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MARCH 1986 £1.20

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IC290E	Low Multi-Mode Mobile	449.00
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IC25H	2m 45w FMA	359.00
IC27E	25W FM mobile	379.00
IC45E	70c 10w FM	345.00
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ICS

We now have in stock the full range of ICS RTTY/ASCII/AMTOR/CW products and the remarkable ALM-203E. This keypad operated handheld 2M transceiver has a host of features yet costs much the same as limited facility thumb-wheel units - just £209.00.

TRIO

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TS940S	9 Band TX General Cov RX	1695.00
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AT 230	All Band ATU/Power Meter	157.99
SP230	External Speaker Unit	47.73
TS530S	160m-10m Transceiver	698.00
TS430S	160m-10m Transceiver	720.00
PS430	Matching Power Supply	138.00
SP430	Matching Speaker	39.50
MB430	Mobile Mounting Bracket	13.17
FM430	FM Board for TS430	45.00
TS130S	8 Band 200W Pep Transceiver	633.06
SP120	Base Station External Speaker	30.74
AT130	100W Antenna Tuner	108.62
MC50	Dual Impedance Desk Microphone	36.19
MC35S	Fist Microphone 50K ohm IMP	17.01
LF30A	HI Low Pass Filter 1kW	24.68
TR7930	2M FM Mobile	329.00
TR9130	2M Multimode	499.00
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TM401A	7cms FM 12W	316.00
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TR3500	70cm Handheld	270.00
TR2600	New 2M FM Synthesised Handheld	275.00
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R600	Gen. Cov. Receiver	299.52
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HS5	Deluxe Headphones	26.68
SP40	Mobile External Speaker	16.46
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TR3600	70CM Handheld	292.00

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MR750U	Additional motor unit	64.64
MR300U	Additional motor unit	64.64
DR7600X	Heavy duty. Preset control	189.37
KS065	Deluxe bearing	27.30
KR500	Elevation rotator (not Daiwa)	144.90

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Tono 9000E	Reader/Sender	P.O.A.
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HK702	Straight keyer marble base	30.95
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HK708	Straight keyer	14.95
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HK806	Straight keyer	39.95
MK704	Twin paddle keyer	13.50
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Vibrokeyer Standard		63.98
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MISC		
AFR8000	TOR/RTTY/CW Decoder	684.57
AFR2010	TOR/RTTY/CW Decoder	496.80
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AFR1000	Low cost version of above	260.00
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Telereader	CWR610E CW/RTTY/ASCII	195.00
STAR		
MASTERKEY Electronic Iambic keyer		49.95
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GW Morse Keys		

YAESU

FT690	6m Multimode	269.00
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FP700	PSU	150.00
FC700	Tuner	105.00
FT77s	10w. version	449.00
FMU77	FM Board for FT77	28.35
FL2050	Linear Amplifier	115.00
FT290	2m M/Mode Port/Transceiver	315.00
FT290	With Mutek front end fitted	345.00
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MMB11	Mobile Bracket	30.00
NC11	Charger	11.50
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YHA15	2m Helical	7.65
YHA44D	70cm ½ wave	9.95
YM49	Speaker Mike	20.20
MMB15	Mobile Bracket	14.55
203R	NEW 2m H/Held/C/W FNB3	195.00
FT209R	NEW 2m H/Held/C/W FNB3	239.00
MMB10	Mobile Bracket	8.80
NC9C	Charger	9.60
NCB	Base/station Charger	64.80
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MH1B8	Hand 600 8pin mic	15.70
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YH55	Padded phones	15.35
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FRV8800	Convertor 118-175 for above	80.00
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FT709R	70cm H/Held	259.00
FT270R	2m 25W F.M.	315.00
FT270RH	2m 45W F.M.	365.00
FT2700R	2m/70cm/25W/25W	499.00
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BNOS

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LPM 144-10-100 2m. 10W In. 100W out. preamp	175.00
LPM 144-25-160 2m. 25W in. 160W out. preamp	255.00
LPM 144-3-180 2m. 3W in. 180W out. preamp	295.00
LPM 144-10-180 2m. 10W in. 180W out. preamp	295.00
LP 144-3-50 2MN. 50W out. preamp	125.00
LP 144-10-50 2M 10W in. preamp	125.00
LPM 432-1-50 70cm. 1W in. 50W out. preamp	235.00
LPOM 432-3-50 70cm In. 50W out. preamp	245.00
LPM 432-10-50 70cm. 10W in. 50W out. preamp	195.00
LPM 432-10-100 70cm. 10W in. 100W out. preamp	335.00

Miscellaneous

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L30	30W Dummy load	8.05
L100	100W Dummy load	35.20
L200	200W Dummy load	42.55
CT300	300W Dummy load	69.00
DRAE	2m Pre-set A.T.U.	14.50
TOKYO HI-POWER		
HC200	10-80 HF Tuner	82.50
HC400		
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Sigma	2 way 'n' Skts	19.95
Welz	2 way S0239	22.95
Welz	2 way 'n' Skts	41.90
Drae	3 way S0239	15.40
Drae	3 way 'n' Skts	19.90

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STAR MEMORYKEYER. Eight memories. Existing STARMASTER-KEY will also be available. Watch this space for further details.
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REGULAR COLUMNS

CONSTRUCTION

FEATURES

REVIEWS

Unfortunately, due to lack of space, Aerial Bent In Eire has had to be held over.

50MHz, A New Dimension for the U.K.

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.

IC-551. 50MHz Base station

This base station has all mode capability, SSB, CW, AM and FM (when optional FM is installed). It covers 50-54MHz with 80 watts variable R.F. output power (40 watts A.M.), Dual VFO's for split frequency operation. 3 memory channels and memory scan, program scan with adjustable scanning speed and auto stop when a signal is received. A powerful audio output, 2 watts at 8ohms for easy listening even in noisy surroundings.
Other features include a noise blanker, AGC fast or slow RIT, VOX passband tuning and speech processor. Options include:- PS15 20 amp external power supply, IC-EX106 FM unit and IC-HP1 headphones.
These two transceivers allow you to explore this fascinating part of the spectrum. UK stations have worked int VE, VO, W1,2,3,4 and 8. The UK beacon GB3NHQ has been received as far west as Washington State. Please contact Thanet Electronics Limited or your local ICOM dealer for more information on these 6m transceivers.

British TELECOM
Cellnet

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ICOM

IC-751 The ICOM Flagship

SM-10 Desk-top Mic

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 transmittors 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 equalisizer 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 PS55 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.

ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet ICOM Thanet Electronics
Sea Street, Herne Bay, Kent CT6 8LD
Tel: (0227) 363859.
Dept. HR

LETTERS

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 the beginning of the article, Basil 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 manufacturers 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, 26HI256.

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 known 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 G8QRM?

Sir, I have just had my attention drawn to your January 1986 issue. I note that "William, G8QRM" infers that the RSGB is a secret organisation; one of the many humorous aspects of 'Sideswipes'.

Please could you let me know the real name and callsign (if any) of the author of 'Sideswipes'.

David A. Evans, G3OUF
General Manager/Secretary RSGB.

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 this 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, G6MEN.

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, G4OHK/VK4YC.

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, G4IJI.

Please address correspondence to:
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LPM 144-25-160	2m, 25W in, 160W out, preamp	217.00
LPM 144-3-180	2m, 3W in, 180W out, preamp	247.00
LPM 144-10-180	2m, 10W in, 180W out, preamp	247.00
LP 144-3-50	2MN, 50W out, preamp	108.00
LP 144-10-50	2M, 10W out, preamp	108.00
LPM 432-1-50	70cm, 1W in, 50W out, preamp	197.00
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ASP/A	r.f. speech clipper for Yaesu	82.80
ASP	As above with 6 pin conn	89.70
D75	Manual RF speech clipper	56.35
D70	Morse Tutor	56.35
MK	Keyboard morse sender	137.40
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AD370-MPU	Active dipole with mains p.s.u.	69.00
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DC144/28	2m converter	39.67
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RADIO TODAY

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

CONGRATULATIONS

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".

The DTI say that the limited allocation is because of "extreme pressure on the spectrum" although another reason is the pressure from overseas. Certainly, a number of broadcasting transmitters are at risk from potential interference, and the band is not internationally recognised as an amateur service allocation.

An RSGB spokesman spoke of the protracted discussions and negotiations and of the DTI's willingness to put themselves out on a limb with European Authorities campaigning hard against UK amateur allocation. It was for this reason that there had to be a restriction in numbers and a simple and enforceable solution was to prohibit Class B's from the band. He was hopeful that a number of the restrictions would be lifted after the one year review period, when users of the TV transmitters in Belgium, Germany, Sweden and Norway saw that there was no interference caused. Although the 50-50.5 segment should remain with amateurs as primary users, an extension of the band would have to be shared with existing users on a secondary basis. However, the society sees no problems with this arrangement.

No one likes restrictions, the spokesman continued, but we have to remember that if things go wrong in the early stages of use, it would be tragic to see the withdrawal of the allocaton. In many ways the restrictions imposed could have been far more rigid. The DTI was able to produce statistics to back its claim that UK amateurs are a "harmless lot" who should be able to use 50MHz.

The existing permit holders have paved the way and a little restraint in the early days should secure the band for the future use. Unfortunately, there are vulnerable transmitters such as Antwerp (power out 0.01kW) which could be swamped by large signals from the UK. The band's potential can still be explored and its propagation studied without abuse of our privilege.

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 come into force on 1st March 1986.

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Software Refresh

Owners of Spectrum (48k) and Spectrum Plus computers have an increasing choice of CW tapes. Though the G1FTU CW program is the first to claim to take them out of the 'toy' class.

The G1FTU 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 now 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 G1FTU 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.

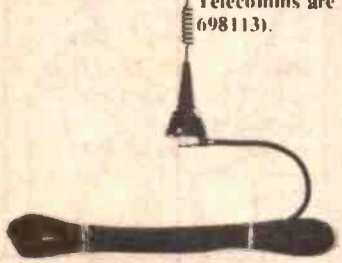
Although the museum will actually be based in Portsmouth, the plan is to use one or more travelling exhibitions to bring it to the people. However, there is still an enormous amount of work to do — much of it in restoring the equipment to some semblance of cleanliness! All the work — and the travelling 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 3.5dB gain with wide angle coverage necessary for operating in built up areas. Both antennas are supplied with 4.8m 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

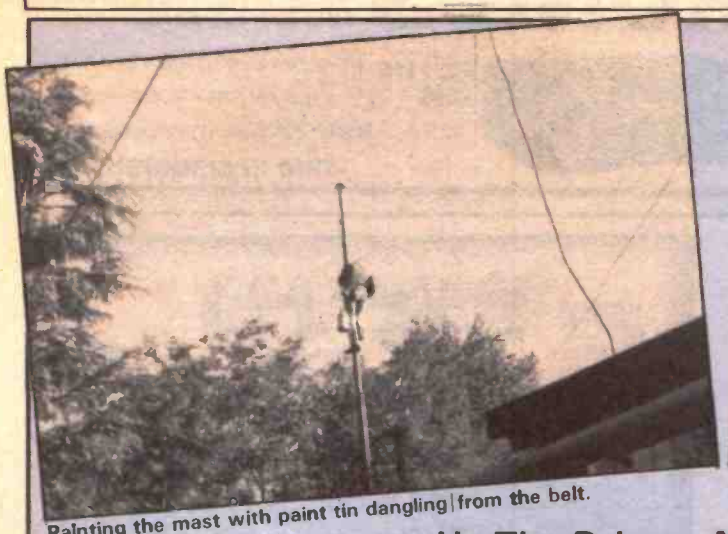
The Derby DARS, incorporating Derby Wireless Club 1911, is issuing a special commemorative certificate as part of their 75th Anniversary celebrations.

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"×6" SAE, 85p (UK) or 5 IRCs (outside UK) to G4HDP 97 Woodlands Road, Allestree, Derby, DE3 2HH.

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.



Painting the mast with paint tin dangling from the belt.

The new mast is bolted into the tabernacle. The dust bin is out of the way on the roof.

Up The Pole — A Masterly Affair

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!

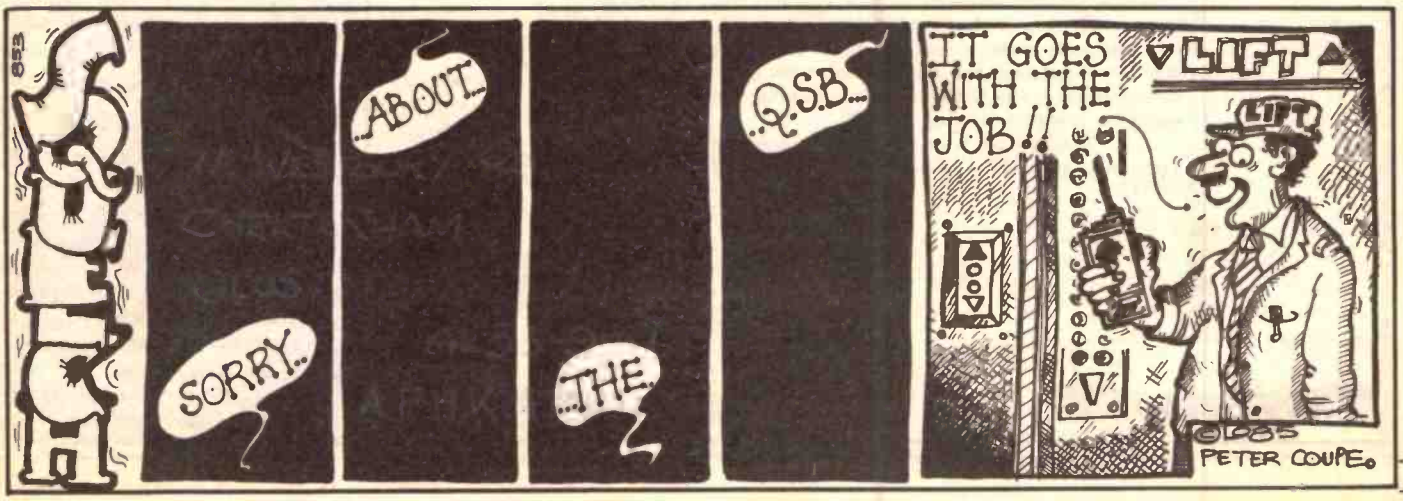
In fact the pole was delivered in just seven days and manoeuvred into the back garden where it was placed on trestles. It was undercoated with two coats of green paint, eye-bolts and guy-line attachments were made at the top and the butt drilled with precisely measured holes for the tabernacle bolts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

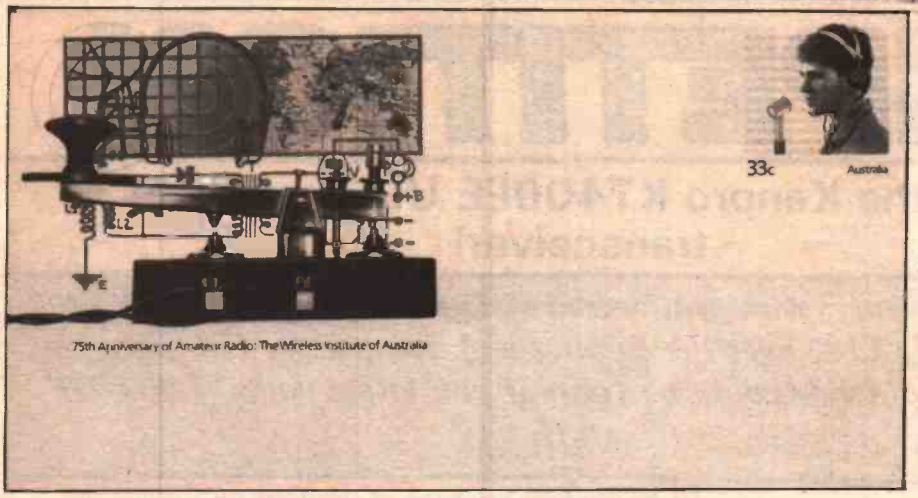
The steeplejacks proceeded to remove the faulty mast by introducing a ladder. This was lashed to the tabernacle and served as a 'gin-pole' lifting device enabling the team of three to lift the mast from the tabernacle. It was allowed to rest on the wall and the top 12' sawn off. Then the remaining 18'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





75th Anniversary of Amateur Radio: The Wireless Institute of Australia

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

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

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 emminent radio amateurs from around the world, were expected to attend.

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!"

Rally Roundup

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

The Bury RS Hamfeast 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 '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 Andrews 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 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 weere 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.

COMPETITION

Win the Kenpro KT400EE UHF handheld transceiver!

Get onto 'Seventy' with synthesised style from Kenpro. The KT400-EE, 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 QQV06-20A 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

Complete fully and clearly. If you are a winner, this will act as a label for your prize. Post to Kenpro Competition, Ham Radio Today, 1 Golden Square, London W1R 3AB to arrive by the first post 28th February. Don't forget to follow the advice in the How To Enter section including writing your choice of the answers on the back of the envelope!

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Your choice of answers A F H K M P .....

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. All 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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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 the hf 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 RT network, London Company frequencies, European control centres etc. An ideal companion for the hf airband listener. Send today for you copy.

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Pse Pse Pse QSL!

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.

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 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 '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!

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

G8 UO's poetic plea for a QSL.

To G5 JO
QSO 01 11/1/53

G8UO

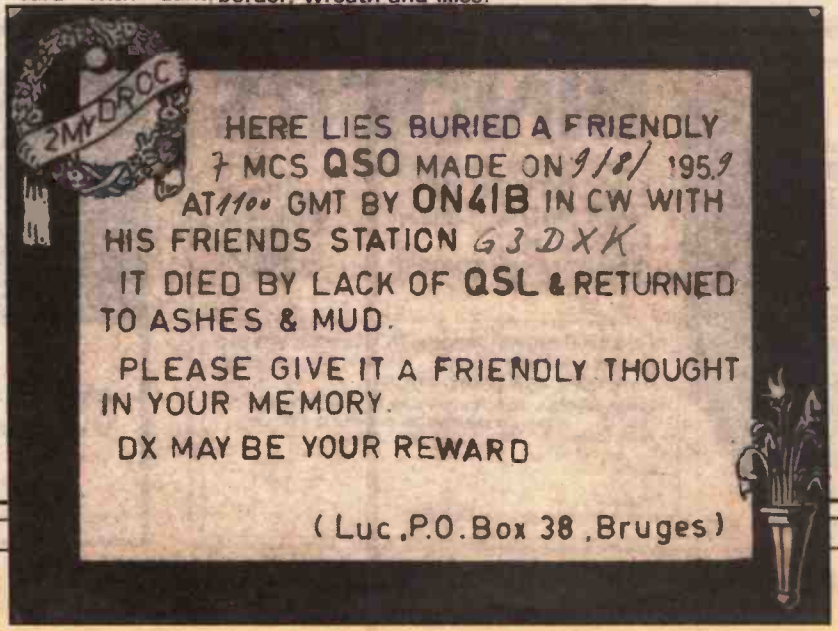
KEIGHLEY
YORKSHIRE

WHERINELL'S THAT QSL?

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.

U ARE MY ONLY 160 QSO WITH CAMBRIDGE & HV ABT QSL OM?

ON4 IB's mourning card with dark border, wreath and lilies!



address; they *never* seem to ask for yours!

