

# RADIO TODAY

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● REVIEW—THE FRG9600 SCANNER HF CONVERSION

● HOW TO INSTALL AN INVISIBLE AERIAL

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<b>YAESU FRG9600</b>	MK3 PACKAGE: MK3 Receiver, ICOM AH7000 Super		

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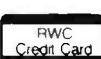
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VOLUME 5 NO 7 JULY 1987

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**Published by:**  
Argus Specialist Publications Ltd  
**Distributed by:**  
SM Distribution Ltd  
**Printed by:**  
Adlard & Son Ltd, The Garden City  
Press, Letchworth, Herts SG6 1JS  
**Design by:**  
ASP Design Studio  
**Editorial and Advertising address:**  
(please mark your letter for the  
appropriate department)  
Ham Radio Today  
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1 Golden Square  
London W1R 3AB  
Tel: 01 437 0626

**Subscriptions and back-issues:**  
Ham Radio Today Subscription  
Dept, Infonet Ltd, Times House,  
179 The Marlowes, Hemel Hemp-  
stead, Herts HP1 1BB.  
Tel: (0442) 48432  
**Subscription rates:**  
UK £17.30, o/seas surface £21,  
USA surface \$28, o/seas air £39.  
**Back issues:** £1.70 inc p&p

Member of the Audit  
Bureau of Circulation



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# Thanet Electronics is dead LONG LIVE ICOM (UK) LTD.

As from the 16th march 1987 Thanet Electronics Ltd have been trading under the new banner of ICOM (UK) LTD.

Nothing else has changed, still top quality ICOM equipment and service from one of the UK's leading Amateur radio importers.



To celebrate our name change we are offering to those persons who selected the following badge numbers at N.E.C. this year a gift from the ICOM range. To claim your prize just send your winning badge to ICOM (UK) LTD and we will send you the fantastic ICOM Micro 2, 2 metre handportable. Naturally this does exclude those persons who already claimed their prize at the N.E.C. The numbers are 1271/2751/3200.

This summer ICOM (UK) LTD will be one of the sponsors for Richard Branson's Transatlantic Balloon Challenge. They will be using ICOM communication equipment.



## IC-275E/475E 25 Watt 2 metre/70cm. Multimode Transceivers.

### Tech Talk from ICOM: THE EXCITEMENT OF SATELLITE COMMUNICATIONS

An ever increasing number of radio amateurs are joining the excitement of Phase 111 - type satellite communications. This new medium combines the communications range of the 20 and 80 metre bands with the line-of-sight reliability of 2 metres. Its equivalent to a totally new band, and a vast technical background is not necessary for enjoying the action.

ICOM is able to help you enjoy the fascinating new capabilities of OSCAR and future amateur satellites. Its all mode 2 metre and 70cm base transceivers bring the operating conveniences of low band units to the VHF and UHF amateur bands. They can be used for local FM operations via repeaters or for SSB/CW communications via Phase 111 satellites. The IC-1271E all mode 23cm transceiver is in a class of its own, providing mode L satellite uplink capability. (Mode L: 1269MHz uplink, 436 downlink) (Mode U: 435 uplink 145 downlink).

Satellite relayed signals are somewhat weak in nature and the IC-275E's low noise/high sensitivity receiver gives the highest performance for hearing everyone regardless of their uplink performance. The noise blanker prevents pulse type electrical interference from masking desired DX signals, the selectable AGC can follow fast fades associated with spin modulation. There are also the 99 mode memories which can be used for inter-mixed FM repeater and SSB/CW operators. When the IC-275E is equipped with the optional mast mounted AG25 GaAsFET pre-amp, it becomes a satellite operations dream come true.

ICOM's IC-475E 70cms transceiver has a continuously front panel adjustable power output to allow for daily signal variations. This overcomes the practice of overloading a satellites on-board receiver. The IC-475E also includes 99 all mode memories for the ultimate in operation flexibility.

Using the ICOM CT16 satellite communications interface these base stations will track together via the ICOM CI-V system. If you are interested in joining today's most excitement era of amateur communications, ie, OSCAR and future Phase 111 satellites, ICOM is the logical choice for top performance equipment.

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# ICOM

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### Micro 2E/4E

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### IC-2E 2 metre Thumbwheel Handportable

This popular handheld from ICOM is still available. For those amateurs who require a straightforward and effective FM transceiver the IC-2E takes some beating. Frequency selection is by means of thumbwheel switches (with 5Khz up switch) simplex or duplex facility. Power output is 1.5 watts or low 150 milliwatts (2.5 watts possible with BP5A battery pack).

### IC-02E/04E 2 metre and 70cm Keypad Handportable

These direct entry CPU controlled handhelds utilise a 16 button keypad allowing easy access to frequencies, memories and scan functions. Ten memories store frequency and offset, these handhelds have an LCD readout and power output is 2.5 watts or low 0.5 watt. 5 watts is possible with the IC-BP7 battery pack or external 13.8v DC.

### IC-12E 23cm Handportable

Similar in design and style to the 02E/04E this 1296Mhz handheld utilises ICOM's experience in GHz technology, gained by the excellent IC-1271E base station. Power output is 1 watt from the standard BP3 nicad pack, external 13.8v DC powering is available to the top panel jack. With the growing number of repeaters on 23cm. The IC-12E makes it an ideal band for rag chew contacts.

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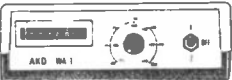
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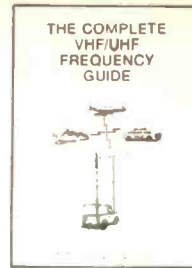
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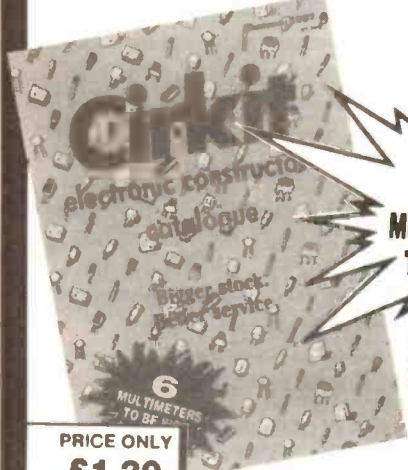
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# LETTERS

## Racism on the Radio

Dear HRT, I constantly read and hear comments from Licencees about people who use CB (the childrens' box) and their supposed lack of intelligence (in some cases true) and the banal conversations that take place on this particular part of the radio spectrum. But what about other frequencies? 144.6 MHz for a start.

I was listening to the local net on 144.800 last night (26/4/87) when I heard some of the locals discussing a boxing match that had been screened the previous night. The bout was between an Irishman and a Columbian, and quite a bout it was too, with the Columbian winning by a knock out in the 13th round after being floored himself a good few times in the previous rounds.

During the conversation one amateur chipped in with "what annoyed me was the use of the head by the Nig-Nog". Had I not been putting my young son to bed at the time, I may have gone back with the comment "what annoyed me was the use of the word Nig-Nog".

I am a Jamacian who has lived in this country for the past 28 years and from time to time I am subjected to this kind of talk, but before anyone says that I have a chip on my shoulder about being black let me assure them that I do have a sense of humour and as far as comments go I can sort out the wheat from the chaff. Some comments made are of a jocular nature and taken as such but others are full of malice.

This is not the first time that I have heard this kind of patter on the local net, nor is the vitriol spouted by these covert red necks confined solely to race. Many of the devotees of the net are 'A' licencees who can be heard globally on the other bands. What poor ambassadors they must be for British amateur radio. I wonder if when talking to people with a high concentration of melanin in their skin they address them as Nig-Nogs? Or is it different when they are chasing DXCC or some other award?

My call sign by some quirk of fate could be given as Golf One United Kingdom Subject. I wonder if I could change it to Golf One Annoyed

Black Man? Or maybe some people might like to see me return to the land of my birth and take out a 6Y5 call sign.

D. Simmons G1UKS.

*For prejudices such as these to exist in society generally is obnoxious enough, but for racism to surface in amateur radio — a hobby based upon communication across political, racial and religious divides is totally unacceptable. Fortunately, for once there is something which can be done about such things as an amateur radio licence is issued upon the understanding that reasonable levels of behaviour are observed, which clearly does not seem to be the case here.*

*The Department of Trade and Industry recommends that such incidents should be reported to the Radio Communication Division, DTI, Waterloo Bridge House, Waterloo Road, London, SE1 8UA together with time, frequency and callsign details so that the matter can be investigated by the RIS.*

*We would be interested to hear the outcome of such investigations, and would recommend that other operators steer clear of stations who express such views — they are not fit to hold a licence.*

## Beware of the bogus 'BZQ

Dear HRT, May I please ask the assistance, of your excellent magazine, in advertising the fact that as far as I can ascertain my callsign — G2BZQ — is currently being pirated on 80 meters CW, by someone signing G2BZQ/QRP, and my usual name abbreviation 'Rich'. There is reason to believe that it is using other bands.

He/She should be easy to identify, as the fake, because:

1. I never sign call sign G2BZQ/QRP. I only use G2BZQ.
2. I only operate, for some hours, up to 6 am local time.
3. For many months I have only used 80 metres CW in connection with antenna research projects.

May I suggest, to the person

concerned, that he/she uses the vacant callsign — G9ABF/QLF!

Thank you, in advance, for your assistance.

Richard Q. Marris G2BZQ.

Dear HRT, A week ago I erected an inverted Vee for 3.5MHz sixty feet above my home. It was supported on a 20lb breaking strain fishing line running from the top of my flagpole some thirty yards to a neighbours tree.

I returned after a visit during which hundred mph gales ripped through the area to find all intact.

Is it too low, d'ye think?  
Trevor M. Artingstoll, Dyfed.

*Without doubt. Putting your Vee up a further 10 to 20 feet will significantly improve reception even if the system is a little more weather prone. Besides which — why should you have all the luck!*

## How do I get started?

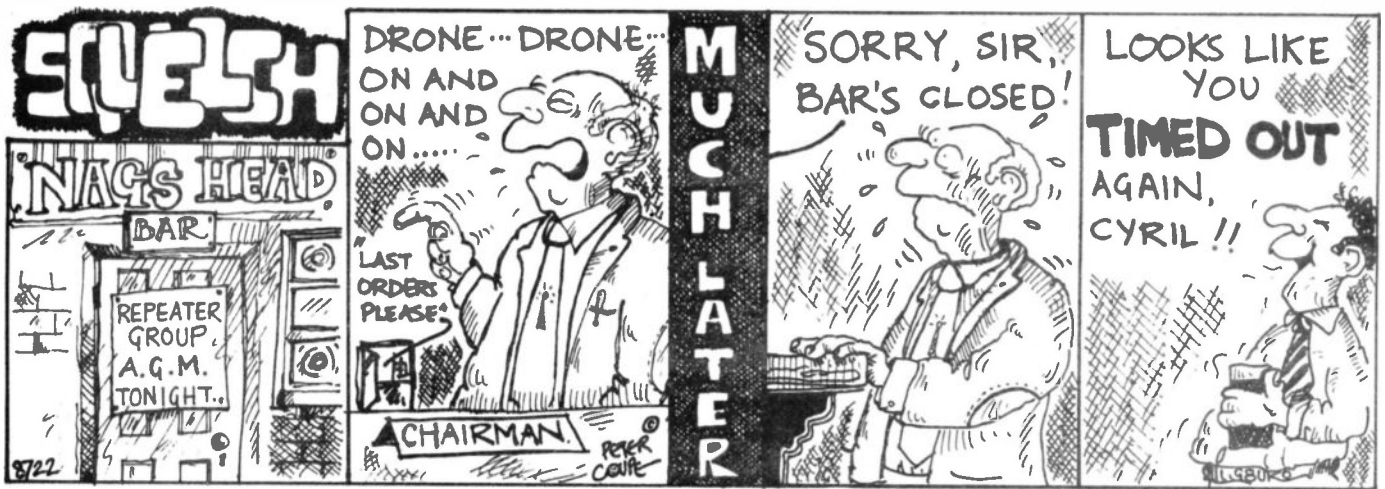
Dear HRT, Could you please help me, as a novice or less to the hobby, I would like some help. I have a Grundig Satellite 2000 which I was given. Could you please advise me as to the type of aerial to use for SW listening or any improvements I can make. I realize that the set will have its limits but any improvement will help.

G. Hume, Chobham.

*We usually get quite a number of similar letters here at the HRT offices so hopefully we can help quite a few beginners at the same time.*

*Generally speaking, the best advice for anyone who is just getting into the hobby is not to rush out and spend a fortune on expensive equipment but to start exploring the short wave bands with fairly cheap gear in the first instance. If the radio you are using has an aerial connection then it is a fairly simple matter — just erect as long a piece of wire as high as you can and hook it up to the set. Signal strength will be further improved if you install an earth, and the safest way to do this is to drive an earthing stake such as a length of pipe three or four feet long*





into the ground and connect this to the earth terminal on the back of the set. Note that this earth connection should not be confused with the normal mains electricity earth wire in a mains plug — the mains plug should be left as it is. This will give the best chance of picking up weaker (and therefore usually more interesting) stations.

Once this system has been used for a while it may be worth considering adding an aerial tuning unit (ATU) to the station — essentially this device goes between the aerial and the receiver so that the Rx 'Sees' less of the wave band at the same time that wdy weak stations are not so easily blotted out by the very strong ones; a number of ATUs are on the market, some are in kit form and make an excellent project. The other advice we would give is to visit your local radio club, quite often there is a wealth of information on tap from experienced enthusiasts who are only too happy to help.

### Sub-Standard service?

Dear HRT, I feel I must write to you in response to the letter of J C Bolton G4XPP in my May addition. Maybe he and many others would like to know that in July 1980 I purchased a C58 Standard 2 metre multimode rig. At 2030 hrs on the evening I acquired it, it worked lovely. The next morning it did not work. I took the thing back to Waterloo, Liverpool from where it was purchased, I hasten to add, for cash. Six months later I got the C58 back from Communique of Purley, Surrey after getting my local Consumer Protection people in on it (it cost me £25.00). I have written and phoned the agents for Standard quite recently (Nov. 86). I have even sent them a cheque for the items I requested, ie a mike for the C58 also a DC power cord c/w plug, so far I have not heard a word from the agents, neither has

my cheque been cashed, so that's OK by me.

In November of 1986 my C58 was sent to the Standard agents in Edgware Road, London for some kind of repair to the CPU. Whilst the C58 will out perform any other rig in its class by a hell of a long way I do feel the Standard Corporation of Japan should look for another agent in the UK. I actually wrote to the Standard Corp. in Japan. My letter was returned "UNKNOWN IN TOKYO", how are you on that. It is now April 23rd 1987 and my C58 is still away under repair — since the middle of November 1986. My comments are, a damn good rig, second to none, ruined by the service facilities offered in the UK, or should I say lack of service facilities here. Anyone contemplating buying a Standard rig please think again.

Dennis Fennash, GW4 FLZ.

### RSGB gets a gold star

Dear HRT, My compliments to the RSGB re: morse tests, as they took a lot of stick last year. I took a test at Wigston Magna on Saturday 28th February. My pass result arrived from RSGB HQ on the following Thursday 5th March, complete with an A licence application form. Unfortunately RALU took 12 days to cash my cheque and send me my licence and that was in the slack period between RAE results.

Alan Sammons, GOHBC.

Since it has been such a topic of discussion, it would be interesting to hear how other people have fared since the RSGB have taken over the UK morse test. Do those in sparsely populated areas get an adequate service? And if so perhaps the RSGB could take over from the RALU as well!

### Right name, wrong call

Dear HRT, For the past week I have met the postman every morning expecting to receive a cheque for authors' fees — no luck. I have also been checking the bank account of that very worthy fund "keep G4RPS in cigars" expecting a donation — no luck.

It is with regret therefore that I must inform you that the article (excellent though it is) "A Piece of the Past" published in HRT May 1987 was not written by G4RPS as published.

Dick Wander, G4RPS.

Oops! In the May '87 edition of 'HRT', we featured an article by Tim Wander on the renovation and construction of a 1920's crystal set. Unfortunately however we got the callsign wrong, Tims call is G6GOX, not to be confused with G4RPS which belongs to his dad. Sorry about the muddle — at least we got the right family!!

Dear HRT, I read with great interest the article on QRP, and also the letters in response in the May issue.

I am a 'SWL' and have heard many signals from over 190 countries on HF. I see no challenge in hearing a 500w beam signal, especially when one has to contend with the QRM generated by these signals.

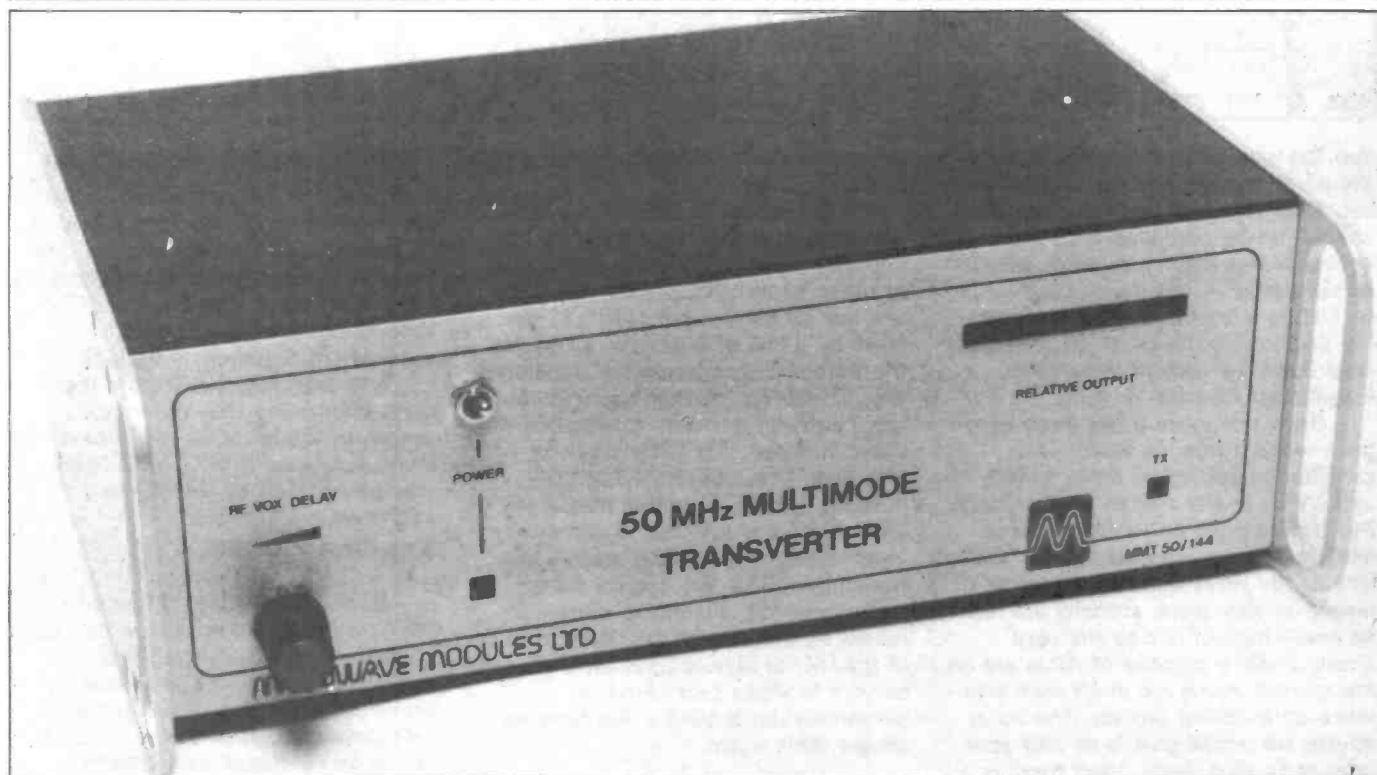
What infuriates me is the way unnecessary power is being fed into inefficient feeder/aerial systems for the sake of convenience. For example, a ¼ wave vertical with four ½ wave radials fed with 15m of UR67 will radiate only half of the power sent to it! And if RG58 is used only a quarter! On the other hand twin open wire feeder and a well placed dipole will radiate 99% of the power sent to it.

I wonder if Mr Wilson has checked his ERP recently.  
M. Probert, Basingstoke.

# Review-MICROWAVE MODULES

## 50MHz

# TRANSVERTER



Spruced up to look for the new series of MM units.

Microwave Modules have been making transverters now for many years, and have nicely filled a large gap in the requirements of amateurs worldwide for getting multi-band VHF/UHF coverage by using their main station transceiver. It would be perfectly honest in my opinion to say that 2m, 70cm, and 23cm DX activity in the UK has been helped enormously by their products, with seasoned HF operators being easily tempted by a 'simple in-line box' into exploring new bands with their many and varied propagation modes, in the true pioneering spirit of amateur radio.

Over the years they have introduced many new products, often they are just taken for granted which I feel is a pity, as I believe the MMT50/144 is the current leader in state-of-the-art 50MHz transverter technology. Two models are pro-

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***One approach to 50MHz working is to use an existing transceiver plus a transverter. Chris Lorek, G4HCL, examines the microwave Modules unit as a possible solution.***

---

duced, using input frequency bands of 10m or 2m. As many amateurs, especially Class B licensees encouraged by the coming of 50MHz to all UK amateurs, will have 2m equipment available in the form of an FT290 or whatever, the 2m input version was the unit thought to be of greatest interest to readers, and hence was the model chosen for review.

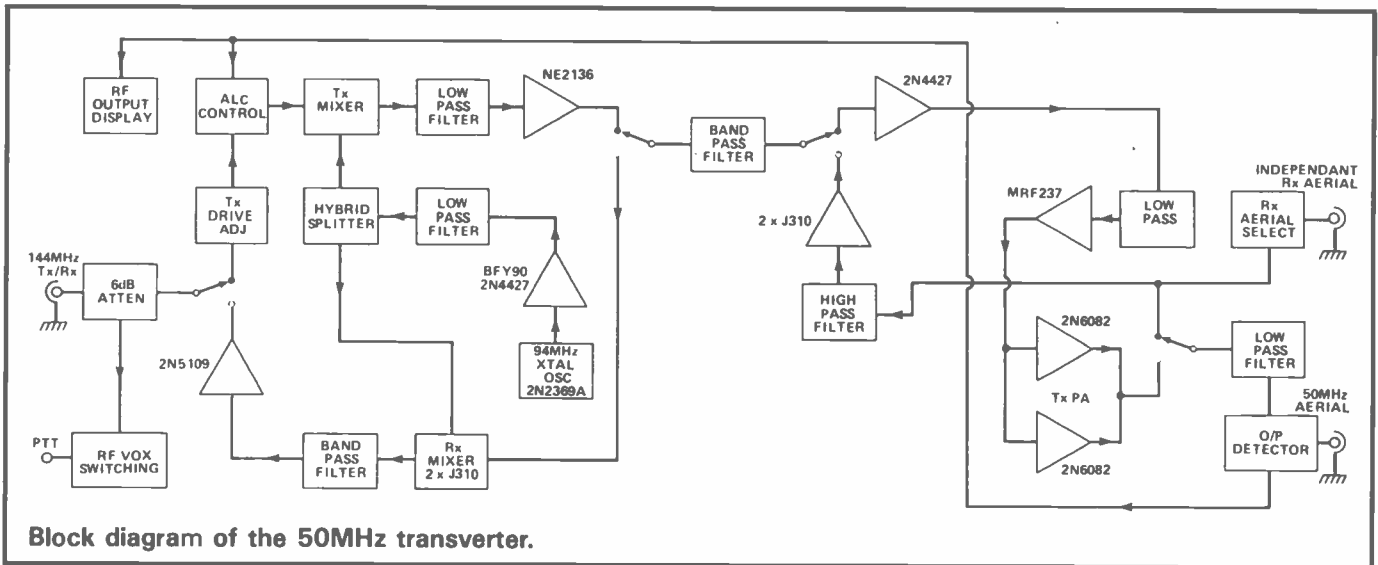
Early MM transverters appeared in a featureless black diecast box, but a radical departure took place with their current 2m transverter by

the introduction of a smart sectioned case made from alloy panels. As the accompanying photograph shows, this has also been employed for their 6m offering, hence giving a functional front panel with all connections at the rear in contrast with previous units.

### Overview

The transverter operates from a nominal 13.8V DC supply, drawing a maximum of 4 amps. 20W pep maximum output is specified from a 2m input drive level of 150mW —





15W, an LED bargraph indicating the relative output power. The unit is supplied factory adjusted for a 10W drive level, however an internal sensitivity control accessible from the rear panel allows the user to adjust this to suit their specific needs. A higher power transceiver may of course be used with an appropriate external attenuator. RF sensing of the driver transmit power is employed giving automatic changeover, a front panel mounted control gives adjustment of the 'hang' time before switching back to receive mode, and 'hard' PTT switching may also be used.

Three RF connectors are fitted to the rear panel, these connect to the 6m aerial, the transceiver, and also give provision for an independent receive input facility when using an

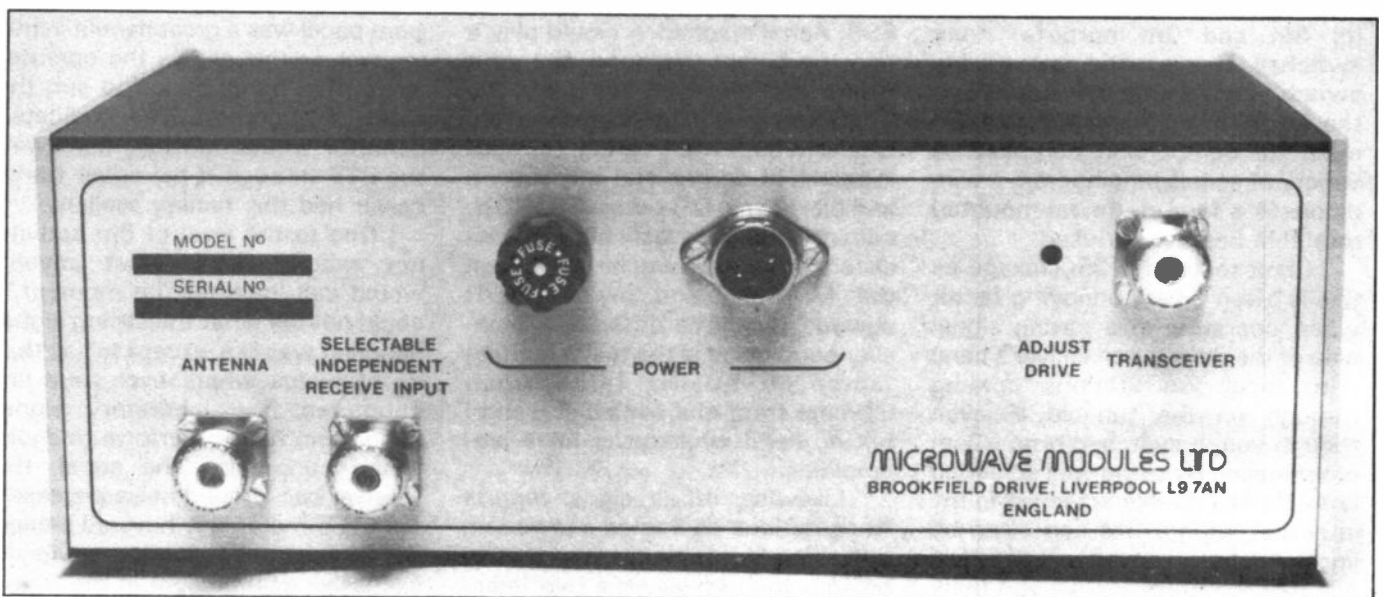
external linear amplifier or suchlike. RF ALC (Automatic Level Control) gives a degree of protection against overdriving and SWR protection is incorporated to protect the expensive RF power transistors against aerial system faults. DC power with negative earth is supplied to a 5 pin DIN socket also on the rear panel, this may be between 12V and 14.5V but the manufacturers give dire warnings against exceeding this voltage.

A well written manual is supplied with the transverter, giving simple operating instructions, user recommendations such as coax type, effect of aerial VSWR etc, a technical description, block diagram and comprehensive full circuit diagrams. Two matching PL259 RF plugs, a locking metal DC connector,

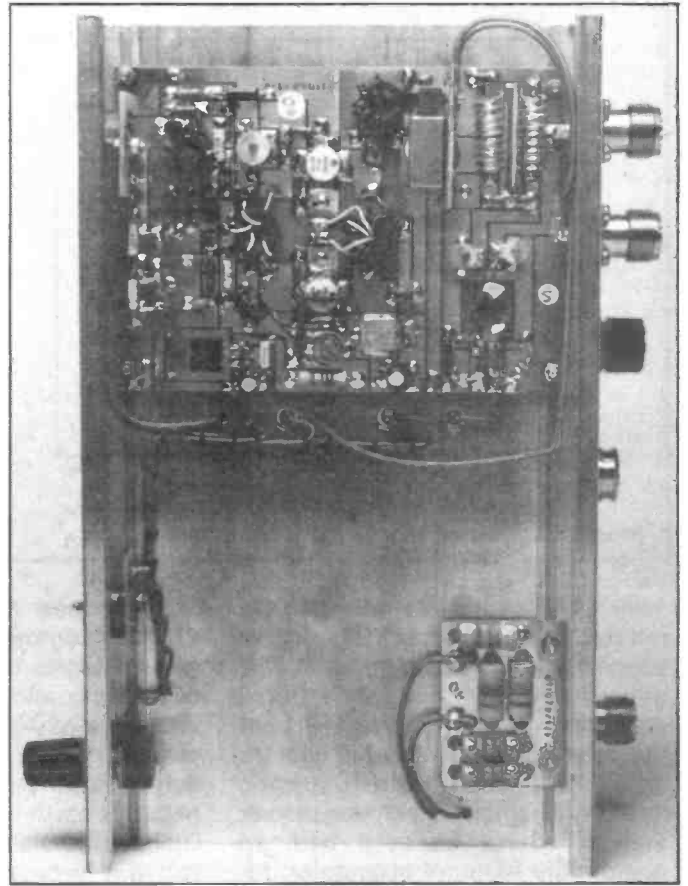
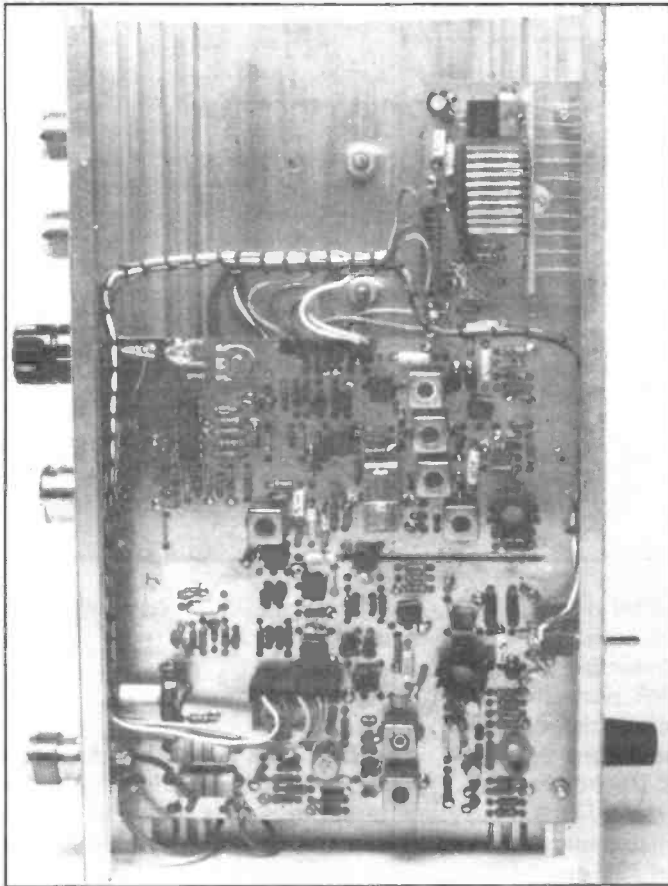
and a spare 5A fuse are also supplied.

### First Impressions

I have used (and come across many more) of the older MM transverters, thousands of which are still in use today, showing their popularity and reliability! Some are now getting a little long in the tooth, but did of course represent good performance in their time. On closely examining the MMT50/144 both physically and studying the circuit diagram, I have to say 'They've got it right'. Maybe I should add 'Again', but let's not be too generous! The PA transistors are rated at over double the claimed output to ensure good linearity, the receive circuitry uses the latest in strong signal active



Rear panel connections.



PCBs are attached to a sturdy extruded aluminium case cum heatsink.

technology and the appearance of the unit gives it a 'professional' look rather than something the amateur has knocked up himself in a diecast box, tempting him to hide it away on a top shelf or behind other equipment.

### On the Air

The transverter was coupled to my FT107M/FTV107R system with its 6m and 2m outputs, coax switches being used to quickly switch between the 6m output and the 2m output/transverter combination for comparison purposes. A variety of aerials ranging from a wire dipole to a four ele tower-mounted rotatable beam were used.

I first tested for 2m leakage as this is often a very annoying factor when operating in a strong signal area of the driving transceiver's band with local 2m stations coming through on the tunable IF even though you're switched onto 23cm or whatever. By using well screened coax (I used double screened in my inter-unit wiring) this can often be improved, but transverter signal leakage can sometimes make you think you're hearing a rare station when

they're operating on a completely different band. One amateur was proudly boasting of the weak FM Russian stations he was hearing on 145.6MHz using his homebrew 2m/10m converter, until it turned out that they were using 10m!

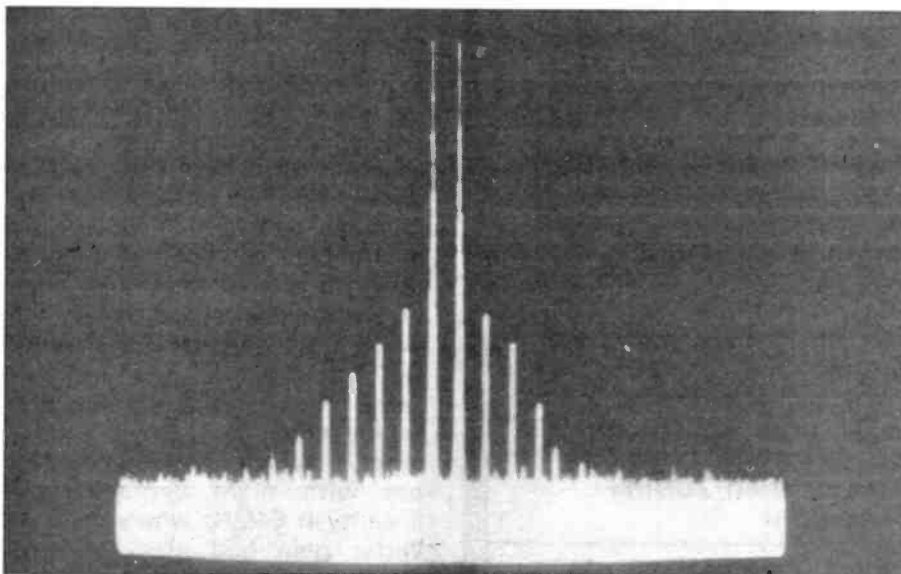
By tuning to the local 2m repeater (a 59+++ signal) and switching in the MM transverter, not even a heterodyne was noted on SSB. Aerial resonance would play a part here, but even so the unit passed this test with flying colours. Confident that I could reasonably believe what I was hearing, I set out in search of signals. The only beacon audible at my QTH was GB3NQH, coming through weakly but at a consistent strength. Switching between the MM unit and my FTV107R showed very little difference, however band noise is the major limiting factor on 50MHz rather than ultimate front end sensitivity, and I felt no need whatsoever for a pre-amplifier.

