The Trio TS940S—The Ultimate Rig

Kenpro 70cm ‘Handie Talkie’ — Cheap and Cheerful?

Dirt Cheap—Convert a Pye Westminster!

Advanced Satellite Working By Arthur Gee, G2UK, President AMSAT UK
REGULAR COLUMNS

LETTERS ............................................. 6
RADIO TODAY ..................................... 10
PRACTICALITIES ................................ 26
METREWAVE ....................................... 47
RADIO TOMORROW ............................... 49

CONSTRUCTION

TRY A TRANSVERTER — THE MATCHING PA .... 18
A 20W PA for the 4 or 6m transverter. Designed by Tony Bailey, G3WPO.

A BRICKWALL AUDIO FILTER ............... 38
Improve the quality of your communications receiver with this filter from Robert Penfold.

CONVERTING PYE WESTMINSTERS ......... 43
Chris Lorek, G4HCL, moves onto 2m with some rather bulky 'Wessies'.

FEATURES

PSE PSE PSE QSL .................................... 16
John Heys, G3BDQ, reveals some desperate tactics used for elusive exotic cards.

AMATEUR RADIO AT THE LA OLYMPICS .... 22
How amateur radio played an important co-ordinating role behind the scenes.

WORKING OSCAR 10 — THE ADVANCED SATELLITE .......... 34
Dr Arthur Gee, G2UK, describes what makes this satellite tick...

REVIEWS

REVIEW: KENPRO KT400EE UHF HANDHELD .... 28
Trevor Butler, G6LPZ, takes this 70cm handle for walkies.

TRIO TS940S — THE ULTIMATE RIG? .............. 52
A rig that dreams are made of?

COMPETITION.
YOUR CHANCE TO WIN THE KENPRO KT400EE. .... 32
NEXT MONTH IN HRT ................................ 32
ADVERTISEMENT INDEX ......................... 32
Free Readers Ads ............................... 60
Classified ........................................ 64
Emporium Guide ............................... 65

Unfortunately, due to lack of space, Aerial Bent In Eire has had to be held over.
IC-505. 50MHz transceiver

The IC-505 is a 50MHz band SSB, CW, FM (optional) transceiver, and has already gained an excellent reputation worldwide. The dual VFO system has been developed using advanced computer and PLL technology. The IC-505 features 6 channel memories and can be used independent of emission modes, memory scan, program scan which searches only specified frequency band. LCD ensures clear visibility even in sunlight. The R.F. amplifier, a dual gate MOSFET features high gain and low noise characteristics. The IC-505 accepts a standard dry cell pack, rechargeable nicad battery pack (BP10) or 13.8v external power supply, 3 watts R.F. output, 0.5 watts low power, 10 watts at 13.8v. Accessory circuits include split frequency operation, noise blanker, squelch and CW break-in. Options include:- EX248 FM unit, PS45 AC Power Supply and LC10 Carrying Case. All these features make the IC-505 a great transceiver for operation on the 50MHz band.

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The IC-751 is the Flagship of the ICOM range, it is a competition grade ham transceiver with a 100KHz – 30MHz continuous tuning, general coverage receiver and a full featured all mode solid state transmitter that covers all the WARC bands. Utilising an ICOM developed J-Fet DBM, the IC-751 has a 105dB dynamic range and a switchable choice of pre-amp 0-20dB attenuator. The transmitter features a high reliability 2SC2904 transistors in a low IMD (-32dB @ 100W) full 100% duty cycle. Other features include 32 tunable memories, mode selective scan, frequency scan and memory scan, full break in on CW and Amptor compatibility, Pass band tuning, notch filter, variable noise blanker, Dual VFO’s for DX or 10m repeater operation. The IC-751 is fully compatible with ICOM auto units such as the AT500 and IC-2KL. Options include internal or external power supplies, frequency controller, Speech synthesizer, various optional filters and SM6 or SM10 Desk Microphone.

The SM10 desk top microphone consist of an electret condenser microphone element with a compressor amplifier, plus tunable equalizer for maximum control of the audio characteristics of your transmitted signal. The SM10 is highly sensitive and produces clean crisp audio.

IC735 compact HF Transceiver

As predicted the ICOM IC-735 has rapidly gained the reputation it deserves. When compared with similar ‘top names’ transceivers the IC-735 towers above them (despite its smaller size). The IC-735 has a larger number of programmable channels, but notably most important is the superb sensitivity in all modes SSB, CW, AM and FM. This superior sensitivity is due to the excellent front end performance. All amateur frequencies from 1.8MHz to 30MHz are available including the three new bands 10, 18 and 24MHz. RF output is approximately 100 Watts. Tuning ranges from 100KHz to 30MHz, made continuous by using a high-side IF and a CPU control system. RTTY operation is also possible.

Dynamic range is 105dB with a 70.451MHz first IF circuit. Pass-band tuning and a sharp IF notch filter provide clear reception even under duress. Preamp is 10dB and attenuator 20dB. Computer remote control is possible via the RS-232C jack. Options include: the AT-150 automatic antenna tuner, the FSSS AC power supply and the SM-6, SM-8 and SM10 desk mics. Why not find out more about the IC-735 by ringing us or your local ICOM dealer.
CB CONVERSIONS

Sir, A few months ago I had the opportunity to purchase a Ham International CB rig. Remembering that I had seen an article in Ham Radio Today concerning the conversion to 10m, I purchased the rig. I took it to a local professional radio engineer together with the article from the August 1984 edition written by Basil Spencer, G4UNM, and asked for it to be modified. Taking the details from the article, three crystals were ordered 21.5MHz, 21.725MHz and 21.95MHz as recommended but after many hours work it was still impossible to get the rig to operate on the required frequency range, although it would operate at higher frequencies. On reading a further article in your December '85 issue, I note that completely different values are recommended for the crystals. I have now spent £25 on crystals which are of no use to me or anyone else and I cannot get my money back.

I welcome your comments on this matter as I feel strongly that both you and Mr Spencer have a moral obligation, unless there is some point that I have missed.

We are very sorry that this unidentified reader should have spent £25 on inappropriate crystals. However, we must point out that near (25 on inappropriate crystals. Spencer pointed out (in bold capital letters) that the actual frequencies employed in rigs do vary and this should be kept in mind. We are surprised that a ‘professional radio engineer’ didn’t check the frequencies before ordering the crystals. Basil’s article was a general guide to how to do the modifications, the later articles by Roger Alban are more specific. We must emphasise that many amateurs do make changes to their products, and readers using this article to modify CB rigs should still check that what they’re doing is appropriate.

HI OR NOT HI?

Sir, With reference to your article on converting Ham International series of CB rigs to 10m in Jan ‘86 HRT. I refer of course to the leading photograph of the Ham International range of radios, the so called infamous seven. With respect I would point out that most of the radios shown are not and have never been sold as Ham International. For example, rig displayed as ‘Excalibur’ at the bottom of the photograph is in fact a Jumbo not an Excalibur. These were made by ‘Marco’ gold front; ‘Colt’ with a silver front and Ham International Jumbo jet black.

The Ham International range was as follows: Jumbo FM/AM/SSB mains base station 120 channel, Concord FM/AM/SSB mobile unit 120 channel, Multimode II FM/AM/SSB mobile unit 120 channel, Puma AM/FM mobile unit 120 channel and Viking AM/FM mobile unit 80 channel. These were the basic five radios sold in the UK by Ham International for the 11m band. The only radios to carry the HI brand name.

While I suppose it was possible Ham made the boards for other radios, the design was different to their branded radios, and less reliable. I always found Ham International radios to be reliable and efficient for 11m band use. Having used them for the past ten years. I wonder why you brand them as infamous?

Terry Clayton, Ham International Owners Club, 26 HZS6.

Thank you for the information on the various rigs that are available on the second hand market especially with some of the imported ones. However, in the first part of the article, Dec ‘85, there was a table specifying seven different rigs with very similar PCBs which the author had modified to 10m. The caption which referred to the rigs as infamous did not in any way reflect on their manufacture, merely their illegality.

WHO IS G8 QRM?

Sir, I have certainly drawn to your January 1986 issue. I note that “William, G8 QRM” infers that the RSGB is a secret organisation and with many aspects of the hobby, some warranted and some definitely not. From Mr Thompson’s letter, it would appear that he regards ‘established’ CW operators as the source of complaints regarding CW procedures etc. In my book, there are two categories of so called established CW operator. Firstly, the operator who has passed the DTI morse test and is therefore qualified to operate in this mode on all allowable segments of the spectrum and secondly, those who have been operating on the bands over many years and have acquired a high degree of skill and proficiency in all aspects of this mode. In the first case, the operator is akin to the analogy of the driving test - qualified but still learning and improving his technique. In my opinion, a complaint would never arise if in fact the category of operator fell into the second type, as this operator would be concerned in

The author of ‘Sideswipes’ is called William and does have a radio amateurs licence and callsign.

HELP NOT HINDER!

Sir, I am at present studying for my ‘A’ licence. I find HRT encourages and helps future radio amateurs with advice and help whenever you can. Yet every month, I read that the C and G exams should be more difficult — do this and that — make it harder to get licensed — from other readers. Surely if the Home Office took notice of all their suggestions a good deal of enthusiasts would not have bothered. Instead of what others should do — sound practical advice will be of more use. I say put your spare time to practical use. I would like to feel that if I should ever be asked for help or advice or see that my help would be of use to a new radio user, I will do so cheerfully and willingly.

S G Braid

MORSE TEST ONLY A STARTER

Sir, I was motivated into a reply to Mr Paul Thompson, G6MEN, by some disturbingly vague statements regarding so called ‘established’ CW operators. In my time, I have certainly heard on the air comments regarding many aspects of the hobby, some warranted and some definitely not. From Mr Thompson’s letter, it would appear that he regards ‘established’ CW operators as the source of complaints regarding CW procedures etc. Well in my book, there are two categories of so called established CW operator. Firstly, the operator who has passed the DTI morse test and is therefore qualified to operate in this mode on all allowable segments of the spectrum and secondly, those who have been operating on the bands over many years and have acquired a high degree of skill and proficiency in all aspects of this mode. In the first case, the operator is akin to the analogy of the driving test - qualified but still learning and improving his technique. In my opinion, a complaint would never arise if in fact the category of operator fell into the second type, as this operator would be concerned in
his endeavour to assist the newly licensed G1 as part of the learning process.

Comments regarding the excuse given for 'poor knowledge of procedures' are not in my opinion valid. What I would attribute the cause to is the now almost total lack of SWL 'apprenticeship'. A few years engaged in listening to the bands and noting procedures was duly worth its weight in gold, when eventually the ticket arrived and one started to operate with a good knowledge of what was supposed to be undertaken — this does not happen today and I'm sorry to say has given rise to the poor state in which we find our procedures today.

With regard to those persons who suffer from various medical problems, DTI are all too aware of these problems and bend over backwards in order to assist. It is possible to arrange to have a medical certificate from your doctor which would enable you to take the test in your own home. I believe this might be arranged in some cases via our good friend the RAIBC. Personally, I know several amateurs who are now operating happily on the bands after such an arrangement.

Lastly, the idea of providing QSLs as documentary evidence of a QSO; authenticity is certainly not acceptable due to being wide open to misuse, and indeed as mentioned, would not ensure the 12wpm requirement.

A Smyth, GM3XNE.

FOLLOWING ON

Sir, Your comment on my letter (Dec '85) that my suggested alternative route to a class A licence would lower the overall standard and speed of CW operation. I maintain that this need not be the case. The suggestion depends on the judgement of the A class ops contacted, who would have to be satisfied with the 'novices' sending and receiving speed, and with his accuracy. The required number of QSLs would take their time in coming via the bureau, ensuring that the novice will have plenty of time to practise. I never claimed that this would be an easy route.

On the subject of abuse, nothing has ever been invented that has not been abused.

Paul Thompson, G6 MEN.

MOD YOUR '290 NICAD PACK

Sir, I have just read the letter from Mr J C Darby, G4TVC (HRT Dec '85) regarding thermal runaway of an FT290 NiCd battery pack.

The same experience befell my 290 shortly after purchase in Australia several years ago. Upon reporting this to the local agent, I received nothing but patronising cynicism; in other words, it had not been reported previously, and there was no stock answer. I was left to discover the reason myself (poor thing). It did not become apparent until it had happened a second time, as eight 'C' size NiCd's are expensive (even in VK).

The problem, as Mr Darby rightly points out, is the small switch inside the external power receptacle, which is, or should be, depressed by insertion of the correct axial type plug, thereby disconnecting the socket from the battery pack whilst external power is being used. This is a fine idea, but it doesn't work all the time, even if the right plug is used.

The simple answer is prevention, by inserting a diode to isolate the battery pack from the socket. This proved quite an easy task, requiring removal of the battery carrier to gain access to the inside of the rear apron. I used a 1N4004 diode, which happened to be available, but any general purpose diode should suffice, assuming that it will stand the current required on high (?) power.

There are two things to note before you carry out this mod: make sure that you do not isolate the charging socket, as well; be aware that this mod would void your guarantee, unless carried out by your dealer. You can now use any old plug assuming it fits the hole on your '290, '790 or '690R.

Phil Perry, G4OHKNK4YC.

PS Mr Darby is not in a minority, as I know of at least twenty unfortunates to whom this problem has happened and probably there are many more, who think that they themselves have 'done something wrong'.

MORE G7 CALLS

Sir, Humberside College of Higher Education (Hull) have a G7 +2 letters callsign in their radio operators room. This was also used while tuning up the M. N. MF/LF transmitters into dummy loads.

I don't know how far it radiated but the signal would be picked up in radio operations room nearby!

Mike Walker, G4 IJI.

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HAM RADIO TODAY MARCH 1986
50 MHz Is Here!

After much debate and lengthy consideration, the announcement was finally made on December 16th with the Department of Trade and Industry releasing the details on the conditions of usage for 6m. The allocation of 50-50.5MHz had been announced by Minister of State, Geoffrey Pattie, back in June, 1985 together with the re-allocation of the Old 405 VHF television frequencies.

The DTI news has been given a mixed reception though, for there are many restrictions to the allocation which comes into force on 1st February. The allocation is on a primary basis and transmissions will be permitted even during the hours of continental television broadcasting on adjacent frequencies. However, a number of the other clauses will upset many of the staunch campaigners.

The main restriction is that the allocation is only available to Class A licensees within the UK. The maximum power has been limited, to 25W FM/CW, 100W PEP SSB (ERP), which is 14dBW carrier or 20dBW peak envelope. Any transmitting antenna must be no more than 20m above ground and although there is no size restriction this will be limited by the ERP. No mobile, portable or temporary premises operation is allowed and all antennas must be horizontally polarised. Finally, it has been stated that there shall be no repeater operation in the band.

It should be emphasised, that these restrictions will be reconsidered after one year, and it may be that some are removed or changes to the allocation are made. The DTI has made it quite plain that it has noted considerable resentment from other neighbouring administrations. Because the band is used by European Broadcasting networks, as well as "land mobile radio" both overseas and in the UK usage by amateurs must be on a "non interference basis".

Planning Laws Changed?

There has been great talk on the airwaves about a change in planning laws obviating the need to apply for permission to erect aerial masts. As far as we can discover, these rumours are completely unfounded.

What the government has done is to introduce a number of measures aimed at easing the burdens on small businesses in respect of planning permission for extensions to factories and warehouses. Buried amongst all this (presumably in expectation of a boom in sales of commercial DBS equipment) is an easing of restrictions on satellite dish antennas.

Richard Tracey, Parliamentary Under Secretary of State at the Department of the Environment, said in a written answer to a Parliamentary question on the 20th December 1985: "House occupiers will be able without specific planning permission to erect satellite dish antennas of up to 90cm in diameter on or at the front of their houses, as well as at the rear as now, but this relaxation will not apply in the SDO areas (ie National Parks, Areas of Outstanding Natural Beauty, National Scenic Areas, conservation areas and the Broads — Ed.) where present controls will remain in operation. The requirements for listed building consent remain unchanged."

So, the change in regulations affects satellite dishes only up to 90cm, and makes no mention of masts. Our advice is that if you're in doubt, you should apply for the planning permission anyway. The new regulations came into force on 1st March 1986.

The winner of the Microwave Modules 144MHz to 28MHz transverter (Competition HRT, December 1985) is Mr Porter who is presently based at Moi Airbase in Kenya. CONGRATULATIONS
Hardware Refresh

Owners of Spectrum (48k) and Spectrum Plus computers have an increasing choice of CW tapes. Though the GIFTU CW program is the first to claim to take them out of the ‘toy’ class.

The GIFTU CW program will enable the computer to generate and decode morse audio directly. A new method of software filtering has been devised for reception and the generated tones for transmit can be adjusted to suit the operator.

Apart from the usual features, the program has nine user memories of up to 255 characters each which can be saved on cassette and a special memory for your contact’s callsign which can be altered during reception.

The filtering on receive can be tuned and there is ‘auto tracking’ of the incoming speed which is displayed on the screen. On transmit both the speed and tone can be adjusted.

For manual key addicts, the program can be connected via a standard joystick interface. If no interface is available, quite reasonable iambic type operation may be achieved by using two of the keyboard keys directly.

The GIFTU CW program costs £10 inclusive (£11 in Europe) and orders from amateurs should be accompanied with their call-sign.

Further information is available from John Pearson, 42 Chesterfield Road, Barlborough, Chesterfield, Derbyshire, (phone 0246 810652).

Museum Moves

The National Radio Museum is no more! But there is no need to mourn its passing, because it has been incorporated into the new Communications and Electronics Museum, which was actually established in July 1984.

The objectives of the museum are to establish a collection of both civil and military equipment, from the earliest times and where possible including documentation, to provide these as a source of study, and to show the importance of the British contribution to these fields.

The museum’s collection is mostly from two private collections, one from Douglas Byrne, who’s collection effectively was the National Radio Museum, and one from Dr Graham Winbolt, who has an extraordinary amount of vintage military hardware.

Although the museum will actually be based in Portsmouth, the plan is to use one or more travelling exhibitions to bring it to the people. However, there is still an enormous amount of work to do — much of it in restoring the equipment to some semblance of cleanliness! All the work — and the travelling exhibition — is being made possible by generous sponsorship from Rank Xerox, but the museum will also be receiving help from Portsmouth City Museums, Victory Radio and the South Hampshire Industrial Mission.

The museum is actively looking for the loan or donation of equipment, even if modified, and all kinds of documentation, photographs, memorabilia, etc. If you can help, contact Dr G Winbolt, Chairman of the Trustees, Communications & Electronics Museum, The Cottage, Castle Road, Pucklechurch, Bristol (tel 027 582 2843).

For a future issue, we’ll be sending someone down to the museum to see how the work is going, so watch this space!

Two new 934MHz antennas are now available from Telecomms of Portsmouth. The G900A and G900R are designed to offer 3.5dBi gain with wide angle coverage necessary for operating in built up areas. Both antennas are supplied with 4.6m of cable and a low loss base connector. The G900A is fully adjustable with a steel whip whilst the G900R is finished in black.

The antennas are from the Nevada range and cost £25 each. Telecomms are at 189 London Road, North End, Portsmouth (0705 698113).

75th Award in Derby

The Derby DARS, incorporating Derby Wireless Club 1911, is issuing a special commemorative certificate as part of their 75th Anniversary celebrations.

To obtain the award, stations in the UK must contact GB3ERD, the special event station operating each month from the Council House in Derby, plus four other Derby stations. Stations outside the UK need only contact two other Derby amateurs.

All contacts must be made in 1986 and claims should be submitted with a copy of log details, certified by two other amateurs, a 9”x6” SAE, 85p (UK) or £1RCs (outside UK) to G4HDP 97 Woodlands Road, Allestree, Derby, DE3 2HJ.

Correction

In recent advertisements, we have published the wrong telephone number for Technical Software. The number should be 0286 881886. Our apologies for any inconvenience caused.
Many radio amateurs have masts or towers to support their aerials. Inevitably, the periodic servicing of such becomes necessary and may cause problems. In the writer's case, two 30' wooden masts mounted in steel tabernacles required attention; but although space would have permitted one to be lowered, the other, located in a very circumscribed position, presented a very difficult problem!

Age and increasing disability prevented personal attention to the work, so assistance had to be sought. Recent correspondence in the amateur press has indicated that others would appreciate help on this problem too.

Research revealed quite surprisingly that there existed a firm of steeplejacks in the neighbourhood, and it was decided to see if this type of small job interested them. A quick phone call brought their operative to the house, where he appraised the work to be done and gave a quotation for the job of repainting the masts and checking the running gear, halyards etc. In view of the work and risks involved this quote was considered to be very reasonable and the instruction given to go ahead.

When the operator began work I was intrigued to find that he proceeded to climb the masts (which are 6" at the butt and 3" at the top) using only simple rope 'stirrups' and a waist belt around the pole. The whole operation went smoothly and without fuss leaving the mast gleaming in new paint with all details carefully overhauled.

The second mast (located in a very confined space) was found on inspection to be badly weathered at about half way up. The damage was such as to make replacement advisable and this the firm undertook to effect.

Originally, the poles were supplied by Hyde & Clements of Wrotham in Kent. A phone call established that they would repeat the order for "one 9 metre pole, stripped, peppered, capped and delivered" with some 10/14 days delivery. The price was some eight times that charged for the original pole in 1968!

In fact the pole was delivered in just seven days and manoeuvred into the back garden where it was placed on trestles. It was undercoated with two coats of green paint, eye-bolts and guy-line attachments were made at the top and the butt drilled with precisely measured holes for the tabernacle bolts to pass through.

The steeplejacks proceeded to remove the faulty mast by introducing a ladder. This was lashed to the tabernacle and served as a 'gin-pole' lifting device enabling the team of three to lift the mast from the tabernacle. It was allowed to rest on the wall and the top 12' sawn off. Then the remaining 18' butt was then lifted out over the wall.

Unfortunately, the replacement pole presented quite another problem! In the event, the new 30' pole was carried from the rear garden into the front. Its placement in the confined space where the tabernacle was located was accomplished by passing it, butt first, over the 8' wall. One of the operatives at the tabernacle pulled the butt down whilst the other two pushed up from outside; the butt slid into the tabernacle and one of the holding bolts pushed home. A further concerted effort pushed the pole into the vertical and the second securing bolt was slid into place. Halyards and guy wires had already been fitted. All that remained was for the aerial to be checked over, attached to the halyard and hoisted into place.