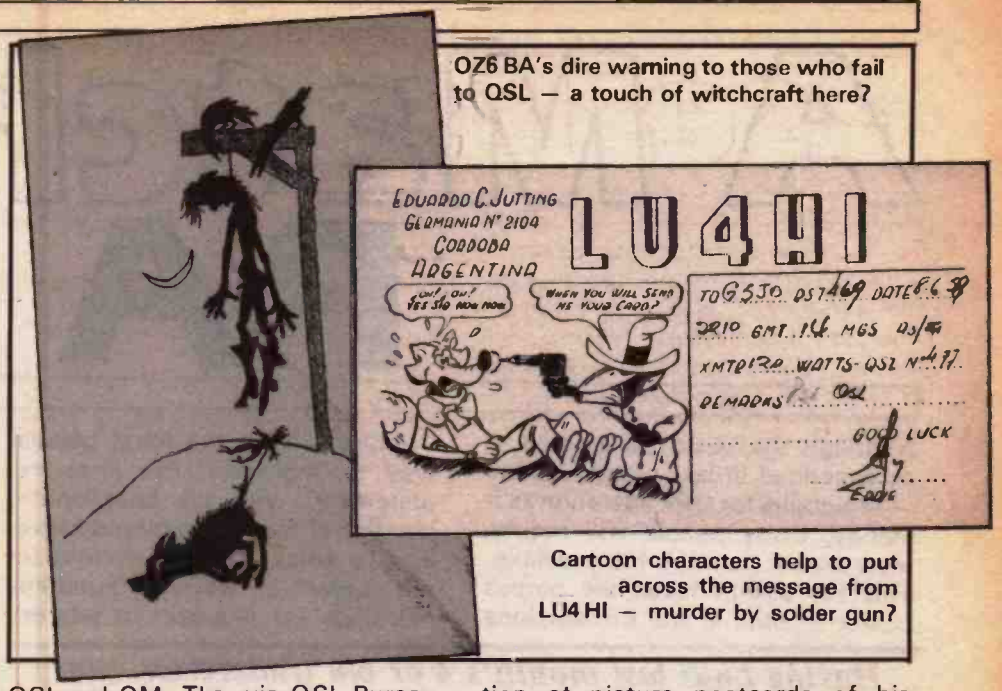
QSL Tactics

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, G5YX of Cambridge had printed at the foot of his cards, "Remember 5YX 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 who was saying "Won't you QSL". He then cleverly went on to state, "Dear OM, Perchance 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 ON4IB. 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 OZ6BA 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. . ."



OZ6BA'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?

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 tardy gentleman there was in fact a Christian Missionary! On the back of that precious card was scribbled "Mni tnx for views of your lovely QTH but I have destroyed your other p i c t u r e s . "

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 rottenist non-QSL'ers do have a small scrap of humanity left within their hearts and with some effort that precious and needed scrap of pasteboard 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 diploms. Best 73 es good luck."

A Matching PA

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 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.

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.

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.

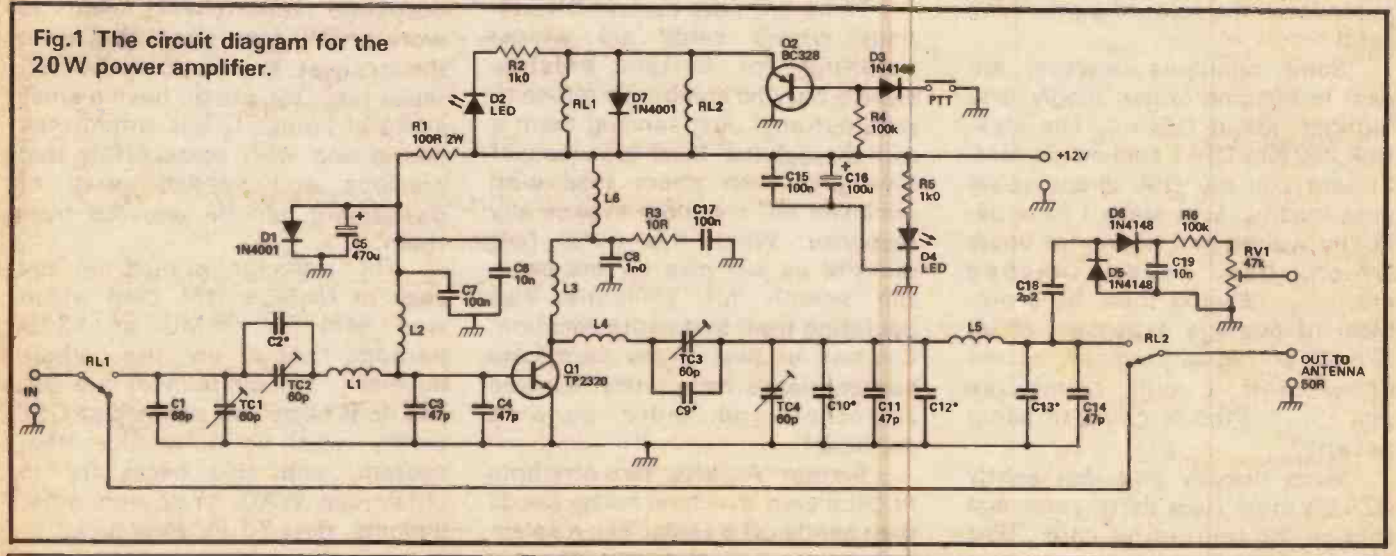
Class AB is the most popular way to implement this linear requirement, with the base/emitter junction of the device biased to produce a small collector current (of the order of several hundreds milliamps for this sort of power). As long as this bias point is accurately maintained, the output will be 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,

Fig.1 The circuit diagram for the 20W power amplifier.



rated at somewhat higher dissipation than is required and for an infinite VSWR, with internal ballast resistors helping to make the device nearly indestructable. 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, earthing 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.

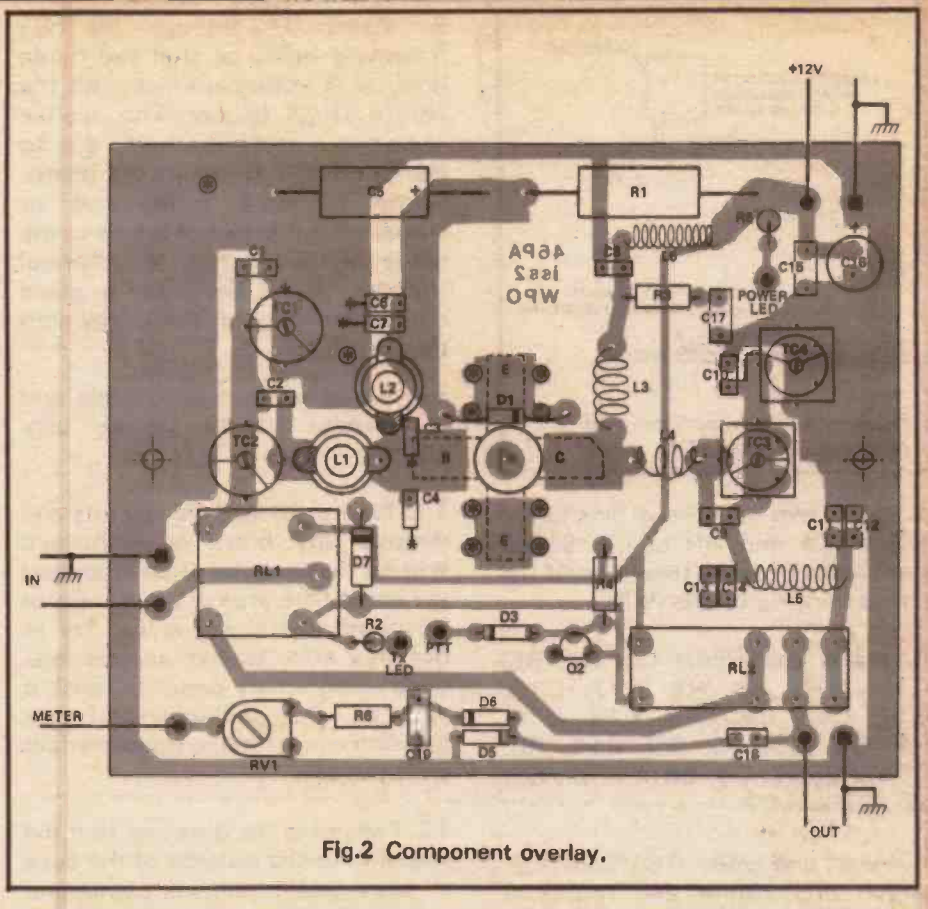


Fig.2 Component overlay.

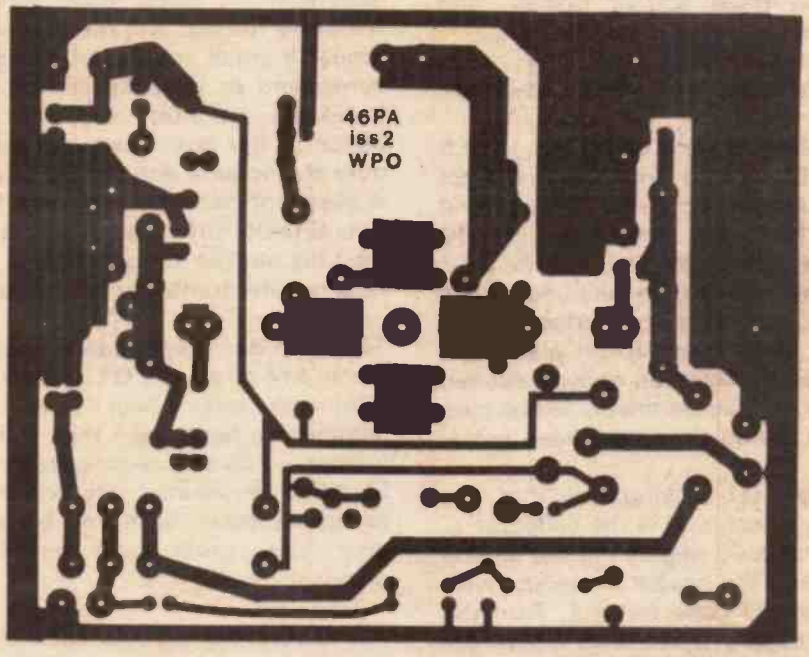


Fig.3 Foil pattern.

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.

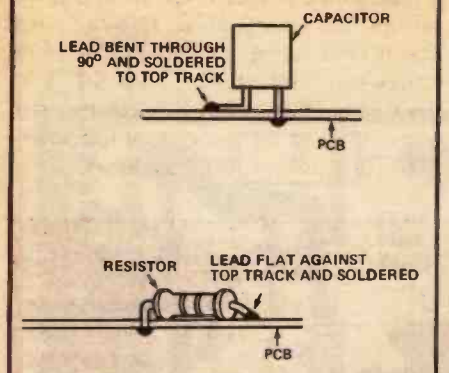


Fig.4 Inserting capacitors and resistors onto the PCB.

2. Insert two more 1mm 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 10mm 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 1mm 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 1mm 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.

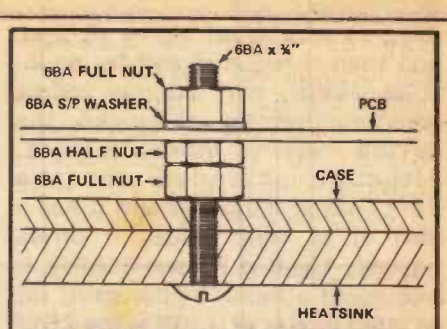


Fig.5 How to mount the PCB and heatsink on the case.

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 amps FSD or more) in series with a 13.8V power supply and wire into circuit. Connect a dummy load (50 ohm 25W+) 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 repeak 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

R1	100R 2W
R2,5	1k
R3	10R
R4,6	100k
RV1	47k 10mm vert preset

CAPACITORS

C1	68p
C2	4m 22p 6m 47p
C3,4,11,14	47p
C5	470u axial electro
C6	10n
C7,15,17	100n
C8	1n
C9	68p
C10	4m 68p 6m 120p
C12,13	6m only 15p
C16	100u radial electro
C18	2p2
TC1,2	5-60p foil trimmer 10mm
TC3,4	5-60p foil trimmer special

All are ceramic disc unless otherwise stated.

SEMICONDUCTORS

Q1	TP2320
Q2	BC327/8
D1,7	1N4001
D2	green LED
D3,5,6	1N4148
D4	red LED

RELAYS

RL1	KUIT-B 12V
RL2	OM1

INDUCTORS

L1	4m S18 yellow no core 6m S18 violet no core
L2	S18 violet no core
L3	7t 6.5mm id 22 swg to fit space
L4	4m 4t 18swg tinned Cu 6.5 id to fit space 6m 6t 22swg tinned Cu 6.5mm id to fit space
L5	4m as 4m L4 6m as L3
L6	15t 24swg en Cu 6.5mm id to fit space

MISCELLANEOUS

1 PCB; 1 heatsink; 19 1mm connection pins; 1 diecast box; miscellaneous nuts and bolts 6BA; 2 SO239; 1 red 5mm LED; 1 green 5mm LED; 1 grommet; 1 3.5mm jack socket; 1 length of UR67 coaxial cable; 1m red power lead; 1m black power lead; lengths connection wire, 22swg tinned Cu wire, 24swg en Cu wire and 18swg tinned Cu wire.

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Amateur Tales From The LA Olympics

At the Los Angeles Olympics, radio amateurs played a surprisingly large and important role in the communications network, as Tom King, VK2ATJ, explains...

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 zigzaged 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 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, K6ZT, 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.

The author talking through one of the 200 2m repeaters in the greater Los Angeles area.

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.

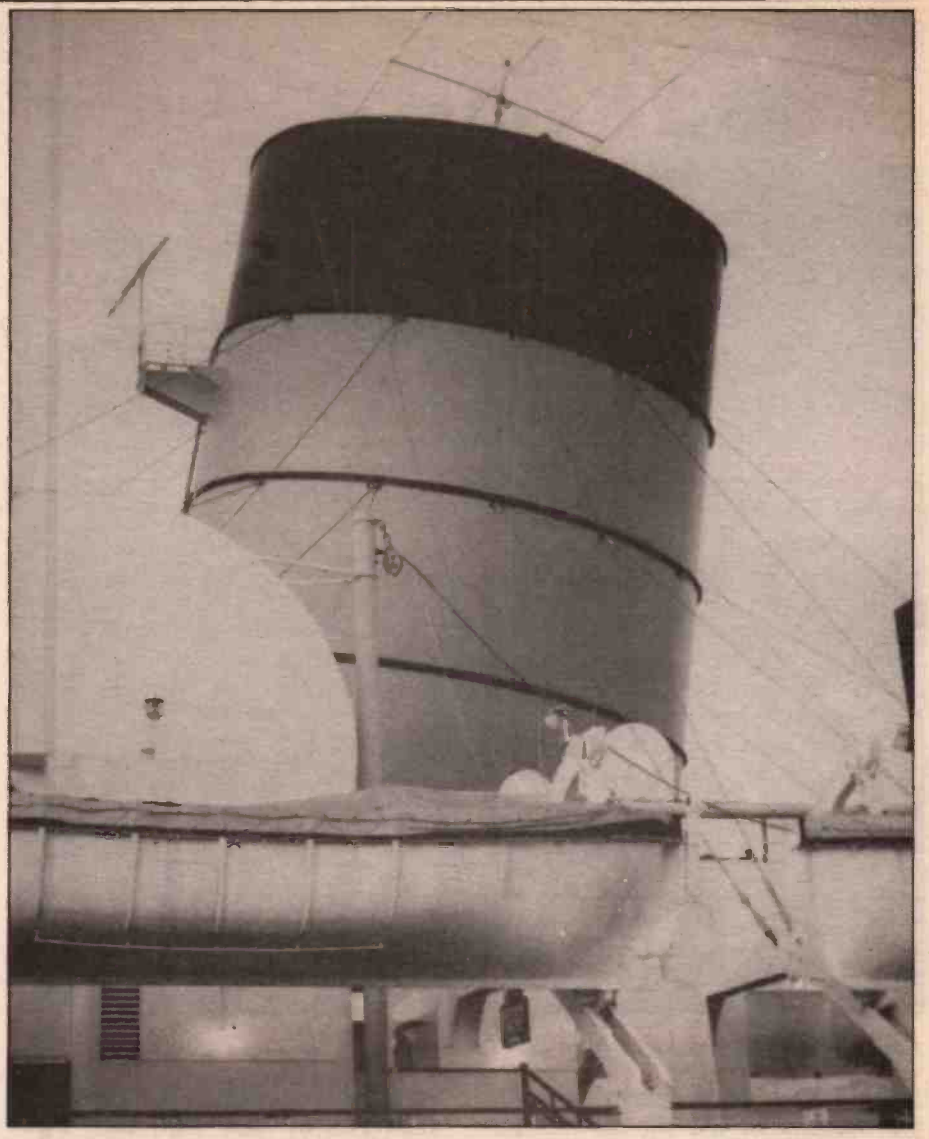
High Security

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 4½ 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 2½ 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 Shozo 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.

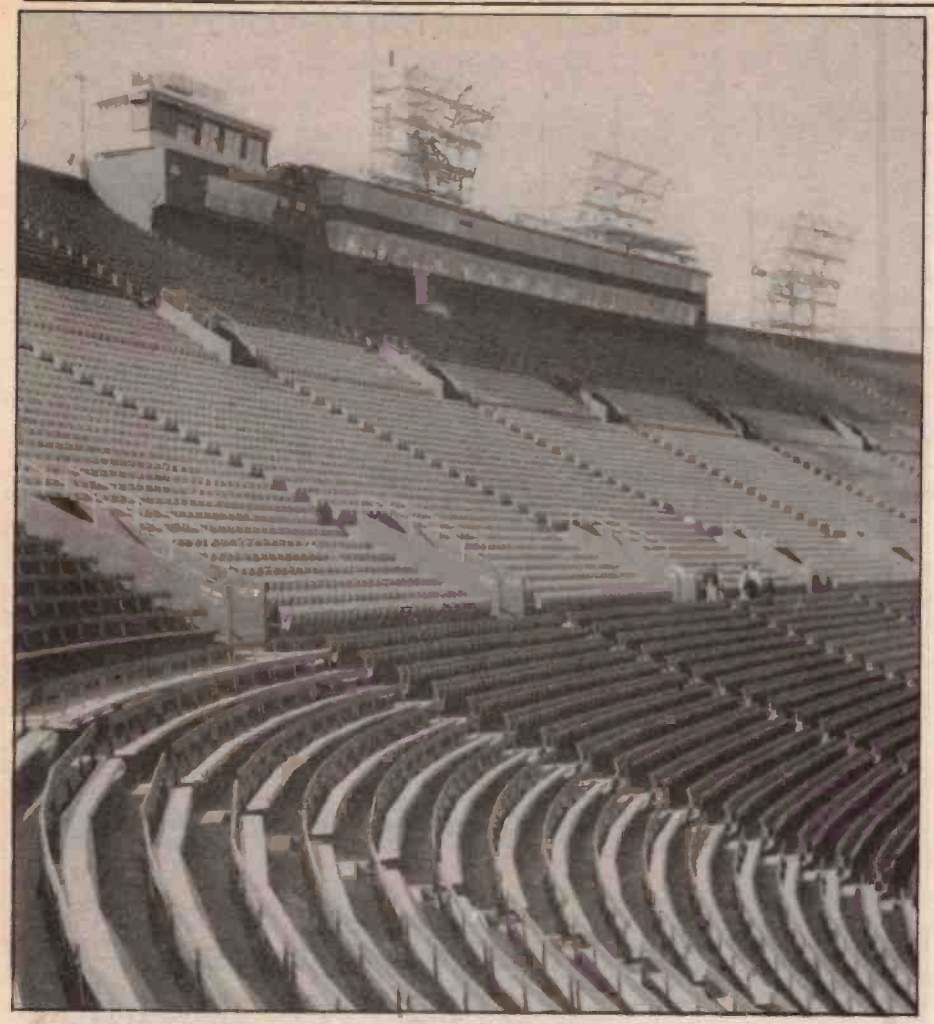


One of the more interesting shacks to act as a relay station for Olympic traffic was W6RO, the Long Beach ARC station on the Queen Mary, now a floating hotel south of LA.

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 4½ 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



Part of the 95000 capacity Memorial Coliseum.

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.