Likewise, off-air signal reports from stations contacted showed no difference in transmission quality being noted between the two, indicating that the transverter was oper-

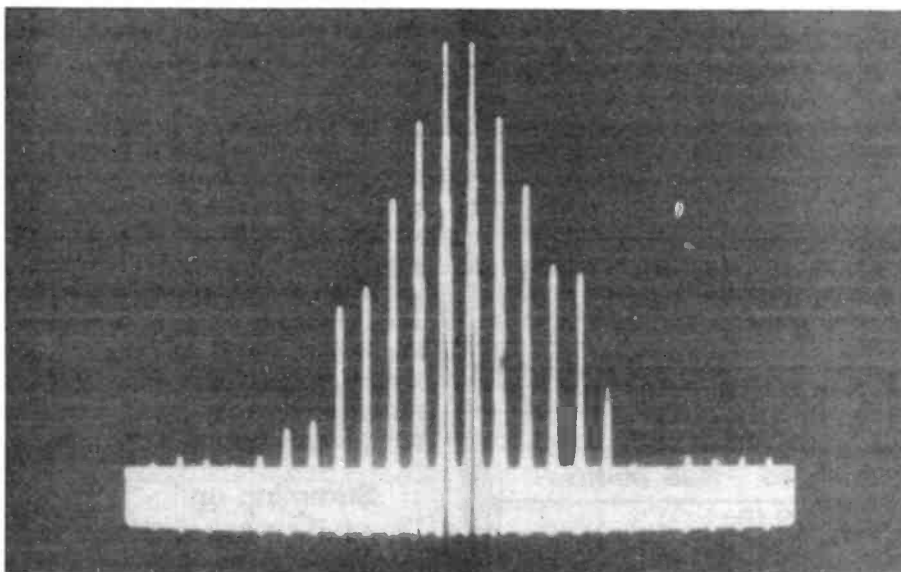
ating in a linear fashion without undue 'spreading'. I tested the RF sensing before using the hard switched PTT facility and this operated very well without reports of the first syllable of words being lost. I didn't like the repetitive soft clicking of its relays though, although this is purely a personal aversion (I usually find it annoying to use VOX as well). The hang time adjustment on the front panel was a great benefit in this respect as this allows the operator to set the 'hang' period to suit the style of operation. The dedicated operator would normally hard wire the PTT through if his driver transceiver had this facility available.

Due to the level of 6m activity not exactly being what anyone would call 'high' at the moment, I could not tell what the strong signal handling was like, except to say that no problems whatsoever were encountered, the laboratory signal generators had to perform this job! When connecting the aerial, the receiver background noise increased but the S-meter only hovered around the S1 mark, showing there was no excessive gain present in the transverter that could markedly degrade

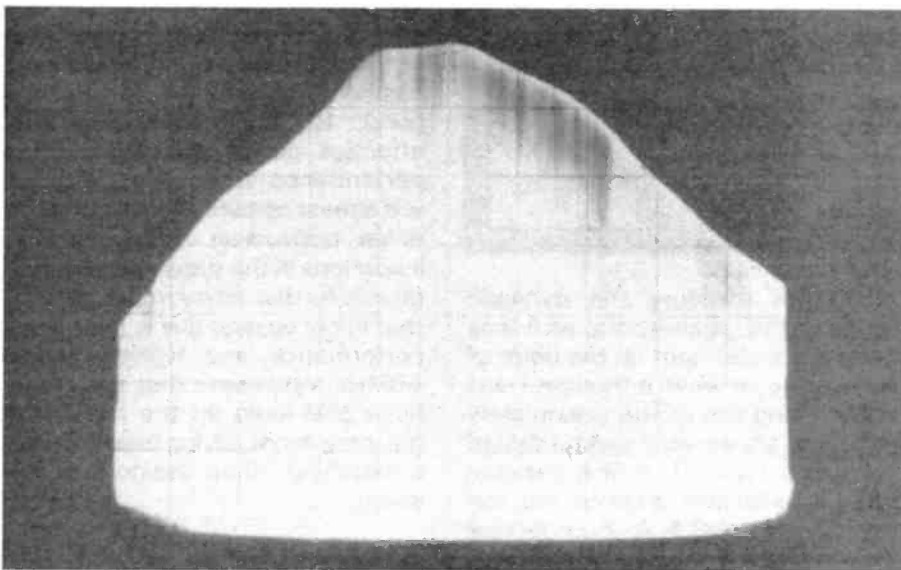




50.25MHz Tx signal at 3dB below ALC threshold: Horizontal scale =.5MHz/div, Vertical 10dB/div..



50.25MHz output 3dB into ALC: scale as above.



Tx gain bandwidth plot centred on 52MHz: Horizontal scale 2MHz/div, Vertical 10dB/div..

the overall system dynamic range. In long ragchews, the case temperature remained cool, and the signal did not noticeably degrade in quality from any linearity change with temperature. No reduction of power output was noted even after long operating periods, and I could not detect any frequency drift.

### Circuitry

The receive signals are passed through a five-pole low pass filter, followed by a three-pole high pass filter, to the receive RF amplifier. This employs the novel principle of using paralleled J-FETs to increase the overall transconductance and hence give an improved dynamic range. A broadband transformer follows, then into a bandpass filter common to the Tx path, and into a balanced J-FET mixer. A further broadband transformer couples the output to the 144MHz IF bandpass filter, then through a large-signal bipolar post amplifier and onto the relay, attenuator, and output socket.

On transmit, the signal passes through the input attenuator and relay to the variable sensitivity potentiometer, followed by the ALC controlled diode attenuator. The transmit mixer again uses a pair of balanced J-FETs, the resultant 50MHz output being passed via a three-section low pass filter to a bipolar broadband amplifier. The common bandpass filter comes next, followed by further amplification, filtering, and final amplification which is performed by a pair of 2N6082 bipolars operating push-pull in class B. These use a clever feedback technique to further improve their linearity. Another five-pole low pass filter precedes the output detector and aerial connection, the detector feeding both the ALC circuitry and the LED RF output display.

Mixer injection is obtained from a 94MHz crystal controlled Colpitts oscillator operated in common base with a stabilised voltage supply. This drives a two transistor feedback buffer amplifier followed by a five-pole low pass filter to generate a clean injection signal for the transmit and receive mixers.

A very neat internal construction method is used, as shown by the internal photograph, a roller tinned PCB with ground plane helping to

## LABORATORY RESULTS

All measurements taken at 50.25/144.25MHz with 13.8V DC supply unless otherwise stated.

### Receive section

Conversion Gain:	6.5dB
Bandwidth:	5.2MHz to -3dB points
1dB Compression Point:	Greater than 700mV (+10dBm)
144MHz Rejection:	72dB
Other Spurious Responses:	43.75MHz -49db All others 25MHz - 500MHz less than -70dB

### Transmit section

Maximum Output Power:	14.7W constant carrier, 19.8W pep SSB.
RF Sensing Level:	2mW
Input Drive Power For Full Output:	Min 126mW Max 19.5W
Bandwidth:	4.1MHz to -3dB points.
Harmonic Levels:	2nd -69dBc 3rd -48dBc 4th -71dBc 5th -57dBc
144MHz Leakage:	-59dBc
Input VSWR:	Less than 1.2:1
Hang Time Adjustment:	0-1.6 secs.
Frequency Accuracy:	Within 100Hz

give good reliability and circuit stability. A 15V Zener diode follows the 5 amp fuse to afford protection from excessive voltage supply.

### Laboratory Tests

The receive path gain and bandwidth were measured first, these showed a sensible 6.5dB gain with a well shaped bandpass response. The 144MHz rejection was very good, as found in the on-air tests. I

could not measure the dynamic range of the receive path, as it was perfectly linear right up the point of RF sensing, ie when it thought I was transmitting into it! This is extremely good and shows how careful design work has paid off. A few minutes with a calculator showed the frequencies of possible spurious receive responses, the only one of note was -49dB down at 43.75MHz (twice 94MHz minus 144.25MHz) which is

near to the designed bandpass at 50MHz.

On transmit, the output was very clean with a rapid falloff of high order IMD products, more akin to that observed from high performance valve amplifiers. The ALC circuitry maintained this linearity well under conditions of excessive drive, but also limited the maximum constant carrier output to a dB or so below the maximum pep level. The ALC was incidentally very accurately set as supplied to the specified 20W. When tested over the 50-53MHz range, little change was observed, but with slight degradation in linearity at 54MHz where the transverter gain had also fallen off somewhat. The accompanying spectrum analyser photo shows the gain flatness under non-limiting conditions, note the maximum output being controlled by the ALC is very flat in level. The harmonics were well suppressed, the 2nd harmonic falling in Broadcast Band II was well down but I would still be tempted to place a simple coax stub filter in line with the aerial feed to suppress this even further in use.

In all, a very good RF performance indeed, I was particularly impressed with the receive side which shows the type of performance one can get if you really put your mind to it.

### Summing up

A lot of thought and design effort must have gone into this transverter, and it appears to have paid off very well indeed. Rather than say it is over-engineered for the current level of UK activity on 6m, I would say it has been designed with the future in mind, for the ultimate in cost-effective performance. The on-air performance when using this unit will almost certainly be limited by the driver transceiver rather than any limitations in the transverter itself. I'll go one further (sorry muTek) and say that in my opinion this is the highest performance and highest quality 50MHz transverter that I've seen. I hope MM keep up the good work (no, they're not paying me), let's have a matching 70cm design from you soon!

*My thanks go to Microwave Modules, Aintree, Liverpool, for the supply of the review transverter.*

# FRG9600+HF



Front view of the FRG9600.

***First and foremost the FRG9600 is a VHF/UHF scanner, but if you fancy testing the water on HF the latest Withers modification could be the answer. Mick Senior, G4EFO investigates.***

If you are considering purchasing an FRG9600 with the HF conversion option produced by R. Withers Communications, I would advise you to read the previous reviews by Tony Bailey, G3WPO. Tonys' articles reviewed the FRG9600 in its basic form as a VHF — UHF scanning receiver in some detail and will be useful background to this review which deals solely with the HF option. The reviews appear in the Oct 85 and Dec 86 issue of HRT and will give all readers an excellent insight into this VHF/UHF scanning receiver. After taking these reviews into consideration it would be prudent for all would be purchasers to read the spec sheet issue by R Withers on his conversion. The basic conversion gives the owner the additional frequency coverage of 100kHz to 60MHz by adding a simple HF up-converter.

### **The up converter**

The up converter PCB is very neat and small. It measures approximately 20mm by 45mm and is mounted inside the FRG9600 adjacent to the SO239 aerial socket (see photo). The PCB contains 11 capacitors, three resistors, a crystal,

one transistor and a balanced mixer package and it feeds into a small relay operated by the miniature toggle switch on the back panel. The relay provides switching between the SO239 and N type aerial connectors. The converter, which has an IF output of 100MHz, has no gain and at first instance this may seem a little odd. It is however, becoming very popular in commercial fields to use receivers with little or no RF gain in the front end as high performance can be achieved by using a selective front end and relying on a good aerial installation. This is a very sensible practice as it affords the user a high degree of immunity to crossmod and inter modulation products when used in areas of high field strength. The up converter employs a double balanced ring mixer which gives good dynamic range and therefore helps to give good selectivity.

### **How it works**

By using an IF of 100MHz the receiver is tuned from 100MHz to 160MHz to achieve coverage of 000kHz to 60MHz. When the converter is switched into circuit the first '1' of the display is suppressed

in the Withers conversion. Using the up converter and listening on the shortwave bands is very easy; the receiver should be in the normal VHF receive mode to start the operation — let us assume that you wish to receive the Radio Four transmitter on 200kHz. Simply programme in the frequency 100.200 via the key pad and then select the up-converter by means of the toggle switch on the back panel. The converter is automatically brought into circuit and the first digit disappears leaving the display showing 00.200 for 200kHz. In the same manner, if you wish to listen on 3.720MHz, dial 103.720 and switch the toggle. The '1' disappears leaving 03.720 showing and the receiver is tuned to 3.720MHz.

Ray Withers recommends the use of dipoles or other resonant aerials for every band to be used. Although this is good practice it will probably be impossible for the average user to string up several aerials, so perhaps a more practical solution would be to use a long wire with a small ATU to resonate the antenna. This will certainly give improved results over random pieces of wire. By careful use of a resonant aerial and the receivers attenuator, excellent results can be achieved. Spurious responses and wide band noise can occur if the aerial impedance is high. Careful use of an ATU and the attenuator in the receiver will help to minimise these effects.

### **Performance**

Taking into account that this is not a dedicated shortwave receiver but a VHF/UHF unit with an add-on converter, the FRG9600 performed very well both in the lab and when receiving signals 'off air'. Whilst using random pieces of wire good results were achieved and the addition of a simple ATU gave very acceptable results, probably on a par with an average general coverage receiver. One thing that should be kept in mind is that this conversion is designed to give general coverage performance and *not* to act as a



'state of the art' DX chaser on twenty metres. I cannot over emphasise that the use of an ATU or resonant aerial makes all the difference. It is worth spending half an hour putting together a simple variable L/C circuit for this purpose.

The receiver sensitivity as measured in the lab gave the following result. The signal levels listed were the levels required to give a S9 indication on the receiver sent for evaluation. Although the figures for the medium and long wave may appear to be high they are not alarming and the receiver performs perfectly well when used with the correct antenna. The built in attenuator on the front panel alters the signal level by about 12dB. This is very useful in some cases to get rid of the internal 'birdies' of the FRG9600.

Frequency	Sensitivity
30MHz	2.5uV
20	2.0
10	2.5
5	3.5
1	10.0
200kHz	650.0

### Assessment

My only criticisms of the unit have already been covered by Tony, G3WPO and concern the few birdies which appear, making the scanner stop at random places, although annoying they did not distract from my enjoyment of this receiver. One other slight problem is the squelch setting on AM. If you forget and have the squelch set as used on a conventional FM system the received audio takes on a strange 'Norman Collier' quality with the exclusion of modulation peaks and speech sibilants which presumably vanish down the sides of a top cut filter.

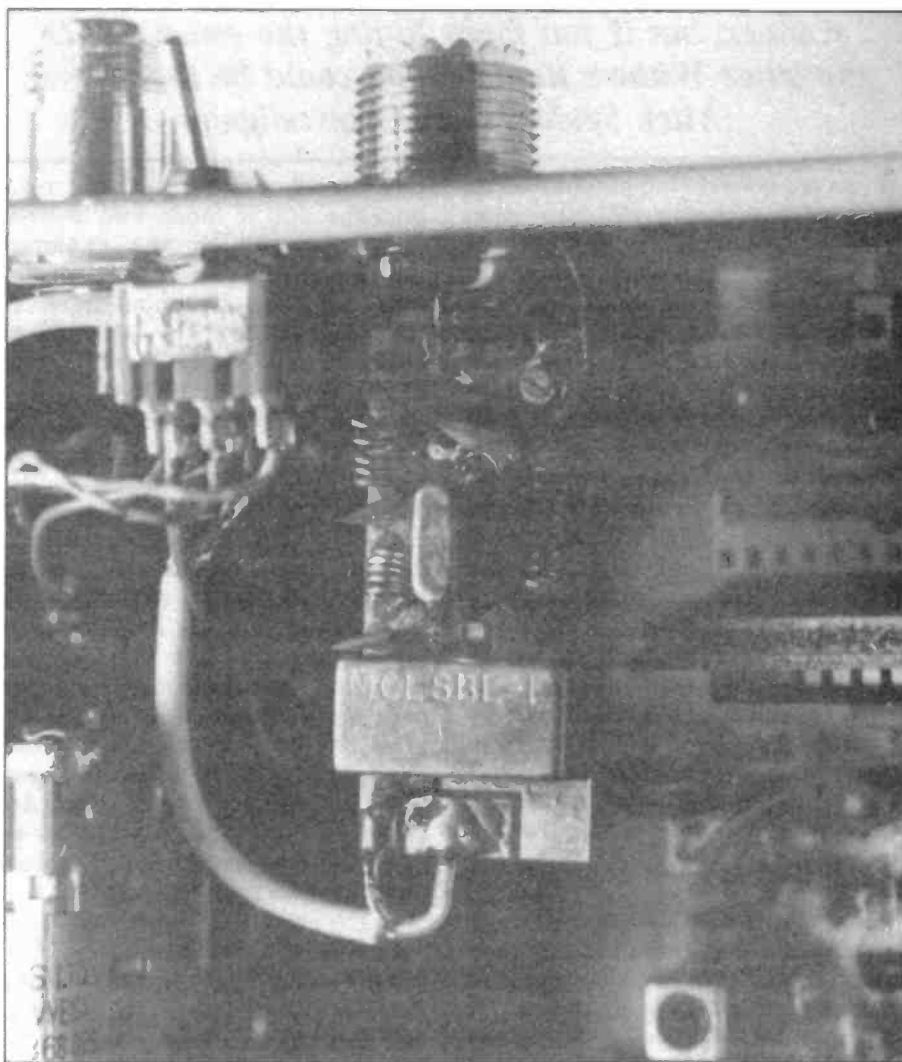
When used as a general coverage receiver the FRG9600 and converter gives good results on the shortwave broadcast bands. Whilst listening on the 49 meter band, (around 6MHz) the usual stations were very strong and Radio Luxembourg, Netherlands, Budapest and Moscow plus many others were received without problems. Listening on the eighty metre amateur band also gave reasonable results. Several 'G' stations were heard and a few PA's although no DX was received. In

all honesty it was not expected — but the hope was there!

In the accompanying leaflet produced by R Withers, the company does state that due to the frequency translation method used and the limitations of the IF/AGC circuits, some unwanted signals can be expected. It is refreshing to see that a company is being straightforward with its customers and conveying the facts rather than making exaggerated claims which are impossible to achieve. If, as suggested earlier, you read the accompanying leaflet the user should be in no doubt as to the limitations of the system. The company states that the gain is 2 uV FM @ 12dB SINAD on the LF/HF bands, 'but is somewhat less for AM'. This seems a strange claim to make as most LF and HF broadcast stations use amplitude modulation. The company also state that gain is

somewhat less below 1.6 MHz. Perhaps it is, but as a user I have found that it is a good general coverage receiver giving the owner continuous coverage from 100kHz to 950MHz on AM, FM Upper and Lower sidebands with scanning facilities. Now at £625 (plus £5 p & p) what other receiver can give those facilities? To my mind, having read the spec sheet and being aware of the limitations it is a very good buy. Existing owners can also have their receivers modified, if you have already had the earlier expansion to 950MHz fitted then adding HF will cost £99 inc. carriage. Unmodified units of the original specification will cost £129.50 but this price includes extending the receiver coverage up to 950MHz as well as the HF mod.

We would like to thank R. Withers Communications of Birmingham for the review sample.



Part of the Withers mod', the switch selectable up-converter board — the frequency display leading digit is also blanked when in HF mode.

# RADIO TODAY

## Ultra Light Telescopic Masts

A new range of telescopic masts, made from advanced carbon/glass composite material which is widely used in aerospace components is offered by Antenna Technologies. Up to 12 metres (40ft) in height, these masts are much lighter than metal masts so that they can be easily carried by one person, yet they are tough enough for military use.

The design has evolved from the need to have reliable, simple and light masts that can be deployed quickly by any non skilled personnel. The 12 metre mast column for example weighs less than 8½ kilograms (19 pounds), and retracts to 1½ metres whilst the eight and six metre versions are even lighter. Composite material construction also offers

other benefits such as resistance to corrosion and icing, and long maintenance free life.

The masts are raised by extending the tube sections manually and locking them in position with quick lock/release collars, thus avoiding the use of pneumatic seals or compressors. Any height up to the fully extended height can be chosen and the mast will not rotate when deployed. Vehicle mounting brackets are available, and standard masts are supplied in a canvas carrying case complete with stays and stakes. Applications include masts for tactical and emergency communications antennas, and environmental monitoring.

Antenna Technologies, Horace Road, Kingston Upon Thames, Surrey KT1 2SN, tel: 01-546 7808.



## Low Down On Lowe

If you'd like to meet the designer of the HF125, your opportunity will come on the 17th June; and you could also meet Lowe's technical director, John Wilson, G3PCY.

Both John and another John, John Thorpe who designed the HF125, will be addressing the assembled throngs at a Lowe Electronics radio evening, in the

Charlton Arms Hotel, Church Street, Wellington, Telford, there will be a talk-in on S22 from 7 pm, and the evening proper kicks off at 7.30.

Besides the talks, you'll have the opportunity of seeing the all-British HF125 receiver and the latest models from Kenwood (see Trio).

A cup of coffee and a biscuit will be available *free of charge* to the first 50 people to arrive.



## AMRAC Up!

Membership of AMRAC, the national amateur radio and computer club has increased tenfold in the 12 months to May, 1987 and currently stands at just over 800.

The club produces a bi-monthly newsletter *AMRAC-*

*USER* which covers all forms of computer communications, with heavy emphasis currently being given to packet radio. Membership is £8 (UK) per annum and further details may be obtained by sending an SAE to the secretary, Phil Bridges, G6DLJ, c/o AMRAC, P.O. Box 39, Hythe, Hants, SO4 6WY.

Peter Pennington, G4EGQ, was recently awarded a life membership of the SE Kent (YMCA) ARC in recognition of his help in getting over 200 people up

and down the country through the RAE. Pete, a modest man, spends his spare time helping others, both inside and outside the amateur world.



## SSTV on a Spectrum

Following on from successes with RTTY and CW programs, John Pearson, GIFTU, has developed a program for SSTV Tx and Rx.

The program allows the Spectrum computer to both transmit and receive slow scan TV pictures, and it is compatible with the old black and white and the newer colour hardware such as the SCI.



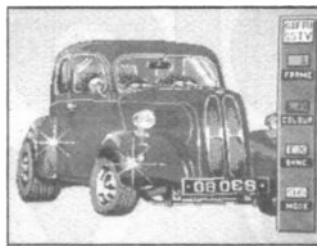
8 second SSTV received from the USA via HF.

John says that the receive system developed for the GIFTU SSTV Tx/Rx is brand new and was developed with performance

on both HF and VHF in mind. The program has adaptive fly-wheel-type sync to prevent picture tearing, combined with a noise rejection system that can allow several corrupted frames to combine to produce an enhanced picture.

The received picture neatly fills the screen, and the program features a new linearity system to produce good results on both photos and text displays. Smooth shading is used, and the user has fine control over the contrast and brightness of the incoming picture via 'live' controls and on-screen displays.

The program can receive 8, 16 and 32 seconds per frame black and white SSTV, and also 24, 48 and 96 second colour SSTV, which is displayed in black and white. Other receive features include up to 5 frame stores (plus the screen itself) which can be saved or printed out. Facilities have been included for graphics printers and alternative storage devices. The program also has variable input sensitivity and many



Sample screen ready for transmissions (it's a pity we can't show this one in colour).

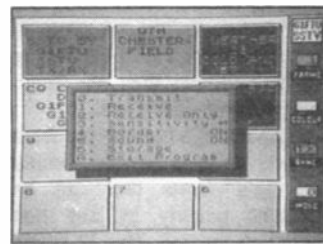
other detail features for convenience and special effects.

In transmit mode the program can send both text and Spectrum graphic screens, in black and white or colour SSTV. All of the Spectrum colours and grey levels are used to the full. Modes available are 8, 16 and 32 second frames for black and white, and 24, 48 and 96 second frames for colour. Both line sequential and frame sequential colour transmissions can be made.

Text transmissions can be made in all modes. There are 9 text memories which may be

edited before or during transmissions. There is also a personalised CQ memory and a special grey scale and colour bars facility. All text memories are on view at once in a neat 'window' type display.

The program costs £12 in the UK, £13 from Europe\* and £14 elsewhere. The microdrive version is £2 extra, and the Opus disc version £4 extra. The price includes a comprehensive instruction booklet and a second cassette with 20 minutes of sample SSTV audio and a selection of quality screens as examples for transmission. Further details are available from Pearsons Computing, 42 Chesterfield Road, Barlborough, Chesterfield, Derbyshire. Tel 0246 810652.



Title screen for the program.

Tom Douglas, G3BA, is presented with an illuminated scroll to commemorate his 50 years association with radio, for much of which he has been involved with

the Midland Amateur Radio Society, whose president, Stuart Laing G80DT (left) made the presentation. Photo: Tim Jebbett, G0GPZ.



## No News Is Good News?

There has been no news yet about the government's response to the publication of a report recommending 'selling' the radio spectrum to users (HRT).

The Minister of State for Industry and Information, Geoffrey Pattie, made some of the usual noises about 'still appraising the full implications...' of the report, which hopefully means

that it will be consigned to the dustbin of history. However, some sources suggest that if re-elected, the government will go ahead with this scheme which will make the UK the first country in the world to auction off bits of the radio spectrum.

The report, 'De-regulation of the Radio Spectrum in the UK', is published by the DTI for HMSO and costs £9.50; it was written by CSP International.

## Yet Another Award!

Haywards Heath College ARS has instigated the West Sussex Award, for no particular reason except, maybe, the fun of it all.

There are two classes to the award, called, with stunning originality, class I and class II. To gain class I you must work or hear at least 20 West Sussex stations with at least two in each of the seven district councils' areas.

For class II, you must gain 25 points for working or hearing West Sussex stations, points being accumulated as follows: 5 for GIVIC, the club's call sign; 5 points for GB4HHC or BG8HHC

(but you can't have both together); 3 for any present or past member of the society, inside or outside the county; and 1 for any other fixed West Sussex station.

To claim your award, send £1 sterling plus two 1st class stamps (or two IRCs) to C Hinton, GITCH, HHCARS, Haywards Heath College, Harlands Road, Haywards Heath, W. Sussex RH16 1LT. You will need to send the relevant details from your log book, signed either by two other hams or by your local friendly club officer. The award itself is an attractive map on a pale green card, showing district and parish boundaries of the county.



## VHF From Anything

Cap. Co Electronics Ltd says that its new range of VHF aerial tuning units are so adaptable that you can tune any HF dipole, long wire, vee beam, G5RV, rhombic, inverted vee, existing VHF beam or vertical antenna on to VHF! The main limitation is that it cannot be used on trapped dipoles or trapped HF beams.

Cap. Co's press release says that during testing, they tuned up their bench soldering iron and got a QSO with Wigan — a distance of nine miles away — with a signal report of 5 by 5 from 5 watts! They say they also managed to feed a rear windscreen heater element, a normal car radio antenna and an aluminium patio window frame, which worked "as an incredible quad aerial"! So, the press release goes on to say, prospective purchasers should be able to press the nearest fence, metal window or balcony into use, if there is no other way of putting up an aerial.

Cap.Co says that the performance of its ATU is due to the use of a pi-network circuit, and that this also has the effect of reducing TVI due to the attenuation of unwanted harmonics in the output signal.

The VHF unit, designated

the SPC-100, is available now and costs £59.95 inc VAT plus £3 p&p from Cap.Co Electronics Ltd, 63 Hallcroft, Birch Green, Skelmersdale, Lancs WN8 6QB, tel 0695 27948.

For the future, there are two Cap.Co products due for imminent launch which may well be of interest to HRT readers. The first is a microprocessor controlled ATU, which will automatically tune antenna loads of under an ohm to several thousand ohms over 1 to 30MHz, and handle up to 25kW of RF! The unit will retail for about £400, or slightly under the Icom ATU — but Cap.Co says that its ATU will have superior specs.

The other product is a loop antenna for 160, 80 and 40 metres. Described by Cap.Co's Tony Johnston as the 'ultimate tribander', it will offer very good directionality with very low noise. What's more, it will be small enough to be mounted on a piece of nylon or timber, and will not require planning permission. Tony says that the antenna 'defies normal aerial technology!' The antenna will cost about £200 to £300 and will be available shortly. We here at HRT will be making sure we get our hands on the first review sample!



## RAYNET Shortage

Surrey RAYNET desperately needs to recruit additional members, as it is presently under-strength by about 20 people.

Surrey RAYNET will be attending the following public events in and around the county, and the people on the stand will

be very pleased to talk to any interested amateurs:

**Shamley Green Fete**, Shamley Green (27th June);  
**Netherne Hospital Fete**, Coulsden (also 27th June);  
**St John Ambulance Fete**, Haslemere (18th July); and  
**Guildford Town Show**, Stoke Park, Guildford (5th and 6th September).

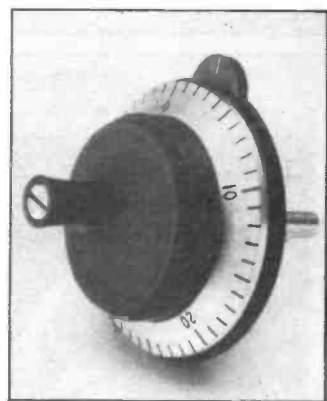
## St. John's Centennial

1987 is the Centenary Year of St John Ambulance Brigade. The highlight of the year will be the staging of The Great St John Party taking place in Hyde Park on 20th June. This will be quite a spectacular occasion as many thousands of St John members and friends will be attending.

As part of the celebrations The Grafton Amateur Radio

Society, based in North London, will be running a Special Event Station from Hyde Park. The station, call sign GB4SJA, will be primarily working on the HF bands — SSB and hopefully RTTY. VHF operation on 144MHz should also be on the go. Grafton will start GB4SJA at 17.00 on Thursday 18th June and end at 17.00 Saturday 20th June. Continuous working throughout this period is planned, subject to available operators.

If your Nevada RC26 roller-coaster coil is missing a turns counter, then you need look no further than the Nevada TC48 turns counter pictured here. Priced at £12.95, the 48-turn counter is available from Telecomms, 189 London Road, North End, Portsmouth, Hants PO2 9AE, tel 0705 698113. Telecomms say that they are on the lookout for any new ideas and products and would be happy to hear from budding inventors. But do they know what they are letting themselves in for?



## DX Expedition to Eire

A group of amateurs from the BBC amateur radio group (Caversham) and the Newbury and District Amateur Radio Society will be activating several rare squares in the south-west of Eire this summer.

From July 17th to July 31st, activity will be from UL (IO41), UM (IO42) and VM (IO52) squares. Operating times are not specified as this will depend on finding suitable sites.

From August 1st to August 10th, activity will be continuous (subject to the availability of operators) from a coastal site 1400ft above sea level in VL (IO51) square. This will include

the European VHF, UHF and microwave contests on the 1st and 2nd of August and also the RSGB lower power VHF and UHF contests on the 8th and 9th of August.

Activity will centre around the following frequencies: 80m: 3.645MHz; 10m: 28.567MHz SSB, 29.670MHz FM and 28.885MHz cross band; 4m: 70.234MHz; 2m: 144.234MHz; 70cm: 432.234 MHz; 23cm: 1296.234MHz.

Operators will include:— Bob, G6HUN (EI3VTU), Al, G4VSQ (EI2VZB), Roger, G3UAX, John, G1AWD, Roger, G6IBI, and Tim, G4WGU, and the group may be joined by Andy, EI7AYB, Bill, EI9FK, Charlie, EI5FK, and Paul EI2CA.

## Yellow Sheet Comes Ashore

Kanga Products thought that the 'Yellow Sheet' circulated amongst radio clubs in the USA was such a good idea, that they decided to start up one over here and send it to all the clubs they could find in the radius of 50 miles from Dover.

The cost of advertising in the sheet is small, just 50p per item

up to a maximum of £2.00 for ten items (but it's still not as cheap as a free readers' ad in HRT!).

If your club is in the area and not receiving the ad sheet, then check that the club sec isn't hogging it! If this isn't the case, then contact Kanga Products, 3 Limes Road, Folkestone, Kent CT19 4AU, telephone 0303 76171. Use the same address if you want to get an ad on the sheet.

# First UK review—the KENWOOD TM221E



At this year's NEC exhibition, Kenwood revealed their new baby for 2m FM mobile, the TM221E together with the promise of a matching TM-421E 70cm unit and (wait for it) a handset controller to link the two together giving full duplex and even

10, 12.5, 15, 20 or 25kHz steps, with the usual 600kHz repeater shift facility and an auto toneburst. A one-push 'listen on input' facility allows you to quickly check whether you're in simplex range before a QSY attempt is made. The transmitter

mode, a programmable band scan is available, memory channels A and B storing the lower and upper frequency limits in this case. The scan initiates in the last selected direction of frequency shift, halting again for five seconds when an active channel is found.

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*There was only one in the country so guess who got hold of it? Chris Lorek, G4HCL, reviews Kenwoods new mini-mobile.*

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cross-band repeater operation! So new that the displayed unit was for demonstration only to whet amateur's appetites, but the HRT team were fortunate in leaving with the first UK review sample to test for our readers.

## Features

I'm often impressed with how tiny the Japanese are making their sets, particularly handhelds and this 45W set is no exception measuring a very small 138mm(W) × 38mm(H) × 193mm(D). It offers coverage of 144 – 146MHz in user-selectable 5,

also has a nominal 5W low power facility for local working.

Up to fourteen memory locations are available, numbered 0-9 and A-D, storing frequency, repeater shift, and toneburst on/off; memory channels C and D may be used for odd Tx/Rx frequency shifts if required. Channels may be scanned for activity by a single button push when in memory mode, the scan stopping on a busy channel for five seconds before continuing. Any of the channels may be locked out from the scan mode if required, whilst still allowing manual selection. In 'VFO'

## Scanning

In all cases, the scan may be halted by pressing any of the set's buttons, apart from the power controls, but including the mic PTT. A priority alert may also be initiated by a further single-button push, regardless of whether the set is monitoring a single frequency or merrily scanning away. Here, memory channel 1 is sampled every five seconds and the set gives a double bleep from the speaker when this channel is active. A flat piano style key array is used to select the majority of the above functions.

The main tuning knob controls the frequency when in memory mode, and memory channel when in memory mode, the VFO/M button toggling between the two. The main

control knob is supplemented by Up/Down buttons fitted to the microphone. Further rotary knobs control receiver volume and squelch, and small push buttons above these select high/low transmit power and overall On/Off. A 'MHz' button is fitted to allow selection of the desired MHz segment using the main knob or Up/Down buttons.

An Amber LCD gives an indication of operational frequency, memory channel and status, priority selection, busy, on air, toneburst on/off, offset selected, reverse repeater mode, and a bargraph type S/RF indication, the latter giving a



The optional RC-10 handset will allow remote control and cross-band duplex working.

transmit modulation indication when using low power. A small top-mounted speaker is used on receive and an extension speaker lead may be plugged into the rear panel if required. Also on the rear panel are flying leads for aerial and DC power connections.

### Remote Control

Even though the set itself is very compact, it may be mounted remotely and out of sight if required. All of the rig's functions apart from DC power and RF output selection may be controlled from an optional RC-10 handset, this looking very similar to a cellular telephone handset. In use, it may be placed in an easily visible position, such as on the flat upper portion of the dashboard where the set itself could not be mounted due to depth restrictions. When used with the 221s 70cm partner, the TM-421E, the RC-10 can control both sets, allowing full cross-band duplex as well as an in-car repeater facility. Both of these will be available in the UK in the near future and we will be featuring a review of the complete system in a forthcoming issue. This certainly appears to be a novel alternative to dual band mobile rigs for the future!

### First Impressions

Yet again the Japanese are going smaller and smaller in size, but at the same time offering more for your money such as high power and improved receiver performance. I was glad to see that a substantial heat-sink has been used, often the temptation with small sets is to skimp on this, the result being overheated PA's when used for long transmit cycles. This leads to power 'slumping' on long overs, eventually followed by the untimely demise of the expensive PA module itself. The transceiver's height is complemented by the

availability of the remote controller handset, allowing it's positioning in otherwise impossible places, with the set safely bolted in out of sight.