The removal of the old mast and the installation of the new took just two and a half hours. The whole project was accomplished with completely professional competence and an admirable absence of fuss, leaving this very satisfied customer.

If you would like to know the address of the firm, contact the editorial office.

please mention HRT when replying to advertisements. 73 G4NXV
Celebrations ‘Down Under’

The world's oldest amateur radio organisation, the Wireless Institute of Australia, celebrated the 75th anniversary of its foundation during 1985. Tony Smith, G4FAI, reports on just some of the events organised to celebrate it.

Back in 1910, groups of radio experimenters throughout Australia were trying to discuss the problems of licensing with the Postmaster General's department—the authority responsible for administering Australia's earliest law on the subject, the Wireless Telegraphy Act of 1905.

The PMG wanted to discuss these matters with just one body representing all amateurs. So the WIA, originally inaugurated in Sydney and Melbourne, took on a national role, forming Divisions to look after amateur radio affairs relative to individual States.

WIA held many events to mark the anniversary and Australia Post released a pre-stamped envelope on 22nd May. Displays of amateur radio activities were mounted in many post offices to coincide with the release, which was one of the most popular ever issued by the postal authorities.

A special call-sign, VK75A, first used during the Anniversary Morse contest in March, was subsequently used on the air for other events throughout Australia. A commemorative QSL card is being sent to all amateurs contacting the anniversary stations, and short-wave listeners sending validated reports will also receive the card.

Book packs, containing basic amateur radio material from Australia, New Zealand, USA, and Britain, were made available by WIA, at cost, for Divisions, clubs, etc, to present to local schools and colleges during the year. The first presentation was made by the Australian Ladies Amateur Radio Association to a Centre for the Young Disabled, in the hope of generating an interest in electronics and radio amongst the Centre's users.

WIA has instituted a search for its longest serving member and for the longest licensed, still active, radio amateur. So far they have discovered a number of active amateurs licensed from 1920 onwards, and 93 year old Harry Angel, VK4HA, who still goes on the air daily.

A special ‘75th’ Award was available for amateurs contacting (or SWL's logging) 75 members of WIA during the celebration period. Various formal events have been held throughout the country, intended to culminate in a Federal Dinner in Melbourne in November, where the Minister for Communications, the Secretary-General of the ITU, the President of the IARU and many eminent radio amateurs from around the world, were expected to attend.

Rally Roundup

Two highly successful 'rallies' now start the rally season off with a bang; they are the Bury Hamfest and Cambridgeshire Repeater Group's massive junk sale.

The Bury RS Hamfest is on Sunday 9th February at the Mosses Youth and Community Centre, Cecil Street, Bury which is just 'minutes' from the M6. The doors open at 11 and there is an admission fee of 50p. If you get lost, there is a talk in on S20.

The junk sale extravaganza run by the Cambridgeshire RG has grown considerably in its four years to the size of a 'monster'. This year's 'rally' is on 23rd February starting at 10.30am and will include many trade stands, refreshments and of course the 'monster' junk sale bring and buy auction with bargains guaranteed.

The venue is Pye Telecommunications, St Andrew's Road, Cambridge. Admission is 50p with free parking. A talk in by G3PYE will be on S22. Further details are available from Chris, G4HCL, on 0354 740672.

Pirate Snooping Stops

Department of Trade surveillance on pirate marine radio ships Mi Amigo and Mi Communicator was halted on 13th December, and the Radio Interference Service withdrawn. The exercise was described by Minister of State Geoffrey Pattie as 'very successful...we have achieved our objective...to find who was supplying the ships.' The fact that Laser 558 had stopped broadcasting was an added bonus, he continued and he hoped that Caroline, who quickly adopted the wavelength, after Laser went off air, would also cease broadcasting.

The monitoring began at the beginning of August. It revealed evidence concerning a number of possible offences which has been passed to UK and continental police. The DTI were quick to point out that although they have stopped surveillance, they are still concerned about the pirate transmissions, in particular any interference made to helicopter beacons in the North Sea.

Commemorative pre-stamped envelope issued by Australia Post on 22nd May 1985.

WIA's special QSL card to commemorate operations from various parts of Australia during the celebration period.

The Tasmanian Hamfest in June, celebrating both WIA 75 and the Tasmanian Division's own 60th anniversary, re-enacted a 1901 pioneering ship-to-shore wireless experiment. At that time, only four years after Marconi had undertaken similar experiments in Wales, signals were transmitted from the Blinking Billy Lighthouse to a British warship, HMS St George. The re-enactment involved the use of a WW1 spark transmitter, for which special permission was given by the Department of Communication. A signal was sent from the same lighthouse to a vessel at sea. The message was re-transmitted to a receiver at the Hamfest, and subsequently to Cardiff in Wales.

There has been a lot more going on 'down-under' than can be mentioned in the space available. Amateur radio obviously holds a respected place in Australian life, and it just remains to say, "Happy anniversary, and congratulations WIA!"
Get onto ‘Seventy’ with synthesised style from Kenpro. The KT400EE, currently £189 over the counter and donated by UK importers Hi Tec Worldwide could be yours if you know your VHF/UHF stuff.

So you think you know all about VHF/UHF operation?

1. Contacts between Zimbabwe and Cyprus on VHF/UHF are most likely to be enabled by which of the following modes of propagation?
   A trans-equatorial
   B tropospheric scatter
   C aurora

2. At VHF/UHF the factors which affect the performance of a receiver are different from those of the HF bands, in particular with regard to
   D atmospherics
   E ignition interference
   F noise generated by the components of the receiver

3. Which of the following valves makes a good medium power RF amplifier at VHF/UHF?
   G QV06-20
   H QV06-20A
   I QV04-7

4. Sporadic ‘E’ propagation at VHF is seasonal and nearly all of it occurs in Europe between
   J February and May
   K May and August
   L August and November

5. The high Q stripline filter, often used for bandpass filtering for interference prevention, has one major disadvantage
   M very narrow bandwidth
   N difficult to set up
   O enormously expensive

6. The colinear antenna, often used now by 2m FM operators, was developed by two of the earliest pioneers.
   P Marconi and Franklin
   Q Hertz and Marconi
   R Maxwell and Hertz

How To Enter
Look at the questions nearby, which have a number of possible answers and using your skill and knowledge choose which you think are correct. Write them in sequence on the coupon below and on the back of your envelope. For example if you think the answer to question 1 is A and question 2 is D, your sequence will begin A, D, ...

Send your entry to Kenpro Competition, Ham Radio Today, 1 Golden Square, London W1R 3AB. The closing date for the competition is first post 28th February. Complete the coupon fully and clearly — if you are a winner this will be used as a label. Each correct entries will be placed in a large box and the winner drawn by the lovely Julie. You may enter as many times as you like, but each entry must be on an official coupon — not a copy — and sealed in a separate envelope.

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This publication has now sold well over 2500 copies since it was advertised only a few months ago. Now the recent updated version is selling even better. No self respecting listener should be without a copy. If you enjoy exploring the short wave bands then this publication will add to your enjoyment. It covers the hf spectrum from 2 to 30 mHz and gives details of transmissions outside the amateur bands. Specially designed for the UK and European listener it sets out in a very easy way a comprehensive list of hundreds of interesting transmissions that will keep you occupied for days on end! Only a fraction of the cost of other similar publications it contains details of Marine, Air, Military, Embassy, Press and News agencies. Many listings have time schedules included together with comprehensive RTTY details. It tells you the frequencies used by civil and military aircraft whilst flying the Atlantic, when and where to pick up the press bulletins, long distance marine traffic etc and much more. Send today for your copy of this worthwhile publication.

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Prepared in response to many requests for more information about the air traffic on the hf bands this little guide sets out to explain to the beginner how a band works in relation to air traffic. It contains full details of the world aircraft frequency bands in the range 2 to 23 mHz together with control frequencies and those commonly used for Oceanic control. Also included are many VOLMET frequencies, the Search and Rescue frequencies used by RAF helicopters and Nimrods, the HF RTF networks, London Company frequencies, European control centres etc. An ideal companion for the hf airband listener. Send today for your copy.

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To QSL means to confirm receipt of a message — it meant just that in the early days of amateur radio. The pre-1914 amateur radio scene in the USA centred upon the relaying of messages across that 'Kosher' and that he or she may be entitled to receive a "Worked All Inner-Mongolia on One Watt" document (with wax seals and signed by the Mayor of Ulan Bator). I know a British amateur who in recent years has developed an insatiable appetite for awards. He has them all beautifully displayed all around the walls of his large and well equipped shack. He once confided that the framing and glazing for this lot alone lay in the region of £1000!

Into 'sheepskin' hunting? Then you'll understand the frustration of waiting for QSL cards from exotic DXers. John Heys, G3BDQ, looks through his QSL card collection for some tried and trusted methods of QSLing.

country using just primitive spark transmitters and 'solid state' receivers (crystal detectors!). Much of the traffic handled was third party material and the confirmation of its reception was important.

When amateur licences were re-activated after the war in 1919, communications techniques had improved and the distances achievable between stations had increased from tens to hundreds of miles. At that time someone 'invented' the concept of the QSL card, the receipt of which confirmed that a distant or 'DX' station really had been worked. Disbelieving fellow operators could then be shown the proof of contact which was prominently displayed upon the shack wall; and no doubt relatives and friends of the proud recipient of the QSL cards were also suitably impressed!

Sheepskin Chasing

A mere wall covering of QSLs is now not enough to further the aggrandisement and ego inflation of many DX chasers today — they are drawn towards the accumulation of awards or 'Sheepskins'. The most worthwhile of these certificates of DX operating prowess require a great number of those elusive rectangles of card to be scrutinised and checked before the coveted award is granted.

It has been estimated that at any one time there are millions of QSL cards crossing and re-crossing the oceans and continents of the world; all destined to be positive evidence that DX claims are

There must be, past or present, very few amateurs who could honestly place hand over heart and declare that they had QSL'd each and every amateur they had contacted. Indeed, I have run across many who proudly and perversely state that they never ever send out QSL cards. Oddly, these latter characters — there must be many of them worldwide — never mention this fact to those they contact! It is rare indeed to work someone who defiantly tells you, "I never QSL OM". A CW contact now always includes the obligatory "QSL via Buro" which phrase I now deduce really means, "Send me your card via the Bureau". The rarer stations which surface on SSB very often go on at length to give you their full postal...

Some moons ago, ol' pal, ol' pal, we had a QSO, Mayhap 'twas short, mayhap 'twas long, as ether contacts go, But whether it was long or short, I have this much to add, It gave me just as big a kick as any I have had, And there is something you should know I sent you my QSL card many months ago. Perhaps the postman pinched it or perhaps I am not quite sane, So in case you think I am joking, I am sending this again. Again I ask you, pal o' mine, deny no more my plea, Just get the lead out of your feet and send that card to me.

ON4IB’s mourning card with dark border, wreath and lilies!

HERE LIES BURIED A FRIENDLY
† MCS QSO MADE ON 9/11/1959
AT 1100 GMT BY ON4IB IN CW WITH
HIS FRIENDS STATION G3DXK
IT DIED BY LACK OF QSL & RETURNED TO ASHES & MUD.
PLEASE GIVE IT A FRIENDLY THOUGHT IN YOUR MEMORY.
DX MAY BE YOUR REWARD

(Luc, P.O. Box 38, Bruges)
OZ6 BA’s dire warning to those who fail to QSL — a touch of witchcraft here?

Cartoon characters help to put across the message from LU4HI — murder by solder gun?

QSL Tactics

Within my large collection of both ancient and modern QSL cards there are many which attempt to either wheedle, cajole, bully or shame their recipients into sending back a card. In 1927, G5VYX of Cambridge had printed at the foot of his cards, “Remember 5XY om — he deserves a QSL does not he?” Three years later SWL Evans of North Wales told G5JO, “All gud stns QSL. Duz Urs?”

In the 1950’s, G2AYG had special ‘follow up’ cards printed which were sent to those miscreants who dared not to return a QSL. He illustrated his cards with a drawing of a sobbing and rather tubby gent was saying “Won’t you QSL?”. He then cleverly went on to state, “Dear OM, Per chance my QSL has gone astray, and not having received your card, although some considerable time has elapsed since our QSO, I take the liberty of repeating the details of the latter. 73 and may the DX come back to your call OM”. In similar vein W3EVW in 1946 also had a seductive card containing the message, “I sent you a card for our QSO of... and inasmuch as collecting QSLs is as much a pleasure to me as other phases of Amateur Radio. I would greatly appreciate getting your card, if you have any; so won’t you please send me one in return for mine, or at least a written verification”. Illustrated nearby are a couple of humorous exhortations from G8UO and ON41B. The latter has a reminder in the form of a mourning card!

Some amateurs however appear to become rather ‘niggly’ and ‘uptight’ about QSLing. The Mexican ZE2R in 1961 said on his card, “I sent you my QSL direct or via your bureau. Ever since I have patiently waited and hoped for yours which has never reached me... should there be a problem of postage expenses, either airmail or regular; please let me know and I will reimburse you...” Who is going to admit poverty?

More directly and less subtly OZ6 BA more than thirty years ago said on the front of his card, “Pse QSL crd OM. Tks. via QSL Bureau Copenhagen Box 79. If not, look back — hee hee.” On the back is a ghastly portrayal of a naked figure hanging from a gallows being attacked by crows! A letter to the late G3BID from VE1ARR tugs at the heartstrings and it included, “Dear Friend, Checking my notes I believe I had a QSO with you on October 27th at 1900. If this is correct would you please confirm with your QSL card? I will send mine in return. I am sending this landmail. If your card comes airmail I will do the same. I am physically handicapped, and the reason I am writing this is to make sure. It costs me more money this way, but I want to be honest. There is no need to reply if I am wrong. Would appreciate your cooperation...”

The Stubborn Ones

There are now certain DX stations whose cards are almost essential for certain prestige awards but who stubbornly refuse to send out any! Just sending them a card through the ‘Buro’ is a waste of time and even direct mail with enclosed IRC’s seldom evokes any response. When this tactic fails most of us just give up and begin the search for someone else operating from that exotic location: but one or two of my certificate hunter friends have lately resorted to other and more cunning methods!

Station “A”, after two attempts to get a card which he sorely needs then sends off a Dollar Bill, a selection of picture postcards of his town and even includes a few ‘naughty’ cards of the sea-side holiday variety. These go off by Registered Airmail and each exercise costs a small fortune. An unfortunate rebound to such a venture was the QSL from darkest Africa which revealed that the tarty gentleman there was in fact a Christian Missionary! On the back of that precious card was scribbled “Mn i nx for views of your lovely QTH but I have destroyed your other pictures...”

My other friend ‘B’ now resorts to simple lies. He brazenly writes a letter to the offending DX station stating that as he is now 87 years of age (he is actually 50!) going deaf, and also unlikely to see through another sunspot maxima; he must have that one remaining card to secure the coveted “...Award”! Amazingly this desperate tactic (cheek) seems to work and it does show that even the meanest, laziest, poorest or rottenest non-QSL’ers do have a small scrap of humanity left within their hearts and with some effort that precious and needed scrap of postage can be wrested from them.

The message printed on the back of HA5C’s QSL card which was sent to G6MU in 1939 perhaps sums up the whole business. “Vy gld to meet u dr OB. Pse dont forget the sending of QSL cards, which is a vy nice Ham custom, and also necessary to obtain the WAC, WAZ and other diplomas. Best 73 es good luck.”
Although the basic transverter — as described in last month’s issue — is suitable for QRP operation as it stands, many people will require more power than the 1W available. This PA design takes the output power of both 4 and 6m versions Class AB is the most popular way to implement this linear requirement, with the base/emitter junction of the device biased to produce a small collector current (of the order of several hundreds milliamps for this sort of power).

Having built last month’s 4 or 6m transverter, you may want more than the 1W out. This matching PA will give 15W PEP on SSB and a minimum of 20W out on FM/CW. By Tony Bailey, G3WPO.

up to 15W PEP of SSB or 20W (minimum) of FM or CW from a single stage transistor amplifier running from +12 to 14V DC. Relay switching is provided and is controlled by the basic transverter.

Linear Transistor Amplifiers

RF power amplifiers are often operated in class C mode for FM and CW signals; but for this application a linear mode of amplification is required for SSB. Trying to run SSB through a class C amplifier will result in considerable distortion to say the least.

As long as this bias point is accurately maintained, the output will be linear. However, there are factors which will try to alter this DC biasing once RF is applied. As the drive is increased, RF devices try to bias themselves off. So, you need a constant voltage source. This is further complicated by the fact that as the junction temperature rises with increasing current, the required base/emitter junction voltage for a given collector current is decreased. With virtually all high power amplifiers of this type having their emitters earthed, a constant bias voltage will result in the junction temperature rapidly increasing leading to thermal runaway and destruction of the device.

Temperature compensation is available in many forms from the simple to the complicated. For this sort of power, though, the simplest reliable solution is to use a forward biased diode in thermal contact with the transistor device. As the temperature increases, the voltage drop across the diode junction decreases and reduces the bias with increasing temperature. Fortunately, easily available power diodes have the right characteristics to give the correct compensation without resort to further circuitry. The low impedance plus a reservoir electrolytic capacitor helps smooth the peak bias requirements.

Circuit

Input signals at 50 ohms from the transverter are matched to the base of amplifier transistor, Q1, via TC1/TC2/L1 and associated capacitors. The bias voltage is applied via L2 and decoupling C5/6/7 from R1/D1, and is maintained at approximately 0.6V. The amplifier device used is a TRW TP2320,
rated at somewhat higher dissipation than is required and for an infinite VSWR, with internal ballast resistors helping to make the device nearly indestructible. Although intended for the 88-175MHz bands, where it has a gain of at least 10dB, it offers typically 13dB at 70 and 50MHz. It also gives a much higher gain: for an input power of 0.5W some 20W output is available when correctly matched.

L3 and the decoupling network C8, R3, C17, L6 etc isolates the RF generated at the collector from the DC supply. The RF output is matched into 50 ohms by TC3/TC4/L4 and associated capacitors. To reduce harmonic levels to acceptable levels, the PA stage is followed by a low pass filter (C11/L5/C13) with a roll off at 55 or 74MHz, before passing to the antenna.

Input and output control of the signals is via two relays, which are normally energised on transmit, routing signals through the amplifier. It is also possible to leave the relays unenergised on transmit, thus bypassing the PA and leaving basic QRP operation. The relay control output from the transverter is connected to the 'PTT' connection on the PA. When this goes low, Q2 conducts and energises the relays. A PTT switch can also be used to control the PA if required with only a very small current passing through the contacts. Two indicator LEDs are also provided indicating power on and Tx operation.

Like the basic transverter, a rudimentary form of power indication — simple rectification of the output signal — has been incorporated and can be used to drive a 100-200uA meter.

Construction

A double sided PCB has been used to ensure stable and repeatable operation of the PA. Like the transverter, most components that need an earth connection are soldered directly to the top surface of the board. In most places, earth holes have been drilled but these are only to show the position of the earth lead. If it is also connected to a track on the underside, the lead should be passed through the board and soldered both sides.

The complete board mounts in a custom drilled diecast box — it must be screened for operation — with the main heatsink mounted on the outside of the box. It is even more important with the PA to keep the leads short when making connections as there is a lot more RF power about to cause problems.

1. Insert and solder 1mm dia PCB connection pins at the ten points marked with a solid circle on the layout. Do not fit the ones around the leads of Q1 yet. Solder both sides where necessary.
2. Insert two more 1 mm pins to the left of C5 and left of L2. Solder both sides of these then clip off the excess on top of the PCB.

3. Insert and solder C5, R1, R5, C15, C16, C8, R3, C17, C10, C11, C12, C9, C13, C14, C18, R4, Q2, D3, D6, D5, C19, R6, RV1, R2, D7, C4, C3, L1, L2, C2, C6, C7 and C1.

4. Insert and solder TC1 and TC2, which are 10 mm and round in shape. Then fit TC3 and TC4, which have square bodies, and solder.

5. Then fit RL1 and RL2 and solder.

6. Carefully wind and fit L3, L4, L5 and L6. Use a drill of the correct diameter to wind the wire around and bend the ends down at 90 degrees to go in the PCB. The coils should end up with their undersides 1 mm above the top surface of the PCB. When they are in place, the winding separation can be evened up with a screwdriver. Make sure there are no shorts between turns.

7. Take Q1 making sure that you know which end is the collector - this has a 45 degree cut out on one lead and the header is marked with a C at the collector end. Turn the PCB upside down and insert the header into the hole so that the collector faces L4. Check that the mounting bolt is at right angles to the PCB in all directions, then using a hot iron, solder all four leads to the foil strips around all edges.

8. Fit the eight 1 mm through link pins around the emitter leads of Q1. Solder both sides and cut off the excess pin length.

9. Insert D1 through its two mounting holes so that the diode body is in actual contact with the centre of Q1 header. The overlay shows it outside the body due to the physical cut out in the board. Some heatsink compound or Vaseline should be put between the diode and header to aid thermal transfer. Solder the diode in place noting that the cathode is soldered to the top foil.

10. Check all transistor/diode and component values before proceeding further.

11. Take the drilled diecast box and remove any burrs or embossed writing that may be present around the immediate area of the transistor mounting hole using a file. Try to get this area as flat as possible, even using emery paper to finish it off, as the underside of the transistor must make good contact with the box.

12. Following the drawing, bolt the heatsink to the outside of the case - again some heatsink compound or Vaseline between the two will be beneficial - using 6BA screws with one full nut and one half nut. Smear a small amount of heatsink compound or Vaseline around the transistor mounting hole on the inside of the box. Place the board over the screws and secure with a shakeproof washer and one half nut. Should any holes not line up then file out the screw holes on the PCB not the transistor stud hole.

13. Then being very careful not to place any strain on Q1, screw its mounting nut down onto the heatsink to hand tight then a little further - do not overtighten! Q1 contains beryllium oxide which is extremely toxic, so if you break it take very great care over its disposal.

14. Mount the SO239 sockets in the case with their earth tags in contact with the top plane of the PCB. Solder the tags and wire the centres to the input and output sockets. Mount the PTT jack socket using short lengths of insulated wire. Put the power leads through the grommet into the case. The indicator LEDs are glued into their holes and wired directly to the appropriate points.