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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 Altis, the forested shrine of Zeus. As many as 40,000 spectators came from 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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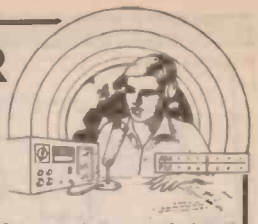

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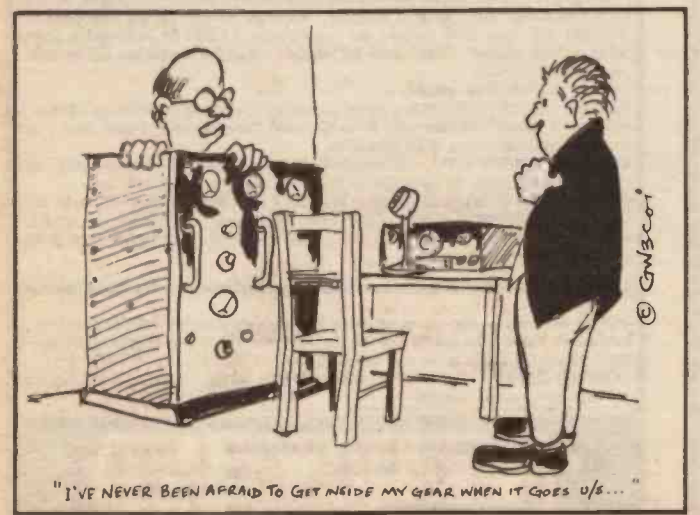
Practicalities

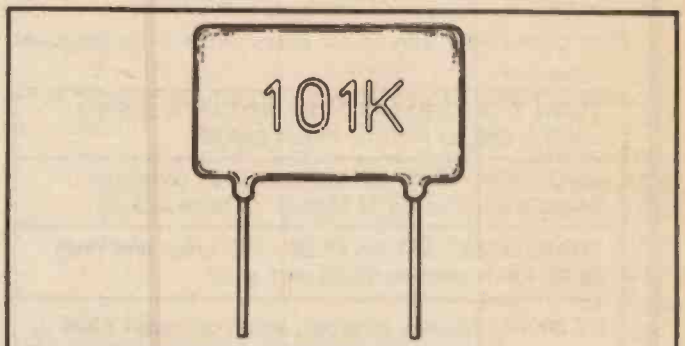
There must be very few radio amateurs operating on the HF bands who have not used a long wire aerial at one time or another, either for listening or transmitting. After all, it is a very easy form of aerial to construct: just a long length of wire and if we get technical it can be cut to a resonant length. In addition to this it is very easy to erect — no expensive feeder required either. Furthermore, a long wire can be made to look almost invisible.

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.





Do you know what this capacitor value is?

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

101 would be 10×10^1 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.

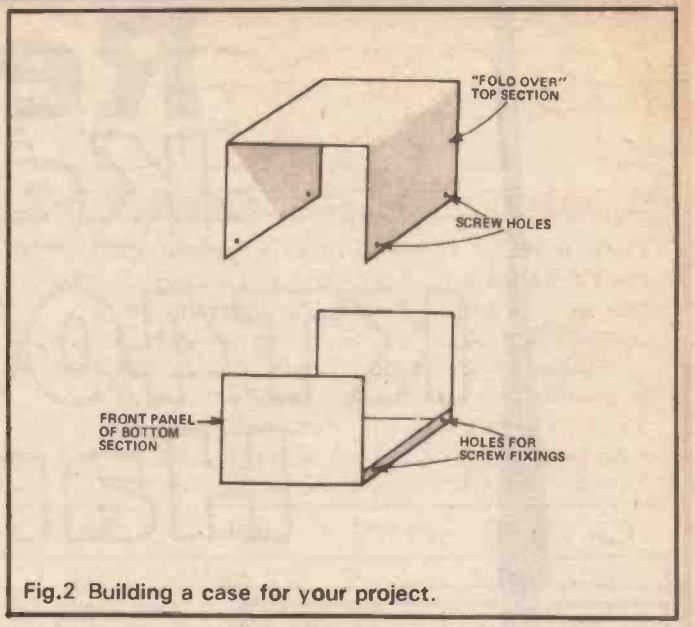


Fig.2 Building a case for your project.

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.

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Review
Kenpro KT400EE UHF Handheld

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.

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 handhelds from both Trio and Yaesu, with key-pad entry and memories, and, the Palm series from the now defunct FDK, with Belcom appearing eventually on the scene as well.

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.

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 an eyelet via a split ring. A cloth type strap is supplied, rather than the plastic one tends to find on portables, this is very comfortable to use and, unlike its counterpart, doesn't lay in its rigid form and generally get in the way.

Measuring some 60 x 40 x 170mm the rig is capable of transmit and receive in the frequency range 430-439.995 in mode F3E (FM), either simplex, or duplex with a fixed transmit shift of plus 1.6MHz. The majority of the controls are located on the top panel, flat at the rear with a sloping front. The combined on/off and volume control is, like the squelch, a rotary pot, both including a clear indication of the position of the control by a pointer. To the left of these controls, the BNC socket for connection of antenna. It is a shame that a 'cheap' type of socket has been employed comprising of only two inner connecting pins, which has a relatively short life. Sandwiched between the BNC and the rotary controls is a miniature push-to-make switch — the tone burst activator. A single push, for the re-

quired duration, produces 1750Hz tone on the transmitted carrier. It is not necessary to press the PTT simultaneously.

Below the tone burst switch a red LED (rectangular) indicates that the unit is in transmit mode. Should this fail to come on during transmit, indications are that the battery needs charging. The three rotary frequency selection switches are in the centre of this top panel, to the left a 2.5mm socket for PTT and mic lines and below a 3.5mm for audio output, with an in-built switch which cuts the internal speaker when this accessory socket is in use. To the right of the thumbwheels there is a large, locking switch which selects the option of a 5kHz high offset from the main frequency.

The remaining controls are located to the rear. Inset into the rear panel are two slide switches to select simplex or duplex working, and either high (rated 1.5W) or low (150mW) power output. Apart from the battery pack which slides from the bottom, that's about it from the exterior.

Utilising PLL circuitry, with a 5V rail for most of its electronics, the Kenpro boasts that it can withstand a working voltage of between 5.5 and 12 volts DC. The rated voltage is quoted at 8.4V. Current consumption is said to be some 170mA with full audio, on receive; and about 22mA in standby mode. On transmit, at the high power setting, current is a specified 700mA and reduces to 300mA in low power position.

Accessories

The standard battery pack contains five 1.2V 250mA rechargeable cells and a voltage, therefore, of 6V. Other battery packs are available in the range of approved accessories which also include the following. A slide-on battery pack to accommodate dry cells, a DC to DC converter to allow operation from a 12V DC supply; a mobile charging cord to provide the necessary voltage from a car cigarette lighter to either charge the NiCad pack, or to run into the DC-DC converter.

Also among the optional extras, a range of alternative antennas. A half-wave whip (for use with the VHF version, the KT200EE) and a

The panel view. Note the position of the tone button between the BNC socket and the squelch control.

⅝ wave whip for the KT400EE, both terminating in BNC plugs. Leather type cases are also available, allowing access to all controls when in place, as well as enabling easy changing of the battery pack, without having to remove the entire protective case. The case also incorporates a pocket for carrying 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 possession, 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 conducted 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.

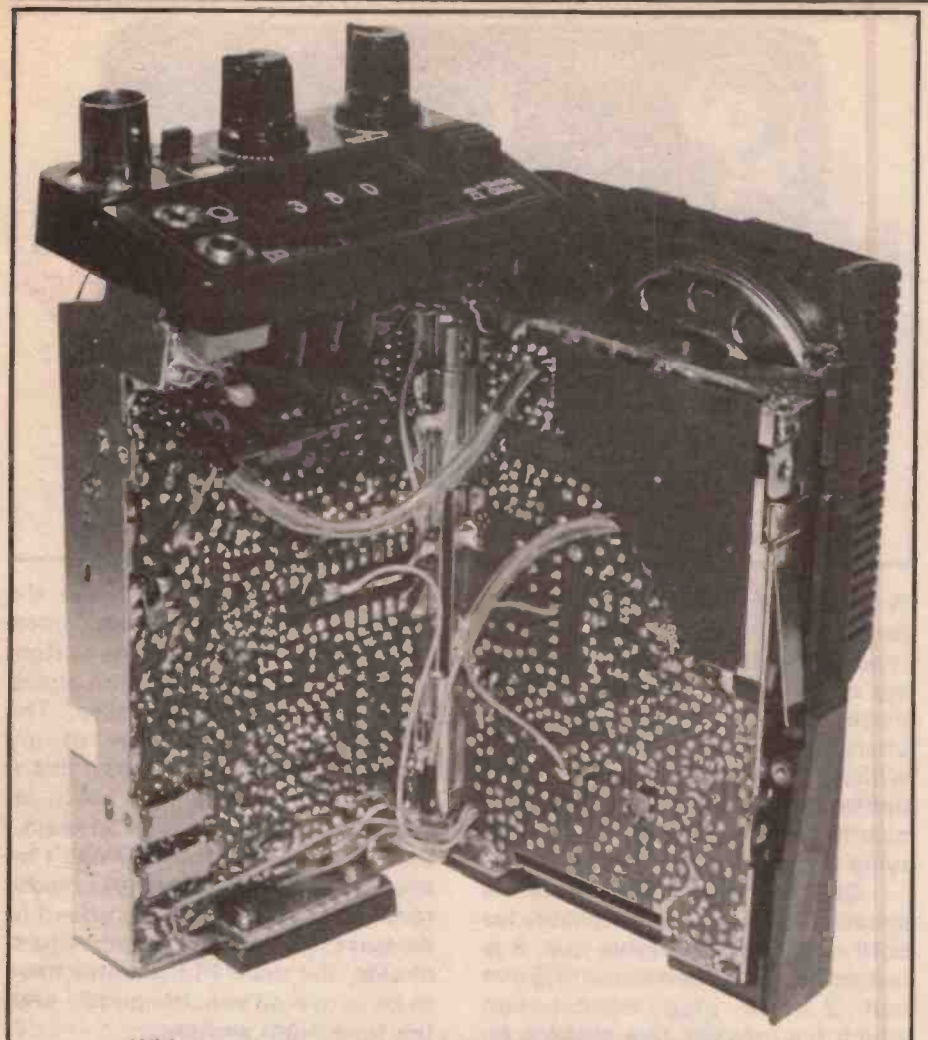
Trying to activate the tone burst circuitry, I found that my finger would not fit between the BNC socket and the squelch control so I could not push the tone button. I took my glove off and tried again, once more without success. The answer was to use one of my smaller fingers — not easy but it worked. The red LED lit up to indicate 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 handhelds, 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' loudspeaker.



With the rear cover removed, the hinged assembly swings apart to reveal the copper side of the PCB.

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 straight forward 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 comtemplating 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 £425 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.

An interior view with the front panel removed showing the compartment side of one board in its metal surround.

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

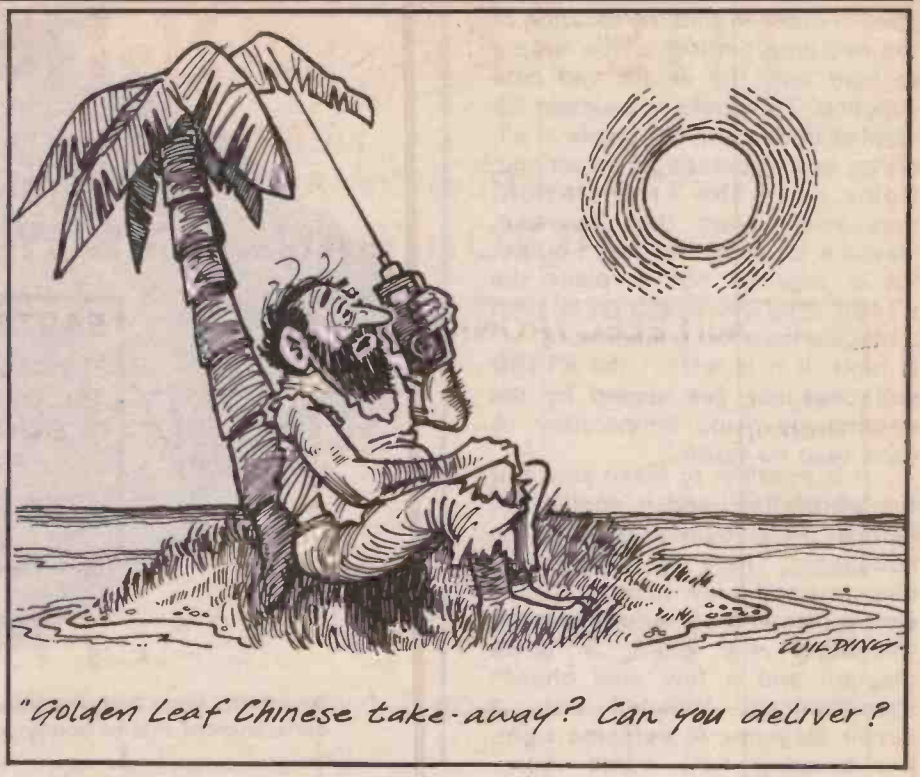
Before handing the sample back, I took the opportunity to try an alternative antenna. Walters and Stanton supply a wide range, and allowed me to test their stub helical and telescopic ⅝ wave. The stub helical — just 80mm long — was more convenient than the ¼ wave supplied by Kenpro, although at times less effective. It was possible to work the local repeater using the helical and it seemed less prone to changes in polarisation than the ¼ 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 ¼ wave (just 175mm), and in the extended mode (at 465mm), a fine, ⅝ 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.



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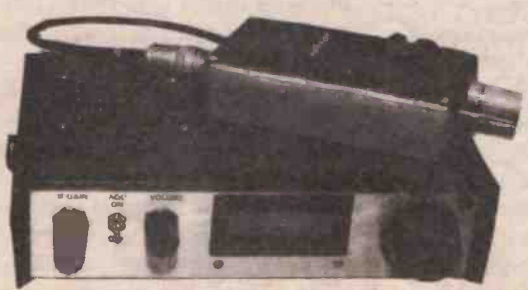

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Working Oscar 10

The Advanced Satellite

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, ie 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.

of the UOSAT and Russian RS types, which are ideal for 'cutting your teeth on' in this field.

Those readers who have taken the plunge and have acquired the basic skills and principles of satellite techniques will no doubt be anxious to get on to the techniques necessary for dealing with the next phase of satellites, phase 3 as they are called. At the moment, OSCAR 10 is the sole representative of phase 3, but further satellites are either being built or planned.

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

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 35600 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

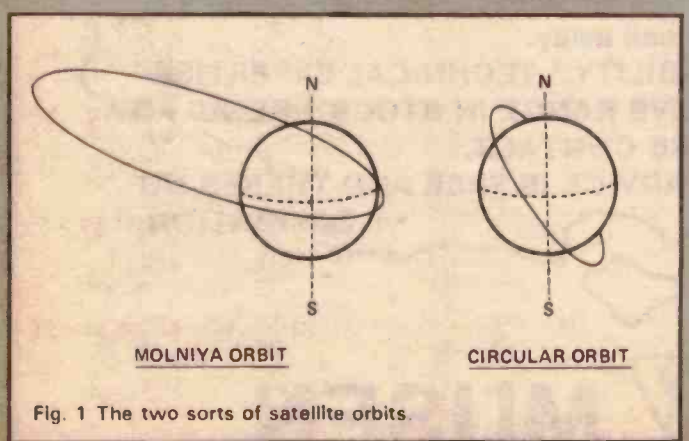


Fig. 1 The two sorts of satellite orbits.

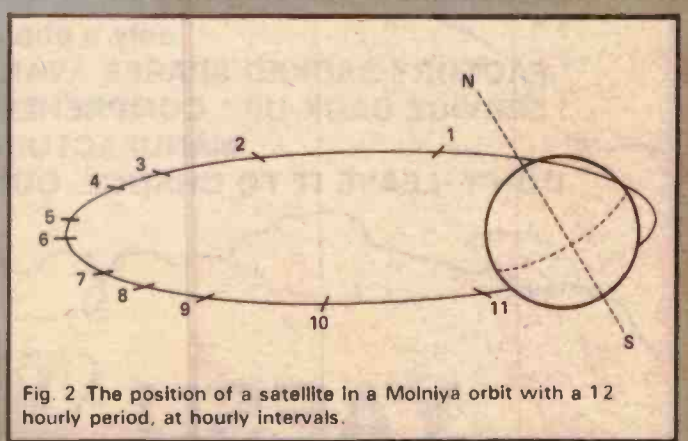
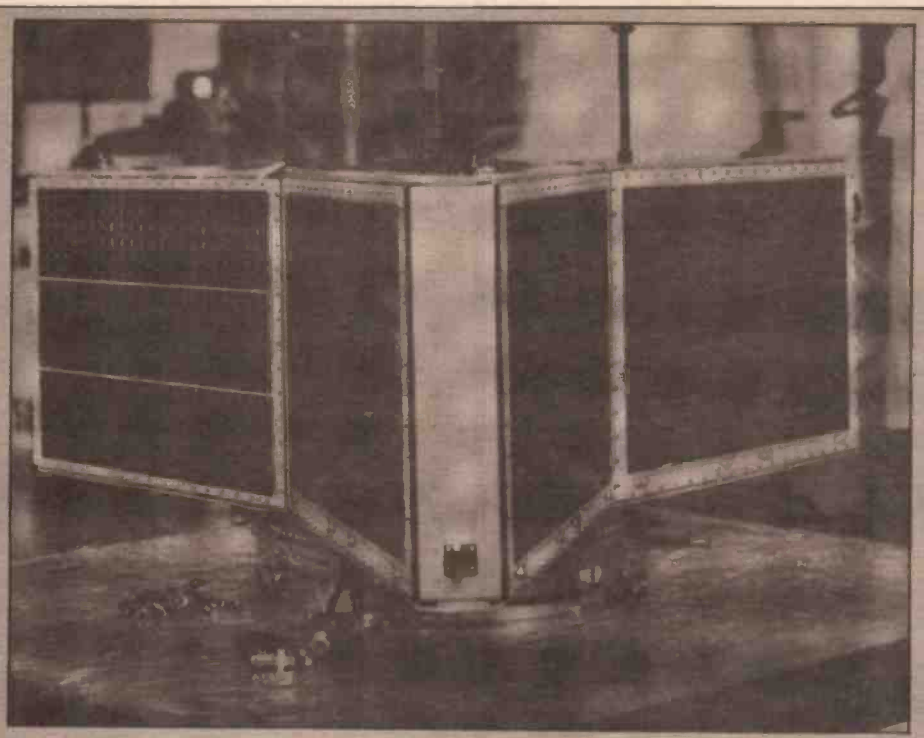


Fig. 2 The position of a satellite in a Molniya orbit with a 12 hourly period, at hourly intervals.



Oscar 10 in all its earthly glory.

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

15:NOV:85 1826			16:NOV:85 1828			17:NOV:85 1830			18:NOV:85 1832			19:NOV:85 1834		
1420	268		1335	268		1255	258		1210	258		1125	257	
1455	205	30	1405	204	32	1320	196	35	1235	189	36	1150	182	38
0120	133		0020	149		2230	170		2100	166		1900	157	
20:NOV:85 1836			21:NOV:85 1838			22:NOV:85 1840			23:NOV:85 1842			24:NOV:85 1844		
1040	256		0955	254		0915	243		0830	240		0745	236	
1105	176	38	1020	172	38	0935	169	38	0850	168	37	0805	169	35
1340	127		1150	116		1040	109		0940	104		0845	100	
25:NOV:85 1846			26:NOV:85 1848			27:NOV:85 1850			27:NOV:85 1851			28:NOV:85 1852		
0700	232		0615	227		0525	226		1905	247		0440	220	
0720	170	33	0635	172	30	0555	150	27	1915	244	0	0510	152	24
0755	96		0705	94		0615	95		1940	239		0530	93	
28:NOV:85 1853			29:NOV:85 1854			29:NOV:85 1855			30:NOV:85 1856			30:NOV:85 1857		
1745	259		0350	216		1655	259		0305	209		1605	262	
1830	237	5	0425	153	21	1740	231	10	0340	153	18	1650	225	14
2020	226		0445	92		2035	220		0400	92		2050	214	
01:DEC:85 1858			01:DEC:85 1859			02:DEC:85 1860			02:DEC:85 1861			03:DEC:85 1861		
0210	207		1515	268		0120	201		1430	267		0020	198	
0255	152	15	1600	219	18	0210	150	12	1510	214	22	0120	157	9
0310	106		2105	209		0225	108		2120	204		0140	110	
03:DEC:85 1863			03:DEC:85 1863			04:DEC:85 1865			05:DEC:85 1867			06:DEC:85 1869		
1345	267		2305	195		1300	267		1215	267		1135	257	
1420	210	25	0030	158	6	1335	201	28	1245	200	31	1200	193	33
2150	197		0050	123		0000	131		2305	141		2155	153	

Fig. 3 An extract from Orbital Calendar showing the entry for 6th December 1985. See text for details.