I was surprised to see no facility for the Kenwood DCL (Digital Channel Link) option, the forthcoming TW4100E dual band mobile has this so the system has not been discontinued. I really feel it won't catch on unless more sets come equipped with it though.

### In Use

The set mounted was first in a clearly visible position, then after I had familiarized myself with its operation I moved it to the driver's side lower shelf to see how it performed using touch-only control. The RC-10 was unavailable at the time of review, so the standard fist microphone together with a neckband mobile mic were used for comparison purposes.

The frequency display was very clear and changing frequency or channel was very simple using the main knob or Up/Down mic buttons. I did find the small volume and squelch controls rather fiddly though, my fingers often catching on the protruding mic plug. The rotary controls are illuminated around their

edges making night-time location very easy. The lower piano-style keys were a different matter however. With the set positioned in the clear, these could easily be operated by sight, however at night or when otherwise operated by feel they were rather a pain. As frequency scan initiation could not be done from the microphone control buttons, I mainly wanted to find the 'Scan' key, this being physically positioned in between the other functions. The slightest bump in the road caused me to accidentally operate others when trying to select one function and I often had to slow down to use them. When manually searching for activity, rotating the main knob at a rate above around four channels per second caused me to miss signals, due to the receiver speaker being momentarily muted on each step. In the end, I found use of the Up/Down mic buttons far more convenient for most purposes.

### Audio Quality

The audio from the internal speaker was remarkably clear and free from the usual rattles and distortion at high volume often associated with similar tiny sets. Even at high motorway speeds I didn't need an external speaker, very impressive. Audio reports on transmit were a little on the thin and topky side so as I had found this with other Kenwood mobile sets using the same microphone, a quick swop with a Heatherlite neckband condenser mic was made. This immediately gave an improvement in 'fullness' of audio; previous results from using a Kenwood MC-55 boom mic would suggest a similar improvement.

Under long 'waffle' periods on high power, the set kept reasonably cool with the heatsink rarely becoming hot to the touch. The receive sensitivity matched the high output power nicely, but I found the squelch 'filtering' when receiving signals at threshold level, showing a lack of hysteresis. I personally found this slightly annoying, but under these conditions one can often back the squelch off completely, each amateur having their own operating preferences. I liked the use of flying leads for the rear RF and DC power connections, these are more expensive for the manufacturer to incorporate than chassis-mounted



sockets, but they provide far greater flexibility to the user in terms of the rig's mounting position.

### Insides

The diecast chassis houses most of the analogue RF and audio circuitry on a motherboard PCB with accompanying sub-boards, the separate diecast rear heatsink has the transmitter power amplifier circuitry sunk into it. A metal front panel, with its plastic outer trim, plugs into the main transceiver unit and houses the digital control circuitry, display, and user controls. All three sections are tightly screwed together to form a solid set that should stand up well to the vibrations and knocks encountered in mobile use.

On receive a dual conversion superheterodyne is used with intermediate frequencies of 10.70MHz and 455kHz. A PIN diode switch passes receive signals through the

GaAsFET front end, into a three stage Toko cavity filter and on to the receive mixer. First IF filtering is performed by two monolithic dual crystal filters, followed by mixing to 455kHz; further amplification and demodulation being handled by a 7761 IF subsystem IC, with a CFU455F filter to give further adjacent channel selectivity.

On transmit a directly-modulated final frequency VCO (Voltage Controlled Oscillator) is used, the output being amplified and passed to the rear panel circuitry where an M57726 block PA module and discrete low pass filter are used to achieve the final 45W output. The VCO is controlled by an M54959 synthesiser IC which is under serial control from the front-panel mounted uPD751069 microprocessor. The usual lithium battery backup is employed, being sandwiched between two boards in the control unit.

### Laboratory Tests

The receiver sensitivity showed a quite reasonable figure of 0.14uV, if it was more sensitive you'd be likely to have problems with externally generated noise in the average mobile installation. The adjacent channel selectivity, particularly at 12.5kHz spacing, was impressive and would allow useful performance with both 12.5kHz and 25kHz channelling depending on which part of the country you are in, as well as which part of the band in congested areas. The 3rd order IMD rejection (where two signals combine to produce further unwanted interfering signals in the receiver), was also good considering the impressive front end sensitivity, likewise the blocking rejection where adjacent strong signals cause the wanted signal to disappear into the noise.

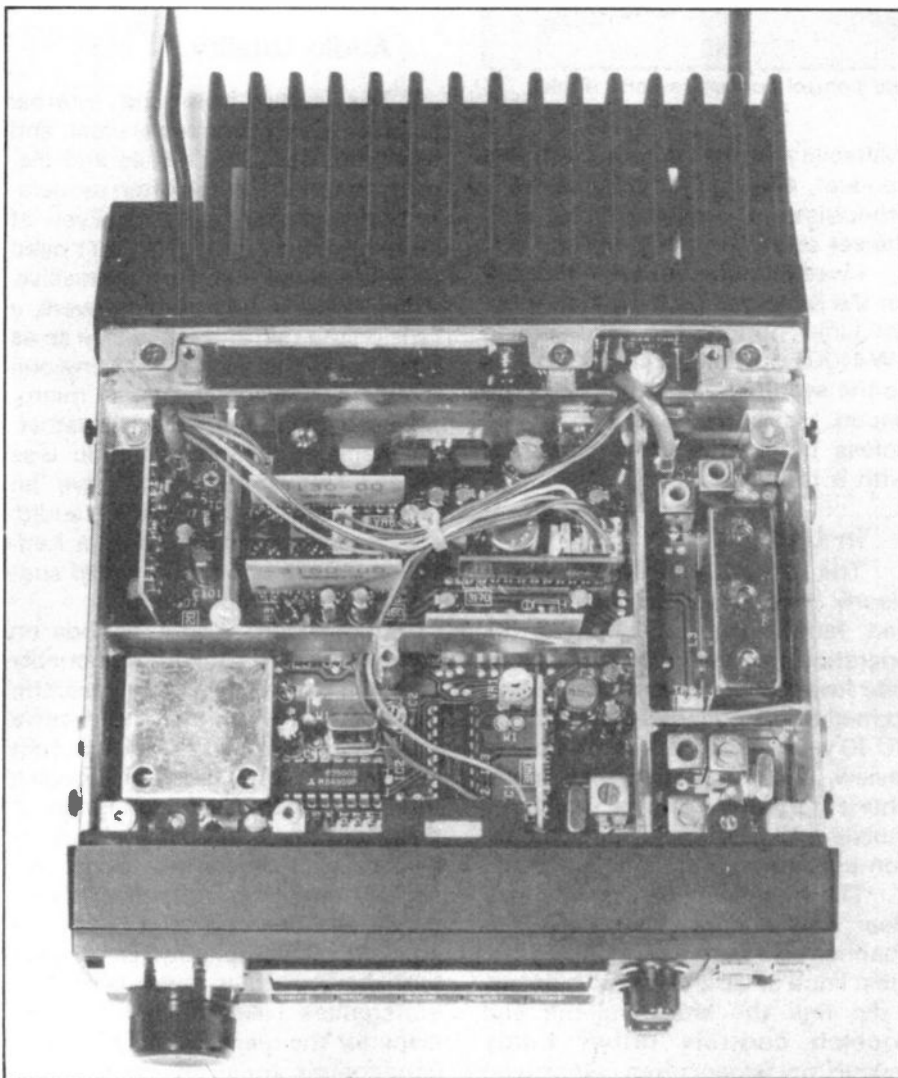
This good performance would suggest quite reasonable results would be obtained if used as a base station with a large aerial as well as for its intended primary use as a mobile. The squelch had a useful dynamic range — helpful in this application, which is more than can be said for the S-meter which showed the usual lack of dynamic range often found in FM only rigs.

On transmit the output was extremely clean in terms of unwanted harmonic content, and the deviation was correctly set at just under the recommended 5kHz maximum, hence not causing more problems than necessary to users 12.5kHz away. The low power facility was accurately set, and was very stable with voltage and frequency variations.

### Summary

The technical performance of the set is excellent, especially considering its size and current selling price of £334. I found some of the controls difficult to use by 'feel' when mobile, but one must appreciate that the available front panel space does place certain limits here. Overall, I thought it was a marvellous set and I look forward to trying the add-on RC-10 system controller which I feel will extend its versatility greatly.

*My thanks go to Lowe Electronics Ltd. for the loan of the review set.*



The rig offers a neat modular layout and a hefty heatsink amongst its features.

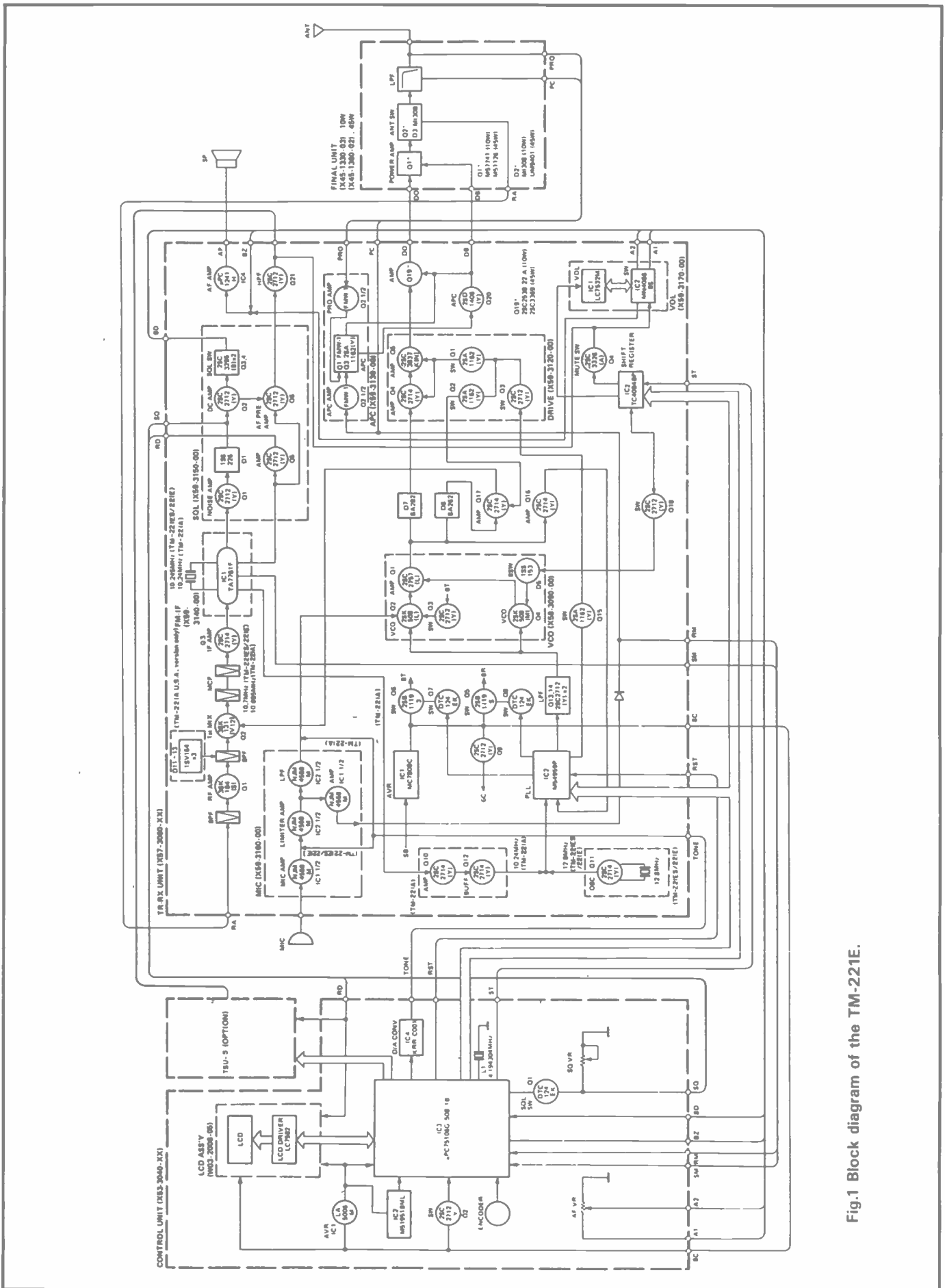


Fig.1 Block diagram of the TM-221E.

**Laboratory Results  
— TM-211E  
Receiver**

Sensitivity
0.141uV pd for 12dB SINAD (across 144-146 MHz)

Squelch Sensitivity	
Threshold	0.065uV pd (2.5dB SINAD)
Maximum	0.622uV pd (30dB SINAD)

**Adjacent Channel Selectivity:** Measured as increase in level of interfering signal, modulated with 400Hz at 30% system deviation, above 12dB SINAD ref. level to cause 6dB degradation of 12dB SINAD on-channel signal.

Separation	Rejection
+12.5kHz	47.5dB
-12.5	54.0
+25	73.0
-25	74.5

**Image Rejection:** Increase in level of signal at -32.6MHz to give identical 12dB SINAD signals; **83.0dB**

**Blocking:** Increase over 12dB SINAD level of signal 1MHz away to cause 6dB degradation in 12dB SINAD on-channel signal;

Spacing	Level
+100kHz	88.0dB
-100kHz	87.5
+1MHz	103
-1	104
+10	104
-10	104

**Intermodulation Rejection:** Increase in level over 12dB SINAD level of two interfering signals giving identical 12dB SINAD on-channel 3rd order intermodulation product;

Spacing	Level
12.5/25kHz	54.5dB
25/50kHz	75.0dB
50/100kHz	75.0dB

**Maximum Audio Output:** Measured at 1kHz on the onset of clipping

Load	Output
3ohm	3.55W RMS
8	2.25
15	1.35

S-Meter Linearity		
S1	0.219uV pd	-12.0dB
S3	0.356	-7.8
S5	0.508	-4.7
S7	0.661	-2.4
S9	0.872	0db ref
S9+	1.18	+2.6
S9++	1.68	+5.4

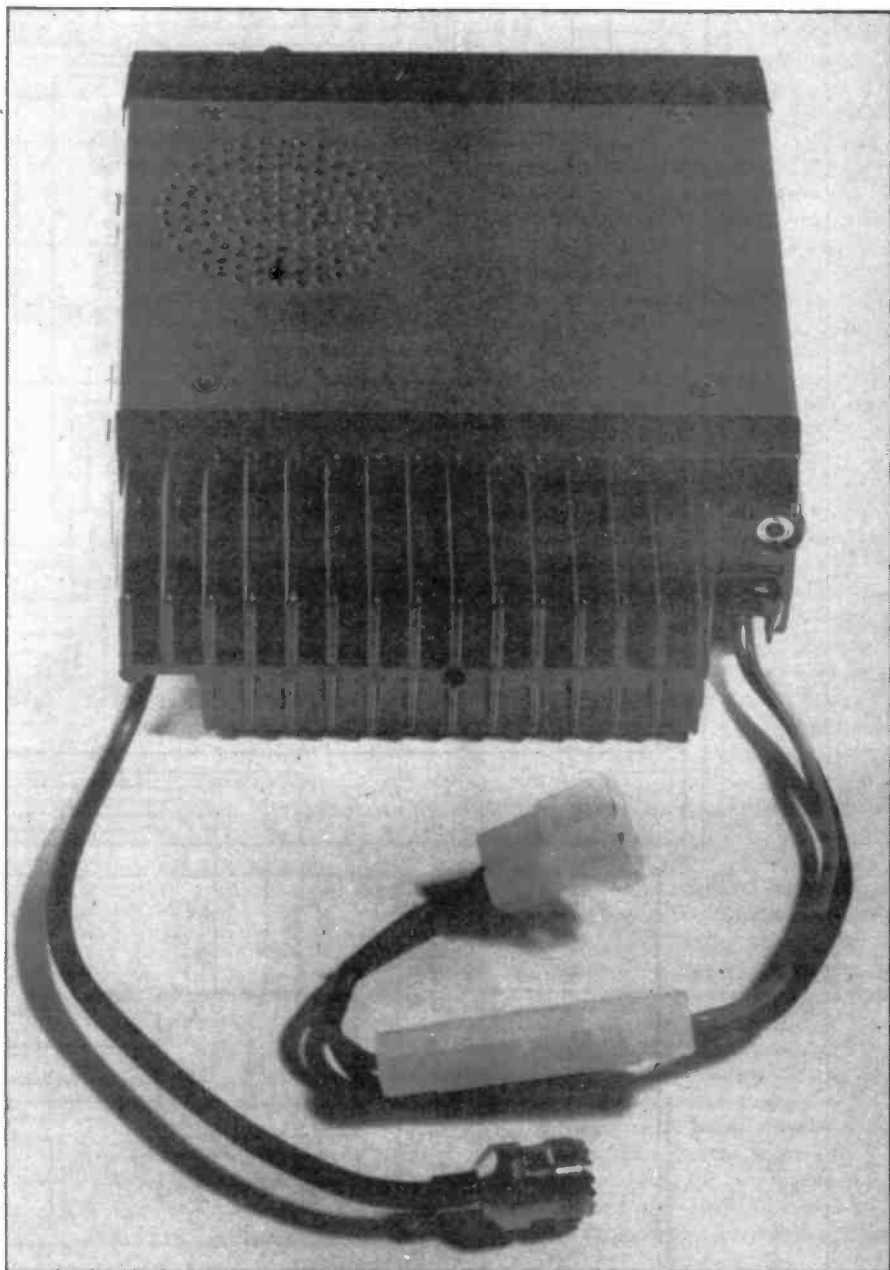
**Transmitter**

TX Power and Current Consumption			
Freq	10.8V Supply	13.8V Supply	15.6V Supply
144MHz	31.8W/6.12A	46.0W/7.08A	49.0W/7.11A
145	31.6W/6.10A	45.9W/7.05A	48.7W/7.09A
146	31.5W/6.08A	45.8W/7.05A	48.6W/7.09A

Low power in all cases well regulated at 4.90W/2.50A

Peak Deviation	4.49kHz
Toneburst Deviation	3.12kHz
Frequency Accuracy	-70Hz at switch-on

Harmonics/Spuril	
2nd Harmonic	-86dBc
3rd Harmonic	-92dBc
4th Harmonic	-98dBc
all other harmonics less than -100dBc	
Spuril at +/-10.7MHz -84dBc	



'Flying lead' connections for power and antenna can aid installation.



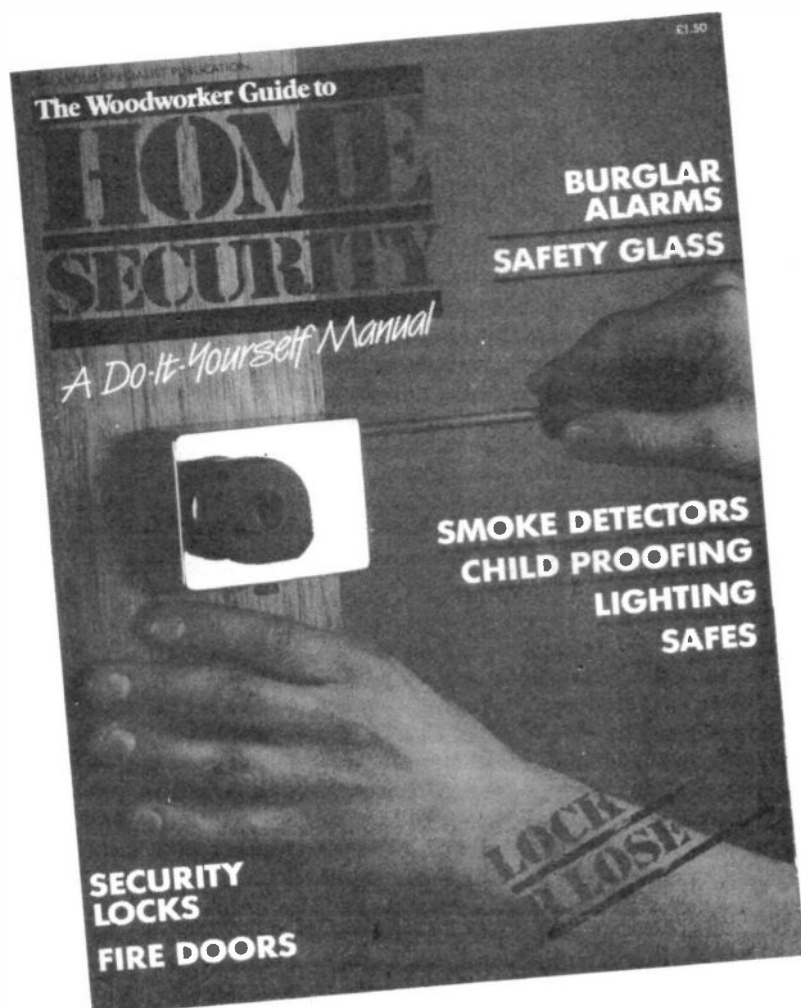
# RADIO Tomorrow

- 1 Jun** Welwyn/Hatfield ARC: Radio control demonstration.  
Rhyl DARC: Activity night.  
Burnham Beeches RC: Natter night with film on Airport Control.  
Stourbridge DARS: Night on the air.  
Sutton & Cheam RS: Natter night.  
Todmorden DARS: Treasure hunt for G4HYY Trophy.
- 2 Jun** Dartford Heath DFC: Pre-hunt meeting, Horse & Groom, Leyton Cross Rd.  
Loughborough DARC: Night on the air.  
Fylde ARS: Talk 'Computing'.  
Warrington ARC: Morse receiver MkII, Bill Green G8HLZ.  
Chichester DARC: Goodwood evening meeting.  
Wakefield DRS: Demo — Electronic Mail by G4BLT.
- 3 Jun** Cheshunt DARC: NFD preview and discussion.  
Rolls Royce ARC: Talk 'Scopes and Amateur Radio' by Ron G3YEE.  
Sutton & Cheam RS: Committee meeting.  
SE Kent YMCA ARC: Natter night.
- 4 Jun** Reading DARC: Away leg of quiz v Maidenhead club.  
Salop ARS: Natter night.  
North Wakefield RC: Talk 'Semiconductors' by G3JMS.  
Vale of Evesham RAC: 2m Foxhunt.  
Pontefract DARS: Discussion on present and future club equipment.  
Mid Sussex ARS: Informal evening.  
Yeovil ARC: Talk 'How to use a Smith Chart' by G3MYM.  
Bredhurst RTS: NFD planning.  
E Kent RS: Talk 'Two metre DX' by Ken Willis G3VR.
- 5 Jun** Coventry ARS: Morse tuition & night on the air.  
Maltby ARTS: Club quiz, first round.  
Maltby ARC: Activity night on air.  
Harrow RS: Activity night.
- 6 Jun** National Field Day.  
Cheshunt DARC: NFD at Cheshunt lakes.  
Loughton DARS: Aylmers Farm Field Weekend, special event station GB2LRS. Sutton & Cheam RS: NFD at Courtlands Farm, Banstead.  
Bredhurst RTS: NFD at County Showground, Detling.
- 7 Jun** National Field Day.  
Dartford Heath DFC: Club hunt, 2.30 pm, Dartford Heath.  
Cheshunt DARC: NFD at Cheshunt lakes.  
Loughton DARS: 2nd day of GB2LRS special event.  
Spalding DARS: Annual Spalding Mobile Rally. To be held at Springfields Gardens, Spalding from 10 am to 5 pm Details from Dennis G4OO on 077 586 382.
- 8 Jun** Atherstone ARC: Talk 'Satellites' by Adrian Chamberlain G4RDA.
- 9 Jun** Keighley ARS: Informal meeting.  
Loughborough DARC: DF event No. 3.  
Reading DARC: VHF NFD discussion.  
Stourbridge DARS: Night on the air.  
Chester DARS: Treasure Hunt — 7 pm start from Chester Rugby Club.  
Dorking DRS: Informal evening.  
Wakefield DRS: DR contest.  
Warrington ARC: RSGB film 'Electromagnetic Waves and Thin Film cct'.  
Verulam ARC: Activity evening.
- 10 Jun** Cheshunt DARC: Natter night.  
Stockport RS: NFD post mortem.  
Trowbridge DARC: Junk sale.  
Bath DARC: Computer night.  
SE Kent YMCA ARC: Treasure hunt led by G4EGQ.
- 11 Jun** Salop ARS: Calibration night.  
North Wakefield RC: Night on the air.  
Yeovil ARC: Talk 'Decibels' by G3MYM.  
Northampton RC: Bring & Buy.  
Pontefract DARS: Talk 'History of Amateur Radio' by Ray Price G3VID.  
Mid Sussex ARS: Talk 'Packet Radio'.  
Southgate ARC: Talk 'History of Morse' by Tony Smith G4FAI.  
Bredhurst RTS: Talk 'Big Antennas Around the World' by Al Slater G3FXB.
- 12 Jun** Wimbledon DARS: Talk 'Making light bulbs' by Ray Nicholson G4SQG.  
Coventry ARS: Night on the air — out portable.  
Itchen Valley RC: Talk 'The History of PCBs' by Mike G6LMK.  
Maltby ARTS: Natter night.  
Maltby ARC: Talk 'TV Troubleshooting' by G1CAQ.  
Harrow RS: Talk 'Microwave Modules Products and Meteosat' by Mike Senior G4EFO.
- 15 Jun** Rhyl DARC: Slide show 'Your shacks' by Alan GW4HDR.  
Stourbridge ARS: Talk 'Fifty years of AM radio' by Alec G3GF.  
Burnham Beeches RC: Visit to Gatwick Airport Control Centre.  
Todmorden DARS: Children in Need — discussion night.
- 16 Jun** Loughborough DARC: Magazine review and technical chat.  
Midland ARS: Talk 'Foxhunting tips' by Chris,

16 Jun	G8FTU and Barry, G8DEJ. Chester DARS: Surplus equipment sale. Wakefield DRS: 2m QRP contest discussion. Warrington ARC: Barbeque, hosted by Debby & Mike Mansfield.	26 Jun	Service' by M J Holdsworth & M Lipscombe. Maltby ARTS: Natter night. Maltby ARC: Maltby Festival special event station briefing.
17 Jun	Cheshunt DARC: Portable on Baas Hill Common. Stockport RS: Informal natter night. Yeovil ARC: Talk 'How to make tuned circuits' by G3MYM. Hastings ERC: Visit to Dungeness power station.	28 Jun	<b>Thirtieth Longleat Rally, Longleat Park, Warminster. Rally opens at 10 am.</b>
18 Jun	Salop ARS: Night on the air. North Wakefield RC: Spen Valley junk sale. Northampton RC: Mobile DF contest. Vale of Evesham RAC: Informal meeting. Gardeners Arms, Charlton. Pontefract DARS: RAYNET practice. Mid Sussex ARS: Club's 21st Anniversary at the Windmills, Clayton. Bredhurst RTS: Construction & Natter night. E Kent RS: Car Rally.	30 Jun	Keighley ARS: Talk by G4EJP, RSGB regional rep. Dartford Heath DFC: Pre-hunt meeting, Horse & Groom, 9 pm onwards. Loughborough DARC: Social evening. Chester DARS: Visit by Bert Donn G3XSN, Region 1 Rep. Wakefield DRS: On the air. Warrington ARC: Talk 'Rip van Winkle's Story' by Charles Wells G4ZZG.
19 Jun	Coventry ARS: Morse tuition & night on the air. Sutton & Cheam RS: Inter club quiz v CATS. Maltby ARTS: Talk 'Clandestine Radio' by Pat Hawker G3VA. Maltby ARC: Computer Night. Sutton & Cheam RS: Inter-club quiz. Harrow RS: Activity night.	2 Jul	North Wakefield RC: Talk 'Basic logic' by G4RCH & G3ZXZ. Yeovil ARC: Talk 'The Miller Oscillator' by G3MYM. Northampton RC: Visit to Pitsford. Vale of Evesham RAC: Demonstration '10GHz & 24GHz construction and operation' by GODJA. Mid Sussex ARS: Informal evening. Bredhurst RTS: Construction & natter night. E Kent RS: Visit by Thanet, test equipment demo & rig checking facilities.
20 Jun	<b>All Asia 48 hour contest.</b> Mid Sussex ARS: Burgess Hill town festival.	3 Jul	Coventry ARS: Morse tuition & night on the air. Maltby ARTS: Preparation for NFD. Maltby ARC: Activity night on air.
21 Jun	<b>Denby Dale Radio Rally, at Shelley High School on the B6116 near Skelmanthorpe. Talk-in S22, SU22 and 10m FM. Doors open 11.00 am. Further details from: Gerald Edinburgh on Huddersfield 602905.</b> <b>Wakefield DRS: 2m QRP Contest.</b>	4 Jul	<b>VHF National Field Day.</b>
22 Jun	Sutton & Cheam RS: Two metre foxhunt. Atherstone ARC: Club night & night on the air.	5 Jul	<b>VHF National Field Day.</b> Dartford Heath DFC: Club hunt, 2.30 pm, Dartford Heath.
23 Jun	Loughborough DARC: Portable evening. Reading DARC: Talk 'HF linear amplifiers' by Peter Chadwick, G3RZP. Chester DARS: Barbecue — bring your own steaks etc. Dorking DRS: Activity evening on 2m & 70cm SSB. Wakefield DRS: Talk 'RNARS & RSARS' by G5VRY. Warrington ARC: Open forum. Verulam ARC: Talk 'PO Box 88, Moscow' by A Slater G3FXB.	6 Jul	Atherstone ARC: DF hunt 2. Rhyl DARC: Night on the air (GW4ARC & GW1ARC). Welwyn/Hatfield ARC: Talk 'Ten metre band'. Stourbridge DARS: Night on the air. Burnham Beeches RC: Preparation for McMichael Rally. Sutton & Cheam RS: Natter night. Todmorden DARS: Visit by Police Dog Handler ( <i>must be a rough club this one! — Dep Ed</i> ). Chichester DARC: Special opening meeting for the public with amateur radio demonstrations for Chichester 912 festivities. Warrington ARC: RSGB film 'JARL visit to China'.
24 Jun	Cheshunt DARC: Natter night. Stockport RS: Talk 'Behind the controls'. Chiltern ARC: G5RV. Trowbridge DARC: Natter night. Bath DARC: Planning for Longleat. SE Kent YMCA ARC: Talk 'Solving TVI Problems' by G4HXE.	7 Jul	Wakefield DRS: Talk by G3WWF. Chiltern ARC: Natter night & /P evening. Trowbridge DARC: Talk 'Bee keeping and Amateur Radio'! Bath DARC: Slow Scan TV.
25 Jun	Edgware DRS: Informal VHF NFD briefing. North Wakefield RC: Talk 'Land mobile radio' by G3SEY. Yeovil ARC: Natter night. Northampton RC: National Field Day final briefing. Pontefract DARS: Informal evening. Mid Sussex ARS: Talk. Southgate ARC: Informal evening. Bredhurst RTS: Talk & demo 'Compact disc players'.	8 Jul	North Wakefield RC: Visit to British Gas Control Centre. Northampton RC: Discussion evening. Mid Sussex ARS: Bring & buy sale. Bredhurst RTS: Talk 'Dayton Hamvention, Ohio' by G3VTT.
26 Jun	Wimbledon DARS: Talk 'Making Light Bulbs' by Ray G4SQG. Coventry ARS: Surplus equipment sale. Itchen Valley RC: Talk: 'The Radio Investigation	9 Jul	Wimbledon DARS: Summer camp planning meeting. Coventry ARS: Two metre DF contest. Maltby ARTS: Talk 'The RSGB' by Mike Elliot G4VEC. Maltby ARC: Three in a row — mini-talks by members.
		10 Jul	<b>IARU HF contest 48 hour duration.</b> Wakefield DRS: Barbecue at G4VRY.
		11 Jul	<b>IARU contest.</b>
		12 Jul	<b>Sussex Mobile Rally.</b>

- 14 Jul Keighley ARS: Informal meeting.  
Bury RS: Surplus equipment sale.  
Chester DARS: Talk 'Computer Interfaces' by Derek G4UXD and Roger G8GWX.  
Dorking DRS: Informal meeting.  
Warrington ARC: Talk 'Language Laboratories' by Paul Forster GOCBN.  
Wakefield DRS: Debate.
- 15 Jul Hastings ERC: Talk 'Operating Rayleigh'.
- 16 Jul North Wakefield RC: Barbecue and fox hunt.  
Vale of Evesham RAC: Informal meeting, Gardeners Arms, Charlton.  
Mid Sussex ARS: Informal evening.  
Bredhurst RTS: Construction & natter night.
- 17 Jul Coventry ARS: Night on the air.  
Maltby ARC: Home projects night.  
Sutton & Cheam RS: Talk 'Wire antennas for DX bands' by Geoff G4FKA.
- 18 Jul Bredhurst RTS: Special event station GB4PB.
- 19 Jul **McMichael Rally at the Haymill Centre near Slough. Doors open 10.30 (10.15 for disabled), many traders, car boot sale, mini fairground, ATV and special event station GB4MR (on air 18th & 19th).**
- 20 Jul Rhyl DARC: Members night — funny QSOs.  
Welwyn/Hatfield ARC: Fox hunt.  
Burnham Beeches RC: Radio control demonstration.  
Stourbridge ARS: Talk by John G4CVU.  
Todmorden DARS: Natter night.
- 21 Jul Midland ARS: Treasure Hunt.  
Chester DARS: Talk 'Receivers — Part 2' by Dennis G3EWZ.  
Warrington ARC: Open forum.  
Wakefield DRS: Annual Open Pitch & Putt, Holmfield Park.
- 22 Jul Trowbridge DARC: Natter night.  
Bath DARC: HF night on the air.
- 23 Jul North Wakefield RC: Talk 'Satellite TV' by Rob G4APV.  
Bredhurst RTS: Demo 'British Army Radio Sets 1922-1955' by Bob Warner.
- 24 Jul Maltby ARC: Amateur radio open forum.
- 28 Jul Keighley ARS: Talk & demo on Data transmission by G4XGN.  
Reading DARC: Annual boat trip.  
Chester DARS: Your questions answered.  
Dorking DRS: 2m & 70cm portable operation plus barbecue at Devils Dyke.  
Warrington ARC: 'Find the buffet' (!) hosted by Mike Mansfield G6AWD.  
Wakefield DRS: Installing club HF beam.
- 30 Jul North Wakefield RC: Monthly meeting.  
Bredhurst RTS: Construction & natter night.
- 31 Jul Wimbledon DARS: General activity evening.  
Maltby ARTS: Natter night.  
Maltby ARC: Junk sale.

Will club secretaries please note that the deadline for the August 1987 segment of *Radio Tomorrow* (covering activities from 1st August to 1st October 1987) is 22nd June.



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# 50MHz getting started

At the time of writing, activity on 6m is exciting but at a low level when compared to 2m as only Class A amateurs have access to the band combined with location and ERP restrictions. This of course is part of the ongoing experiment to see if we

band? Let's whet your appetite a little . . .

## What Does 6m Offer?

6m is very much like a cross-over from HF to VHF, where inter-G working up to 300km is fairly

mechanism behind these events, suggestions include multiple hop Sporadic-E or some unknown ducting effect where the signals travel in an E-layer duct linking two areas. Propagation time-measurement, leading to a better understanding of the effect, is just one area where amateurs can contribute to world science, hence showing our worth and in fact justifying our continued existence. It also has the magical attraction of wondering whether the reply to your CQ call will come from London or New York.

Meteor scatter communication, where meteor trails are used to reflect radio signals, is again far better on 6m than 2m with burst lengths lasting far longer to permit more effective QSO's. Monitoring one of these beacons shown in **Table 1** will give you a demonstration of this, resulting in rapid bursts of enhanced signals during meteor showers. In the past, some have been so long as to permit good meteor scatter reception of full-colour slow scan pictures transmitted on 6m, so you don't need to be an expert in fast CW or use sophisticated gear to obtain meteor scatter contacts.

