right is a knob to vary the contrast of the SSTV transmission on your monitor. To the right of that is another 'LED', this time a red



Inside the interface. Please note that the above pic is of a pre-production model.

one, which indicates the commencement of a new 'frame' of an SSTV transmission. The exterior and interior of the unit can be seen in the photographs nearby.

Connection to the 'Beeb' is simplicity itself. A 20 way ribbon cable with a 20 way female IDC connector at either end (please note this is supplied as an extra) plugs into the Beeb's user port at one end and the IDC socket of the unit at the other. The only other connection necessary is a three pin DIN plug to input the audio from the receiver/transceiver. All the power for the interface is taken from the Beeb using one of the latest DC to DC chips which gives plus 15 volts and minus 15 volts from an input of plus 5 volts.

The actual program supplied by Johnny Melvin is on a cassette and is in two parts. You type * RUN SSTV to load it, (in my case I had first to type * TAPE to tell the computer that a cassette was going to be used instead of a disc), and when the first part is loaded it will display a caption with the callsigns of G3LIV/G8UEE. The computer then goes on automatically to load the machine code part of the program. When this has done this, the screen will appear to be blank. Do not despair! All that is needed is to input a genuine SSTV signal — not forgetting first of all, to switch the unit on by the power switch on the left front. If you are fortunate enough to possess a disc drive for your 'Beeb' then information is included to enable you to save the program to disc, which, of course, makes it much quicker to load.

There are twelve commands which can be controlled by various keys and these are as follows:-

Key '1'	7 sec frame timing used for 128 line SSTV
Key '2'	16 sec frame timing used for 256 line SSTV
Key '3'	32 sec frame timing used for 256 line SSTV
Key '<'	Reduces the picture width
Key '>'	Increases the picture width
Key 'D'	Fills in 'even' lines. This highlights captions and gives a denser black/white ratio. (for 7 second frame only)
Key 'S'	Reverts 'D' to standard SSTV
Key 'P'	Positive video
Key 'N'	Negative video
Key 'C'	Hard copy via Printmaster ROM, if fitted. Obtainable from Computer Concepts of 16, Wayside, Chipperfield, Herts.
Key 'E'	Emphasize. Converts 'S' screen to 'D' screen
Space Bar	Frame retrigger and clear screen

SSTV pictures received by G3RDG.

The usual standard for SSTV is a 7 second 'frame'. If 7 second signals are being displayed, Key '2' can be selected to give reduced picture size, but with higher resolution. Personally, I mostly used the reduced picture size, giving a very satisfactory picture, as is shown by the examples copied from my printer in Fig.3 and 4.

Although I am looking at the complete boxed unit, as I mentioned earlier, Johnny Melvin also supplies a printed and drilled fibreglass circuit board together with the cassette of the program, full information and component overlay for £17.50 inclusive of VAT. The instructions for the assembly of this PCB are very clear should you want to collect the electronic components and construct the PCB yourself. The circuitry contains some ten ICs, three transistors and twelve diodes as active components.

Using The Interface

I found that using the interface required considerable care in tuning the transceiver, and, to be fair to Johnny, he does say that. Since no tuning indicator was provided, as is usual in RTTY, it was really a question of learning the tone to tune into, and memorising it ie what audio frequency was coming out of my transceiver's loudspeaker when an SSTV signal was resolved on my computer's monitor). However, having once got this into my head (ear?), the rest was fairly easy. The illustrations are of pictures received on the 14 MHz band, on 14.230 kHz to be precise, as this is the small section of the band which is used for SSTV.

(14230 is definitely the best place to find SSTV transmissions and is reasonably well known for this across the world. That being said, 20m always seems fuller than the other HF bands of people running too much power with too little ability in the use of their receivers. Ken found on a number of occasions people calling CQ on SSB on top of SSTV transmissions on this internationally recognised frequency — Ed.)

Signals were found on other HF bands, although the ones I received were not good enough to illustrate here. Other sub-sections of the bands where SSTV signals may be found, using the IARU recommended frequencies, plus or minus 5 kHz, are 3.735 MHz, (the popular UK frequency on this band being 3.730 MHz), 7.040 MHz, 14.230 MHz, 21.340 MHz and 28.680 MHz. There are also signals on a recommended frequency of 144.500 MHz, (the popular UK frequency on this band being 144.230 MHz), and also on 70 cms, the frequency being 432.500 MHz. It is necessary to monitor the chosen frequency for some time before a signal comes up. Even on 14.230 MHz one did not always find a signal. I found, naturally perhaps, that the weekend was the best time for reception. There are several nets for SSTV buffs. A UK net at 0830 UTC on Sunday morning on 3.730 MHz (I listened for this without success on two occasions), a USA net at 1800 UTC on Saturday on 14.230 MHz, a Canadian net at 2130 UTC on Sunday on 14.180 MHz, and finally an Oceania net at 0100 UTC on Sunday on 14.230 MHz.

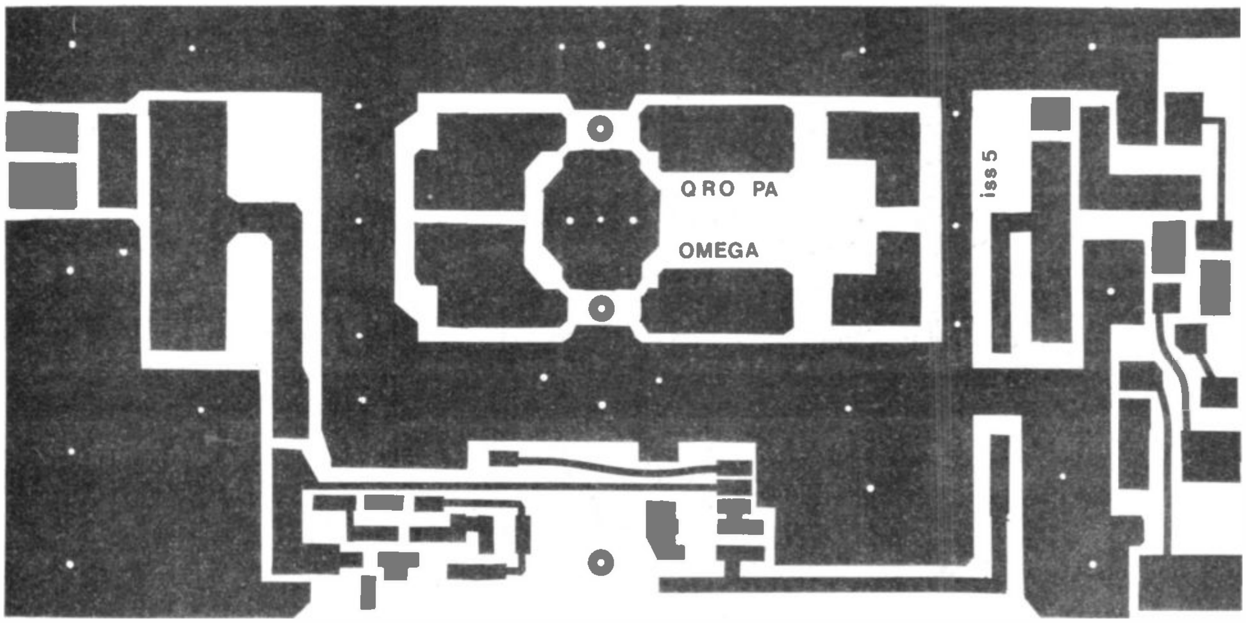
Conclusion

I have been using the interface now for a month or so, and have had no trouble with it. The unit is well made, electrically and mechanically, and attractive in appearance. I greatly enjoyed using the interface and would recommend it to anyone looking for a new facet of Amateur Radio to experience without being bankrupted. The unit as reviewed costs £95.00 inclusive of VAT. As mentioned above, it requires a 20 way double ended ribbon cable to connect it to the Beeb, which can also be obtained from Johnny Melvin. The cost of this is £10.00. Thanks are due to Johnny Melvin, G3LIV 2, Salters Court, Gosforth, Newcastle, Tyne and Wear, for the loan of the unit for this review.

Addendum

Project Omega High Power Amplifier January '85

The editor still can't believe it! We managed to get the foil pattern the wrong way round. Apologies and here it is again...



Some modifications to the TOTSUKU TR2100M

The Totsuku TR2100M 2m SSB/CW transceiver is very good value for money but has several annoying defects. Bernard Pallett, G3VML, offers some modifications which will considerably improve the 'operability' of this rig.

Wanting to work both the SSB and FM portions of the 2 metre band, but at the same time owning a FM mode only transceiver, I could either purchase a multimode transceiver and dispose of my perfectly good FM rig, or purchase a SSB mode only transceiver to supplement my existing 2 metre equipment. Since I am mainly HF orientated, my main criteria was to achieve my ambition for as little cost as possible. With all these points in mind I did eventually purchase the Totsuku TR2100M SSB transceiver, since this appeared to meet most of my requirements, the cost being a reasonable £115.

My first impressions of the TR2100M were that although the transceiver was fairly compact and well constructed, the overall performance left a bit to be desired. The two main problems concerning performance were firstly, the variable crystal oscillator (VXO) was prone to frequency drift which made contacts with other stations very difficult; secondly, the receiver unit was somewhat insensitive. From the ergonomics points of view, I found it to be fairly good, bearing in mind the small size of the unit. However I found the four rear slide switches, which are very close together, very trying to use.

My overall impression was that the design concept was not quite right. Totsuku intended the TR2100M to be both a mobile and a lightweight portable, but I felt the size and weight was more akin to a mobile base station. With this in mind, I decided the space occupied by the internal battery holder could be better utilised by installing a receiver pre-amp to improve the receiver sensitivity. I also decided to remove the attached telescopic aerial, which can only be used on low power transmit. The front panel space left could now be used to fit a push button switch to select the CW-SSB mode, thus doing away with one of the dreaded rear slide switches.

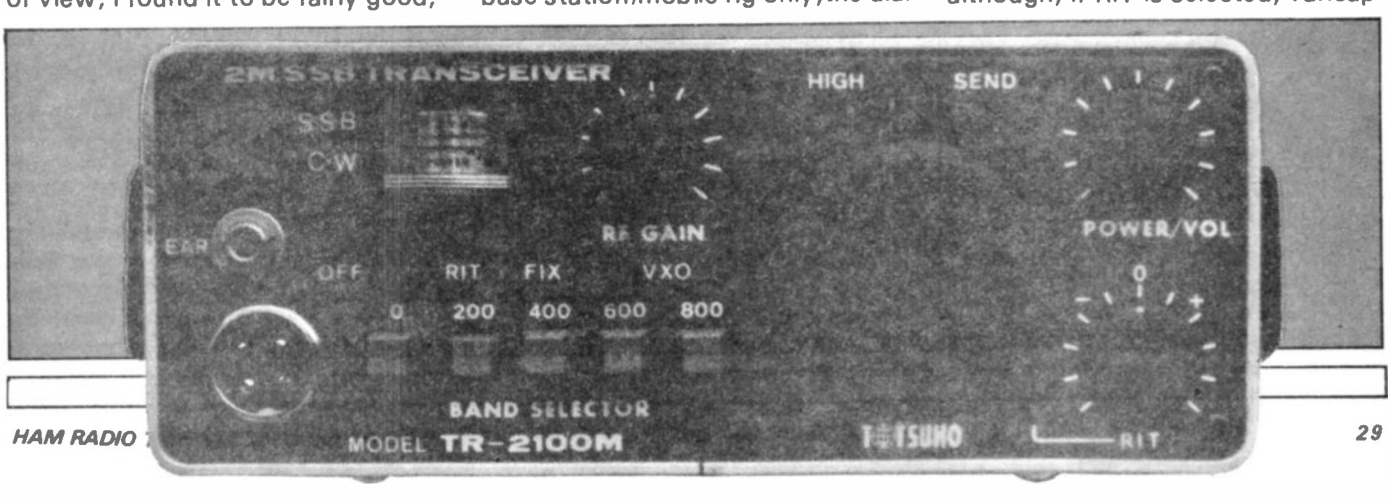
Since the transceiver will now derive its 13.8V from an external power source, it is no longer necessary to consider conserving dry cell battery life. Noting my intention to remove the internal battery holder thus making the rig a base station/mobile rig only, the dial lamp can be hard wired, thus paving the way for the removal of yet another rear slider switch. This will leave just two rear slider switches, those being 'high-low' power transmit select and 'noise blanker' on/off.

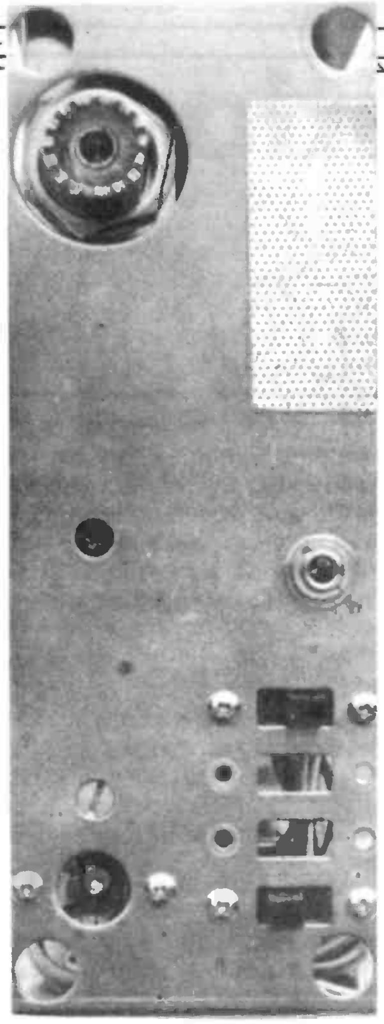
Most of the modifications I shall discuss are realistically beyond the scope of the novice. In any case, no alterations should be attempted without the correct tools suitable for PCB work and access to a multimeter is essential.

VXO Circuit

The first topic to be discussed is the VXO unit — which I consider the most vital circuit of the transceiver because the transceiver is frankly un-useable unless the VXO can be made frequency stable. Before proceeding further, it will be as well to discuss briefly the VXO-frequency multiplier PCB and to point out the problem areas.

Transistor Q1 and its associated components form a variable crystal frequency oscillator (VXO). The VXO circuit is designed to pull the oscillator frequency to a maximum of approx 22kHz, from the natural resonant frequency of the crystal selected. The VXO crystals are XTL 3 to XTL 7, XTL 2 is used for fixed frequency only. The actual amount of frequency pull is achieved by adjustment of the tuning capacitor VC1-VC2, although, if RIT is selected, varicap





Modified rear panel. A small piece of aluminium gauze can be mounted over the ventilation slot (top right).

diode D1 will alter the VXO frequency to a greater or lesser extent — typically approximately ±3kHz frequency shift. The nominal operating frequency of the VXO is 15MHz. The remaining two stages formed by transistors Q2, Q3 and their associated components form a X9 frequency multiplier. The nominal output frequency appearing across pins 1 and 2 of the PCB connector is 135MHz; this signal is utilised by the main PCB board for both the transmit and receive circuits.

The 8.9V power supply for the oscillator PCB is derived from a stabilised voltage source located on the main PCB board and is applied to pins 3 and 4 of the oscillator board connector. The supply to transistor Q1 and the base circuit of Q2 is further stabilised by the circuit formed by zener diode D2 and resistor R12. This stabilised voltage is 6.2V.

The greatest problem is with the design concept of using a VXO circuit followed by a X9 frequency multiplier. A slight drift of the VXO frequency of, say, 100Hz will therefore cause a total frequency drift of 900Hz at the oscillator board inputl I suspect that Totsuku adopted this method in order to keep the oscillator board as compact as possible whilst at the same time keeping the costs to a minimum.

Most of my efforts to find a solution to this drift problem were directed to the actual VXO circuit itself, plus any associated circuits. My experience led me to believe the main causes of drift could be slight changes in the stabilised supply to the VCO; thermal drift within transistor Q1 causing small changes in the quiescent current flowing through transistor Q1; voltage changes across vari-cap diode D1; thermal changes within the selected crystal. After many hours of experimentation I did finally implement the following alterations which, when completed, did vastly improve the frequency stability of the TR2100M in both transmit and receive modes.

How To Take It Apart

The first thing we must do is to dismantle the unit — preferably working on a large serving tray, That way you will not loose any of the screws and the unit can be moved around with ease whilst on the tray. Providing you proceed with caution, you should not have too much trouble taking the unit apart and reassembling it again .

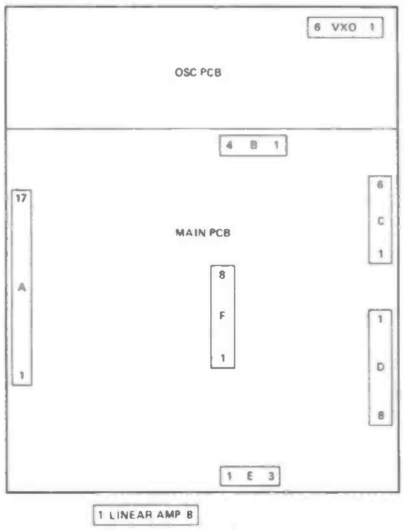


Fig. 1 Connector positions on TR2100M chassis

Start by removing the fixing screws from the component side of the two PCBs, total 8 screws and washers. You will notice when removing the outer cover how densely packed the chassis is. It is fair to say that no matter how careful you are in dismantling and reassembling this unit, you will be extremely lucky if the odd wire does not drop off. Before you proceed further it is advisable to obtain an enlarged copy of the circuit diagram. One of the so-called 'instant print' shops, which are appearing on the high streets in evergrowing numbers, should be able to do this for you.

Next, unscrew and remove, by pulling forward through the front panel, the telescopic aerial. Remove the battery holder assembly and cut the battery holder cables back to their final destinations. Unscrew all the screws located along both outer sides of the chassis unit, after which detach all fixtures fitted to the rear of the chassis. The chassis support metalwork is now ready for removal.

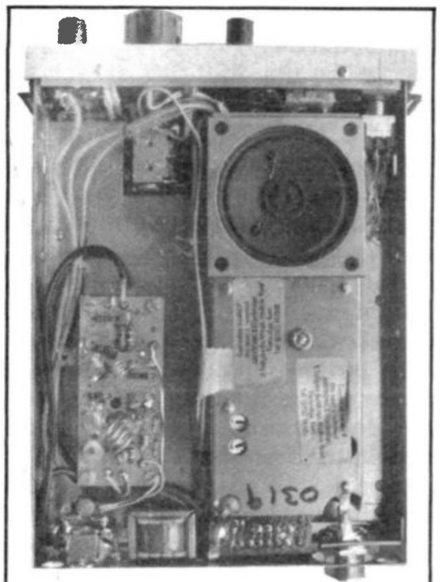
Finally, on the transmit side at least, separate the multi way connectors to the linear amp module and remove the fixing screw. Before final detachment of the module from the chassis, unsolder the white speaker cable. Detach the tag strip now exposed. The chassis metal screening plate now can be removed, exposing the underside of the two PCBs.

It is wise to carry out all the intended modifications prior to reassembly. However, only carry out *part* of the installation work concerning the receiver pre-amp and the repositioning of the SSB-CW selector switch to the front panel at this stage. These alterations are to be further discussed.

The format I have used on my diagrams for connections is best illustrated by example, viz A9 and D3, means connector A pin/socket number 9 or connector D pin/socket number 3 and so on.