Testing

1. Double check that Q1 is the correct way round!

2. Using an insulated trim tool, set the four trimmers to half mesh. Connect an ammeter (4 amp FSD or more) in series with a 13.8V power supply and wire into circuit. Connect a dummy load (50 ohm 25W = 1) to the output in series with a power measuring meter of some description capable of indicating RF output.

3. Switch on power. The current drain should be around 220mA or less indicating that the PA is drawing bias current. Earth the centre pin of the PTT socket - the relays should change over.

4. With a drive source capable of delivering not more than 1 watt connected to the input socket and turned to minimum, go to transmit in either FM or CW (key down) mode. Slowly increase drive until a reading is obtained on the output power meter. Peak TC3 and TC4 for maximum output, then TC1 and TC2. Increase drive until around 20W output is obtained and repeat TC3/TC4 and TC1/TC2 (in that order).

Repeat these adjustments until the maximum output power is obtained. Don't touch the output trimmers with your hand as there is a high RF voltage present at maximum power output. After final trimming, you should obtain at least 20W output for 0.5-1 watt of drive, possibly as high as 25 watts with some samples - maximum current drawn should not exceed 3-4 amps. The PTT line can then be connected to its normal source for on-air operation - the external relay control output on the matching transverter.

For FM or CW use, the amplifier
may be driven to maximum saturated output; but for SSB, the output should be limited to 15W PEP for best linearity. Don’t forget that the box should be mounted with the heatsink uppermost when in use to aid heat dissipation.

Kits

Full kits for this PA for either 4m or 6m operation are available from Cirkit Holdings PLC, Park Lane, Broxbourne, Herts EN10 7NQ (tel: 0992 444111). They include all components, drilled tinned and screened PCB, relays, wire the drilled case and heatsink plus hardware. Price is £49.80 inc VAT, the PCB costs £5.20 inc. An order should be accompanied with 60p for postage and packing.

The PA Component List

RESISTORS

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<td>RV1</td>
<td>47k 10mm vert preset</td>
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CAPACITORS

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<td>C3,4,11,14</td>
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SEMICONDUCTORS

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<td>Q1</td>
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<td>TC1,2</td>
<td>foil trimmer 10mm</td>
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<td>TC3,4</td>
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RELAYS

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<td>RL1</td>
<td>KUIT-B 12V</td>
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<td>RL2</td>
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INDUCTORS

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Ham Radio Today March 1986 please mention HRT when replying to advertisements. 73 G4NXV
While billions of spectators watched some of the world’s finest athletes compete in the 1984 Los Angeles Summer Olympics, a little publicised but massive amateur radio communications network was playing a significant role in ensuring the enormous success of the Games. The story of how the largest contingent of amateur radio operators ever to be coordinated for communications assistance at the Olympics is a long behind the scenes tale involving several years of preparation and set in many communities nationwide.

Lessons learned from the numerous drills and rehearsals were first put to the test during the famous torch relay from Greece to the host city of Los Angeles. It involved the single greatest number of amateurs of the entire 23rd Olympiad. The 1984 torch relay was the longest ever in Olympic history. The US portion of 9000 miles began on May 8 in New York City and zigzagged westward to Los Angeles through 33 states. Almost all of the east coast-based torch bearers were members of the Telephone Pioneers of America. Amateurs were responsible for maintaining radio communication between the vehicles during the entirety of this marathon.

144MHz — both simplex and repeater frequencies — was the mainstay of communications with the car caravan which, at times, numbered 40+ vehicles. Additionally, 70cm was used in California because of crowded 2m conditions, while HF was used to contact east coast friends and relatives and through the Telephone Pioneers of America’s American Telephone and Telegraph headquarters in New Jersey. In the 82 days of the relay, countless amateurs were involved in supplying the vital radio link.

The Organisation

Numbers are more precise when looking at amateur radio participation in the actual Games as nearly 700 amateurs played an integral part at competitive venues and special events in 23 cities from Palo Alto to San Diego. The coordination for this Southern California amateur radio network began two years previously between the Los Angeles Olympics Organising Committee and Jay Holladay, W6EJJ, Irv Emig, W6CC, and Tom Rothwell, K62T, Chairman of the Los Angeles Area Council of Amateur Radio Clubs. They saw that amateur radio could provide back up communications in four specific areas: L.A. Police Department communications support, out-of-stadium cooperation with the Red Cross, Olympic Village traffic relay station and communications support within the Olympic Village.

A three station amateur radio set up was used in conjunction with the Los Angeles Police Department as a police surveillance task force. A dozen radio amateurs manned a mobile van in Los Angeles County around the clock to provide backup communications for the Department of Defense and all law enforcement and public safety agencies. 100 amateurs provided communications for the full rigged “Tall Ships Parade” during the Olympic art festival. The greatest number of hams to participate in a single Olympic event occurred during the yacht races from July 31 through August 8. A team of 225 operators coordinated communications for the Long Beach-sited races which involved 186 yachts from 60 nations.

The longest and most gruelling Olympic event — the 26 mile, 385 yard marathon — involved perhaps the single biggest organisational challenge. It required nearly 4500
volunteers to provide a smooth running communication system for fourteen zone chiefs, 52 mile chiefs, 4000 course marshalls, eight physicians, 12 nurses, 14 trainers, 20 roving Red Cross teams, security and law enforcement personnel and 23 race management officials — and it worked flawlessly.

High Security

Because of very tight security all amateur participants underwent an extensive background investigation by the FBI. The Amateur Radio Olympic Support Committee was asked to accomplish their communication mission with the minimum practical number of security clearances. Priority therefore was given to highly qualified volunteers who were able to make a significant time commitment. Village volunteers were expected to be available for two shifts a day for at least two — if not all four — weeks.

The security clearance and commitment requirements were even enforced with the amateur team selected to operate the special events station NG840. 40 out of 200 volunteers were scheduled three per shift for 12 hour days for 4 ½ weeks to operate from a ticket booth in the corner of the University of California Los Angeles campus. Using a 100 watt transceiver and masts at 15 feet to avoid surrounding trees, NG840 operators contacted 40 countries in the first two weeks. A linear raised this total to 84 countries in the remaining 2 ½ weeks. Commemorative contacts topped the 8000 mark.

The traffic total exceeded 100 messages with an estimated three times that many athletes turned away due to lack of third party agreements. Oddly enough just six countries accounted for the bulk of passed traffic: Australia, Brazil, Colombia, Israel, Romania and the USA. Messages were also sent to Zimbabwe as well as countries in South and Central America.

Despite NG840’s relatively obscure location, a number of dignitaries watched the operators provide public service and commemorative contact duties. These included Shocho Hara, JA1AN, President of the Japan Amateur Radio League, Don Wallace, W6AM, Bill Lippman Jr, W6SN, trustee of W6USA, the station at the 1932 Los Angeles Games, Monaco tennis coach, Jean Pierre Gasarotti, 3A2LB, Philippine swimming coach, Pete Lozada, DU1NRL, Austrian sailing team captain, Harold Pieler, OE8LLK and Ron Tucker, coordinator of the 1988 Winter Games in Calgary.

Although NG840 was primarily active on HF frequencies the VHF/UHF bands received a thorough workout during the Olympic. In fact, the widespread use of daily VHF/UHF communications was so intense that the Olympic Village Stations Committee made special arrangements for mobile repeater setups where this was practical and available. Otherwise, the OVSC obtained permission for exclusive use of specific machines for the duration of amateur participation at the LA Olympics. If you think that Los Angeles was without VHF/UHF repeaters for 4 ½ weeks note that there are 200 144MHz, 75-100 220MHz and 150 440MHz repeaters in the greater Los Angeles basin.

The First LA Olympics

It’s not known how many, if any, VHF repeaters were in the LA basin when Los Angeles hosted its first Olympics. Five radio amateurs activated the W6USA station during those games but little else is known. However, the 1932 competition was noted for its early amateur participation. Due to the deep economic depression so many nations protested at the expense of
travelling to Los Angeles that up to six months before the Games no country was firmly committed to participating. The International Olympic Committee and its secretary, Zack Farmer, came up with an idea of an Olympic village where athletes could be housed and fed for $2 a day. A crowd of 105,000 were the only people in the world to actually see the live colour and excitement of the first day festivities – television coverage was not introduced until the 1936 Berlin Games.

It was very different in 1984. With the extensive use of communication satellites an estimated half of the world's population in 120 nations watched the opening ceremonies of the 1984 Olympics. In the USA alone, 200 million people viewed the pageant on an estimated 135 million TV sets.

High Technology

The use of communications satellites and a sophisticated VHF/UHF network was only two examples of how high tech electronics was used during the 1984 Games. A control device on the arm of the official starter linked the starting gun with photo finish cameras located in a timing cabin. Not only were pictures produced at 1/100 of a second using electromechanical printers but a separation distance of only 2 mm between runners and swimmers could be determined by this equipment. The old standby, the measuring tape was officially rendered obsolete as officials measured the horizontal jumping events with a slide carriage device trained on an optical detector with accuracy to a millimeter. In addition, discus, javelin and shotput throws were measured using trigonometry on portable calculators. Additionally, starting blocks were wired to an electronic detector to expose premature takeoffs.

All sports information was electronically relayed to the Coliseum's two new scoreboards: one, a full matrix board for displaying game in progress information and the other, a full colour video board for displaying instant replays and other visual material. The full colour board contains highest state-of-the-art technology available offering unparalleled resolution and brilliance. Its 36ft by 48ft viewing screen makes it the largest colour video board in existence.

Nearly 3000 years ago, a dozen finalists lined up at the start of dromos, a 200 yard track. The title of “Fastest Man” in the known world was at stake. Sprints covered one stade, the length of the stadium. Long distance races measured in multiples of stades were run up to about 5 km. These foot races along with the pentathlon, an exhausting competition consisting of running, leaping, discus throwing, wrestling and javelin throwing were the featured events of the original Olympics.

In the victory ceremony, trumpets blared and the winners were brought before the Hellenodikal tribunal. There they were crowned with wreaths of wild olive from the sacred grove of Zeus. There was no higher honour and a winner freely feasted for months, his statue prominently exhibited. In addition, he became a lifetime hero and was exempt from taxation forever.

The early Olympic Games were held to celebrate the Festival of Hercules (the god who raised the infant Zeus). They had a semi religious tone which endured for more than 10 centuries. Celebrated every four years the sports festival was held at holy Olympia in an idyllic Greek valley near the Altes, the forested shrine of Zeus. As many as 40,000 spectators came throughout the Panhellenic world including the Greek colonies in Ionia, Egypt and Asia Minor, Africa, Italy and all parts of the Mediterranean.

The multitude slept on the ground, worshipped, feasted, drank and cheered. Even during war time between rival Greek states the Olympic Games continued. They endured through 320 stagings spread over 1170 years from the first recorded gathering in 776 BC to 394 AD. No institution created by man has ever lasted so long.
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HAM RADIO TODAY MARCH 1986
Ian Poole, G3YWX, evaluates the pros and cons of long wire aerials and IC holders and explains the increasingly used system of labelling capacitors.

In many ways a long wire does have a lot of advantages, but there are a few drawbacks some of which may not be so obvious. Firstly, as the aerial itself has no feeder it will start radiating at the beginning of the wire. This will mean that some of the power required for radiation will be absorbed by nearby objects making it less efficient. It can also mean that there are fairly high power densities in the vicinity of the operator, or anyone else who may be near the shack. Whilst it is not easy to measure the power levels, it is worth bearing in mind some of the discussions which have been taking place in the amateur press with regard to RF power density levels as a health hazard. Therefore when using a long wire it is well worth keeping power levels to a minimum.

One other problem which can be encountered when using a long wire is that of TVI. As the aerial is unbalanced and likely to be radiating in the vicinity of TV sets and the like, it is quite probable that it may give rise to various forms of interference. From the point of view of health and interference, the best idea is to remove the source of RF as far away from any houses as possible even though there are other penalties incurred in doing this.

The Use of IC Holders

Most of us will from time to time build up circuits of one sort or another either from a design in a magazine or from a design dreamed up on the back of the proverbial cigarette packet. With the ever increasing use of integrated circuits, this almost certainly means that ICs will be used occasionally. This is fine if the circuit works first time. However if, as is usually the case, there is a bug, this has to be traced through. If it then appears that the IC is at fault then it has to be removed.

Unfortunately it is not easy to remove an IC from a printed circuit or a piece of veroboard without damage to the board or the IC which may be perfectly good. When I am constructing equipment using ICs with the dual in line packages I almost invariably use holders. After all they only cost a few pence and they can save a great deal of time, and damage to boards and components.

Some may argue that holders introduce another source of faults. Whilst this is true, I have found that once the IC has been inserted correctly they do prove to be very reliable. Incidentally, one of the largest sources of faults with IC holders is the IC pin getting bent under the circuit during insertion and therefore not making contact.

Capacitor Labelling

Anyone who does any construction will realise that capacitor values can be marked in several different ways. Normally, the value is directly printed onto the capacitor or it is marked using a colour code. There is, however, a further system which is being used increasingly, mainly on values below 1uF. If it is read incorrectly it will appear to give unusual values of capacitance. The system is very simple using only three numbers and avoids the use of decimal points which can easily be missed or scratched off.

The first two numbers represent the significant figures of the value, the third number is a multiplier and in order to simplify matters still further, all values are in picofarads. For example a capacitor marked

Do you know what this capacitor value is?
101 would be 10 x 10' or 100 pF. This will very often be followed by a letter representing the tolerance: J is +/− 5%, K is +/− 10%, Z is +80% − 20%. Therefore if a capacitor is marked 101J it would be 100 pF +/− 5%.

**RF Screening and Painted Cases**

One easy way in which the appearance of a constructional project can be greatly enhanced is to build it into one of the ready made and painted cases which are readily available from places like Electrovalue and RS Components. As I have mentioned before these cases provide a cheap, easy and effective method of giving that professional touch to the project.

Unfortunately there are a few pitfalls and points to watch when using any form of painted case. Being what they are, many amateur radio projects require careful screening and this may not be provided by these cases if precautions are not taken. One of the types of case I have used consists of two metal sections as shown in Fig.2. As each section is painted it will mean that there is at best only poor contact between the lid and main chassis, and in the worst case none at all. In order to overcome this the paint should be scraped away around the screw holes and then a star washer can be used to bite into the metal through any oxide when the screw is tightened. In this way a good solid electrical connection will be made which may save many problems later.

Not only are adjacent sections of metalwork affected in this way. Many connectors such as BNC or SO239 connectors will rely on an earth connection to the chassis, and similarly the paint should be scraped away from around these. This may seem a great shame spoiling a new case, but it can be done quite neatly and on the inside so that the overall finish is not degraded.
From the house of Kenpro, perhaps better known for their antenna rotators, comes a range of amateur handie-talkies. It has been interesting over the last few years to see the growth and general development at this end of the market. Firstly there was the now ubiquitous Icom range of IC2E and matching IC4E closely followed by the then more complex handi Sun

First Impressions

First impressions of the Kenpro KT400 are that it is comfortable to hold, not too heavy (around 500g), and worth a closer look. Packed in its polystyrene box, it comes complete with nickel cadmium battery pack, charger, wrist strap, belt clip, ear piece, a 2.5mm and a 3.5mm plug and ¼ wave antenna. The belt clip requires fixing with two self tapping screws provided and easily fits using the two holes to the rear of the rig. The wrist strap fixes to

With 70cm activity growing fast, it is encouraging to see a wider range of products coming onto the market. Trevor Butler, G6LPZ, takes a look at the Kenpro KT400EE UHF handheld transceiver which comes without breaking the bank.

Then things began to take an interesting turn; Icom joined the ranks of those with key-pads and facilities galore, whilst their competitors introduced miniaturized budget versions, incorporating the thumbwheel switches Icom had been criticised for. Certainly thumbwheels allow for frequency selection without the need for a large space for the electronics associated with key-pads. Thumbwheels are either liked or disliked, and whilst their critics wax lyrical about the virtues of alternatives, it must be said that thumbwheel switches have their uses. We all await a suitable alternative.

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Review

Kenpro

KT400EE UHF

Handheld
from a 12V DC supply; a mobile
following. A slide-on battery pack
A half-wave whip (for use with the
tras,a range of alternative antennas.
DC converter.
NiCad pack, or to run into the DC -
cigarette lighter to either charge the
necessary
dc converter to allow operation
available in the range of approved
of 6V. Other battery packs are
able cells and a voltage, therefore,
without having to remove the
the entire protective case. The case
also incorporates a pocket for car-
ning an additional antenna.
One very useful addition is the
speaker mic, which is invaluable for
both mobile and portable use. It is
terminated in a combined 3.5mm
and 2.5mm plug combination
which fits into the two sockets on
the top panel of the rig.

Field Trials

Having stared at my new toy,
and taken it apart in various ways
to accommodate our friendly
photographer, I began the field
trials in earnest. Starting portable,
clutching my proud new posses-
sions, complete with fully charged
battery pack, ¼ wave and speaker
mic I left for the pub, about twenty
minutes walk away, using a route
which would be good for access to
the local repeaters.

Having already discovered that
FM activity on UHF was at times
limited and that most operation,
certainly locally, seemed to be con-
ducted through the local ‘box’. I
prepared to ‘fire-up’. It took no
more than a few seconds to
discover some annoying little
problems with the KT400, perhaps
some which could have been ironed
out with a few more hours spent on
the drawing board design.

Trying to activate the tone
burst circuitry, I found that my
finger would not fit between the
BNC socket and the squelch control
so I could not push the tone button.
I took my glove off and tried again,
one more without success. The
answer was to use one of my
smaller fingers — not easy but it
worked. The red LED lit up to in-
dicate transmission — or at least I
think it lit up, for the LED can’t be
seen while the finger is pressing the
tone burst switch directly above it!
At least, as with some other hand-
helds, the main PTT doesn’t have
to be activated simultaneously with
the tone burst switch.

Too Low!

My actions raised the local
repeater, and I duly began working
a station. After exchanging all the
usual pleasantries, I received a
complaint: my audio was too low,
and although the other chap had
turned up his volume control, every
‘K’ he received “almost took my
ears off” as he said.

I tried to alter the distance from
which I spoke into the speaker mic,
and even reverted to the inbuilt
electret, all without any joy. In the
end I had to adjust the mic gain pot
inside the rig.

The received audio was just
loud enough, through the speaker
mic, at full volume, and was able to
compete with high ambient noise
levels from passing cars. The
quality received through the
internal speaker, however, was not
nearly so effective. Thin, poor and
low level, even at maximum gain,
all the result, it would seem, of a
poor quality, ‘wafer-thin’ loud-
speaker.
Many contacts were made whilst portable and once the mic gain was adjusted, extremely good audio reports were received. Speech was able to overcome most background noise levels, both when using the internal speaker, and with the speaker mic, an addition I strongly recommend.

The thumbwheel switches proved quite easy to use; it's not often that one needs to scan the 70cm band, because generally known frequencies are used, tuning is straightforward with the switches. The 5kHz offset switch was too large and tended to be pushed accidentally, thereby rendering the unit to operate off frequency. Indeed, with the rig in my coat pocket, I often found this switch in the wrong position, and the on/off switch, volume control, in the on position — running the batteries down. There is a very soft touch to the main power switch, and being rotary, again it can be accidentally moved to its 'on' position quite easily.

Charging Around

I found myself charging the battery pack more often than would be normal because of the problems encountered above. The charger is terminated with a two-pin shaver type mains input, this is ideal for use in some overseas countries, from hotel shaver points and the like, but not from a standard domestic three pin outlet. An adaptor is therefore needed, which can easily be obtained from many electrical shops. An even easier way of charging is to use a normal 12V bench power supply and insert this output into the charging socket on the battery pack.

The battery pack has an inbuilt regulator and a red LED to indicate that charging is taking place. It does not extinguish to say when satisfactory charging is complete so I had to be careful not to overcharge.

There was a lot of empty space within the battery compartment, and the whole pack could be smaller, similar in size to the popular Icom packs. I tried to see if the Icom and Kenpro packs were interchangeable — they both slide off in a similar manner and have identical looking connecting pins. While the Icom pack would fit onto the Kenpro, the KT400 pack had to be forced onto an IC2E, and indeed prised off. This would appear to be because of the difference in the centre (positive) connection. Icom use a sprung metal clip, while the Kenpro pack relies on a self-tapping cross headed screw, which fouls the Icom base plate. A little modification, though, and the two would be compatible. A useful feature for any Icom owners contemplating the Kenpro range.

Two screw terminals to the base of the pack allow for fast charging using a base charger.

Going Mobile

Having decided that this little rig was ideal for the portable user, I tried some tests /M, although I think it is fair to say that the rig is not specifically designed to work under such conditions. Nevertheless, the results were pleasing and a number of satisfactory contacts were made.

The main problems are, that under mobile conditions, thumbwheels do not provide for the most convenient method of frequency selection, and the switches on the rear panel, the simplex/duplex and the hi/lo power switches were not readily to hand. Even at maximum volume, the speaker had problems, distortion occurred and it was very hard to hear some stations, especially when travelling at speed. This situation was improved a little by the addition of an extension speaker, but still more audio gain from the rig was required.

Trying to read the frequency display in the dark was very awkward, the white characters printed on the thumbwheels though were visible under the influence of the interior lamp, given suitable positioning of the rig.

Something which is sometimes overlooked is the handbook. I was forced to interrogate the one sup-
plied in order to find the location of the mic amp controls. This led me to read fully the details and data supplied. The books is a simple A5 stapled document, 23 pages in all, giving basic operating instructions. Some of the translation, presumably from the Japanese, leaves a lot to be desired. I quote: "It is required not to place the KT400 after pre-operation in such a place where the temperature is high. If it is left... the KT400 will unusually get heated by the enormously rising temperature. A care must be taken."

It is possible to make sense of the translation, and it should not hamper the enjoyment of using the equipment. There are some sketch diagrams and a few photographs, a simple plan of the internal key areas (including mic gain), a block diagram and a few well chosen specifications. Included also, a circuit diagram. A welcome sight, it's amazing how some manufacturers still neglect to include such a document. I recently spent £4.25 on a radio and then had to spend another £4.50 to buy a circuit diagram and alignment procedure booklet.