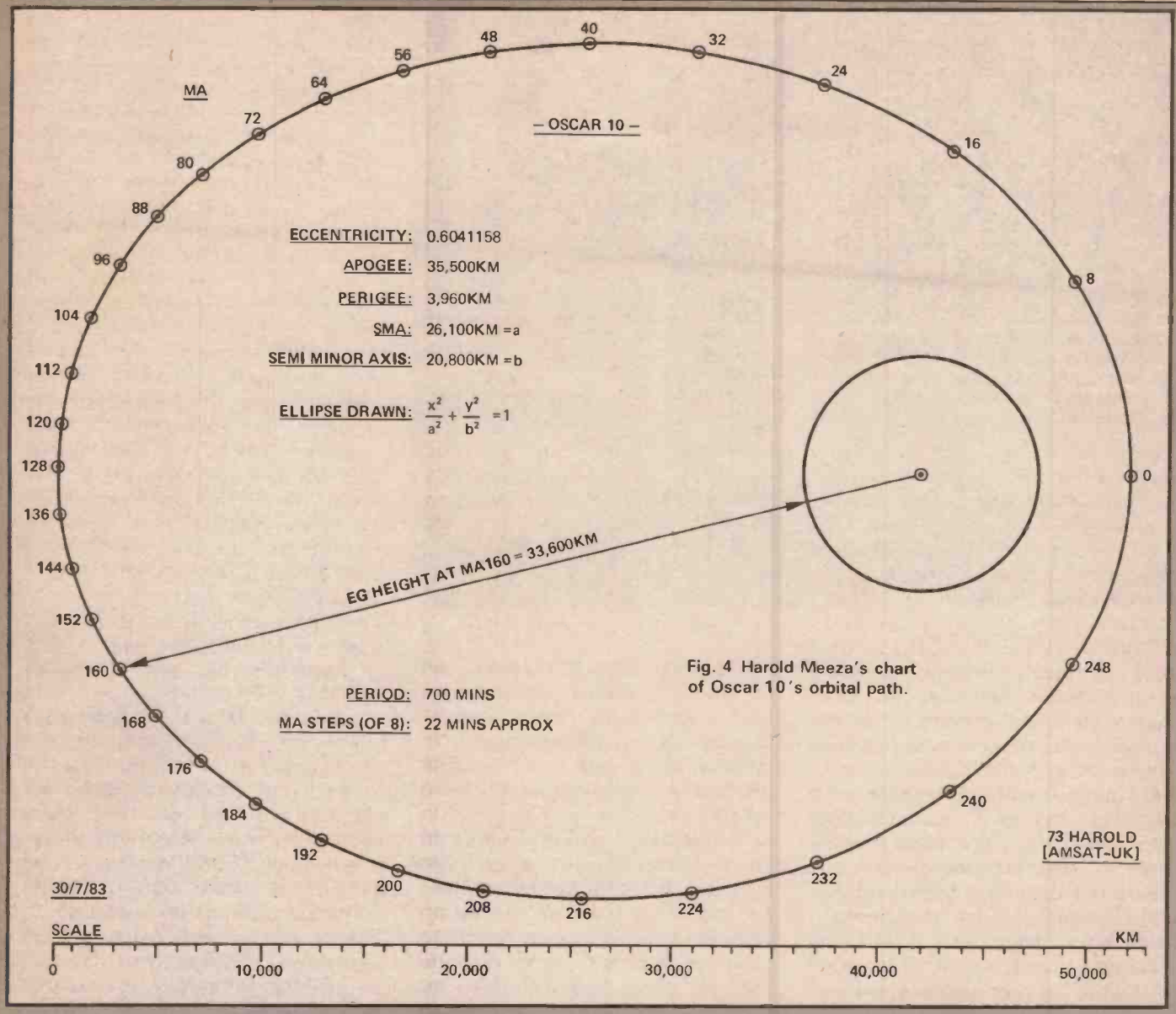


Fig. 4 Harold Meeza's chart of Oscar 10's orbital path.

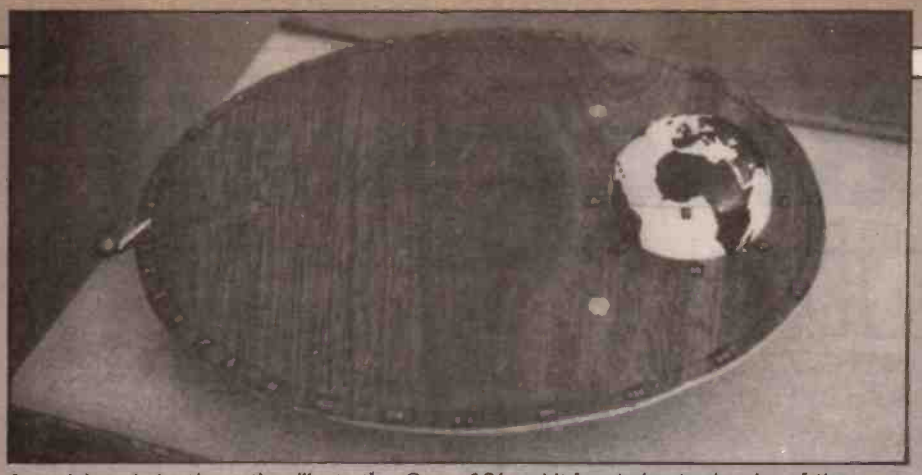
issued from AMSAT-UK to cover the period October 1985 to December 6th, in the section for OSCAR 10 we look up the parameters for December 6th. The entry 1136 is the time, GMT, when the satellite reaches a point on its passage round the earth. At that time it comes into range of a station in the location 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



A model made by the author illustrating Oscar 10's orbit in relation to the size of the world (based on the original model by Jim Millar). The globe is two "Airwick" container covers with the rest of the model scaled down appropriately. The globe is detachable from the rest of the model and can be placed in different orientations to suit appropriate data.

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 Meeza, of Chatham, England, and is shown in **Fig.4**. The Mean Anomaly figures start at perigee and go on in steps round the orbital track to finish back at perigee 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 any reader who would like to make it up should get a copy of that issue. Much more information about Oscar 10's orbital parameters can be obtained from this model than just an indication of the position of the satellite around its orbit, all of which is described in the article. Incidentally, a good description of Harold Meeza's Chart appears in the same issue on page 18, under the title "Scale Drawing of the OSCAR 10 Orbit".

What's On Oscar 10?

Oscar 10 was launched by an Ariane Launcher on 16th June 1983. It caries 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 5EQ.

The Brickwall Audio Filter

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 300Hz 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-

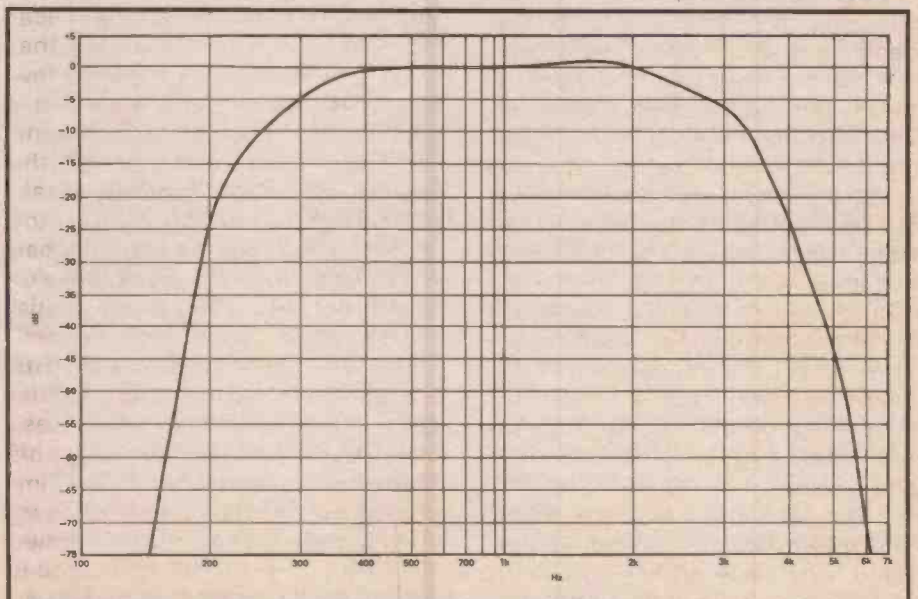


Fig.1 Frequency response of the prototype audio filter.

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 swopped 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.

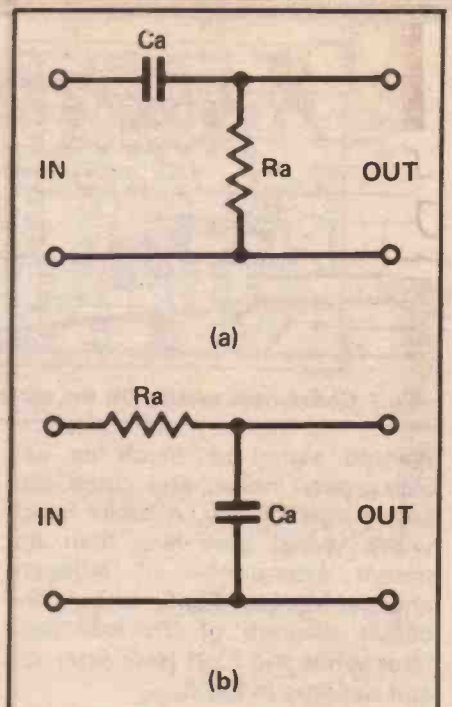


Fig.2 Basic RC high-pass and low-pass filters.

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 (or 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.

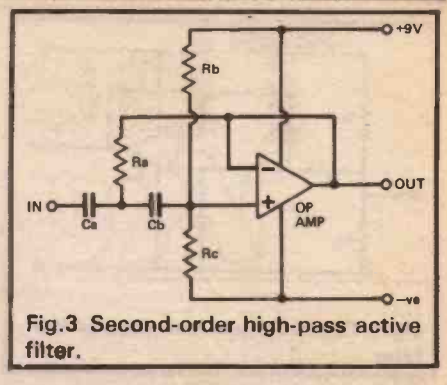


Fig.3 Second-order high-pass active filter.

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 and Cb 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 and Cb 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

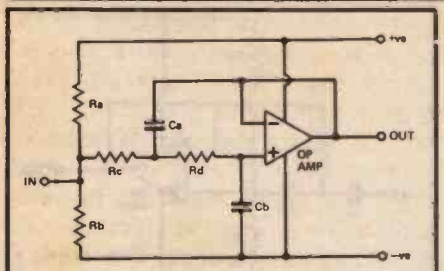


Fig.4 Second-order low-pass active filter.

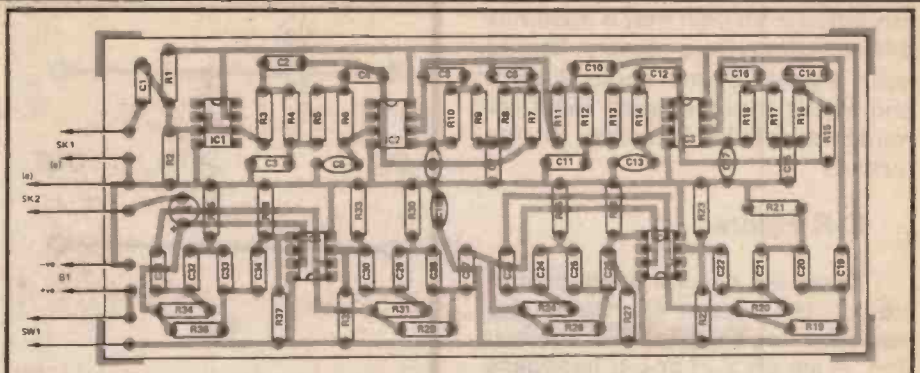


Fig.7 Component overlay for the audio filter board.

just the elimination of the slow initial attenuation rate, but also an increase in the ultimate attenuation rate (to 12dB 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 300Hz, and a low pass filter with a cut off frequency of around 3kHz. 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 24dB per octave. Four filter blocks therefore gives an overall total attenuation rate of 96dB 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 24dB 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 102dB per octave.

I originally felt that the high pass filter would be of little benefit,

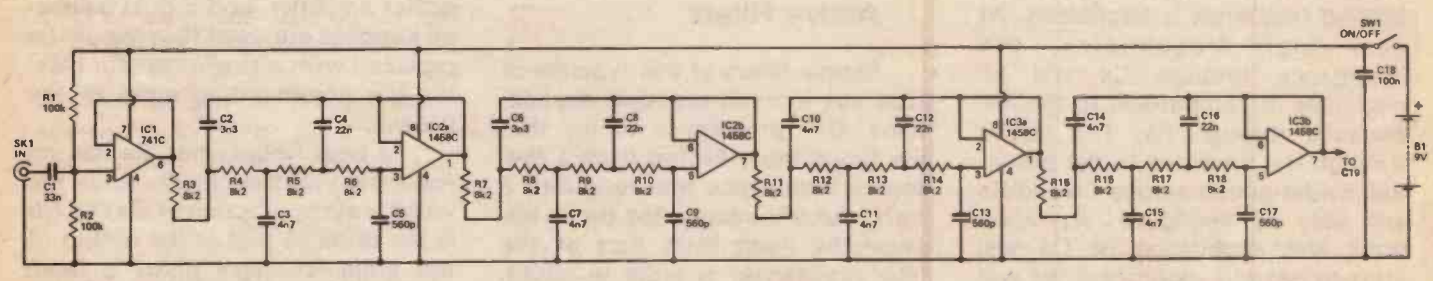


Fig.5 Circuit diagram of the low-pass filter stages.

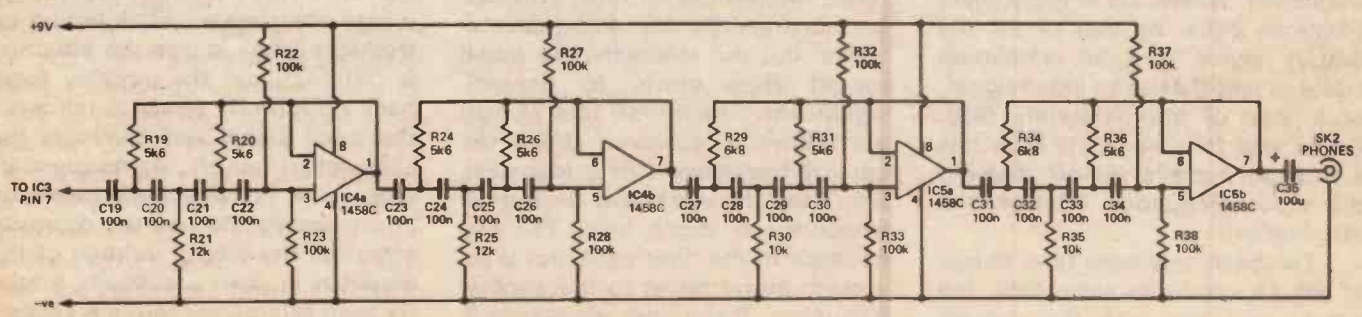
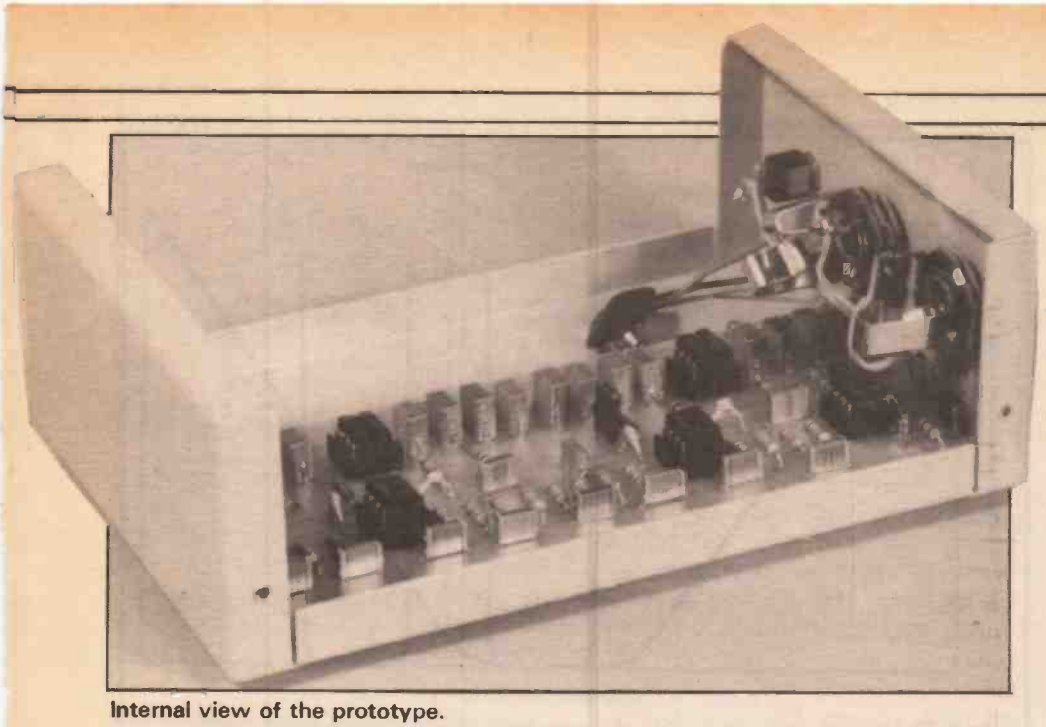


Fig.6 Circuit diagram of the high-pass filter stages.



Internal view of the prototype.