Mods For Frequency Stability

1. Drill a series of ventilation holes in the underside of the outer cover and remove the rough edges. Touch up the paintwork with the aid of a black cellulose paint spray



Inside the Totsuko TR2100M

can. File a slot in the rear of the cover and a corresponding slot in the chassis metalwork. This is done by refitting the outer case back on to the transceiver and with a scriber (using the slot at the back of the case as a template) mark out the corresponding slot to be cut into the chassis metalwork. Dismantle the transceiver again to cut this second slot. Fit rubber feet to the underside. These are shown on the detail drawing and instructions **Fig. 2**. These improve the ventilation in the oscillator region, where a 'heat trap' problem exists.

2. Removal of zener diode D1. I discovered, quite by chance, made a great improvement in frequency stability. I have not fully determined the reason for this although I have a theory which I am endeavouring to prove.

3. Replace diode D2 with a varicap diode type BA121. This will not only improve frequency stability but will result in smoother RIT operation.

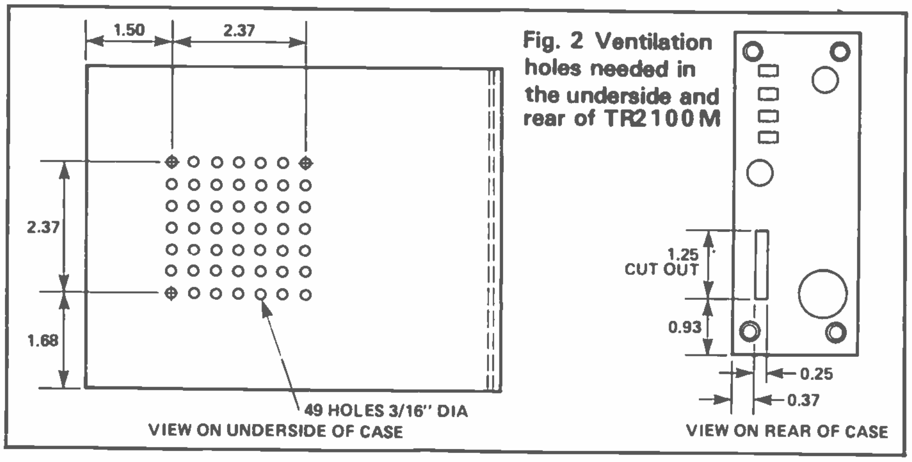


Fig. 2 Ventilation holes needed in the underside and rear of TR2100M

4. Replace transistor Q1 with a BC109 and fit a heat sink which increases its thermal stability. Before fitting it, cut the leads to approximately 5mm and fit sleeving to each lead. (You may find it unnecessary to complete all these modifications to achieve acceptable results). On completion of these modifications, I found that after allowing a 30 minute warm-up period, my TR2100M will remain within 0.6kHz of the selected frequency, for 2 hours on both transmit and receive modes. But, during this period, the oscillator will drift — 1.25kHz from the selected frequency. Therefore it is worthwhile to switch the transceiver on and leave for perhaps 30 minutes prior to operating.

Press To Talk Circuit

Another problem circuit requiring some modification is the Press To Talk circuit (PTT) which is located on the main PCB. Before discussing the actual modifications to this circuit it might be as well to briefly describe the operation of the circuit.

Transistor switch Q14 is normally biased to cut off. However, when the mic PTT is made, Q14 becomes forward biased. The resultant collector current energises changeover relay RLA and switches the main PCB circuits from receive to transmit mode. Also the Tx indicator illuminates. If the power select switch had been in the 'high' position relay RLB would also energise, switching in the main linear amp unit.

The two problems concerning this circuit are that no voltage transient protection has been provided for Q14, and transistor Q14 is over-rated for the task allotted to it. The essential modification to be made is to fit diode type IN4001 between connector pins A2 and A6 as shown on **Fig.3**. Use a solder sucker to remove solder — there is space on connector tabs to insert a diode leads into the eyelet without removing existing cables, then resolder. This is because of transient protection for the transistor Q14. Another useful modification is to replace the transistor with a transistor type 2N1305. Because this device is physically larger than the original and the device body has to be raised above the height of the surrounding components, the leads need to be about 10mm in length. Fit sleeving to each lead before installing.

Installing a Receive Pre-amp

There are many fine 2 metre receive pre-amps available on the market, either in kit form or ready built. From personal choice I fitted the Wood and Douglas Type 144 PA4 pre-amp. Cost and performance apart, the main attraction was that it was suitable to be mounted on short 6BA threaded stand-off pillars. By doing it this way, should it become necessary at a later date to remove the pre-amp, you will not need to tear the rig apart! Use the pre-amp PCB as a template to mark out the hole positions for the 4 stand-off pillars. The location of the pre-amp is not critical; from the illustration given in this article you should get a good idea where I located mine.

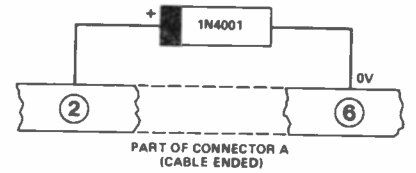


Fig.3 Voltage Transient Protection for Q14

Before drilling the fixing holes, carefully remove the cellophane backing from the opposite side of the chassis plate and retain for re-use. After drilling out the 4 fixing holes, counter sink the holes on the opposite side. Make sure the screw heads cannot protrude above the surface of the metal work. Attach the 4 threaded pillars to the metalwork and apply a small amount of 'loctite' to the screw

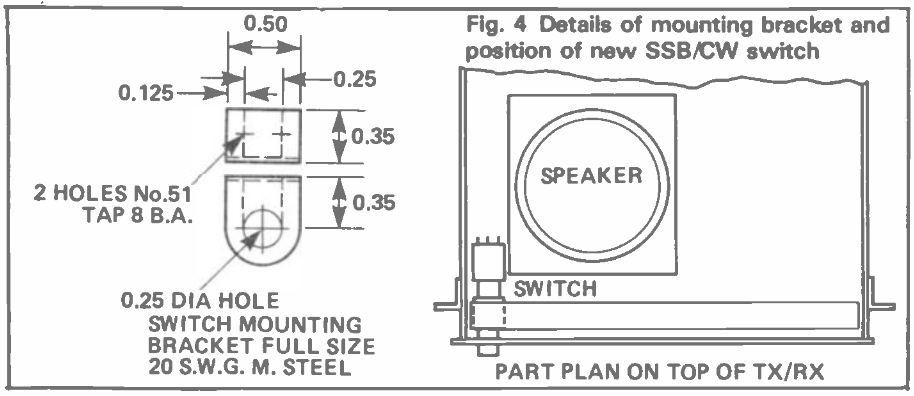
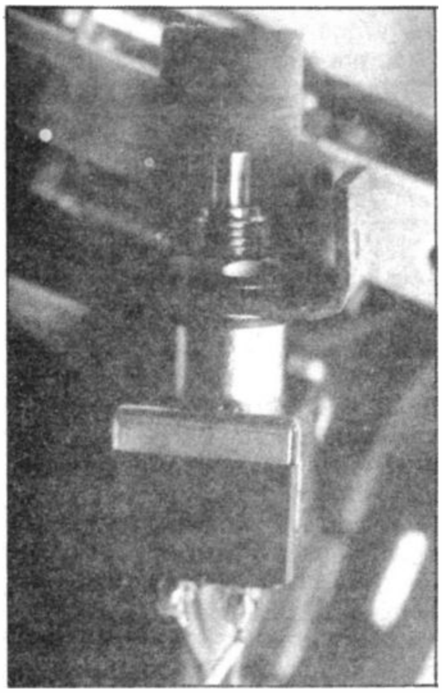


Fig. 4 Details of mounting bracket and position of new SSB/CW switch

heads. Refix the cellophane backing sheet.

When you are ready to connect up the pre-amp to the rest of the transceiver, locate where the RF signal input and the RF signal output destination (concerning the pre-amp module) are located on the main transceiver PCB. When you come to study the main PCB circuit diagram, you will notice that the receive path is from the change-over relay to the primary of L9. This is not copper circuit track as



SSB/CW switch and bracket

depicted, but it is in fact a miniature co-ax link. It can be easily located since it originates from the change-over relay and extends to the opposite side of the board. After you have located this link, cut it in two at the middle. Carefully remove each half from the PCB, noting where each inner conductor and screen are connected, and replace each half with fresh lengths of miniature co-ax, each length approximately 12 inches (300mm). The co-ax originating from the region of the change-over relay will eventually be connected to the pre-amp signal input, the other length to the pre-amp output terminals. However, I would leave the remainder of the wiring up until after the unit has been reassembled because then you can route cables into existing wiring looms. Also, you can determine the final cable lengths more accurately.

The positive supply for the pre-amp can be derived from connector A9. Should you require a Tx switched positive supply for pre-amp de-sense, it can be derived from connector A10. If in doubt, consult the instruction sheet supplied with the pre-amp regarding switched power supplies.

Remaining Alterations

Before re-assembly, snip off both the SSB-CW and the dial on-off rear panel switches. Reassemble the transceiver and complete the pre-amp wiring up. To hard wire the dial lamp, locate the cable ends associated with the rear panel dial lamp switch and extract these two cables from the cable harness to their distant ends. One end should terminate at the dial lamp, the other to connector C4. Unsolder and remove the cable at C4 and route the cable from the dial lamp along

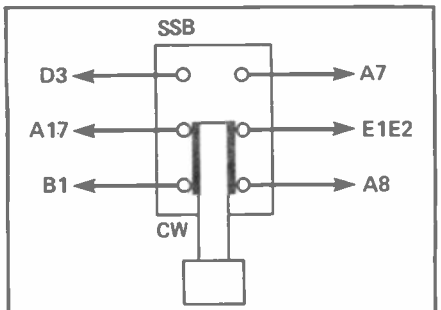


Fig. 5 SSB/CW switch connections

the cable harness and terminate at connector C4.

To fit the SSB-CW switch to the front panel, remove the plastic aerial bush from the front panel. This can be best done by crunching it to bits with a pair of pliers! The push button switch is a miniature alternate action RS components code 339-257. You require a 10mm button RS 339-617 to fit on the switch spindle. You will find this button slightly over-size. I chose to rub the edges of the button down rather than enlarge the hole in the front panel.

Using the spare steel plate left over from the removal of the battery holder, construct the bracket; details are given in **Fig.4**. Next, remove the silver coloured metal trim, fix the push button switch complete with button to the bracket then offer the complete assembly up to the transceiver. Operate the switch several times to check that there is no sticking. If there is, you may have to file a bit off the bracket until you get it right. When you are satisfied, drill the two 8BA clearance counter-sunk holes into the lip of the transceiver metalwork then offer up the complete switch assembly to the correct position using the two counter-sunk holes as a reference mark where the corresponding two 8BA tapped holes are to be made in the bracket.

Locate and remove from the cable harness the 6 cables associated with the rear SSB-CW switch, leaving them attached at their far ends. Reroute the cables along existing looms and then behind the front panel towards the solder tags of the push button switch. Where necessary fit new lengths of instrument wire. The connections to the switch are shown in **Fig.5**.

On completion of the modifications, do not switch on the tranceiver until you have made a thorough check to make sure that no wiring mistakes exist, that no cables have dropped off and that no cables have been trapped and short circuited. This is where the circuit diagram and the multi-meter are essential.

Readers are respectfully reminded that any modifications to equipment under guarantee will tend to invalidate the latter.

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ATTENTION ALL WRITERS . . .

. . . or just those of you who sometimes think "I could do better than that!"

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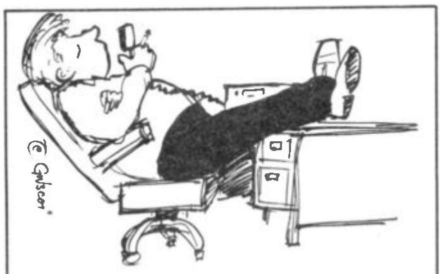
How To Start Your Own Net

It is surprising how many times one hears plaintive remarks about the prevalence of nets on the various amateur bands and how difficult it is to break into them. This problem of 'breaking in' arises perhaps 50% of

Do you have trouble breaking into nets? Or even in getting a QSO? Longwind lights his pipe and gives some advice.

the time and is due to a number of reasons. The main objection most nets have to breakers is that they disturb the flow of routine by requiring a shifting of the receiver in order to decipher an unaccustomed voice. Breakers are somehow similar to the unwanted visit to the campfire of a sabre-toothed tiger.



. . . disturbs the flow . . .

Personally, I have seldom objected to the odd nose being poked in to nets I have been involved in and can even be amused by the way in which some stretch their welcome by, say, making an extended first 'over'. Then, there is the false welcome given to some honest would-be joiners — who are subsequently deliberately missed when the roll is called and the microphone handed on.

Many old timers talk about the pleasant atmosphere which prevailed during radio's early days. In those times, 'breakers' could be sure of a brisk if not fussy welcome — even if their signal was badly distorted and almost unreadable. Indeed they could be way off the net frequency too and no comment would be made. It seems impossible to return to such halcyon days (except perhaps on UHF) so what are we to do if, after putting out many a long period of CQs, we are still bereft of a QSO? Well, like many solutions, this one is reasonably simple. It is necessary to find someone you like talking to regularly and to talk to him . . . well, regularly. Then this regular QSO will collect, silently, a number of listeners, some of whom will be licenced. Some of the latter will find that there is an amount of common ground and will eventually chip in. Of course, these breakers may not find later developments to their liking and will melt away but there will soon be others. This is how nets are built up.

Of course, they wax and wane as members leave and join for many reasons — and soon enough the operator who once used to grumble about the difficulty of 'getting in' will realise that nets have their imperfections. The main one is frequently having nothing to talk about and unfortunately this usually finds relief in criticism of everything. It is seldom possible to sustain discussions which are of intense interest to all the members of the net but nevertheless the establishment of a group will tend to impose a focal point on one's operating. To folk who are isolated

. . . criticism of everything . . .

. . . He lacked pomp . . .

from society either by chronic disability, location, geography etc they can often become essential in providing regular human contact.

Finding someone to talk to regularly can be some task. In my own case, the common ground was that the other fellow had a similar sense of humour. He lacked pomp and treated me with as much irreverence as I felt for others — and he did so right from the start. I could chat with him about various things but as I am interested in a wide variety of subjects there was never any difficulties in any random QSO with anyone in that regard. No, the key clicked home when we realised that we could freely speak to each other without offence to the point where one could terminate a QSO because one had nothing left to say and was bored. We were soon joined by others and today can sometimes have as many as 12 stations joining and leaving — but sometimes only one turns up!

Of course, having read all this you may not want to start your own net as the cure may appear worse than the disease. You may wish to continue to deplore the lack of simple QSOs — well, if you can't beat 'em and you don't fancy joining 'em keep right on with the CQ's — you are probably sure of meeting someone like yourself — if you call for long enough!

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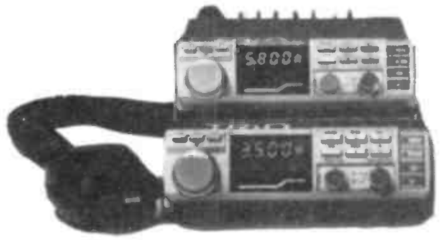

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Trio TS711E

the state of the art on 2m?

Considerable time has elapsed since Trio ceased production of the very popular TS700 series of 2m multimodes. When the TS711E was announced a few months ago, it was obvious from the spec' that their design engineers had not been idle. Angus McKenzie has been over an early sample especially for HRT...

Trio's first range of 2M base station 'multimodes' began with the TS700, followed by the 700G and ended with the 700S. In the last few years, they have introduced base station rigs with both 2 m and 70 cm capability, the TS770 and later the '780. As the '700S became rather long in the tooth, and was, in any case, discontinued some while ago, it became clear that Trio needed to release a really good multimode base station rig for 2m. Very sensibly, they bided their time until they could develop a really innovative new design which would have the potential of outclassing almost all the competition in many aspects. From my own experiences with Trio equipment, I would suggest that their forte is excellent ergonomics, and this was well evidenced from the first by their new TS711E.

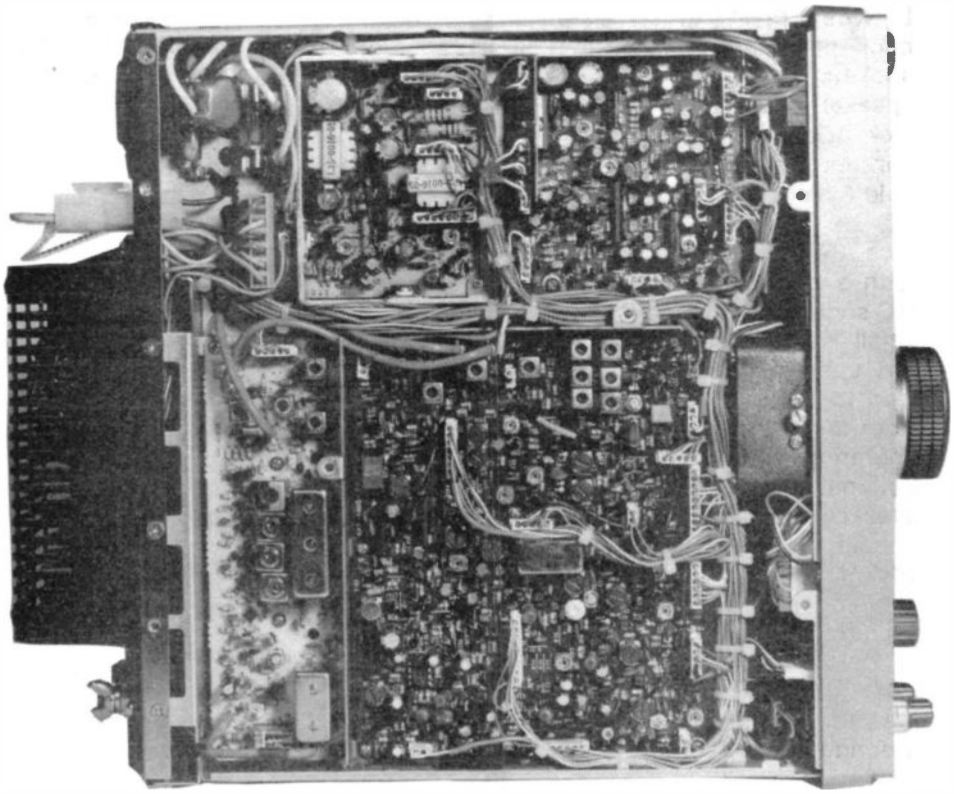
The rig is provided with facilities for FM, CW, USB and LSB, and incorporates 40 memories and several different types of frequency access. One of the most interesting and unusual new features of the '711E is the digital code squelch (DCS) and automatic station identification system. Whilst the two aforementioned facilities are quite complex, they may well establish themselves quite quickly in the UK. It is possible to put into the rig your own call sign so that each time you begin or end a period of transmission on FM, a series of bleeps lasting around 0.3 sec or so is transmitted, allowing other stations to identify your station if they have the appropriate display unit. Furthermore, the 711E (and, indeed, other future Trio systems) can be set to 'open up' from squelch only if somebody else calls you with their and your code sequence which you have previously programmed the 711E to accept — this is the DCS. If your rig is equipped with the optional callsign display and you are one of a group of amateurs who have a common calling channel, then the fact that one of them wants you will be obvious since their call sign will be displayed on your unit as a request for you to contact them back when you return home. The call sign display (CD10) costs an extra £110.25 and will work with any FM rig, whilst the DCS facility is built into all 711Es.