Auroral propagation with its characteristic electric-shaver raspiness is often evident as well, in fact just a week after the band was opened to all Class A's a phenomenal aurora occurred, which allowed communication with virtually every country in Europe with access to the band.

## Activity

The current band is 500kHz wide, **Fig. 1** shows the recommended bandplan which gives you an idea of where to start looking for activity. The majority of contacts presently take place using SSB, with calls initiated on 50.200MHz combined with a QSY up or down follow-

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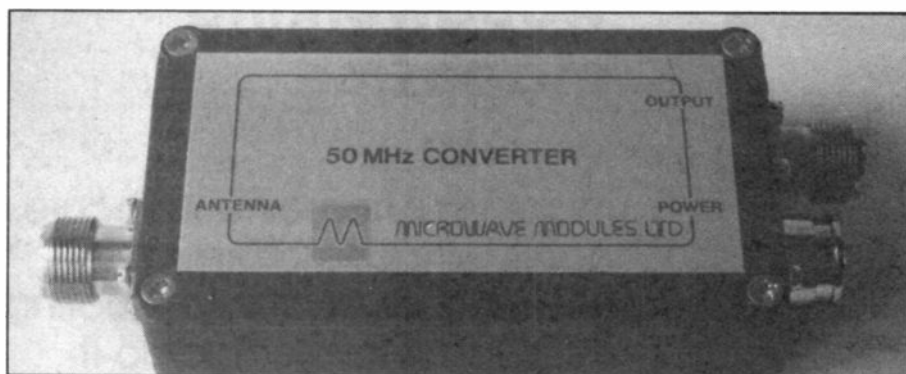
***Following the success of the 50MHz experiment, the band is now going to be widened and opened up to class Bs. More bandwidth means more interest, so Chris Lorek G4HCL shows us how to get started on Six.***

---

can 'fit in' with other services, notably Band I TV, also using the band in Europe. The RSGB statements of 'wait till 1st Feb 1987, when more hopeful news should appear' unfortunately didn't seem to come to fruition when the Great Day came. However John Butcher MP, Parliamentary Under Secretary of State for Industry, recently gave

common but in the sunspot maxima, F2 refraction acts like 10m to give world wide communication. We're now in the doldrums between sunspot cycles 21 and 22, so at the moment there's not much of this around, but think of all the DX you'll work as cycle 22 increases in sunspot level.

You may have encountered



The Microwave Modules 6m converter:

hope to Class B's by hinting that all amateurs would have access to both the 50MHz and 70MHz bands in the future. There is also hope that 6m will be increased to cover 50-52MHz. There are still unknown facts about propagation on these bands where amateurs could perform a valuable service, so do you fancy exploring an exciting new

Sporadic-E on 2m, where signals between two localised regions are greatly enhanced. This is far more prevalent on 6m, and the approaching summer months should certainly give many examples of this, with transatlantic QSO's possible. I say *possible*, because amateurs have shown this to be the case, but the experts are puzzled as to the



The Icom IC-505 50MHz transceiver.

ing establishment of a contact. There are also various pockets of FM activity around the country, using 50.45 and 50.475MHz, some of these are local nets using modified surplus equipment obtained at economical prices (I've seen 49MHz 40 channel synthesised Midland sets sold new at a rally stand for £1 a time). If 50-52MHz is allocated to all UK amateurs, it may seem sensible to follow a similar bandplan to that used on 2m, with room for all tastes and activities.

If some of this has inspired you to start up on the band, then read on and see how simple it is to do so.

### Getting Going

There are several ways to getting equipped, namely:

- 1) Transverting from existing gear,
- 2) Home built equipment,
- 3) Modification of surplus gear, and
- 4) Commercial 50MHz transceivers.

Transverting or using a receive converter with an existing 2m or 10m set is by far the easiest way of starting up on the band. For those who want a transverter, the Microwave Modules Unit (transverting from 2m to 6m) is reviewed elsewhere in this issue and a matching 10m-6m model is also available, both are currently priced at £289.80.

However before a large financial outlay, you may wish to have a listen around using a converter in line with an existing receiver. You'll find that many 6m operators may also be listening for replies on the established crossband frequency of 28.885MHz, so you don't necessarily need 6m transmit capability to get a contact to start with! Microwave Modules produce the MMC 50/28 6m-10m converter (see photo) for £37.95, or if you're a dab hand with a soldering iron you may care to build your own. Jack Hum,

G5UM describes a 'build-it-from scratch' converter in *HRT July 84* that would suit the amateur with some constructional experience. If you'd like printed circuit pattern details or indeed a full kit then *HRT Feb 87* featured a converter project from 6m to 2m or 10m, available for just under £30 from Cirkit Holdings, although this does not include case or connectors.

Jack G5UM also described a homebrew crystal-controlled valve transmitter in *HRT Nov 85*, and for those fortunate enough to have a suitably equipped junk box, this may get you going on CW at very little cost as well as providing an element of nostalgia. Alternatively Tony Bailey G3WPO described a 0.5W/1W solid state transverter in *HRT Feb 87* with circuit board patterns which is also available as a kit from Cirkit for £58 plus the cost of case etc. A matching PA to give 15W pep was described by Tony in *HRT Mar 86*, and in *HRT Sept 86* I showed how to modify a low cost surplus amplifier to boost this to around 50W pep. I make no apologies for mentioning HRT so much, as there have been far more constructional articles for 50MHz equipment here than in any other UK amateur magazine!

If you have an old CB multimode rig lying around, you may like to read Roger Alban GW3SPA's article in this issue on converting some models to 50MHz multimode, which could provide a useful stand-alone rig that doesn't tie up an existing transceiver, allowing you to monitor 6m and put out the occasional call whilst primarily operating on another band. These sets are often available from the second hand ad pages, often comically as a swap request for a 2m or HF multimode, but occasionally offered at sensible prices.

In the *Oct* and *Nov 86* issues of HRT, Ted Neil GW3ARP describes a VFO modification to use with ex-commercial two-way radio equipment operating on 4m and 6m. Although no retuning information is given for the equipment, this may be performed by amateurs with some experience, and if there is sufficient demand the editor may even be persuaded to publish a constructional article on 6m conversions! Due to forthcoming DTI regulations, by 1990 there is likely to be a flood of suitable PMR gear on the amateur market. Some G-Band Pye Westminster's operating on 40-50MHz FM have already appeared, and several are in fact already in use on 6m.

If you want a stand-alone rig for the band but soldering irons and trimming tools are not for you, then several black-boxes are of course available. The Icom IC505 and Yaesu FT690R (reviewed in *HRT May 85*) offer versatile use as a base station, mobile, and shoulder-strap portable and recently the FT690R MkII has been introduced offering a higher claimed performance over its



The old-style Yaesu FT-690.



The new FT-690 MkII.

predecessor. For more dedicated users, the Icom IC551 gives a base station facility, and the Kenwood TR9300 offers mobile or base station operation. The multi-band Yaesu FT726R may be fitted with a 6m plug-in module, as you can the range of Yaesu FTV107R and FTV901R transverter frames. Due to variations in the Yen exchange rate, current prices of Japanese equipment have not been quoted as these will undoubtedly have changed when this appears in print!

Power restrictions on the band have limited the availability of amplifiers, but if you feel you'd like more power output for base station use, BNOS currently manufacture power amplifiers for 6m, operating from a 13.8V supply. With 3W or 10W input, 50W maximum out is claimed from the LP50-3-50 and LP50-10-50, both at £152.17, and their LPM50-10-100 claims 100W maximum output with 10W drive at £204.35. Microwave Modules also have an amplifier in the pipeline, and if the power restrictions are lifted in the future, Heatherlite have plans for a 4CX350A 400W amplifier switchable for both 4m and 6m!

### Aerials

6m aerials, being three times the wavelength of 2m, are of course three times the size! But don't let this put you off, as signals on 6m do get that bit further with a given ERP

(Effective Radiated Power). In my opinion, it is certainly worthwhile getting at least a modest beam up if you already have a rotator in use for other bands. If not, then a simple dipole can still get you out nicely but you could suffer from greater QRN generated from thermostats, computers, TV timebases and the like. For this reason a very high receive sensitivity is not often required, as when tuning around you'll frequently hear background noise present similar to that experienced on the upper HF bands. Masthead preamps and indeed any in-line preamps fitted to linear amplifiers will often not be required unless you have a very deaf receiver.

To improve your receive signals therefore, a beam is required rather than anything else at your end, remembering of course to try and place it above the level of surrounding electrical interference! All operation at present is horizontally polarised, with an ERP limit of 20dBW pep SSB and 14dBW carrier (dBW being the power in dB above 1W). In simple terms, you add your aerial gain in dB to your transmitter output in dBW, remembering to subtract the feeder loss again in dB. For instance, a transmitter of 13dBW (20W) pep feeding into a 7dB gain aerial will give 20dBW with a slight margin in hand due to feeder loss, typically around a dB.

There are many manufacturers offering aerials for the band, the photo shows a three element beam from MET, designed to specifications of the US National Bureau of Standards (NBS), offering a claimed 7.1dBd, with 2 ele and 5 ele versions also available. It is shown mounted on my tower below a 9 ele beam for 2m for comparison purposes, showing that a 6m yagi isn't anywhere near the size of an HF monstrosity! I must say that it was hurriedly put together to photograph

for this article, taking only 40 mins to assemble and erect, yet guessing at the gamma match positioning resulted in an SWR of less than 1.2:1 over the band with good reports received — I was impressed.

Another British manufacturer, Jaybeam, who have been producing aerials for many years, currently offer a 4 ele yagi for 6m, together with a very interesting dual-band trapped 4 ele beam operating on both 4m and 6m, with respective claimed gains of 7dBd and 6dBd. This could offer a very inconspicuous array for the two bands if released to all amateurs.

Cue Dee also manufacture a dual-band yagi, using 11 elements of which five are used on 6m and six used on 4m, the elements being interlaced on a common boom, with 6dBd again claimed on both bands. Tonna produce a 5 ele yagi which has been popular with UK amateurs and claims a gain of just under 8dBd. Sandpiper Communications in South Wales make a range of 2, 3, 4, 5 and 6 ele yagis, together with dual band 4m/6m and 6m/10m yagis, and cross-polarised 6m/2m yagis, (ie horizontal on 6m, vertical on 2m), as well as offering to produce custom-built aerials to the user's individual requirements. The Altron AQ620 compact 2, 3, and 4 ele HF yagi, reviewed in *HRT Apr 87*, offers 6m capability as well as 10m, 15m and 20m, and Altron have also recently introduced a 3 ele dedicated 6m beam onto the market. If you fancy building an aerial yourself, or modifying an old Band I TV yagi, then Mick Senior G4EFO's article in *HRT Aug 86* gives you all the details.

Feeder loss on 6m is nowhere near as high as that experienced on 2m or 70cm, and you can safely get away with using UR67 and still achieve good performance. Unless you have a horrendously long cable run there is no need to use H100 or



The Trio (now Kenwood) TR-9300 rig.

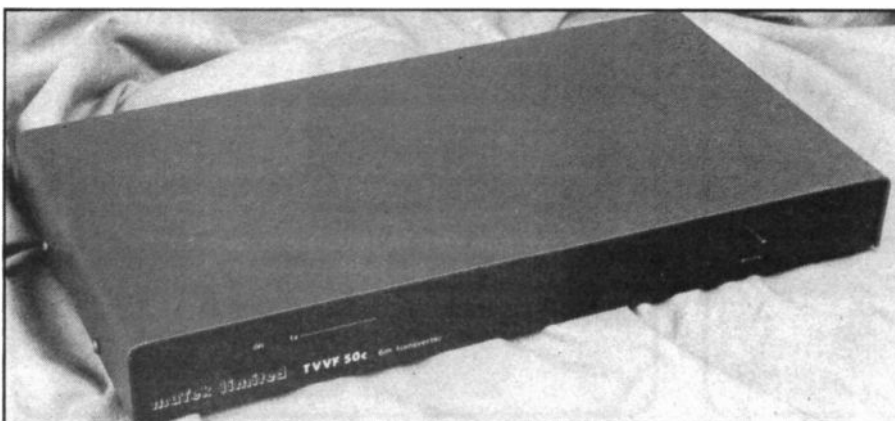
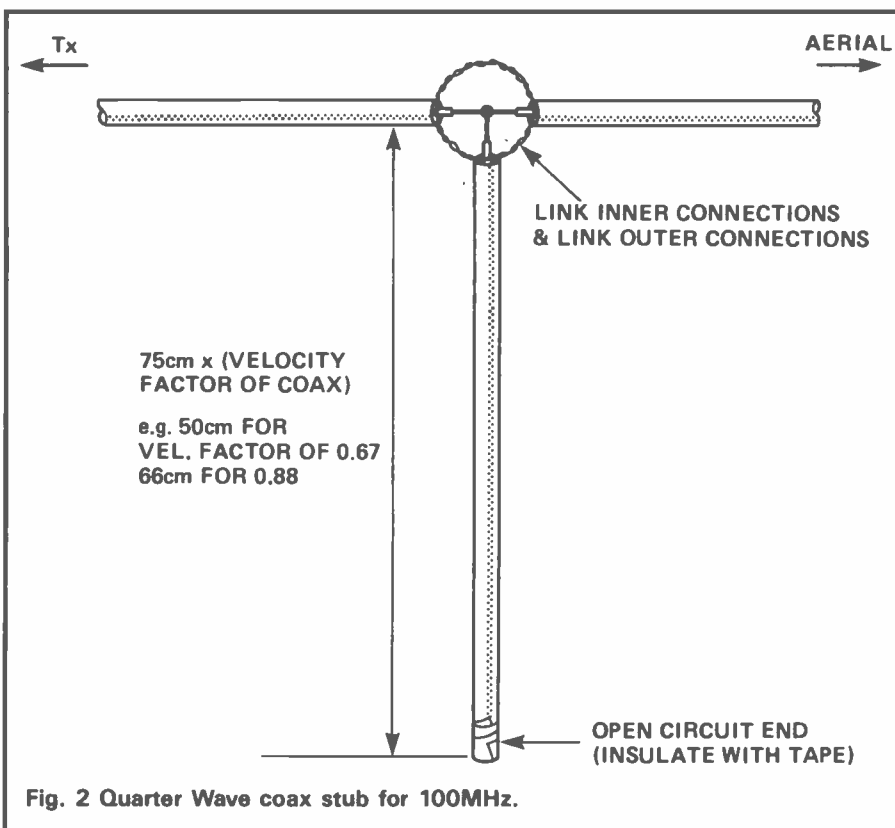


Yaesu's FT-726 tribander, available with a 50MHz option.



UK 50MHz BANDPLAN (50–50.5MHz)	
50.000 CW ONLY	50.020 — UK BEACONS 50.080
50.100 NARROWBAND MODES	50.110 WORLDWIDE DX CALLING 50.200 SSB ACTIVITY CENTRE 50.300 CW METEOR SCATTER CENTRE 50.350 SSB METEOR SCATTER CENTRE
50.400 ALL MODES	
50.500	

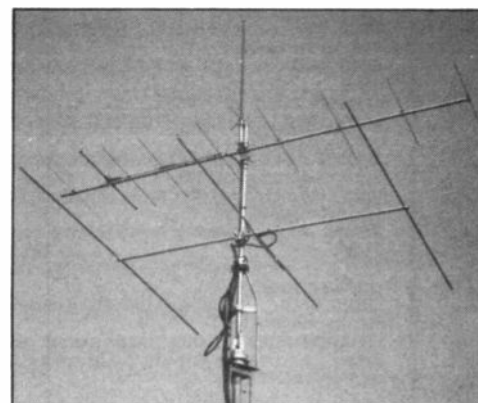
**Fig. 1 50MHz Bandplan.**



Although no longer available from new, the Mutek 2m to 6m transverter can be found on the secondhand market.

the various types of Helix coax.

So there we are, plenty to choose from. I have mentioned the *claimed* gain in each case rather than *actual* gain, as this would normally be used to determine the maximum transmitter output power you could run. It is interesting to note that in an independent survey at Annaboda in Sweden, not one manufacturer's gain claim was substantiated, in fact one very popular make was the one found to have the highest difference between claimed and actual gain!



### Second Harmonics

As a final note, remember that the second harmonic of 50MHz falls right in the middle of Broadcast Band II, in a section presently occupied by certain non-broadcasts that we shouldn't listen to. To save embarrassment or a knock on the door from either a neighbour or RIS officer, make sure that you take steps to keep its level as low as possible. HRT reviews of commercial equipment for the band have always stressed this, and BNOS produce an in-line bandpass filter for the purpose. As an alternative, a simple quarter wave coax stub filter as shown in Fig. 2 will give a useful attenuation of 100MHz and is simple to construct.

So have fun, let's hope 6m comes available to all very shortly, and of course, good DX!

Some 50MHz Beacons to Listen Out For		
FREQ	CALL	LOCATION
50.005	ZS1SIX	CAPE PROVINCE
50.020	GB3SIX	I073TJ
50.050	GB3NHQ	I091VQ
50.055	LA	OSLO
50.060	GB3RMK	I077UO
50.070	W2CAP/B	CAPE COD, MASS

Table 1 50MHz beacons.

# HOKUSHIN aerials.

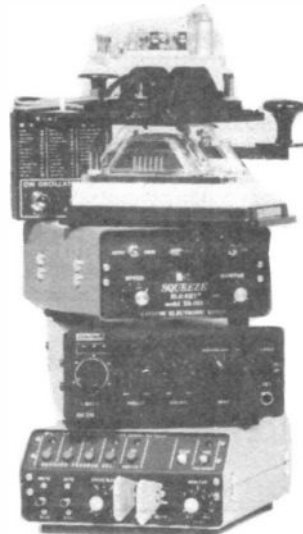
## BASE STATION AERIALS

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**HF5R**...Radial kit for use with HF5 when mounted on chimney or gable end..... £54.81 inc vat, carriage £7.00  
**GPV5**...Two metre base station colinear, 6.5 dB gain, 3.1 metres high ..... £64.92 inc vat, carriage £7.00  
**GPV5S**...as above but 3 section colinear, 7.8 dB gain, 4.45 metres high ..... £51.97 inc vat, carriage £7.00  
**GPV7**...Seventy centimetre triple 5/8 base station colinear, 6.8 dB gain ..... £45.59 inc vat, carriage £7.00  
**GPV720**...Dual band (144/430 MHz) base station aerial. £45.68 inc vat, carriage £7.00.

## MOBILE AERIALS

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**2W**...Two metres 7/8 whip, 4.5 dB gain, foldover base £24.23 inc vat, carriage £2.00.  
**OSCAR430**...Seventy centimetre triple 5/8 whip, 6.3 dB gain ..... £27.72 inc vat, carriage £2.00.  
**OSCAR720**...Dual band (144/430 MHz) whip ... £24.59 inc vat, carriage £2.00.  
**HS770**...144/430 MHz diplexer for use with OSCAR720 .£18.02 inc vat, carriage £1.50.  
**G88**...Gutter mount (requires RG4M cable assembly) . £6.26 inc vat, carriage £1.25.  
**RG4M**...Cable assembly for G88 base, complete with 90239 and PL259 plug ..... £6.26 inc vat, carriage £1.00.  
**12B**...Car wing mount with 90239 top and bottom.£5.75 inc vat, carriage £1.00.  
**HS7MB**...Car boot mount including cable and PL259 £15.42 inc vat, carriage £1.50.  
**MAS005**...High quality mag mount with cable and strong protective cover to prevent paintwork damage.. £22.90 inc vat, carriage £2.00.

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**TK5** Morse practice oscillator £13.65 inc vat, carriage £1.50  
**HK705** Straight key £21.82 inc vat, carriage £2.50  
**HK708** Deluxe version on heavy base £43.30 inc vat, carriage £3.00  
**HK704** Squeeze paddle £20.25 inc VAT, carriage £1.50  
**HK150** Electronic keyer with built-in side tone, solid state or relay keying £133.75 inc vat, carriage £3.00.  
**HK1024** Electronic keyer with 1024 bit memory £241.98 inc vat, carriage £3.00.  
**DK210** Daiwa electronic keyer, requires paddle £73.98 inc vat, carriage £2.50.



**BY1** black base £67.42 **BY2** chrome base £76.97 **BY3** gold plated base £141.75 Vat inc.

Bencher Single Paddle  
**BS1** black base £67.42 **BS2** chrome base £76.97 Vat inc.  
 Carriage on BENCHER keys £3.00.

# data equipment

**CD600** ... RTTY, CW, ASCII, TOR, AMTOR decoder, output for UHF television, monitor and printer, can also be used as morse tutor.  
**CD600** ... £215.14 inc VAT, carriage £7.00.  
**CD670** ... A higher specification RTTY, CW, ASCII, TOR and AMTOR decoder complete with liquid crystal dot matrix display, variable RTTY shift, normal/reverse mode switch, outputs for TV, monitor and printer and can also be used as morse tutor.  
**CD670** ... £327.77 inc VAT, carriage £7.00.  
**CD660** ... Similar in specification to the CD670 but without the built-in dot matrix display.  
**CD660** ... £264.97 inc VAT, carriage £7.00.



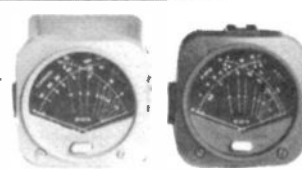
# DAIWA meters

**CN410M** ... Frequency range 3.5 to 150 MHz, forward power switchable 15/150 Watts, reflected 5/50 Watts, SO239 connectors.  
**CN460M** ... Frequency range 140 to 450 MHz, forward power switchable 15/150 Watts, reflected 5/50 Watts, SO239 connectors.  
**NS448 with remote head** ... Frequency range 900 to 1300 MHz, forward power switchable 5/20 Watts, reflected 1.6/6.6 Watts, N type connectors.  
**NS660P** ... switchable meter reading (average, normal PEP and hold PEP) and provision for optional remote head (U66V), frequency range 1.8 to 150 MHz, forward power switchable 15/150/1500 Watts, SO239 connectors.  
**U66V** ... remote head, frequency range 140/525 MHz, max 300 Watts, N type connectors.  
**SC80** ... extension cable for U66V, approx 20 metres long.  
**CN410M** ... £61.78 inc VAT, carriage £1.50.



**NS660P** ... £115.00 inc VAT, carriage £2.50.

**CN460M** ... £65.40 inc VAT, carr £1.50.



**NS448** ... £86.60 inc VAT, carriage £2.50.

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# AR2002 receiver



**Frequency range of the AR2002** is from 25 to 550 and from 800 to 1300 MHz. Modes of operation are wide band FM, narrow band FM and AM. The receiver has 20 memories, memory scan and a search mode which checks frequencies between user designated limits.

The receiver has a push button keypad for easy frequency entry and operation.

A front panel knob allows the listener to quickly step up or down in either 5, 12.5 or 25 kHz steps from the frequency initially chosen.

The AR2002 has a front panel LED bar "S" meter.

There is a front panel 3.5 mm jack socket for headphone use.

A socket for the optional RS232 interface (RC PACK) is provided on the rear panel. The RC PACK consists of an 8 bit CPU with its own ROM and RAM and with your own computer acting as a dumb terminal many additional operating facilities become available. Of course, if you want to write your own programs using the RC PACK as an interface then "the sky's the limit".

**AR2002 Receiver . . . £487.30 inc VAT, carriage £7.00**

# TWO

from

# KENWOOD, the TR751E

now, a 70cm version, the TR851E £789.00 inc VAT



There has been a KENWOOD two metre multi-mode mobile transceiver for the last six years. Beginning with the successful TR6000 and continuing with the TR9130, amateurs have always found the series to be reliable and above all easy to operate, especially whilst mobile. Advances in technology have enabled KENWOOD to further improve on the TR9130. Additional operating features have resulted in an even easier to use and smaller transceiver. However KENWOOD have not discarded the valuable experience gained over the last six years. The result is the TR751E, a new generation of multi-mode mobile transceiver.

The TR751E is the first multi-mode mobile transceiver that can be set to select the correct mode whilst scanning the band. By setting the rig to vfo and selecting AUTO mode before pressing the SCAN button, the TR751E will move up or down the band changing both mode and step rate according to the and plan (5kHz/SSB, 12.5kHz/FM, or 1kHz/SSB, 5kHz/FM depending on the selected frequency step).

The transceiver has two VFO's and 10 memory channels. Memory information is easily transferred to either vfo. Each memory holds information on frequency, mode and also the step rate to be set when transferring the memory information to vfo. Memory channel one is also the ALERT frequency, memories 7 and 8 relate to DCL and memory 0 programs the user defined limits of frequency scan.

The TR751E can be set to scan between user programmed limits or around them depending on the frequency set when the scan is started. When AUTO mode is set the transceiver will select the correct mode as it scans. In addition

to scanning each memory, the TR751E can be set to scan those memories programmed with the same mode. Pause on an occupied channel is time operated but can be changed to carrier hold by an internal modification.

Operating on 13.8 volts DC, power output from the transceiver is 25 watts (high) and approximately 8 watts (low). The low power setting applies to all modes. When compared with the TR9130, the TR751E is smaller and lighter. TR751E (TR9130) 180mm (176mm) wide, 60mm (68mm) high, 213mm (253mm) deep, 2.1 Kgs (2.4 Kgs).

The TR751E is perfect for base station use. When operating on SSB, signals can easily be found using the frequency step set to 5 kHz, fine tuning quickly achieved by switching to the 80 Hz rate. Operation is also ideal on FM, the rig stepping in either 12.5 or 6 kHz steps. Full repeater facilities are also available including reverse repeater. Receiver performance is excellent, our first sample amazed us, FM, 0.14uV for 12dB SINAD and SSB, 0.09uV for 10dB S+N/N.

As an option, the TR751E can be fitted with DCL. Compatible with the DCS system, DCL (Digital Channel Link) enables your rig to automatically QSY to an open channel. The DCL system searches for an open channel (checks the next eleven 25KHz spaced frequencies above the one stored in memory 7), remembers it, returns to the original frequency and transmits control information to the other DCL equipped station that switches BOTH rigs to the clear channel.

For the blind operator the KENWOOD TR751E is perfect. As each mode is selected a tone which give the appropriate morse letter (F for FM, U for UBB, etc) and when fitted with the optional VBI board, a digitally encoded girl's voice will announce on request the operating frequency.

In addition, the TR751E has an illuminated analogue 2/Rf metre, all mode squelch, MHz select keys, a noise blanker, semi break-in CW with side tone, RIT, memory channel up/down keys and a frequency lock. KENWOOD's attention to detail can be seen in the design of the included mobile mount, a clamp system with rubber pads protecting the rig as it is slid in and out and for security, the clamp can be easily locked in the closed position.

There is so much more to say about the TR751E, so why not ring us and let's talk about it.

**TR751E . . . . . £649 inc VAT, carriage £7.00**  
**MU1 (DCL modem) . . . . . £32.63 inc VAT carriage £7.00**

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# Getting onto 50MHz with the HAM INTERNATIONAL

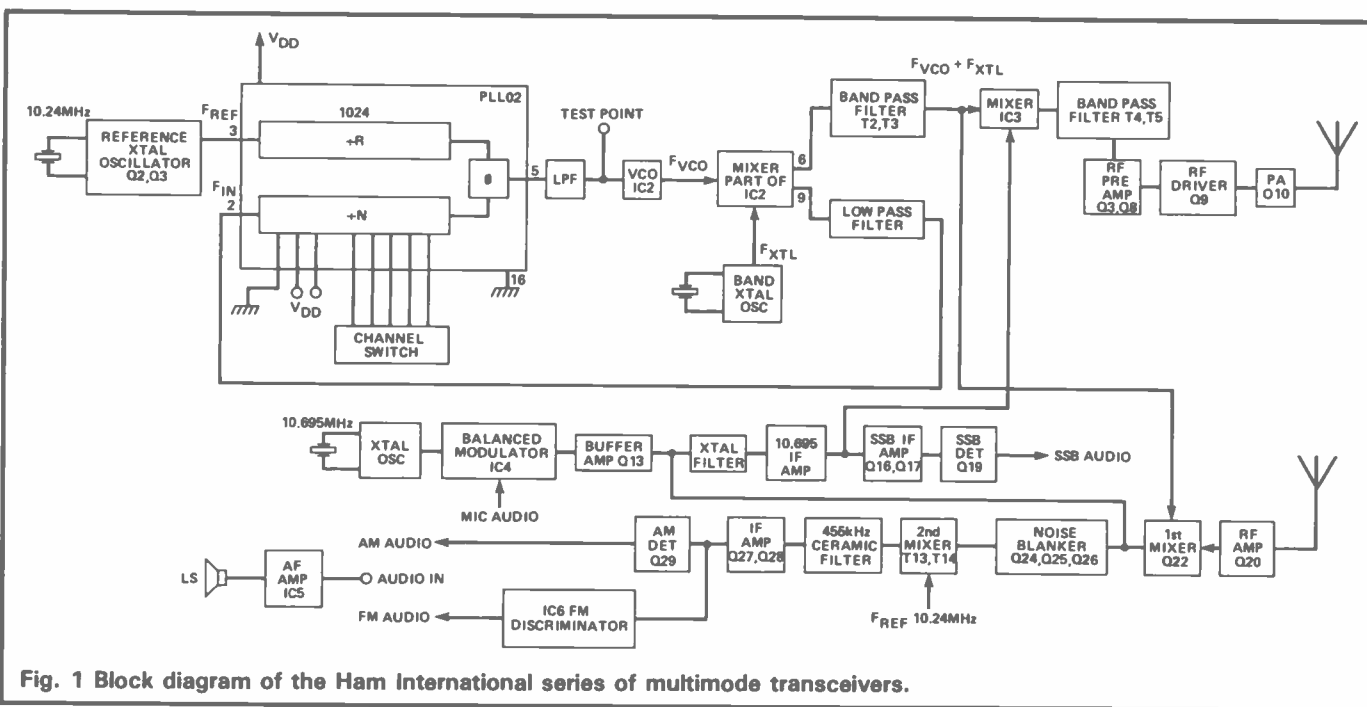


Fig. 1 Block diagram of the Ham International series of multimode transceivers.

*With the six metre band being expanded and opened up to all licence holders, Roger Alban, GW3SPA, offers a timely conversion project for the Ham International CB range.*

## Getting onto Six

Most six metre designs which have appeared to date require the use of the main station transceiver and a transverter to be able to operate. The disadvantages of this approach is that it ties up the main rig and also involves a great deal of fiddling with connecting cables etc. The idea with this project was to follow the previous method used for ten metre conversions and have a stand alone multimode rig dedicated for use on six metres which would continuously monitor the band for openings.

In the author's early ten metre

design, an EPROM was inserted between the channel switch output logic lines and the programmable logic inputs to the divide by N register in the PLL chip (see Fig. 1) to adjust the logic values to put the set on ten metres by using a 20.555MHz band crystal pulled down to down 20.5525MHz. Let us suppose that we now require the set to operate on six metres. In the ten metre conversion the final transmit frequency was obtained by subtracting 10.695MHz from the output frequency of the band pass filter formed by T2 and T3. If we now arrange that the output from

the transmitter mixer should be the sum of the band pass filter frequency added to 10.695MHz, the resulting transmit frequency will be  $40.295\text{MHz} + 10.695\text{MHz} = 50.99\text{MHz}$ . Therefore, by careful selection of the value of N, it is possible to retune the set to operate on six metres. This all sounds fairly straightforward at first but there are two main problems, one simple, and one difficult to resolve.

Let us deal first with the simple problem. In the original design the manufacturer resolved the problem of inverted sidebands (generated by the mixing process) by the simple expedient of swapping the front panel labels over! The mixing process taking place in the six metre conversion does *not* result in such an inversion, therefore the front panel labels must be changed to reflect this.

A very serious problem was dis-

covered when the set was on transmit. An examination carried out using a spectrum analyser (Fig. 3) revealed a large number of unwanted spurious signals which were only a few dBs below the wanted transmit frequency. The second problem stemmed from the fact that the band crystal oscillator frequency of 20.5525MHz caused mixing products which fell within the passband

opened up to cover 50MHz to 52MHz and use by class B licence holders will be permitted in addition to relaxation of power restrictions.

When converting any CB set to operate on new frequencies, it is worthwhile to standardise on the relationship between channel number and operating frequency. The author has decided to adopt a design where channel 1 low band

corresponds to an operating frequency of 50.00MHz, and channel 11 mid band corresponds to 50.50MHz. To change the operating frequency of the set it will be necessary to install an EPROM between the channel switch and the programme lines of the PLL chip so as to adjust the logic values for the desired values of N.

Let us assume that the set is to operate on 50.00MHz on channel 1 low band. From Fig. 1 the output frequency from the band pass filter formed by T2 and T3 will be:  $50.00 - 10.695 = 39.305\text{MHz}$ . The VCO will be operating on a frequency of 39.305MHz minus the new value of the band crystal oscillator which is 21.2525MHz that is 18.0525MHz. The value of the frequency  $F_{in}$  being injected into the programmable divide by N register will be  $21.2525 - 18.0525 = 3.200\text{MHz}$ , so the value of N will be  $3.2\text{MHz} \div 10\text{kHz} = 320$ . In a similar manner the divide by N values for the other operating frequencies can be calculated and stored as data inside an EPROM to appear on the output data lines when the appropriate address logic is applied.

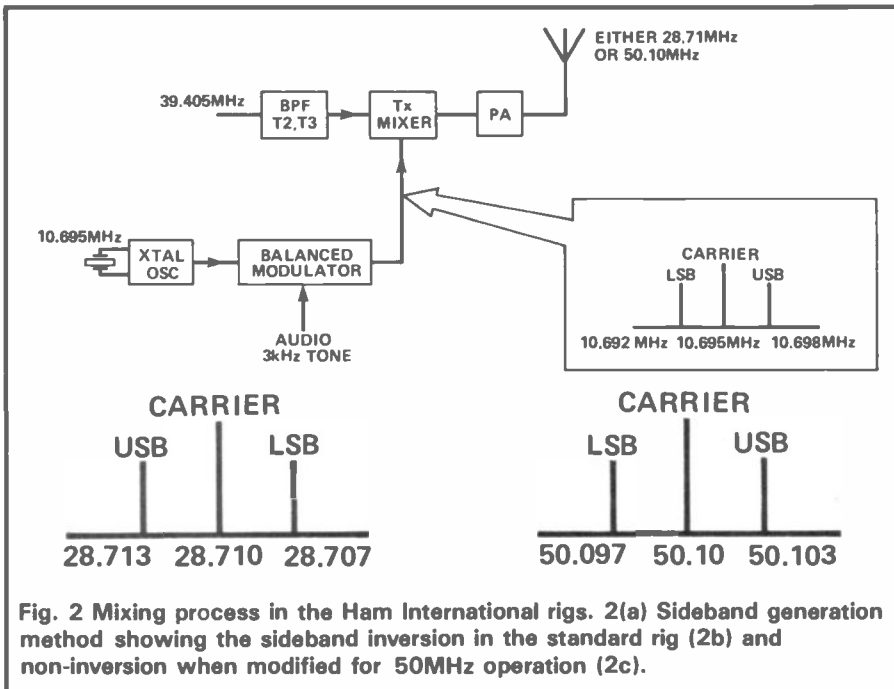


Fig. 2 Mixing process in the Ham International rigs. 2(a) Sideband generation method showing the sideband inversion in the standard rig 2(b) and non-inversion when modified for 50MHz operation (2c).

of the band pass filter T2/T3, resulting in a variety of spurious signals being amplified by the subsequent transmitter stages on ten metres and also six metres. The same cure was adopted as in the 'Ham International Update' for Ten where, by simply shifting the band crystal oscillator to 21.2525MHz, the spurious signals were moved outside the passbands. This is the solution adopted for the six metre conversion described here. It must be said that there still remains one 'sprog', but as this was measured as being better than 50dB below carrier level, it was considered acceptable. Fig. 4 shows the revised frequency spectrum when using a 21.2525MHz crystal with the set tuned to channel 1 using a new EPROM.