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 4dB 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,

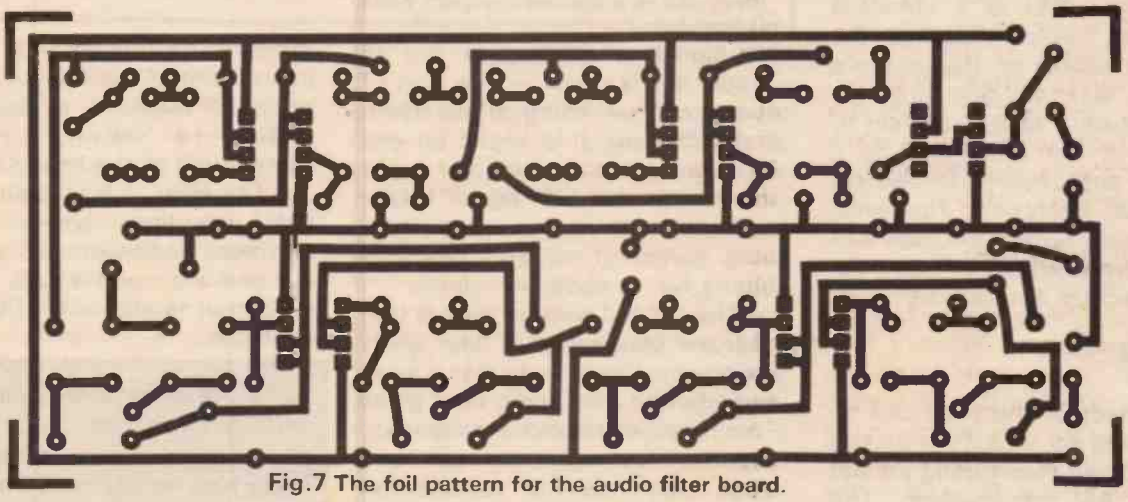
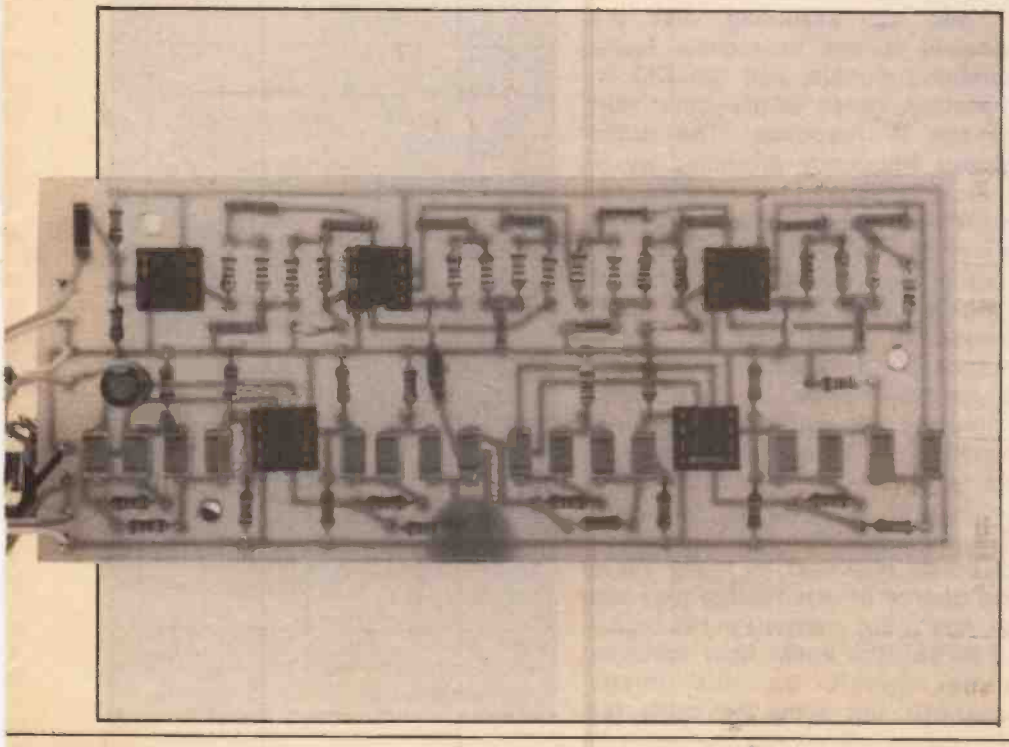


Fig.7 The foil pattern for the audio filter board.

The completed circuit board.



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 rapidly 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.

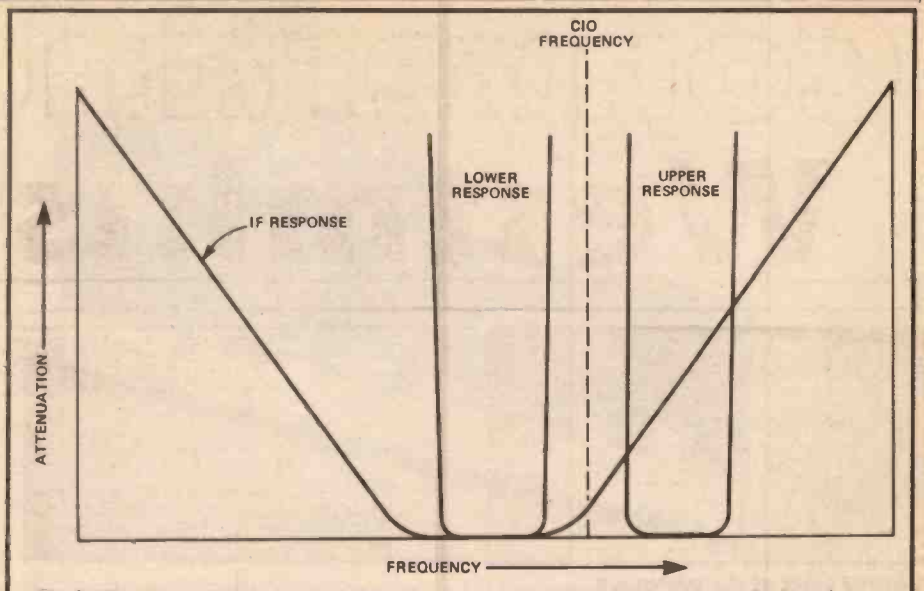


Fig.8 The combination of a wide IF bandwidth with a narrow audio band gives rise to a second any-pass band.

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 frequencies 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 ¼W 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 carbonate
C35	100uF 10V radial elect

SEMICONDUCTORS

IC1	uA741C
IC2,3,4,5	LM1458C

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.

Converting Pye Westminsters

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.**

Rumours that the author has cornered the UK market in Pye Westminsters in anticipation of this article being published are (almost) entirely without foundation.

The Westminster range has AM and FM sets, with different frequencies from 32.5MHz up to 470MHz. A 68MHz AM set looks absolutely identical to a 145MHz 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: 50kHz spacing, ± 15kHz filters;
V: 25kHz spacing, ± 7.5kHz filters;
S: 12.5kHz spacing, ± 3.75kHz filters.

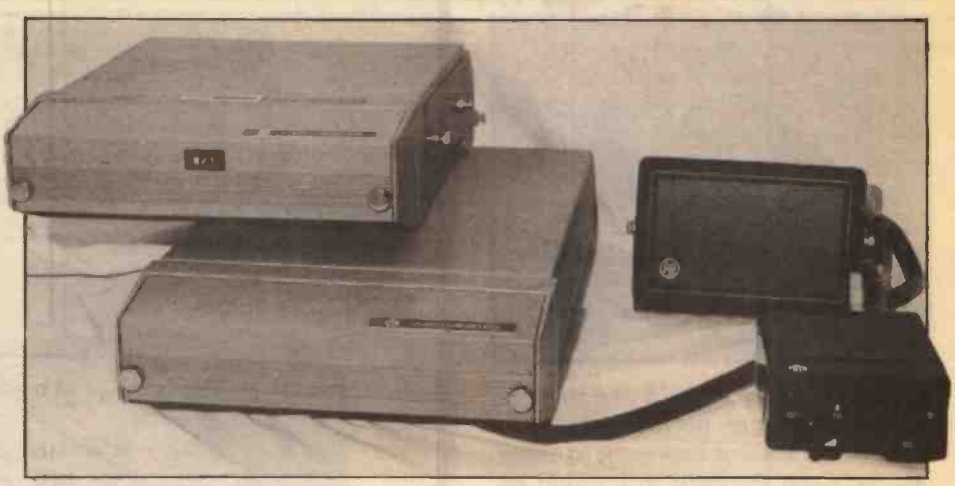
Look out for a V set if you want it for 2m; you will suffer from adjacent channel interference with an N set (fairly old and hence rare), and from distortion on receive with an S set (newer and hence more common). If you do end up with a set with unsuitable spacing then Garex Ltd, amongst others, can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

FREQUENCY	DESIGNATION	MOD	MOUNT
32.5 MHz-40 MHz	H Band	FM	Remote
40 MHz-50 MHz	G Band	FM	Remote
68 MHz-88 MHz	E Band	AM/FM	Dash/Remote
132 MHz-156 MHz	B Band	AM/FM	Dash/Remote
148 MHz-174 MHz	A Band	AM/FM	Dash Remote
405 MHz-440 MHz	T Band	FM	Remote
440 MHz-470 MHz	U Band	FM	Remote

Table 1 The different Westminster frequency ranges.



W15FMB VHF set on top of W15U UHF set.

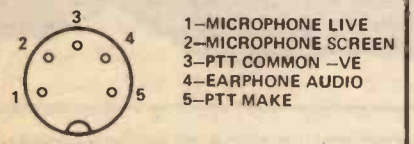


Fig. 1 Microphone connections.

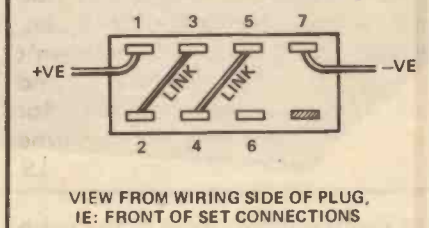


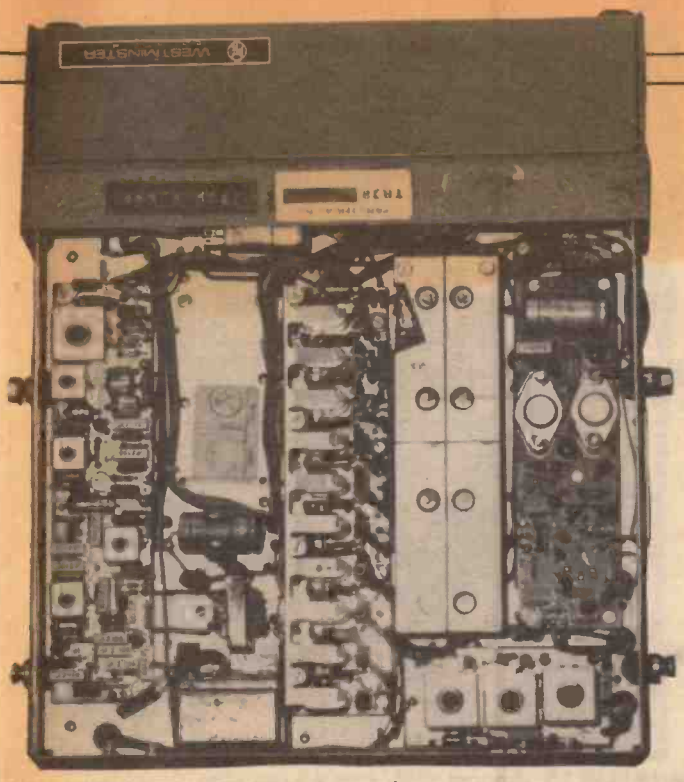
Fig. 2 Negative earth DC plug wiring.

Rx Crystal = (Rx Freq MHz-10.7)/2MHz (68-88 MHz the 4m band)
or
(Rx Freq in MHz –10.7)/3MHz (132-174 MHz including 2m)

Tx Crystal = (Tx Freq in MHz)/24MHz (68-88 MHz for 4m)
or
(Tx Freq in MHz)/36MHz (132-174 MHz for 2m)

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.



W15FMB 10 channel VHF, internal bottom view.

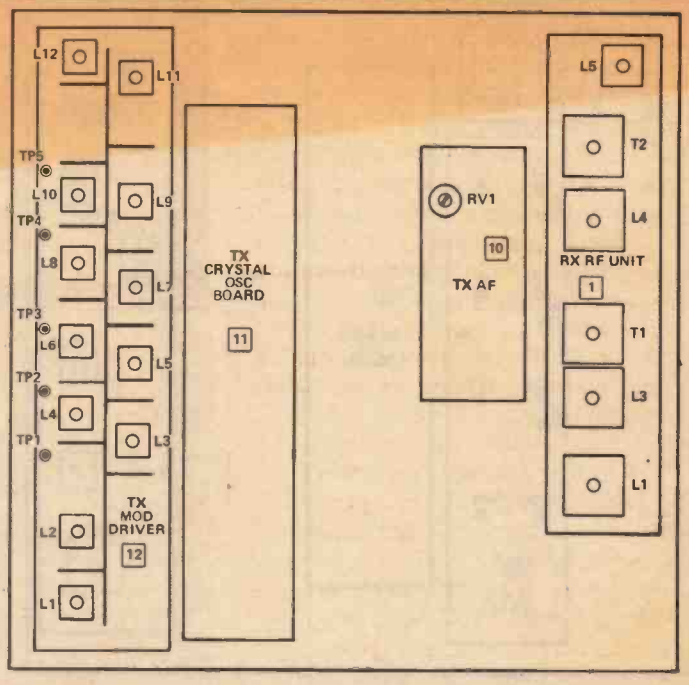


Fig. 3 W15FM bottom view of alignment points.

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 at the end of the board, next to L11, and feeding the RF into a power meter or 50 ohm resistor with a diode probe across it (from our RAE days we all, of course, know how to knock one of these up using a few components). The more basic of us may choose to use a light bulb in an emergency, although this will not give exactly 50 ohms. Tune L10, L11, and L12 in that order for maximum power (around ¼ watt), then retune L10, L9, L11 and L12 for absolute maximum.

We start on the real power alignment by reconnecting 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-shape 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

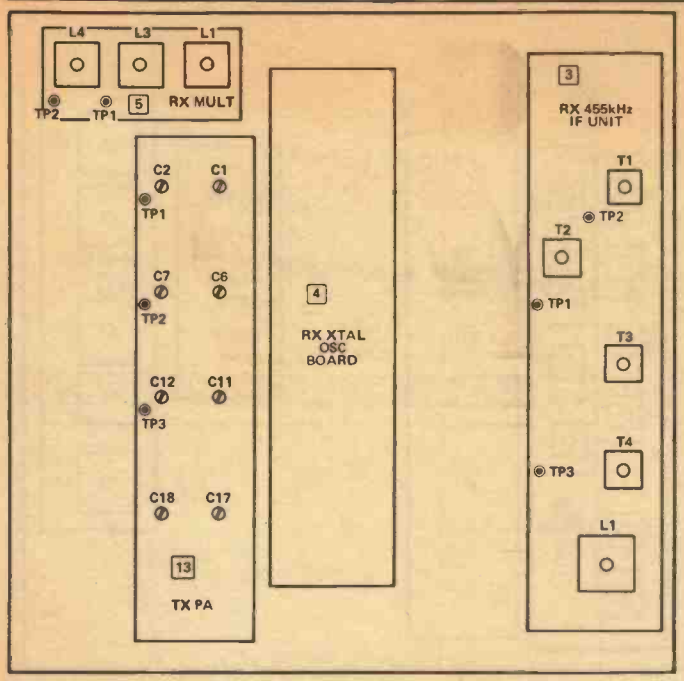
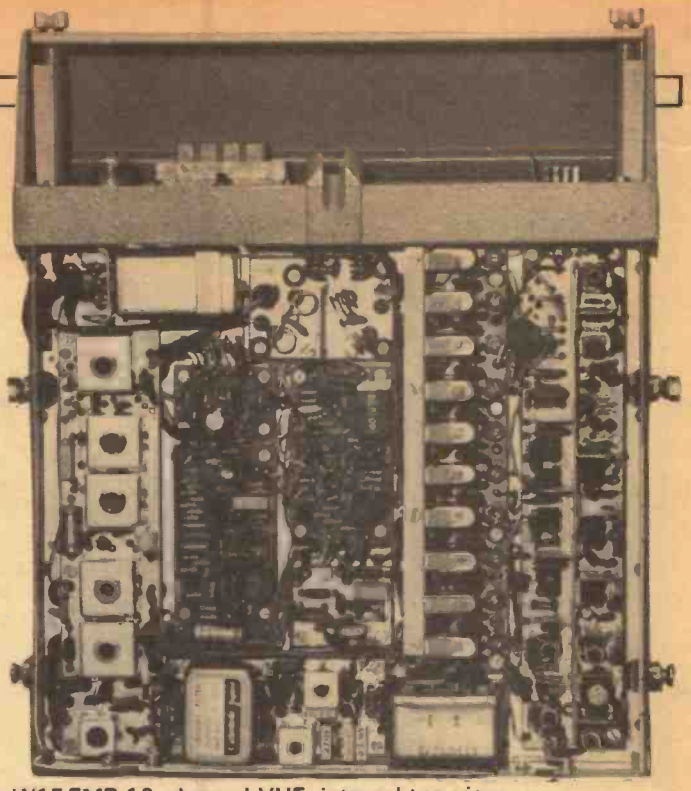


Fig. 4 W15FM top view of alignment points.



W15FMB 10 channel VHF, internal top view.

to give this a quick twiddle also with the help of another amateur, unless of course you have access to a deviation meter! RV1 on the Tx AF board (board 20, both clearly marked) sets the peak deviation; mic gain is pre-set and not adjustable. A useful hint is to use the local repeater, shouting a loud 'four' or whatever into the microphone while another station quickly checks repeater input and output for the same loudness on both signals — most repeaters are very accurately set and maintained.

Receiver Alignment

Again, a multimeter is useful here, as 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, T1, 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 0.35uV 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 TR5 (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, Heswall, Wirral, Merseyside L61 6XT (051 342 4443)

Quartzlab Marketing Ltd, PO Box 19, Erith, Kent DS8 1LH (01 318 4419)

Metre Wave

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.

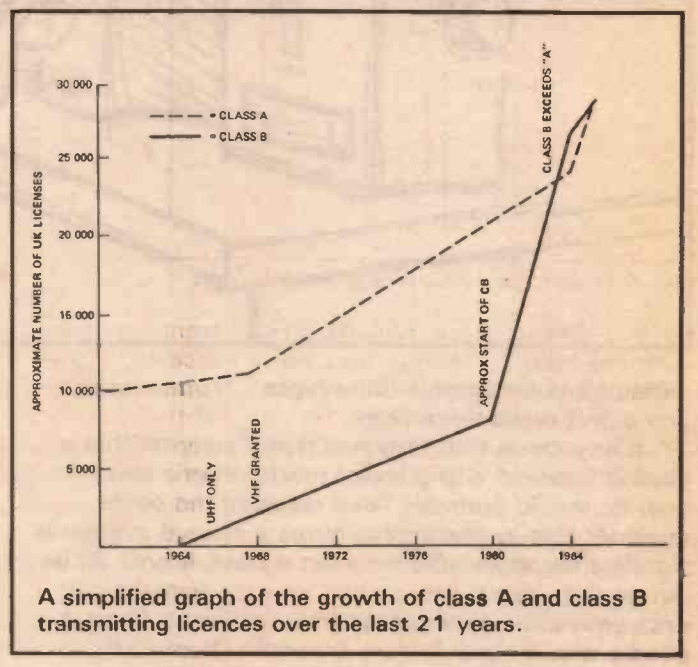
21 years of a special VHF only licence! To those who recall its advent in 1964 "it seems only yesterday". To those who accept the class B ticket as the perfectly normal, almost routine means of entering amateur radio it is hard to realise that when the licence was envisaged, it was regarded as something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



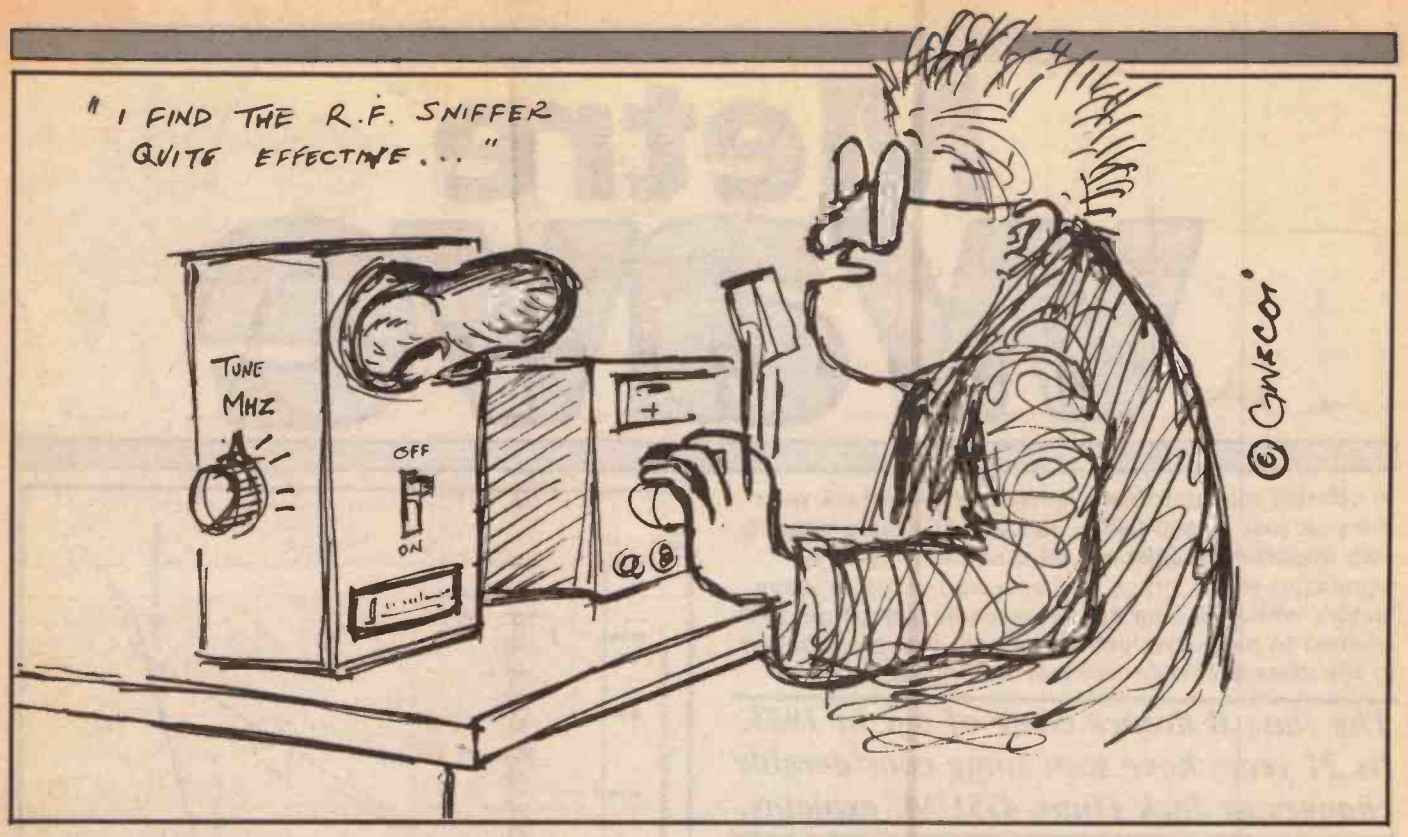
A simplified graph of the growth of class A and class B transmitting licences over the last 21 years.