As far as I know, Trio's new tuning mechanism is unique in offering, on the same tuning knob, either click-steps or continuous rotation, switchable either from memories, VFO position or with a 'continuous/stepped' function button. The frequency steps are different, dependent on mode, and on FM, click-steps are either 12.5 or 5kHz, whilst on SSB and CW they become 1 and 5kHz steps. In the continuous rotation mode, the synthesiser steps are selectable at 10 or 100Hz increments, a full rotation representing around 9.5 or 95kHz per rev, but this is also modified by the actual achieved speed of rotation. This facility makes it easier to make a fast QSY up an down the band on CW and SSB modes.

Well Laid Out

Front panel 'functions' are very well laid out; most are logic switches, although a few are mechanical types. The logic control buttons select 1750Hz tone burst on/off, repeater offset (–, + or simplex), FM, USB, CW and LSB. An auto-mode facility automatically selects CW below 144.15, above which SSB is selected up to 144.5. From this frequency to 145.85, FM is selected; tuning from 145.85 to 146MHz returns the rig to SSB. Another row of buttons select scan function, memory write, reverse repeater or lock frequency, alert (priority) channel, and CHS (this gives the facility to change memory channel position whilst in VFO mode). The bottom row of buttons are all concerned with digital code squelch etc., working on FM only.

On the right side of the front panel are buttons for continuous or stepped VFO, VFO A or B, RIT on/off and RIT clear (a pot allowing RIT to –/+ 9.9kHz, the offset being indicated digitally on the main frequency dial). The remainder of the logic buttons include step size, memory to VFO and switched memory or VFO operation and common channel direct access, which would usually be set for a calling frequency. Two buttons select either split VFOs for Tx and Rx or cause both VFOs to work on the same frequency (ie for Simplex operation). Two large buttons 'step' the frequency in 1MHz steps, up or down. This seems a little silly on the European model in my opinion, and I would have preferred one of them to select 12.5 or 25kHz steps for FM.


From the bottom. . .

Switch Selection

The remaining switches are mechanical 'in/out' ones, selecting processor on/off, meter ALC or RF output, Rx RF attenuator (19dB), noise blanker on/off and voice synthesiser activate (spring loaded). This speech synthesiser is an optional extra (type US1, £25.60 inc. VAT), and gives a read out, or rather, 'talk out', of frequency to 100Hz, and also provides a – or + sign at the end to signify repeater shift in use.

Three split concentric rotaries provide adjustment of output power on Tx and mic gain (the latter on SSB only, which seems a pity), RF and AF Rx gain, and IF shift/squelch (the latter operating on all modes, but IF shift on CW and SSB only). The IF shift control, incidentally, is centre-indented which helps you to replace it to a nominal centre position. Also, on the front panel is a quarter inch jack for headphones and a locking 8 pin socket for mic interconnection.

A long panel across the top includes all the 'read outs' including a meter, which reads ALC or output power on Tx and 'S' meter on Rx. The digital frequency read out is light blue on a black background, and is very easy to read. A flourescent tube display provides the frequency readout and additional visible information includes memory channel selected, RIT offset, and various 'status' (ie what functions have been selected) displays, including VFO, priority etc.

The rig is encased completely in metal, has a carrying handle on the right side cheek and feet on the left one. At the rear of the underneath are two large feet, whilst under the front are another two and a pull forward bail stand, which raises the front about 3cm. A hole in the top cover allows a screw driver to be inserted to adjust CW semi 'break-in' delay time between fast and slow. On the back panel are two 3.5mm jack sockets for an external 8 ohm speaker and a CW key, a 2.5mm jack being fitted for external PTT control. A dummy plug covers up a hole which can be used for mounting an accessory computer interface. The rig is normally supplied with a mains input on a standard IEC socket, but adjacent to this is a small 13.8V DC input for car battery operation (fitted with a jumper lead to feed DC back into the rig from the internal mains PSU when operating from the mains) and an optional DC connection lead is available.

An accessory 13 pin DIN socket provides the following interconnections: (1/2) no connection, (3) data output (audio from the top of the Rx audio gain control, at least 300mV claimed into a load greater than 4.7k ohms), (4) ground, (5/6/7) no connection, (8) ground, (9) mic mute (when shorted to ground this disables the complete mic pre-amp on Tx, and enables data input to the rig), (10) no connection (11) data input (audio level 500mV for onset of ALC on SSB, subject to mic gain control, but fixed gain on FM providing +/− 3kHz deviation), (12) ground and (13) external PTT input, ground for Tx operation. It will thus be seen that the rig can cope with feeds to and from an external tape recorder or an RTTY terminal or similar.

Unfortunately, there is a serious lack of provision for operating an external linear and for putting ALC back into the rig. Lowe Electronics, the importers, have informed me that for a nominal charge they can add a small 9V relay internally, activated on Tx to provide a short circuit on two of the spare accessory pins, although at present they cannot see an easy way of gaining an ALC input. The antenna interconnection is on an SO239 socket, below which is an earth wing nut. Also mounted on the back panel is a very large heat sink with a built-in fan which speeds up to provide extra ventilation when the transmit duty cycle is heavy (ie when operating on FM).

Sophisticated Memories

Of the 40 memories included, memory 1 is the alert or priority channel, and memories 36 to 38 can accept separate frequencies for Tx and Rx. Memories 2 to 35 accept normal information, including mode, repeater shift and tone burst on/off, and also the state of the continuous or stepped VFO. Memories 39 and 40 are provided for selecting two frequencies at the edges of the searching mode, scanning in between these being painfully slow in 1 or 5kHz steps when the squelch is off, but extremely rapid with the squelch on in all modes. When 'search' is enabled with the rig set at a frequency outside the limits in these memories, then searching will be across the band, excluding frequencies within the limits of the 'search'.

Searching The Band

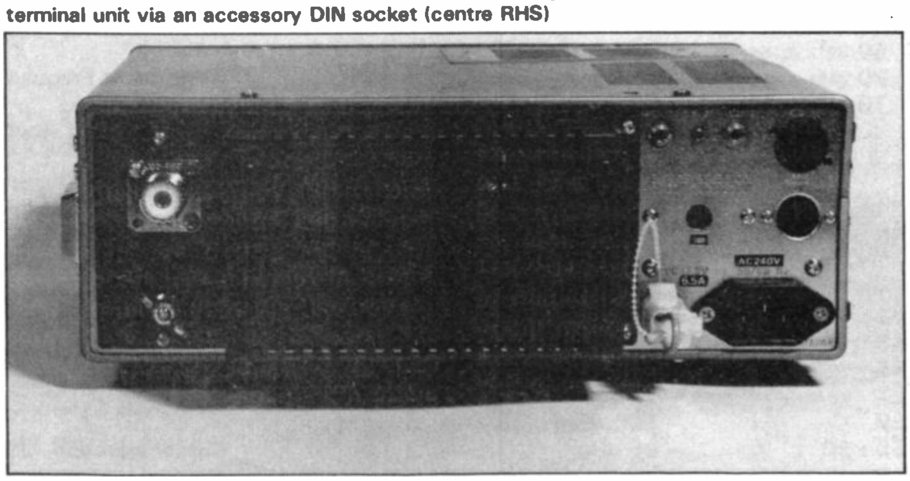
'Searching' can be either up (ie searching low to high) or down and this is quite useful. You can also select memory scan, and there is provision for scanning all channels or just channels of the selected mode. You can also put into a memory channel an 'opt out' signature, allowing the scan to jump over the channel which can then only be selected directly. I found one provision particularly useful, that of transferring *any* memory frequency instantly to VFO. I placed 144.3, for example, into memory 2 and instantly returned to the SSB calling frequency after completing a QSO and then tuned up and down from it.

There are several niceties which Trio have incorporated into the '711E. If you press a mode button you will actually hear the letters FCU or L in morse code to remind you of the selected mode, which is fabulous for a blind operator. Unfortunately, the order in which the buttons are placed represents a rather rude word and will somebody please tell this to the Japanese!

The auto button when pressed also emits an "A" in CW. Depressing any of the other controls is accompanied by a 'pip', but, in the case of memory 'write', a series of eight pips is heard and in order to insert the frequency you have to depress this button again, resulting in a long pip to signify the acceptance of the instruction. When the rig is in 'auto-mode' you can hear a little pip each time you reach a band section change, ie the bottom and top of the entire band and the intersections between the CW and SSB segments. If you turn round the memory channel selections (VFO knob is used for this when memory mode is in use) then you will hear a 'pip' sound when you reach memory 1.

The ability of the memory facilities to accept mode, repeater shift and even tone burst on or off is extremely useful. You can step channels up or down either from memory or normal from the mic supplied, type MC42S, (an optional table stand model, type MC60A, £62.80 inc. VAT, is also available). The speech synthesiser can be actuated by depressing the speech button, usefully placed at extreme bottom right of the front panel. The tension on the VFO knob can be varied for both continuous and click steps by adjusting a screw through a hole towards the front of the bottom panel.

The TS711E can take feeds to and from an external tape recorder or an RTTY terminal unit via an accessory DIN socket (centre RHS)



On The Air

For three weeks I have had a great deal of pleasure using this rig on all modes. On FM, I received several complimentary comments about the speech quality, the transmission seeming very tightly controlled within the 12.5kHz channelling, causing virtually no interference to the adjacent channel. On SSB, the quality was very good, and despite my going into ALC at full power the transmitted IM products did not, in practice, seem to affect the quality of the signal quite as much as the lab tests indicated they would, unless my signals were very strong. I consider that the ergonomics are about the best I have ever experienced on an amateur rig, and Trio have obviously spent considerable time in having a good think before developing this unit. All the facilities worked very well and I did not find the layout at all confusing. Somehow the '711E was easier to get to know than many other rigs of similar complexity that I have checked.

The receiver 'front end' shows no significant improvement in sensitivity over its predecessors which is, perhaps, a pity but the RFIM performance is clearly better. I did not note any of the problems that have beset many other 2m rigs, especially on FM, due to powerful out-of-band signals causing interference, which are totally absent on this

TRIO TS-711E LABORATORY RESULTS

RECEIVER TESTS

Sensitivity (FM 12 dB sinad)

144.025 MHz	−120.5 dBm
144.950 MHz	−123.0 dBm
145.975 MHz	−123.0 dBm
(SSB 12 dB sinad)	
144.4 MHz	−123 dBm
144.975 MHz	−124 dBm

Attenuator 19 dB

Selectivity; FM,
Blank Carriers off channel to degrade Sinad by 3 dB

+/− 12.5 kHz spacing	70/71 dB
+/− 24 kHz spacing	79.5/80.3 dB

Selectivity; SSB,

3 dB Bandwidth	2.4 kHz
6 dB Bandwidth	2.5 kHz
40 dB Bandwidth	3.5 kHz
60 dB Bandwidth	4.6 kHz
80 dB Bandwidth	10.4 kHz

RFIM Performance (FM)
Carriers off channel for 12 dB Sinad product
(ref. 12 dB Sinad)

50/100 kHz spacing	73.55 dB
100/200 kHz spacing	74.42 dB

Calculated intercept point −7.5 dBm

Reciprocal Mixing Performance
RF levels required off channel to degrade Sinad by 3 dB (ref. noise floor)

200 kHz spacing	121 dB
100 kHz spacing	118 dB
50 kHz spacing	112 dB
20 kHz spacing	104 dB
10 kHz spacing	98 dB
5 kHz spacing	89 dB
3 kHz spacing	66 dB

S Meter;
RF levels required to give the following meter readings

	FM	SSB
S1	−122 dBm	−108 dBm
S3	−110 dBm	−105 dBm
S5	−106 dBm	−101 dBm
S7	−103 dBm	− 96 dBm
S9	−100 dBm	− 89 dBm
S9+20	−96 dBm	−72 dBm
S9+40	−91.5 dBm	−56 dBm
S9+60	−85.5 dBm	−41 dBm

FM Capture Radio	4.5 dB
FM Audio Quieting (at 12 dB Sinad)	16 dB
FM 3dB Limiting Point	−126.6 dBm
Maximum Audio Output (10% THD into 8 ohms, FM)	3.0 W

FM Audio Distortion (125 mW into 8 ohms)

1 kHz deviation	1.25%
3 kHz deviation	2.8%

SSB Product Detector Distortion
(at −80 dBm) 1.5%

FM Best Obtainable Signal-to-Noise Ratio
CCIR/ARM Weighted at −70 dBm 63 dB

TRANSMITTER TESTS

RF output power *See Text*	FM	USB	CW
144.05 MHz	*22W	36W PEP	25W
144.3 MHz	*20W	36W PEP	—
144.8 MHz	*20W	—	—
145.8 MHz	*25W	36W PEP	—

*changes with temperature

FM Carrier Frequency Accuracy	−40 Hz
CW Frequency Error	−120 Hz ref counter
Peak Deviation (Loud Shout)	5 kHz
Tone Burst Deviation	4 kHz
Tone Burst Frequency	1750 Hz within 1 Hz
Repeater Shift Accuracy	Within 10 Hz
Tx Harmonic Distortion (144.8 MHz FM) Both 2nd and 3rd harmonics	<−65 dB
FM S/N ref full deviation	−53 dB
SSB noise (min gain minimum)	−95 dB ref peak carrier, 100 Hz bandwidth ie Total noise *−82 dB*
Carrier rejection, USB	−80 dB ref full output

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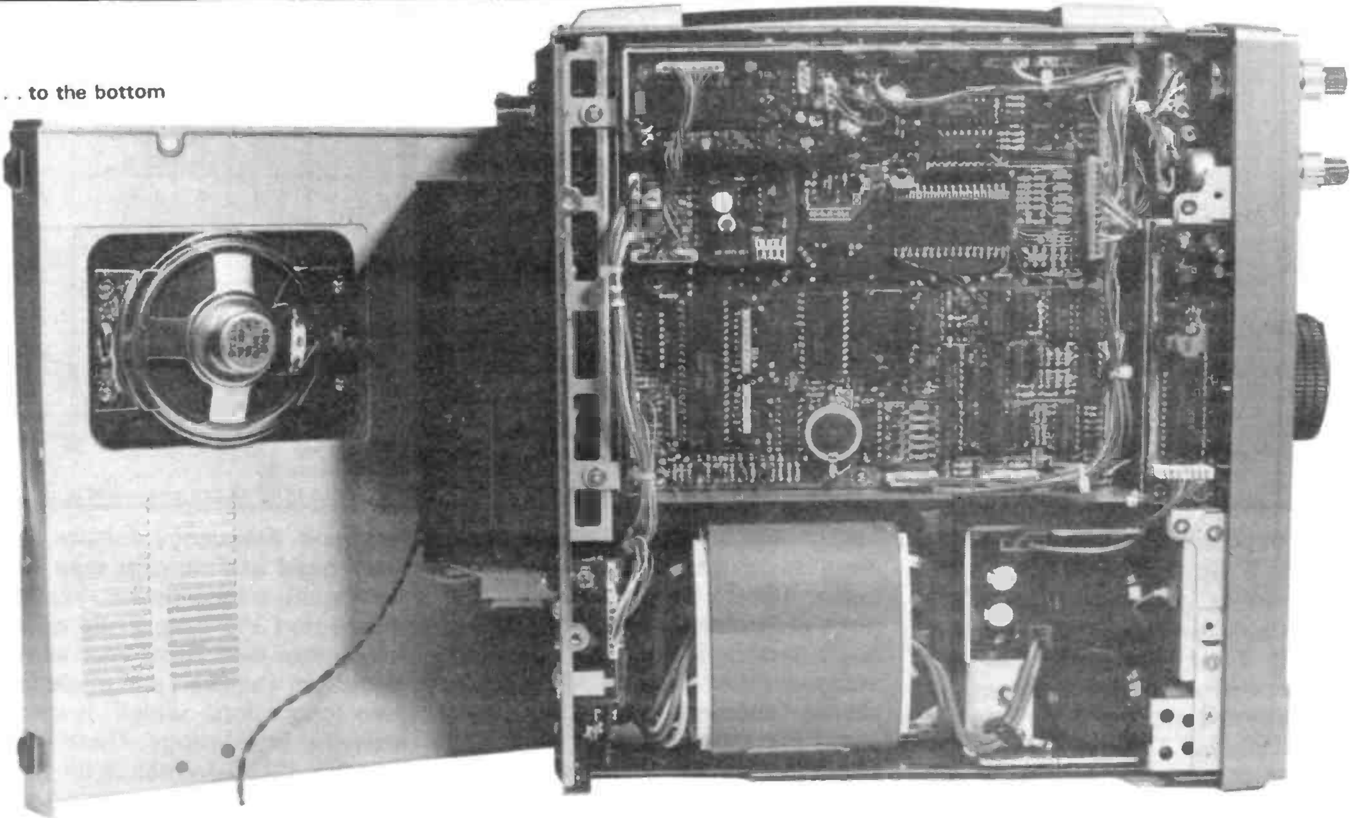


model. General hash seems at a lower level indicating a superior reciprocal mixing performance. The IF passband on SSB seems to be a reasonable compromise between DX capabilities and good audio quality, although I regret that no optional CW filter is available. On FM the selectivity seemed excellent and audio quality was good.

Excellent AGC

There seemed to be a reasonable amount of power in the audio output and AGC characteristics on SSB were just about how I like them for average use, AGC speed automatically changing to fast on CW. The noise blanker worked fairly well but I have heard slightly better ones. The attack of the AGC/product detector circuitry is very fast and speech peeks seem very well controlled without any sign of 'cracking'. The Squelch worked excellently on all modes and the IF shift control was very useful.

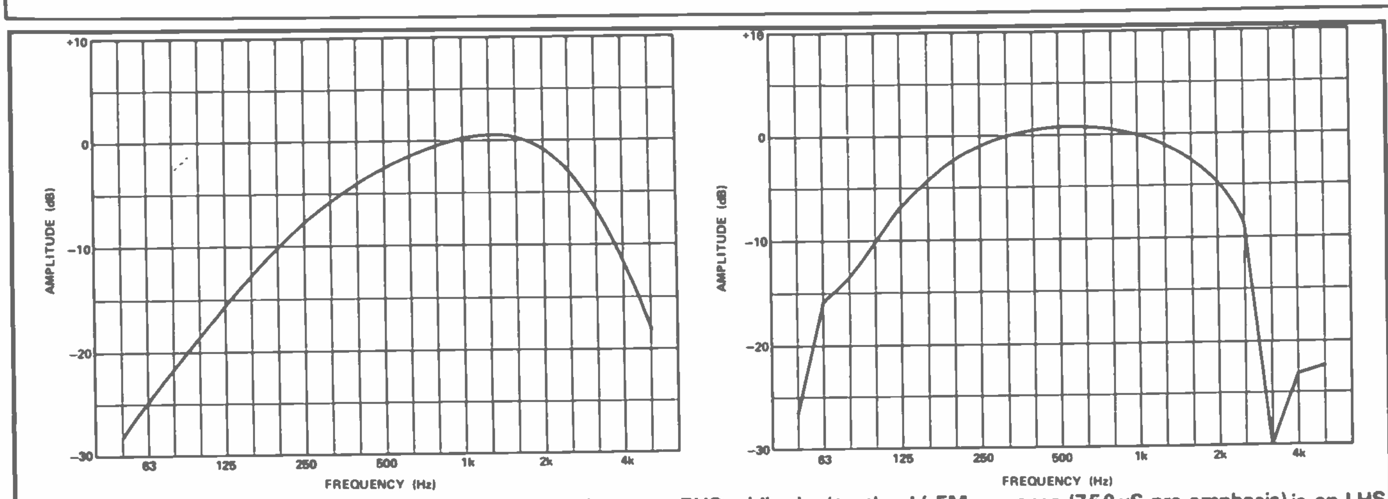
Using the appropriate procedures, we put my own call sign into the DCS memory and found that this, when switched on, gave a 'burst' at the beginning and end of each transmission. Many of the locals suggested that this was reasonable enough for two or three periods of transmission, but became a little tiresome to listen to after this — you can switch DCS on and off. (By the way, note that the DCS works on FM only). I was not able to try the digital code squelch facility as there was nobody locally who could send the appropriate signals unfortunately. In time, when there are more rigs with DCS fitted about, I feel this could be an extremely useful facility.

