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SCANNERS

HAM RADIO TODAY

OCTOBER 1994 £1.80

LISTENERS SPECIAL

How to get tuned in without getting ripped off

AR-8000
wideband receiver reviewed



YAESU FT-2500
high power 2m mobile



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HAM RADIO TODAY

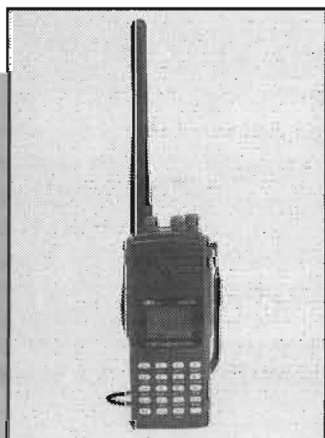
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CQ de G8IYA

Editorial

Should we all be getting our soldering irons out?

In last month's 'CQ de G8IYA' I talked about possible changes, especially in licensing. I think this 'deja-vu' feeling I occasionally get (see the issue the month before) is happening too often!

As many amateurs know (from this month's HRT, last month's 'Stop Press' in HRT, and of course from being active on the bands) our licence conditions have now been changed to give us higher power limits on 160m and 6m, and no more aerial or ERP restrictions on 6m. You can now even operate maritime mobile on 6m if you wish. The RA have also realised, and acted on, the enormous growth of the use of computers in our hobby, with a 'tightening up' of the conditions on computer-based log keeping (just to make sure a 'hard copy' printout is available as well as a disk-based copy) and that the operator of an unattended packet station can be contacted if the need arises.

Coming back to licence enhancements on 6m, many readers will know that much work has been done, often well in the 'background', by such bodies as the UK Six Metre Group. HRT's VHF/UHF Message columnist, Geoff Brown GJ4ICD, is indeed the Chairman of this group, who tells us the group put a lot of work into this. He was understandably very pleased indeed with the news! A great deal of propagation research has been done by hams on 6m, and it's true to say that Geoff's predecessor in HRT, Ken Ellis G5KW, was a pioneer in this. They do this for a hobby, for the good of amateur radio. We reap the benefits. Thank's chaps, you know who you are....

Regarding the digital communications part of the changes, many amateurs were initially rather worried about having to inform 'big brother' of how to make sure their unattended packet stations could be shut down in an emergency. A simple letter to your local RIS office giving the required details of who to contact is all that's usually needed. 'Big Brother' could of course have said "Right, no

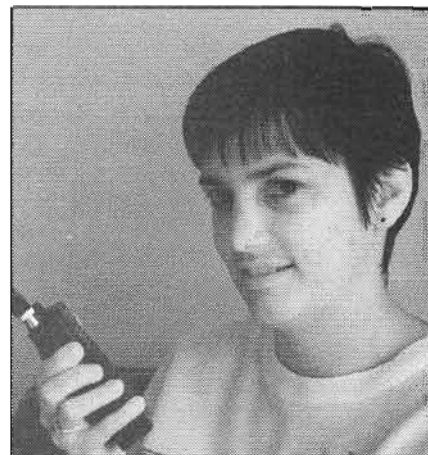
more unattended digital operation", at least without a similar paperwork exercise as needed for formal 'site clearance', for example like that needed for a speech repeater or for 'non-cleared' 70cm packet channels.

The RA also took the advantage of updating the CEPT 'countries list', letting us know where we can operate without formalities. They obviously don't want to restrict the growth of amateur radio, and particularly the future. It just seems to me that they want and need to keep control of it!

Pan-European 12.5kHz?

Another possible change, this time voluntary, is the idea of going over to 12.5kHz channel spacing on 2m and in the future on 70cm (see this month's 'Radio Today'). What do you think? Maybe I should buy a pile of crystal and ceramic filters in readiness? But then, what happens when I want to sell my rig, or even just use it on a trip abroad, say to mainland Europe. Our licence lets us operate abroad in many European countries without any pre-formalities whatsoever, and customs don't bother with our transceiver imports/export any more. Many amateurs do take advantage of this, just listen to any UK or foreign 2m repeater in a popular tourist destination during the holiday season.

On another aspect of European 'roaming', I can buy a tiny GSM (Global System for Mobile telecommunications) digital cellular handheld telephone for a couple of hundred pounds, about the same as a 2m handheld. I can take this along, without any modifications, to make and receive calls in Southampton, London, Glasgow, Paris, Munich, Vienna, Lisbon (no, the call costs *aren't* horrendous, at 5p/min cheap rate and 12.5p/min peak rate, from my area to anywhere in the UK, little different to a normal phone). I could also communicate a bit cheaper with my 2m handheld whilst visiting these



places. But it looks like it may be less expensive to use a GSM phone for general chatting when I go abroad rather than get my 2m handheld modified and de-modified each time. Likewise with visitors to the UK.