### The PLL Modification

The DTI released the 50.0 to 50.5MHz band to UK class A licensees on the 1st February 1986. However the band will shortly be

### EPROM Circuit

Before commencing the modi-

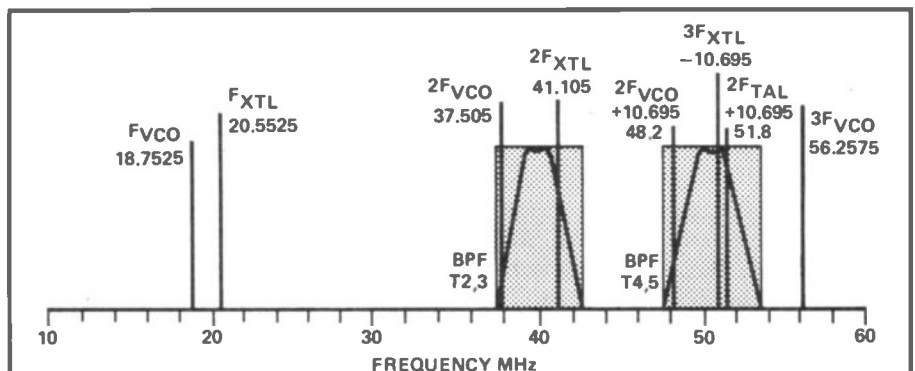


Fig. 3 Original output spectrum using the standard crystal pulled down from 20.555MHz to 20.5525MHz.

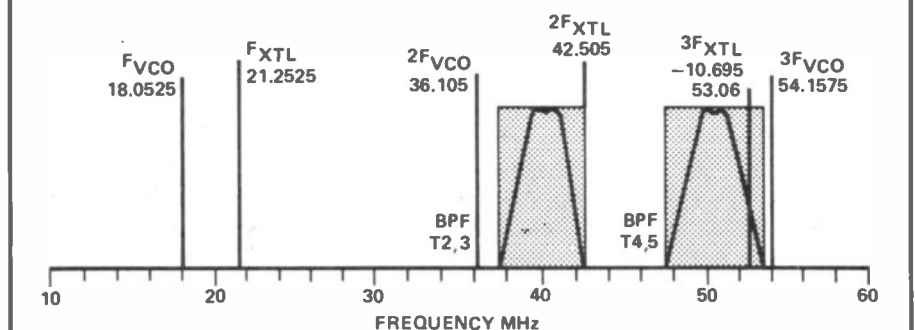


Fig. 4 Spectrum created by using a 21.2525MHz crystal.

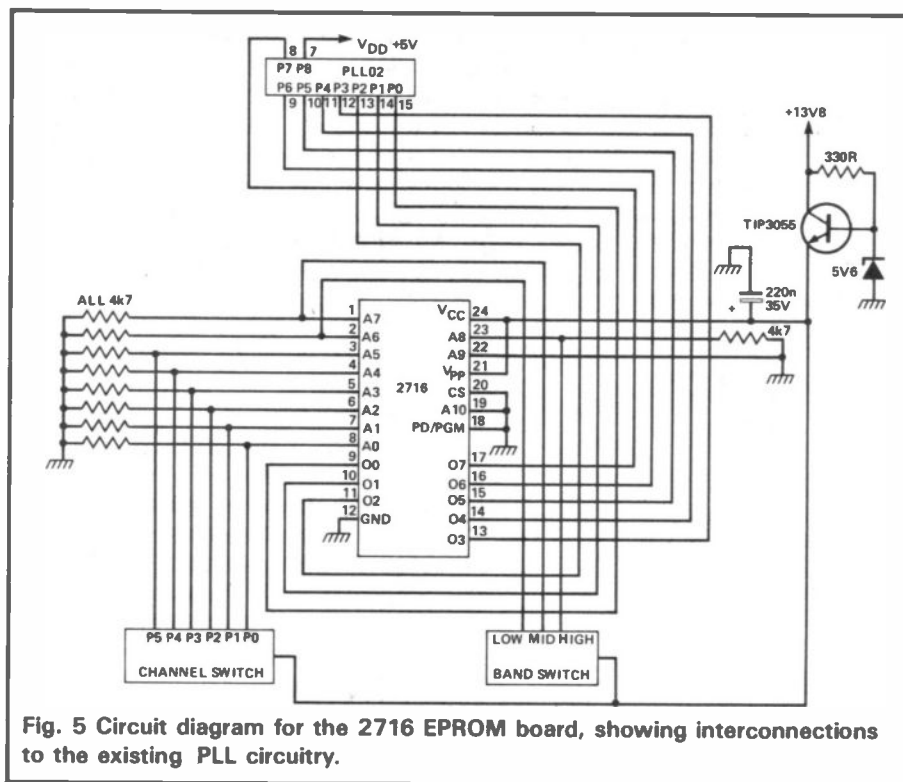


Fig. 5 Circuit diagram for the 2716 EPROM board, showing interconnections to the existing PLL circuitry.

fication, it should be established that the set is operating correctly as it will be far more difficult to clear faults on a partly modified set! Also, for anyone attempting the modification, test equipment will be required if you are to stand a reasonable chance of succeeding with the modification. A good quality oscilloscope capable of operating on DC will be required, a sensitive frequency counter capable of measuring 50MHz and a stable signal generator will be needed to finely align the receiver front end.

The first stage of the modification is to adjust the PLL chip programmable binary values using an EPROM. The EPROM chosen for this application is the Intel 2716 because it only requires a single 5 volt supply, however, the EPROM draws an operating current of approximately 100mA and therefore a separate stabilised supply will be required from the 13.8 volt supply to the set.

The circuitry surrounding the EPROM is shown in Fig. 5. The programme lines from the channel select switch (P<sub>0</sub> to P<sub>5</sub>) are connected to the 2716 address lines A<sub>0</sub> through to A<sub>5</sub> and 4k7 pull down resistors are connected to these so that they are maintained at logic 0 (zero volts) when the channel switch has no output on any of the pro-

gramme lines. Address lines A<sub>6</sub>, A<sub>7</sub>, and A<sub>8</sub> are connected to the band switch so as to alter the input address of the 2716 for each individual band. The unused address lines A<sub>9</sub> and A<sub>10</sub> are grounded to ensure that they remain at logic level 0.

The parallel data output lines from the 2716 (O<sub>0</sub> to O<sub>7</sub>) are fed directly to the input programme lines of the PLL chip as shown. In the unmodified set programme lines P<sub>7</sub> and P<sub>8</sub> are connected to the supply rail of the set. For our purposes it will be necessary to cut the PCB track to programme line P<sub>7</sub>, and connect pin 8 of the PLL chip directly to O<sub>7</sub>, pin 17 on the 2716 EPROM.

The 2716 is fed from a stabilised 5 volt supply produced by a TIP 3055 acting as the pass transistor and a 5.6 volt zener diode. The pass transistor is attached to the side of the rig and insulated from the chassis with a mica washer so that the case of the rig acts as a heatsink. The stabilised 5 volt supply is fed to the centre wiper of the band and channel select switches. Previously these two switches were fed from the 5.6 volt supply to the PLL chip, so these wires will have to be located and disconnected before re-wiring. The 2716 EPROM contains 2k of memory which is more than adequate to supply the various logic

values required to generate the operating frequencies which we require.

The EPROM circuit is built on Veroboard following the component layout shown in Fig. 6 and the cable connections to the channel and band switches are made with ribbon cable, a right angle bracket being used to attach the board to the side of the rig. It is wise to fit the EPROM *after* all the soldering has been completed and a thorough voltage check has been carried out to ensure that there are no crossed wires and the voltage regulator is working correctly. The required address and data contents of the EPROM is shown in Table 1, the information has been displayed in hexadecimal form for convenience.

### Adjusting the Band Crystal Oscillator

It will be necessary to change the frequency of the band crystal oscillator to 21.2525MHz as described earlier for this conversion. The three existing band crystals should first be unsoldered from the PCB in all cases.

### PTBM121D4X board

With sets containing the PTBM-121D4X PCB the band crystal oscillator is contained on a separate PCB which is attached to the side of the case using an L-shaped bracket. Terminals 4, 5 and 6 are connected via the band switch to the collector of Q30, via terminal 13 on the main PCB. Q30 is a 5.6v Automatic Voltage Regulator (AVR) which is switched, via the band switch, to select the required band crystal.

In the six metre modification only one band crystal will be required, so the wires connecting terminals 4, 5 and 6 to the band switch can be removed and the 21.2525MHz crystal can be soldered into the crystal position X1. Terminal 4 can now be connected directly to terminal 13 on the main PCB.

### PTSY016A0X board

In the other models, the band crystal oscillator circuitry is mounted on the same board as the PLL chip and VCO circuitry, this PCB can be found just behind the front panel. If



you own a set with the PLL PCB numbered PTSY016A0X, the band crystal is selected by connecting terminal D via the band switch to either terminals L, M, or H. The existing wires from terminals L, M, H and D must be removed and terminal D connected direct to terminal L. Solder the 21.2525MHz crystal onto the PLL PCB in crystal position X2.

### PTOS006A0X board

If you own a set with the PLL PCB numbered PTOS006A0X, or a Multimode II or Jumbo set, the required band crystal is selected by connecting terminal 4 on the same PCB via the band switch to either terminals 5, 6 or 7, the old wiring having been removed from the set. Connect terminal 4 direct to terminal 5.

The band crystal oscillator operates on half the frequency of the other models so the crystals will be half the value of the other band crystals. For the six metre modification you will require a 10.62625MHz crystal which should be installed in the X2 position. Also, remove the wires from the terminals 1, 2 and 3 which are connected via the band switch to terminal 1 which is the set earth. These wires select the appropriate crystal trimming capacitor for fine tuning to the correct frequency. When ordering the new crystal, the specification required will be 10.62625MHz, fundamental mode with about 28pF

load and a tolerance of  $\pm 20$ ppm at 25°C.

In these models the oscillator frequency is doubled by the tuned circuit T1, the secondary being indirectly connected to the input of the mixer circuit formed by part of IC2. To adjust the crystal frequency a digital frequency counter and an oscilloscope is required.

### Logic Modification

Before you adjust the crystal oscillator, you will need to make one modification. In the standard set, the frequency of the oscillator is altered by adjusting the small trimming capacitor which is in series with each crystal. The cold end of the three trimmers are connected together and coupled to earth via a single common trimmer which has a switching transistor connected in parallel, on USB, AM, and FM, this transistor conducts — shorting out the common trimming capacitor. On LSB the transistor is turned off and the frequency of all three crystals can be lowered by adjusting the common trimming capacitor. It was mentioned earlier that because we are now adding 10.695MHz in the transmitter mixer, we do not experience inversion of the side bands so for the six metre modification it will be necessary to increase the frequency of the band crystal oscillator by 1.5kHz on LSB. Therefore, the logical level being fed to the switching transistor needs to be inverted.

### PTOS110A0X board

With models containing the PTBM121D4AX PCB (which also use the separate band crystal oscillator board PTOS110A0X) the switching transistor is Q2 which conducts on LSB. It will be necessary to invert the action of transistor Q2 by adding an inverting transistor to the PTOS110A0X PCB. The original switching circuit is shown in Fig. 7a and this can be modified using a BC108 transistor inserted between terminal 3 and the base of Q2 as shown in Fig. 7b. With the set switched to LSB and a digital frequency counter connected to test point TP3 (near IC2) adjust CT5 for a frequency reading of 21.2525MHz then re-check the LSB setting and adjust CT5 if necessary. Remember that the front panel LSB position is actually USB for the six metre conversion and the lettering should be changed.

### PTSY016A0X board

If your set contains the PTSY016A0X PCB, then you will still have to invert the switching logic; the original circuit for the band crystal oscillator is shown in Fig. 8a. The logic can be inverted by soldering in a BC108 transistor between the logic input terminal marked BL and the base of Q5 (the switching transistor) as shown in Fig. 8b.

### PTO5006A0X board

If you own a set containing PTOS006A0X PCB, the logic level is inverted using a BC108 inserted between the input terminal marked L and the base of the switching transistor Q5 as shown in Fig. 9b. Fig. 9a shows the original circuit.

The additional logic inverting circuitry can be constructed above the component side of the PCB. The test point for measuring the crystal oscillator frequency varies from one model to another; it is TP3 for the PTBM059C0X and the PTBM121-D4AX and TP1 for the PTBM-125A4X board. To peak the crystal oscillator output simply connect the oscilloscope to the appropriately test point and adjust T1 for maximum reading. Re-check the crystal oscillator frequency and re-adjust the trimmer capacitors if necessary.

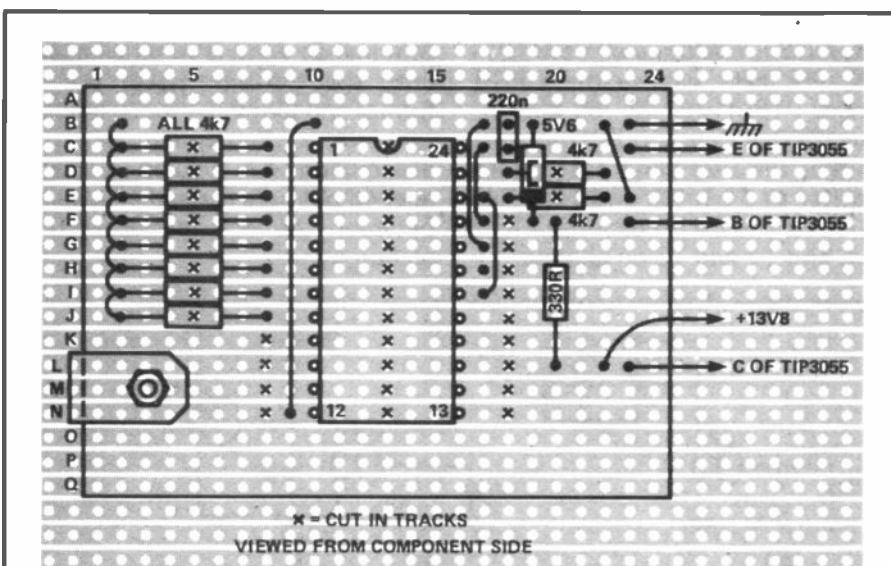


Fig. 6 Component overlay for the Veroboard EPROM add on.

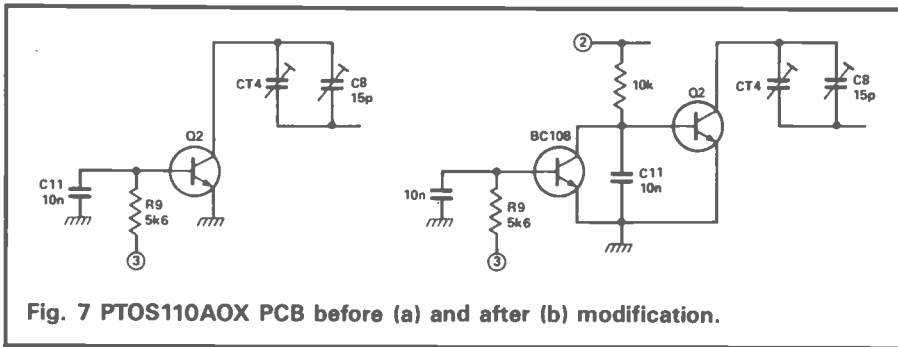


Fig. 7 PTOS110AOX PCB before (a) and after (b) modification.

### VCO Tuning

The next stage of the modification is to tune the VCO so that the phase lock loop will 'lock'. This is done by monitoring the DC voltage feeding the VCO capacitance diode. Ham International have provided a test point for this; on the PTBM-121D4X PCB it is TP1, TP2 on the PTBM059COX PCB and TP3 on the PTBM125A4X PCB. Connect the 'scope to the test point (which can be found adjacent to the VCO tuning 'block' near the front left hand component side of the PCB) and set the Y amplifier to 1 volt per division with the trace at the bottom of the display graticule.

With the set on channel 1 low band, adjust the VCO core (with the correct trim tool) until a reading of approximately 4.0 volts is obtained. Now tune the set to channel 11 mid band and observe the VCO voltage, it should be about 2 volts. The VCO voltage will decrease as the channel number is increased between channel 1 low band and channel 11 mid band. Ensure that the VCO voltage does not drop to zero or reach 5.6 volts, the value of the supply voltage feeding the PLL chip. The loop should now be locked. If for some reason you cannot obtain lock, it is worth checking to see that you have the correct logic value on the programme lines feeding the PLL chip.

### Ten Metre Tuning

At this stage it is worth making sure that the modification has been successful so far. No alteration has been made to the transmitter circuitry so it should be possible to tune the transmitter up onto ten metres to check it out. Fig. 10 gives the values of the various operating frequencies for each channel, together with the corresponding fre-

quency on ten and six metres. Channel 1 low band, should be on 28.91MHz and channel 11 will be on 29.11MHz.

The transmitter can be quickly tuned to ten metres; with an SWR meter and 50 ohm dummy load connected to the aerial socket, key the transmitter on channel 26 low band using AM or FM and adjust L11, L12, L13, and L14 for maximum power.

With the set tuned to channel 1 low band, adjust T3 and T5 for maximum power, then switch to channel 11 mid band and adjust T2 and T4 to obtain maximum output. Repeat this procedure until there is no further improvement. If you have tuned the transmitter correctly, you should now find that the power will not vary by more than about 3dB over the selected frequency range between channel 1 low band and channel 11 mid band. Now T2 and T3 will not have to be re-tuned when the set is re-adjusted to operate on six metres, and it also shows that the modification is working so far.

The transmitter tuning procedure given is intended for rigs with PCBs PTBM059COX and PTBM121D4X. For sets with a main PCB number PTBM125A4X (eg a Lafayette 1800 or Colt 1600DX) you will find that the two band pass filters comprise of T1 & T2, and T3 & T4. Adjust T2 and T4 on channel 1 low band, and T1 and T3 on channel 11

mid band. The remaining tuned circuits (T5, L13, L15, and L16) should be tuned for maximum output on channel 26 low band. The transmitter section of the set should now be fully tuned on ten metres.

### 6m Mods — rewinding T4

The band pass filter located on the output side of the transmitter mixer consists of two separate tuned circuits T4 and T5 coupled by a small value capacitor, the two coils are wound on Toko 10K coil formers with the terminal connections as illustrated in Fig. 11a. The coil former bobbin is shown in Fig. 11b, and consists of three separate areas. You may find that some bobbins will contain four separate areas, in which case, ignore the winding area at the top of the bobbin. T4 was unsoldered and removed from the PCB, the screen cover was removed revealing the coil former by a plastic pot core which acts as a spacer between the metal screen and the coil former.

For 6m use the internal 82pF capacitor must be removed and replaced by a 40p component. Referring to Fig. 12, L1 will consist of three turns, L2 will be one turn and L3 is not required. To wind the new value of T4, either completely strip the windings from the original or start with a new coil former. Using 36swg wire, start by winding L2. The winding starts on terminal 1, wind one turn clockwise onto the middle section of the coil former and terminate the winding on terminal 2. Next wind L1, which starts on terminal 2; wind 3 turns clockwise onto the top section of the coil former and terminate the winding on terminal 3. Remember when re-assembling the screen a plastic shaped pot core is used as a spacer between the coil former and the screen can.

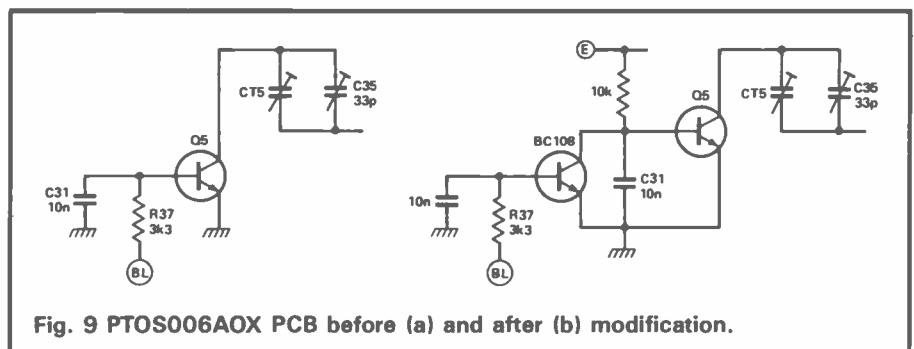


Fig. 9 PTOS006AOX PCB before (a) and after (b) modification.

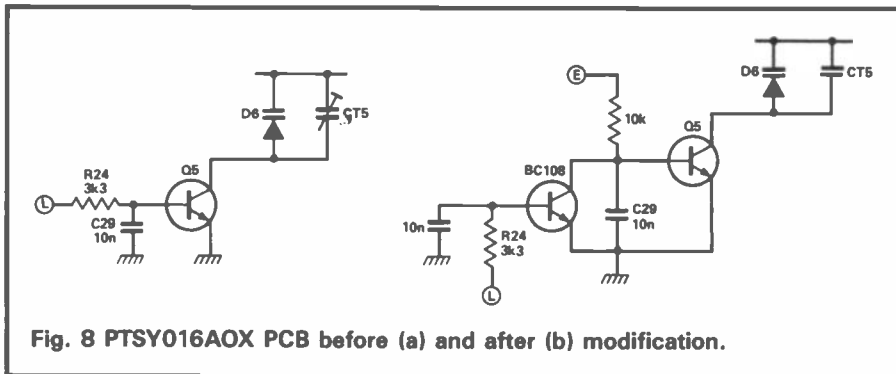


Fig. 8 PTSY016AOX PCB before (a) and after (b) modification.

### Rewinding T5

The new T5 can be wound using a similar approach, note that the original coil former of T5 is surrounded by a ferrite pot core. The value of the internal capacitor in T5 will become 40pF, L1 will consist of two turns, L2 will be one turn and L3 should have two turns.

Proceed as follows:— using 36swg wire, start winding L3 from terminal 4; 2 turns are wound clockwise on to the bottom section of the coil former and the winding is terminated on terminal 5. Next wind L2, starting on terminal 1; 1 turn is wound clockwise onto the centre section of the coil former and is terminated on terminal 2. Finally, wind L1 starting on terminal 2, winding 2 turns clockwise onto the top section of the coil former and terminating the winding on terminal 3. When re-assembling the screen can, do not forget to replace the ferrite pot core.

When the coil former has been re-soldered back onto the PCB, a 38pF capacitor can be added to the track side of the PCB (across terminals 1 and 3) to replace the original internal 82pF capacitor.

### Rewinding T6

The next stage of the modification is to rewind T6, Fig. 13. A 47pF capacitor (C49) is soldered to the PCB and this must first be replaced with a 27pF component. The new value of L1 will consist of four turns, and L2 will consist of one turn. However, if you decide to modify the original coil, then you can carefully remove 3 turns from the top of L1 and 1 turn from the top of L2 instead of completely rewinding it. Note that the varnish which covers the coil winding is not heat resistant, and so will not need to be

scraped away before the wire is soldered.

### Transmitter Modification

The next stage of the conversion is to tune the transmitter driver and power amplifier stages. The driver stage is tuned and matched to the power amplifier by a Tee network consisting of C54, C55 and L8. For the set to operate on six metres it will be necessary to change the value of these three components. C54 is an 82pF capacitor which was changed for a 33pF, C55 a 220pF capacitor is replaced by a 100pF capacitor and L8 (originally 3.5 turns) has one turn removed. The output of the power amplifier is matched to the 50 ohm load by an LC network which consists of three coils L12, L13, and L14 plus capacitors C56, C57, C58, and C59. L12 (4.5 turns) has one turn removed. L13, consisting of four self supporting turns needs to be rewound with only two turns. L14 (2.5 turns) wound on a 6mm diameter coil former, must have one turn removed.

Capacitor C56 (150pF) will need to be replaced with an 82pF component; C52 (560pF) should be replaced by a 270pF; C58 (470pF) needs to be replaced by a 220pF and finally replace C59 (270pF) with a 100pF capacitor. You may also find a capacitor placed in parallel with L13 which should be replaced by a 22pF component. In some sets you will find a self supporting coil and a 150pF capacitor soldered to the aerial socket, in the six metre design, this low pass filter will need to be removed and the aerial socket connected directly to the PCB.

### Transmitter Tuning

The transmitter stages of the set

can now be tuned for maximum output power. First we need to tune T4 and T5 which forms the band pass filter on the output side of the transmitter mixer circuit. With a dummy load and SWR meter connected to the aerial socket, adjust the tuning core of T5 on channel 1 low band for maximum output then switch to channel 11 mid band and adjust T4 for maximum power. Repeat this exercise several times until no further adjustment of the tuning cores is required. Remember that you *do not* have to adjust the tuning cores of the band pass filter formed by T2 and T3.

Next, switch the set to channel 26 low band, the set should now be operating on 50.25MHz, the middle of the amateur six metre band. Now adjust the tuning cores of T6, L8, L12, and L14 for maximum power. You may find it necessary to adjust the value of L13 by increasing the spacing between the turns using a trimming tool. Re-check the output power between channel 1 low band and channel 11 mid band. The output power level should be reasonably constant between 50.00MHz and 50.50MHz. If not, then you will have to re-tune the band pass filter formed by T4 and T5.

The author used a Bird ThruLine Wattmeter and recorded an output power of 1.6 watts. If you should find that your output is below 1 watt, then it is possible to increase the output power by making an adjustment to the transmitter mixer tuning. Remove L3 (a coil wound on a resistor) and replace it with a coil consisting of 20 turns closewound using 36swg enamelled wire, securing the turns with nail varnish. A 100k, ¼ watt resistor will make a suitable former. We will also need to change the value of C37 to a 45pF capacitor and C38 to a 33pF capacitor which will increase the gain of the transmitter mixer circuit and hopefully should have increased the drive to the power amplifier stage and consequently the output power.

You may have been a little confused to find that the tuning coils numbered in your set does not correspond with the numbers given by the author above. The reason for this is that the author's set, a Ham International Highgain V contains a main PCB numbered PTBM121D4X which is also similar in component

Channel No.	FTX 6 metres	FTX 10 metres	T <sub>2</sub> , T <sub>3</sub>	FXTAL	Freq	Fin	-N	Hex
Low 1	50.00	28.61	39.305	21.2525	18.0525	3.20	320	40
Low 2	50.01	28.62	39.315	21.2525	18.0625	3.19	319	3F
Low 3	50.02	28.63	39.325	21.2525	18.0725	3.18	318	3E
Low 4	50.03	28.64	39.335	21.2525	18.0825	3.17	317	3D
Low 5	50.04	28.65	39.345	21.2525	18.0925	3.16	316	3C
Low 6	50.05	28.66	39.355	21.2525	18.1025	3.15	315	3B
Low 7	50.06	28.67	39.365	21.2525	18.1125	3.14	314	3A
Low 8	50.07	28.68	39.375	21.2525	18.1225	3.13	313	39
Low 9	50.08	28.69	39.385	21.2525	18.1325	3.12	312	38
Low 10	50.09	28.70	39.395	21.2525	18.1425	3.11	311	37
Low 11	50.10	28.71	39.405	21.2525	18.1525	3.10	310	36
Low 12	50.11	28.72	39.415	21.2525	18.1625	3.09	309	35
Low 13	50.12	28.73	39.425	21.2525	18.1725	3.08	308	34
Low 14	50.13	28.74	39.435	21.2525	18.1825	3.07	307	33
Low 15	50.14	28.75	39.445	21.2525	18.1925	3.06	306	32
Low 16	50.15	28.76	39.455	21.2525	18.2025	3.05	305	31
Low 17	50.16	28.77	39.465	21.2525	18.2125	3.04	304	30
Low 18	50.17	28.78	39.475	21.2525	18.2225	3.03	303	2F
Low 19	50.18	28.79	39.485	21.2525	18.2325	3.02	302	2E
Low 20	50.19	28.80	39.495	21.2525	18.2425	3.01	301	2D
Low 21	50.20	28.81	39.505	21.2525	18.2525	3.00	300	2C
Low 22	50.21	28.82	39.515	21.2525	18.2625	2.99	299	2B
Low 23	50.22	28.83	39.525	21.2525	18.2725	2.98	298	2A
Low 24	50.23	28.84	39.535	21.2525	18.2825	2.97	297	29
Low 25	50.24	28.85	39.545	21.2525	18.2925	2.96	296	28
Low 26	50.25	28.86	39.555	21.2525	18.3025	2.95	295	27
Low 27	50.26	28.87	39.565	21.2525	18.3125	2.94	294	26
Low 28	50.27	28.88	39.575	21.2525	18.3225	2.93	293	25
Low 29	50.28	28.89	39.585	21.2525	18.3325	2.92	292	24
Low 30	50.29	28.90	39.595	21.2525	18.3425	2.91	291	23
Low 31	50.30	28.91	39.605	21.2525	18.3525	2.90	290	22
Low 32	50.31	28.92	39.615	21.2525	18.3625	2.89	289	21
Low 33	50.32	28.93	39.625	21.2525	18.3725	2.88	288	20
Low 34	50.33	28.94	39.635	21.2525	18.3825	2.87	287	1F
Low 35	50.34	28.95	39.645	21.2525	18.3925	2.86	286	1E
Low 36	50.35	28.96	39.655	21.2525	18.4025	2.85	285	1D
Low 37	50.36	28.97	39.665	21.2525	18.4125	2.84	284	1C
Low 38	50.37	28.98	39.675	21.2525	18.4225	2.83	283	1B
Low 39	50.38	28.99	39.685	21.2525	18.4325	2.82	282	1A
Low 40	50.39	29.00	39.695	21.2525	18.4425	2.81	281	19
Mid 1	50.40	29.01	39.705	21.2525	18.4525	2.80	280	18
Mid 2	50.41	29.02	39.715	21.2525	18.4625	2.79	279	17
Mid 3	50.42	29.03	39.725	21.2525	18.4725	2.78	278	16
Mid 4	50.43	29.04	39.735	21.2525	18.4825	2.77	277	15
Mid 5	50.44	29.05	39.745	21.2525	18.4925	2.76	276	14
Mid 6	50.45	29.06	39.755	21.2525	18.5025	2.75	275	13
Mid 7	50.46	29.07	39.765	21.2525	18.5125	2.74	274	12
Mid 8	50.47	29.08	39.775	21.2525	18.5225	2.73	273	11
Mid 9	50.48	29.09	39.785	21.2525	18.5325	2.72	272	10
Mid 10	50.49	29.10	39.795	21.2525	18.5425	2.71	271	0F
Mid 11	50.50	29.11	39.805	21.2525	18.5525	2.70	270	0E

Fig. 10 Various operating frequencies for each channel selected

numbering to that of the PCB numbered PTBM059COX, however if your set contains the PTBM125A4X PCB then the component numbering will be different. Tuned circuits T4 and T5 will be numbered T3 and T4; T6 will be numbered T5 and C49 will be numbered C47. In the transmitter drive circuitry, C54 will be numbered C52, and C55 will be numbered C53 whilst L8 will be numbered L7. In the transmitter output impedance matching network, L12 will be numbered L11, L13 becomes L12, and L14 will become L13, C56 becomes C54, C57 becomes C55, and finally C58 will be renumbered C57.

### Receiver Tuning

The receiver front end consists of three tuned circuits, T9, T10, and T11, numbered T7, T8, and T9 in sets with a PTBM125A4X PCB. An investigation of T9 in the authors set revealed that the coil former contained two windings L1 (10 turns) and L2 (3 turns), both covered by a ferrite pot core. For six metre use L1 will need to be five turns and L2, two turns.

The coil former can be rewound, or a surplus Toko 10k coil former obtained from a crap CB set. Using 36swg enamelled wire L2 starts on terminal 4 and two turns are wound clockwise onto the bottom section of the coil former with the winding terminated on terminal 3. Next wind L1 starting on terminal 1, three turns are wound clockwise onto the middle section of the coil former followed by two turns wound clockwise onto the top section, the winding is terminated on terminal 3. When reassembling, remember to insert the ferrite pot core before replacing the screen can.

### Rewinding T10

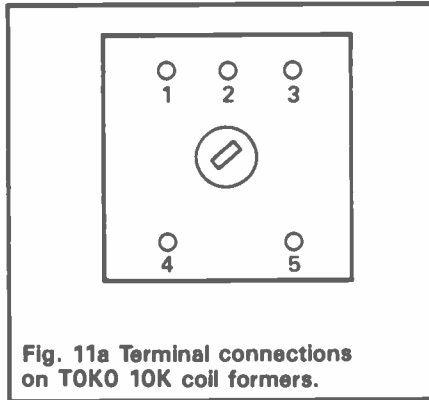
T10 should be unsoldered from the PCB and the screen can carefully removed to reveal a plastic spacer. These are three separate windings L1, L2, and L3 as illustrated in Fig. 12, but note that the latter is not used so it can simply be removed. The internal 85pF capacitor should also be discarded at this stage. To wind the new coil, either use a Toko 10k series former or the original component (with the old windings removed of course!) and proceed as



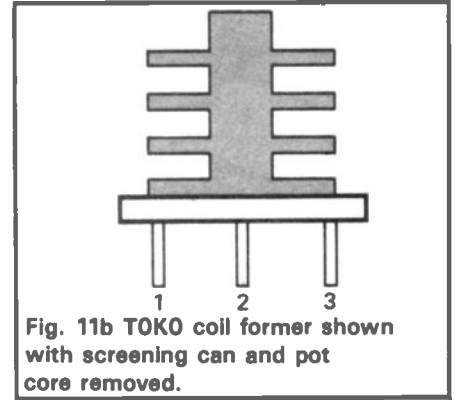
Channel	Low Band		Mid Band	
	Address	Data	Address	Data
1	0 7 F 4 0	0 0 B F 1 8		
2	0 7 E 3 F 0	0 B E 1 7		
3	0 7 D 3 E 0	0 B D 1 6		
4	0 7 B 3 D 0	0 B B 1 5		
5	0 7 A 3 C 0	0 B A 1 4		
6	0 7 9 3 B 0	0 B 9 1 3		
7	0 7 8 3 A 0	0 B 8 1 2		
8	0 7 6 3 9 0	0 B 6 1 1		
9	0 7 5 3 8 0	0 B 5 1 0		
10	0 7 4 3 7 0	0 B 4 0 F		
11	0 7 3 3 6 0	0 B 3 0 E		
12	0 7 1 3 5 0	0 B 1 0 D		
13	0 7 0 3 4 0	0 B 0 0 C		
14	0 6 F 3 3 0	A F 0 B		
15	0 6 E 3 2 0	A E 0 A		
16	0 6 C 3 1 0	A C 0 9		
17	0 6 B 3 0 0	A B 0 8		
18	0 6 A 2 F 0	A A 0 7		
19	0 6 9 2 E 0	A 9 0 6		
20	0 6 7 2 D 0	A 7 0 5		
21	0 6 6 2 C 0	A 6 0 4		
22	0 6 5 2 B 0	A 5 0 3		
23	0 6 2 2 A 0	A 2 0 2		
24	0 6 4 2 9 0	A 4 0 1		
25	0 6 3 2 8 0	A 3 0 0		
26	0 6 1 2 7			
27	0 6 0 2 6			
28	0 5 F 2 5			
29	0 5 E 2 4			
30	0 5 D 2 3			
31	0 5 C 2 2			
32	0 5 B 2 1			
33	0 5 A 2 0			
34	0 5 9 1 F			
35	0 5 8 1 E			
36	0 5 7 1 D			
37	0 5 6 1 C			
38	0 5 5 1 B			
39	0 5 4 1 A			
40	0 5 3 1 9			

**Table 1** The Eprom memory address/data codes required to blow your own Eprom

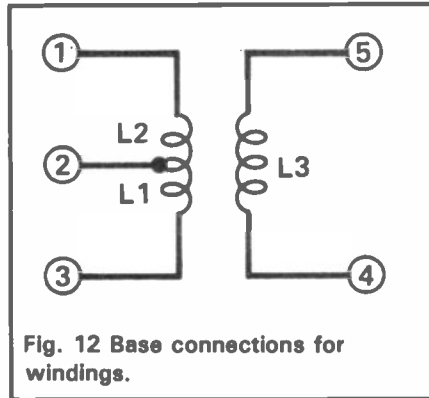
follows. Start by winding L2 beginning from terminal 1 with two clockwise turns wound onto the middle section of the former, finishing up on terminal 2. Next wind L1 beginning from terminal 2, winding two turns, clockwise onto the top section of the former and terminating the wire on terminal 3.