The ability to vary power output on all modes on Tx is excellent, but I am moved to remark again, "why did Trio allow the mic gain control to operate on SSB only?" Some peoples' voices are a lot quieter than others, and some users tend to habitually 'eat' the microphone (!) whilst others sensibly keep a few inches back. Trio should also provide more facilities on their accessory socket. However, this rig is really particularly noteworthy as I find it difficult to detail any more irritations and this is a compliment!

In the Lab

The RF input sensitivity on both SSB and FM is quite reasonable, although there was some deterioration at the CW end of the band. The input attenuator nominally 20dB, but measuring 19dB, comes in the antenna input circuit and I feel that this would have been more usefully set for 10dB. The RFIM performance was excellent, the intercept point being reasonably high. The reciprocal mixing performance is extremely good, local oscillator noise being far lower than usual. Even at only 5kHz off channel, phase and amplitude noise on the oscillator measured well, thus explaining the very clean sound when tuning across the band. IF selectivity on SSB was just about right for good audio. FM selectivity was really excellent, even at 12.5kHz spacing.

The 'S' meter on SSB only gave 18dB difference between S1 and S9 and I would have preferred a more logarithmic law, figures above S9 also being very optimistic. Ironically, the S meter was actually better on FM up to S9, but above this, 20dB indicated steps occurred with only 5dB level increases. The AGC plots of SSB showed that it takes 1.5 seconds for gain to recover when the input level changes from −70 to −100dBm, and this seems about right considering the actual recovery characteristics. The −100 to −15dBm drop showed that just 11dB of audio level is recovered



TS711E receive audio responses. THe SSB response is shown on RHS while the 'textbook' FM response (750uS pre-emphasis) is on LHS

and this takes much longer — around 5 seconds.

Product detector distortion is reasonably low, whilst distortion of FM at 3kHz deviation was just slightly high, although this was not considered a problem. A maximum output level of 3W was obtained into 8 ohms which should be plenty of 'welly' for most users. In the subjective trials, I noted that very strong signals that were, themselves, of good quality seemed to reproduce with an astonishingly wide dynamic range on an external speaker (Trio model SP-180), and this was explaind by the remarkably good signal-to-noise ratios measured in the laboratory, both unweighted and weighted. A rig which can give a 60dB signal-to-noise ratio is a good one on FM, and shows extremely low synthesiser noise.

The squelch control had a reasonable range of adjustment and a very weak signal could open it up, both on FM and SSB. The AGC threshold was at around 1uV input on SSB, levels above this being virtually identical on the audio output. FM limiting characteristics were excellent, signals a few dB below the 12dB sinad sensitivity point still coming up virtually to full audio output level. Input quieting measurements versus sinad sensitivity showed that there was slight distortion on FM, no doubt primarily due to the narrow selectivity which thus seems to be optimised very well.

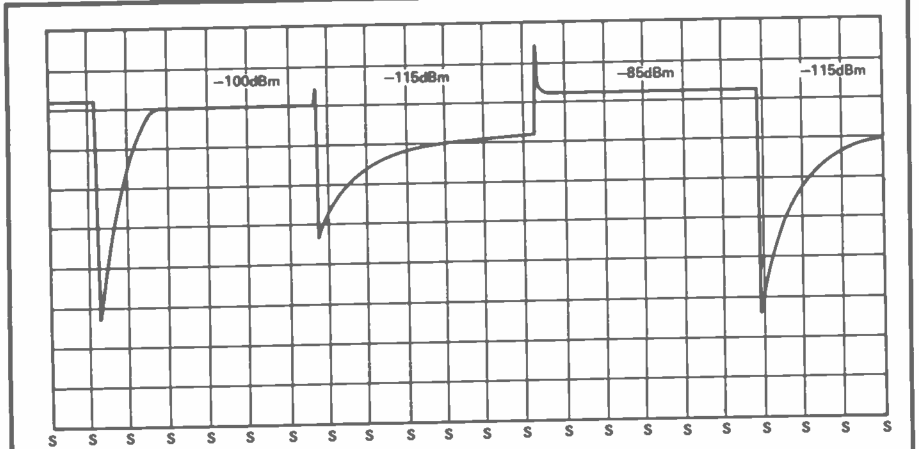
Looking at the receive audio responses, FM seems almost 'textbook' in giving excellent attenuation below 300Hz and very rapid attenuation above 3kHz. On SSB, with the 'IF shift' control at centre, the reproduced response seemed to favour the LF end a little too much, but a small adjustment to IF shift, of course, rectifies this. Received frequency accuracy was within 100Hz on SSB/CW and optimum results on FM were obtained on channel.

Attention To Tx

We decided to go to town on the transmitter section as I considered this rig to be a very important one. Frequency accuracy was very good and no drift was noted over quite a long period. We interconnected the output via a 30dB attenuator load into a very esoteric spectrum analyser, and made many two-tone plots which were extremely interesting. These show that the IM performance on SSB is extremely good up to around half power, but the performance with two-tones going into ALC is rather poor. During the tests one oddity occurred — the power output capability seemed to drop down after a long period of transmission as the PA got hotter. This has remained a mystery, but is probably due to the test sample being a very early production model.

We also checked the bandwidth occupied by normal and compressed speech, and it will be seen, from the diagrams nearby, that when the compressor is used, the transmitted bandwith is widened due to there being more intermodulation products generated over a given time period. We spent quite a considerable time in attempting to obtain a sensible carrier balance reading, eventually finding just a trace of carrier at −80dB ref full output, which is truly remarkable. Perhaps even more astonishing is the lack of noise transmitted, both within the audio pass band and outside it, for, with mic gain at minimum, the noise within the IF Tx filter bandwidth was some 82dB below full output, thus showing amazing dynamic range.

There was no detectable output off channel which shows that the excellent reciprocal mixing performance noted on Rx is also present on Tx. We had a look at se-



TS711E AGC response

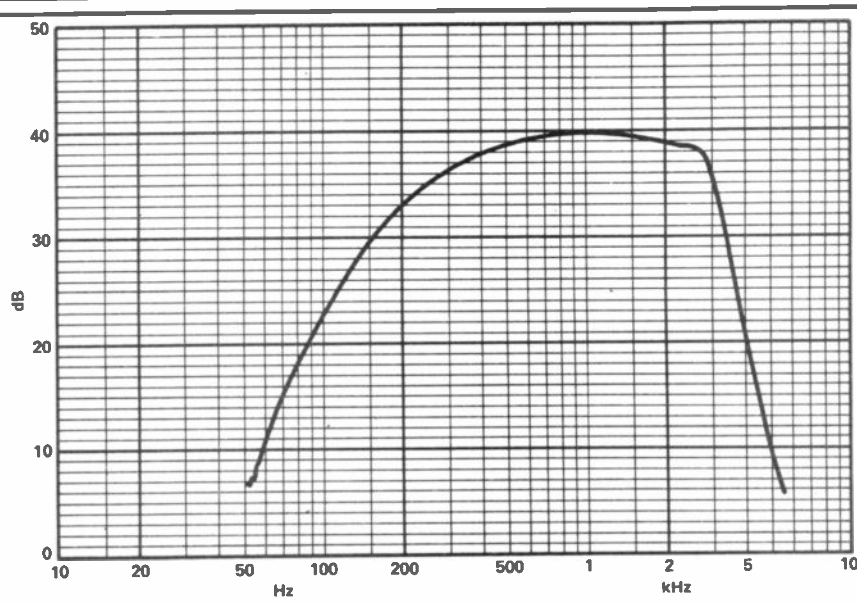
cond and third harmonic output and nothing was detectable on the analyser which had a noise floor of −65dB. FM deviation was superbly well controlled, never exceeding 5kHz but averaging around 4kHz on normal speech. The tone burst frequency and level was again extremely accurately set. We checked the approximate signal-to-noise ratio as transmitted in the passband 300Hz to 3.4kHz by holding the mic in the middle of the laboratory. With all my colleagues behaving like small mice, and in between my tummy rumbles, we obtained a signal-to-noise ratio of 53dB which is excellent, the result again showing the '711E displaying no evidence of synthesiser whine.

We spent some time investigating maximum power outputs and found that SSB gave an absolute maximum of around 36W PEP, but under some conditions we saw only around 20W or so when the rig became hot. FM power measured between 20/27.5W, also dependent upon temperature. Power output on all modes could be reduced to around the 2.5W level. For the two-tone tests we injected the signal into the data input on the accessory plug and shorted the appropriate pin to disable the internal mic amp.

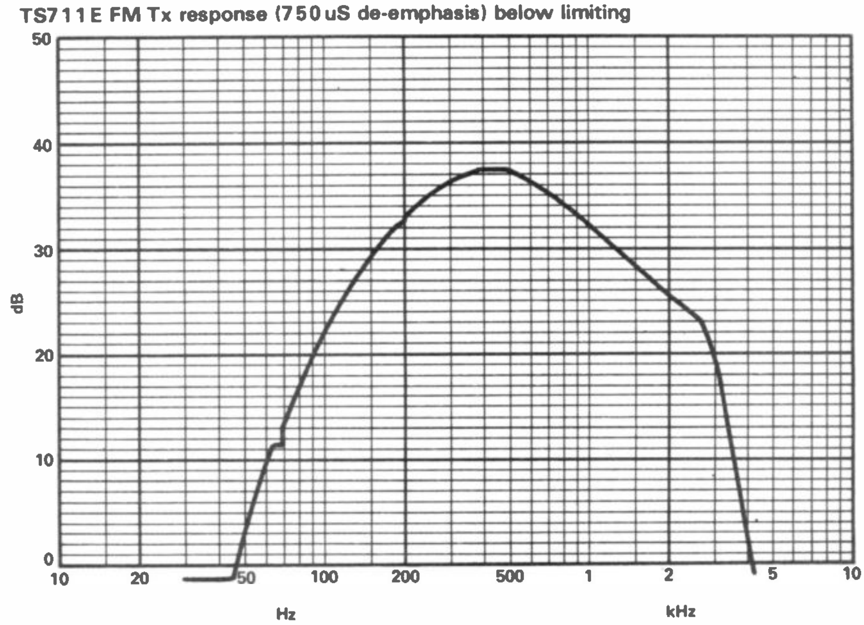
The transmitted response on FM was checked with 750us de-emphasis in the Marconi 2305 modulation test meter. Pen charts were made of the response below limiting and 20dB into limited. The normal response was another text-book one, as good as I have ever seen on an FM rig (note the very rapid attenuation above 3kHz). The limiting response curve is also excellent proving that this transmitter is unlikely to cause any interference to adjacent channel signals provided the receiver at the other end has a respectable selectivity.

Returning to the spectrum analyser, plots were made of the power density of speech with and without the compressor switched in. **Fig. 1** shows the difference between the two, ie the additional amount of IPs generated when using the processor.

The tests were undertaken at 144.4MHz, with 2kHz per division shown horizontally, between 60 and 65dB range being shown vertically **Fig. 2** shows the amount of space taken up by an FM transmission. The Spectrum analyser was set at peak hold, and each period of speech was or at least 1.5 minutes. The FM plot was at 5kHz per division horizontally. The two tone tests on SSB show many IPs. Note the distinction between the two tones placed 1kHz apart, **(Fig. 3 and 4)** and 200Hz apart **(Fig.5)**. In the case of the former, the IPs are generated after the IF filter, and thus you can see the intermodulation performance of the entire RF section. When the tones are 200Hz apart, the IPs are generated by a combination of distortion in the mic



TS711E FM Tx response (750uS de-emphasis) below limiting



TS711E FM Tx response (750uS de-emphasis) 20dB into limiting

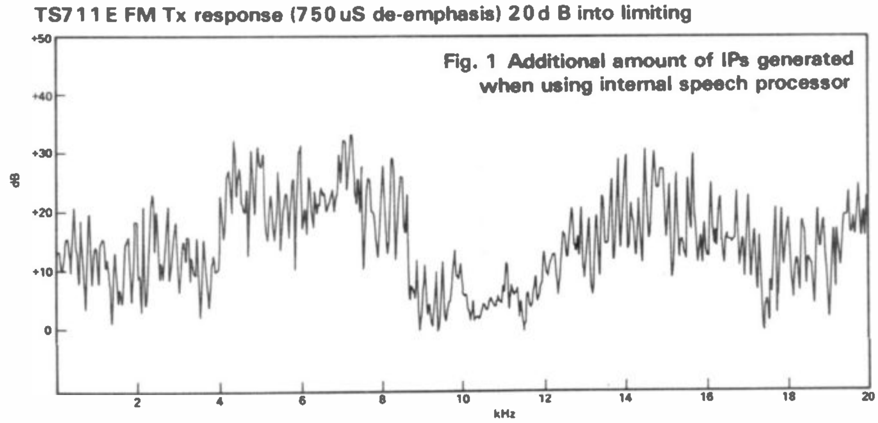


Fig. 1 Additional amount of IPs generated when using internal speech processor

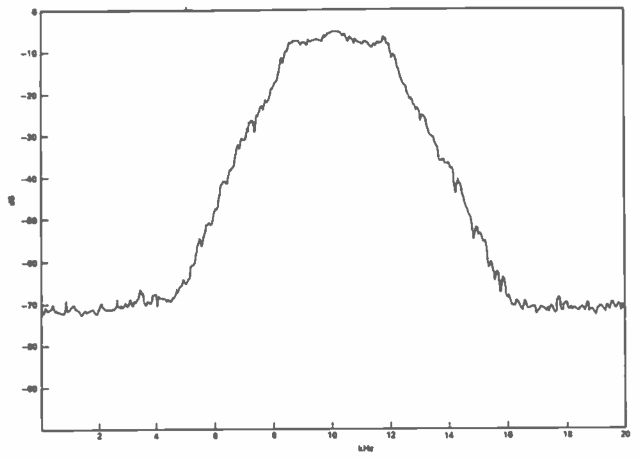


Fig 2 (see text)

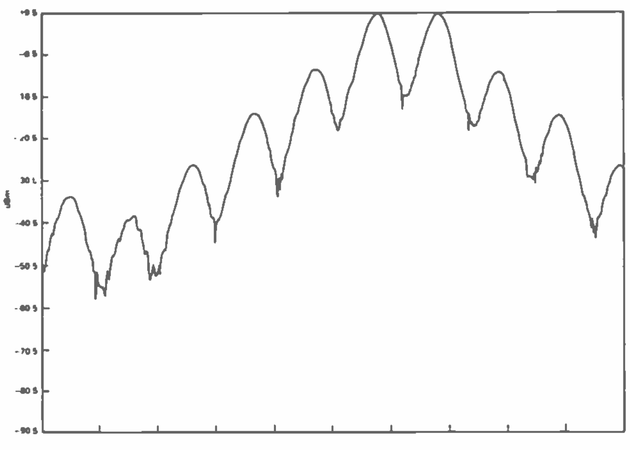


Fig. 3 36W SSB 2-tone test. NOTE 1kHz per horiz div

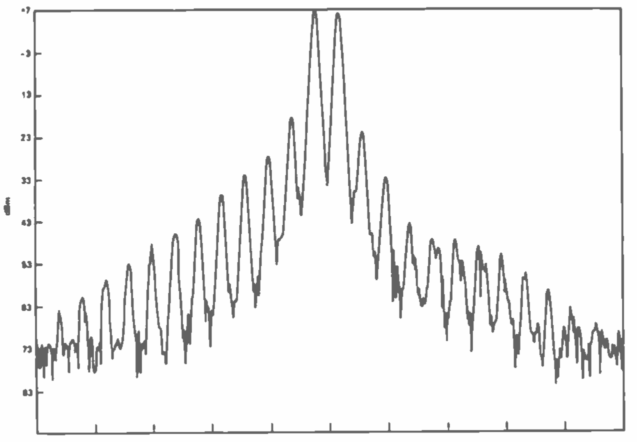


Fig. 4 20W SSB 2-tone test. NOTE 500Hz per horiz div an tones 200Hz apart

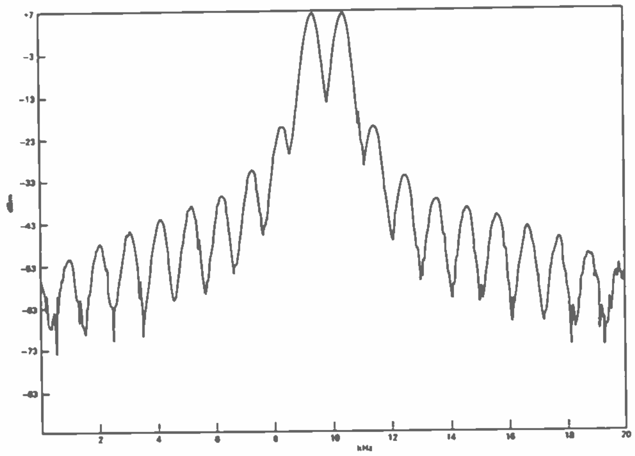


Fig. 5 20W PEP 2-tone test. NOTE 2kHz per horiz div

amp and modulator, and the RF output stages.

It will be seen that the lower order products are only marginally worse on the close-in spacing than on the wider spacing, and this indicates that the mic amp/modulator circuitry is very clean indeed. The only plot which is not good is the one where the rig was working flat out at 36W PEP, and the third order product of −14dB is not good enough. The dramatic difference between this plot and the 20W PEP plot, only 2.5dB lower, shows how much better the rig is if it is not driven into ALC.

Conclusions

I am full of praise for this delightful new 2m multimode. The technical performance in both the transmitter and receiver sections is excellent, with the exception of the intermod products when transmitting into ALC, and a slight output power drift with temperature (both these problems are almost certainly sample faults, though). The receiver compares extremely favourable with most others on the market, and just the RF input sensitivity needs improving slightly if you are not using a low gain masthead preamp, which I would recommend for real Dx working.

I feel that the only other comparable rig for 2m, is the IC271E with muTek front end. The choice between the Trio and the Icom is not easy, for whilst I personally prefer the Trio because of its superior audio quality, the ergonomics bearing no comparison because of the Trio's amazing facilities, the Icom rig has better input sensitivity and 'front end' RFIM performance.

I strongly recommend you to request the importers to add the relay control circuitry, but you will have to be very careful indeed to avoid overloading the input to a linear, especially as there is no provisions for ALC. As far as cost is concerned, the Trio and Icom rigs are similarly priced if one includes the mains power supply for the Icom (TS711E, £792 inc. VAT). However, the Trio speech synthesiser and pip provisions are far better and cheaper than those of the Icom.