The Kenpro diagram was well laid out, with many of the points of reference sensibly numbered for identification, even crystal values given. There seemed to be a green LED somewhere which I still have not located in real life. A number of components included in the battery pack - namely three resistors, two diodes and a capacitor - are not shown within the battery representation on the schematic diagram. I did notice an interesting little circuit, comprising two transistors, an LED and a resistor which, according to the circuit, are not attached to anything... except earth.

Access to the interior is easy, four base screws and two screws on the rear panel. Removing the rear cover, the front one folds back on flying leads; the internal construction is rather like a sandwich. A metal surround, which unfolds on a centre hinge, to reveal the back of the two boards, solder side.

Inside Story

Internal construction is quite good, although the wiring immediately below the thumbwheels is untidy and hangs out in a bulge. A plastic strip with copper tracks runs from the main PLL IC to the thumbwheel switches and saves much interconnecting wiring. The crystals are well seated, although a number, together with other components are sealed in a metal box. The lid of this is soldered making access difficult, although a number of holes have been left for adjustment.

There is no circuit description included in the handbook, although with a straightforward and basically sound piece of equipment, perhaps it was felt that one was not justified. The receiver is a double superheterodyne, with IFs at 21.6MHz and 455kHz. Quoted sensitivity is less than -6dB at 20dB QS and better than 26dB at S/N with a 1uV input. Selectivity is rated at -60dB (+/- 15kHz) and spurious sensitivity at less than -60dB. The audio output is rated at 400mW at 8 ohms with less than 10 per cent distortion.

The transmitter deviation is +/− 5kHz and spurious emissions quoted at less than 60dB.

It is interesting to note that the mic amp employed is an IC, certainly nothing shoddy here. The first receiver stage is bipolar, with tuned input circuits, to a common-emitter input, a crystal being used to provide the duplex offset.

The receive path is conventional, a low pass filter, RF amp, first mixer stage, crystal filter to first IF amp, second mixer, ceramic filter, second IF, FM detector and through to an audio amp and the speaker. The transmit circuitry is again of good, well tested design: mic amp, with built in limiter and a low pass filter in the IC, a VCO FM modulator, the split path than goes to a three times multiplier, buffer amp, driver and final stage. The other route is via the PLL mixer, programmable divider, phase detector, and loop filter, including the 5kHz offset option. There's not much room inside with all this lot, but a skilled hand should be able to weald a soldering iron if necessary.

Alternative Antennas

Before handing the sample back, I took the opportunity to try an alternative antenna. Walters and Stanton supply a wide range, and allowed me to test their stub helical and telescopic ¾ wave. The stub helical - just 80mm long - was more convenient than the ¾ wave supplied by Kenpro, although at times less effective. It was possible to work the local repeater using the helical and it seemed less prone to changes in polarisation than the ¾ wave, if attracting some strange looks from passers by. It's very...
flexible and therefore difficult to damage.
A lot of success was found with the telescopic whip, which when retracted forms a rigid \( \frac{1}{4} \) wave (just 175mm), and in the extended mode (at 465mm), a fine, \( \frac{3}{4} \) wave with extra gain! A large spring-cum-loading coil, at the base makes the structure flexible—many telescopic whips meet their end because of their rigidity. When signals were good, the whip could be used in its shorter position for added convenience and when the going got tough a quick pull, and more gain... And for a mere £10.95 it can be yours, the stub helical (the slim 7 BNC) retails at just £7.95, really any serious portable operator could well do with both. Even without the extra antenna, the Kenpro KT400 is a very handy handi-talkie, well worth owning, easy to use, without frills, but providing the basics for the increasingly popular UHF bands. It won't really double as a base station, but can be used in a mobile environment with a little practice. I'd buy one tomorrow...now I wonder if I can get a discount...

-- Our thanks to Hi-Tec Worldwide Ltd for the loan and to Waters and Stanton for the antennas.

HAM RADIO TODAY

NEXT MONTH

BREAKING IN TO WORLD CONTESTS
G4JVG looks at the CQ WPX, at the end of March, and CQ worldwide DX contests.

WESTMINSTERS FOR 70cm
More conversions from G4HCL.

REVIEW: muTek 6m TRANSVERTER

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HAM RADIO TODAY MARCH 1986
In the June and July '85 issues of HRT, the writer contributed two articles outlining how the beginner gets started on amateur radio satellite communication. These two articles dealt with the satellites 'in view' of a particular location on earth. This 'view' time depended on the height of their orbit above the surface of the earth and the time of their period, i.e., the time they took to encircle the earth.

Have you been successful in working Uosat 1 and 2 and perhaps the Russian RS satellites? Arthur Gee, G2UK, and President of AMSAT UK explains how to get started on the phase 3 satellite — Oscar 10.

The satellites discussed in the first two articles orbit the earth in a circular path. They are classed as phase 2 satellites. From the point of view of operating time, they have the disadvantage that their circular orbit resulted in only a short time during which they were visible at any one point on earth. This 'view' time depended on the height of their orbit above the surface of the earth and the time of their period, i.e., the time they took to encircle the earth.

Elliptical Orbits

Satellites can be put into quite a different orbit — an elliptical one instead of a circular one — so that the apogee (the greatest distance from earth) of their elliptical orbit is way out in space and their perigee is close in to the earth. These are known as Molniya type orbits. This gives a very different characteristic to the period of time when they can be worked. When the apogee is right out in space, the time available to contact them is long; when passing through perigee it is short. The long period of time during which the satellite is travelling out to its apogee may be a matter of hours, whilst the perigee passage may be only an hour or so at the best (see Fig.1).

Oscar 10 is the first of the amateur radio satellites to be put into such an elliptical orbit and is the first of the phase 3 satellites. Its apogee is around 35,600 km and its perigee is about 3650 km. The orbital period of Oscar 10 is about 12 hours whereas the phase 2 satellites have orbits from one and a half to two hours.

The astronomer Kepler was the first to investigate the motion of the planets and the laws he postulated apply to satellites orbiting the earth. Basically, he discovered that when a planet — or a satellite — is in orbit around another body — the parent body — its path around the parent body is an ellipse, the parent body being at one focus of the ellipse.

The speed of a satellite in a circular orbit is constant throughout the orbit; but this is not so with a satellite in an elliptical orbit. It travels faster when passing through perigee and slowest when passing through its apogee. Fig.2 shows the position of a satellite with a 12 hour orbital period at hourly intervals and illustrates its variation in speed. So, during its passage outward, around the apogee point inward again a much longer period of time elapses than when its travelling around the perigee point. This offers more time...
for radio communication to take place for stations in that hemisphere of the world facing the apogee point, than is available with a satellite in a circular orbit.

There is another aspect of a Molniya orbit we must consider too. The orbital path in space of the satellite is of course exactly the same but throughout the year the earth changes in its position with regard to the orbital path. The changing position of the earth throughout the year gives us spring, summer, autumn and winter, etc. Moreover, as the earth travels round the sun during the year, further changes in relation to the sun occur regarding the satellites orientation to the sun. This produces periods of ‘eclipses’ when the solar panels are in such an orientation to the sun and earth that they get a minimum of solar radiation and the power available aboard the satellite from the solar panels is severely depleted.

Another feature of this elliptical orbit to be considered is that the relative positions of the apogee and perigee points of the ellipse move around with respect to the earth’s surface. For some time the apogee will favour the northern hemisphere but it will slowly drift round so that it comes to be orientated toward the southern hemisphere. When first launched in June 1983, the apogee was facing the northern hemisphere; now at the beginning of 1986 it faces the southern hemisphere. So this gives a variation in the area of the earth’s surface from which radio communication with the satellite can take place.

Understanding Oscar 10’s orbit and working out just when it will be available for communication from any particular place on the earth’s surface is a pretty complicated business. Perhaps it is more in the realm of astronomy than radio and far more complicated than predicting circular orbits, and certainly presents some practical problems.

How To Predict Oscar 10’s Orbit

There are two possible ways of tackling the matter available to the radio amateur. We can do it if we are a computer buff, by making use of Kepler’s Laws and applying the mathematics involved using the computer to do the required calculations. The parameters used in the calculations are known as Kepler’s Elements. These are promulgated regularly, as the changes demand, by the various amateur satellite organisations. Using this method, both the direction and the elevation of the satellite can be calculated.

A much simpler method is to use Orbital Prediction Charts, available from the same amateur satellite organisations, in which the bearing of the satellite is given for each day, together with the time available for communicating and the elevation of the aerial for stated times throughout the period available. The best way of explaining this is to refer to Fig.3 which shows an extract from a recent Orbital Calendar. For example, let’s see how the entry for the 6th December 1985 is interpreted.

In the section of the Calendar
issued from AMSAT-UK to cover the period October 1985 to December 6th, in the section for OSCAR 10 we look up the parameters for December 6th. The entry 1136 is the time, GMT, when the satellite reaches a point on its passage round the earth. At that time it comes into range of a station in the location for which the calendar has been compiled, in this case 359 degrees longitude and 51 degrees latitude. This is in fact, East London. At 1136 GMT, the satellite just becomes audible and it does so in the direction of 257 degrees — compass bearing. At 1200 hrs, it reaches the apogee, at which it changes direction and begins to return towards the earth. Its bearing from the earth at this point in its orbit is 193 degrees. The figure 33, alongside this entry, is the height in degrees above the plane of the earth that it reaches at this point in its orbit, ie its elevation at this time.

Beneath these two entries in the calendar is a third entry, which shows the time at which the satellite disappears from view — radio-wise — down over the horizon, along with its bearing in degrees at the time it does so. With this information, we know when to start listening for it and the direction in which the aerial should be pointing.

Getting The Antenna Right

It is very important that the antenna should be pointed at the satellite in azimuth, but it is not quite so important that it be adjustable in elevation. A permanent degree of elevation is acceptable since the variation in this parameter is not as much as the azimuth. Ideally the antenna should be made variable in both parameters but putting an elevation control on the mast supporting the aerial system, adds considerably more expense and mechanical complication than is justified. In the author’s case, the aerial is ‘cocked up’ at about 20 degrees, which seems to be a good compromise. An ordinary antenna rotator system serves perfectly well to control the azimuth direction.

The position of the satellite along its orbital path is indicated by a parameter called the Mean Anomaly. This is a term used by astronomers to denote angles. A telemetry signal is given out by the beacon on Oscar 10 every hour on the hour, giving the Mean Anomaly.
in morse code at that particular moment. Reference to a suitable chart then shows just where the satellite is along its orbital path. Such a chart has been drawn up by Harold Meza, of Chatham, England, and shown in Fig.4. The Mean Anomaly figures start at periapse and go on in steps around the orbital track to finish back at periapse again. It should be noted that the figures used run from zero through to 256—not to 360 as one might have expected. On Harold's chart the figures run in steps of eight, each step taking 22 minutes approximately for a complete orbital period of 700 minutes.

So if we have a set of tables such as we have in the Orbital Calendar, the chart, a radio receiver covering the frequency of the satellite's transmissions and a rotatable directive aerial system, we can listen for the satellite at the time and in the directed indicated in our Orbital Calendar table. Having heard from the beacon's telemetry what the "M.A" is, we have a pretty clear idea of just where the satellite is in its path at the time we are listening to it.

A very good visual picture of the characteristics of this type of satellite orbit can be had by making up a model described by Jim Millar, G3RUH, in the October 1983 issue of Oscar News, the journal of AMSAT-UK. A full description of the model is given in the article and can be placed in different orientations to suit appropriate date.

What's On Oscar 10?

Oscar 10 was launched by an Ariane Launcher on 16th June 1983. It carries two transponders at VHF and in the L band. The VHF transponder accepts 70cm uplink signals and retransmits them down in the 2m band. The L band transponder is 23cm up and 70cm down. There are two alternative telemetry beacons for each mode, one known as the general beacon gives telemetry data relating to various parameters, news etc; the other, the engineering beacon, gives more detailed information about the various systems aboard the satellite relating to how it is functioning. The general beacon on 145.810MHz is the one most used and is the one listeners will be using for most of the time. Details relating to the Mean Anomaly, schedule changes, news messages etc, are sent over this beacon in morse code.

The first thing you will notice on listening to Oscar 10 is that its signals go up and down in a peculiar sort of "wow" noise. This is due to spin-modulation and is very helpful in identifying it, as the "wow" is very characteristic. It is thought to be caused by the satellite spinning on its axis thus rotating the aerials which go in and out of phase as they rotate. Also it is thought that at the time of its ejection from its launcher rocket, a slight collision occurred between the satellite and the rocket which may have slightly damaged one of the aerials. This may not be functioning properly so adding to the phase variation. These signals do have a marked distortion at times which is sufficiently severe to make their interpretation quite hard to resolve. There is also the little matter of the polarisation of the aerial system, but more about that later.

Next month we will deal with details of the receiving equipment needed for Oscar 10 and consider aerials and receivers, pre-amplifiers and the special considerations needed to get good reception. In the third part we'll deal with the transmitting side of things. We shall confine our attention to the 2m down, 70cm up facilities as this is the main channel used by most Oscar 10 'buffs'. The L band facility is a highly specialised one for which you have to have a considerable amount of experience of microwave communication before attempting to use this facility on Oscar 10.

It is essential that those who really want to get involved in satellites join AMSAT-UK, the organisation which looks after the interests of the amateur radio satellite enthusiasts in this country. It is through them that such things as Orbital Calendars, computer software, printed circuit boards for interface units and much else is available. Membership details can be had by writing—preferably enclosing an SAE—to AMSAT-UK, 94 Herongate Road, Wanstead Park, London, E12 5EO.
Does your communications receiver have just the basic IF filtering? Well, this audio filter designed by Robert Penfold may provide a practical solution.

Most modern communications receivers, and the more expensive types from the past, have good quality IF filtering which gives a degree of selectivity capable of coping well with crowded band conditions. This is of little comfort to anyone who has one of the many receivers equipped with only quite basic IF filtering, such as inexpensive mechanical filters or just the selectivity provided by the IF transformers. The most satisfactory way of improving the selectivity in a receiver of this type is to fit a high quality crystal or mechanical filter, but this involves tampering with the receiver's interior, which, understandably, many people are not prepared to do. In fact this is not a good idea except where the constructor is suitably experienced, or a helper with appropriate experience is available.

If modifying the set is ruled out, the only remaining option is to use an audio filter. Although I have seen it stated on more than one occasion that audio filters cannot reach the standard of performance required for this, this is definitely not the case. In the past, many audio filter designs have used simple 12 or 18dB per octave filters, but in theory practically any desired attenuation rate can be achieved. In practice, cost and complexity have to be taken into account — something less than the ultimate level of performance has to be accepted — but there are ways of obtaining sharp selectivity at moderate cost. Results can rival those obtained using a high quality IF filter; but they can not equal them in all respects, as we shall see shortly.

This audio filter design simply plugs between the headphone output of the receiver and the headphones. The headphones can be practically any low, medium, or high impedance types.

The ideal audio passband for communications purposes is generally accepted as being from about 300 Hz to 3kHz and this filter is designed to have −6dB points at these frequencies. The response outside the passband should fall away as rapidly as possible. Fig.1 shows the response of the prototype filter, which has no significant ripple within the passband, and very rapid attenuation rate at both skirts. In fact the ultimate roll-off rate is 96dB per octave on the high frequency side of the response, and some 102dB per octave on the low frequency side. With some types of filter there is only a modest amount of attenuation at some frequencies well outside the passband, but this is not a characteristic of the type used in this design. Outside the frequency limits shown in Fig.1 the at-
tenuation is so high that it becomes difficult to measure reliably. Strong input signals below about 150Hz and above approximately 6kHz are rendered totally inaudible at the output.

C-R Filters

There are several ways of providing the type of frequency response required in this application. A simple C-R or L-C bandpass filter might seem to be the obvious solution, but they are not suitable as they tend to have an inadequate roll-off rate, or if the Q is increased to combat this, the bandwidth becomes too narrow for voice signals. One way round this problem is to use some form of multiple bandpass or tuned circuit arrangement, and filters of this type can certainly provide good results. An alternative method, and the one adopted in this design, is to use two high slope active filters, one low pass and one high pass filter. In terms of the number of components required this second method is a rather extravagant solution, but as the components required are just resistors and capacitors costing a few pence each it is not a very costly approach.

A basic C-R high pass filter consists of one resistor and one capacitor connected as shown in Fig.2a. Capacitor Ca has an impedance that increases as the applied frequency is decreased. At very high frequencies, the impedance through Ca will be negligible in comparison to the impedance through Ra. The losses through the filter due to the potential divider action across Ca and Ra will also be negligible. At some point the impedance of Ca will start to become significant, as will the losses through the filter. At the frequency where Ca’s impedance becomes equal to that of Ra the output signal has an amplitude equal to half that of an input signal, or a loss of approximately 6dB. Below this frequency the filter has a 6dB per octave roll-off (halving the input frequency doubles the attenuation).

The basic low pass filter circuit of Fig.2b works in essentially the same way, but with the resistor and capacitor swapped over. It is at low frequencies where Ca has a high impedance when compared to that of Ra that the circuit has minimal losses. At high frequencies the impedance of Ca drops to a significant level, which causes a voltage drop through Ra by a potential divider action. Again, the −6dB point is at the frequency where Ca has an impedance equal to that of Ra. Above this frequency the filter has a 6dB per octave attenuation rate.

Active Filters

Simple filters of this type are of little use in most practical applications. One problem is simply that the filters must be fed from a low source impedance and feed into a high load impedance for these impedances must form part of the filter resistance) in order to obtain correct operation. Another is the rather limited roll-off rate. This can be increased by cascading several filters, but the relatively low initial roll-off then starts to become significant. The roll-off rate of 6dB per octave is achieved above the cut off frequency (for a low pass filter), but the rate below the cut off frequency is much less. The impedance of the filter capacitor is inversely proportional to the applied frequency. If the filter resistance is (say) 10k, and the capacitor has an impedance of 10k at 500Hz, its impedance will be 20k at 250Hz. This gives a 6dB loss at 500Hz, and about 3.5dB at 250Hz. In other words an attenuation rate of just 2.5dB per octave immediately below the cut-off frequency.

When several identical filters are cascaded this low initial roll-off accumulates to give a significant effect on the response for several octaves prior to the attenuation rate reaching something approaching its ultimate level. What most practical applications require, including this one, is a much more abrupt introduction of the ultimate attenuation rate. The standard form of improved filter is the active type using bootstrapping. Fig.3 shows the basic second order (12dB per octave) high pass filter circuit.

The operational amplifier merely acts as a unity gain buffer amplifier. The series capacitance of Ca andCb forms a simple high pass filter in conjunction with the parallel resistance of Rb and Rc. These two resistors also bias the input of the buffer amplifier, and if dual balanced supplies are used they would be replaced with a single resistor biasing the non-inverting input to the 0V rail.

At high frequencies Ra has no real effect on the circuit, since the voltage at the junction of Ca andCb is the same as that at the output of the amplifier. This gives a fixed voltage across Ra and no signal current flows. At frequencies where the passive filter action introduces small losses the situation is different and the positive feedback through Ra tends to reinforce the input signal and eliminate the slow initial roll-off. At frequencies where the passive filter produces heavy losses, Ra has the opposite effect as the output voltage of the amplifier is then practically static. Ra then effectively forms a second high pass filter circuit with Ca. This gives the desired effect with not
just the elimination of the slow initial attenuation rate, but also an increase in the ultimate attenuation rate (to 12 dB per octave) as well.

Fig. 4 shows the equivalent low pass filter configuration. Here Rc plus Rd are the filter resistors, and Ca plus Cb are the filter capacitors. Ra and Rb are bias resistors, biasing the amplifier via the filter resistors.

Both circuits have a low output impedance provided by the buffer amplifier, but they still require a low source impedance in order to work efficiently and predictably.

**Practical Circuit**

The required bandpass filtering can be obtained by using a high pass filter with a cut off frequency at about 300 Hz, and a low pass filter with a cut off frequency of around 3 kHz. A narrower bandwidth would tend to reduce the wanted signal as much as any background noise, and could also impair intelligibility. A wider bandwidth would give less than optimum attenuation of adjacent channel signals. Fig. 5 shows the circuit diagram of the low pass filter while the high pass filter circuit appears in Fig. 6.

IC1 just acts as an input buffer stage which provides a low source impedance to drive the low pass filter, and a suitable bias voltage for the input of the filter. The filter itself consists of four almost identical active filters in series. Each filter block differs from the basic configuration only in that two sets of filter components are used with each amplifier, doubling the attenuation rate to 24 dB per octave. Four filter blocks therefore gives an overall total attenuation rate of 96 dB per octave. Filters having high attenuation rates such as this are often referred to as 'brickwall' filters. This is presumably due to the wall-like frequency response graph of such a filter, but it is also a fairly apt description of the sound produced when a full bandwidth signal is subjected to high slope filtering.

The high pass filter uses the same general scheme of things with four almost identical 24 dB per octave filter stages. There is a slight peak in the response of the filter just above the cut off frequency, but C1, R1, and R2 at the input of the unit form a low pass filter which tames this peak. These three components therefore effectively form part of the high pass filter and raise its total attenuation rate to 102 dB per octave.

I originally felt that the high pass filter would be of little benefit, but...
and that the low pass filter would be of most use in counteracting adjacent channel interference. Practical experiments would suggest that this is not the case. When added to the author’s receiving equipment the high pass filter normally provided the greatest reduction in noise and interference. The original intention of using a low attenuation rate of about 4 dB per octave for the high pass filter was consequently abandoned.

It would be perfectly feasible to add more filter blocks to increase either or both of the roll-off rates. However, it seems to be necessary to add a lot of extra components in order to give very little discernable increase in practical performance, and four blocks per filter probably represents the best compromise between complexity and performance.

The circuit is powered from a 9 volt battery, and the current consumption is about 8 milliamps.

**Construction**

Details of the printed circuit board and wiring are provided in Fig. 7. Construction of the board should not be difficult provided the specified types of capacitor are used in the filters. Alternative types, even if suitable with regard to their electrical characteristics, would probably not fit onto the board properly as it has been designed for miniature printed circuit mounting types. In many projects the values of resistors and capacitors are not critical, but this one is an exception. Substituting near values for the filter components could result
in unwanted peaks in the frequency response, a reduction in the initial roll-off rate, or in an extreme case it could even result in the circuit oscillating.