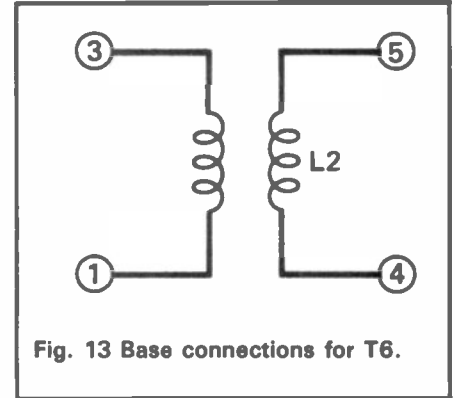
**Fig. 11a** Terminal connections on TOKO 10K coil formers.



**Fig. 11b** TOKO coil former shown with screening can and pot core removed.



**Fig. 12** Base connections for windings.



**Fig. 13** Base connections for T6.

After the rewind, place the plastic spacing piece over the top of the coil former and then replace the screen can and solder the coil back onto the PCB. Finally, a new tuning capacitor of 39pF can be soldered between terminals 1 and 3 on the track side of the PCB.

### Rewinding T11

T11 is removed from the PCB and the screen can carefully removed to reveal a ferrite pot core covering the windings. Remove this core, discard the internal capacitor and the existing windings before proceeding.

The first winding to be wound is L2 (see Fig. 13a). This winding starts on terminal 5, and one turn of 36swg wire is wound clockwise onto the bottom section of the coil former with the winding terminated on terminal 4. Finally wind L1, starting on terminal 1, winding two turns of 36swg wire clockwise onto the middle section of the coil former and adding a further one turn clockwise onto the top section of the coil former, terminating on terminal 3. After the winding has been completed, place the ferrite pot core over the top of the coil former and replace the screen can. Solder the coil back into the PCB of the set and solder a

39pF capacitor across terminals 1 and 3 on the track side of the PCB. All that remains to do now, is to tune up the receiver front end.

With the set switched to channel 26 low band, inject a 50.25MHz signal into the aerial socket from a suitable signal generator. The author had the set switched to FM and the signal generator producing a deviation of 3kHz. The tuning cores of T9, T10, and T11 should now be adjusted to obtain maximum audio from the loudspeaker. The receiver sensitivity was checked and found to have a threshold better than 1uV. The set should now be ready for air testing.

The purity of the transmitter signal has been checked on a spectrum analyser and the only spurious signal has been checked on a spectrum analyser and the only spurious signal was in excess of 50dB down on the carrier, this being a mixing product of the VCO and crystal oscillator third harmonic in the transmitter mixer.

*The EPROM referred to in the text may be obtained by sending a cheque or postal order for £8.50, made out to C B Alban and addressed to Roger Alban, c/o Ham Radio Today, 1 Golden Square, London, W1R 3AB. Please allow up to 28 days for delivery.*



# Listening On...

*Things are on the move in the short-wave world — our resident radiophile surveys the changes.*

## 1987 EDITION

# WORLD RADIO

# TV **WRTH**

# Handbook

Although by the time this is read it will already be half-way through the year, my new copy of the "World Radio TV Handbook", 1987 edition, has recently arrived on my desk. This annual publication is a must for anyone interested in DXing on the broadcast bands, or just in listening to specific stations.

### The WRTH

The "World Radio TV Handbook" (or WRTH as it is more usually called) contains almost 600 pages of all sorts of information on radio and television stations around the world, including their operating times and frequencies, some details of their programmes, their management personnel, their publications, QSLing policy and much more besides. There are several pages of introduction in English, French, Spanish and German, the rest of the book being solely in English. There are articles on predicted solar activity in 1987, details of international broadcasting organisations and religious broadcasting organisations and lists of the estimated number of radio and television receivers in each country. There is also an article on propagation by George Jacobs, W3ASK, a retired Voice of America engineer and propagation expert.

The major part of the book, though, is taken up by a country-by-country listing of all known radio stations (and a smaller section, with less detail, is a country-by-country listing of television stations). Taking a country at random, the Seychelles, we see that the local time is GMT+4 hours, the languages used there are Creole, English and French, the electric current is AC 50Hz, 230 volts, and that there are two radio stations, "Radio Television Seychelles" and the "Far East Broadcasting Association" (FEBA).

The WRTH — a must for all keen broadcast listeners.



# FEBA - Seychelles

CONFIRMING YOUR REPORT

on 11.955 MHz, at 16.57 hours, GMT

on 1st April 1972.

With thanks,

Mary Berry.

QSL Secretary

Far East Broadcasting Ass'n,  
P. O. Box 234, Victoria,  
Seychelles (via Mombasa Kenya)

FEBA - Seychelles  
is a member station of  
FEBC Radio International

For full details of FEBA Seychelles transmissions see the latest copy of WRTH.

For each of these stations their address is given, their telephone number and cable and telex information. The names of their directors, chief engineers are also given, in addition to the frequencies used, the times of broadcasts, all the languages used (FEBA uses 22 languages including such well-known tongues as Oromo, Tigrinya and Telugu), the powers of the transmitters and even the geographical co-ordinates of the transmitter sites.

A useful aid in identifying radio stations is that the actual words used in the station identification are given, sometimes in many languages. For example, if you think you might have logged the Somali Broadcasting Service, with a weak signal and over-ridden with QRM, it is useful to know that their station identification is "Halkan wa Radio Muqdishu" in Somali, or "Huna Mogadishu idha'atu-l-gumhuriya . . ."

Bearing in mind that some countries have a multiplicity of radio stations (there are 426 commercial stations listed in the USA and the entry for Brazil lists no fewer than 1156!) it is not surprising that the WRTH cannot give as much detail for every station in the book. However, almost any station you are likely to hear on short wave, medium wave, or long wave is listed by frequency, and the address is given for all of them.

At the back of the book are separate frequency listings, giving the power of each transmitter

(where known) of long and medium wave stations in Europe/Africa/Middle East, East Asia/Pacific, North America, Central and South America, and finally a world-wide frequency listing for all known short wave stations. Since most international broadcast stations change their frequencies four times a year (some more frequently, others less so) most of this listing above 6MHz can be taken only as a very approximate guide of what is on any specific frequency, but where it is extremely useful is on those frequencies around 3.2 and 4.7MHz, the so-called tropical bands, where stations are generally broadcasting for internal audiences and where most stations use the same frequency for many years.

Finally, there is a section reviewing some of the new receivers currently on the market, an article about the work of the BBC Monitoring Service and an article about some of the world's clandestine radio stations.

The WRTH is up-dated and thoroughly revised every year. However, by the time it is published it is always at least a little out-of-date in as much as stations *do* change frequency very often. Having said that, the WRTH is probably the best guide anyone could wish for to what is on the short wave bands, anywhere. Anyone at all interested in this aspect of the hobby should get a copy, though probably only the real enthusiasts would buy one every

year. For the average radio amateur or SWL perhaps one every two or three years would be more like it. For the really keen SWL, who has to know the complete Turkish-language schedule of Radio Budapest, the WRTH does, however, publish a series of up-dates in the form of the WRTH Newsletter.

One station that just got into this year's WRTH, though its entry states that it was under construction at the time of editing, is WCSN, with studios in Boston, Massachusetts, and a single 500kW transmitter at Scotts Corner, Maine, in the USA.

## WCSN - a new service

WCSN in fact only started regular programmes on 1st April this year. The station is operated by the Christian Science Monitor organisation which, despite the name, is basically a news organisation, publishing the highly influential Christian Science Monitor newspaper. They pride themselves on being a completely independent and objective organisation and that their news programmes are totally un-biased. When I heard them, a few days after the start of regular programmes, they were putting out an enormous signal on 15270kHz at 1600-1800 GMT, and asking for reception reports to be sent to "World Service of the Christian Science Monitor", PO Box 860, Boston, MA 02123,



Both Radio Sweden International and Radio Nederland have been giving interesting glimpses into the goings-on at the WARC conference in Geneva.

USA. They also announced further transmission times as 2000-2200 on 9465kHz and 0000-0200 on 7365kHz, though this may well not be the complete schedule. Apart from the news on the hour, which did indeed seem to be very detailed and objective, I heard a mailbag-type programme, in which they acknowledged letters from listeners and answered queries about their organisation. As I understand it, this organisation also now owns radio station KYOI, which is on Saipan island in the western Pacific. At present KYOI broadcasts rock music for young Japanese listeners, though it seems possible that it may also start to carry "World Service of the Christian Science Monitor" programmes at a later date. Meanwhile, however, a recent report on Radio Sweden International's "Sweden Calling DXers" programme said that KYOI was broadcasting at 0200-0800 GMT on 17775kHz and at

0800-1700 GMT on 11900kHz.

### Re-vamp for BBC World Service

Most listeners to the BBC World Service in England tune in on 648kHz medium wave. This comes from a 500kW transmitter at Orford Ness in Suffolk, on the east coast of England, and is intended primarily for listeners in Belgium, Holland, northern France and north-west Germany — although once when on a motoring holiday in Europe I listened to this transmitter with excellent reception even in the middle of the day almost as far east as the East German border, and a long way south in Germany. A note in the May edition of the BBC's "London Calling" publication says that as from May 9th there will be a far smoother blend of programmes from BBC World Service to BBC French and German and "English-by-

Radio" lessons on this frequency.

The new service is called simply "BBC 648" and will be from 0330-0600, 1030-1100 and 1615-1900 GMT. BBC French, German and English-by-Radio programmes have always been carried on 648kHz, so what the new "BBC 648" service is, remains to be seen as I write this just before Easter. At times other than those above, normal BBC World Service programmes will be carried as at present. This transmitter is on the air twenty-four hours per day.

BBC World Service listeners have been deprived of their feedback programme since "Letterbox" was taken off the air, amid many complaints from loyal listeners, a year or two ago. Also in May though, a new programme called "Write On" and presented by Paddy Feeny will be introduced. It is intended to give listeners a chance to air their views on BBC World Service programmes — a sort of world wide "Points of



The Radio Nederland 'Media Network' studio in the days when it was called 'DX Juke-box'.





The BBC is planning some changes for its 648kHz service.

View". The producers are inviting listeners to write in with their comments, and to give their phone number, so that the listeners themselves can then be interviewed on the air by the programme-makers. It sounds quite a novel idea and I look forward to hearing how it develops. The programme can be heard at 2315 GMT Wednesdays, with repeat broadcasts at 1445 GMT on Thursdays and at 0730 GMT on Fridays. All these programmes can be heard on 648kHz, with the two repeat airings also on the long-time BBC favourite frequencies of 5975, 9410, 12095 and 15070kHz, as well as a number of others.

### WARC 'intruder' resolution

Listeners to Radio Netherlands' "Media Network" programme, as well as Radio Sweden International's "Sweden Calling DXers" and other DX programmes, can't have failed to have notice that there has recently been another WARC, or World Administrative Radio Conference, taking place in Geneva. For the radio amateur, perhaps the most welcome resolution has been that the IARU, the International Amateur Radio Union, has persuaded delegates to prohibit broadcasting in the 40 metre amateur band, between 7000 and 7100kHz. What effect this will have

on the many broadcasters who are intruders into this band remains to be seen, but at least it is a most welcome step in the right direction.

### AM to be phased out

In order to reduce the terrible congestion in the broadcast bands (which, incidentally, is at its worst when, like now, we are at the bottom of the sunspot cycle and stations have all crammed into the 31, 41 and 49 metre-bands) ordinary double sideband AM transmissions are to cease before the year 2016. Instead, SSB transmissions will become the norm for broadcast stations as well as amateurs on the short wave bands. The change-over will be done gradually, with stations reducing the level of carrier by first 6dB and later 12dB. I would guess that initially stations using several frequencies simultaneously will put out one frequency in SSB, while the others remain in the AM mode, until listeners get used to resolving the new form of transmission. Some stations, such as Radio Austria International and Radio Sweden International have already experimented with SSB transmissions within the broadcast bands (as opposed to SSB "feeders" used for getting signals to relay stations, which Radio Moscow and the BBC

have been using for many years) and several other stations are expected to follow suit in the near future.

### It does not compute!

One subject that was apparently much discussed at the WARC conference in Geneva was the idea of using a computer to allocate frequencies to broadcast stations, which they would then be obliged to use, instead of the free-for-all that exists at present. It seems that there are just too many transmissions for the available number of frequencies, assuming 5kHz spacing, and so the idea was not a great success; the computer would allocate your station a time-slot for a specified language, but would refuse to allocate you a frequency if there were not enough to go round. Another problem was that the computer worked on an hour-by-hour basis. This is fine if your station's transmissions are an hour or less in duration, but for those stations which broadcast for many hours at a time in one language — or like the BBC World Service and Radio Moscow World Service are on the air twenty-four hours a day — it is clearly unacceptable to expect listeners to re-tune their receivers every hour on the hour just because the WARC computer says its time for a move!

So, after much argument, a compromise was reached, and that is that everything should continue as it is at present until about 1992, when there would be another WARC conference. Meanwhile, the boffins were going to go away and improve the computer programme, to take into account transmissions of greater than one hour duration and the problem of no frequencies at all being allocated for certain transmissions. Then the computer would be tried on part of the short wave spectrum, to see if it works in practice, while the remainder of the spectrum was allocated as at present.

I can hardly wait until the 1990's to see if the Geneva computer really helps with the overcrowding on the short wave broadcast bands. By the time it comes into effect, though, we will be on the crest of the sunspot cycle and overcrowding will not be the great problem it is at present!

# STAR CMOS KEYER



Fig.1 Front panel of the keyer, with toggle switches set prior to clearing memories.

like the Yaesu FT101ZD. As supplied the speed range is from 7 to 42 words per minute (wpm).

## Initial Setting Up

On obtaining one of these keyers, the first thing to do is flush the memories of any odd characters which may be stored in them. After this has been done, reset the speed control to the normal setting and press the desired memory button. Memory scanning will start at once, so start keying your message straight away or you will lose space. In the LOAD position morse input is not transmitted while the memory is loaded.

If you complete your message before the LED goes out, wait until it does before moving on to the next memory. I was rather dubious about not knowing exactly when the memory would be filled, until it had, but after practicing with it for a while I soon got used to it. After loading the memories as necessary do not forget to put the toggle switch in the SEND position before selecting memories again, or the contents will be lost. Sounds obvious? Yours truly erased messages more times than he cares to remember initially.

In the SEND position any keyed morse will be transmitted and memories can be transmitted simply by pressing the appropriate red button. Memory transmission can be halted at any time by momentarily pressing the paddle. To give an example of what can be stored in the memories, the following were programmed by myself while testing the keyer.

- (1) CQ CQ CQ CQ DE G3ZPF G3ZPF G3ZPF AR K
- (2) NAME DAVID DAVID QTH NR DUDLEY NR DUDLEY
- (3) RIG TS930 TS930 ES ANT INV VEE INV VEE APEX 30 FEET
- (5) TEST TEST DE G3ZPF G3ZPF

In these days of oriental domination of the Amateur market it is rare to see a British made unit which competes not only in performance but also in appearance and price too. Some months ago, Tony Dewsbury started making the 'Star Masterkey'

which gives operating instructions in some details, but does not (unfortunately — Ed.) include a circuit diagram.

The keyer retains all of the features of the basic Masterkey and adds no less than eight memories,

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***There are a few home-grown alternatives to imported electronic morse keyers — Dave Reynolds, G3ZPF, takes the Dewsbury memory keyer for a test run.***

---

which proved popular from the moment it was introduced. It was inevitable that a memory version would follow, and recently I was asked to put it through its paces for 'Ham Radio Today'.

The unit comes in packaging which should survive the rigours of the postal system with ease, and first impressions on opening it were how smart it looked in its black and gold livery. The appearance of a fairly simple case has been improved dramatically by the addition of a screen printed front plate. An A5 handbook is supplied with the unit

each of which can store about 50 characters. The precise number of characters which can be stored will depend on the message as the length of morse characters varies, but the quoted figure seems a realistic estimate.

The unit measures 153mm wide x 78mm high x 197mm deep, and is supplied with four AA batteries already fitted. Sidetone is variable in both pitch and amplitude, and the keyer will operate rigs with either direct or grid block keying which makes it suitable for either solid state rigs such as the TS930, or valve rigs

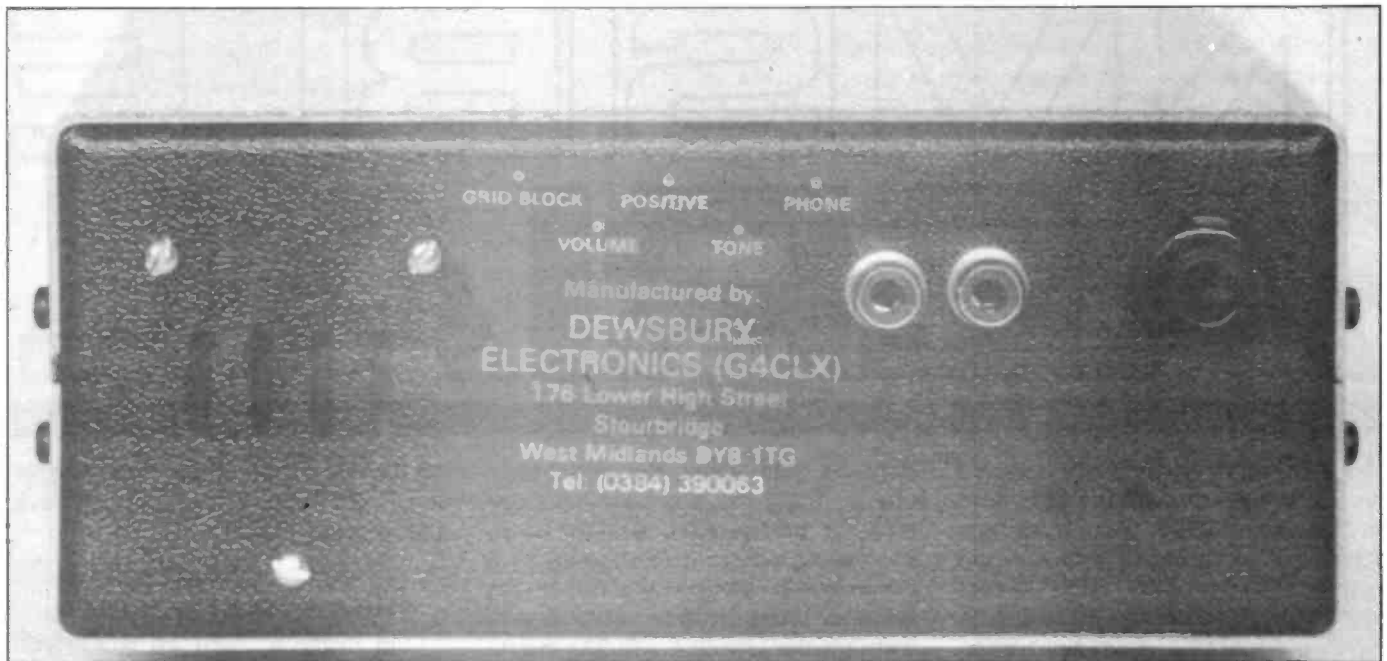


Fig. 2 Rear view showing keying sockets for solid state and valve rigs, together with headphone jack. The two holes at the bottom right give access to presets to adjust sidetone pitch and volume.

### G3ZPF TEST TEST TEST DE G3ZPF TEST

The reason for putting the 'test' message in memory 5 is that with the auto character space switched on, memories 1 and 5 will repeat endlessly until the paddle is pressed momentarily. Auto character spacing is selected by the toggle switch to the left of the speed control.

#### In Use

One of the first things I discovered when trying out the keyer was how rusty I had become as I now exclusively use a straight key. Consequently a good deal of time was spent off-air getting used to it before venturing on to the bands. It keyed my TS930 and TS520 perfectly, and seriously tempted me to give up using a straight key for good. The only problems with sending were all due to myself, and I can thoroughly recommend this unit to anyone looking for a memory keyer, especially as it is only about 50% of the price of many comparable imported units.

The only criticism I have to make is that it would have been nice to have had a pause facility on memories, to allow insertion of RST into messages for instance, and to have been able to 'chain' memories together for longer messages, but having said that I've yet to come across a keyer that does, apart from microprocessor based devices.

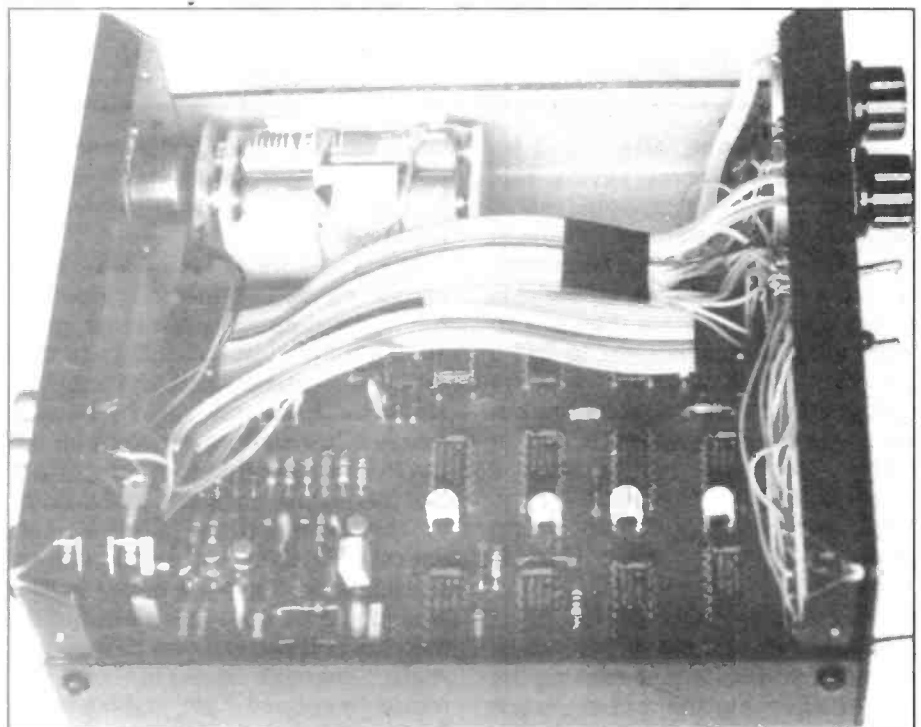


Fig. 3 Internal view of keyer. All components are mounted on a high quality PCB, and main cabling runs use ribbon cable for neatness. The wiring harness is arranged to allow the board to be removed for servicing whilst still connected.

#### Comments

This model does not supersede the original keyer, which continues to be produced at £54.70. Those readers requiring the extra facilities of the CMOS Memory Keyer will need to find £95.00 incl, with p&p for both devices being £3 extra.

You will also need a paddle unit to go with these keyers, and a variety can be obtained, varying from £17 to about £120 (!!).

*I would like to thank Dewsbury Electronics of Stourbridge, for supplying the review unit.*

# INVISIBLE AERIAL

The AOG aerial was a well-known type in pre-war days, and is almost as common in 1987, though perhaps a bit less understood and blessed with a different name, 'AOG' in fact stands for 'Act of God' and sums the type up admirably. 'Best Bent Wire'

drawing pins. Thus, the aerial took shape; from the standoff insulator terminal on the ATU, straight up to the ceiling where it is retained by a drawing pin, along the room to the window (supported by another pin) through the wooden window frame

on the 'local' net, where most people are 15-25 miles away, I seem to have the biggest signal.

## How to feed an AOG

In order to feed an AOG, you need an ATU, and an earth. My ATU has been feeding numerous versions of the AOG, from various homes, for some thirty years. More of this ATU in a moment. On the earth side, I have driven a spike into the ground, but radiating from the top of the spike there are around thirty radial wires, each buried about two inches below the surface for the sake of the mower blades. In addition, there is one insulated counterpoise wire which runs along the floor, under carpets, bent to fit the space — out of the shack, along the landing, round a bedroom, and so forth. Heaven knows how long it actually is. At the shack end it is connected to the earth terminal of the ATU. The outside earth is brought up to the shack by using the braiding from an old length of coaxial cable which had weathered beyond further service as coax; with the braid and the inner joined at each end to give a low-resistance connection.

Don't forget that the earth lead has finite length, and so in this case it forms part of the overall aerial system. Thus, if you are on the first floor and thinking of operating on say ten metres, you may find that the earth lead length is a quarter-wave or multiples thereof long, in which case you get awful RF problems. An RF burn off the mike case is painful, and forces you to solve the problem; either by 'tuning' the offending lead to be series resonant, or by simply changing the length, or by adding a quarter-wave counterpoise under the carpet, rather similar to the random

---

*Nobody can can complain about your aerial if it isn't there, we show you how to put the adage 'out of sight — out of mind' into practice!*

---

was another name, often used for checking one's morse keying too; Random Length Wire would serve well enough, but we draw the line at calling it, as so many do, a Long Wire. Properly, a wire used as an aerial is a long wire if it is more than a half-wave long; thus it is right to call a 66-footer a long wire if you are talking about 14MHz operation, but not if you are discussing 1.8, 3.5, or 7MHz. This can lead to such a question in the club Quiz as to 'When is a 66' long wire not a long wire?

## A typical AOG aerial

Clearly, if you have an AOG aerial situation, you are in fact 'making the best of a bad job' and that approach guides your whole thinking. For example I have a garden rather less than 26' x 20' plus an embargo on aerials. Thus, my AOG is totally conditioned by that and the fact that my shack happens to be in the small bedroom, which in this house is at the back. Clearly, my AOG requires a second AOG — it must become invisible!

The next design parameter was defined by the presence of a reel of 28 swg wire in the junk box, along with a reel of garden string and some

by simply opening the window tossing the reel out and re-closing it, and then downwards to the end of the garden.

It is caught there in a loop of garden string tied to the upright of the fence at about two metres, runs across the end of the garden to the other corner fence post and another string tie; back towards the house, where it is insulated and kept up by the PVC down-pipe from the gutter, and then finally back across the front of the house to a point almost directly beneath the shack where there is a washing-line pulley in the wall, and thus a place for a string to hold the end and insulate it. Truly, an AOG! Invisible enough, too — nobody's noticed it yet, and it's been up for over a year now.

Obviously, while one may have some idea what the length was when you strung it up, windage will stretch it quite rapidly. As far as mine goes, about all I can say is that it is probably longer than a quarter-wave on Eighty, and less than a quarter-wave on Top Band. Is it effective? Were it not available I couldn't work either band *at all* so to that extent it's great. Frankly, I didn't expect a lot from it, but on Eighty it has yielded SSB QSOs all over the country, and



one just described above. Be quite clear though — the more time and energy you spend on the earthing arrangements, the better the aerial will perform, and that goes for *any* aerial fed against earth, Marconi-fashion.

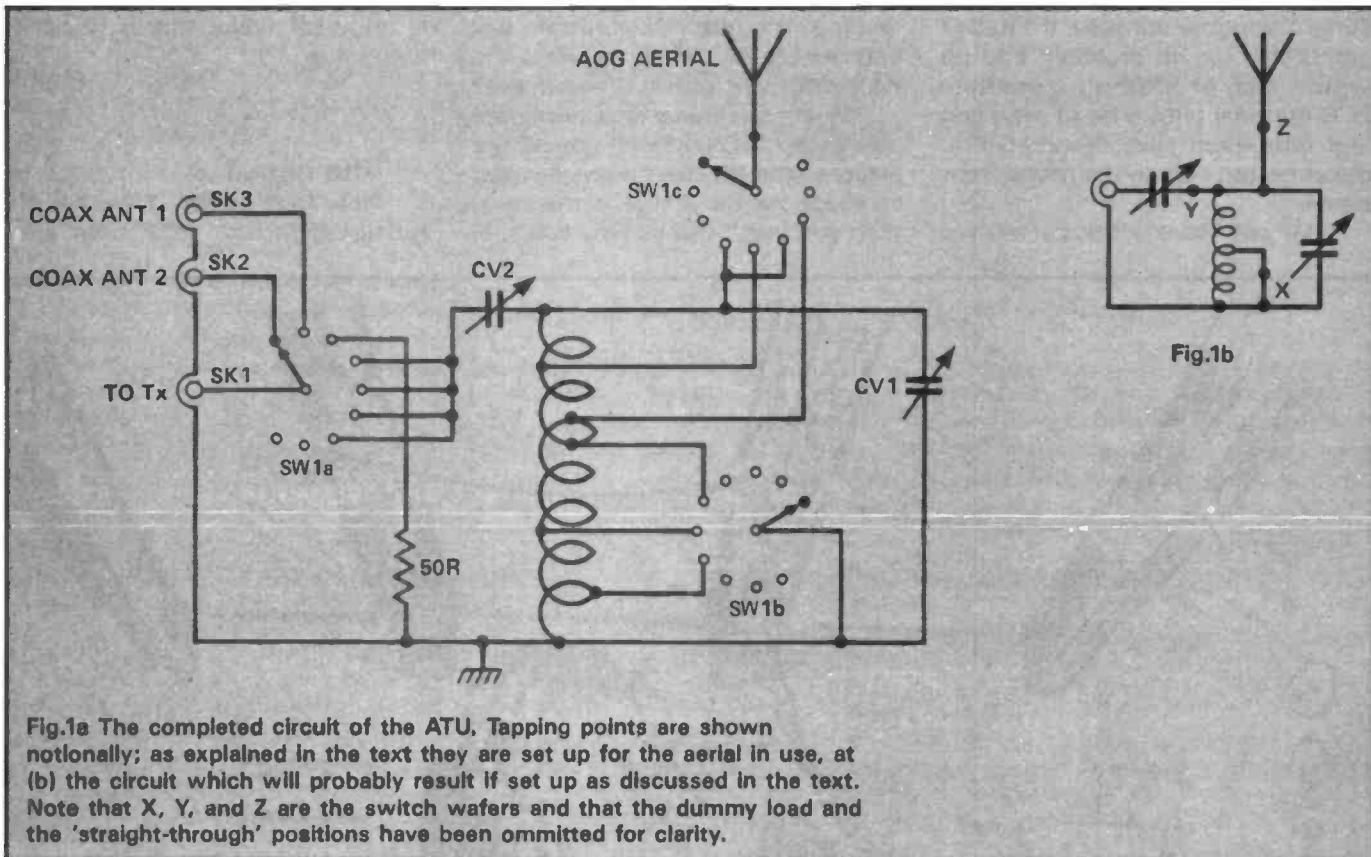
### The tuning unit

When it comes to these feederless systems, you want the ATU to be as flexible as possible; while commercial 'anything-to-anything'

lowest band you are aiming for without quite using the maximum capacitance. For me, twenty turns comes out on Eighty, spaced out along a former of about 2½ inches diameter. The wire was the heftiest tinned copper I had at the time — about 14swg although it was really a little too beefy for comfort. Turning to the tuning capacitors, you are looking, as 'rule of thumb' for about 1.5pF for each metre of wavelength; for Top Band that means

tune up on very low power first, that means we can reduce plate spacings.

To remind you of RAE and all that, at resonance  $f=1/2.LC$  and  $Z=V/I$ , both for a perfect tuned circuit. The practical tuned circuit has resistance so  $I$  increases from zero and  $Z$  reduces from infinity. What it boils down to in practice is that you'll have to do a bit of 'bodging' on Ten because the capacitor won't be small enough and



systems may work on one band or another, they probably won't play on all bands, or even the ones you want. Thus, one must make one's own. First, find a suitable case, Minffordd at Festiniog is one possibility, or you can bend one up yourself, using the vice, a couple of bits of wood, a hammer, and some nuts and bolts, or self-tapping screws. For the coil, you go to the local garden and DIY shop, and look at the PVC pipe they insist on selling as guttering downspout when it is obviously coil former!

Now wind some wire onto it. If you have a grid dip oscillator (GDO), the easy way is to tack it across the tuning capacitor to be used in the ATU, and then 'dip' the tuned circuit to satisfy yourself it will cover the

160x1.5=about 240pF, or 15pF on 28MHz. It isn't over critical though; on Ten stray capacitance plus the residual capacity at minimum will probably swamp your target, while on Top Band you might be scratching for a big enough value with adequate spacing between rotor and stator vanes. Which leads us neatly to the question of plate spacing! Obviously, if the aerial is not connected and 400W of RF are poked into the input, there is no loading, lots of volts, and almost certainly a strong smell of ozone will ensue. On the other hand, with a low-impedance aerial connected across the coil (say, 50 ohms) so that the loaded 'Q' is down to about 4 as we want it, then the voltage across the coil at resonance will be that much less — and if we

you'll possibly have to scratch for a big enough plate spacing and maximum capacity on Top Band. As for the other bands you can probably get away with what you have. For example, on Top Band where my aerial is low impedance, I have 'got away' with a capacitor of the sort that appeared in AM/FM radios of the valve era and 100 watts peak output, *provided* that I tune up at ten watts or less; but more recently a nice wide-spaced unit came into my hands at a club junk sale; it goes up to Eighty nicely, but for Top Band I still had to 'bodge' by shunting the variable with a fixed mica capacitor and 'sticking to lower power. Of course, I could have added a few turns to the coil, had I thought of it at the time. . . . !

Now we come to the series capacitor. Two points arise here. Firstly, we have to mount it so it is isolated from earth. Secondly, we want a lot of 'puffs.' My solution at the time was to use a two-gang 500pF broadcast capacitor salvaged from an old pre-War superhet radio. Were I doing it again, I would use the three-gang 500pF which is lying in the junkbox, hoarded for such an occasion. For the aerial terminal, I used a ceramic feedthrough insulator originally designed for feeding an aerial through a window. If I hadn't got that, I would probably end up with a disc of SRBF or glass-fibre PCB material with a bit of studding and nuts each side, mounted in a decent-sized hole in the metal front panel.