The '711E's appearance is very good, the layout very clear and the size (285×310×110cms including projections) is a good compromise between accessibility of controls on the front panel versus compactness. The rig weighs 7.1kgs and is thus on the heavy side for mobile use, although fine for home or portable locations. I have no doubt whatsoever that this will become a very popular rig and if you know any 'white stick' operators, please do let them know about the rig for it will be a godsend to them. I cannot wait to see what else Trio have in their pipeline, for at last they are taking notice of what their customers are saying and introducing facilities which are so useful.

I would like to thank my colleague Jonathan Honeyball for helping with the measurements and Lowe Electronics for kindly loaning a very early sample for this review.

DSB80 Revisited

Back in March 1983 *Ham Radio Today*, we published a design for a QRP DSB/CW Transceiver known as the 'DSB80', which turned out to be one of the most popular pro-

Here is a general update on one of the most popular projects yet published in HRT, along with an improved PCB foil pattern. By Tony Bailey, G3WPO, and Frank Ogden, G4JST.

jects ever published by the magazine. Since then, there have been a large number of mods to the design, partly to correct errors in the original text, also to improve the performance of the design and overcome a few problems that arose during construction. Most people have had few difficulties and got straight on the air, but they may care to incorporate some of the following ideas.

This article will also bring all known corrections together and should help those who have maybe started construction and not finished yet, or have had problems that they think they cannot solve. Thanks go to constructors who spotted the errors and kindly (or occasionally rudely!) told us about them. But then we are only human....

Incidentally, a number of people have queried whether DSB is legal. Yes, it is! The latest licence Schedule specifically points out that DSB emissions are classified under the same heading as AM emissions.

1. Errors. There were a number of errors in the original text — this was our first attempt at publishing a detailed constructional article of this type and lots of uncorrected errors crept in! We hope we have improved since then (a bit). Some corrections have been published already but are repeated here.

The following list needs to be read against the original text as printed.

Circuit Diagram

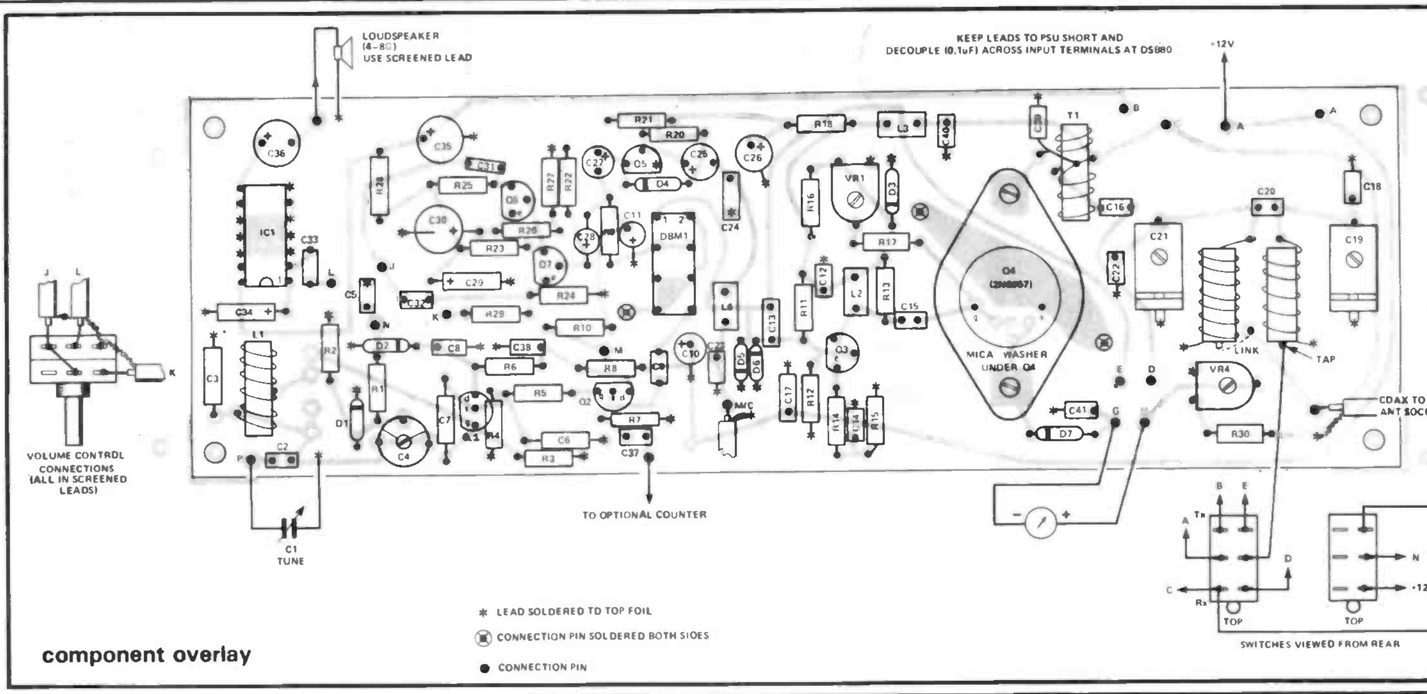
a) The numbering of C6 and C7 should be reversed (the layout diagram is correct ie C6 is the earthed capacitor). *C6 and C7 are both the same value so this does not affect the construction in practice.*
b) Pin 1 on the SBL1 is connected to C13, not as shown.
c) R10 has been changed to 15k for more drive.
d) TR1 and TR2 should both be replaced by J310 transistors. This gives increased oscillator drive and helps defeat 'FM'ing' (see later).
e) The lead from R18 goes to the junction of R16 and L3, not as shown (this is OK on the PCB).
f) R8 has been changed to 47R.
g) The circuitry associated with TR6 can be deleted (ie TR6 R19/31). There was an error on the PCB that was spotted just after publication that obviated their use.
h) C27 has been changed to 2.2uF radial 16V.
i) C30 has been changed to 220uF axial 16V.
j) RV3 can be a log pot for better drive linearity.
k) TR4 (the PA) was specified as a 2N6657. While this is available still, its price has rocketed. We have replaced this with a VN66AF. This is a different package and requires modifications to the PCB layout (such PCBs are supplied with kits). Otherwise the PA circuit is the same. Note that the VN66AF, besides having the normal three Gate, Source and Drain leads, also has a metal Tab common to the drain.
l) The SBL1-8 has been replaced by a straight SBL1. Under normal conditions this is perfectly adequate unless you live very close to a BC station. If this is the case, the SBL1-8 may be preferable, but is unfortunately not so easy to get hold of.

Components List

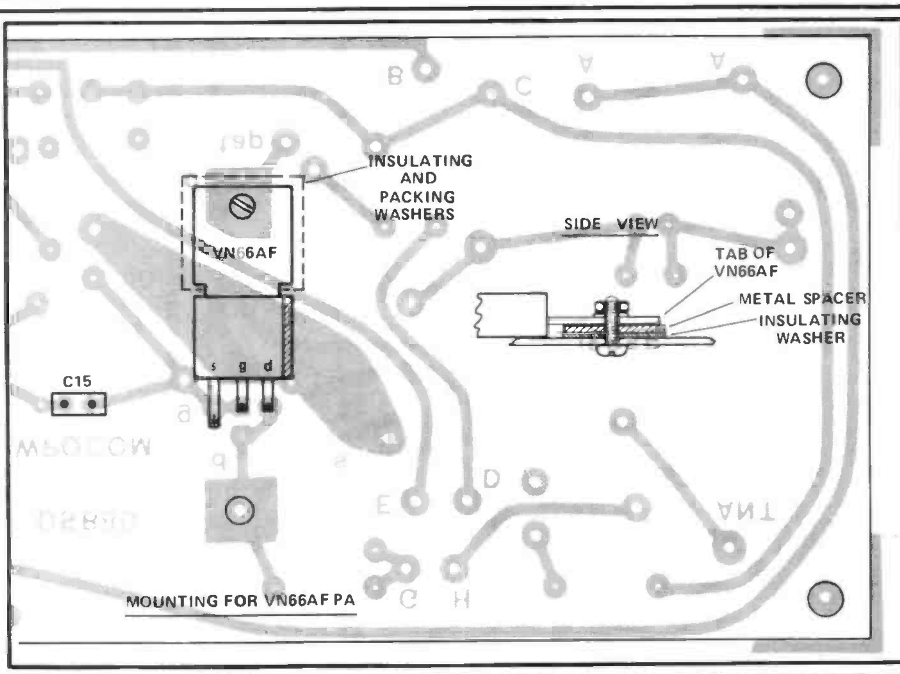
a) Delete R19 and R31.
b) Change R8 to 47R.
c) Change R10 to 15k.
d) Delete C34 from the 10n list.
e) Change C27 to 2.2uF radial electro 16V.
f) Change C30 to 220uF 16V axial.
g) Change TR1/2 to J310.
h) Change TR4 to VN66AF.
i) Amend L1 to 40 turns.
j) RV3 can be any value log pot from 5 to 100k. A log pot gives better drive linearity than the original linear type.

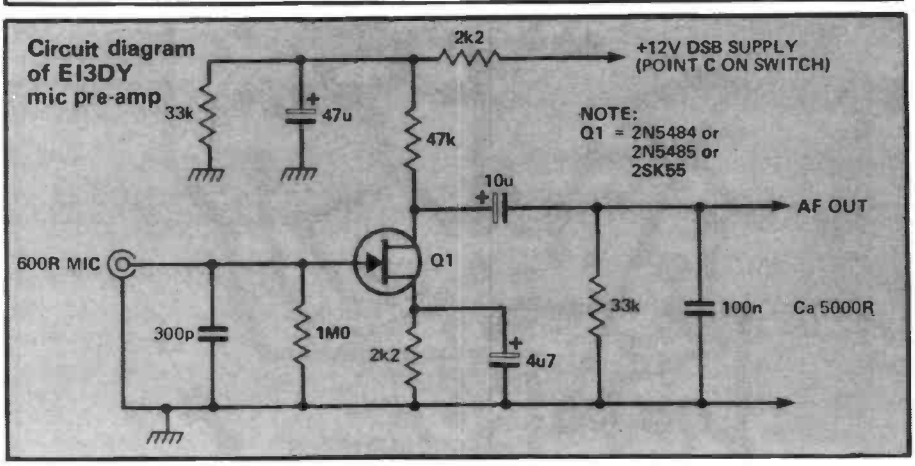
Component Layout

a) Delete TR6/R19 and the adjacent link.
b) The capacitor to the right of R22 is C27.
c) TR1 and TR2 case orientations are reversed by 180 degrees for J310s.
d) C39 is not located where shown. It is attached with one end directly to T1 tap, and the other end to the PCB top foil.
e) The capacitor to the right of L3 is C40.
f) On the switch connections, bottom right of diagram, points D



component overlay





Circuit diagram of EI3DY mic pre-amp

and E should be interchanged. Remember, when wiring up with toggle switches the contacts are 'made' on the opposite side of the switch to the direction of the toggle! Thus, the original drawing shows the toggle protruding on the *opposite* side of the appropriate 'connections'.

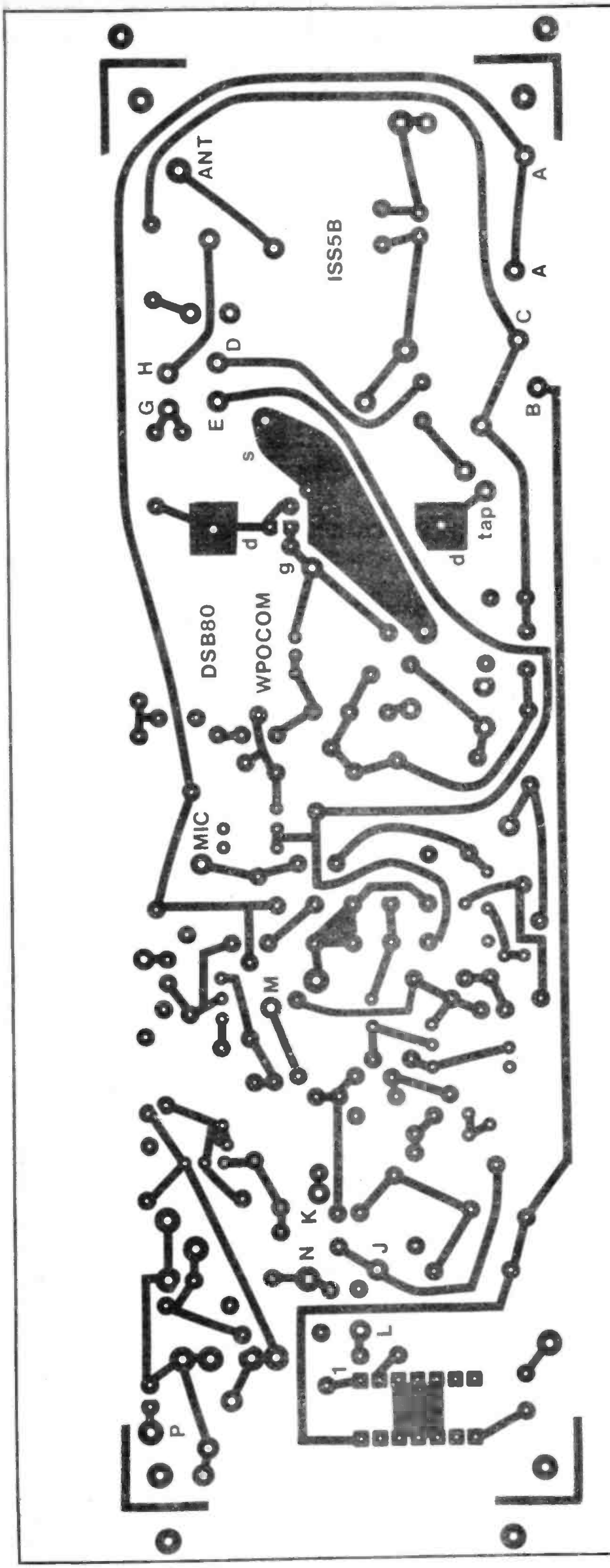
g) To aid PA stability, add a 100n ceramic capacitor across one of the point A's to earth, and also one across the power input sockets. Long undecoupled PSU leads may cause instability.

h) **To avoid FM on DSB, or chirp on CW**, which is often the biggest problem with the DSB80 or similar transceivers, *keep all leads well away from the VFO circuit and capacitor*. This involves running leads around the back of the case and not across the front. This point, together with the changes to TR1 and 2 should cure all FM. A cure adopted by some people has been to rebuild the VFO on a separate PCB. FM is caused by RF getting back into the VFO circuit, and is a common problem with direct conversion sets. This is also the reason that you cannot easily use the DSB80 on 40m, except with a remote VFO.

i) There is some variation in the permeability of the dust iron cores used in the VFO and PA output filters (L1 and L4/5). It may be necessary to amend the VFO turns one way or the other to get correct coverage. With the PA filters, additional or less capacity in positions C18/C21 may be needed for resonance.

Latest PCB

The latest PCB pattern for the track side of the board is reproduc-



Foil pattern

ed here. It allows for the VN66AF (as well as the 2N6657), and has redundant tracks removed. the drawing gives an amended component layout. The VN66AF needs an insulating washer and a metal packing washer under its tab so that it can be mounted flat against the PCB, without bending the tab.

Further Suggestions

1. Mic amplifier. It is necessary to use a fairly high output mic to get the required drive on DSB. The best audio quality results from a dynamic mic, and these are often low output, low impedance types. The additional mic amplifier circuit shown here is due to Mike Staunton, EI3DY, and can be added as an external amplifier on a small piece of Veroboard if found to be required. This board attaches directly to the existing mic input.
2. The basic DSB80 is not ideally suited to multiband operation because of the amount of switching required and the fact that the PA was designed for a single band only. A few people have attempted a multiband receiver from the bones of the DSB80 and a suitable multiband VFO circuit was published in SPRAT, the journal of the G-QRP Club, recently, but the switching of the PA end of things is much more difficult. The driver would have to be switched also, and it would be best to build these stages on a completely separate board, possibly with a separate PA for each band. The values needed for the latter can be extracted from the DSB2 article in the April 1984 issue of HRT.
3. If you are using an antenna of other than 50 ohms (which is very likely) then you will need a matching unit to get the proper power output from the VMOS PA stage. It is no good, as some people have done, trying to tune the filters directly into your long wire! You may get some power output, but more likely eventual loss of the PA stage! Although the PA is virtually indestructible from many views, it can be damaged by the overheating that results from some types of mismatch which cause a large current to be drawn from the PA.

KITS for this project available from WPO Communications at £37.45 for the PCB and all components including switches and pots.

The Case for . . . 'F' Units?

'S' units have been used as an indication of signal strength since the beginning of amateur radio. They started life as a totally subjective method of expressing how strong a signal was, in the days before test equipment or 'S' meters as we now know them were available. The original RST code was devised in the 1930s for expressing READABILITY, STRENGTH, and in the case of CW, TONE, of incoming signals. Although this article is only concerned with signal strength, the original definitions of the RST system are reproduced here as a matter of interest in **Table 1**.

Are other people's idea of S9 your S7? Graham Packer, G3UUS, proposes an alternative to that hoary old chestnut, the 'S' unit.

The 'S' unit part of this reporting system still has relevance today and is used, at least unintentionally, by amateurs who distrust their 'S' meters. (*That is probably most of us — Ed.*) Such comments as "The 'S' meter here is only reading S-7, but your end stopping really", or, "You've gone from S-4 to S-9 now you've switched from 10 to 30 watts" (!) are often heard. As you will see in a moment, an increase from S-4 to S-9 should mean upping a 10 watt transmitter to *ten thousand watts!*

Many references to 'S' units have appeared over the last 30 years, either *suggesting* or, in some cases, categorically *stating*, that an 'S' unit is a 3, 4, 5, or 6 dB increase in signal level over a previous value. Most modern literature fortunately agrees that an 'S' unit should be a 6 dB (or four-fold) step. No reference for S-0 has been agreed or can be agreed upon yet, (S0 — No signal!) yet, without one, there is no real basis to the 'S' unit system anyway.

All in all, it seems that there must be a better way to express signal strength. If, after reading this article, you can provide a better way to express signal strength, then tell the Editor!

Table 1 The original 'R-S-T' code circa 1930s.

Readability

1. Unreadable
2. Barely readable, occasional words distinguishable
3. Readable, with considerable difficulty
4. Readable, with practically no difficulty
5. Perfectly readable

Signal Strength

1. Faint, signals barely perceptible
2. Very weak signals
3. Weak signals
4. Fair signals
5. Fairly good signals
6. Good signals
7. Moderately strong signals
8. Strong signals
9. Extremely strong signals

Tone

1. Extremely rough hissing note
2. Very rough a.c. note, no trace of musicality
3. Rough, low pitched a.c. note, slightly musical
4. Rather rough a.c. note, moderately musical
5. Musically modulated note
6. Modulated note, slight trace of ripple
7. Near d.c. note, smooth ripple
8. Good d.c. note, just a trace of ripple
9. Purest d.c. note

The Professional Approach

Microwave and satellite communications engineers have to plan their systems carefully. An error in their 'link-budget' calculations of 3 dB or 2:1 could mean specifying a transmitter of twice the output really necessary to maintain reliable communications. This might result in a transmitter of 10 kW output being specified instead of one rated at 5 kW. Such a transmitter could well cost over twice the price, and this doesn't include up-rated feeders, test equipment and power supplies, all of which will have to be purchased.