An instrument case which has approximate outside dimensions of 150 by 100 by 50 millimetres is suitable for this project, but any similar case should suffice. This represents about the smallest size that is adequate, bearing in mind that the printed circuit board is 145 millimetres long. The board is mounted on the base panel of the case using M3 fixings, including spacers to prevent the connections on its underside from short circuiting through the case. On/off switch SW1 and the two sockets are mounted on the front panel. On the prototype SK1 is a standard jack socket, which matches the headphone socket on the author's receiver. A standard jack lead connects the output of the receiver to the input of the filter. SK2 is a stereo jack socket wired for (series) monophonic operation. However, the input and output sockets can obviously be changed to suit your particular set-up if necessary.

In Use

The affect of the filter can be demonstrated by switching on the CIO or BFO and then tuning the set across an AM transmission. The usual strong heterodyne whistle will be heard when it is at frequencies within the passband of the filter, but when adjusted outside the passband (on either side) the heterodyne should ideally drop below audibility. The characteristic brickwall sound should also be self evident when the filter is in use.

As pointed out at the beginning of this article, adding an audio filter is not the same as having a high quality IF filter which gives a similar bandwidth, and under some circumstances an audio filter can give noticeably inferior results. It is as well to be aware of the limitations of the filter and the problems that can arise.

One odd effect that occasionally crops up is where the wanted signal changes in volume, quite often rapidly, for no obvious reason. This is due to the AGC circuit, which normally takes its drive signal from the last IF amplifier. If, for instance, a strong CW signal is present at the IF output, it will result in the gain of the receiver switching up and down as the CW signal is keyed on and off. However, the audio filter might well render the CW signal totally inaudible with the wanted signal being switched up and down in volume for no apparent reason.

The second point to note is that a narrow bandwidth IF filter gives just one passband, whereas a wide IF bandwidth plus audio filter gives a main response and a secondary response, rather like the main and image responses of a superhet receiver. Fig.8 helps to explain this phenomena.

We are assuming that the receiver is set to receive lower sideband signals, and the CIO is, therefore, tuned to the upper skirt of the IF response. The audio output frequency produced by IF signals is equal to their displacement from the CIO frequency. The wide IF bandwidth results in interference over a broad range of frequencies below the CIO frequency producing an audio output; but the audio filter provides a narrow bandwidth and good immunity to adjacent channel interference. Signals at frequencies above the CIO frequency also produce an audio output, but the IF filtering produces some attenuation of these. However, in many cases the degree of attenuation may not be very great, perhaps in the region of 20dB. The audio filter removes some signals on this image response, but some inevitably fall within it's passband. Correct positioning of the CIO on the skirts of the IF response is important in order to obtain optimum attenuation of the image response.

The filter is less than ideal for CW reception, where a much narrower bandwidth will suffice. It will give improved results though, if no proper (audio or IF) CW filter is available.

Components List

**RESISTORS**

- R1,2,22,23,27,28,32, 33,37,38 100k
- R3 to R18 8k2
- R19,20,24,26,31,36 5k6
- R21,25 12k
- R29,34 6k8
- All resistors ¼ W 5% carbon

**CAPACITORS**

- C1 33nF carbonate
- C2,6 3n3 carbonate
- C3,7,10,11,14,15 4n7 carbonate
- C4,8,12,16 22nF carbonate
- C5,9,13,17 560pF ceramic plate
- C18 100nF ceramic
- C19 to C34 100nF ceramic
- C35 100µF 10V radial elect

**SEMICONDUCTORS**

- IC1 uA741C
- IC2,3,4,5 LMT458 C

**MISCELLANEOUS**

- SW1 SPST miniature toggle switch
- SK1 Standard jack socket
- SK2 Stereo jack socket

Case about 150 x 100 x 50mm; printed circuit board; 9 volt battery and connector; five 8 pin DIL IC holders.
**SPECIAL NOTE**

So far as we know, the procedures described here will apply to all working VHF/FM Pye Westminsters— but we cannot account for any models which are beyond our experience. Please note that a certain level of knowledge and experience will be necessary to carry out the mods.

If you’re like me, you’d like to have a rig in the car permanently, but dislike the idea of leaving it in there all the time. Perhaps you could be worried about theft, or maybe you’d like to operate both mobile and fixed but can only afford one decent rig.

**Chris Lorek, G4HCL, shows how to find the right one and how to get it going.**

Radiotelephone manufacturers such as Pye Telecom now make microprocessor-controlled sets with digital readout and so on, in very small sizes, and older rigs like Westminsters are now readily available on the second hand market at extremely low prices (many people throw them away!). Westminsters appear in both remote and dash mount versions; the dash mount is ideal as a local club net or repeater/Raynet monitor, but is a little large for car mounting nowadays. The remote mount version is superb for fitting out of the way, in the boot or under your seat, linked to a small box under the dash with volume, squelch, and channel controls on it. This also makes the rig much more resistant to theft.

My last car was broken into twice by thieves about ten years ago. The first time, the boot was crowbarred open, the airhorns and headlamps went on and off from the alarm system. And in the panic the thieves were foiled by the chain around my three boot-mounted Westminsters. The second time a thief got into the interior and thought a control box was the radio; again he didn’t hang about and went with virtually nothing. If I had had Japanese mobile gear in at the time, I would have been much worse off!

I still operate 4m, 2m, and 70cm from the car, with Pye sets albeit a little newer, but now people tend not to think of radiotelephone equipment as readily saleable gear, which is good news in a number of ways. You should be able to pick up a second-hand Pye Westminster for anything from 25p to £15 depending upon frequency band and condition; but beware, make sure you know what you are buying. Readers of my article on Pocketphone 70’s (in the Jan 1986 issue of Ham Radio Today) will have heard this before: look at the serial number plate.
The Westminster range has AM and FM sets, with different frequencies from 32.5 MHz up to 470 MHz. A 68 MHz AM set looks absolutely identical to a 145 MHz FM set from the outside, apart from the riveted serial number plate. So how do you know which is which?

There were seven frequency ranges commonly made; these are shown in Table 1.

I intend to deal with the VHF FM Westminster in this month’s issue; next month will reveal all on the UHF types.

The usual set will have W15**** marked on its plate, together with its original frequency; if the riveted plate has been removed then leave well alone! Following the W15 will be AM or FM, self explanatory, followed by B or D, signifying boot (remote) mount or dash mount respectively. The final letter, will if appropriate (VHF sets) indicate the channel spacing, and hence filter width:

N: 50 kHz spacing, ± 15 kHz filters;
V: 25 kHz spacing, ± 7.5 kHz filters;
S: 12.5 kHz spacing, ± 3.75 kHz filters.

Look out for a V set if you want it for 2m; you will suffer from adjacent channel interference with an N set (fairly old and hence rare), and from distortion on receive with an S set (newer and hence more common). If you do end up with a set with unsuitable spacing then Garex Ltd, amongst others, can sell you suitable filters.

Don’t be tempted to buy an AM set hoping to convert it to FM, it just isn’t worthwhile unless you’re a glutton for work. Even if you already have an AM set, I’m afraid it is often cheaper to throw the AM set in the bin. Sorry but that’s how it is!

There may be another number at the end of the equipment code: this shows how many channels the set is capable of being used on, normally 1, 3, 6, or 10. A look inside the covers would be a wise move before purchase though, to see how many crystal positions are available on the printed circuit boards (two needed per channel).

**Boot and Dash Mounts**

The circuitry used in the equipment is virtually the same in dash and boot mounts, the difference being only in the control. A multiway connector on the boot mount connects to an ‘umbilical’ cable terminated in a small box with the controls; two models of control box have been made with identical circuitry. Do, however, make sure you get a box and cable if you buy a boot mount set: often installers remove the sets from cars along with the control box, but leave the cable due to difficulties of removal, so don’t get caught out! Don’t worry too much if neither microphone nor speaker come with the set, any 3 to 8 ohm speaker and 500 to 2000 ohm dynamic microphone will work, although the originals will usually give the best performance. The microphone plug usually is a five-pin 270 degree DIN, commonly available, although some dash mount models have the mic cable permanently wired in. Fig.1 shows the connection format.

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Table 1 The different Westminster frequency ranges.

<table>
<thead>
<tr>
<th>FREQUENCY</th>
<th>DESIGNATION MOD</th>
<th>MOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>32.5 MHz-40 MHz</td>
<td>H Band FM</td>
<td>Remote</td>
</tr>
<tr>
<td>40 MHz-50 MHz</td>
<td>G Band FM</td>
<td>Remote</td>
</tr>
<tr>
<td>68 MHz-88 MHz</td>
<td>E Band AM/FM</td>
<td>Remote</td>
</tr>
<tr>
<td>132 MHz-156 MHz</td>
<td>B Band AM/FM</td>
<td>Dash/Remote</td>
</tr>
<tr>
<td>148 MHz-174 MHz</td>
<td>A Band AM/FM</td>
<td>Dash Remote</td>
</tr>
<tr>
<td>405 MHz-440 MHz</td>
<td>T Band FM</td>
<td>Remote</td>
</tr>
<tr>
<td>440 MHz-470 MHz</td>
<td>U Band FM</td>
<td>Remote</td>
</tr>
</tbody>
</table>

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Garex Ltd, amongst others, can sell you suitable filters.
The power lead with the plug is also sometimes missing, and many amateurs have tried in vain to wire one up without the correct information. Fig. 2 reveals all! I would advise fitting a five amp fuse in line.

**Getting It Going**

First obtain some crystals for your desired channel, whether this be the local repeater, club net, or channel used by Raynet. The frequencies needed are given by the formulae below.

Both crystals are HC6/U size and types suitable for common frequencies are available ex-stock from PM Electronic Services and Quartzlab, although any reputable crystal firm will no doubt be pleased to supply to order.

**Transmitter Alignment**

Don't be put off by amateurs saying "you need stacks of test gear to get it going". With my first Westminster I had QSO's after 20 minutes using a cheap multimeter and an even cheaper power meter, followed by the help of other amateurs on the local repeater. A frequency meter helps a lot, though, but most amateurs who don't own one can bribe, cajole, or otherwise con someone into lending them one!

Start by plugging the crystal in, applying 13.8V DC supply, and terminate the aerial connection into a load (preferably non-radiating!) via a power meter if you have one. Connect the multimeter negative to power supply negative, and set it to a voltage range of 10V or thereabouts. Find yourself a matchstick, old knitting needle, or similar non-metallic object and file the end down to give a tuning adjustment tool for the ferrite cores in your set.

Referring to Fig. 3, key the PTT, and connect meter +ve to board 12 TP1 and tune L1 and L2 for maximum, returning as required to give absolute maximum, then tune L3 for minimum reading. Transfer the meter +ve to TP2 and tune L4 and then L3 for maximum, then L5 for minimum. Simple isn't it? Transfer to TP3 and tune L6 and then L5 for maximum, then L7 for minimum. Connect to TP4 and tune L8 then L7 for maximum, then L9 for minimum.

Next use this driver board as a low-power transmitter by disconnecting the coax we removed, and twiddling the PA on the other side of the chassis. Transfer the multimeter +ve to TP1 on the PA board, and tune C1 and C2 for maximum. You may need a different-shaped trimming tool here, as these trimmers have screwdriver-sized slots in them. Then transfer to TP2 and tune C6 and C7 for maximum; transfer again to TP3 and tune C11 and C12, again for maximum. By now, you should experience that magical feeling when you see your in-line RF power meter rising, showing that you're in business. Tune C17 and C18 for maximum 'smoke' into the 50 ohm load, and if you're aligning a 2m set then it's safe to go back and tune the remaining trimmers on the PA for absolute maximum. If it's a 4m set, then leave the others alone, you should be getting plenty of power, in the order of 12-18W in each case.

A frequency meter or local amateur with a centre-zero meter on his receiver can help in setting your exact frequency: the adjuster is the small ceramic capacitor next to the appropriate crystal. The deviation should already be set to some level that will make you heard, but you will no doubt need...
Receiver Alignment

Again, a multimeter is useful here, as it is a strong local signal on the band. First of all, plug the aerial in and connect speaker and 13.8V DC. Because the receiver switching bandwidth is less than that of the transmitter, it would be useful to tune the receiver on the channel nearest the centre of your desired operational frequency range, although this is only important if you need to operate on, for example, a repeater as well as a frequency on the lower part of the band. Connect the multimeter negative to the negative supply line, and positive to board 5 TP1. On the centre channel, tune L1 and L3 for maximum, then transfer to TP2, and tune L4 for maximum, returning L1, L3, and L4 for absolute maximum on TP2.

Turn the set over and align the front end for literally the best received signal. This may take the form of a local signal with variation of the other station's power, variation of both transmitter and your aerials in type and beam handling, and so on. Those lucky enough to have access to a signal generator will of course not need me to tell them how to use it!

An initial tuning aid is TP1 on board 3; tune all coils on the front end board (board 1) for maximum voltage on TP1, reducing the received signal as necessary to keep the reading at around 0.7V. Final tuning is carried out on a weak signal, tuning L1, L3, L1, L4, T2 and L5 on board 1 for best quieting. If the set has been used in service before, then the IF and squelch circuitry will have been aligned and I would recommend that you leave well alone. Misalignment of these on the "twiddle everything you see until you can hear something mate" principle can cause a lot of headaches later on unless you have access to IF generators and the like.

Netting the receiver onto frequency may initially be done by tuning the coil adjacent to the respective crystal for best (least distorted) reception. A more accurate check may be performed by connecting your multimeter to board 3 TP3, and tuning for zero voltage. The more enthusiastic amongst us may even fit a centre-zero meter to this point if desired.

And that's it, piece of cake! Typical receiver sensitivity is in the order of 0.35μV for 12 dB SINAD, possibly a little deaf by today's standards but certainly useful for most operation with local signals. The sensitivity may be improved by fitting a simple preamp, and I can recommend the Timestep Electronics BF981 job which is very reasonably priced indeed. Alternatively by replacing TR3 and TRS (2N3819's) on the front end board with J310 transistors, and varying the values of R6 and R14 (120R originally) for 10mA current through them to suit, a useful improvement may be obtained.

I hope this article has proved useful in identifying a possible solution as to what to do for a cheap, useful mobile or base monitor rig. Next month the series continues with a look at the UHF Westminster, and how to considerably ease problems by getting the correct crystals.

Useful Addresses:
Garex Electronics Ltd, 7 Norvic Road, Mansworth, Tring, Herts HP23 4LS (0296 668684)
PM Electronics Services, Alexander Drive, Wirral, Wirral, Merseyside L61 6XT (051 342 4443)
Quartzlab Marketing Ltd, PO Box 19, Erith, Kent DA8 1LH (01 318 4419)

HAM RADIO TODAY MARCH 1986
In offering his customary reminiscent lookback over the year just closed (HRT, January 86) there was “a very important tailpiece”. He was referring to a significant event which had occurred in metre wave history which all amateur radio media apart from HRT seemed to have overlooked, namely that the concept of the class B licence came of age in 1985.

The class B licence came of age in 1985. Its 21 years have seen some considerable changes as Jack Hum, G5UM, explains.

21 years of a special VHF only licence! To those who recall its advent in 1964 “it seems only yesterday”. To those who accept the class B ticket as the perfectly normal, almost routine means of entering amateur radio it is hard to realise that when the licence was envisaged, it was regarded as something rather special.

21 years ago, the black box era with its concomitant Japanese invasion was very much in the future. If you needed equipment to get going on metrewave you built it yourself. What you constructed was likely to be a transmitter to give you telegraphy plus AM telephony with a companion converter feeding the station receiver at an appropriate IF. Single sideband was an esoteric art mastered only by the more technical enthusiasts enjoying access to adequate test equipment to make it function. To everyone else VHF amateur radio consisted of pump handle morse and AM phone.

The do-it-yourself ethic so widespread among the VHF and UHF fraternity brought with it a tremendous amount of experimentation and learning by doing. Probably more was done in the ‘50s and ‘60s to lay the foundations of metre wave amateur radio than at any other period. Certainly repeaters and that oriental “invasion” were many years ahead; yet one could maintain that more interest and knowledge were acquired then when you did it yourself than now by simply pressing a Jap mike-switch.

Within this busy ferment of experimentation was a significant corpus of would-be radio amateurs. These enthusiasts felt the compulsory morse test inhibited their experimentally inclined intentions and frustrated their desire to obtain a transmitting licence allowing these intentions to be put into practice. They asked: would it not be possible to institute some form of permit (perhaps VHF only) which would not demand the morse test as a pre requisite?

So was born the idea of a transmitting licence and no morse test, to appeal to applicants prepared to have their activities confined to what was then the 420MHz band and higher frequencies.

Enter the 8 + 3s

Curiously, the class B innovation was announced almost as an afterthought (at least that is how it looked to many of us) to a general review of the terms of the amateur licence which was made in 1964. Nevertheless, it was just what the more technically minded were looking for. With it came a brand new callsign block: G8-plus-three-letters. Until then a G8 had always worn two letters after the numeral, indicating a licence issued in the mid-1930s. Now the metre wave scene would need to adjust itself to a new callsign sound.

None of this happened just for the asking or by sitting back waiting for something to happen. It was the product of much patient case-making and in particular of the part played by the then RSGB President, Lord Wallace.

Today there exists, in some circles, the feeling that a class B licence is in some way inferior to a class A one, and that you graduate to class A status. 21 years ago, there was no such feeling: to hold the class B ticket meant that you were a technically knowledgeable person truly conversant with the then
difficult and intractable ‘ultra highs’. If you weren’t you didn’t make them work.

If anyone at that time had dared suggest that a class B licensee was a lesser mortal than a class A one, he would probably have received the polite rejoinder that in electronics terms a class B system is significantly more efficient than a class A one! At its outset the class B licence had an aura of technical exclusiveness — almost elitism — about it. Class A people would consult class B people about such things as the mysteries of the ultra highs, or how the then new fangled UHF transistors could be persuaded to produce results.

Because the early class B licensee was confined to the then difficult frequency spectrum of 420MHz and up, the take-up in his numbers was slow. But a dramatic change was about to happen: on March 11 1968, the Government announced that 144-146MHz would be released for class B use.

At that time, the callsign sequence had reached about half way into the G8B-series, which, allowing for about 620 callsigns per block probably fewer than a thousand class B stations were operational when the 2m band was released. Liberalising the B licence brought an almost 50% increase in its numbers in the following year, and by 1970 the annual increase had overtaken that of class A applicants.

This trend continued into the succeeding years, until by 1979 the callsign block had reached the G8P-series, which at 620 callsigns per block could have represented almost 11000 class B licences. In fact that many class B people had taken the morse test and transferred to class A and hundreds had given up amateur radio altogether — two phenomena which have continued to the present day.

A count of any callbook of the 1970s shows that well over 7000 class B licences were extant at the end of the decade.

The CB Impact

By now Citizen’s Band operation was beginning to spread throughout Britain. The development at first had little impact on the practising radio amateur except to make him rather cross when the lay press, always ready to seize on a hot new story like CB, confused them!

But in another respect CB did exert a significant effect on the amateur radio movement. It brought thousands of communication experienced operators keen to pursue their interest more widely than was possible in the CB context. And so, as CB licences diminished in numbers, the ‘80s unfolded, amateur licences increased. Most of them were class B, for this was the type of licence which CB operators found most to their liking, and to accord with their previous experience.

A big moment early in 1984 was when the class B total exceeded that of class A. Whether or not this trend will continue is conjectural: official figures issued in October 1985, disclosed that there were 27900 class A licences in force and 27780 class B, a slight reversal of the trend. Could it be that the peak of CB influx has been reached and passed? As the number of CB licences in Britain declines so may the number of people transferring from that genre.