G/HBxxxx/M, sorry old man, you're totally unreadable through overdeviation on this repeater....beep. Unless of course, every other country immediately follows the UK lead. Anyone listening out there?

This month's free PC software

This month I'm offering a copying service for a bumper 'rig modification' collection on disk, packed full of public domain text files with modifications for ham transceivers, receivers, and scanners. As well as this, there's a copy of a shareware 'auto exam' program on the disk, where you can sit a randomized 'mock US licence exam' of any class you choose on your PC, to see how you'd get on!

For your copy, you need to send a blank, formatted, 1.44Mb PC disk to 'HRT Disk Offer - Oct 94', HRT Editor, ASP, Argus House, Boundary Way, Hemel Hempstead, Herts, HP2 7ST, together with a stamped self-addressed envelope (or envelope and IRC for overseas) and the 'corner flash' from this month's contents page, and your disk will be returned to you, full. No SAE, corner flash, disk, or disk not correctly formatted, no returned software. Next month's disk will contain a superb Morse tutor program plus a few other 'goodies'. If you haven't yet subscribed, or placed a regular order with your newsagent, maybe now's the time?

LETTERS

Letter of the Month

Dear HRT,

Some six month's or more ago now, I started to get more than a little interested in 6m SSB. After consultation with various other amateurs, notably Dave G0MJY, I decided that I would have a go at some 'home brew', in preference to going out and spending what could be an awful lot of cash on an off-the-shelf 'black box'. After several false starts I decided to also enlist the help of another Dave, namely G4EQR. After lengthy discussions and various experiments with VFOs etc., we eventually came to the conclusion that the best way to achieve my objective was to build basically what would be a 28MHz transceiver, with a 10m to 6m transverter on the end.

Having decided this I then contacted Chris Howes, who is a supplier of kits such as exciters and VFOs etc, in order to build up the basic transceiver. Having built the basic units, I installed them in the box and turned on. Somehow one of my crocodile clips came off and shorted out the PA stage on the exciter board. Several frantic phone calls, to try to find someone who could provide me with replacements for several smoked

transistors, culminated in a trip over to Derek G3ZOM, who disturbed his Sunday afternoon to supply me with the relevant components.

I tried it all again and this time it worked! Well sort of anyway. I noticed when I keyed the mic, all sorts of strange things were happening, the worse thing being that this thing was taking off just as reliably as a Boeing 737! I came to the conclusion that the innards required more screening, I had so far used double sided PCB for this purpose, but when I went to the cupboard, it was bare. Blast, I knew I should have picked some up at that last rally. Several more phone calls and a packet message to Andy G7KPF, brought me some material that was made for the job. Even more arrived from Dave G0MJY (good old Dave!). I installed the screening and solved that problem, it was still doing strange things on transmit though. A visit to G0MJY and also G4EQR, with my fledgling radio and immediately a fault was discovered with my wiring, Hooray! It was at last transmitting without any problems, now for the receiver.....

This part of the project would see me almost tearing out my hair in frustration, no matter what I did I just couldn't get the thing to receive. Tests

with GDOs, signal generators, etc., all proved that the radio worked, but when plugged into an aerial, nothing, deaf as the proverbial doorpost so to speak. More worried phone calls. Eventually I then decided to enlist the assistance of our local 6m man and resident expert on these matters, Eric G8BKL. Eric agreed to have a look at the problem, he too gave up a Sunday afternoon in order to help me out, this being after he had just come back from a RAYNET exercise! Eric soon found the problem, it being mainly a combination of alignment and some dubious wiring practises on my part. Apart from some loose ends, the project after a couple of months had at last reached a successful conclusion, this being proved by a contact with DL3AIE, my very first contact outside the UK on 6m!

The point that I wish to make though, is that none of this would have been possible for me to achieve, without the very active participation of all those amateurs aforementioned. So thank you all, you're an example of how the spirit of amateur radio is alive and well, amongst the rank and file of what must be the worlds greatest hobby.

73 Jamie, G7OJZ

Dear HRT,

With regard to Tom Waters G0GQJ/N8WHF's letter in HRT, August 94. Since the RSGB has nothing to do with the US licence exam or examiners, it is surely wrong to criticise them for not being able to provide information on the whereabouts of other VE's.

The enquiry should have been made

of the ARRL and not of our national society. After all, it is rather like asking the gas board for details of electricity prices!

Michael G. Shread GM6TAN

Editorial Comment

One could say that the RSGB has

'nothing to do', directly at least, with a number of amateur radio matters, but they do often try to help if they can. Regarding US licence exams, they have indeed in the past publicized dates of such exams held in the UK by broadcasting this information around the UK on their weekly GB2RS news service.

£10 for the Letter of the Month!