Microwave transmitters rarely achieve a 'Prime-Power-to-RF' conversion efficiency of better than 25% (that is, the ratio of mains power input to RF output, including the running of cooling fans, control equipment and indicator lamps), therefore 40kW from the mains would be required rather than 20 kW. Would *you* like to pay the extra electricity bill? This tends to make professional communications engineers do their sums properly!

Communications engineers express everything in dB relative to some fixed reference point, usually the milli-watt or sometimes (for transmitters) the watt. These units are the dBm and dBW — see **Table 2**. Once you define everything in terms of dBm, gains in dB (for amplifiers) and losses in −dB (for attenuators), all you have to do is to add or subtract as appropriate to determine just how much power, how much antenna gain and how great a receiver sensitivity you need to give a required signal

Table 2 Power Expressed in dBm and dBW		
POWER (W)	dBm	dBW
1000	+60	+30
100	+50	+20
10	+40	+10
1	+30	0
0.1	+20	−10
0.01	+10	−20
0.001	0	−30

strength over a given path. **Table 3** shows a link-budget for the system in **Fig . 1** using dB values, but this is really worthy of an article in its own right and may be covered in the future.

Note that we have a fade margin of 72 dB! This means that reliable communications could be carried out over this 30 km line-of-sight path with ¼ wave whip antennas at each end (knocking off the 18 dB total antenna gain) and reducing the transmitter output power from 40 W to 10-20 mW. This isn't as silly as it might sound, as I'm sure many of you readers must have had contacts of 30 km plus using 1W hand-helds feeding 'rubber ducks'.

Using dB calculations also frees you from characteristic impedances. It doesn't really matter whether a 50 ohm system is used at the transmitter end and a 75 or 300 ohm system at the receiving end *as long as the correct gain and attenuation figures are obtained in each impedance system,* remembering of course that we are talking about matched systems throughout. This frees us from quoting receiver sensitivities of '0.5 uV in 50 ohms', just to state '−118 dBm' which would hold true no matter what the system impedance.

Where Do We Go From Here?

Now where does all this get us? The purpose of this article is to propose that we all start giving meaningful reports to people in terms of dB over some fixed value, and the most convenient to use appears to be −120 dBm. This is close to the maximum sensitivity of many receivers, and is 1×10^{15} watt, or 1 femto-watt using the Internationale System of units. (SI — System Internationale — see **Table 4**)

By all means stick to 'neg dBm' if you like, all the 'pros' will know what you mean, but it always produces negative values for receiver sensitivities and somehow positive values always seem easier to appreciate. What sounds easier; to tell a station he has gone up from −94 to −89 dBm, or from 26 to 31 dBf, even though they are one of the same?

For most amateur purposes, dB steps are too fine. They are of great interest when measuring the gain of a linear amplifier, or determining absolute receiver sensitivity, but not really applicable when a signal is wandering slowly up and down in QSB. Also, the contest boys would not readily insert another digit in a '59001' report to make it 'five-plus-three-nine-zero-zero-one' for instance, especially if it didn't have immediate international recognition.

So why don't we use the 'f' unit? Each 'f' unit is a 10 dB step and this is more than adequate for general reporting. In the example above, instead of saying, "You've gone from 26 to 31 dBf OM" it would probably be just as well to say, "You've gone up from 2½ to 3 'f' units" **Table 5** and **Fig. 2** shows the relationship between dBm, dBf, 'S' units, 'f' units and microvolts into 50 ohms.

Small Range

The alert reader will have already spotted that a very sensitive receiver, such as that used in a moonbounce set-up, could well provide an output with a signal *less* than f-0. As long as a fixed reference is used, this has always been true of the 'S' unit scale as well. In fact, the 'S' unit scale has a remarkably small dynamic range, 9x6 = 54 dB; far, far less than the 100 or so dB dynamic range of modern communications receivers, necessitating the '10 over S9, 20 over S9 scale — which brings us back to the 10 dB steps proposed for the 'f' unit!

Negative 'f' units are only going to concern a handful of stations and these people are used to talking in 'neg-dee-bee-em' anyway, thus this anomoly has no practical significance. No more, "You're 60 over S-9 OM", reports though. If he/she was *that* strong, they'd probably rate 10, 11 or 12 on the 'f'

Table 3. Typical Link-Budget for 2m FM System			
Transmitter Output Power	40 W	= 16 dBW =	+46 dBM
Transmitter Feeder Loss (20m of RG67 at 1.0 dB per 10m)		−2 dB =	+44 dBm
Transmitter Antenna Gain (ref. isotropic)		+12 dB =	+56 dBm
Path Loss (30km at 145 MHz)		−106 dB	−50 dBm
Receiver Antenna Gain (ref. isotropic)		+3 dB	−47 dBm
Receiver Feeder Loss (10m of RG67 at 1.0 dB per 10m)		−1 dB	$\boxed{-48\ \text{dBm}}$
Receiver Sensitivity		−120 dBm	
Received signal level		$\boxed{-48\ \text{dBm}}$	
FADE MARGIN		= 72 dB	

Fig. 1 Gains and losses in a radio system expressed in dB

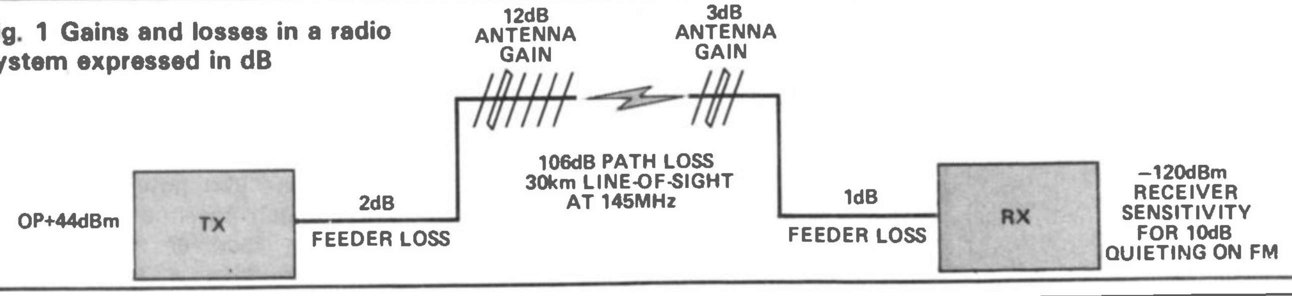


Table 4 Multiplier and dividers used in the System Internationale

Name	Symbol	Power	Multiplier/Divider
Terra	T	10^{12}	1 000 000 000 000
Giga	G	10^{9}	1 000 000 000
Mega	M	10^{6}	1 000 000
kilo	k	10^{3}	1 000
-	-	1	1 Volt, Amp, metre etc.
milli	m	10^{-3}	1/1 000
micro		10^{-6}	1/1 000 000
nano	n	10^{-9}	1/1 000 000 000
pico	p	10^{-12}	1/1 000 000 000 000
femto	f	10^{-15}	1/1 000 000 000 000 000
atto	a	10^{-18}	1/1 000 000 000 000 000 000

unit scale, and unless they were running a megawatt you could probably open the window and shout their report!

Putting 'F' Units Into Practice

Get a 'pro' to borrow from their work place a decent signal generator covering the bands of interest and bring it along to the local radio club. If it isn't the latest all-singing-all-dancing variety with everything built in, then they will also have to bring along a step-attenuator plus conversion transformers for 50/75/300 ohms, if anyone has a receiver with these impedance inputs.

Now get to work with felt pens and Letraset! The important reference to get onto your scale is 0 dBf of course. If your set is a bit deaf then 10 dBf is usually more than adequate. Remember to set your RF gain to maximum and any built-in switchable attenuators out of circuit. In the case of modern HF receivers, the Pre-selector must be 'on the nose' of course. You may be surprised to see how much your receiver gain varies with frequency and some scheme for calibrating 0 dBf for each band could well be needed. (You will also be surprised how meaningless your existing '6dB-per-S-unit' calibration is!) One way is to mark the 0 dBf point for the 'deafest' band on the receiver (usually 10m) with the RF gain at maximum and then back off the RF gain on each other band so the meter reads the same. Put an ink spot (different colour for each band?) on the RF gain cursor.

If your receiver covers only one band (like most VHF or UHF sets) then you can calibrate the meter up to the point of receiver overload (or needle-round-the-end-stop), but, as was just mentioned, this may not be possible for multiband sets. To give meaningful reports you will now need a decent 'step-attenuator'. By clicking in dB until the meter again reads f-0 you can perform whatever measurements you want to. . .

One last, very important point. 'Eff' and 'Ess' sound very similar when spoken of the air. Make certain whoever you are talking to knows which system you are giving him a report in! If he is in anyway confused, suggest that he buys a copy of this months magazine!

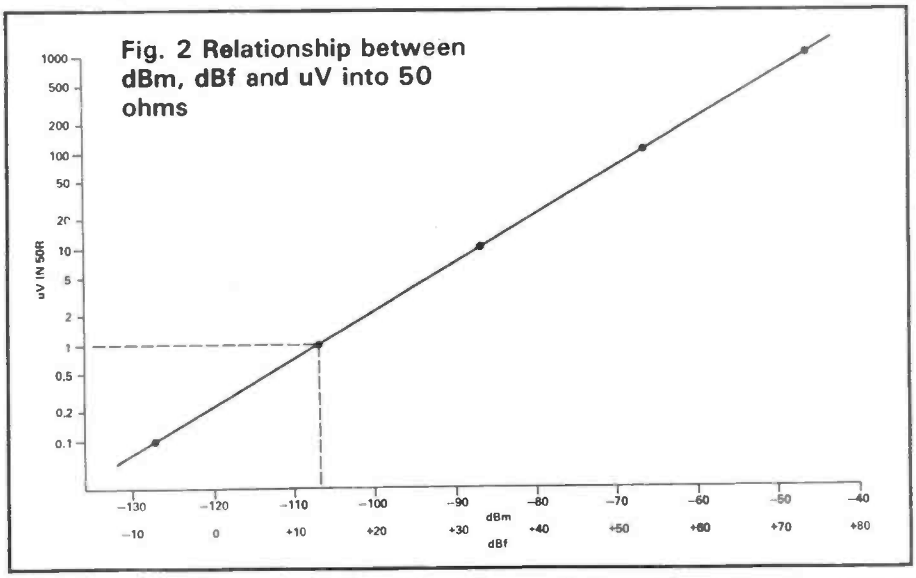


Fig. 2 Relationship between dBm, dBf and uV into 50 ohms

Table 5 'S' units and 'f' units with respect to dBm and dBf

dBm	dBf	'S' units	'f' units
-20	100		
-22	98		
-24	96		
-26	94	+40	
-28	92		
-30	90		f-9
-32	88		
-34	86		
-36	84	+30	
-38	82		
-40	80		f-8
-42	78		
-44	76		
-46	74	+20	
-48	72		
-50	70		f-7
-52	68		
-54	66		
-56	64	+10	
-58	62		
-60	60		f-6
-62	58		
-64	56		
-66	54	S-9	
-68	52		
-70	50		f-5
-72	48	S-8	
-74	46		
-76	44		
-78	42	S-7	
-80	40		f-4
-82	38		
-84	36	S-6	
-86	34		
-88	32		
-90	30	S-5	f-3
-92	28		
-94	26		
-96	24	S-4	
-98	22		
-100	20		f-2
-102	18	S-3	
-104	16		
-106	14		
-108	12	S-2	
-110	10		f-1
-112	8		
-114	6	S-1	
-116	4		
-118	2		
-120	0	S-0	f-0

An article on the construction of a suitable step-attenuator will be featured in a forthcoming issue of HRT.

ALL MODE TRANSCEIVER

PROJECT OMEGA

This month, Tony Bailey, G3WPO, and Frank Ogden, G4JST, describe the alignment and testing of the Omega 100W PA.

Powering Up

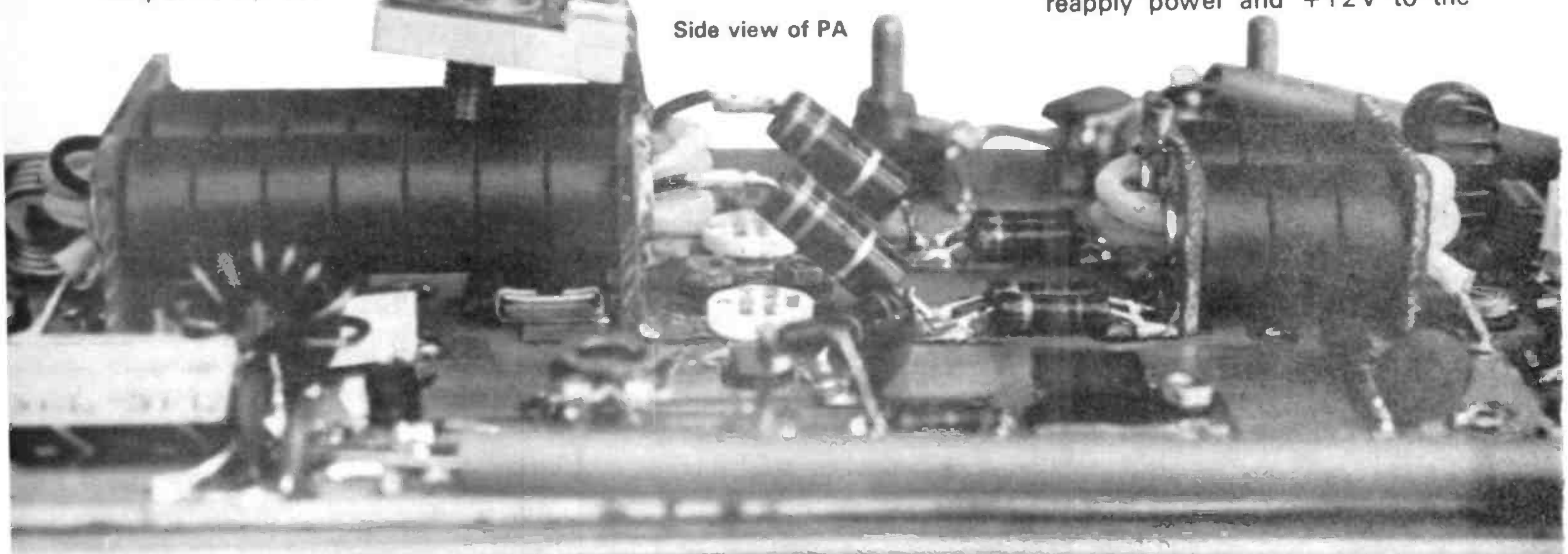
Now comes the part where one gets to be a bag of nerves! Providing you follow these instructions carefully, you stand little chance of damaging the transistors — *always keep an eye* on your current monitoring meter and switch off at the first sign of trouble.

You will require, preferably, a well regulated PSU capable of delivering upwards of 22 amps at 13.8V DC. It should be fitted with some form of current trip, either a fast cut-out that can be varied, or fixed at not greater than 20/22 amps — *a fuse is of no use* — the transistors are the fastest fuses available and will go before the fuse itself. The safest PSU to use is one with totally variable voltage, and this is how the check outs will be described. If you are fixed at 13.8V, then the instructions can still be followed, but with an even greater vigilance on the current monitor meter!

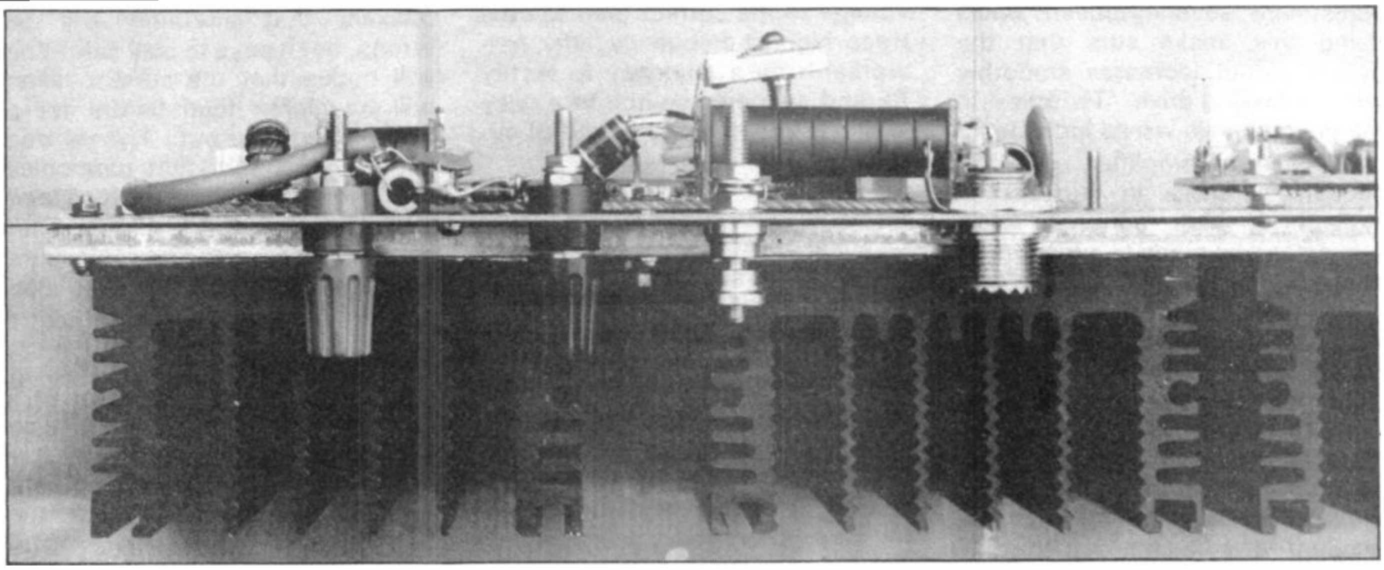
Connect the output of the PA direct to a 50 ohm dummy load capable of dissipating 100W safely using suitable coaxial cable. Connect the input of the amplifier to the QRP PA output directly, using miniature coax. Power should be available to both the main Omega units and the PA — do not connect up the bias supply yet. The PA can lie on the bench alongside the main case so that you can gain easy access to it.

Set VR1 on the PA fully anticlockwise. With the PSU set at 5V, apply power to the PA only (no drive) and check that no current is drawn — if it is, then there is a short or something else is amiss. Now check the bias supply. Change the PSU voltage to 13.8V. While monitoring the voltage (2.5V range) at the tab of D1, apply +12V to the base of Q4. Then swing VR1 through its full travel — the voltage should vary over about 0.5-1.5V. If much bigger or very low, look for the problem. Remove power. Now connect R3 into circuit.

With VR1 fully anticlockwise, reapply power and +12V to the



Side view of PA



Side view of PA/heatsinks

base of Q4. Monitoring the current taken by the PA and, adjust VR1 carefully for 200mA total. While doing this keep putting a finger on each of the transistor headers to monitor their temperatures. At 200mA neither of them should get detectably warm. If one or both heats up, switch off *immediately* as you have a thermal contact problem. Leave running like this for 5 minutes. Make sure that the bias current does not change appreciably and that the transistors at the most get barely warm.

If all is well, turn up VR1 so that you are getting a total of 1A, or so, bias current for a moment. Again monitor temperatures with your finger and look for uneven heating between the two devices, or rapid increases in bias current. You will probably detect a temperature rise now, but not more than warm. Again, switch off if any problems arise.

Now For The RF Tests. . .

If the PA passes these tests then you are ready to do RF tests, assisted by a drop of your favourite tipple if thought necessary. . .