We will have a coaxial socket

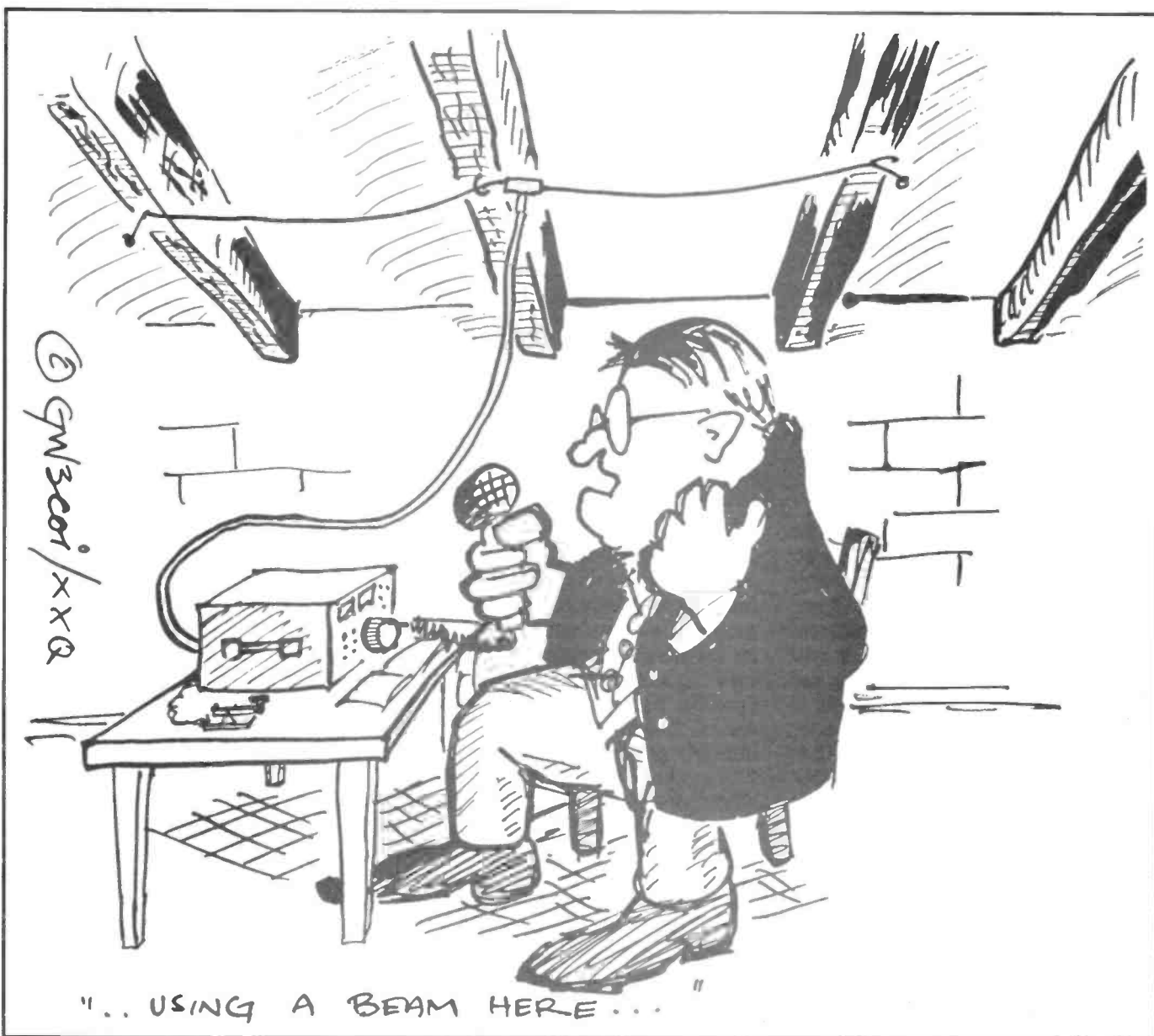
going off to the transmitter side and the earth line is terminated in a solder tag which goes nicely under a panel fixing screw. Finally, a bandswitch. Mine was a three-wafer ceramic switch, with nine ways on each wafer, of the old-fashioned 'standard' Yaxley size. If you bear in mind the need for low power in tune-up, you can get away with a smaller size, but never ever, 'hot switch' an ATU bandswitch. For one thing it will not do the switch any good, and for another the sudden change of loading on the transmitter will surprise the PA valves, or wreck the PA transistors; either is expensive!

Most people can accommodate dipoles for 14/21/28MHz around the place, so the ATU isn't normally used on those bands. If that is the case, then you won't use all nine ways, in

which case you could add a couple of coaxial sockets, and use them to switch straight through, so you can keep both the AOG and the dipoles available at the flip of a switch. My own version contains a dummy load too. Thus mine goes; coaxial 1, coaxial 2, dummy load, AOG 160, AOG 80, AOG 40 as you go round the switch, plus some spare positions. A short flex lead terminating in a croc-clip and long enough to reach any turn on the coil comes off the last wafer position and is 'stowed' tidily; this is used for setting-up.

### The circuit

Now look at Fig. 1, VC1 is the tuning capacitor, VC2 acts as a



'loader'; the bandswitch wafers respectively provide for shorting out part of the coil, setting the tapping point on the coil to which the capacitor VC2 goes, and setting the point on the coil to which the aerial is tapped. Mostly, you will end up with both the latter wafers joining their leads to the top of the coil, resulting in the circuit at Fig. 1(b) — but they are there to cope with the case when your own AOG insists on the full treatment.

Mounting of VC2 involves insulating both sides from earth. To achieve this, my own method was to make a perspex 'foot' for the capacitor, with deep counterbores for each fixing screw joining perspex to capacitor. The perspex was then screwed in the same manner to the mounting bracket, and the bracket in turn to the back of the front panel. Where the spindle came through the front panel, the panel hole was given a big enough hole to handsomely clear the spindle all round. For the knob, use one without a grub screw, such as you'd get from an old AC/DC domestic set or a TV. I have had an RF arc between my finger and the

grub screw while tuning, before I went for the right type!


### Setting up

Imagine we are looking at eighty metres. Firstly tune up the rig into a dummy load; back off the drive to a mere whiff, and switch to receive. Connect the ATU, rotate S1 to the croc-clip lead position. Join VC2 and the aerial to the top of the coil and tune VC1 and VC2 for a 'peak' in receive bearing in mind that they interact. Turn the transmitter on at low power and using an SWR meter tune for zero return. *Do not touch transmitter tuning at all during this.* Once you have found this setting, see whether the ATU tuning is 'flat' enough for both VC1 and VC2. turn to full power and look for distress signals. There should be none. Now wire the settings from the switches to the coil properly, disconnect the croc-clip leads and repeat the test to insure that all is well. Then start again for the next band.


If you can't find the peak either on receive or transmit, you will probably find yourself either 'wanting more C' or the converse; if

you seem to need more capacitance at VC1, add more turns to the coil, or vice versa, (Yes, that's right — think it out for a tick!). Check that the capacity of VC1 at midband looks about right by eye; try tapping the aerial down the coil then try tapping VC2 down the coil until you are happy. Don't forget: 1. To go to receive before you move clips or solder connections and 2. To give the PA plenty of rest, 6146s in a fanned rig can run for 30 seconds or more at low power, then allow a minute or so for cooling. I have found that I can adjust the settings for 160/80/40/20 from scratch in about thirty minutes or less using this method. I have always had an end-fed at every QTH no matter what other aeriels have been in use and this ATU design and tune-up procedure has loaded up everything offered to it over somewhat in excess of thirty years.


In use on the bands, either tune up on low power, or alternatively note all the settings; then when you QSY from 80 to 20 for instance, you just pre-set the ATU while you are still on receive, and switch to send for a touching-up operation only.




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The TX-3 RTTY/CW/ASCII TRANSCEIVE program is now available for the Spectrum. It has all the facilities of the BBC and CBM64 versions and will operate with an interface or T.U. Forget what you thought you knew about Spectrum direct decode systems. This one will transceive 300 baud RTTY or ASCII at 170Hz shift with only a simple interface. Its performance and facilities outclass other software by a large margin yet it is very easy to use. Some of the features are: Split-screen type-ahead operation, receive screen unwrap, 24 large memories, clock, review store, call sign capture, RTTY auto CR/LF, CW software filtering and much, much more.

The program comes with an adapter board which plugs into the Spectrum expansion port and accepts the interface or T.U. It will work with any 48/128k Spectrum, including the +2. Tape + adapter £35. Users of the CW QSO program can upgrade for £25. BBC and CBM64 program £20 tape, £22 disc. TIF1 INTERFACE has computer noise reduction, RX filters, TX outputs for MIC, PTT and KEY. Perfect for our TX-3 and RX-4 programs. Kit £15 (assembled PCB + cables & connectors), ready-made boxed with all connections £25 (state rig).

### SPECTRUM RX-4 RECEIVE

We now have a version of this amazing program using the adapter board mentioned above. This enables even better reception of RTTY/CW/SSTV and AMTOR with any 48/128k Spectrum, including the +2. Uses TIF1 (see above) for all modes or a T.U. for RTTY and CW. Tape + adapter £40. Existing RX-4 users can upgrade for £21. RX-4 is also available for BBC, CBM64 and VIC20 £25 tape, £27 disc (not VIC20). The BBC RX-4 is now completely compatible with the Master Series. Master users may exchange their programs free of charge.

We also have superb BBC, CBM64, Spectrum, VIC20, Electron programs for Morse Tutor £6, Locator £7, Logbook £8 and RAE Maths £9 as well as a great UK/Europe and World Map and Locator for BBC/Electron £10. Any BBC or CBM64 program also on disc at £2 extra.

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## technical software (HRT)



Fron, Upper Llandwrog, Caernarfon LL54 7RF  
Tel: 0286 881886

# Practicalities

Involvement in amateur radio must be one of the best ways to learn about electronics and radio communications. Despite the fact that it is usually not possible for the average amateur to build all his or her own equipment, a great deal can be learnt by tackling smaller projects.

**Ian Poole, G3YWX, assesses some new ideas for some old problems — and points out a new danger to amateurs as well.**

Examples of suitable projects appear quite frequently in HRT. Some of these can be built from scratch by buying all the components, making the printed circuit boards or using pin boards and then bashing the metal. However, if kits are available they can be much easier to build, avoiding the mess of making the PCBs, the hassle of finding all the right components and the time taken in doing the metal work. Either way, construction not only teaches electronics but also gives a lot of satisfaction when one says "I built it!".

In addition to actually building equipment there is a lot to be learnt from setting a station up and maintaining it. Although it might just be possible to have little or no technical involvement in putting a station together this is not usually the case. Most amateurs spend a lot of time thinking about the best rig to buy, looking into the type of aerial which will give the best results in the space and generally figuring out all the details of the system.

Then, after all the parts have arrived, the station has to be set up. Everything from making up cables to erecting aerials has to be done. All of this requires more expertise than people might think. All of this is part of self-training in the field of radio communications and this is one reason why many radio companies prefer to employ radio amateurs.

Now to move on to some practical ideas . . .

## Hi-fi interference and toroids

Toroids can be surprisingly useful in many applications. For example they are often seen being used in the output filters of QRP transmitters. However, they find many uses in RF chokes in a whole variety of applications and they can often provide a solution where other forms of choke do not work.

One area in which toroidal chokes can be particularly effective is in treating hi-fi interference. It often happens that RF, particularly from HF transmitters, can be picked up on long speaker leads and presented to the output of the audio

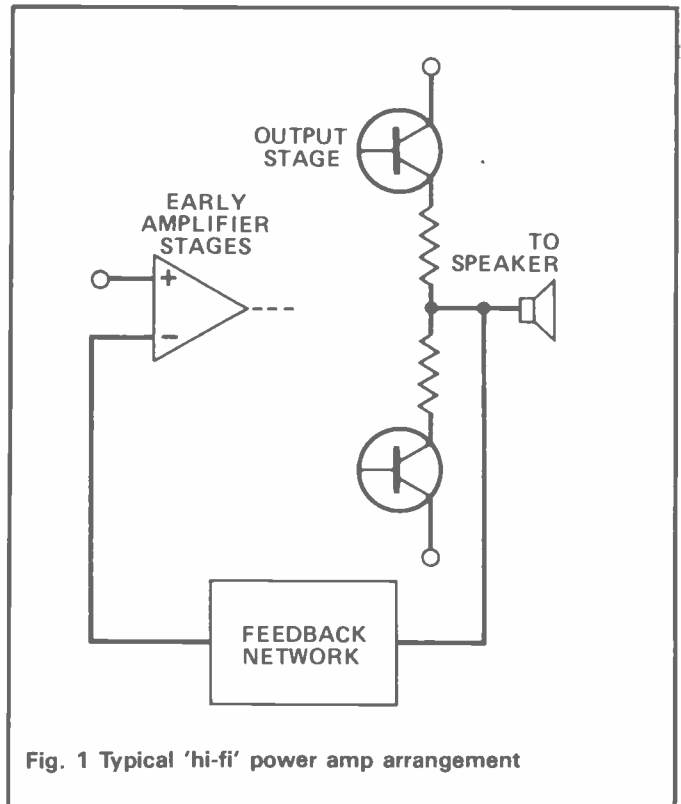


Fig. 1 Typical 'hi-fi' power amp arrangement

amplifier. Sometimes this RF can be rectified directly by the output transistors, but more often than not the RF is carried along the negative feedback network to earlier stages of the amplifier. Here the circuitry is much more sensitive to RF, and even small amounts of pickup will produce nasty noises in the output.

One remedy is to place a small capacitor across the output of the amplifier to bypass the RF to ground. Another solution which is often more effective is to use a toroidal choke. This can easily be made by taking a suitable ferrite ring

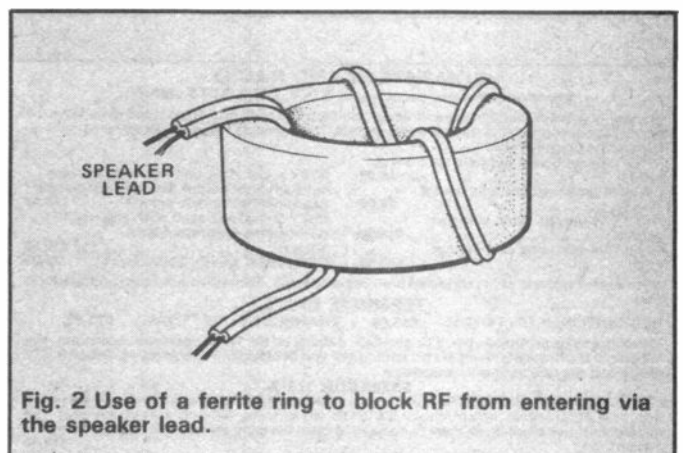


Fig. 2 Use of a ferrite ring to block RF from entering via the speaker lead.



from the junk box and winding the speaker lead four or five times round it. The number of turns will not usually be critical and will usually be limited by the number of times the speaker lead can be passed through the ring.

This method will often cure the problem without the need for modifying the amplifier, and so avoid you making void any warranty. Also you will not arouse the enduring displeasure of a neighbour when he sees you attacking the new hi-fi system with a soldering iron.

### Voltage regulators

The need arises quite often for a simple regulator circuit in one form or another. Although one was outlined in the *Practicalities* which appeared in the Dec 86 issue of HRT, it is sometimes necessary to have a slightly more sophisticated one. It is often useful to have one which provides better regulation, has a sense circuit, and one which can be adjusted to give exactly the correct voltage. The simple emitter follower circuit which was described before had no adjustment and the output voltage depended entirely upon the zener diode.

The circuit which is shown in Figure 3 is only slightly more complicated and its operation is still quite simple. Q1 forms the series pass transistor which is controlled to give the correct output voltage. It is driven by Q2 which acts as a differential amplifier which senses the voltage at point A and compares it with the zener diode voltage. If the voltage at point A is greater than the zener voltage plus the turn on voltage of the transistor then it will cause more current to flow through Q2 pulling the base voltage of Q1 down. This in turn will reduce the output voltage and hence the voltage at A. Similarly if the voltage at

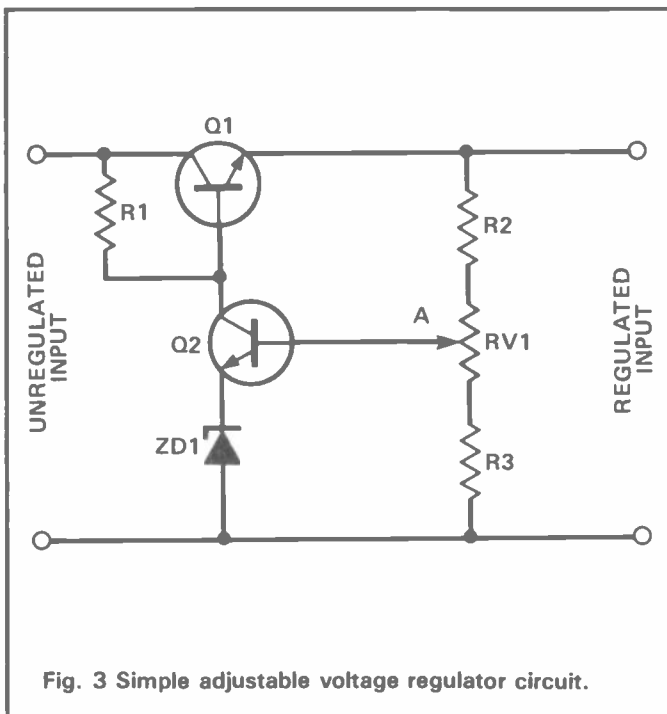


Fig. 3 Simple adjustable voltage regulator circuit.

A is too low then the output voltage will be raised. This means that the circuit will always try to correct itself if any changes take place. As the gain around the feedback loop is fairly high it means that the amount of regulation will also be fairly high.

For optimum results the value of the zener voltage should be about half the required output voltage and the source impedance of the potential divider should not be too high. A suitable value for a 12 volt supply might be around 1k although this is not critical. The resistor R1 is included to provide sufficient current at all times for the zener diode to operate correctly. Its value should be calculated to give a current flow of between five and ten milliamps for most applications.

### Unknown danger

We must all be aware of the more obvious dangers associated with operating and running radio equipment. For example, can anyone out there not know that high voltages, and in particular AC mains voltages are potentially lethal? This is not to minimise the dangers, indeed electrocution continues to claim many lives every year, but the risks are well known. However, relatively few are aware of the risks associated with components containing beryllium oxide.

This substance has excellent heat conductance properties and good electrical insulation. Because of this, it is used in many RF power transistors where large amounts of heat have to be conducted away from a relatively small area. However, it is a hazardous substance and prolonged exposure can cause lung disease, skin disease and nervous disorders. It is unlikely that occasional contact will cause any ill effects, the problems listed being caused in industrial processes where exposure has been over a period of years. All the same, sensible precautions should be taken.

The beryllium oxide, which is a fine white powder, is normally contained by the power transistor's encapsulation, so the first precaution is to avoid breaking the seal of power devices. Normal handling and soldering are perfectly safe, but excessive heat or force should be avoided. If the case is punctured, and any beryllium oxide does escape, be careful not to get it on your skin or to inhale it. If you do get it on the skin, then wash it off as soon as you can. If it gets into a cut or graze, wash very thoroughly, and treat by normal first aid; get it inspected by a doctor to check that it will heal properly. You should also see the doctor if you inhale any of the substance, and we would suggest going along to the casualty department of the local hospital without too much delay.

### Trees as aerial towers

Unfortunately there are very few of us who have such a large expanse of land that we are able to choose exactly what aerials we would like with no consideration for size, looks and so forth.

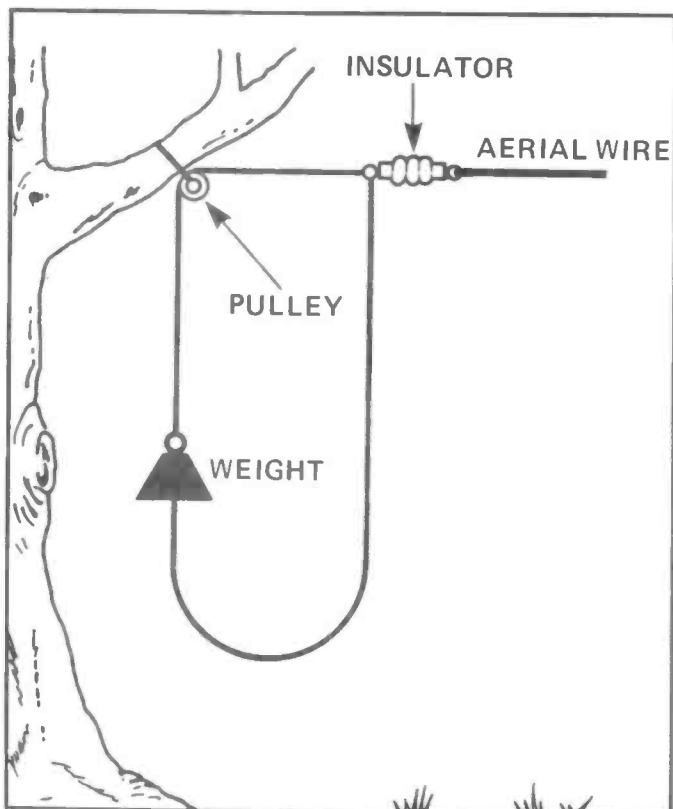


Fig. 4 One method of anchoring an aerial to a tree.

For most of us aerial design is a matter of fitting the proverbial quart into a pint sized pot — or worse. As well as space there are other points to consider too, visual impact and what the spouse will say being major factors! Therefore wire aeriels attached to various anchorages such as the chimney or another suitable part of the house and suitably located trees are the norm for most of us.

The use of trees is fine in many circumstances. However, radio amateurs being what they are will try to get the aerial anchorage as high as possible in the tree, and trees being what *they* are will bend in the wind and more so higher up. So a suitable method of overcoming the movement of the tree and keeping the aerial taut has to be found.

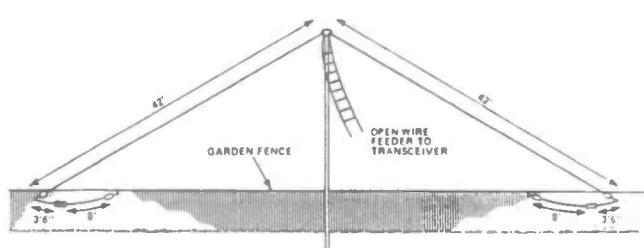
One suitable method is shown in Figure 4. In this system a weight is used instead of a fixed anchor at the end of the line; provided that the pulley causes no undue friction the tension in the aerial will be equal to the weight. Therefore regardless of the movement of the tree the aerial will always have the same degree of sag.

When choosing the weight it should be made heavy enough to keep the aerial taut but not so heavy that the aerial is placed under undue strain with the possibility of failure. In addition, when choosing the point in the tree to anchor the pulley it should be ensured that it is suitably free from nearby branches or other obstacles which may foul the system.

# HAM

# RADIO TODAY

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## 160m ON A POSTAGE STAMP

Sometimes you *can* get a quart into a pint pot, if you really try. Consultant Ed, Steve Ireland G3ZZD, gets out his shoe-horn ready for 1.8MHz working.

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**FT290R** Sommerkamp all mode transceiver as new, boxed, little used with instruction manual, ni-cads, case, charger HB9CV. £200. Tel: 061 681 2141.

**SONY ICF2001** receiver 150KHz-30MHz, AM-SSB 76-108MHz FM, scan, direct entry, memories etc, little use, £145. C. Hughes, 6 Woodpecker Close, Sundorne Meadows, Shrewsbury SY1 4UB. 0743 241194 after 1900 hrs.

**VINTAGE** radios and Hi-Fi, also quantity of test equipment plus hundreds of magazines going back to the 1920's. Tel: 01 462 4614 for lists, anytime.

**CB/HF HARRIER CBX** £10, PWR/SWR meter £5, frequency counter £10, Tagra 4 element beam £15, Electronica Mk1 £10, H/gain S/rod £10, Commodore Vic 20, Tandy TRS 80 — Offers? WHY? in Ham? Mark, 051 423 2783.

**DELTA 1 934** transceiver, pre-amp beam, colinear, excellent condition, little used, £397. Tel: 083 787 338. (Devon)

**TEN FM** converted CB JWR M2 same board as Icom and DNT/LCL, good working order, superb audio, £25 or might P/X for Trio 2300 plus cash, WHY? (2m/70cms) Have Rigonda Bolshoi radiogram chassis for components, any offers? Tamworth (0827) 58004.

**SONY AIR-7** receiver, bought from Sony, with mains PSU, £170. Tono 550 RTTY, CW terminal unit, £180. Tel: (0772) 704009 evenings.

**FT290R**, FP80A PSU, FL2010 Lin, £335. FT790R, £225. SMC HS-8400 scanner, £120.

**FT708R** 70cms h/held, £175. Eddystone 8400RX, £60. R1155RX+PSU, £45. W+D ATV TX 10 watt, £50. Dragon 32 computer + RTTY terminal, £100. V reg Garelli moped, £65. Tasco 60mm telescope, £35. Brian, 0278 685206 (Somerset).

**ICOM 3200** dual band FM mobile with dual band antenna, mint condition, with original packing, £140 ono. Power supply 13.8V 30A, offers? Complete RTTY station, BBC-B, sideways Rom, including RTTY, monitor, quality printer, terminal, valued £940. Sell £850. 0227 276004.

**ORGAN** generator PCB 8" x 4" 96 note 5 footages + 5 drawbars, £40. Post paid. FRG 7700+memory, slight readout fault, offers? Seon Smythe 0436 71181.

**TRIO R2000** plus VHF converter, £375. Also AR2001 scanner, £250. Phone Birmingham 021 747 8004.

**PANASONIC RF3100** receiver covering 150KHz-30MHz, full digital readout and includes USB/LSB narrow and wide AM plus VHF/FM 88-108MHz. 240V AC or internal batteries, bargain, £120. Call Colin, Melton Mowbray 64287.

**FT980**. All band transceiver, mint condition with manual, £900. Tel: East Grinstead 312374.

**MONITORSCOPE** Yaesu Y0301 for sale. Excellent condition, boxed, instruction manual — need cash for rotator, £200 ono. Tel: Cairnryan 202, after 6 pm. E. Gaston.

**MARINE** receiver 1.6 to 3.8MHz, 600KHz to 1600KHz, 150 KHz to 425 KHz. All transistor, 24V operation, £30. Valves,

EL95, 5763, 12AT7, 12AX7, EF80, EF91, QV03/12, ECL86, QV03/10, EZ80, QV08-100B, many others, half price. KW2000E manual £2.50. Transformer, new, 1250-0-1250 1000-0-1000 300 m/a, offers? 0268 792079.

**BROTHER M-1109 DMP** (NLQ) with RS232 and Centronics interfaces, boxed with manual, only 5 months old £180 ono, Tektronix T-932A oscilloscope, 35MHz dual trace with manual, £180 ono, Tektronix 1A2 plug-in unit in vgc, £50 ono. Tel: 01 471 0669 after 6 pm, ask for Danny.

**T1154** Sale or exchange for useful ham gear. G4POE QTHR Tel: Leek 381308.

**SHACK** clearance. VHF aircraft converter, intercom, B&D drill, PSU 3-9v 400M/A, Sony stereo mic plus 8 mono asst, multimeter, timeswitch, transistor, sound mixer, infrared wall heater, valves, other bits. Roy GOEWC QTHR, £25 the lot or split. Bristol 776891.

**MICROWAVE** modules 70cm amp MML432/30-L one year old, little use as new 1 or 3 in 30W out, list £169, offered at £110. G4WLD, John 0185 8096.

**TRIO 830S** as new, used mostly on receive, boxed, can be seen working, £725. Genuine reason for sale by licensed amateur. Tel: 061 653 7525.

**MOSLEY TA33JR** 3 ele, £80. Hygain 18AVT/WB-A 5 band vert, £75. Hidaka VS-41 4 band HF vert, unused, £65. Icom 202 2m SSB transceiver, £90. All boxed, plus manuals, Halli-crafter Sky Champion plus manual, £20. G2AQJ. 0722 25929.

**TRIO R600** gen cov RX-150KHz to 30MHz, digital display, AM/SSB/LSB + FM fitted, will accept £230 ovno (good cond). 9 Brandywells, Kingsnyp-ton, Umerleigh, N/Devon EX37 9SP.

**TRIO R1000** General coverage receiver, mint. £200. KW2000B unused since KW overhaul, immaculate £230. AR88D working, dirty, £25. Valve voltmeter Kent M22, £30. Testset LCR 373A, £30. All with manuals, dummy load, 120W 50 ohm, £12. Slate microphone base, £12. Kirkby, Cumbria 0229 89 635.

**FDK 700E** 2m FM M/rig M/Brkt, h/book, 5 3/13 Yagi, CO80 a/matcher, AEC 50, SWR, p/meter, o/set, t/burst, 0-25W. £175 ono will split or swap + cash for FC102 FTV102DM. Tel: Brian G1UWV 0425 6715860.

**SOLARTRON PSU** 6.3v 0-500v as new, boxed VCR97 tube, wavemeter W1117. R1155 Jayswitch, type 115 PSU for R1155/54 generators. Control box MN26. TU6B tuner may exchange for TU10B. R1355, mains conversion, with RF26, mint RA1B. Wanted: BC 348 with or without dynamotor if front panel is alright. 52 Bramble Lane, Mansfield, Notts.

**NATO 2000** will convert to 10MHz, open to offers. Wanted: FM 27MHz of good quality, also speech processor, Yaesu 7700 or equivalent. Tel: 0283 221870.

**HF station** FT707, FC707, FP707, £525. Strumach veratower SP60, never erected, brake winches, cables, ground post. £475. Reason for sale. Tel: Dun-cocher 74530 GMOFHJ.

**YAESU FT708R** 70cm FM transceiver, 10MHz coverage, 25KHz or 50KHz steps, 10 memories. £200 ono. Tel (0273) 418345.

**KWM2** army technical manual, £7. Swan 350, £5.50. Hallicrafter SX28RX £5.50. Drake TR4CW, £6.00. Drake TR7, £6.50. Swan 100TX, £6.50. CR100 £5.50. Atlas 359 XL, £7.00. AR88D, £5.50. AR88LF, £5.50. Photostat manual copies, printers folder. Yaesu FT102 transceiver, mint, all filters fitted. £595. G3HID. 0278 782511.

**SCANNING** service manuals for sale — AOR 2001, AOR 2002, Regency MX 5000, MX 7000, SX 200N, Yaesu FRG 9600, Tandy Pro30, Pro31, Pro32, Pro2021, Trio rigs TH21E, TH41E. Ring for copy. Anytime 0473 85526. Please add postage.

**RTTY TU, ST5MC**, as new £100. Also GW4WRD RTTY program on tape, for BBC-B, £10. Also technical software TX-3 RTTY/CW/ASCII transceiver program, £15. Tel: Eddie, GW40MF 0544 267140 after 7 pm.

**RTTY TU, ST5MC**, as new £100. Also GW4WRD RTTY program on tape, for BBC-B, £10. Also technical software TX-3 RTTY/CW/ASCII transceiver program, £15. Tel: Eddie, GW40MF 0544 267140 after 7 pm.

**TS530S** HF transceiver CW filter fitted with AT230, excellent cond, £595. FT707 160m and FM fitted also FC707, FU707-DM, FP707, prefer no split, £585. FT208R handheld with charger and case, £180. Call Ian on Horsham 0403 68765.

**NOVEX** 12/500MG video monitor, 250V AC 50Hz 35W with composite video input design for data display applications, contrast, brightness, v hold, h/hold, controls, £50 ono, cash sale, buyer collects. Tel: 0245 356531.

**FT290R, FP80A** PSU, FL2010 Lin, £335. FT790R, £225. SMC HS-8400 scanner, £120. FT708R 70cms h/held, £175. Eddystone 8400 RX, £60. R1155 RX+PSU, £45. W+D ATV TX 10 watt, £50. Dragon 32 computer + RTTY terminal, £100. V reg Garelli moped, £65. Tasco 60mm telescope, £35. Brian, 0278 685206 (Somerset). **PANASONIC RF3100** receiver covering 150KHz-30MHz, full digital readout and includes USB/LSB narrow and wide AM plus VHF/FM 88-108MHz. 240V AC or internal batteries, bargain, £120. Call Colin, Melton Mowbray 64287. **MARINE** receiver 1.6 to 3.8MHz, 600KHz to 1600KHz, 150 KHz to 425 KHz. All transistor, 24V operation, £30. Valves, EL95, 5763, 12AT7, 12AX7, EF80, EF91, QV03/12, ECL86, QV03/10, EZ80, QV08-100B, many others, half price. KW2000E manual £2.50. Transformer, new, 1250-0-1250 and 1000-0-1000 300 m/a, offers? 0268 792079.

**RECEIVER. NRD-525** with matching speaker, NVA-88, £950. Could deliver, Midlands. Tel: 0604 718707.

**BLAST** for Spectrum 48K, basic to machine code compiler, plus much more, cost £24.95 new, will accept £10. Also Speech for Spectrum 48K, no hardware needed, program on cassette for £3.95. Howard Jones, 120 Kingfisher Way, Upton, Wirral L49 4PS.

**COMMODORE C16** computer, books, tapes, data cassette, good condition, had very little use, £40. Would exchange for Search SR9 on 2m or air band or a similar monitor receiver. Phone Deeside 816435, anytime.

**BARGAIN** Yaesu FT77 HF rig, vgc, £360. Ten tec HF ATU, £40. Welz power+ VSWR meter, £38. Jay-beam tri-band dipole, £40.

Trio receiver, £30. Heathkit scanner 50MHz-500MHz, £90. D. Paine, 8 Bramble St, Burnley.

**TS530S** HF transceiver CW filter fitted with AT230, excellent cond, £595. FT707 160m and FM fitted also FC707, FU707-DM, FP707, prefer no split, £585. FT208R handheld with charger and case, £180. Call Ian on Horsham 0403 68765.

**NOVEX** 12/500MG video monitor, 250V AC 50Hz 35W with composite video input design for data display applications, contrast, brightness, v hold, h hold, controls, £50 ono, cash sale, buyer collects. Tel: 0245 356531.

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**TRIO 430S** 6kAM 1.8 SSB filters fitted also F.M. Module Mc60A desk mike unmarked con-DX used mainly S.W.L. cost new £1,140 asking £750 incl MC42S mike/M p/cable. Want trio TS820.RX, BRT400. Rascal 197. POCOM 2010 RTTY unit. Milton Keynes 313507.

**YAESU FT101ZD** mint condition 11m-45m fitted professionally £375. Mick Davies 586 9851, daytime — \$ 904 7420, evenings.

**NPR 934MHz** commtel transceiver brand new never used with scanning microphone cost £475 lost interest in radio £325 ono Crest AP205 twin input, masthead amp new £135 secondhand sky-king rotator as new £30 — Worksop 0909 481552.

**APPLE II Europlus**, two disk drives, monitor, printer, 80 column card, grappler, ramex, microsoft card, tabs, apple clock, centronics printer card, parallel interface, suppterminal, plus lots and lots of software sell or swap for wide range scanner. Vicki 882 8661 X302.

**VHF RX 26-30 54-176 MHz** £20. SWR/PWR/F.S. meter HF/VHF £8.50. Freq. meter 500 MHz £40. Home brew

scope £20. Video camera power supply/adaptor, £25. L.C.R. bridge £14; transistor tester (HFE) £9. Valved R.F. signal generator, £15. Home brew two-tone osc £7. low pass filter £3 — 01 907 2253. **YAESU ft101E G3LLL** FM (worth £70) new valves mint cond fan mic speech-proc bargain £325 ovno. G1ULV 0209 714342, after 6pm.

**TRIO TS-820 S** transceiver AT-200 tuner TV-502 transverter SP-820 speaker £650 yaesu ft-7B mobile transceiver with YC-7B display £250 trio dip meter DM-800 £45 eddystone receiver EC10 £45 AVO8 £50 Scopex 4D10A £85 all working order. Jim, 0707 874245 (Herts).

**HONEYWELL** 132 column 150 CPS RS232 dot matrix printer £125 ICL termiprinter 118 column RS232 £65 Scotch DC300A cartridges £15 AMD9511 arithmetic processors £95 wanted counter plug-in adaptor HP10536A, converters HP5254B, HP5255B — 07842 51409, after 7pm.