Even so, any observer taking a retrospective look back over the last 21 years from today’s vantage point must marvel at the way British amateur transmitting stations have multiplied five fold in numbers — from a bare 12000 then to nearly 60000 now. If this trend continues, there will be 120000 of us at the end of the next 21 years which will mean levels of QRM literally unheard of today. It will be interesting for an HRT reader of the year 2007 to look back to 1986 to see if these prognostications have by then come true!
Your at-a-glance guide to what's happening around the clubs, on the air and in general radio-wise.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>3 Feb</td>
<td>Borehamwood and Elstree ARC: meeting.</td>
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<td></td>
<td>Basingstoke ARC: Wood and Douglas equipment at the Forest Ring Community Centre, Sycamore Way, Winklebury.</td>
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<td></td>
<td>Southdown ARS: meeting.</td>
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<td></td>
<td>Todmorden DARS: AGM.</td>
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<td></td>
<td>S Tyneside ARS: meets every Monday at the Martec Club in S Shields.</td>
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<td></td>
<td>Braintree DARS: meeting.</td>
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<td></td>
<td>Worcester DARC: talk by G3POR.</td>
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<td></td>
<td>Morecambe Bay ARS: Wood and Douglas Kits by G Rouse.</td>
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<tr>
<td>4 Feb</td>
<td>Bury RS: meets every Tuesday at the Mosses Centre, Cecil Street, Bury.</td>
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<td></td>
<td>Stevenage DARS: construction contest.</td>
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<td></td>
<td>Wolverhampton ARS: Transmitter Testing - Frequency, Power, Deviation etc.</td>
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<td></td>
<td>Salisbury RES: meets every Tuesday from 7.30 at the Grosvenor House Centre, Salisbury.</td>
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<td></td>
<td>White Rose ARS: DXpedition to Laccadives (VU7) video.</td>
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<td>5 Feb</td>
<td>S E Kent (YMCA) ARC: natter night.</td>
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<td></td>
<td>Mirfield RC: meets every Wednesday.</td>
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<td></td>
<td>Three Counties ARS: Satellite TV by G8CMQ.</td>
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<td></td>
<td>Glenrothes DARC: meets every Wednesday in the library in Leslie.</td>
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<td></td>
<td>Pontefract DARS: homebrew show.</td>
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<td></td>
<td>Havering DARC: surplus equipment and junk sale.</td>
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<td>6 Feb</td>
<td>Fareham DARC: on air natter night.</td>
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<td></td>
<td>N Wakefield RC: social night.</td>
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<td></td>
<td>Abergavenny and Nevill Hall ARC: meets every Thursday.</td>
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<td></td>
<td>Dunstable Downs RC: AGM.</td>
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<td></td>
<td>Horndean DARC: 2L slide show by G4PWG.</td>
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<td></td>
<td>Horsham ARS: 23cm and Up by G3GRO.</td>
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<tr>
<td>7 Feb</td>
<td>Ayr ARG: On To 6m by G4MNF.</td>
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<tr>
<td></td>
<td>Amateur Radio and Computer Club: meeting at the Crown, Bishops Waltham starting at 8pm.</td>
</tr>
<tr>
<td></td>
<td>S Manchester RC: meets every Friday in the Norris Road Community Centre, sale at 8pm.</td>
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<td></td>
<td>W Kent ARS: surplus equipment sale.</td>
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<td></td>
<td>Braintree DARS: club dinner.</td>
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<td></td>
<td>Maidstone YMCA Sportcentre ARS: Howe Communications display with G4KOH.</td>
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<tr>
<td>9 Feb</td>
<td>Dartford Heath DFC: pre hunt meeting.</td>
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<td></td>
<td>Bury RS:安装HF Station — avoiding the pitfalls by G4JAG.</td>
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<td></td>
<td>Chester DRS: HF Aerials by G3EWZ.</td>
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<td></td>
<td>Workspot ARS: QRP by G6DCT.</td>
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<td></td>
<td>Bromsgrove ARS: Severn Valley Railway.</td>
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<td></td>
<td>White Rose ARS: natter night.</td>
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<td></td>
<td>Farnborough DRS: my favourite piece — an equipment evening by the members.</td>
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<tr>
<td></td>
<td>Havering DARC: informal.</td>
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<tr>
<td></td>
<td>Fareham DARC: project box presentation.</td>
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<td></td>
<td>Conwy Valley RC: Test Equipment by GW3JGA.</td>
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<td></td>
<td>Pontefract DARS: project evening.</td>
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<td></td>
<td>N Wakefield RC: on the air.</td>
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<td></td>
<td>Wimbledon DARS: meeting.</td>
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<td></td>
<td>Nunsfield House CA ARG: surplus sale.</td>
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<td></td>
<td>Clifton ARS: meeting.</td>
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<td></td>
<td>Dunstable Downs RC: Air Traffic Control.</td>
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<td></td>
<td>Glenrothes DARC: meeting.</td>
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<td></td>
<td>Todmorden DARS: informal chat night.</td>
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<tr>
<td></td>
<td>Braintree DARS: BNOS equipment display with G8UYV and G6FGE.</td>
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<tr>
<td></td>
<td>Morecambe Bay ARS: film show.</td>
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<tr>
<td></td>
<td>Rugby ATS: talk by RIS.</td>
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<tr>
<td>10 Feb</td>
<td>Atherstone ARC: Radio Expedition to the Aland Island by G4IWA and G8SYE in the Physics Lab, Atherstone Upper School, Long Street, Atherstone starting at 7.30pm.</td>
</tr>
<tr>
<td></td>
<td>Milton Keynes DARS: Modern Multi Screen Cinemas by Mike Murphy at the Meeting Place, Hodge Lea, N Milton Keynes, starting at 7.30pm.</td>
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<tr>
<td></td>
<td>Bury RS: Installing Your HF Station — avoiding the pitfalls by G4JAG.</td>
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<tr>
<td></td>
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<td>Midland ARS: meeting.</td>
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<td>Stevenage DARS: junk sale.</td>
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<td></td>
<td>Wolverhampton ARS: discussion night.</td>
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<td></td>
<td>AGM at the new venue of The Wellington in Theobald Street, Borehamwood.</td>
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<td></td>
<td>Chester DRS: Demonstration of Microwave Modules equipment by G3VYB.</td>
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<tr>
<td></td>
<td>White Rose ARS: surprise night.</td>
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<td></td>
<td>Three Counties ARS:Steam Railways by G32RM.</td>
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<td></td>
<td>BT Reading RC: meeting.</td>
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<td></td>
<td>Havering DARC: Contest Operating — demonstration and talk.</td>
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<tr>
<td></td>
<td>Worcester DARC: informal.</td>
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<tr>
<td></td>
<td>Fareham DARC: on the air natter night.</td>
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<tr>
<td></td>
<td>N Wakefield RC: coach visit to Jorvik Museum at York.</td>
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<tr>
<td></td>
<td>Pontefract DARS: Antennas by G3HCW.</td>
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</tbody>
</table>

HAM RADIO TODAY MARCH 1986 please mention HRT when replying to advertisements. 73 G4NXV
21 Feb
Ayr ARG: ZS Radio by ZS6CBF.
Nunsfield House CA ARG: technical film show.
Clifton ARS: video evening.
W Kent ARS: Introduction to Contesting by Dave, G4BUO.
Maidstone YMCA Sportscenecte ARS: Paint Spraying by G3 REM.

23 Feb
Cambridgeshire Repeater Group junk sale extravaganza at Pye Telecoms, St Andrews Road, Cambridge starting at 10.30. Many traders and the monster junk sale, bring and buy auction. Bargains guaranteed! Free parking, refreshments available with admission 50p. Talkin on S22.

24 Feb
Atherstone ARC: club night/night on the air.
Wolverhampton ARS: night on the air.
Chester DRS: meeting.
Bromsgrove ARS: club night.

25 Feb
White Rose ARS: natter night.
Farnborough DRS: open evening for RAE and CW students
Havering DARC: pre contest briefing and informal.
Fareham DARC: Component Types by G4ITF.
Workshop ARS: Mystery Lecture night by G3ZVG.

26 Feb
N Wakefield RC: meeting.
Pontefract DARS: meeting.
Basingstoke ARC: RSGB film show.
Braintree DARS: meeting.

27 Feb
Doncaster Amateur Radio Rally at Aldwick Leisure Centre, Welfare Road, Woodlands, Doncaster. Admission 50p and doors open at 11am. Many trade stands, bring and buy and refreshments. Further details G8XUT.

3 Mar
Borehamwood and Elstree ARC: meeting.
Basingstoke ARC: RSGB film show.
Braintree DARS: meeting.
Worcester DARC: meeting.

4 Mar
Dartford Heath DFC: pre hunt meeting.
Stevenage DARS: Receiver Alignment — bring your own receivers.
Wolverhampton ARS: Antennas and Feeders by G8 MWR.

5 Mar
White Rose ARS: construction contest.
Milton Keynes TV visit.

6 Mar
N Wakefield RC: social night.
Horndean DARC: Hilsea Lions by G4 DTU.
Pontefract DARS: natter night.
Horsham ARC: grand spring junk sale.
Ayr ARG: Repeater Mystique by GM4 COX.
S Manchester RC: meets every Friday in the Norris Road Community Centre. Sale at 8 pm.
W Kent ARC: meeting.
Clifton ARS: Bus Location.
Maidstone YMCA Sportscenecte ARS: Morse by G3ORH.
Hastings and Southdown clubs: social.
Basingstoke ARC: Library exhibition special event GB4BLE.

7 Mar
Cambridge ARC: video evening.
W Kent ARS: Contesting by Dave, G4BUO.

8 Mar
Hastings and Southdown clubs: social.
Basingstoke ARC: Library exhibition special event GB4BLE.

9 Mar
Wolverhampton ARS: natter night.
Farnborough DRS: club operation evening.

10 Mar
Fareham DARC: Update on 6m by G4JCC.

11 Mar
N Wakefield RC: social night.
Horndean DARC: Hilsea Lions by G4 DTU.
Pontefract DARS: natter night.
Horsham ARC: grand spring junk sale.
Ayr ARG: Repeater Mystique by GM4 COX.
S Manchester RC: meets every Friday in the Norris Road Community Centre. Sale at 8 pm.
W Kent ARC: meeting.
Clifton ARS: Bus Location.
Maidstone YMCA Sportscenecte ARS: Morse by G3ORH.
Hastings and Southdown clubs: social.
Basingstoke ARC: Library exhibition special event GB4BLE.

12 Mar
Fareham DARC: Component Types by G4ITF.
Workshop ARS: Mystery Lecture night by G3ZVG.

13 Mar
Conwy Valley RC: judging the club construction projects.
N Wakefield RC: visit to Skelton Grange power station.
Pontefract DARS: final arrangements for annual components fair.
Milton Keynes DARS: second hand equipment sale.
Clifton ARS: club meeting.
S Essex ARS First Mobile Rally at the Paddocks Community Centre, Canvey Island.
Contact G4 FMK on 0268 683805.
Pontefract DARS: Annual Components Fair at the Carlton Community Centre, Carlton.
Larger than ever this year! Details from G4ISU 0977 792784.

14 Mar
Wimbledon DARS: meeting.

15 Mar
Borehamwood and Elstree ARC: meeting.
Basingstoke ARC: RSGB film show.
Braintree DARS: meeting.
Worcester DARC: meeting.

16 Mar
Dartford Heath DFC: pre hunt meeting.
Stevenage DARS: Receiver Alignment — bring your own receivers.
Wolverhampton ARS: Antennas and Feeders by G8 MWR.

17 Mar
Stevenage DARS: AGM.
Borehamwood and Elstree ARC: informal constructors night.
Wolverhampton ARS: RTTY on the Cheap.
White Rose ARS: rally briefing.

18 Mar
Midland ARC: meeting.

19 Mar
Three Counties ARC: The Case of 'F' Units by G3UUU.
20 Mar
Worcester DAR: informal.
Fareham DAR: on the air natter night.
N Wakefield RC: Construction by George Dobbs at the Pontefract club.
Greater Peterborough ARC: Simple Aerials by G400.

21 Mar
Ayr ARG: bring and buy sale.
W Kent ARS: meeting.
Clifton ARS: Cellular Radio.
Maidstone YMCA Sportscentre ARS: junk sale.

23 Mar
White Rose Rally
Mid Devon Rally in the Panier Market Hall, Tiverton from 10 am till 5pm. Further details from G6ZMC on 0884 254889.

Contacts

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<tr>
<td>Aberavon &amp; NH ARS</td>
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24 Mar
Atherstone ARC: Satellites by G4ROA.
Bromsgrove ARS: club night.
Wolverhampton ARS: night on the air.

26 Mar
White Rose ARS: natter night.
Farnborough DRS: Fundraising Silly Sale with G4SKG.

27 Mar
N Wakefield RC: meeting.

28 Mar
Clifton ARS: meeting.

Will club secretaries please note that the deadline for the May segment of Radio Tomorrow (covering radio activities from 1st April to 1st July) is 24th February 1986.
A 'mega' review of the TS940S — the 'mega' base station rig. Chris Lorek, G4HCL, assesses its performance in real terms and gives a few pertinent figures to please the 'boffins'.

In most people's lives, we have 'dreams' of having a bit of luxury. For some amateurs, this is ownership of a 'top of the range' rig and the Trio TS940S is certainly a major contender. The advertising says it is "a competition class HF transceiver having every conceivable feature" coupled with many staggering claims for performance — in figures meaning little to most amateurs. But does it work as well, and how does it compare to your present rig? Is it worth selling up present gear and buying one?

Bells and Whistles

The front panel is rather daunting at first, as you can see from the photo nearby. In fact, it took me a few moments to find the on/off switch, and that was after I had spent a few hours reading the instructions! The layout of the controls soon became familiar with use.

Modes of operation are USB, LSB, CW, AM, FM and FSK (RTTY), with provision for full break-in on CW. General coverage receive over 150kHz to 30MHz is specified, coupled with amateur bands transmit facility. The receiver actually covers down to 30kHz.

Frequencies may be entered either by direct key input, by 1MHz up/down controls, or by one touch amateur band selection buttons. The main tuning knob rotates at 10kHz per rev on SSB/CW and 100kHz/rev on AM/FM. When you spin it quickly the step size increases to give a rapid QSY. Two displays are provided: the main frequency is given by a blue-green fluorescent display supplemented by a quasi-analogue sub scale with red pointer; and a separate dot-matrix LCD gives graphical information of filter bandwidth, shows memory and VFO frequency, auto ATU operation, and can even give you the time!

It has forty memories in four blocks of ten, each capable of storing frequency and mode plus facilities for scanning programmed memories or frequencies in between them. The independent VFOs have provision for split operation in normal and reverse modes, frequency lock and instant entering of VFO to memory (and back again) — giving instant QSY from memory. RIT and XIT functions use a multiturn optical encoder giving up to +/- 9.99kHz offset, with the main frequency display showing the actual frequency in use together with the offset indicated separately.

The usual SSB speech processor is separately adjustable for both output and input clipping levels and both audio peak and IF notch filters are fitted. The upper and lower filter slope positions when in SSB mode can be adjusted by two concentric knobs and a VBT control narrows down the bandwidth if required on CW and AM. Two noise blankers are offered: NB1 which is suitable for short duration pulses and continuously variable in blanking threshold; and NB2 suitable for longer duration pulses such as the 'woodpecker'. AGC is switchable between fast, slow and off and an RF attenuator gives up to 30dB in 10dB steps.

An all-mode squelch is incorporated, as well as all-mode power control. A CW 'pitch' control allows you to set the received CW tone to your preference whilst keeping your transmit frequency constant. The meter indicates signal strength on receive; together with selectable compression level, ALC, power, SWR (automatic), PA collector current, or PA collector voltage on transmit. An audio monitor facility is provided for listening to your transmitted audio. An optional aerial tuning unit may be fitted and operated via a front panel button.

On the top cover of the set, a sliding panel reveals slider controls for AM carrier level, FM mic gain, VOX preset controls, memory bank...
and display resolution selection, and calibrator on/off. And round to the rear panel... (phew!). There are numerous sockets for main and external receiver aerials, IF output, transverter, morse key, FSK input, extension speaker, accessories such as computer interface and so on. Two fans are fitted, for the PA and power supply, switching on as needed.

Now, where was that on/off switch?

**Get Your Gimmicks Here!**

A timer is provided if you wish to use the set to wake up to Terry Wogan, Radio Moscow or The Lower Plodding Chipbury Woodpecker Breeding Net. Examination of the ‘remote’ connector however shows a timer switch which may be used to switch on a tape recorder if you wish and this may be useful if you are an avid broadcast listener.

When an operating mode selector button is pressed, a morse character, the first letter of the selected mode, is emitted at a preset level via the internal speaker. You can only vary the level by a preset control — it is not affected by the main volume control, an annoyance to me. A blind operator would have to either turn the volume to minimum each time he changed mode, or set the level to an extremely loud volume to easily use this facility.

A dimmer switch is even provided so you don’t hurt your eyes with the display and meter lights at night.

**One or Two Grumbles**

"Every conceivable feature" the ads say — rather a spectacular statement I think! There are few things it doesn't have. Before even switching the TS940S on, I thought it would have been nice to have a centre-zero 'S' meter and selectable Tx/Rx split as a keen 10m FM operator. Although the full CW break-in facility suggests suitability for AMTOR operation, it is let down badly in this mode — and standard RTTY — due to the IF filtering for FSK mode being centred on tone frequencies of 2125Hz mark and 2295Hz space — the American standard. This means that unless you have switchable mark and space tone frequencies on your terminal unit you can only operate the TS940 in SSB mode and have to put up with greater adjacent channel interference than with a dedicated filter with good shape factor.

I couldn’t find much else to grumble about though, which is very unusual for me!

**Design and Construction**

For those interested, the block diagram is shown in Fig.1. A high first IF frees the operator of preselector controls — switched bandpass filters being used for differing frequency ranges. This also affords good immunity to image
The PCB for the transmitter power amplifier inside the back panel of the TS940S.

The supplied instruction manual is well written and has a two-page section on operation in each mode, which is particularly easy to follow. There is a three page section on ‘Maintenance and Adjustment’ which includes a few simple user adjustments, but very little electronic fault finding information, unfortunately. Mention is made of the two backup batteries, one for memory backup (5 years life) and one for the timer (3 years life) but no information is given on replacement. This, I feel, is a serious omission which then requires the average user to send the rig to the dealer for this to be done.

A ‘Technical Information’ manual is available, giving a very comprehensive guide to the technical design of the equipment. I enjoyed reading it very much indeed, despite the odd Japanese-English literal translation such as ‘The chassis is a box-bending structure’!

At the time of review, a Service Manual was not available for purchase, but would be available ‘in due course’.

Why Doesn’t It Work?

Connect it up, switch it on (after finding the right switch), set it to 80m, why can’t I hear anything? Spend half an hour reading the setting up instructions again. Recheck everything, all ok, still transmits but no receive...I found it received at 14MHz but cut off drastically above 20.9999MHz...

...Minor relief! After giving the suppliers a call I dived in with my test leads and signal generator. Logical reasoning showed the problem to lie with the switched band-pass filters, the set being about 70dB deaf on other frequencies. A faulty internal connection was quickly found and repaired, rendering normal operation. So I heaved a sigh of relief and had a cuppa.

In Operation

Although only on loan for a few weeks, the set was tested on air for over 60 hours. This simulated around two months of ‘average’ operation — if there is such a thing — on a variety of aerials embracing a long wire, an 80m trap dipole, a ground mounted HF5V trap vertical and a three element TA33jnr on top of

responses. The RF amp uses 2SK125 J-FETs in a cascode amplifier followed by two 2SK125’s each in the first balanced mixer and buffer amplifier. This offers the possibility of good dynamic range specified at 102dB IMD for 20m, 50kHz spacing, 500Hz CW bandwidth, for the technical boffins, but see later.

The transmitter PA shown in the photo nearby is a broadband ferrite coupled design and uses a pair of Motorola MRF-422 transistors in the final stage. These operate in push-pull mode at 28V to give good linearity and hence a clean signal with low distortion and ‘splatter’. It is interesting to note that Japanese transistors are not used here. Examination of the manufacturer’s data on these transistors shows them to be run well within their ratings of 290W dissipation and 100W output power each. Temperature and VSWR monitoring circuits guard against destruction through operator misuse or the odd accident. Trio claim about one hour of constant transmission is possible at full power before the PA starts shutting down automatically.

A multi-loop synthesiser generates the required mixing frequencies in the set, controlled by microprocessor. This also controls many other functions such as memory storage and retrieval. And here’s the catch: a synthesiser driving a Voltage Controller Oscillator (VCO) often introduces an effect known as ‘reciprocal mixing’. Noise on the VCO tuning lines modulates the oscillator over a wide frequency range causing poor dynamic range and selectivity, no matter how well the filters and front end have been designed and built. It is this problem that I will be concentrating on in this review, as no matter how good the figures look, you can’t work ‘em if you can’t hear ‘em!

The mechanical construction comprises a die-cast front panel and sheet metal chassis, housing standard printed circuit boards with discrete components, interconnected by multitudes of plugs and sockets with flying leads. This makes user fault finding in situ very easy. The rear heatsink is an integral part of the ducted cooling system, which makes very little noise when the fans come into operation.

Opening The Box

After almost doing my back in carrying it to the shack — the TS940S weighs nearly half a hundredweight — the set was unpacked with some assistance. Lowe Electronics had thoughtfully provided a mains lead fitted with the correct British 13A plug. Other supplied accessories comprised 13 and 7 pin DIN plugs, a spare fuse, and the instruction manual and warranty card, but unfortunately no microphone. If I had not asked for one when collecting the rig I would have been rather disappointed on having to make a further journey. The TS940S has adjustable front feet so that you can adjust the front panel to the tilt required — a nice touch.

Major relief! After giving the
On listening around the bands, my immediate thought was what a pleasure it was to operate, all controls falling to hand so easily. Good ergonomic design the boffins call it. Tuning was an absolute pleasure, the 10Hz steps of the synthesiser acting virtually like a continuous VFO. After about 15 minutes the power supply fan came on, which was very quiet, this continues to operate even when you switch the set off until the temperature reduces to the required level.

The memories were a delight to use. On tuning around interesting frequencies were quickly programmed in, which saved much note-taking and retuning time once band conditions and activity were ‘sussed out’. As four separate banks of ten memories were available I used one bank for day to day use; one for interesting RTTY frequencies on general coverage, one for broadcast stations of interest; and the last for 10m international beacons which were automatically scanned when I was otherwise occupied in the shack (not very often when I had the '940 within reach). Very little CB breakthrough was noted on the latter, even though there are three operators within sight.

In communication, audio reports were very complimentary indeed. Every amateur — even the ‘old boys’ preferred the processor to be switched in, as this improved readability with absolutely no reported degradation in quality. Although I am used to having a variable IF bandwidth, the graphic display was useful in showing exactly what was happening and this was my chosen display much of the time.

The CW pitch control shifts the fourth IF passband in the demodulator while at the same time raising or lowering the received pitch. I found this absolutely superb as I much prefer a lower CW pitch of around 550Hz, which has meant in the past having my RIT or XIT preset slightly off frequency to achieve accurate netting and a pleasing tone at the end. On the TS940, CW netting is very accurate using the monitor function, rather than trying to guess the correct beat frequency and possibly missing that rare DX in the pile-up. Although not used in QSO, the full break-in was tested and coped right past 30 wpm.

The noise blanker performed admirably and reduced the S9 + 20dB 160m Sunday dinner-time noise down to S2, making signals which were previously drowned perfectly readable. Try as I might, I could not find a ‘woodpecker’ to test NB2, but laboratory simulation using a pulse generator showed this to be equally effective. There is a noise blanker threshold control, enabling you to set the level only to the level needed, I found that the expected signal degradation only occurred when I set the level in excess of the ‘7’ position. The attenuator was never needed, at least it didn’t make any difference to readability, even on 40m at night.

An optional voice synthesiser module, giving a frequency indication, is also available but was not tested. This would be extremely useful to those with falling or no sight.

**Grumblings**

I found the notch filter to be superb in cutting out QRM, although it did affect the received quality especially when the SSB bandwidth was narrowed down. This made it quicker to use as it was easier to ‘home in’ on an unwanted CW signal; but I would have preferred a sharper response like the one shown on the publicity leaflet.

The CW Variable Bandwidth Tuning (IVBT) narrowed the pass-band down, but the slope was not as sharp as I would have liked, with adjacent channel signals still being audible and in some cases overpowering. This is of course a compromise using the existing filters. So I went cap in hand back to the suppliers and asked in my usual cheeky manner whether I could also be trusted with the £130 worth of optional 8.83MHz and 455kHz CW filters to try.