Remove all power and connect the bias output from the logic switch to the base of Q4 (it should also go to the QRP PA bias). Adjust TC1 and TC2 to maximum capacity (fully screwed up). A PA supply separate from the Omega supply is needed for these initial tests. change the voltage to 5V, and if you have a variable current limiting, set it at about 5A.

Power up and set the RF drive control to minimum. Tune to 20 or 40m and peak the preselector. Switch to TUNE and carefully increase the drive while continuously monitoring the current. The idea now is to slowly increase the drive until a couple of amps are taken by the PA, all the time monitoring the temperature of the transistor headers with a finger. If all is well, slowly increase drive until about 5 amps are taken. Then slowly increase the PSU voltage a couple of volts at a time to allow more current to be taken, until you reach the point when more drive is required to take more current. Adjust the variable current limiting, if being used, to suit.

Increase The Drive

Carry on increasing the drive and current, and monitoring the header temperatures. If you watch the power output on a power meter, you will find that the amplifier is very inefficient at low currents. Even at 10A at 13.8V you will only get around 25W output, but this will start to increase rapidly as the current goes above 10A. Above 10A, the header temperatures may start to get uncomfortable to touch after a short time, but there should still be little difference between the two. The heatsinks will now be getting warm to hot, although the one furthest from the transistors takes a while to heat up compared with the others.

If all has gone well up to about 10/12A, back off the drive, increase the PSU voltage to 13.8V, and raise the drive again up to 10A, then further up until you have 50/60W output. Once this level is reached, it is wise to do the testing in shorts bursts of 5 seconds or so, in case anything goes wrong. You stand more chance of noticing problems if the PA is not running continuously. Continue increasing the drive until you get 110W output. This should occur at a current of around 17/19A or so. Some power (1dB or so equals 10W) will be lost in the low pass filter network when this is connected. Also, some of the power being seen is unwanted harmonic energy at this stage, which will be filtered out later. At this point do not allow the current to exceed 20A at 13.8V. VR2 should be set so that the circuit starts to conduct at 20A and will not allow the current to rise any higher as the drive is increased.

Remove the drive and check that the bias current is still around its original level of 200mA while the amplifier is still hot.

So Far So Good

If all has gone well, change to 28MHz and apply drive. The power output will be lower for the same drive level, but you should be able to achieve 90/100W. The efficiency is also likely to be better on this band and the amplifier will probably draw less current than on 20m. At full power output, adjust TC1 and TC2 with an insulated tool for maximum power output (carry out the adjustment several times). While doing this, make sure that the power output increases smoothly with increasing drive. 'Twitches' in the power levels would indicate instability in the amplifier, as would sudden increases in current. Be vigilant at high currents when testing and be ready to switch off if needed.

Note that R10 and R11 will get very hot — this is normal. Also, some heating of the output transformer ferrites is normal.

You can now also test out the other bands for power output, but be careful on the lower bands with the drive levels — less is likely to be required for a given power output.

Low Pass Filter Modification

The low pass filter network can now be checked out with the amplifier. However, there is a modification to the filter we have found necessary. With the high RF power levels around the filter, the diodes used to route the switching voltage to the correct filter (on the three highest frequency filter networks) have a tendency to rectify RF and suddenly switch in a relay which is supposed to be out of circuit!

The cure is to add a 100n bypass capacitor from the cathodes (banded ends) of each of the three sets of diode networks. This can be done without disturbing the filter board by soldering these capacitors directly on the top of the PCB. Looking at the layout diagram of the filter, three capacitors are required, one from the cathodes of D5/6/7 to the PCB foil nearby, and similarly from D3/4 and D1/2. Keep the leads short and solder one end directly to one of the diode leads in each case.

Final Tests

When this is done, reconnect up with the low pass filter in circuit, using coaxial cable, with the output of the filter straight into the dummy load. Run the amplifier up on 20m again, starting at a low PSU voltage just to be safe, increasing somewhat quicker than before. It is unlikely that anything will be wrong, but it pays to play safe! You will notice that the current taken will be higher than before for a given power output. This is due partly to the fact that harmonics are no longer reaching the load, and partly because the low pass filter network does not present a pure resistive load (as the dummy load did) thus changing the amplifier loading characteristics.

The power output being aimed at is 100W on all bands, except for 24 and 28MHz, where 80/90W would be normal for 3W drive. If you have more available then higher powers will be possible.

If there is an inordinate power loss on any band compared with previous tests, then it is likely that the low pass filter network needs some adjustment, as explained in Part 5 of Omega, (p39 *HRT* December 1983).

The next part will see the description of the control and accessory PCB, and the modifications to the logic switch we have found necessary, together with the final connection details.

RADIO Tomorrow

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

1 Jan Chichester DARC: 'bring along a computer' evening in the Long Room.

2 Jan S Bristol ARC: *discussion "What's Legal" with G3OUK.*
Cheshunt DARC: natter nite.

3 Jan Cray Valley RS: *Assorted Panics by G3GJW.*
N. Wakefield RC: natter night.

4 Jan Maltby ARC: *G8VHB talk.*
Medway ARTS: natter night.
Radio Society of Harrow: Used Equipment Extravaganza!
Dunstable Downs RC: junk sale.
S. Manchester RC: *Oscilloscope Design and Development by G4AOK.*
Loughborough ARC: CW night, could this be a new year's resolution? Top floor, Brush Sports and Social Club, 18 Fennel Street, Loughborough, starting at 8pm.
Coventry ARS: night on the air

5 Jan Exeter ARS: annual Christmas dinner.

7 Jan Sutton and Cheam RS: natter night in the Downs Bar.
Horndean DARC: *talk by G6NZ.* Visitors and potential members are very welcome. An active constructors section is aimed at those knowing little of radio techniques.
Venue is the Merchistoun Hall on the A27 near the Schooner Inn from 19.30.
Derwentside ARC (Consett): new venue Consett Association FC, Belle Vue Park, Consett. The meeting starts at 7pm and old and new members are very welcome.
Leighton Linsdale RC: to be advised, venue Room A64, Vandyke Community College, Vandyke Road, Leighton Buzzard beginning at 7.30 pm.
Worcester DARC: Videos 'Aerial Circus' and 'JARL visit to China'.

8 Jan Dartford Heath DFC: pre hunt meeting.
Bristol ARC: night on the air.
Bury RS: *How To Blow Your Rig Up! by Harry Leeming, G3LLL.*
Loughborough ARC: constructors group starting at 7pm.
Oswestry DARC: passing through or staying a while in this lovely border area? Visitors are very welcome every first Tuesday in the month, at 8pm. The venue is the Bell Hotel opposite the Parish Church.

9 Jan Three Counties ARC: *Did Morse Get It Right? by Alan Chester, G3CCB.*
S Bristol ARC: CW activity night.
Cheshunt DARC: *The Morse Telegraphy with G4FAI.*
Farnborough DRS: *G3AQC's Aerial Circus.*
Rugby ATS: are the voltages correct? Bring along your multi-meters and have their calibration checked!

10 Jan Edgware DARS: AGM
N. Wakefield RC: visit to Pontefract junk sale.
St. Helen's DARC: Morse classes starting at 7.30 pm, main meeting 8pm. Venue is the Conservative Rooms, Boundary Road, St. Helens.

11 Jan Coventry ARS: bring a computer (and let everyone see what you got for Christmas!). The venue is the club's usual meeting place — Baden Powell House, 121 St. Nicholas St, Radford, Coventry. It starts at 8pm.
Maltby ARS: computer night.
Medway ARTS: *How Can I Work Meteorscatter? by Ken Willis, G8VR.*
S. Manchester RC: *Radio Analysis by G6EAO.*
Loughborough ARC: social evening in the bar downstairs.

13 Jan Dartford Heath DFC: club hunt.

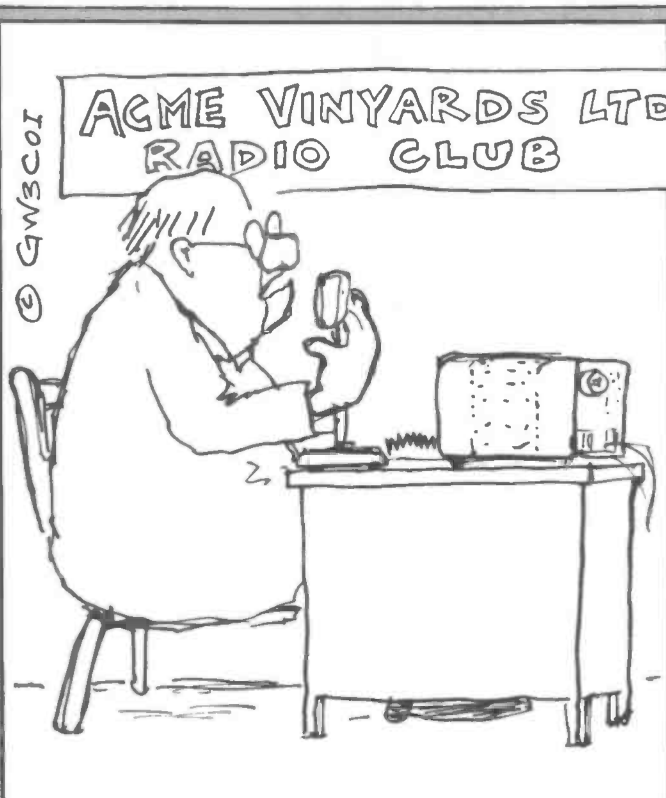
14 Jan Derwentside ARC (Consett): meeting at the new venue Consett Association Football Club.

15 Jan Fylde ARS: AGM, election of officers.
Bristol ARC: *70cm Dish Redesign and Construction.*
Kidderminster DARS: main meeting, starting at 8pm, at The Aggborough Community Centre, Hoo Road, Kidderminster. Anyone with an interest in the radio spectrum welcome.
Loughborough ARC: constructors group.
Bury RS: informal.

16 Jan Hastings ERC: *Compact Disc Demonstration by Sony.*
S. Bristol ARC: looking back at 1984 with the aid of slides and films with G8XIH.
Cheshunt DARC: natter night.
Rugby ATS: informal plus Christmas social details.

17 Jan Cray Valley RS: natter night.
Chichester DARC: *Satellite Communications Systems by Graham Swann.*

18 Jan Maltby ARS: RSGB video.
Coventry ARS: Annual Dinner at the Beechwood Hotel.
Medway ARTS: natter night.
Sutton and Cheam RS: *QRP by G4BUE.*
S. Manchester RC: *Microwave by G3PRF.*
Loughborough ARC: visit to a lecture in



"YOUR SIGNALS ARE FULL BODIED WITHOUT ANY HINT OF IMMATURITY.... "

Leicester, title to be annunced.

20 Jan Glenrothes DARC: *Dxpeditions OY, TF, 9L, ZB and VP2M (Monserrat) by GM3YOR.*
Worcester DARC: informal.

21 Jan Leighton Linsdale RC: to be advised.

22 Jan Bristol ARC: computer night — *Z80 Machine Code in the Beginning.*
Bury RS: informal.
Verulam ARC: *Microwaves by G8MWR.*
Loughborough ARC: constructors group.

23 Jan Three Countries ARC: *Steam Railways by G3ZRM.*
S. Bristol ARC: 4m activity night.
Cheshunt DARC: *The RSGB — Questions and Answers with Smudge Lundegard, G3GJW.*
Farnborough DRS: construction contest winner hosted by G4JNT.
Rugby ATS: informal.

24 Jan Edgware DARS: informal.
N. Wakefield RC: *Test Equipment by G8UYZ.*
Greater Peterborough ARC: AGM.

25 Jan Maltby ARS: *Morse — The Great Debate with G6RIL and G3ZVG.*
Medway ARTS: 'JARL visit to China' video.
Coventry ARS: night on the air.
S. Manchester RC: *RTTY by G4NTY and G6MYB.*
Loughborough ARC: *Portable QRP Operation in Germany on 3.5MHz by G4RVW.*

29 Jan Bury RS: informal.
308 ARC: closing date for the constructional competition.
Loughborough ARC: constructors group.

30 Jan S. Bristol ARC: construction workshop.
Cheshunt DARC: natter night.
Rugby ATS: an amateur radio video (title to be announced).

Poole RAS: **Open evening at Poole College of Further Education, North Road, Poole. From 7-9pm, there will be a demonstration of as any aspects of amateur radio as possible.**

31 Jan N. Wakefield RC: monthly meeting.

1 Feb Medway ARTS: construction contest.
Dunstable Downs RC: *AMTOR, RTTY and Packet Radio by Ian Wade, G3NRW.*
Loughborough ARC: open forum.
Coventry ARS: A visiting speaker (to be finalised).

2-3 Feb **RSGB 7 MHz phone contest. 1200-0900 GMT. Bands 7.04 MHz-7.10 MHz.**

4 Feb Sutton and Cheam RS: natter night.
Horndean DARC: *RSGB — Questions and Answers by regional rep. Trevor Emery, G3KWU.*
Worcester DARC: club activities 1984 slide show.

5 Feb Dartford Heath DFC: pre hunt meeting,
Fylde ARS: Secret Listeners video.
Kidderminster DARS: main meeting.
Oswestry DARC: meeting at the Bell Hotel, opposite the Parish Church,, starting at 8 pm.
Loughborough ARS: constructors group.
Bury RS: informal.
Chichester DARC: club meeting.

6 Feb Three Counties ARC: *Propagation by G3LTP.*
S. Bristol ARC: *Cables and Connectors by G4KUQ.*
Cheshunt DARC: *club project discussion with G4ZCX.*
Rugby ATS: informal.

7 Feb Cray Valley RS: *My Shack.*
N. Wakefield RC: on-the-air night.
Kidderminster DARS: committee meeting.

8 Feb Medway ARTS: AGM.
Loughborough ARC: *SSTV night with demo.*
Coventry ARS: night on the air.

10 Feb Dartford Heath DFC: club hunt.
Bury RS: Hamfeast mobile rally in the Mosses Centre, Cecil Street, Bury (3 minutes from junction 2 M66). Talk-in on S22. All the usual attractions including a large bring and buy stall. Food and drink available. Doors open at 11am. Further details from G1BWN QTHR.

12 Feb Bury RS: *Building and Launch of OSCAR 10 video, questions and answers with David Cadman, G8UVE, on amateur satellites and AMSAT UK.*
Loughborough ARC: constructors group.

13 Feb S. Bristol ARC: 70 cms activity night.
Cheshunt DARC: natter night.
Rugby ATS: informal.

14 Feb Edgware DARS: practical techniques evening.
N. Wakefield RC: lecture/visit.

15 Feb Sutton and Cheam RS: junk sale.
Dunstable Downs RC: AGM.
Loughborough ARC: visit to a lecture at Leicester, title to be announced.

18 Feb Worcester DARC: informal.

19 Feb Fylde ARS: informal.
Kidderminster DARS: main meeting.
Bury RS: informal.
Loughborough ARC: constructors group.

20 Feb Three Counties ARC: *RSGB in the Regions by Trevor Emery, G3KWU.*
S. Bristol ARC: 1985 contest planning evening.
Cheshunt DARC: *AMSAT with Ron Broadbent, G3AAJ, of AMSAT UK.*
Rugby ATS: Tx test night, bring along your rigs for a quick performance check.

21 Feb Cray Valley RS: natter night.
N. Wakefield RC: Music night — live music and refreshments.
Chichester DARC: club meeting.

22 Feb Loughborough ARC: *From multimeters to scopes — test equipment in the shack by G8BUB.*

23 Feb S. Manchester RC: quadruple midnight direction finding contest (!)

23-24 Feb RSGB 7 MHz CW 1200-0900 GMT. Bands 7.00-7.03.

26 Feb Bury RS: informal.
Loughborough ARC: constructors group.

27 Feb Cheshunt DARC: natter night.
Rugby ATS: Rx test night — your receiver's checked over.
S. Bristol ARC: construction progress reports.

28 Feb Edgware DARS: slow CW on the air.
N. Wakefield RC: monthly meeting. Greater Peterborough ARC: *Microwaves by G3WDG.*

1 Mar Loughborough ARC: social evening.

Will Club Secretaries please note that the deadline for the April segment of Radio Tomorrow (covering radio activities from 1st March to 1st May) is 18th December.

Contacts

Axe Vale ARC	Roger Jones	Upottery 468
Barking RES	R. Woodberry	01 594 4009
Bath DARC	G4UMN	Frome 63939
Braintree RS	J. Roberts	0376 448678
Bristol ARC	T. Rowe	0272 559398
Bury RS	B. Tydesley	0282 24254
Cambridge DARC	D. Wilcock	0954 50597
Cheshunt DARC	Roger Frisby	0992 464975
Chichester DARC	C. Bryan	0243 789587
Coventry ARS	R. Tew	0203 73999
Droitwich DARC	G4HFP	0299 33818
Donegal ARC	EI3BOB	074 57155
Dunstable Downs RC	Phill Morris	Dunstable 607623
East Kent RS	Stuart Alexander	0227 68913
Edgware DARS	John Cobley	01-360 4342
Exeter ARS	Roger Tipper	0392 68065
Farnborough DRS	Mr Taylor	0252 837581
Fylde RS	PRO	Lytham 737680
Halifax DARS	DL Moss	0422 202306
Harrow RS	Dave Atkins	0923 779942
Hastings ERC	Dave Shirley	0424 420608
Haverhill DARS	Rob Proctor	0787 281359
Hornsea ARC	Norman Bedford	0262 73635
Horsham ARC	Pete Head	0403 64580
Kidderminster DARS	Tony Hartland	Kidmin 751584
Leighton Linslade RC	Pete Brazier	052 523 270
Maltby ARS	Ian Abel	Rotherham 814911
Medway ARTS	Andy Wallis	0634 363960
Mid Ulster ARC	DF Campbell	0762 42620
North Cornwall RS	John West	Bude 491/6
North Wakefield RC	S. Thompson	0532 536653
Oswestry DARC	Brian (GW6YTY)	0691 831023
Poole RAS	G3XBZ	0202 730012
Preston ARS	George Earnshaw	0772 718175
Shefford DRS	G4PSO	Hitchin 57946
S. Bristol ARS	Len Baker	0272 834282
S. Lakeland ARS	Dave Warburton	Ulverston 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	Telford 597506
Three Counties ARC	R. Hodgson	0428 77368
Tiverton (South West) RC	G. Draper	03634 235
Vale of White Horse ARS	Ian White	Abingdon 31559
Verulam ARC	H. Clayton Smith	St Albans 59318
WACRAL	G4NPM	0795 873147
Welland Valley ARS	J. Day	0858 32109
West Kent ARS	J. Green	0892 28275
Westmorland RS	G. Chapman	0539 28491
Wirral ARS	Cedric, G4KPY	625 7311
Wirral DARC	Gerry Scott	051 630 1393
Worcester DARC	D. Batchelor	Worcester 641733
Worthing DARC	Jim Hicks	0903 690415
308 ARC (Surbiton)	Dave Davis	01 399 5487

Free Readers' ADS!

WANTED: Cobra 148 GTL multimode with or without linear. Must be working with Morse key facility. Have: 144-174 Storno (mobile) or selection of Pye mobiles (Hi Band) AM & FM. All working and complete. Call Andy on Hitchin (0462) 700178 weekends. No cash.

WANTED YAESU FRG7700, FRT 7700 exchange for realistic DX-400, Chinon CE-4S, Optomax 135 mm telephoto lens, Miranda wide angle lens. Phone 0443 755876.