**AMSTRAD 464** CPC computer with colour monitor + boss joy stick around £300's worth of games. All together £600's worth, sell at £399 ovno. 12 Pleasance Road, Putney, London SW15 5HP.

**SONY Air7** receiver bought November 1986 from Sony, £170. Tono 550 terminal for RTTY C.W. Good condition, £180. (0772) 704009, eves.

**FOR sale FT290R** boxes nicads case communique SWR/FWR meter both mint condition LW8 beam, £250; Phillips BW monitor model LDH2123, new, unused, £100 ono. Sheffield 0742 583799, after 6pm.

**SONY ICF2001**, £75, Spectrum plus and datacorder £65, standard C58 with various accessories £335 **YAESU FT2F** xtalled two metre transceiver £50 technical software logbook for spectrum £5, mike G1-XGM. 01 671 3545, anytime.

**SALE.** Valves, boxed, unused, 50L6GT, 35L6GT, 2525GT, 3525GT, 3425GT, 2524GT, 125J7GT, 12J7GT, 12Q7GT, 125Q7GT, 65K7GT, 6Q7GT, G5Q7QT, 6A7GT, 6L7g, 6F9G. Many others, all at low



prices, final clearance. Wanted AR88D for spares. A. E. Jeffrey, 42 Dennis Road, Padstow, Cornwall PL288DF. **YAMAHA** PF15 electronic piano, mint condition, rarely used, original price £1000 will sell for £500. Garo, 01 4993500.

**FOR** sale Phillips D2999 world radio, 1.6 2999 MHz L/W M/W FM, digital readout, keyboard or manual tuning, clock, batt, or mains, mint, boxed with manuals, £160ono. 091 5267902.

**TEKTRONIX** 547 50 MHZ oscilloscope 1AE dual trace plug-in unit, 1A4 quad trace plug-in unit, + manuals, leads and trolley, all calibrated and in G.W.O., £300 ono. 01 4710669, after 6pm, ask for Danny.

**FOR** sale R1155N £25 R1155E £25 Bendix RA1 £20 BC 348Q £30 PCR3 £10 Grundig satellite £40 everyone must go need space or will be scrapped, prefer buyer to check and collect. Thomson, 0450 75089, southern Scotland.

**ORGAN** generator P.C.B. 8"x4" 96 note 5 footage's + drawbars £40 post paid FRG7700 + memory slight readout fault. Offers. Tel: 0436 71181. Seon Smyth.

**FOR** Sale: FT480R multimode, scan mic, mobile mount handbook plus workshop manual, only £275. Tel: 0753 28304, after 8pm only.

**934** hand set NP.900. Personal radio charger for in car use. Yaesu MH12 speaker mike, plus other extras, £450. Basildon 555 836.

**QUAD** FM3 stereo tuner quad control unit 33 quad 303 stereo amplifier, £170. Basildon 555 836.

**UNIDEN** H.F. RX. Communications receiver with P.S.U. 120v or 240v or DC.12 volts 150KHz to 29.9999KHz plus 76 to 108 MHz SSB AM FM direct entry or manual tuning with memorys with manual and box £175 or exchange UHF RX or W.H.Y. — Leon 01 785 9325. S W London.

**TRIO** T.S.700 multimode transceiver with matching mic, S.W.R. meter all XTL5 fitted loudspeaker manual all mint £250 wanted racal MA79 exciter unit G4LW. Trowbridge 3166.

**ASR33-TTY** with tape punch and tap reader, very good condition, unmodified, complete with manuals and small quantity of paper and ribbons, £30 ono. Hinckley (0455) 30669, Chris G6EYK QTHR.

**ICOM** IC25E 25 watt FM mobile HM10 mic £150 Sanyo VTC5150 beta video vgc £100 stereo five band graphic equaliser £25 microwave modules RTTy converter MM2000 £40 write no callers, 31C Anerley Park, Penge, SE20 8NF.

**H.R.O.** receiver matching speaker power supply 1.7-30 mcs coil packs + L.F. B.C. coil packs circa 1940 h/book G.W.O. C.W. 1930's head phones used daily on 160m 80m etc collectors item £100. Peter, days, 0642 456327, pref buyer collects (Cleveland) no offers.

**KENWOOD** R2000 communications receiver V.H.F. fitted £400 ovno. Medway (0634) 41191.

**FOR** sale. Icom ICR7000 communication receiver covering 25 MHz to 2GHZ complete with remote control immaculate condition £750 insurance and garr included. John G4YDM QTHR — 091 4162606.

**COMMTel** 444 base ant, 32ft vertical, never used still in boxes £40 ono K40 mobile ant, 1 month old, £20 ono K40 mobile ant, 1 year old £12 ono. Wanted 1KW dummy load. Halifax (0422) 823320, after 6pm weekdays.

**DATONG** D70 morse tutor. Also a good old fashioned up and down horse key in working order (0206) 394336 (Essex).

**FOR** sale H.F. transceiver FT707, with powerpack FP707, antenna tuner FC707 and YM36 microphone, £450ono. Ask for Kevin — Belfast 641048.

**100** watt two metre M.M. linear 13.5 volt no RX pre-amp type 144/100 £80. Wanted circuit of commtel PSU type PS 1310S. York (0904) 768545.

**TOWER** self standing lattice 40ft, £200 ono. Contact B.U. Amateur Radio Society, Brunel Univeristy, Uxbridge, Middlesex, UB8 3PH.

**FOR** sale Sony CRF320 de-luxe 32 band receiver mint

manual plus service circuit trouble guidebook manuals, buyer collects, £270. Bookham 56741, (Surrey).

**UHER** 4000 reporter professional tape recorder in de-lux case with spare microphones nicad battery and charger was almost £700 would take £400 or exchange for YAESU FT101ZD with ATU if possible. Michael — York (0904) 30883.

**YAESU** FT101 2DMK3 fitted with fan boxed with manual £450. **YAESU** FTV 901 transverter fitted 2M module boxed with manual £125. 01 394 1465 (Ewell) G6ZPS.

**RA17** MKII, good condition, manual, spare valves, £125; **KW2000A** PSV spare P.A. valves, manual, £100. Tewkesbury (0684) 296369.

**YAESU** FT790R 70CM multimode with nicads charger etc, £280 ono, six metre 5ELE tonna yagi £30, practical wireless meon six metre transverter in case, works well, £35. G31LO. Nailsworth. GLOS — 0453 83 3411.

**RECEIVER** HoweS RCDX 20M SW makers PCB in case with tuning capacitors etc £21 ono. Tony (0372) (Epsom) 26016. **YAESU** FT.290R. complete with nicads and charger 25W amp £280. 0582 660788.

**YAESU** FT726R fitted 144, 50 MHz also CW filter and MD-1 base mic, ex.cond., £775. 60ft telescopic trower base mounted, £200, 2m, xtal scanner, £50. 10m rig, £15. Lee G4RKV 0227 360841 (not QTHR) buyer collects or pays carriage.

2 meter linear 20 to 30 watts O/P for 2 tgo 3 L/P solid state £35 N.O.; 16 ele tonna 2 meter aerial £18 N.O.; Eddystone 730/4 gen cov RX in good condition £85. Mark — 01 847 3122.

**BELCOM** linear 2 handbook, circuit diagram, frequency modification ie: change channel selection from 144.100 144.330 to cover from 144.170 144.410 on TX/RX £2.50 Pye PF1 pocketphones circuit diagrams alignment info \$1.50. Co. Durham 701429.

**VALVE** radios working and complete philco 4 W/B Bush 3 W/B barker 3W/B pilot 4 W/B BUSH V.H.F. 3W/B portables mains/bat Roberts 3 W/B Pye

2 W/B Vidor 2W/B also Pye 65A requires 2V-120V valve filaments O.K. not tested. 930XY. Daventry 702265.

**YAESU** FT102 fitted AM-FM board FV102DM U.F.O. SP102 speaker above mint little used £725 prefer buyer collect Hanson P-Meter FSS0HP20/2KW £55, 2 meter transverter MMT144/28 3 months old suit above TX £75, Swedish 2 meter 3 element beam, £20. G3IJL QTHR, 01 749 1454.

**ZX81** Scarab RTTY cassette with interface ZX81 16K built as integral unit with Maplin keyboard, lot cost £96, sell £45, GIFTU RTTY cassette for 48K Spectrum. Just plug tx/rx into ear/mic sockets, cost £10, sell £5. G3EGC — Bolton 51502.

**HQI** mini beam offers around £100, also tetronic scope 454a offers. 01 931 0514, evenings GO DOE.

**AMSTRAD** CPC 464 with colour monitor plus screen designer program and some games, all in good condition, £160 — (02756) 3195.

**ICZE** charger SP/mic ¾ mobile antenna £140 ono Marconi signal generator TF144G £25 — 0582 872407, after 6pm (Whipsnade Beds).

**COMPLETE** H.F. station trio TS510 + P.S.U./speaker, mic, datong speech processor, H.B. linear, 18AVT, SWR meter £325 **YAESU** 209 synth H/H, case, FNB3 nicad, NC9C, m/charger, PA3 DC/charger YH2 M/HS GPVS co linear ¾ M/mount ¾ G/mount £275 — Morecambe (0524 414013).

**YAESU** FT709R 70CM FM handheld 4 watts output with FNB 4 nicads, CSC 11 case and YHA 44A antenna, mint condition & boxed, £225. Ken Ballance G3KNB (QTH not OK), 18 Rambleford Way, Parkside, Stafford ST16 1TW or Tel: (0785) 44964.

**STANDARD** C58 2M multimode inc mobile mount ¾ antenna + coax, nicads, charger, case, PSU SWR, meter, HB9CV coax, all you need to get on the air, the cost £250 of offers. Julian Tether, Highview, Culworth, Banbury OX172AX — (0295) 768152. **5X200N** scanning receiver VHF/UHF 26-514MHz 165.00 Sony ICF 5900W FM/AM/SW dual conversion BFO boxed, £49 — 01 657 0430.

**YAESU** FTDX560 80m-10m high power transceiver CW filter fan new PA valves including external VFO external speaker G.W.O. £220 ono. 0375 678833, Arthur, G4K1Q, Essex.

**YAESU** FRT 7700 SWL ATU VGC £30 **YAESU** FF5 filter £5 balun not used £4. (0634) 404096.

**COLOUR** monitor "System Alpmer" 14" £115 ono LDF450A new 70 feet plugs 2 plugs £75 ono LDF450A used approx 45 feet plus 1 plug £25 ono. G4NVT G35M - Basildon (0268) 46428.

**DATONG** Selcall, 2 PTS1 units £50 CTE 767 amplifier 26-30MHz 80WFM new £35 Tandy TRC1001 CB handheld nicads charger microphone rubber duck £65 rotel RVC230 CB £30 Ham International 4200 base microphone £15, buyer collects. Poole (0202) 601214, after 6pm.

**SCANNER** SX200N 26-514MHz 1 year old £170 revcone aerial to match £20 will consider P/X with 2m SSB transceiver 144-28 transverters or value AMP. Could deliver reasonable distance. G1XCO, Steve, Lincoln (0522) 750057, anytime before 10pm.

**HEAVY** duty free standing 24' lattice tower in two sections, £65. DNT 40FM converted to 10m, £25. SMC 10m whip and gutter mount, £15. J-beam 10XY 2m, vgc, £25. Wanted PSU for codar ATS - 045389 814, after 6pm.

**TS820** H.F. TCVR with DC converter, CW filter and desk microphone, £395 ovno. Cardiff (0222) 627151, weekends or evenings, GW80KR QTHR.

**40 ft** triangular steel mast in two 20ft sections + 4ft walk around at top, very good condition, never used, £150, drawing on request. Hungarton 310, G2DGA.

**ICOM** 701 with matching 20 AMP power supply and speaker desk microphone and keyboard, £525. 0782 313448.

**SWEDISH** Ericsson automatic telephone exchange 24"x12"x12" wall mount 10 lines 2 wire system multiple facilities ideal hotel/company complete with manual was £800 wanted good scanner -

H.F. - RX or Ham equipment G6KAR. 0204 43958.

**HEATHKIT** Microprocessor trainer ET3400 plus EE.3401 learning program, £300 would sell, exchange or part exchange for quality transceiver or amateur gear. 0304 282 2843, evenings.

**SAIT** V.H.F. marine transceiver 156-162 MHz 25 watts F.M., as new, with case and circuit diagram, no front panel hence £60. C.T.V.R. 40 46.0-46.39 MHz 5 watt F.M. transceiver, change xtals for 50 MHz, £60. Watford 24752.

**FREE** aerial for 70cm if you purchase my MM 432/50 70CM linear. 10W in 50W out, new, unused, £100. G3MEW. 24 Ascot Road, Copnor, Portsmouth, Hants - 0705 820315.

**TONO** Theta 350 communications computer (dedicated RTTY/ASCII) CW terminal. RTTY 45-300 BAUD auto CW 170/425/850 Hz shift VHF and composite output printer interface perfect £120. 0284 704152 (Bury St Edmunds), after 5.30pm and weekends.

**YAESU** CPU2500R 2M F.M trans, trio/Kenwood UFO120, also vic20 computer for my own collection "Dinky" "Spot-On" "Corgi" equipt vgc. Weymouth 0305 813202.

**ICOM** IC-R71/E superior grade general coverage receiver 100kHz-30MHz plus £350 extras including external speaker, remote control, filters, etc. Excellent condition £750 ono. Also Sony ICF-2001D multi-band radio, 5 year guarantee, bought August '86, excellent condition, £250. 0452 504596, evenings.

**ICOM** 271E finest 2m multimode on the market 32 memories 25W O/P 2 VFO's ex condition £650 ono wanted IC/202 IC/402 in good condition. 0924 823866.

**FOR** sale FT221 **YAESU** multimode as new seven extra crystals fitted handbook £285 datong speech processor £35 or swap AR88D W.H.Y. Gifex, 15 Woodland Grove, Mansfield, Woodhouse, Notts, NG19 8AZ. 0623 641709.

**TEN-TEC** century 22 TCVR, excellent condition, £250. GM3MXN - 0698 887176.

**ALINCO** 203E 2mtr handheld FM, nicad, charger, etc, plus

speaker mic, DC/DC converter for 13.8V operation. Very little use as new in mint condition. £200. Reason for sale passed Morse test, moving to HF. (0432) 53937, evenings.

**TRIO** R2000 mint condition going T/X £375 wanted FTio7 with memory P.S.U. or TS530SP must be mint. Nichols. 0326 290666. (Lizard).

**WARTIME** suitcase radio type A MKIII (B2 minor) or any similar type of Glandestine radio. Any condition and any literature would be welcome. G4FO - 01 949 2317.

**DL2RZ** wraase slow scan T.V. system with matching 5" monitor £195, high quality B/W surveillance camera, small, almost new, C/W lens, £55, IC202S SSB/CW 2m portable, original packing, £95 - 0793 771153.

**B.C.348.** Receiver adapted to mains 240V operation £25. Geoff GOGLW - 0344 52601.

**HEATHKIT** HWY DRP rig £35. GW3YGM - 0437 2015, evenings.

**SONY** ICF7600D compact portable shortwave radio 153kHz-30MHz AM FM/SSB/CW 10 memories with all manuals, accessories, etc, unwanted gift, all boxed, as new, £99. Blackburn, Lancs (0254) 28969.

**YAMAHA** PF15 electronic piano, mint condition, rarely used, original price £1,000, will sell for £500. - Garo 01-499 3500.

**FOR** sale Phillips D2999 world radio, 1.6 2999 MHz, L/W, M/W, FM, digital read out, keyboard or manual tuning, clock, battery or mains, mint boxed with manuals, £160 ono. - Tel: 091 5267902.

**TEKTRONIX** 547, 50MHz Oscilloscope, 1A2 dual trace plug-in unit, 1A4 quad trace plug-in unit, plus manuals, leads and trolley, all calibrated and in good working order, £300 ono. - Tel: 01-471-0669, after 6pm, ask for Danny.

**FOR** sale R1155N, £25; R1155E, £25; Bendix RA1, £20; BC348Q, £30; PCR3, £10; Grundig Sattelit, £40. Everyone must go, need space or will be scrapped. Prefer buyer to check and collect. - Ring Thomson 0450 75089 Southern Scotland.

**YAESU** FL2100Z linear with two new spare valves, buyer to collect, realistic offers please as sale prompted by impending O.A.P status. Allen G3DRN QTHR - 01 947 3914.

**FT77** with FM £400 or exchange for FT101ZD with FM plus cash adjustment. G4JNW - Scarborough (0723) 366360.

**EDDYSTONE** 1830/1 professional HF/MF receiver civil aviation spec. 10D/CA.10696. British MPT sapec. for Marine reserve receiver. 120 kHz-31 MHz 9 bands C/W plinth speaker, A.T.U. extensive technical library, £650 or exchange quality open reel tape deck. Langport 250235.

**FT101ZD** 6 band fan mic manual vgc un-marked, orig pkg £425 incl carriage. GOAWZ. Dave. York (0904) 424817.

**HF5** 80-10 metre vertical aerial, used one week, cost £83, sell £45. Rotherham 850517.

**ORGAN** generator, P.C.B, 8" x 4", 96 note, 5 footage's plus 5 drawbars, £40 post paid. FRG7700 and memory, slight read out fault, offers. - Tel: 0436 71181, Seon Smyth, "De Porres", 67 East Princess St., Helsenburgh G847DG.

**FOR** sale, FT480R Multimode, scan mic, mobile mount handbook, plus workshop manual, only £275. - Tel: 0753 28304, after 8pm only.

**TRIO** 430S 6KC AM, 1.8 SSB filters fitted, also FM module MC60A desk, mike unmarked, condition used mainly SWL, cost new, £1,140, asking £750 inc MC42S mike /M psucable. Wanted Trio TS820RX, BRT400 Racial 197. Pocom 2010 RTTY unit. -Milton Keynes 313507.

**YAESU** FT101ZD, mint condition, 11M-45M fitted professionally, £375. -Tel: Mick Davies, 586 9851 daytime, 9804 7420 evenings.

**NPR** 934MHz Commtel transceiver, brand new, never used with Scanning microphone, cost £475. Lost interest in radio, £325 ono. Crest AP205 twin in put masthead, amp new, £135. Second hand Sky-king rotator, as new, £30. - Worksop 0909 481552.



**SALE** valves, boxed, unused 50L6GT, 35L6GT, 2525GT, 3525GT, 3425GT, 2524GT, 12SJ7GT, 12J7GT, 12Q7GT, 12SQ7GT, 6SK7GT, 6Q7GT, 6SQ7GT, 6A7GT, 6L7G, 6F96. Many others, all at low prices. Final clearance. Wanted AR88D for spares. — A. E. Jeffrey, 42 Dennis Road, Padstow, Cornwall PL288DF. **TRIO** TS-820S transceiver, AT-200 tuner, TV-502 transverter, SP-820 speaker, £650. Yaesu FT-7B mobile transceiver with YC-7B display, £250. Trio dip meter, DM-800, £45. Eddystone receiver, EC10, £45. AVO 8, £50. Scopex, 4D10A, £85. All working order. — Jim, 0707 874245 (Herts).

**FOR** sale FT290R, boxed Nicads case, communicate SWR/FWR meter, both mint condition, LW8 beam, £250; Philips BW monitor model LDH2123, new unused, £100 ono. — Tel: Sheffield 0742 583799, after 6pm.

**SONY** ICF 2001, £75. Spectrum plus and dataorder, £65. Standard C58 with various accessories, £335. Yaesu FT2F xtald two metre transceiver, £50. Technical software logbook for Spectrum, £5. — Mike, G1-XGM, 10 Doverfield Road, Brixton, London, SW2 5NB. 01-671 3545 anytime.

**VHF** RX 26-30, 54-176MHz, £20. SWR/PWR/FS meter HF/VHF, £8.50. Freq. meter 500 MHz, £40. Homebrew scope, £20. Video camera power supply/adaptor, £25. LCR Bridge, £14. Transistor tester (HFE), £9. Valved RF Signal generator, £15. Home brew two-tone osc, £7. Low pass filter, £3. — Tel: 01-907 2253.

**YAESU** FT101E G3LLL FM (worth £70). New valves, mint condition, fan mic speech-program, bargain, £325 ovno. — Tel: G1ULV 0209 714342, after 6pm.

**ASR33-TTY** with tape punch and tape reader, very good condition, unmodified, complete with manuals and small quantity of paper and ribbons, £30 ono. — Tel: Hickley (0455) 30669, Chris G6EYK QTHR.

934 hand set NP-900, personal radio charged for in car use. **YAESU** MH12

spoeker, mike, plus other extra's, £450. — Tel: Basildon 555 836.

**QUAD** FM3 stereo tuner, quad control unit, 33 quad, 303 stereo amplifier, £170. — Tel: Basildon 555 836.

**APPLE II** Europlus, two disk drives, monitor, printer, 80 column card, grappler, ramex, microsoft card, tabs, Apple clock, centronics printer card, parallel interface, superterminal, plus lots and lots of software, sell or swap for wide range Scanner. — Vicki, 882 8661 ex 302.

**HONEYWELL** 132 column, 150 CPS RS232, Dot Matrix printer, £125. ICL Termiprinter, 118 column RS232, £65. Scotch DC300A cartridges, £15. AMD9511 Arithmetic processors, £95. Wanted counter plug-in adaptor HP10536A, converters HP5254B, HP5255B. — 07842 51409, after 7pm.

**HONEYWELL** 132 column, 150 CPS RS232 Dot Matrix printer, £125. ICL Termiprinter, 118 column RS232, £65. Scotch DC300A cartridges, £15. AMD9511 Arithmetic processors, £95. Wanted counter plug-in adaptor HP10536A, converters HP5254B, HP5255B. — 07842 51409, after 7pm.

**AMSTRAD** 464 CDC computer with colour monitor plus Boss Joy stick, around £300 worth of games. Altogether £600 worth, sell for £399 ovno. — Mr Brydges, 12 Pleasance Road, Putney, London SW15 5HP.

**SONY** AIR7 receiver, bought November 1986 from Sony, £170. TONO 550 terminal for RTTY CW, good condition, £180. — Tel: (0772) 704009 evenings.

#### WANTED

**WANTED** circuit of Commtel PSU type PS 1310S. — Tel: York (0904) 768545.

**WANTED** Nato 2000, £90-£100 paid for one that has not been tampered with. Urgent 0283 221870 any equipment for Spadoric E?

**FOR** sale YAESU FTB7, offers over £275. — 0283 221870. **YAESU** NC15 base charger, must be in good condition, also PA3 mobile Pioneer unit. — Tel: 0905 620041 anytime or

leave a message on Prestel mailbox number 219999979.

**WANTED** Belcom LS102 TCVR. Must be in very good condition, no mods. — Tel: Mark at Belfast 795783.

**WANTED** GELOSO VFO unit type 4/104. Dial assembly not strictly necessary but would take both if owner wishes to sell complete. Details: Price/Postage please phone: Doug on Bristol 0272 642101. **HAVE** been saving the pennies and would like an Icom IC-735 rig, IC-PS55 PSU and Capco SPC 3000 ATU. Items must be clean, in full working order and reasonably priced. — Dunstable (0582) 600033.

**WANTED** Linear amp HF commercial or VG homebrew, also receiver for HF. Exchange perfect FT757GX for FT902 or TS8305. For sale 2 mtr MM Linear amp 10 in 40 out. Wanted Shure 526 microstore or similar. Scarisarick 880345 (Southport area).

**WANTED** circuits and any information or Weston analyzer model E772. Eagle transistor tester model TT144 Nombrex C/R bridge model 32 Taylor test meter model 425. Tel: 0795 876374.

**WANTED** 2m FM TX or RX, and cheap 48K Spectrum computer. — Tel: 0631 65104 (Mon-Fri), M. Maccusit, 3 Burnside Place, Oban Argyll PA344JZ.

**WANTED** manual for YAESU FT1012D buy or photocopy your price paid. — Pat 0322 529967.

**WANTED** "Carrying Handle" for Barlow - Wardley receiver XCR30 Mark 2. I have broken mine. — Alan Edwards, 32 Heldhaw Road, Bury St Edmunds, Suffolk. IP32 7ES. Tel: (0284) 60984.

**WANTED** hardware and software for Apple II plus computer to receive RTTY. Also interface etc for the Apple to link to Prestel via Prism 1000 model. Also good compatible printer, letter quality type. — Tel: John (Aberdeen) (0224) 589440.

**WANTED** Cybernet "export" service manual by Lou Franklin. Also detailed information on how to convert Ham Multimode 2 to 10m or anybody locally who could do this for me. — Tel: 0603 614772, 27 Marion Road, Norwich NR1 4BN.

**WANTED** YAESU FT757GX plus FT757HD PSU. Rig must T/X on 11 metre band. Will consider mint Belcom LS102 with 26 to 30 MHz cover. Must be able to part exchange. Ham International Multimode 3 mint with UK40 Factory Board. — Tel: Steve on 0446 710149.

**WANTED** urgently, mobile HF transceiver, all bands ATU, mobile HF whips. — Tel: 0753 28304, after 8pm only.

**WANTED** Collins TCS12, TX and RX PSU and any other accessories, good price paid. — Tel: Tim, 01-530 5937.

**WANTED** HF transceiver, possibly TS520, FT707, FT101 or similar. Must be excellent working order with decent ATV etc. Will pay cash or possible exchange for my FT290R with 25watt Linear and PSU. G8WSK. Portsmouth 0705 672804 (collect 40 mile radius).

**WANTED** manuals for Samwell Hutton Wobulator type 78. Bradley electronic Testmeter CT471. GIFEX 15 Woodland Grove, Mansfield Woodhouse, Notts NG198AZ 0623 641709.

**WANTED** WW2 German radio radar equipment, parts literature. British T1190 WS65 SW66 R208, Electra, remote control units, C-D-F-H, apparatus loudspeaker No 3, No 2, telephone set T AD67 for museum purposes only. Collecting UK. Offering cash or equipment swap. Collins 51JY, Siemens 311 Top-Of-The-Line GC-RCVRS WS1938. Tel: 010 752 801895.

**WANTED** 19 set control box, variometer and other accessories WHY? (restoration project). Also R210 power supply units. 01-300 1894 evenings, weekends.

**BELCOM** LS202E handheld wanted will exchange YAESU FT208R handheld 2½ w output can be turned up to approx 4½-5w output want plans circuit diagrams for valve VHF/UHF. Linear. — Tel: Co Durham 701429.

**WANTED** YAESU 7700 or Trio 2000 for SWL. 01-556 5131 anytime.

**WANTED** oldish HF transmitter or transceiver in good working condition with CW and perhaps AM or SSB. — Tel: (0425) 54371.



**EXCHANGE**

**EXCHANGE** ICOMIC210 FM base station, ¼-10w removeable PSU for mobile use, ¾ over ¾ colinier. For FT707, FT77 or Simular MF multiband transceiver. Telford (0952) 607542 after 6pm.

**EXCHANGE** ST5MC Ritty terminal unit for a Storno channel synthesised radiophone. Tel: 021 788 8447.

**EXCHANGE** SEM 100w Linear/pre-amp and micro professor computer. 64K compatable Apple II progs with PSU manuals. For ICOM 402 70CMS SSB rig or linear only, for 70CMS to 2 meter transvertor please ring Alan, Kings Lynn 829075.

**EXCHANGE** Ham International Concorde Mk2 converts easily to ten metres, three bands, box etc. GWO for Atari 1050 disc drive with software also Skywood HF receiver, £50. Tel: 031 663 2460.

**EXCHANGE** all or part of my Apple 11+/E software collection, mainly printer, graphics utilities eg. Printship, newsroom, fontrix, sideways etc. Valued over £200 for 100w 2 metre Linear. D. J. Bull G6LPH. 103 Hawthorn Hill, Middle Wallop, Nr Stockbridge, Hants, 5020 8NG.

**EXCHANGE** industrial video Grundig SUR4004 not VHS or Betamax working good for parts band 1 and 3 tuners plus VHF with pre amps and lots of electronic goodies swap for 200MHz and freq counter or good signal generator or 15MHz scope buyer must collect for details ring Andy 061-775 5207.

**EXCHANGE** Datong horse tutor plus Trio 9R-59DS general coverage receiver for ATU to suit KW200B will consider home brew. Tom 0289 88348 ask for Tom.

**HAVE** Sommerkamp FT290 Nicads charger and case ¾ x whip Gamma twin 13 element Tonna Toyo SWR meter would consider suitable 934MHz equipment Cybernet Delta 1 NPR and any accessories. Also have FRG-7 TRIO 9R59DS. Phone Ian 0676 40744, after 6pm weekdays anytime Saturday.

**US** Army signal corps frequency meter 125KC - 20MC type BC221AA original box with power supply space crystals also calibration chart swap for good ATU suitable for SWL - Tom 01-803 3844 (London).

**EXCHANGE** Viewdata Prestel terminal, with BT approved, 7" green screen, removable keypad, built in auto-dialler, printer interfaced, computer interfaced, modifiable to use a RS232 terminal, can be used as a computer monitor, key operated on/off switch, Prestels mailbox, made at Brighton by STC Novatel. Coat £1,500. I want VHF Scanning receiver, or 2 meter rig. Brian, Brighton 5599373.

**EXCHANGE** Sony 7600D, in excellent condition for Trio 600 YAESU FR67 or R1155 with PSU please ring John, Tel: 0670 87561 or write John Taylor, 8 Kenmore Road, Swarland, Northumberland.

**EXCHANGE** Tono Theta 350 communications computer (dedicated RTTY/ASCII/CW terminal) with auto CW, 45-300 Baud RTTY, 170/425/850Hz shift, VHF and composite output, printer interface, for Commodore 64 computer plus recorder. Tel: 0284 704152 (Bury St Edmunds) after 5.30pm and weekends.

**EXCHANGE** 48K Spectrum with micro drive and interface 1 with all leads books and two games, cassettes all boxed. For either an FP707, FV707DM, FC707, FRB707 or an FTV707 with modules. Contact Mr J. D. Bolton, 10 Bonness Road, Coniston Park Estate, Timperley, Cheshire WA15 7YA.

FT107 (QRO), IC260 A or E, IC255E, FT707, FTV707 TxVtr do you have any of the above in perfect condition. Please contact Mark, QTHR G4RGB. Tel: Medway (0634) 30822. Must be reasonably local.

**HAVE** sommerkamp FT290 nicads charger and case ¾ x whip gamma twin 13 element tonna toyo SWR meter would, consider suitable 934 MHz equipment cybernet delta 1 NPR and any accessories, also have FRG-7 trio 9R59DS. Ian, 0676 40744, after 6pm weekdays, anytime Saturday.

**EXCHANGE** YEASU 290R with Mutex and mains power and charger. for Yeasu 707 with mains PSU or YEASU 77 with PSU. L HARE GOFYK 4 Mount Park Road, Scarborough, Nth Yorks YO12-5HD. Tel: 373655.

**WANTED** FRG9600 AR2002 Regency MX-8000. I have to exchange C64 computer 1541 drive 1525 printer Sony ICF7600. Lynx computer WHY. - 0622 850240, Mon - Fri before 7pm only.

**EXCHANGE** viewdata prestel terminal with BT approved 7" green screen, removable keypad, built in auto-dialler, printer interfaced, computer interfaced, modifiable to use a RS232 terminal, can be used as a computer monitor, key operated on/off switch, prestels mailbox, made at Brighton by S.T.C. Novatel. Cost £1,500. I want V.H.F. scanning receiver or 2 meter rig. Brian, Brighton 559373.

**EXCHANGE** Sony 7600D in excellent condition for trio 600 Yaesu FR67 or R1155 with P.S.U. John, 0670 87561, or write John Taylor, 8

Kenmore Road, Sarland, Northumberland.

**EXCHANGE:** Tono Theta 350, communications computer (dedicated RTTY/ASCII/CW terminal) with auto CW, 45-300 baud RTTY, 170/425/850Hz shift, VHF and composite output, printer interface, for Commodore 64 computer plus recorder. Tel: 0284 704152, after 5.30pm and weekends.

**EXCHANGE:** 48 Spectrum with micro drive and interface 1 with all leads books and two games, cassettes all boxed. For either an FP707, FV-707DM, FC 707, FRB-707 or an FTV-707 with modules. Contact via QTHR.

**EXCHANGE:** Yeasu, 2.90.R with Mutex and mains power and charger. For Yeasu 707 with mains P.S.U. or Yeasu 77 with P.S.U. L Hare GOFYK. Scarborough 373655.

**SWAP** Selmer treble bass 50 amplifier with Reverb Selmer 18" speaker cabinet Fender strat copy guitar sure Mike boom stand for HF transceiver or 2 meter rig WHY. Tel: York 782554.


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	TOTAL inc. VAT	POST RATE
MML144/30-LS 2m 30W Linear, 1 or 3W input	98.90	B
MML144/50-S 2m 50W Linear, 10W input	106.95	B
MML144/100-S 2m 100W Linear, 10W input	149.96	C
MML144/100-HS 2m 100W Linear, 25W input	159.85	C
MML144/100-LS 2m 100W Linear, 1 or 3W input	169.97	C
MML144/200-S 2m 200W Linear, 3, 10, 25W input	369.84	D
MML432/30-L 70cm 30W Linear, 1 or 3W input	169.05	C
MML432/50 70cm 50W Linear, 10W input	149.50	C
MML432/100 70cm 100W Linear, 10W input	334.65	D

#### TRANSVERTERS

MMT144/28 2m Linear Transverter, 10W o/p	139.84	B
MMT144/28-R 2m Linear Transverter, 25W o/p	289.80	B
MMT432/28-S 70cm Linear Transverter	195.50	B
MMT1296/144-G 23cm Linear Transverter	258.75	D
MMX1268/144 1268MHz Transmit Up-Converter	195.50	D
MMT 220/28 220MHz Transverter 15/output	139.84	B
MMT 50/144 6m Linear Transverter 20W o/p	289.80	B

#### MICROPROCESSOR

MM2001 RTTY to TV Converter	188.83	B
MM4001-KB RTTY Transceiver with keyboard	299.00	D
MMS1 The Morsetalker	129.95	B
MMS2 Advanced Morse Trainer	168.82	B

#### ATV

MMC435/600 70cm ATV Converter, UHF output	35.65	A
MTV435 70cm ATV 20W Transmitter	197.80	B

#### CONVERTERS

MMC50/28 6m down to 10m Converter	37.95	A
MMC144/28 2m down to 10m Converter	37.95	A
MMC432/28-S 70cm down to 10m Converter	44.85	A
MMC432/144-S 70cm down to 2m Converter	44.85	A
MMK1296/144 23cm down to 2m Converter	129.95	B
MMK1691/137.5 1690MHz WX Satellite Converter	144.90	B

#### PRE AMPS

MMG144V 2m RF Switched GaAsFET Preamp	37.95	A
MMG1296 23cm GaAsFET Preamp	74.98	A
MMG1691 1690MHz GaAsFET Preamp	129.95	B

#### OTHER PRODUCTS

MMD1500P 1500MHz Divide by Ten Prescaler	119.60	A
MMR3/25 3dB 25 Watt Attenuator	19.78	A
MMR7/3 7 dB 3 Watt Attenuator	19.78	A
MMR15/10 15 dB 10 Watt Attenuator	19.78	A

Postage/Packing Charges:(inc VAT)

A = 2.35 C = 5.60  
B = 4.91 D = 6.98

DURING THIS YEAR OUR TEAM WILL BE FOR MORE CLUB LECTURES. TO BE SURE THAT WE DO NOT MISS YOURS PLEASE RING MICK, G4EFO, ON 0403 730 767.



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.**