What an improvement! I would recommend the serious CW addict to put his hand deeper into his pocket for them, since the VBT seems to be only a compromise. As previously stated, these filters are unfortunately useless for RTTY/AMTOR unless you have the appropriate terminal unit. The optional AM filter was also loaned at the time and tested.

I found the receiver sensitivity a little lacking for 10m FM use, and the ‘S’ meter appeared a little mean on weak stations, with fully readable FM signals not even moving the needle. The recovered audio and receive bandwidth was perfect though for this use. Unfortunately the 10Hz tuning steps were audible in this mode when tuning across a fully quieting signal, producing a ‘raspberry’ noise in the background.

My shack is a brick outbuilding, one of the advantages of which is that it puts me nearer to the aerials, especially important on UHF/SHF. Unfortunately, the 940 did not like my ground mounted vertical being only 4m away. When transmitting on 10m FM (ie constant power) at an output level of greater than 30W using the first microphone, the PTT ground line sensed the power and did not allow me to dekey. This was also noted on 12m and 15m but not other bands. Fitting a 1000pF capacitor between Tx key ground line and the mic ground line effected a cure. No problems were
found with RF getting in on the SSB audio line.

Finally, I was looking for it and I found it, the dreaded reciprocal mixing. An amateur in the next village, his tribander in line of sight with mine, provided an excellent test often without him realising it (thanks Richard), as well as other strong HF signals. When receiving a weak signal in the vicinity — say within 10kHz — of a stronger signal, the received noise level varied in sympathy with the stronger station, sometimes masking it completely. This can be distinguished from blocking due to the presence rather than absence of noise when it happens. An S9+ signal caused problems to an S3 signal 5kHz away which should not have happened if the specifications are to be believed. Adding RX attenuation only has the effect of reducing all the signals and not improving the problem.

Modifications

This problem is not unknown to the importers. John Thorpe of Lowe Electronics has devised a modification to the set involving addition of a small sub-board (see the photo nearby) which has low pass filters fitted and some other component changes, resulting in a reduction on the VCO tuning line noise floor. This may be fitted as an option by Lowe, together with an improved AM detector and AM filter, for a current price of £98.50 plus carriage. Is it worth the extra I asked myself? There’s only one way to find out!

A local amateur very kindly trusted me with the loan of his brand new modified TS940S (mad fool!), so that I could test the sets side by side. Thank you Derek, I hope it still works. The set was also fitted with the optional ATU giving a chance to test that as well.

Improved Performance

The modified TS940 was air tested with little difference except under very heavy QRM conditions. The general background noise level was reduced, making DX chasing a little better and substantially reducing the tell-tale ‘popping’ noise when close in to illegal broadcasters on 40m.

The automatic ATU, which is fitted inside the TS940 chassis, was tried and gave me much pleasure. The specifications say it will match in SWR’s of up to 3:1 — big deal it doesn’t take long to do that with a manual ATU. However I found it would match almost anything, including my narrow band HF5V over all of 80m. To see what it did when it would not find a match, I set the rig to 1.930MHz, pressed the auto ATU button and to my utter amazement it matched the HF5V system on that! What more can I say!

Laboratory Tests

The receiver selectivity and dynamic range was tested using low-noise cavity tuned Hewlett Packard 8640B signal generators and a hybrid combiner, to ensure I was measuring the performance of the set rather than the generators. Selectivity tests were performed and showed a large skirt spread in the unmodified set because of reciprocal mixing, extending to a bandwidth of 79.5kHz at -100dB in SSB mode. To check the validity of my measurements, I inserted a narrow bandwidth 8-pole crystal filter, matched to 50 ohms in/out, at 21.4MHz in the RF path from the signal generator with virtually the same results. This is very bad indeed and not what I would expect from such a costly set.

Many hours were spent testing and re-testing the selectivity offered in various modes, which are shown graphically. Here we can see the action of the noisy oscillator in the unmodified set against the vastly improved performance in skirt selectivity of the modified set, showing a remarkable improvement of over 20dB in low level skirt selectivity.

The receiver sensitivity figures confirm my on air tests of poor sensitivity on 10m. The S meter tests also confirmed my belief that the meter was slow in moving off the bottom, although above S3 the linearity is excellent. The S9 sensitivity falls reasonably close to the IARU standard of 50uV p.d. The aerial connection was terminated into 50 ohms and the receiver carelfuly tuned over the entire range to test for spurious signals. All were less than the equivalent of 1uV p.d. with the exception of 10.000MHz which has 2.1uV. This may possibly cause problems with WWV reception in Europe.

The intermodulation and blocking immunity was then checked. This test simulates
reception of a weak signal amongst much stronger nearby signals. On the unmodified set, reciprocal mixing was the main problem within 50kHz, further away there was no difference between the two with both measuring very well indeed. IMD was tested as the ratio of increase required of two interfering signals to give a 12dB SINAD signal on frequency. Blocking was tested as the ratio of increase in level of an unmodulated interfering signal to cause 6dB degradation to a 12dB SINAD signal on frequency. Both test figures of interfering signals were referenced to the level required to give 12dB SINAD on frequency.

In real terms this means that if you were trying to receive a just readable signal on 40m in the absence of interference, a broadcaster 50kHz away would need to be around S9 + 45dB to cause you problems. More importantly, two broadcasters 50kHz and 100kHz away would need to be S9 + 35dB to totally carve you up. Remember, this is for a just readable signal, stronger signals would require stronger interfering signals.

Despite the impeccable performance, I could not substantiate the Trio claim of 102dB IMD and 200kHz blocking figure of 139dB. This ties in with the test results in Tony Bailey’s review of the TS930S in the July ’83 issue where the claimed and measured performances differed. I believe Trio may be quoting a calculated performance, or measurements of the front end, rather than the rig as a whole. I am not saying the performance is bad, it is extremely good indeed in the modified set, but if the published performance figures are correct then they are beyond the measurement capabilities commonly available to my knowledge. Even the suppliers could not tell me how they were measured. At this high level of standard does it matter anyway?

The transmitter power output was tested on all amateur bands and found to be just less than 100W on the HF bands and slightly less on the LF bands. Two tone SSB PEP output power was measured on a high frequency ‘scope to be within 0.5dB of the maximum FM/CW power noted in each case. AM power was adjustable via the carrier level control, up to this maximum although this would normally be set to a lower level.

Two tone SSB intermodulation distortion – the ‘cleanliness’ of the transmitted signal – was excellent. This was tested firstly without the processor in; at the onset of ALC, at maximum ALC, and way above ALC to simulate the ‘continental’ method of speech clipping, with very similar results. The tests were repeated with the processor in, at varying input and output levels, with no significant degradation to the signal distortion. This is very good performance indeed.

Throughout the extensive Tx tests, the transmitter was keyed for a continuous period of over 70 minutes at full power, with no adverse effects. The auto ATU showed an acceptable loss of 6W at full power when fed into 50 ohms.

The Real Test

An HF DXer friend, Steve G4VJN, was invited over one weekend during an American HF contest. He brought his FT980, the 940’s main rival at the moment. My FT107M together with the two TS940’s and the FT980 were coupled via a four way coax switch to the aerial system. The tribander was beamed stateside and the fun began.

Throughout the tests, I looked for a weak signal close to, or even better between, strong clean signals such as 2kW W’s beaming this way. The general ‘rubbish’ level was noted on each rig as we quickly switched between them, altering bandwidths, RF gain and attenuator levels for best reception in each case. The end result: yes there certainly was a noticeable difference, but with all the weird noises around the shack emanating from the sets I can’t say the difference was vast. Signals on one set were easier to read than on another, but there was not a total absence of QRM on one with total obliteration by QRM on another.

Signals were initially tuned on the modified 940, the other sets adjusted as required, then vice versa with the FT107 and the FT980. The ‘mush’ level and hence readability – caused by reciprocal mixing – was worse on the unmodified TS940, followed by the FT980 (Steve’s admission, not minel), then the FT107, and finally best of all the modified TS940. Looks like a winner, but I repeat there was certainly not a drastic improvement, and crowded band...
conditions were needed to show it up.
We did not notice any difference in AM quality between modified and unmodified sets, with an AM filter fitted to the unmodified unit. I feel this mod is unnecessary unless you are a hi-fi enthusiast and can hear the difference in a few percent distortion in the limited bandwidth, fading, interference, and so on encountered on the bands. We couldn’t tell any difference in use. The AM filter did however make a small improvement to adjacent channel rejection, but deteriorated the quality a little by cutting off audio frequencies above about 3kHz. The good stability of the set coupled with IF notch facility rendered listening using SSB better under QRN conditions than with the AM filter.

Conclusion
Trios have obviously spent a great deal of thought and design time before producing this transceiver. The only thing that lets it down is the poor noise performance of the local oscillator. This is vastly improved by the Lowe Electronics modification and I would certainly recommend this be done. From discussions with John Wilson and John Thorpe of Lowe, they are willing to perform the PLL mod at a reduced price if one does not require the AM modification as well. The latter mod is I feel only necessary if you are using the set to broadcast engineering monitor standards or primarily for general coverage AM reception rather than amateur radio use.
Throughout the extensive on-air testing I grew more fond of this transceiver than any other I have operated. I was sorry to see it go.

I must thank the many amateurs who assisted me with the air reports and tests, especially G4VJN, G3WW, and SP7EWL. My thanks also go to Derek Merry for the loan of the modified TS940, and last but not least to Lowe Electronics for the load of the main review rig and accessories at short notice.

### Laboratory Test Results

#### Receiver

**Sensitivity for 12dB SINAD (in uV p.d.)**

<table>
<thead>
<tr>
<th>Freq. (MHz)</th>
<th>CW/SSB</th>
<th>AM (30% Mod)</th>
<th>FM (3kHz dev)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.400</td>
<td>0.90</td>
<td>1.75</td>
<td>–</td>
</tr>
<tr>
<td>0.500</td>
<td>6.40</td>
<td>21.0</td>
<td>–</td>
</tr>
<tr>
<td>1.0</td>
<td>2.70</td>
<td>11.0</td>
<td>–</td>
</tr>
<tr>
<td>1.8</td>
<td>0.08</td>
<td>0.58</td>
<td>0.22</td>
</tr>
<tr>
<td>3.5</td>
<td>0.10</td>
<td>0.67</td>
<td>0.22</td>
</tr>
<tr>
<td>7.0</td>
<td>0.11</td>
<td>0.69</td>
<td>0.23</td>
</tr>
<tr>
<td>10.05</td>
<td>0.13</td>
<td>0.74</td>
<td>0.25</td>
</tr>
<tr>
<td>14.0</td>
<td>0.145</td>
<td>0.88</td>
<td>0.27</td>
</tr>
<tr>
<td>18.0</td>
<td>0.16</td>
<td>0.91</td>
<td>0.28</td>
</tr>
<tr>
<td>21.0</td>
<td>0.165</td>
<td>0.92</td>
<td>0.28</td>
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<tr>
<td>24.5</td>
<td>0.176</td>
<td>1.00</td>
<td>0.31</td>
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<tr>
<td>28.5</td>
<td>0.19</td>
<td>1.10</td>
<td>0.37</td>
</tr>
<tr>
<td>29.5</td>
<td>0.19</td>
<td>1.10</td>
<td>0.37</td>
</tr>
</tbody>
</table>

**Internally generated spurious**

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>S meter S9 level sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.000MHz, 2.1uV equivalent level;</td>
<td></td>
</tr>
<tr>
<td>Less than 1uV p.d. on 0.224, 0.2653</td>
<td></td>
</tr>
</tbody>
</table>

**S meter S9 level sensitivity**

<table>
<thead>
<tr>
<th>Reading</th>
<th>Signal (uV p.d.)</th>
<th>Ref. S9 (dB)</th>
<th>Rel increase (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S1</td>
<td>2.15</td>
<td>–28.2</td>
<td>–1.4</td>
</tr>
<tr>
<td>S2</td>
<td>2.50</td>
<td>–26.8</td>
<td>–1.1</td>
</tr>
<tr>
<td>S3</td>
<td>2.80</td>
<td>–24.9</td>
<td>–0.9</td>
</tr>
<tr>
<td>S4</td>
<td>4.5±</td>
<td>–21.6</td>
<td>–3.7</td>
</tr>
<tr>
<td>S5</td>
<td>8.30</td>
<td>–16.4</td>
<td>–5.2</td>
</tr>
<tr>
<td>S6</td>
<td>13.8</td>
<td>–12.0</td>
<td>–4.4</td>
</tr>
<tr>
<td>S7</td>
<td>20.9</td>
<td>–8.4</td>
<td>–3.6</td>
</tr>
<tr>
<td>S8</td>
<td>34.0</td>
<td>–4.2</td>
<td>–4.2</td>
</tr>
<tr>
<td>S9</td>
<td>55.0</td>
<td>0.0</td>
<td>4.2</td>
</tr>
<tr>
<td>S9 + 10dB</td>
<td>190</td>
<td>+10.8</td>
<td>10.8</td>
</tr>
<tr>
<td>S9 + 20dB</td>
<td>500</td>
<td>+19.2</td>
<td>8.4</td>
</tr>
<tr>
<td>S9 + 30dB</td>
<td>1410</td>
<td>+28.2</td>
<td>9.0</td>
</tr>
<tr>
<td>S9 + 40dB</td>
<td>4820</td>
<td>+38.8</td>
<td>10.6</td>
</tr>
<tr>
<td>S9 + 50dB</td>
<td>16300</td>
<td>+49.4</td>
<td>10.6</td>
</tr>
<tr>
<td>S9 + 60dB</td>
<td>63000</td>
<td>+61.2</td>
<td>11.8</td>
</tr>
</tbody>
</table>

**Image rejection**

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>+2x45.05MHz</th>
<th>45.05MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5</td>
<td>127</td>
<td>95</td>
</tr>
<tr>
<td>7.0</td>
<td>120</td>
<td>130</td>
</tr>
<tr>
<td>10.05</td>
<td>118</td>
<td>100</td>
</tr>
<tr>
<td>14.0</td>
<td>115</td>
<td>112</td>
</tr>
<tr>
<td>18.0</td>
<td>113</td>
<td>113</td>
</tr>
<tr>
<td>21.0</td>
<td>109</td>
<td>109</td>
</tr>
<tr>
<td>24.5</td>
<td>113</td>
<td>115</td>
</tr>
<tr>
<td>28.0</td>
<td>112</td>
<td>115</td>
</tr>
<tr>
<td>29.0</td>
<td>110</td>
<td>114</td>
</tr>
</tbody>
</table>

**Unmodded set tested at 7MHz**

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>+1kHz</th>
<th>dB</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>87</td>
<td>63</td>
</tr>
<tr>
<td>40</td>
<td>98</td>
<td>53</td>
</tr>
<tr>
<td>60</td>
<td>105</td>
<td>46</td>
</tr>
<tr>
<td>80</td>
<td>106.5</td>
<td>31</td>
</tr>
</tbody>
</table>

**3rd order intermodulation rejection**

<table>
<thead>
<tr>
<th>Separation</th>
<th>SSB filter (dB)</th>
<th>CW filter (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50kHz/100kHz</td>
<td>87</td>
<td>87</td>
</tr>
<tr>
<td>100kHz/200kHz</td>
<td>87</td>
<td>87</td>
</tr>
</tbody>
</table>

**Spurious response rejection**

<table>
<thead>
<tr>
<th>Measured as above.</th>
<th>28MHz, all more than 110dB over 0.5MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>28.0</td>
<td>112</td>
</tr>
<tr>
<td>29.0</td>
<td>110</td>
</tr>
</tbody>
</table>

**Readings**

<table>
<thead>
<tr>
<th>Ref. S9 (dB)</th>
<th>S meter S9 level sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.3063</td>
<td>59uV</td>
</tr>
<tr>
<td>0.589</td>
<td>80uV</td>
</tr>
<tr>
<td>1.196</td>
<td>1.8</td>
</tr>
<tr>
<td>5.888</td>
<td>3.5</td>
</tr>
<tr>
<td>5.929</td>
<td>7.0</td>
</tr>
<tr>
<td>5.948</td>
<td>10.05</td>
</tr>
<tr>
<td>5.958</td>
<td>14.0</td>
</tr>
<tr>
<td>5.959</td>
<td>18.0</td>
</tr>
<tr>
<td>6.0</td>
<td>21.0</td>
</tr>
<tr>
<td>6.008</td>
<td>24.5</td>
</tr>
<tr>
<td>6.054</td>
<td>28.5</td>
</tr>
<tr>
<td>6.063</td>
<td>29.5</td>
</tr>
<tr>
<td>6.283</td>
<td>104uV</td>
</tr>
<tr>
<td>6.286</td>
<td>20</td>
</tr>
<tr>
<td>7.258</td>
<td>40</td>
</tr>
<tr>
<td>7.289</td>
<td>1065uV</td>
</tr>
<tr>
<td>7.309</td>
<td>14</td>
</tr>
<tr>
<td>7.400</td>
<td>58uV</td>
</tr>
<tr>
<td>8.916</td>
<td>80uV</td>
</tr>
<tr>
<td>8.924</td>
<td>105uV</td>
</tr>
<tr>
<td>9.897</td>
<td>69uV</td>
</tr>
<tr>
<td>10.156</td>
<td>105uV</td>
</tr>
<tr>
<td>10.155</td>
<td>61uV</td>
</tr>
<tr>
<td>17.377</td>
<td>53uV</td>
</tr>
<tr>
<td>18.569</td>
<td>89uV</td>
</tr>
<tr>
<td>19.500</td>
<td>97uV</td>
</tr>
<tr>
<td>23.370</td>
<td>80uV</td>
</tr>
<tr>
<td>24.825</td>
<td>80uV</td>
</tr>
<tr>
<td>26.748</td>
<td>61uV</td>
</tr>
<tr>
<td>27.307</td>
<td>58uV</td>
</tr>
<tr>
<td>29.790</td>
<td>53uV</td>
</tr>
<tr>
<td>30.000</td>
<td>58uV</td>
</tr>
</tbody>
</table>
### Selectivity

<table>
<thead>
<tr>
<th>Unmodified set</th>
<th>Modified set</th>
</tr>
</thead>
<tbody>
<tr>
<td>(in kHz)</td>
<td>(in kHz)</td>
</tr>
<tr>
<td>SSB/CW, normal</td>
<td>-3dB</td>
</tr>
<tr>
<td></td>
<td>1.78</td>
</tr>
<tr>
<td></td>
<td>2.41</td>
</tr>
<tr>
<td></td>
<td>6.65</td>
</tr>
<tr>
<td>SSB/CW, narrowed by 4 clicks</td>
<td>-6dB</td>
</tr>
<tr>
<td></td>
<td>6.30</td>
</tr>
<tr>
<td>SSB/CW, narrowed by 6 clicks</td>
<td>-6dB</td>
</tr>
<tr>
<td></td>
<td>5.39</td>
</tr>
<tr>
<td>500Hz CW filter</td>
<td>-6dB</td>
</tr>
<tr>
<td></td>
<td>5.10</td>
</tr>
<tr>
<td>AM/FM, normal</td>
<td>-6dB</td>
</tr>
<tr>
<td></td>
<td>5.10</td>
</tr>
<tr>
<td>AM, optional</td>
<td>-6dB</td>
</tr>
<tr>
<td></td>
<td>4.38</td>
</tr>
<tr>
<td>Filter fitted</td>
<td>-6dB</td>
</tr>
<tr>
<td></td>
<td>5.63</td>
</tr>
<tr>
<td></td>
<td>1.05</td>
</tr>
</tbody>
</table>

### Transmitter

**Transmitter frequency range in MHz**

1.5-2.0; 3.5-4.0; 7.0-7.5; 10.0-10.5; 14.0-14.5; 18.0-18.5; 21.0-21.5; 24.5-25.0; 28.0-30.0.

**Tx measured maximum power**

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Power (W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8</td>
<td>68</td>
</tr>
<tr>
<td>3.5</td>
<td>79</td>
</tr>
<tr>
<td>7.0</td>
<td>83</td>
</tr>
<tr>
<td>10.0</td>
<td>87</td>
</tr>
<tr>
<td>14.0</td>
<td>95</td>
</tr>
<tr>
<td>18.0</td>
<td>98</td>
</tr>
<tr>
<td>21.0</td>
<td>99</td>
</tr>
<tr>
<td>24.5</td>
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<tr>
<td>28.0</td>
<td>98</td>
</tr>
<tr>
<td>29.0</td>
<td>87</td>
</tr>
</tbody>
</table>

**Tx harmonics and spurii**

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.8</td>
<td>56</td>
<td>-66</td>
<td>-70</td>
<td>-70</td>
</tr>
<tr>
<td>3.5</td>
<td>58</td>
<td>-54</td>
<td>-70</td>
<td>-66</td>
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<tr>
<td>7.0</td>
<td>53</td>
<td>-70</td>
<td>-70</td>
<td>-66</td>
</tr>
<tr>
<td>10.0</td>
<td>51</td>
<td>-70</td>
<td>-70</td>
<td>-66</td>
</tr>
<tr>
<td>14.0</td>
<td>49</td>
<td>-70</td>
<td>-70</td>
<td>-70</td>
</tr>
<tr>
<td>21.0</td>
<td>43</td>
<td>-70</td>
<td>-70</td>
<td>-70</td>
</tr>
<tr>
<td>24.8</td>
<td>43</td>
<td>-70</td>
<td>-70</td>
<td>-70</td>
</tr>
<tr>
<td>28.0</td>
<td>54</td>
<td>-70</td>
<td>-70</td>
<td>-69</td>
</tr>
<tr>
<td>29.0</td>
<td>56</td>
<td>-70</td>
<td>-70</td>
<td>-69</td>
</tr>
</tbody>
</table>

Spurii at -65dB were noted at +/− 3.2MHz from 29.0MHz, increasing to -59dB at 29.69MHz at +/− 100kHz.