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 in to the G8B-series, which, allowing for about 620 callsigns per block meant that 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, as 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 lookback 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!

RADIO Tomorrow

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

3 Feb
Borehamwood and Elstree ARC: meeting.
Basingstoke ARC: *Wood and Douglas equipment at the Forest Ring Community Centre, Sycamore Way, Winklebury.*
Southdown ARS: meeting.
Todmorden DARS: AGM.
S Tyneside ARS: meets every Monday at the Martec Club in S Shields.
Braintree DARS: meeting.
Worcester DARC: *talk by G3PQR.*
Morecambe Bay ARS: *Wood and Douglas Kits by G Rouse.*

4 Feb
Dartford Heath DFC: pre hunt meeting.
Bury RS: meets every Tuesday at the Mosses Centre, Cecil Street, Bury.
Stevenage DARS: construction contest.
Wolverhampton ARS: *Transmitter Testing — Frequency, Power, Deviation etc.*
Salisbury RES: meets every Tuesday from 7.30 at the Grosvenor House Centre, Salisbury.

5 Feb
White Rose ARS: *DXpedition to Laccadives (VU7) video.*
S E Kent (YMCA) ARC: natter night.
Mirfield RC: meets every Wednesday.
Three Counties ARC: *Satellite TV by G8CMQ.*
Glenrothes DARC: meets every Wednesday in the library in Leslie.
Pontefract DARS: homebrew show.
Havering DARC: surplus equipment and junk sale.
Fareham DARC: on air natter night.

6 Feb
N Wakefield RC: social night.
Abergavenny and Nevill Hall ARC: meets every Thursday.
Dunstable Downs RC: AGM.
Horndean DARC: *ZL slide show by G4PWG.*
Horsham ARC: *23cm and Up by G3GRO.*

7 Feb
Ayr ARG: *On To 6m by GM4NFC.*
Amateur Radio and Computer Club: meeting at the Crown, Bishops Waltham starting at 8pm.
S Manchester RC: meets every Friday in the Norris Road Community Centre, sale at 8pm.
W Kent ARS: surplus equipment sale.
Braintree DARS: club dinner.
Maidstone YMCA Sportscentre ARS: *Howe Communications display with G4KQH.*

9 Feb
Dartford Heath DFC: DF hunt.
Bury RS: Hamfeast at the Mosses Centre, Cecil Street in Bury starting at 11am admission is 50p with a talk in on S20.

10 Feb
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.*
Milton Keynes DARS: *Modern Multi Screen Cinemas by Mike Murphy at the Meeting Place, Hodge Lea, N Milton Keynes, starting at 7.30pm.*

11 Feb
Bury RS: *Installing Your HF Station — avoiding the pitfalls by G4JAG.*
Chester DRS: *HF Aerials by G3EWZ.*
Worksop ARS: *QRP by G6DCT.*
Bromsgrove ARS: *Severn Valley Railway.*

12 Feb
White Rose ARS: natter night.
Farnborough DRS: my favourite piece — an equipment evening by the members.
Havering DARC: informal.
Fareham DARC: project box presentation.

13 Feb
Conwy Valley RC: *Test Equipment by GW3JGA.*
Pontefract DARS: project evening.
N Wakefield RC: on the air.

14 Feb
Wimbledon DARS: meeting.
Nunsfield House CA ARG: surplus sale.
Clifton ARS: meeting.
Dunstable Downs RC: *Air Traffic Control.*

16 Feb
Glenrothes DARC: meeting.

17 Feb
Todmorden DARS: informal chat night.
Braintree DARS: *BNOS equipment display with G8UYN and G6FQE.*
Morecambe Bay ARS: film show.

18 Feb
Rugby ATS: *talk by RIS.*
Midland ARS: meeting
Stevenage DARS: junk sale.
Wolverhampton ARS: discussion night.
Borehamwood and Elstree ARS: AGM at the new venue of The Wellington in Theobald Street, Borehamwood.
Chester DRS: *Demonstration of Microwave Modules equipment by G3VYB.*

19 Feb
White Rose ARS: surprise night.
Three Counties ARC: *Steam Railways by G3ZRM.*
BT Reading RC: meeting.
Havering DARC: *Contest Operating — demonstration and talk.*
Worcester DARC: informal.
Fareham DARC: on the air natter night.

20 Feb
N Wakefield RC: *coach visit to Jorvik Museum at York.*
Pontefract DARS: *Antennas by G3HCW.*

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 Sportscentre ARS: *Paint Spraying by G3 REM.*

23 Feb
Cambridgeshire Repeater Group junk sale rally 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.

25 Feb
Wolverhampton ARS: night on the air.
Chester DRS: meeting.
Bromsgrove ARS: club night.

26 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.*
Worksop ARS: *Mystery Lecture night by G3ZVG.*

27 Feb
N Wakefield RC: meeting.
G Peterborough ARC: *VHF Expeditions by G4DHF.*

28 Feb
Wimbledon DARS: meeting.
Clifton ARS: meeting.
Dunstable Downs RC: *Milton Keynes TV visit.*

2 Mar
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 G8XTU.

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.
Mirfield RC: meets every Wednesday.
Three Counties ARC: *Microwaves by G8NDJ.*
Fareham DARC: on the air natter night.

6 Mar
N Wakefield RC: social night.
Horndean DARC: *Hilsea Lions by G4DTU.*
Pontefract DARS: natter night.
Horsham ARC: grand spring junk sale.

7 Mar
Ayr ARG:*Repeater Mystique by GM4COX.*
Amateur Radio and Computer Club: meeting at the Crown pub in Bishops Waltham.
S Manchester RC: meets every Friday In the Norris Road Community Centre, Sale at 8 pm.
W Kent ARS: meeting.
Clifton ARS: *Bus Location.*
Maidstone YMCA Sportscentre ARS: *Morse by G3ORH.*

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

9 Mar
Dartford Heath DFC: DF hunt.

10 Mar
Atherstone ARC: *The RSGB by region rep G8MWR.*

11 Mar
Bury RS: meeting.
Worksop ARS: *Silicon Glen video.*
Bromsgrove ARS: Shelsley Walsh.
Wolverhampton ARS: discusson night.

12 Mar
White Rose ARS: natter night.
Farnborough DRS: club operation evening.
Fareham DARC: *Update on 6m by G4JCC.*

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.

14 Mar
Clifton ARS: club meeting.

16 Mar
S Essex ARS First Mobile Rally at the Paddocks Community Centre, Canvey Island. Contact G4FMK on 0268 683805.
Pontefract DARS: Annual Components Fair at the Carlton Community Centre, Carlton. Larger than ever this year! Details from G4ISU 0977 792784.

17 Mar
Braintree DARS: meeting.

18 Mar
Midland ARS: meeting.
Stevenage DARS: AGM.
Borehamwood and Elstree ARS: informal constructors night.
Wolverhampton ARS: *RTTY on the Cheap.*

19 Mar
White Rose ARS: rally briefing.
Three Counties ARC: *The Case of 'F' Units by G3UUS.*

Worcester DARC: informal.
Fareham DARC: on the air natter night.

20 Mar N Wakefield RC: *Construction by George Dobbs at the Pontefract club.*
Greater Peterborough ARC: *Simple Aerials by G4OO.*

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.

24 Mar Atherstone ARC: *Satellites by G4ROA.*

25 Mar Bromsgrove ARS: club night.
Wolverhampton ARS: night on the air.

26 Mar White Rose ARS: natter night.
Farnborough DRS: *Fundraising Silly Sale with G4ISK.*
Fareham DARC: *Amateur Radio in France by FE5GC.*

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.

Contacts

Abergavenny & NH ARC	GW4XQH	0873 4655
Alyn and Deeside ARS	GW4RKX	0244 660066
Amateur Radio & Computer Club	Trevor	04895 81032
Atherstone ARC	Roy	0203 393518
Axe Vale ARC	Bob	029 74 5282
Ayr ARG	GM3THI	Ayr 42313
Barking RES	R. Woodberry	01 594 4009
Bath DARC	G4UMN	Frome 63939
Basingstoke ARC	Dave	07356 5185
Biggin Hill ARC	G0AMP	0689 57848
Borehamwood Elstree ARS	Tony	01 207 3809
Braintree RS	G6CJA	0376 45058
Brighton DARS	Peter	0273 607737
Bristol ARC	G4YOC	Bitton 4116
Bristol (Shirehampton) ARC	Ron Ford	0272 770504
BT (Reading) ARC	G4MUT	0734 693766
Bury RS	G1PKO	061 764 5018
Cambridge DARC	D. Wilcox	0954 50597
Cheshunt DARC	Roger Frisby	0992 464795
Chester DRS	Alan	0244 40055
Chichester DARC	C. Bryan	0243 789587
Clifton ARS	RA Hinton	01 301 1864
Conwy Valley ARC	G4VVW	0492 636376
Coventry ARS	R. Tew	0203 73999
Darenth Valley RC	G1NMX	Orpington 26951
Dartford Heath DFC	Pete	0322 844467
Denby Dale DARC	G3SDY	0484 602905
Derwentside ARC	G1AAJ	0207 520477
Donegal ARC	EI3BOB	074 57155
Droitwich DARC	G4HFP	0299 33818
Dudley ARC	John	0384 278300
Dunstable Downs RC	Phill Morris	0582 607623
East Kent RS	Stuart	0227 68913
East Lancashire ARC	Stuart	0254 887385
Edgware DARS	John	01 306 4342
Exeter ARS	Roger Tipper	0392 68065
Fareham DARC	Brian	0329 234904
Farnborough DRS	Mr Taylor	0252 837581
Fylde RS	PRO	0253 737680
Galashiels DARS	GM3DAR	0896 56027
G. Peterborough ARC	Frank	0733 231848
Halifax DARS	D Moss	0422 202306
Harrow RS	Dave Atkins	0923 779942
Hastings ERC	Dave Shirley	0424 420608
Haverhill DARS	Rob Proctor	0787 281359
Havering DARC	G0BOI	04024 41532
Hornsea ARC	Norman	0262 73635
Horsham ARC	Pete Head	0403 64580
Inverness ARC	Brian	0463 242463
Kidderminster DARS	Tony	0562 751584
Kingston DARS	G3ODH	Epsom 26005
Leighton Linslade RC	Pete Brazier	052 523 270
Loughborough ARC	Philip	0509 412043
Loughton DARS	G6FWT	01-508 7190
Maidenhead DARC	John	0628 28463
Maidstone YMCA S/C ARS	G4AYD	0622 29462
Maltby ARS	Ian Abel	0709 814911
Medway ARTS	Tony	0634 578647
Midland ARS	G8BHE	021382 0086
Mid Sussex ARS	G1FRF	0791 82937
Mid Ulster ARC	DF Campbell	0762 42620
Mid Warwickshire ARS	G4TIL	Southam 4765
Milton Keynes DARS	Dave	0908 501310
Morecombe Bay ARS	G3PER	Heysham 52659
N. Cornwall RS	J. West	0288 4916
N. Staffs ARS	G6MLI	0782 332657
N. Wakefield RC	S. Thompson	0532 536633
Newbury DARS	G3VOW	0635 43048
Oswestry DARC	Brian	0691 831023
Pontefract DARS	G0AAO	0977 43101
Preston ARS	George	0772 718175
Rhyl DARC	GW1AKT	Nantglyn 469
Salisbury RES	Neil	0980 22809
Shefford DRS	G4PSO	Hitchin 57946
Stevenage DARS	G4ISO	0462 892765
S. Bristol ARS	Len Baker	0272 834282
S. Cheshire	Chris	Kidsgrove 73185
S. Lakeland ARS	Dave	0229 54982
S. Manchester ARC	Dave Holland	061 973 1837
S. Tyneside	G4XWR	S. Shields 543955
S. E. Kent (YMCA) ARC	John	0304 211638
Southdown ARS	P. Henly	0323 763123
Stevenage DARS	Frank, G4ISO	Baldock 892765
Stockton DARS	John Walker	0642 582578
Stowmarket DARS	M. Goodrum	0449 676288
St. Helens DARC	A. Riley	051 430 9227
Swale ARC	B. Hancock	0795 873147
Telford DARS	Tom Crosbie	0952 597506
Three Counties ARC	Keith, G0BTU	0730 66489
Tiverton (SW) RC	G. Draper	03634 235
Todmorden DARS	Mr Gamble	070 681 2494
V White Horse ARS	Ian White	Abingdon 31559
Verulam ARC	Secretary	St Albans 59318
WACRAL	G4NPM	0795 873147
Wakefield DRS	G8PBE	0924 378727
Welland Valley ARS	J. Day	0858 32109
Welwyn Hatfield ARC	Dave	07073 26138
West Kent ARS	B. Guinnessy	0892 32877
Westmorland RS	G. Chapman	0539 28491
White Rose ARS	G4YEK	0423 884481
Willenhall ARS	G4LWI	0902 782036
Wimbledon DARS	G3DWW	01 540 2180
Wirral ARS	Cedric	051 625 7311
Wirral DARC	Gerry Scott	051 630 1393
Wolverhampton ARS	Keith	0902 24870
Worcester DARC	D. Batchelor	0905 641733
Worthing DARC	Roy	0903 690415
308 ARC (Surbiton)	Dave Davis	01 399 5487

The Trio TS940S
The Ultimate Rig?

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

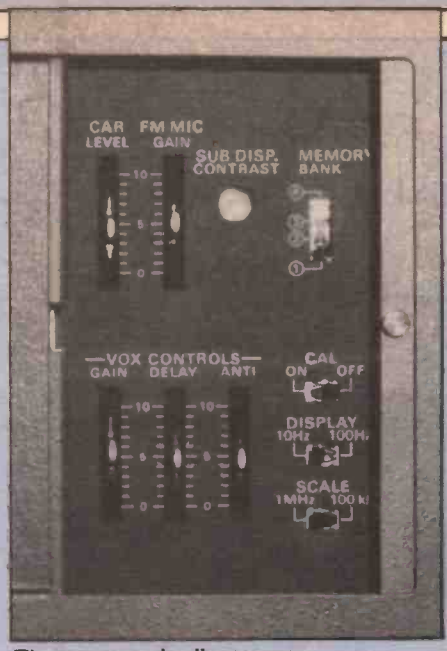
and display resolution selection, and calibrator on/off. And round to the rear panel. . . (phew!). There are numerous sockets for main and external receiver aerials, IF output, transverter, morse key, FSK input, extension speaker, accessories such as computer interface and so on. Two fans are fitted, 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.



The top panel adjustments.

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

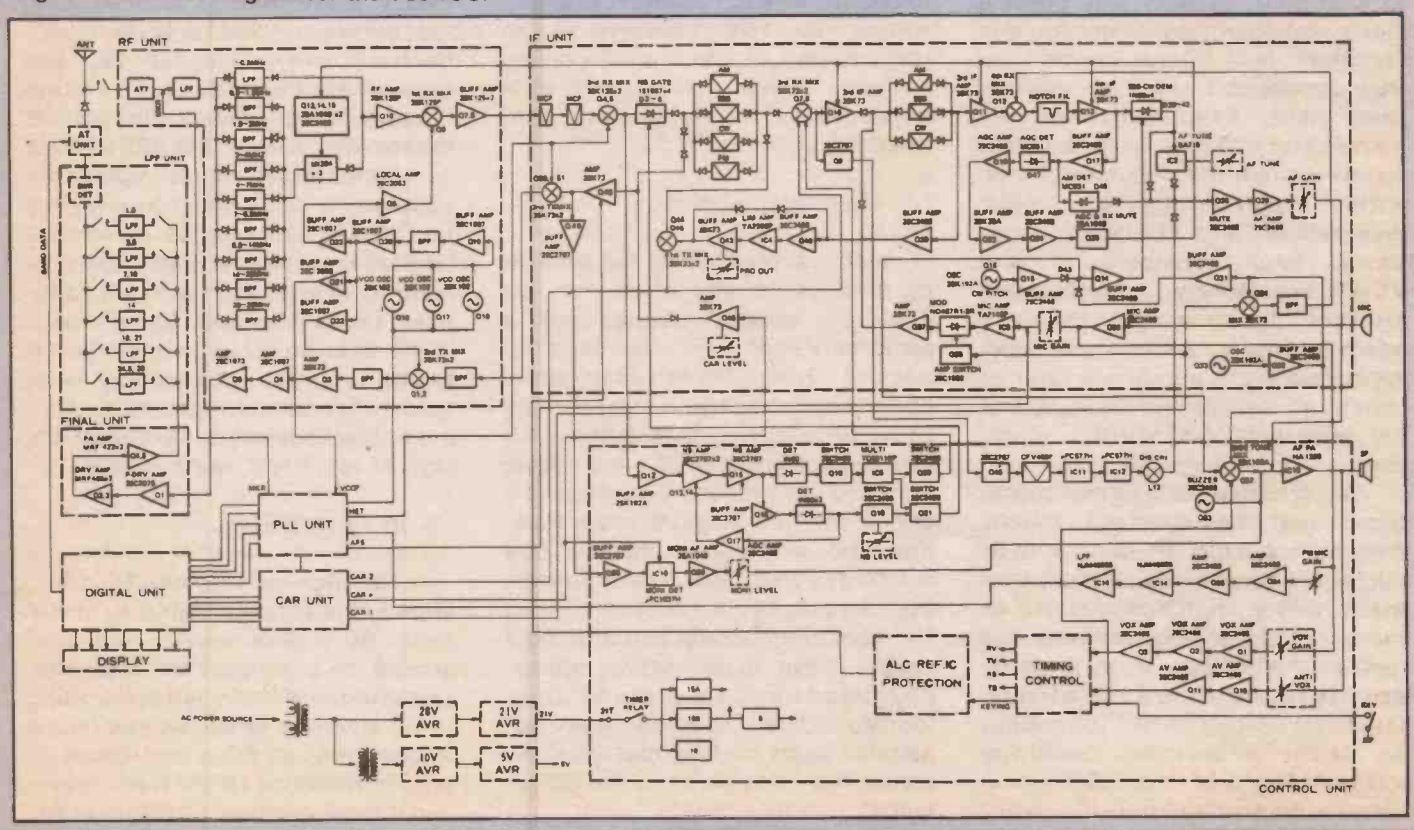
"Every conceivable feature" the ads say — rather a spectacular statement I think! There are few things it doesn't have. Before even switching the TS940S on, I thought it would have been nice to have a centre-zero 'S' meter and selectable Tx/Rx split as a keen 10m FM operator. Although the full CW break-in 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.