NEW BRAIN computer with disc drives and controller 3 megabite software. Runs CPM software eg wordstar original cost £2000, would exchange TS780 with appropriate cash adjustment. G3UDM QTHR 0902 783338.

EXCHANGE stereo system (comprising Dolby cassette, Sony amplifier. Tandy speakers and turntable) for any digital readout communications receiver with SSB. Also monophonic synthesiser needs some work doing. WHY ATV Tx/Rx. No cash available. G1GTV. Tel: Dorking 884737 after 7 pm.

COBRA 148 GTL DX multimode 11m transceiver AM/FM/USB/LSB/CW. Swop for FRG7, or part exchange for FRG7700, or sell £100 ono. Fred Anderson phone Faulkland (037 387) 483.

SHARP VZ3500E vertical linear tracking music centre. automatic play and repeat etc. Metal tape and Dolby. 28 WATTS RMS per channel. Swap for HF receiver, computer with RTTY, or consider Creed RTTY setup or WHY. PHONE, Paul 041 637 0808.

LENCOM LC160 top band transceiver with speaker. Swap for 2m handheld or cash offer. Bird, G3GDB, 01-859 4879 after 7 pm.

TRIO TS130V HF transceiver. 80m to 10m incuding WARC bands. 25W SSB/CW with narrow SSB filter fitted. Mint condition. Only used to drive transverters. Wanted FT225RD or IC251e. PX considered wtih cash adjustment. £380. Ring Graeme. Orpington (0689) 29230 evenings.

BLIND Ex-radio engineer still require cabinet and front panel for AR88 receiver. Also good 6SGY valves, have plenty of bits to swop. West Drayton 441031.

TAPE MAGAZINE for blind radio amateurs needs help reading articles onto tape in your own home. All materials supplied. Suit housebound amateurs. Contact: G4MRB QTI-TNA, 79 Narrow Lane, North Anston, Sheffield S31 7BJ. Tel. (0909) 566301.

WANTED HF transceiver 8 or 9 band. Fair priced, with or without mains PSU buy outright or part exchange Avanti PDLII Quad Beam and rotator plus vertical/horizontal antenna switchbox. Sorry no phone. R. Fensome 12, The Grove, Luton, Beds, LU15PE.

WANTED. Morse key, straight, heavy brass type or similar. Good price offered. Phone (0274) 728219, address 40, Rooley Crescent, Bradford, BD6 1BX, Yorkshire.

WANTED: Early valve amplifiers, Leak, Quad, Williamson, Lowther, Dynaco detc. and old hi-fi. Valves any period, any quantity. Clandestine, suitcase, and compact military radio sets. **For Sale:** Eddystone Receivers, Hammerlund military rack receiver, various other military receivers, and accessories. Please write or telephone: John Baker, 13 Burrard Road, London NW6 1AB (01-794-0823).

HELP tutor wanted to assist husband and wife to prepare upto RAE examination tel: 01 517 3588 after 6pm.

WANTED: BBC B — Information on amateur radio association software, etc. G1IRP, 66 Newpool Road, Knypersley, Staffs ST8 6NS.

WANTED KW2000 B+PSU for club use. Tel. Sec. Oldham ARC Fiona Butterworth 061 652 8862 or PO Box 29. Oldham Lancs.

WANTED Quad 22 or QC II control unit. Also ATU for short wave use. Tel: 0228 26436.

WANTED FT101 or FT101E in very good condition. Also FC902, FC707 or similar ATU. Two metre multimode, portable and/or mobile or base. Also required. Phone David 04024 57722 or 025587 663 anytime.

DRUM MACHINE. Clef master rhythm; 7 voices 12 memories, only £30. Sanyo stereo cassette deck, dolby B, £30. Two Shure unidyne mics with cable £15 each. Sanyo G2005 music centre; 2 years old, £65. Tel Bedford (0234) 781323: Jon Jenkins.

WANTED: Racal PRM 4031 HF/SSB transceiver or it's Larkspur predecessor G4NVX QTHR, telephone Hereford 265725 ext. 247.

WANTED information on Lowe SRX 30 receiver. In particular mods to improve front end, and include FM and digital readout. Any other info appreciated. R. Young G4MQH, 20 Queen Street, Brimington, Chesterfield, Derbyshire, S43 1HT.

WANTED for Yaesu FT 301 transceiver 600Hz CW filter (XF-90C) and 6kHz AM filter (XF-90B). Also external VFO FV-301 or other suitable VFO. Tel. St. Albans 39333.

VANGUARD 6CHNL control box and patch lead wanted for high band Pye Vanguard. G8BSK 290 Priory Road, St. Denys, Southampton, S02 1LS.

WANTED manual and any ancillary equipment for Marconi Instruments sensitive valve voltmeter model TF1100. Also similar for telequipment scope model S51B, will purchase and pay all expenses. Sutton 60 Birch Road, Hurstead, Rochdale. Phone Littleborough 76848 (0706).

FREE TAPE magazine for blind radio amateurs needs help reading articles onto tape in your own home. All materials supplied. Suit housebound amateurs. Contact: G4MRB, QTI-TNA, 79 Narrow Lane, North Anston, Sheffield S31 7BJ. Tel. (0909) 566301.

WANTED FTV901 transverter must be in GWO G4TQK QTHR.

WANTED Trio/Kenwood speaker SP520/Digital display DG-5 2m transverter TV502S. Telephone Coventry (0203) 74811.

WANTED Trio VC10 VHF converter unit. Also ATU Nichols 0326 (The Lizard) 290485.

WANTED Ten-Tec OMNI C. Drake SCC4 5NB TA4 T4XB. Sell old radio books, parts, lists. SAE Trowell, Hamlyn, Saxon Ave., Minster, Sheerness, Kent. ME12 2RP. Tel (0795) 873100.

TRANSVERTER Wanted FTV707, FTV700 2mts/70cm for FT707 or one compatible GB6AHG QTHR. Phone 0705 321857/371183.

WANTED Yaesu FL2100Z HF linear amplifier. Also 2m 100W linear required. Also any equipment for Oscar 10 Tel. Irvine 217611 24hrs. Cash waiting GM4PGL.

URGENTLY WANTED: Manual for Belcom FS1007P transceiver, either to purchase or borrow. Will pay postage. Dave Carter, 32 Welland Crescent, Stockton on Tees, Cleveland TS19OUT Tel.(0642) 582581.

TRIO TR7800 with PS10 PSU £150. Belcom LS20XE £75. MFJ-901 versa tuner with 1:4 Balun £50. Cordless telephone 120V only, hence £25. GM4DHJ, Tel 041 889 9010.

FOR SALE SEM 10-80m Z-Match ATU, new Aug84, £55. Ezitune noise bridge, new Jul84 £25. Packing and carriage included. Phone Egham 33500 G5CDE.

YAESU FRV7700 VHF converter new unused £50. Phone Hythe (kent). 68132.

FT757GX transceiver with FP757 heavyduty power supply speaker microphone boxes manuals, mint cndition transceiver capability 500kHz to 30 MHz. Dealer warranty £750. Buyer collects. Phone How Caple 205.

DATONG more tutor £35. R1155A, unmodified, needs PSU. £20. Tel 01 994 8361.

MOBILE (G3FIF) Long, telescopic whip plus 160M coil, base, £10. 80m coil £8. instrument cases, metal, one with lid £10 lot. Mains transformer 350-0-350. 6V 5A, 5V 4A. £5. Crystal calbrator 100 kHz. 1000kHz 5000 KHz GEC £5. Edwards. Tel 01 445 4321.

FOR SALE Yaesu FR101 receiver with matching speaker 2m and 6m, in excellent condition £250. Kenwood headphones HS5, new £19 ideal for SWL many text books for homestudy course for RAE sell complete. Collect London. Trap Dipole if interested. 01 253 6725.

TRIO R1000 general coverage receiver, mint condition £185. Robert Model R800 3 waveband, mains and battery, new condition, £40. Phone 855-2998 (London).

COLT 485DX black shadow AM/SSB 27MHz transceiver pls base mic. As new £70 contact Jon, Snape 363.

TRIO TS120S transceiver YK88C £340; MB100 mobile mount £10; PS30 £65; VF120 £60; complete £450. Boxed. Strumech versatower ground post £100; 21'×13" bottom section + winch £50; Western DX33 3-element 3-band £120; Met 144/19T £35; CDE AR22R £30. Tel 0565 873205.

FOR SALE Icom R70 with FM fitted and SEM Z Match VGC. £350 not negotiable. Please only to a very good home. Phone Chris Taylor on Nottingham 399657.

TRIO TS515 HF Tx/Rx boxed, good condition £150. Project Omega, all modules, kits, case to complete to QRP level. Approx £750 worth, £275 no time to complete. Buyer to collect or arrange collection. G6DCM QTHR 76 Harrogate Rd., Reddish, Stockport SK5 6EX.

REXINE Carry case for Yaesu FT290R £3. New flexible antenna ⅛wave, for same £4.50. Charge for above, as new £6.50. 5 to 7 amp, regulated power supply £8. G6MNX York 53173 (Mike).

YAESU FC707 ATU perfect condition boxed as new, £75. Tel: Paul, Kings Langley 65823.

HAMASTER 4500 base mike, still in box, £20. Gillingham 3781 (Dorset).

FT707 brand new, 3 months old never used for Tx, 9 months Guarantee left. A bargain at £400 o.v.n.o. Please phone 0283 33526 after 6 pm.

COMPELTE MODEL KIT Sanwa Radio Control system FM 6 channel Tx/Rx 35.070MHz channel 67. 2 OS engines 35 one never used, easy fly plane never flown. Yamamoto plane Banwa battery charger 13V-6V. NiCads for Tx/Rx 5 servos 1 needs slight attention, one still wrapped. Sapre prop. wheel nuts, and many extras. £250 ono or exchange for Yaesu FT290R. With NiCads and case. Mr. Pugh, 5 Back Lane, Normansheath, Malpas, Cheshire SY14 8OR.

FDK MULTI 700E £150, Icom IC202S SSB £100, both excellent condition. Trio JR310 amateur bands-Rx overhauled recently working well £80, microwave modules converter 144-28MHz £15, Class-D wavemeter mains supply £10, Weller Solder Gun £15. 4, Leigh Road, Andover, Hants 51593.

YAESU YC 601 digital frequency display, use with any 101 or 401 series transceiver £65 ono Maurice (G6IMV) 18, Mossvale Grove, Washwood Heath, Birmingham B8-3QJ. Prefer buyer inspects and collects or carriage extra at cost.

FOR SALE. Nato 2000. multimode transceiver, little used immaculate conditions, with manual £95. Zetagi 131 mains linear 200W PEP, 100W FM. VGC £45 or £130 the pair. Phone (0980)-23331. Ext. 2074 daytime or (0980)-23062 after 5pm.

SOMMERKAMP FT480R for sale £260 ono; Zetagi BV 131 linear amp mains brand new never used £60 ono. Tel. Blackpool 46873. After 5.30 eve.

COMMERCIAL communications receiver type Muirhead M100. Fully synthesised 5kHz to 32 MHz digital readout to 10kHz. Cost £1,200 sell for £525 or exchange for TS120V or similar HF transceiver. G4IFD 11 Avondale Road, Pitsea, Basildon, Essex.

FOR SALE Yaesu 101B just re-aligned; Sommerkamp FC902 ATV amost new; Yaesu FF501 HF filter Boxed new; Altai dip meter boxed. New Hygain 12 A-V-Q vertical tri band 20-15-10m boxed, brand new; Icon converted CB FM 10m; spare PA valves for FT101B; spare power mike new unused. Accept £440 ono. Phone Easington 27.2702.

KW2000E in reasonable condition, some spare valves £200 or ono. Semi automatic bug key £15 ono. 4 Grundig dictating machines £5 each ono. Contact Keith GW4NBY QTHRF 0656 56576.

DATONG active antenna outdoor model complete with DC transformer. £42, post paid. Yaesu FRT 7700 aerial tuner £30, post paid. Both complete with makers instructions. Mr. Moore, 76 High St., Ide, Exeter, Devon EX2 9RW.

DRAKE T4X and R4B separates all band with valves manuals, excellent cndition, £480 ono. Drake 2-C Rx 3-30MHz, superb Rx with spares. Manual, Q-mult £90. Ten Tec argonaut 509 QR8 Tx/Rx with audio filter. 5W SSB/CW £250 ono. 0622 39936.

KENWOOD (TRIO) TS530S. Mint condition, virtually unused. Complete with Kenwood MC-50 table microphone. Reason for sale owner deceased. £500 ovno, buyer collects. Telephone SWINDON (0793) 782101, evenings.

TASCO CWR 610E converter, RTTY CW into VDU or TV, receive baudot, ASCII or CW, also code practice on screen. phones and key socket. As new £120, includes instructions and press agencies frequency guide, Ted on Backup 874928 after 7pm.

YAESU FT790 +NICADS +MUTEK pre-amp £230. Approx. 8 months old VGC. Nick, G6YRO, QTHR or tel Warrington. 574173 after 6.30 pm. (weekdays) any time at weekend (FT780 + X-YL to support) reasonable offers considered.

BELCOM transceiver 2m £70. Mobile receiver 2m £25. CB Handheld channels £22. Two mobile CBS £8.50 each. Without microphones. Wanted manual for eagle communication receiver mike. M.DE-WYNTER 2 Woodside, Wimbledon SW19 01-946-2967. Ask for Jane.

PANASONIC 3100L-DR32 digital communications receiver. 32 bands £110, B/new. TRS80 model 464K twin disks plus printer DMP110. Books, programs, disk, paper cassette plus a lot more total value £2800 sell ½ price. Consider exchange, why, plus cash adjust above 4 months old. Ring 0473 85526.

Hickok Professional Valve Tester Model 600A, Attache case type with manual and books to test 100s valves. Offers Wilson, Walton on Thames 243606.

ICOM IC2E 2m hand held, leather case, NiCads, charger £110 carraige paid. Codar ATS 160m Tx £25 carriage paid. Creed 7ERP working order £5. Buyer collects. Write G3VSJ, 38 Barnfield Close, Hoddesdon, Herts. EN11 9EP.

EDDYSTONE 358 service B34 Rx for sale £65 complete. Truvox tape recorder reel to reel R92 £25. Owen, 114 Buersill Avenue, Rochdale. Tel Rochdale 48138.

FOR SALE Yaesu FT101 good condition £380. Yeasu FT290R leather case NiCads, charger, Helical whip £180. Trio TR 7010 crystalled 144.260 to 144.450 complete with mobile mount £80 Phil Hassman, QTHR, GW 4REX (0222) 625702 after 6pm.

FT 290R for sale, NiCads, charger manual but no case VGC £200. Contact Les, G6LOK, (evening), Rochdale 525490.

COMMODORE 8032 64K RAM board, complete with installation and operating instructions £50. Tel. George G6 RIL 0709-816098.

FOR SALE American made bug key, very good condition, £10 post paid. Also HF5 vertical 5 band antenna, no radials £20. Buyer collects. Sutton, 60 Birch Road, Hurstead, Rochdale. Phone Littleborough 76848 (0706).

BELCOM LS202E FM/SSB 2m multimode handheld. Soft case, NiCads, speaker mic, less than 6 months old. Original packing. £190. G4UZG QTHR. Telford (0952) 582903.

REFTEC 934 MHz FM transceiver Mk2. With external signal strength meter include. Excellent condition as hardly used £250. Wanted, £5 to the first person who can supply photocopied manual for AEA MBA/RO CW/RTTY reader. Ring 01-845-4008.

JAYBEAM C5/2mtr colinear £35. Ex computer power supply, 20 amp peak 13.8V, with volt meter £35. Tel: Atherton 0942 876796.

FOR SALE TRS 80 model 100 portable computer 1 year old; as new, little use (8K model) with case, manual, quick reference guide, and PSU £180 ono tel. 01 471 0669 after 5pm, ask for Danny.

TRANSVERTER FTV107 unused Tx under guarantee, complete satellite 2m, 70 cms modules. FRB707 realy box included, plug in and go. Cost £439 offered at £385. FT77FM mobile bracket MM 144/28 transverter excellent conditon £385. No offers on either deal. Contact G4WLD, John 01 857 8096.

FOR SALE FT101ZD matching Yaesu Mic, ATU £500, Trio 7500, Bantex 5/8 whip £150. Going totally QRP, G4RVW Loughborough 412043.

SELLING SERVICE manuals for CR100 £7. 1155 £7. AVO Valvetester CT160 £5. Marconi 2232B receiver £4. Vega 402D mono TV £5. Tektronix 535/545 scope £10. Video Genie £6. others available. SAE enquiry. Maurice small, 8 Cherrytree Road, Chinnor, Oxfordshire, OX9 4QY.

YAESU FRT7700 ATU as new with instructions £30. ACE SWR Bridge with 0-5W power meter. New boxed with instructions £5 Tel. 0795 873100.

FRG7700 £180; FRV7700A £40; TRIO 9R59DS X cal fitted speaker spare set valves £50. All mint condition manuals original pcking. Lafayette HE4. £20. Carr on above extra. Phone Smyth 0436 71181.

KW202 160-10m RX £110 ono, Icom 215 2m FM portable transceiver, 15 channels, all working, NiCads, charger, £95 ono. KW Vanguard Tx 50W cw/am £20. Buyer inspects and collects. G2CMH QTHR, Tel. 0273 559752.

VIC-20 + 16K RAM switchable super expander joystick, 4 games cartridges, including chess books include Vic Revealed; Mastering The Vic 20; RTTY software so you can copy commercial or amateur transmissions. The lot £90. Ring Atherton (0942) 891140.

FOR SALE Yaesu **FRG7** general coverage receiver, excellent condition £125. 01643 5164. After 6pm.

GOLF CLUBS Ben Sayers short set, bag, trolley. Swop for GWO HF receiver or transceiver can deliver reasonable distance Edinburgh. John GM6WBK Phone 031 334 2362.

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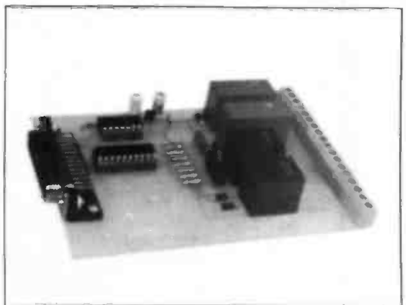

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2M CONVERTER
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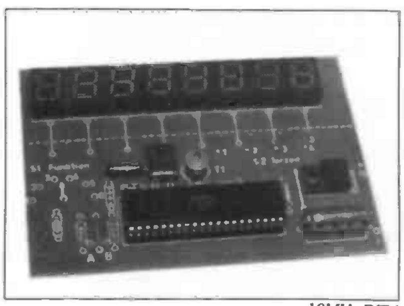
20W - 10dB gain - power amplifier for the 2m band. Automatic TX switch over, RX pre-amp, robust construction 41-01404 32.87



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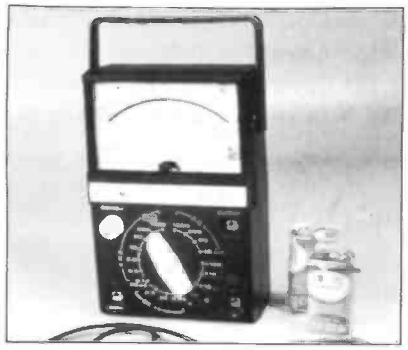

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