**Two tone SSB intermodulation**

<table>
<thead>
<tr>
<th>Order (in dB)</th>
<th>3rd</th>
<th>5th</th>
<th>7th</th>
<th>9th</th>
<th>11th</th>
<th>13th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset of ALC</td>
<td>-41</td>
<td>40</td>
<td>-51</td>
<td>-63</td>
<td>-68</td>
<td>-80</td>
</tr>
<tr>
<td>Max ALC</td>
<td>-48</td>
<td>40</td>
<td>-51</td>
<td>-63</td>
<td>-56</td>
<td>-60</td>
</tr>
<tr>
<td>Above ALC</td>
<td>-41</td>
<td>40</td>
<td>-49</td>
<td>-53</td>
<td>-57</td>
<td>-59</td>
</tr>
<tr>
<td>Max level</td>
<td>-46</td>
<td>42</td>
<td>-51</td>
<td>-54</td>
<td>-57</td>
<td>-60</td>
</tr>
</tbody>
</table>

Minimum power = 12W to within 1dB at all frequencies.

**FM deviation**

+/- 6.4kHz dev max at 340Hz audio frequency

+/- 5.0kHz dev max at 1kHz audio frequency

**Tx Noise Floor**

Less than -100dB measured in 3kHz bandwidth at greater than +/− 1.0MHz
FOR SALE

FOR SALE ham multi mode II £90; Hygain 5 USB/LSB/FM/AM £75; Nato 2000 FM/AM/USB/LSB/CW £120. Phone 0283 221870. Wanted R2000 receiver urgent Phone 0283 221870.

YAESU FT101 fitted fan, 12 VDC PSU, min. handbook mint cond. LLI RF clipper two spare new 6JS6C. £300 or swap for FRG7700 0799-30763 G3EAY.

FOR SALE Marconi counter/frequency meter type TF1417 range 0 Hz to 10MHz. Has a fault, also requires one new nixie tube hence price £28. Buyer collects or carriage extra. Phone Atherton 891140.

TWO world wide teletext decoders complete with all relevant paperwork etc £100 ono. West Drayton 410409.

SALE TS830S, narrow CW filter and MC355 mike £650 or may part exchange for HF mobile rig. Phone Alcock on Nuneaton 386095.

MICROWAVE modules MMT 28MHz to 144MHz linear transverter as new £65. Carriage paid. John G3XKN Toddington Bedfordshire. Tel 05255-2207.

FOR SALE Yaesu FTDX401 and FV401 all in exc cond comp with MC CW-filter spare valves and all in perfect wkg order, 560 watts £250. Buyer collect. Tel 0246 36496.

HAM international concorde 3 AM, FM, USB, LSB, CW 11 meter transceiver outstanding condition, unwanted gift £150 ono. Plus centre feed dipole and mag mount aerial for mobile use £10. Or swap for 2 meter linear amp 25W in 50-100W out or small handheld 2 meter set. Tel Dronfield (0283) 410409.

DX302 quartz synthesizer communication receiver a/c battery 100kHz-30MHz digital readout as new with manual £110. HF transceiver required G0CHF Yateley 871300.

YAESU FT102 HF transceiver with FM board (not fitted) as new £595. Phone Paul G4XHF Crawley (0293) 515201.

HOME BUILT 4 band transceiver Radcom 84 article by Lorin Knight all PCBs, plans 14 x 21 fitted spare setting up complete (nearly) cost £150, parts accept £90 ono or 2m handheld deal. Suitable for re-vamp/spares. Contact G1INGR.

SANYO Beta video, VHF, UHF tuner, pal secam NTSC selection, soft touch control, video in/out sockets. National 19" colour TV, VHF UHF tuner, pal secam NTSC selection video in/out sockets, complete system £300. Tel Milton Keynes 316052.

GW900M scanner CW PSU and 12 months use only. £180 ono. GBKNQ QTHR.


VINTAGE WIRELESS SETS circa 1920's for disposal. Also my collection of Horn speakers, coils, components; early books and wireless magazines, serious offers required. Buyer to collect. Full details tel 0935 815616 (Daytime).

ICOM 2 metre handheld IC2E speaker/mike spare battery and charger £180. Sait marine gen cov professional receiver digital £325. Racal RA17 with SSB adaptor £275. Hammarlund SP400X complete £150. Marine Tx/Rx 218 kHz £90. “Callbuoy” all in beautiful condition (Purley Surrey) 01 660 0794.

KDK 2025 2m FM transceiver, 144-149 MHz, 10 memories, mounting bracket, G4XKX Phone (0232) Belfast 790955 £150 ono (or will px for 2m handheld IC2E etc).

EDDYSTONE 770R mark two 19 to 165 MHz. Covers six UK amateur bands. VVFM FM and SSB. Recently overhauled and realigned professional, £110 ono Tel (0202) 876018.

MARCONI TF1064 VHF/UHF signal generator £40 Pye Olympic £35 Pye Westminster LW15 FM £40. Scope S51B £35. Airemc mod meter £35. Quantity mixed ICs, Eproms, CPUs etc £20. Wanted FT1012D or TS830S, PC1, PC2 radio controller G3XDA QTHR 0775 66533.

934 Cybernet Delta 1 as new £300. Daiwa Search 9 monitor receiver, 9 xtal fitted £27. 13.8V, 5-7A CB PSU, £12. Mike, tel Saffron Walden 27155.

TF1417 2m transceiver with AM/FM/SSB £300. Electroylic and tantalytic capacitance bridge £30 ono. FT102D £53.5kV at 200mA, 5.2kV at 100mA, 5kV at 200mA, 5.2kV at 100mA £66. £10. All plus p&p phone (0709) 674741.

FT207 144/148 NiCad case £180.ダイバイス 144/148 NiCad case speaker/mic charger maintenance service manual plus instruction manual original packing £115 GW4UW QTHR 0654 710548 daytimes.

TRIO TS130V 10 watt 8 band HF transceiver in immaculate condition complete with unused mobile mounting bracket workshop manual etc £365. Yaesu FT708 and FT208 both perfect £160 each remote LS/mike and PA3 unit may also be available. Telephone G3KLF Fareham 236906.

COMPLETE communications package: Acorn Atom computer PNP communications terminal unit with tuning indicators, PSU and switching unit RTTY software on Eeprom, ASCII communications software, toolkit atom needs 12 volts 2 amps. Sensible offers to Keith Maton, G6HNU, 282 Rundells, Harlow, Essex.

MAST for sale, two section. 40 foot, galvanised, good condition, buyer collects. Offers. Chris G1DQN 01 841 2862.

IC290E 1/10 watts FM CW SSB Tona 9 el cross hombayed key all £260. ST5MC 45.50 bauds Cread 444 in very good condition reader and perforator and spare paper £100. Phone Terry, Tadley 2487 G4XMQ after 6.30pm Mon-Fri QTHR.

FT1012D with CW filter £390 FRG7 receiver with commercial FM board fitted £120 TR2400 2m handheld with ST1 stand and speaker £150. Wanted transceiver with leather case etc £15 WPO communications mors £40 Dragon 32 RTTY setup £60 buyer collects George G4JSQ 0762 334648.

FOR SALE Ham multi mode II £250. Buyer collects. Tel Lincoln 46798.

SHARP M280A microcomputer, single screen and data recorder plus expansion unit together with Sharp 5P matrix printer. All in excellent condition, tapes and books £400 ono. Buyer collects. GW6 MOB QTHR (0222) 625908 (evenings).

XTALS for HRT, 10 band. £110 for 2m linear £390 10MHz. Has a fault, also requires one new nixie tube hence price £28. Buyer collects or carriage extra. Phone Paul G4XHF Crawley (0293) 674741.

MARCONI GENERATOR AM/FM video 4-300MHz £300 ono. Electroylic and tantalytic capacitance bridge £30 ono. FT102D £53 5kV at 200mA, 5.2kV at 100mA, 5kV at 200mA, 5.2kV at 100mA £66. £10. All plus p&p phone (0709) 674741.

FT207 144/148 NiCad case speaker/mic charger maintenance service manual plus instruction manual original packing £115 GW4UW QTHR 0654 710548 daytimes.

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FOR SALE Ham multi mode II £250. Buyer collects. Tel Lincoln 46798.
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FOR SALE CW RTTY reader CRW-610E plus Lowe UL-1000 tuned preamplifier plus Trio all band communication receiver 8R-59DS all in very good condition £145. John Wellington 4170887 after 6 o’clock.

FOR SALE Trio 520S with VFO 520 and Z-match in very good condition £350. Marconi 400 watt marine Tx with handbook and QVOB-100 output valves £200 buyer collects. Wanted Trio 820S in mint condition with filters. Mr Sydenham, 41 Alexandra Road, Beccles, Suffolk NR34 9UD.

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FOR SALE or swap HF-Rx digital display DX 300 — Marconi dual for trade or scottoscope with manuals — Yaesu SP980 70cm handheld also 9T-9R pocketphones. Wanted HF transmitter or transceiver. Linear amp 600 MHZ freq counter OWH money adjustment if required. GQCTW Telephone Beawley 4033858.

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FOR SALE KW2000 £500 complete with PSU microphone manual £180 or swap for WPO Alpha SSB transceiver on 160 mtrs G4TGQ THOR DanE End 254 evenings.

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FOR SALE realistic Pro 2003 60 channel scanner covers air ham radio utility and standard FM broadcast bands 8 weeks old in box. Manual current price £295 will sell £190. Phone 228 4835 SW11.

YAESU FRG7700 and FR7000 mint condition £250 ono. 40 The Oval, North Anston, Nr Sheffield.

BRT 400 communications receiver C/W manual £75 KW2000B Tx/Rx C/W AC power supply £220 KW Atlantic C/W A/C power supply £115. Buyers to collect. Phone Ipswich 79479.

FOR SALE HF Tx/Rx FL200B with new O/P and drive valves and FR100B with 1.8 and 1m £185. IC25E 25W FM mobile Tx/Rx boxed £200. M280K computer ideal for RTTY £175. Reasonable carriage paid — G3MTD — Barrie 0271 9571.

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YAESU FT980 general coverage HF Tx/Rx, one year old, complete with Curtis keyer, 300Hz CW filter, 9kHz FM filter manual, service manual, full breakdown, suitable for AMTOR, recently re-added by Importer. Boxed, as new £999 ono. G4WVX Tel 06286 64415.

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FOR SALE FT290 £250, FT790 £250, mobile mount £20, 70cm aerial/mag mount £20, WE1145 rotator £35 all very good condition. Tel (01384) 41657.

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REXTRONIC Multimode covers 27.700 to 29.7000 opron converted superstar 360 (Cobra 148 GTLX board) repeater shift etc perfect £125 wave analyser perfect RF bridge ok several transformers 2,000 to 8,000 volt for above. Wanted Magnum two-184 0245 324555. BSO reel to reel tape recorder 3 speeds. 2 x 8W audio output. All inputs. Echo, reverb, sound on sound tapes and mics £60. Ring Lakeside 0524 417120 ext 974 9am to 3pm.

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SFL DS B-80 (QRP transceiver) complete with digital readout and sidetone ON4ABT, Postbus (evenings). Tel 01 624 5760 or write Chris Lorek, G4 HCL, Y sola Street, Selby, N Yorks Y08 0DY.

SWAP Commodore SX-64 computer which includes CPU, disk drive, monitor in one box for HF transceiver, FT726 70cm module and satellite module AMT2 and BBC software, AMT1 and BBC software, or will sell for C385 one. Ring Cosham 0705 381062.

EXCHANGE Tristar 747 AM/FM/USB/LSB low mid high freq range 26.965MHz 28.305MHz in perfect working order working manual plus data for converting to 10m for any state communication receiver to 30MHz with SSB please phone Paul BB2 (0752) 777579.

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EXCHANGE M7 micro computer multi tuning system Panasonic RF8600BRE for any scanner covering 25 to 500. Must be in mint condition. Telephone 051 263 6724.

WANTED TRIO TS 700S must be perfect with original packing and manual. Contact Graeme Wormald, G3 GGL, 20 Sandbourne Drive, Bewdley, Worcs Tel 0299 403372.

WANTED Telereader made by Comax as sold by Lowe Electronics inostel CW705E receive with monitor or CW706E receiver without monitor for cash or cash and computer. Telephone (0742) 471160 after 7pm.

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And superb programs for BBC-B, CBM64, VIC20, SPECTRUM, ELECTRON

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LOCATOR, QTH or Maidenhead locator or lat/long. Distance, headings, contest points, converts between locator and lat/long.

SOFTWARE

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<table>
<thead>
<tr>
<th>Spectrum</th>
<th>BBC 'B'</th>
<th>DRAGON</th>
</tr>
</thead>
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<td>CBM 64</td>
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<tr>
<td>ZX81 16K</td>
<td>ATARI 600/800XL</td>
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<td>AMSTRAD 464</td>
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SSTV Programmes: 100 kerbit rate, same features as RTTY/CW program. For ZX81 £8.50 inc P&P, ATARI £10 inc P&P.

RTTY FOR YOUR 48K SPECTRUM

Marry driven - 10 programmable memories, split screen morse with four baud rates etc, etc. NO TERMINAL UNIT just a simplefitter! Cassette with full instructions, circuit and wiring layout £8.50 inc P&P.

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HAM RADIO TODAY MARCH 1986
Co-Ax Plugs, Sockets, Adaptors

- **P1** standard 50 OHM BNC plug £0.88
- **P2** 50 OHM solderless crimp type BNC £1.00
- **P3** chassis mounting BNC socket £0.94
- **P4** single hole chassis mounting BNC socket for panels up to 4mm thick £0.88
- **P5** single chassis mounting BNC socket for panels up to 7mm thick £0.88
- **P6** double ended BNC female socket £1.17
- **P7** double ended BNC plug/plug £2.83
- **P8** BNC T connector socket/plug/socket £2.83
- **P9** BNC T connector socket/socket/socket £2.83
- **P10** elbow BNC socket/plug £1.13
- **P11** BNC line socket female/female £0.85
- **P12** PL259 standard plug 5.2mm internal dia. £0.15
- **P13** Reducer for PL259 5.2 internal dia. £0.45
- **P14** right angle PL259 for RG58/U £0.88
- **P15** standard PL259 with built in reducer 5.2mm internal dia. £0.88
- **P16** Reducer for PL259 5.2 internal dia. £0.45
- **P17** dosserless PL259 with built in reducer for RG58/U £0.88
- **P18** SO239 4 hole mounting chassis socket £0.85
- **P19** SO239 female/female coupler £0.85
- **P20** PL259 male/male connector £3.88
- **P21** PL259 (push on) SO239 quick disconnect £0.85
- **P22** right angle PL259/SO239 £1.16
- **P23** PL259 T connector female/male/female £1.37
- **P24** SO239 T connector female/female/female £1.44
- **P25** N type plug to BNC socket £2.42
- **P26** N type plug to BNC socket £2.50
- **P27** N type plug to SO239 £2.50
- **P28** PL259 to N type socket £2.28
- **P29** Phonon plug to SO239 £0.55
- **P30** 3.5mm plug to SO239 £0.75
- **P31** BNC plug to SO239 £1.20
- **P32** PL259 to BNC socket £1.20
- **P33** standard co-ax plug to BNC socket £1.02
- **P34** Phonon plug to BNC socket £0.35
- **P35** Phonon plug to F type socket £0.50
- **P36** push in F type plug to F type socket £0.57
- **P37** PL259 to phonon socket £0.75
- **P38** BNC plug to phono socket £0.94
- **P39** F type plug to phono socket £0.66
- **P40** F type plug to BNC socket £1.10
- **P41** F type plug to phone socket £0.60
- **P42** PL259 plug to plug £2.10
- **P43** F type socket to 3.5mm jack £0.68
- **P44** phonon socket to standard co-ax socket £0.52
- **P45** standard co-ax plug to phono socket £0.66
- **P46** TNC plug £2.75
- **P47** N type in line socket for RG6/9U £1.54
- **P48** N type in line socket for RG8 £1.54
- **P49** N type T connector female/male/female £3.45
- **P50** N type single hole mounting chassis socket £1.20
- **P51** N type four hole mounting chassis socket £1.68
- **P52** N type elbow male/female £3.11
- **P53** N type T connector female/female/female £3.45
- **P54** N type double ended female/female £2.00
- **P55** N type double ended male/male £2.40
- **P56** N type plug for RG8 cable £1.52
- **P57** N type plug for RG8 cable £1.56

Mike and Power connectors

Please note that it is the line socket on the end of the mike

- **MC1** 2 pin in line socket £0.65 ea.
- **MC2** 2 pin chassis mounting plug £0.65 ea.
- **MC3** 2 pin in line plug £1.40 ea.
- **MC4** 3 pin in line socket £0.65 ea.
- **MC5** 3 pin chassis mounting plug £0.65 ea.
- **MC6** 3 pin in line plug £1.45 ea.
- **MC7** 4 pin in line socket £0.70 ea.
- **MC8** 4 pin chassis mounting plug £0.75 ea.
- **MC9** 4 pin in line plug £1.65 ea.
- **MC10** 4 pin right angle line socket £1.40 ea.
- **MC11** 5 pin in line socket £0.80 ea.
- **MC12** 5 pin chassis mounting plug £0.75 3a.
- **MC13** 5 pin in line plug £1.65 ea.
- **MC14** 6 pin chassis mounting plug £0.80 ea.
- **MC15** 6 pin chassis mounting plug £0.80 ea.
- **MC16** 6 pin in line plug £2.30 ea.
- **MC17** 7 pin in line socket £1.35 ea.
- **MC18** 7 pin chassis mounting plug £1.15 ea.
- **MC19** 7 pin in line plug £2.05 ea.
- **MC20** 8 pin in line socket £1.45 ea.
- **MC21** 8 pin chassis mounting plug £1.20 ea.
- **MC22** 8 pin in line plug £2.80 ea.

Co-axil Cable

- **C1** pope H100 £0.75 p.m.
- **C2** pope RG58C/U £0.30 p.m.

Telephone Accessories

- **T1** modular telephone t adaptors £2.50 ea.
- **T2** 2/4a telephone master socket £3.50 ea.
- **T3** 2/6A slave ext socket £3.00 ea.
- **T4** 6m ext leads with modular plug and socket £2.50 ea.
- **T5** 10m ext leads with modular plug and socket £4.00 ea.

AC Power leads

- **AC1** 3 pin IEC plug and lead right angle with 2m cable £2.50 ea.
- **AC2** 3 pin IEC plug and lead straight with 2m cable £2.50 ea.
- **AC3** 3 pin IEC plug with 2m cable £1.00 ea.

Trimming Tools

- **TT1** complete set of 4 double ended trimming tools £1.75 ea.
- **TT2** Hexagonal and rectangular heads £1.75 ea.

DC Power Sockets

- **DC1** centre hole 2.5mm dia shaft length 10mm £0.25 ea.
- **DC2** centre hole 2.5mm dia shaft length 10mm £0.25 ea.
- **DC3** centre hole 2.5mm dia shaft length 14mm £0.25 ea.
- **DC4** centre hole 2.5mm dia shaft length 14mm £0.25 ea.

P&P £1.00. Co-ax 10p p.m. All mail will be sent by normal post unless otherwise requested.
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FEATURES
- 30 WATTS OUTPUT POWER
- SUITABLE FOR 1 OR 3 WATT TRANSCEIVERS
- LINEAR ALL MODE OPERATION
- ULTRA LOW NOISE RECEIVE PREAMPLIFIER
- EQUIPPED WITH RF VOX AND MANUAL OVERRIDE
- LED STATUS LIGHTS FOR POWER & TRANSMIT
- SUPPLIED WITH ALL CONNECTORS

PRICE: £169.05

FEATURES
- 50 WATTS TYPICAL OUTPUT
- RUGGED 145 W DISSIPATION PA TRANSISTOR
- ULTRA LOW NOISE RECEIVE PREAMPLIFIER
- EQUIPPED WITH RF VOX AND MANUAL OVERRIDE
- LED STATUS LIGHTS FOR POWER AND TRANSMIT
- SUPPLIED WITH POWER LEAD AND ALL CONNECTORS

PRICE: £149.50

The two linear amplifiers featured above are suitable for most portable and mobile UHF transceivers such as the FT790 FT709 and even your old Pye Westminster. So go on make it a signal to be proud of, buy a new Microwave Modules 70cms linear.

PRICE LIST FROM 1st JAN 1986

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
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<tr>
<td>MML28/100-S</td>
<td>10m 100W Linear, 10W input</td>
<td>£129.95</td>
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<tr>
<td>MML144/30-LS</td>
<td>2m 30W Linear, 1 or 3W input</td>
<td>£34.20</td>
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<td>MML144/50-S</td>
<td>2m 50W Linear, 10W input</td>
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<td>MML144/100-S</td>
<td>2m 100W Linear, 12W input</td>
<td>£149.95</td>
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<td>MML144/100-LS</td>
<td>2m 100W Linear, 1 or 3W input</td>
<td>£159.85</td>
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<td>MML144/200-LS</td>
<td>2m 200W Linear, 30W input</td>
<td>£334.65</td>
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<td>MML432/10-L</td>
<td>70cm 50W Linear, 1 or 3W input</td>
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<tr>
<td>MML432/10-S</td>
<td>70cm 100W Linear, 10W input</td>
<td>£344.65</td>
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<td>MML432,500-S</td>
<td>70cm ATV Converter, UHF output</td>
<td>£35.65</td>
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<td>MMT144/28</td>
<td>2m Linear Transverter, 25W o/p</td>
<td>£236.90</td>
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<td>MMT144/28-5</td>
<td>2m Linear Transverter, 5W o/p</td>
<td>£30.95</td>
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<td>MMT1296/144-G</td>
<td>70cm Linear Transverter</td>
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<td>MMX1268/144-G</td>
<td>1268MHz Transmit Up-Converter</td>
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<td>2m High Performance Converter</td>
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<td>70cm down to 10m Converter</td>
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<td>23cm down to 2m Converter</td>
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<td>16800MHz WX Satellite Converter</td>
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<td>2m Switched GaAsFET Preamp</td>
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<td>23cm GaAsFET Preamplifier</td>
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<td>MMG1961</td>
<td>1660MHz GaAsFET Preamp</td>
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<tr>
<td>MM/D100P</td>
<td>15000MHz Divide by Ten Prescaler</td>
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<td>MM/3/25</td>
<td>3dB 25 Watt Attenuator</td>
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<td>MM/7/3</td>
<td>7 dB 3 Watt Attenuator</td>
<td>£14.50</td>
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<tr>
<td>MM/R15/10</td>
<td>15 dB 10 Watt Attenuator</td>
<td>£14.50</td>
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