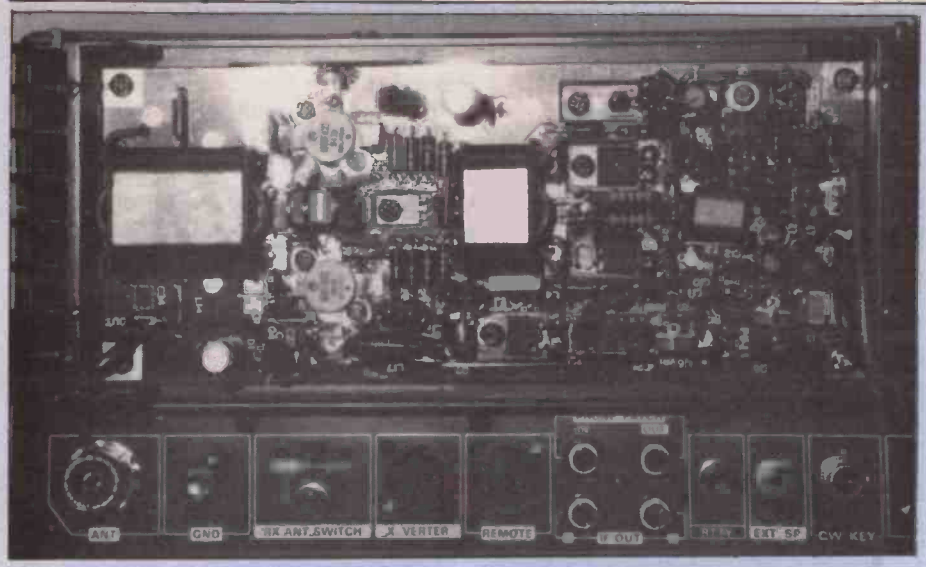
I couldn't find much else to grumble about though, which is very unusual for me!

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

Fig. 1 The circuit diagram for the TS940S.





The PCB for the transmitter power amplifier inside the back panel of the TS940S.

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.

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 20.99999MHz . . . 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 bandpass 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

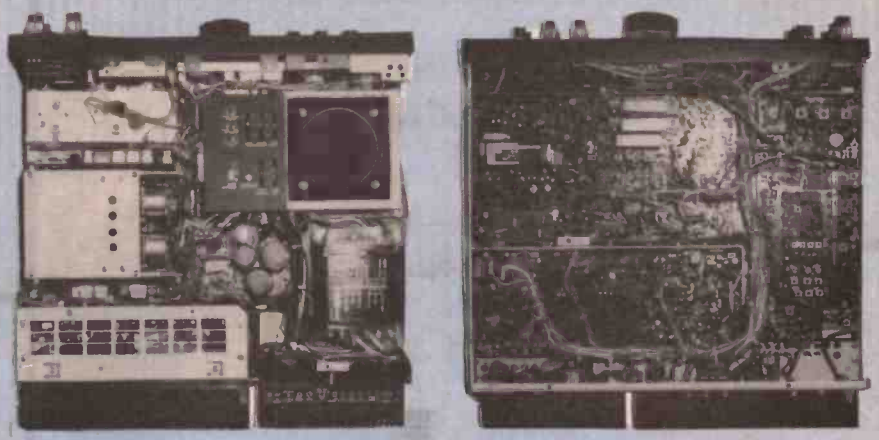
of my tower.

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 ensure 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.



Taking the top and bottom lids off the rig.

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 failing 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.

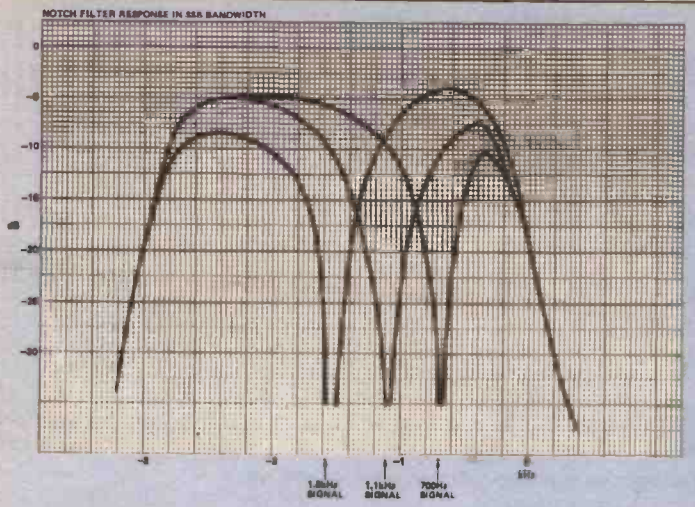
The CW Variable Bandwidth Tuning ((VBT) narrowed the passband down, but the slope was not as sharp as I would have liked, with adjacent channel signals still being audible and in some cases overpowering. This is of course a compromise using the existing filters.

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



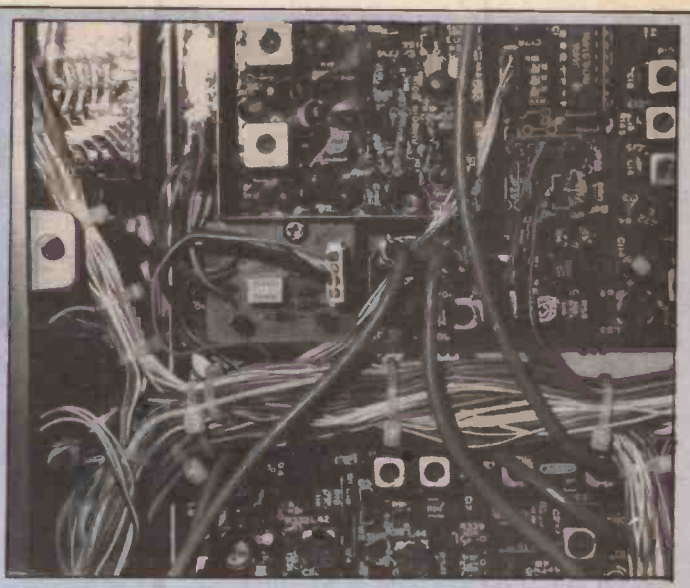
found with RF getting in on the SSB audio line.

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 Electornics 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.



The PLL modification supplied by Lower Electronics Ltd.

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!

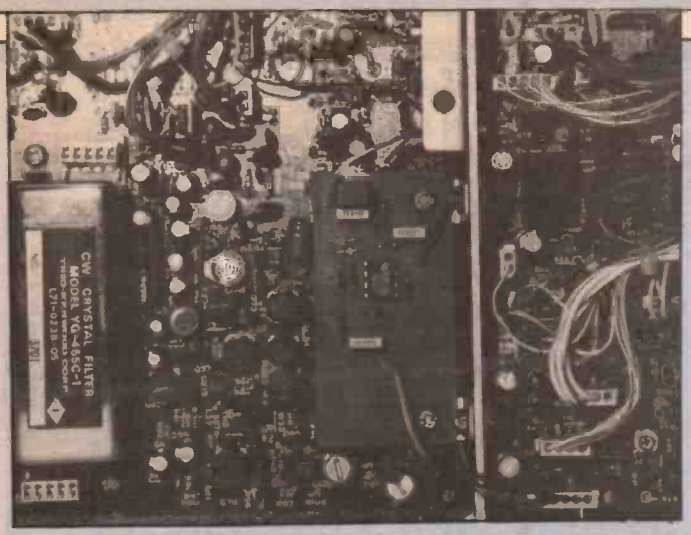
Laboratory Tests

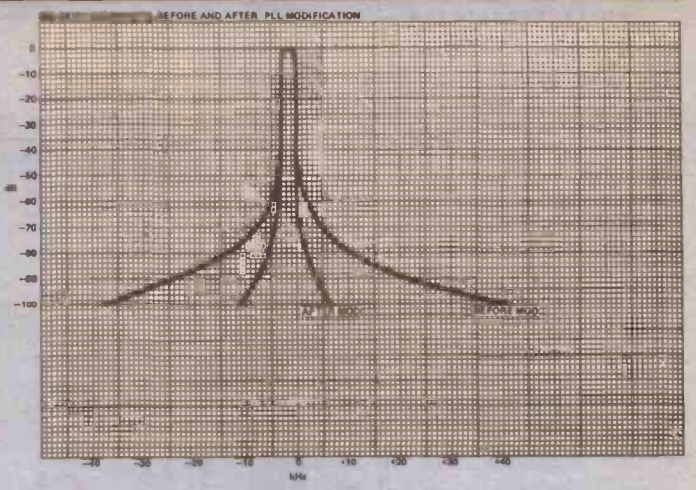
The receiver selectivity and dynamic range was tested using low-noise cavity tuned Hewlett Packard 8640B signal generators and a hybrid combiner, to ensure I was measuring the performance of the set rather than the generators. Selectivity tests were performed and showed a large skirt spread in the unmodified 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 carefully 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





A modification is also available which improves the AM detection and filtering.

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 absense 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 absense 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 mine!), 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 QRM conditions than with the AM filter.

Conclusion

Trio 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. This does not often happen and I think it will be a while before I find a better set of its kind. You pays your money and takes your choice, a mere £1695 in this case.

I must thank the many amateurs who assisted me with on 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.)

Freq. (MHz)	CW/SSB	AM (30% Mod)	FM (3kHz dev)
0.400	0.90	1.75	–
0.500	6.40	21.0	–
1.0	2.70	11.0	–
1.8	0.09	0.58	0.22
3.5	0.10	0.67	0.22
7.0	0.11	0.69	0.23
10.05	0.13	0.74	0.25
14.0	0.145	0.88	0.27
18.0	0.16	0.91	0.28
21.0	0.165	0.92	0.28
24.5	0.175	1.00	0.31
28.5	0.19	1.10	0.37
29.5	0.19	1.10	0.37

Internally generated spurii

10.000MHz, 2.1uV equivalent level;

Less than 1uv p.d. on 0.224, 0.2653 0.3063, 1.196, 5.688, 5.929, 5.958, 5.959, 5.984, 6.0, 6.008, 6.054, 6.063, 6.283, 6.286, 7.258, 7.289, 7.309, 7.400, 8.916, 9.284, 9.897, 16.156, 16.755, 17.377, 18.569, 19.500, 23.370, 24.825, 26.748, 27.307, 29.790, 30.000 MHz.

S meter S9 level sensitivity

Frequency (MHz)	(uV p.d.)
1.8	80uV
3.5	89uV
7.0	78uV
10.05	59uV
14.0	105uV
18.0	56uV
21.0	69uV
24.5	61uV
28.5	58uV
29.5	53uV

S meter linearity on 21.4MHz

Reading	Signal (uV p.d.)	Ref. S9 (dB)	Rel increase (dB)
S1	2.15	–28.2	–
S2	2.50	–26.8	1.4
S3	2.80	–25.9	0.9
S4	4.55	–21.6	4.3
S5	8.30	–16.4	5.2
S6	13.8	–12.0	4.4
S7	20.9	–8.4	3.6
S8	34.0	–4.2	4.2
S9	55.0	0.0	4.2
S9+10dB	190	+10.8	10.8
S9+20dB	500	+19.2	8.4
S9+30dB	1410	+28.2	9.0
S9+40dB	4820	+38.8	10.6
S9+50dB	16300	+49.4	10.6
S9+60dB	63000	+61.2	11.8

IF notch rejection: more than 50dB

Blocking

Measured as degradation of on-channel 12dB SINAD signal to 6dB SINAD by unmodulated interfering signal, modified set.

+/– kHz	SSB filter (dB)	CW filter (dB)
50	98	104
100	107	108
200	108	108

3rd order intermodulation rejection

Measured as ratio difference in level required for 12dB SINAD, modified set.

Separation	SSB filter (dB)	CW filter (dB)
50kHz/100kHz	87	87
100kHz/200kHz	87	87

Spurious response rejection

Measured as above.

28MHz, all more than 110dB over 0.5MHz – 200MHz

Unmodified set tested at 7MHz

+kHz	dB
20	87
40	96
60	105
80	106.5

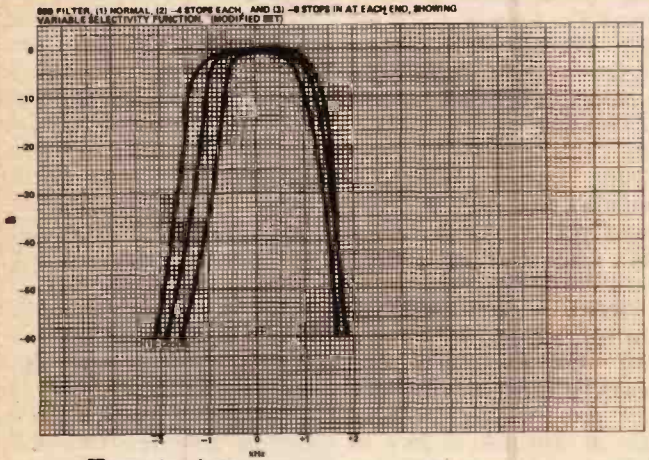
Image rejection

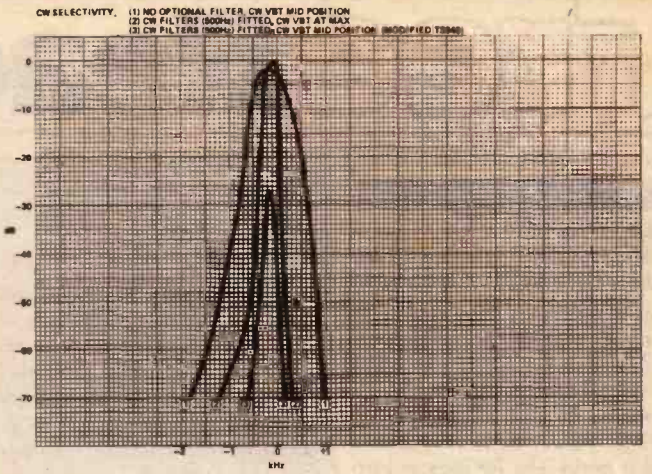
Measured as ratio between on channel 12dB SINAD signal and (+2 x 45.05 MHz) and 45.05 MHz interfering signal giving 12dB SINAD.

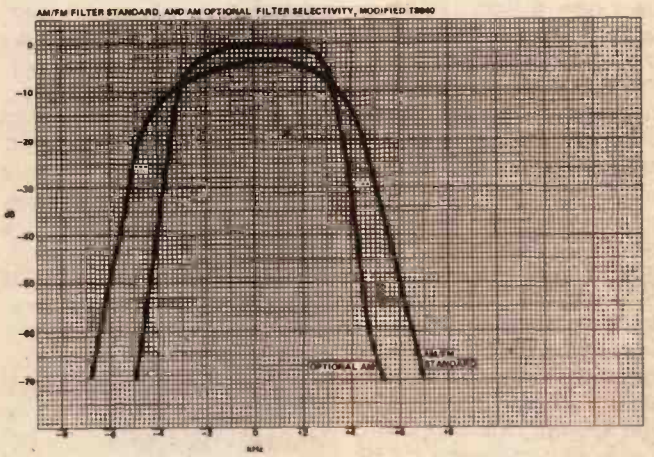
Band (MHz)	+2x45.05MHz in dB	45.05MHz in dB
1.8	124	97
3.5	127	95
7.0	120	130
10.05	118	100
14.0	115	112
18.0	113	113
21.0	109	109
24.5	113	115
28.0	112	115
29.0	110	114

Selectivity

		Unmodified set (in kHz)	Modified set (in kHz)
SSB/CW, normal	-3dB	1.78	2.17
	-6dB	2.41	2.53
	-60dB	6.65	3.90
SSB/CW, narrowed by 4 clicks	-3dB	1.34	1.84
	-6dB	1.98	2.01
	-60dB	6.30	3.69
SSB/CW, narrowed by 8 clicks	-3dB	1.05	1.18
	-6dB	1.39	1.40
	-60dB	5.39	3.15
500Hz CW filter	-3dB	-	0.22
	-6dB	-	0.29
	-60dB	-	1.33
AM/FM, normal	-3dB	5.10	5.47
	-6dB	7.30	7.04
	-60dB	14.03	13.19
AM, optional filter fitted	-3dB	4.38	4.63
	-6dB	5.63	5.86
	-60dB	10.51	9.24







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

Frequency (MHz)	Power (W)
1.8	68
3.5	79
7.0	83
10.0	87
14.0	95
18.0	98
21.0	99
24.5	98
28.0	98
29.0	97

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

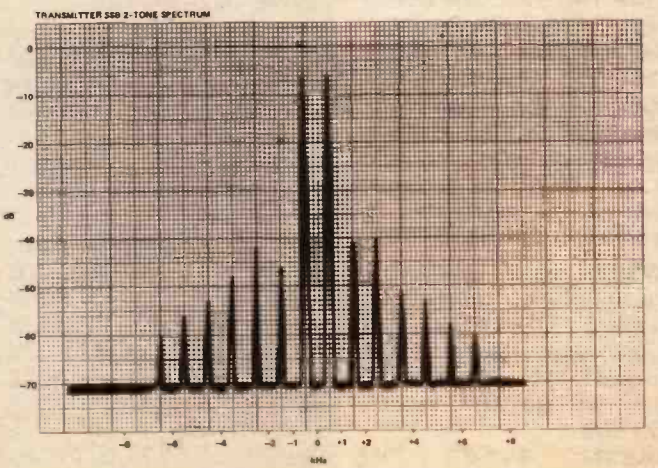
Tx harmonics and spurii lt = less than.

	Harmonics (in dB)				Spurii (in dB)
Frequency (MHz)	2nd	3rd	4th	5th	
1.8	-56	-66	lt -70	lt -70	lt -70
3.5	-58	-54	lt -70	-66	lt -70
7.0	-53	lt -70	-60	lt -70	lt -70
10.0	-51	-50	lt -70	-66	lt -70
14.0	-49	-61	lt -70	lt -70	lt -70
21.0	-52	-63	lt -70	lt -70	lt -70
24.5	-49	-65	lt -70	lt -70	lt -70
28.0	-54	-70	lt -70	-69	lt -70
29.0	-56	-69	lt -70	-68	see below

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

Two tone SSB intermodulation

	Order (in dB)					
	3rd	5th	7th	9th	11th	13th
Onset of ALC	+ -41	-40	-51	-53	-58	-60
	- -46	-42	-48	-53	-56	-60
Max ALC	+ -41	-39	-49	-52	-55	-60
	- -46	-42	-51	-54	-57	-60
Above ALC max level	+ -41	-40	-49	-53	-57	-59
	- -46	-42	-49	-53	-58	-60



Free Readers' ADS!

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, mic, handbook mint cond. LLL RF clipper two spare new 6JS6C. £300 or swap for FRG7700 0799-30763 G3EAY.

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

TWO wireless world teletext decoders complete with all relevant paperwork etx £100 ono. West Drayton 441031.

SALE TS830S, narrow CW filter and MC355 mike £550 or may part exchange for HF mobile rig. Phone Allcoat 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 mic 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 (0246) 410409.

DX302 quartz synthesized 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.

HOMEBUILT 4 band transceiver Radcom 84 article by Lorin Knight all PCBs, plans xtals 14/21 fitted spare setting up complete (nearly) cost £150, parts accept £90 ono or 2m handheld deal. Suitable for re-vamp/spares. Contact G1NGR.

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.

SX-200M scanner CW PSU and ant 12 months use only. £180 ono. G8NKU QTHR.

TONO 550 communication terminal, manual. 12" novex monitor, PSU, 4 books, RTTY Today, Introducing RTTY, World Press Services, Radio Teletype Press Broadcast. All 1 year old. Good condition £350. Buyer collects. Phone Chelmsford 0245 356531.

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 (Dorset).

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 2182kHz £90. "Callbuoy" all in beautiful condition (Purley Surrey) 01 660 0794.

KDK 2025 2m FM transceiver, 144-149MHz, 10 memories, mounting bracket, GI4KIX Phone (0232) Belfast 790855 £150 ono (or will px for 2m hand held IC2E etc).

EDDYSTONE 770R mark two 19 to 165 MHz. Covers six UK amateur bands. VW NFM FM and SSB. Recently overhauled and realigned professionally. £110 ovno Tel (0202) 876018.

MARCONI TF1064 VHF/UHF signal generator £40 Pye AM Olympic £35. Pye Westminster LW15 FM £40. Scope S51B £35. Airmec 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 xtals fitted £27. 13.8V, 5-7A CB PSU, £12. Mike, tel Saffron Walden 27155.

SIGNAL GENERATOR AM/FM video 4-300MHz £30 ono. Electrolytic and tantalytic capacitance bridge £30 ono. HT transformers 5kV at 200mA, 5.2kV at 600mA, 10kV at 700mA, diodes 15kV working £4 6V at 50 amps £10. All plus p&p phone (0709) 67471.

FT207 144/148 NiCad case speaker mic charger maintenance service manual plus instruction manual original packing £115 GW4UWD QTHR 0654 710548 daytime.

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 Eprom, ASCII communications software, toolkit atom needs 12 volts 2 amps. Sensible offers to Keith Maton, G6NHU, 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 hymound key all £260. ST5MC 45/50 bauds Creed 444 in very good condition reader and perforator and spare paper £100. Phone Terry, Tadley 2487 G4XMQ after 6.30pm Mon-Fri QTHR.

FT101ZD with CW filter £390 FRG7 receiver with commercial FM board fitted £120 TR2400 2m handheld with ST1 basestand speaker mic leather case £145 WPO communications morse memory £40 Dragon 32 RTTY setup £60 buyer collects George GI4SJQ 0762 334648.

FOR SALE Trio 7010 SSB/CW 2m transceiver jaybeam 4 ele quad small rotator plus 10m UR67 all good condition £115 the lot or will split ie 7010 £80 quad £20 rotator £20 ono. Tel Lincoln 46798.

SHARP MZ80A microcomputer, integral screen and data recorder plus expansion unit together with Sharp P5 matrix printer. All in excellent condition, tapes and books £400 ono. Buyer collects. GW6MOB QTHR (0222) 625908 (evenings).

XTALS for HRT 10m converter, 38.666MHz, HC18/0 £2. Mains transformers, 12-0-12V at 50mA £1.20. 100kHz xtal oscillator modules, 5V supply £4. Meters, 100mA 59x45 mm £5. Zeners 5.1V £1.20. IN4004 diodes £1.25. Post paid, P.Smith, 3 Raven Avenue, Tibshelf, Derbyshire DE5 5NR.

HAM Concorde mark 1 AM FM CW SSB 26.515 to 28.305 with other mods. Avanti Sigma 4 12V 100W linear modulation, power, SWR meter upto 500W £200 ono but will sell separately or part exchange for 2m multimode. Phone John 0827 54846.

YAESU FT707 multiband HF transceiver with FP707 powerpack FC707 antenna tuner FV707DM memory bank YM34 VOX and YM35

scanning dynamic microphones. Five band vertical trap antenna full instruction manuals mint condition £750 ono Crawley (0293) 28213.

FOR SALE CW RTTY reader CRW-610E plus Lowe UL-1000 tuned preamplifier plus Trio all band communication receiver 9R-59DS all in very good condition £145 ono. Tel Washington 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 QV08-100 output valves £200 buyer collects. Wanted Trio 820S in mint condition with filters. Mr Sydenham, 41 Alexandra Road, Beccles, Suffolk NR34 9UD.

FOR SALE complete expansion system for Texas TI99/4A computer, box, internal disc drive, RS232 and Centronics interfaces, 32K RAM, plus printer and software £250. Wanted World Radio and TV Handbook any year 1980 onwards. Tel (0926) 498388.

TANDY model 100 portable computer and acoustic modem mint condition cost over £600, selling for £295 ono. Will split or swap for HF receiver, VHF/UHF handheld or video gear. Tel Phil (G6UVE) 0892 29221 Kent. (Includes five built in programs).

THORENS 160 II SME series III arm Goldring G900 IGC spare tube arm boards oak plynth bal hinges etc orig packing, plynth cost over £450 — £260. Will exchange with either of the following recorders Yamaha stereo recorder TC800 GL with leather case, new £300 + £295 or Akai Stereo auto rev new over £300 + £135 exchange for Icom R70 Trio 2000 or similar. Basingstoke 882825.

ATU Tentec 228 £65. Tonna unused 20113 £25. Eddystone 940 £110. Datong Antenna AD270 £35. Telephone Broadway 853150.

FOR SALE or swap HF-Rx digital display DX 300 — Marconi dual trace oscilloscope with manual — Yaesu SP980 70cm handheld also 9T-9R pocketfones. Wanted HF transmitter or transceiver. Linear amp 600MHz frequency counter OWHY money adjustment if required. G0CWT Telephone Bewdley 403858.

FOR SALE Monitor 14 inch green screen £40 monitor 19 inch B&W 6 channel £45 terminal unit, 11 inch green screen CCITT V23&V24 £50 Hallicrafters S27 VHF receiver £45 Hallicrafters S27 HF receiver £45 Eddystone 680X HF receiver £110 Eddystone 880/2 HF receiver £225. Telephone Wokingham 782236.

FOR SALE KW2000E complete with PSU microphone manual £180 or swop for WPO Alpha SSB transceiver on 160 mtrs G4TQG QTHR Dane End 254 evenings.

RTTY TRANSCEIVER MM 4000+ RCA keyboard. Latest state of the art microprocessor. Amateur standard ASCII, 110, 150. 300 baud. Murray coded RTTY 45, 5, 50, 75, FSK/AFSK, 4 message stores, auto CQ call, 2 test functions, video output, etc £150 ono. Tel Quatt 780972 (Bridgnorth, Stourbridge area) W. Midlands.

FOR SALE realistic Pro 2003 60 channel scanner covers air ham marine utility and standard FM broadcast bands 6 weeks old in box with manual current price £295 will sell £190. Phone 228 4835 SW11.

YAESU FRG7700 and FRT 7700 mint condition £250 ono. 40 The Oval, North Anston, Nr Sheffield.

BRT 400 communications receiver C/W manual £75 KW2000B Tx/Rx C/W A/C power supply £220 KW Atlanta 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. MZ80K computer ideal for RTTY £175. Reasonable carriage paid — G3MTD — Barrie 0271 816539.

CROTECH 3030 15MHz scope 10hrs use mint manuals and probes £150. Farnell 15 amp PSU not switch mode ideal linears £40 CTE INT 1KW 26-30MHz linear, convert to other HF bands? £150 ono. R. Softley, 14 Topps Drive, Bedworth, Nuneaton, Warwickshire, CV12 0DE.

SELLING UP! Emigration forces sale of: TS430S two months old, as new, boxed £650. FT2700RH dual bander two months old as new, boxed £400. FT101 HF transceiver, vgc, £250. Icom IC280E 2m FM mobile, vgc £130. Phone Bob, (08926) 62790 anytime.

ICOM SM5 microphone, boxed and unused, suits IC720A series, £25 post paid. Minox EC, miniature, "Spy-Type" camera, never loaded, includes flash, case, films, etc only £75. Postage extra. Please telephone 01 472 9058 evenings or weekends.

MULTIMODE covers 27.700 to 29.700 eprom converted superstar 360 (Cobra 148 GTLDX board) repeater shift etc perfect £125 wave analyser perfect R/F bridge ok several transformers 2,000 to 6,000 volts offers for above. Wanted Magnum two 28-144 0245 324555.

B&O reel to reel tape recorder 3 speeds. 2 x 8W audio output. All inputs. Echo, reverb, sound on sound tapes and mics £60. Ring Lancaster 0524 417120 ext 474 9am to 3pm.

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

YAESU FRG7700 plus FRT ATU and FRV VHF converter excellent condition, buyer to collect £270. 0634 404096.

PORTABLE colour TV £75, eight track cartridges £1.50 each, cartridge player £10, TV pre-amp VHF £8, HF pre-amp 2-30MHz £10, stereo tuner useless junk £10, two metre receiver realistic patrolman £50 — Jane 01 946 2967 or Mike 01 674 0513.

LEAK 70 stereo amplifier 35 watts per channel £45 UHF aerial TV caravan/boat/lorry £12 TV pre-amp 7dB VHF £18 2-30 MHz pre-amp £10 — Mike, 14 Doverfield Road, Brixton, London SW2 01 674 0513 or Jane 01 946 2967.

FOR SALE 'New' Heathkit TR x RX transceiver complete just built by professional mod No 5B 102 HP 23B also mains power pack unit all new with mic and stand. Offers for this super radio please 0705 376008.

IC 251E transciever with muTek board £450, 5M5 desk microphone £25, Datong PC1 HF-2M converter £110, Tono 2M-90G linear amplifier £115, microwave modules 432-28MHz down converter £25 G1GZA QTHR Thornbury (0454) 412185.

DATONG FL3 £80. Stolle multimatic rotator £15. Support bearing £5. H/B VFO FT707 £10. LF30A LPF £15. Heath VTVM £20. Heath HM102HF P/SWR meter £15. AVO SG CT378A 2-250MHz £20. Carriage extra. G4IOT QTHR Folkestone 76063.

HQ1 miniquad 6/10/15/20m two element antenna £85. Signal generator up to 30MHz advance model B4B good working order offers. Tel Redditch 0527 41985.

FOR SALE FT290 £250, FT790 £250, mobile mount £20, 70cm aerial/mag mount £20, WE1145 rotator £35 all very good condition. Tel Horsham (0403) 40057.

BELCOM LS20XE handheld £60 ono. Realistic DX160 receiver in good condition 0-30MHz with speaker £75 ono. G1CCL 061705 2680 (North Manchester area) buyer collects. Part exchange for FT290 with ni-cads consider cash adjustment.

FOR SALE FDK 700E 2 metre FM 25 watts £130 G1BWW phone 0462 711722 (Hitchin).

HAM International multimode II, FM, AM, USB, LSB, fine tune. Boxed and suitable for conversion to 10m £120 ovno. Tel 01 949 3097.

STATION clearance Hirschmann rotator never used with control box £25 6 element Yagi beam £10 unused SMC SWR power bridge £10 Shure 444D mic £20. Tel Southend (0702) 618305.

TS130V sell or exchange offer includes chrome bencher and Daiwa electronics plus Trio mic also included in offer DNT40 converted to 10 FM £400 the package or swap for TRS 80 model 3/4 must be 48K with twin drives. Tel 0783 870018.

WHY not treat yourself. Immaculate Hameg 203.5 20MHz dual trace oscilloscope 3x x1 or x10 probes instructions yours for £160 or px plus cash for your unwanted or second HF rig. Offers Simon G1RNB B'Ham 021 783 8609 after 5pm.

YAESU FT207R new nicads, charger £120. AR30 25W 145MHz linear £40. Hammaster 4200 mic wired for FT290R (power from rig) £10. Turner M+2U mic £15. Lowe color genie computer, datacorder, RTTY interface, programs, £130. G1DRG (not QTHR) Peterborough 0733 63714.

AR2001 scanning receiver 25-550MHz good condition complete with PSU telescopic whip £250 ono. Contact Stephen Druitt G8HTZ QTHR phone 0733 239239 evenings. Prestel Mailbox 733239239.

SELL DSB-80 (QRP transceiver) complete with digital readout and sidetone ON4ABT, Postbus 135, 2500 Lier, Belgium or phone 03/480 41 51. Price £60.

TRANSMITTER type 9231 ex govt 200-400MHz good condition weight approx 120lbs offers or exchange R1155 receiver WHY Tel 0380 830428 (Bratton, Wilts).

YAESU FT707 £335 or exchange Delta 1 934MHz complete station. Please ring 0202 734586.

YAESU FT757GX FC757AT FP757HD MD1B8 microphone immac cond new from SMC Sept 85 £900. Yaesu FRG9600 scanning receiver immac cond new SMC Sept 1985 £330. Tel John G4YDM QTHR 091 4162606.

YAESU FT230R boxed and as new only used as Rx £200 also have Belcom 2m Rx/Tx £40 or exchange for 144/28MHz converter. M.Barber, Slough 25708.

YAESU FT102 as new boxed £525. Yaesu FL2100Z 9 band 1KW linear unused £495. TS430S with FM board AM filter and matching speaker £600. Tel 045382 4853.

FT200 with matching PSU/speaker 80-10m SSB, CW, AM, very good condition with manual and spare valves Bargain £155. Tel 021 744 9993.

HW101 mic home built PSU £125 Mamiya 35mm SLR £20 LG300 Tx no PSU 813 PA £15 Geloso VFO £5 G3GZH phone Dunstable 699781.

FREE. What can I do with 700 micro switches bought in error at auction? Any ideas? Send 3 x 17p stamps to cover postage etc for free sample pack to G4NMP, 12 Eilam Road, Kimberworth Park, Rotherham S61 3PQ. Tel (0709) 554665.

FT101Z in good working order with mains auto transformer also FM board (not fitted) new valves, recently C/W instructions also FC290 ATU to match above with illuminated meters £450 buyer to collect. Phone 0733 63851 Peterboro G3MLP anytime.

FOR SALE FT901DM with manual, vgc, £500 ono and FV901DM with manual vgc £150. Tel 01 471 0669 after 5pm ask for Danny. Buyer collects.

DPM IC'S small qty 7107 3½ digit common anode display drivers, complete with four displays and info £7. Includes Pand p (all brand new)! (Total retail about £15) (Maplin catalogue). Chq or PO C. Barker, 52 Spode Street, Stoke on Trent, ST4 4DY.

REALISTIC PRO-2008 scanner covers 68-88MHz 144-148MHz 148-174MHz 419-450MHz 450-470MHz 470-512MHz scans 8 channels internal external antenna receiver in excellent condition £100 ono. Telephone 0983 855113.

EXCHANGE

EXCHANGE new Futaba FP7FGK never used ready to fly plane. 0560 tuned pipe fitted aerobatic model ready to ply plus gliders. For complete 2m station must be multimode. Phone 0638 667267 ask for Martyn G1BFM.

EXCHANGE standard C580U all mode 2m trncvr and £100+ for HF trncvr FT77 or FT707 and PSU WHY ring 01 348 3336.

PRO 2002 50 channel programmable scanner VHF UHF with antennas will exchange for general coverage receover with digital readout. Telephone Droitwich 772501.

EXCHANGE M/modules 2mtr/70cm tvtr (early model) 10w o/p for FV901DM, DR49RX, FRG7RX, MML144/100LS or CCTV gear or sell £95, GW1EXF QTHR tel 04952 56560 ask for Carl.

IC22A fully crystaled up to S22 excellent receiver transmit channel bulb blown but will not affect performance scratched at bottom willingly swap for a scanner Fairmate or Eddystone VHF/UHF receiver. Write Mr A Topping, 7 Robert Street, Selby, N Yorks YO8 0DY.

SWAP Commodore SX-64 computer which includes CPU, disk drive, monitor in one box for HF transceiver, FT726 70cms module and satellite module AMT2 and BBC software, AMT1 and BBC software, or will sell for £385 ono. 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 solid state communication receiver to 30MHz with SSB please phone Paul BB2 (0752) 777579.

EXCHANGE an extensive modern 00 scale model railway collection. All in vgc mostly unused some boxed, loco's carriages track accessories etc. Would like anything HF in working order. Tel John on Swindon (0793) 854293.

EXCHANGE M7 micro computer multi tuning system Panasonic RF B600LBE for any scanner covering 25 to 550. Must be mint condition. Telephone 051 263 6724.

WANTED

TRIO TS700S must be perfect with original packing and manual. Contact Graeme Wormald, G3GGL, 20 Sandbourne Drive, Bewdley, Worcs Tel 0299 403372.

WANTED Telereader made by Comax as sold by Lowe Electronics model CWR675E receive with monitor or CWR670E receiver without monitor for cash or cash and computer. Telephone (0742) 471160 after 7pm.

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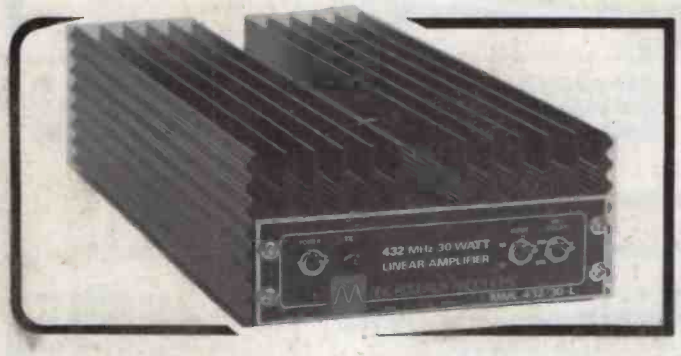

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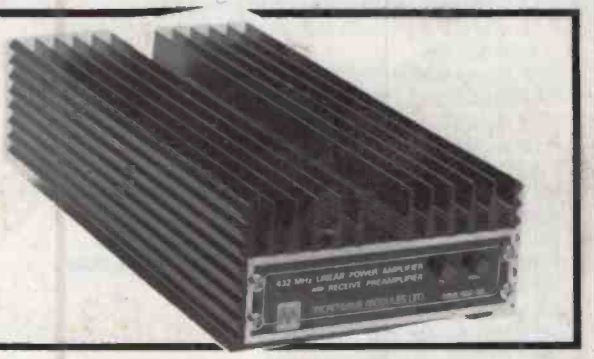

The two linear amplifiers featured above are suitable for most portable and mobile UHF transceivers such as the FT790 FT709 and even your old Pye Westminster. So go on make it a signal to be proud of, buy a new Microwave Modules 70cms linear.

PRICE LIST FROM 1st JAN 1986

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MMC50/28	6m down to 10m Converter	35.65	A
MMC144/28	2m down to 10m Converter	35.65	A
MMC144/28-HP	2m High Performance Converter	47.90	A
MMC432/28-S	70cm down to 10m Converter	39.90	A
MMC432/144-S	70cm down to 2m Converter	39.90	A
MMK1296/144	23cm down to 2m Converter	129.95	B
MMK1691/137.5	1690MHz WX Satellite Converter	145.00	B
MMG144V	2m RF Switched GaAsFET Preamp	37.90	A
MMG1296	23cm GaAsFET Preamplifier	75.00	A
MMG1691	1690MHz GaAsFET Preamp	129.95	B
MMD1500P	1500MHz Divide by Ten Prescaler	119.60	A
MMR3/25	3dB 25 Watt Attenuator	19.95	A
MMR7/3	7 dB 3 Watt Attenuator	14.50	A
MMR15/10	15 dB 10 Watt Attenuator	14.50	A

Postage/Packing Charges:

A = 1.84
B = 3.91
C = 4.60
D = 5.98

DURING THIS YEAR OUR SALES TEAM WILL BE VISITING MOST OF THE MOBILE RALLIES. TO BE SURE THAT WE DO NOT MISS YOURS PLEASE RING MICK, G4EFO, ON 0403 730 767.

Access VISA WELCOME

MICROWAVE MODULES Ltd
BROOKFIELD DRIVE, AINTREE, LIVERPOOL L9 7AN, ENGLAND
Telephone: 051-523 4011. Telex. 628608 MICRO G
CALLERS ARE WELCOME, PLEASE TELEPHONE FIRST

HOURS:
MONDAY-FRIDAY
9-12.30, 1-5.00
E & O.E.