Do you have something constructive to say on the state of amateur radio today? Perhaps you'd like to put your viewpoint to HRT readers, get some discussion going, or give an answer to one of the issues raised? We'll pay £10 for the best letter we publish each month. If your's is featured as such, we'll send you a cheque the month following publication. So write in with your views, to: Letters Column, The Editor, Ham Radio Today, ASP, Argus House, Boundary Way, Hemel Hempstead, Herts HP2 7ST, or fax your letter direct to the Editor's desk on 0703 263429. Please keep your letters short, we reserve the right to shorten them if needed for publication. All letters must include name and/or callsign, no 'name/callsign withheld' letters will be published. Views published here may not necessarily be those of the magazine.

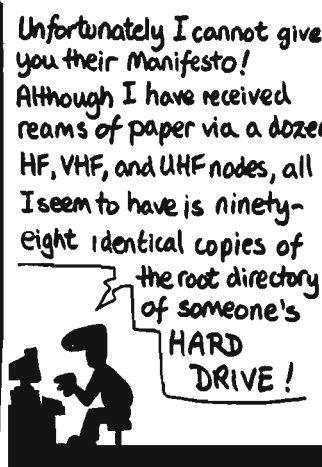
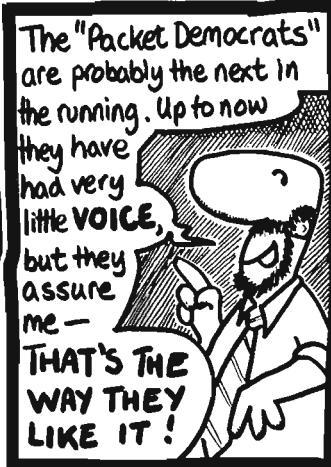
"TONE" BURST



RADIO CLUB ELECTIONS. Part 3

STORY: G7NBP

PICS: G6MEN



Dear HRT,

Could you please inform me of how and where I could obtain a Novice Licence for Ham Radio, as having read through your magazine, I haven't found any information leading to this.

Many thanks for your help and co-operation.

D. Scott

Editorial comment;

This is again typical of the many queries we receive each week. Information regarding the Novice Licence can be obtained from the Radio Society of Great Britain (RSGB), who coordinate Novice training courses in the UK on behalf of the Radiocommunication Agency.

Also, contact the Radiocommunications Agency

themselves and ask them to send you their free publication 'Novice Licence Information Sheet'. The contact details for both these organisations are in 'Club News' each month. We hope you will get the information you want, Mr. Scott, and that you find our hobby interesting!

Dear HRT,

I know it's not the policy of HRT to publish replies from people who have not signed their letters, or added their callsign or QTH. I would hope, that should you be inclined to publish this letter of mine, that one or two replies can be published (*with names/callsigns - Ed*), for I am of the nature that needs to know.

I have long been fascinated by the antics, first upon the CB bands and then, after 1983, the amateur bands, of those faceless morons we oft times refer to as IQ zeros, wallies, planks, toe-rags etc. etc.

Take CB for a start, the minimum outlay for rig, aerial etc is around £100, and whether the idiot uses it with or without a licence is not the point of this letter. What fascinates me is why, after spending this amount of money the only thing they appear to do with their equipment is

act stupid, play music, use foul language and block channels etc. etc., why?

It's an even dafter prospect on amateur radio, where to set up, even a VHF station, one not only needs to pass the RAE and all the attendant costs doing so, the set up will set you back at least £500 plus to do it properly. When they then come onto the amateur bands we have those who block the repeaters, those who jam one specific frequency every day (up here it's 145.425). There are amateurs who work for taxi firms and use frequencies, like 144.400 FM as part of their taxing channels. Then there are those who upon hearing other amateurs talking on SSB, decide to hold down the key on their iambic keyer in the foolish hope that they are jamming the amateurs talking. Why?

On the HF bands you can place a 100% certain bet that within seconds

of you making contact and beginning a QSO, whether it's by phone or Morse, some IQ zero will appear close by, if not over the top of you, calling CQ or just sending unreadable hash!, again why?

To end I would like to quote from the movie 'Dirty Harry' and first say to these cretins; "Go ahead punk, make my day!" and "I's got to know man". Are there any IQ zero's with the guts to answer via HRT? Come on and try!

J. D. Bolton, G4XPP

Editorial Comment;

Well readers, what do you say?

Yaesu FT-2500M

Review

Chris Lorek G4HCL tests a 2m transceiver that's built to take the knocks in life

The FT-2500M isn't a 'wimp' of a 2m transceiver. It's a 'hard case'. Try to shake it to bits, and it won't, drop it onto concrete, it'll survive. Yaesu even say that it's passed tough military-standard shock and vibration tests (MIL-STD-810C to be precise). So, a bit of a shaking about' in your Landrover shouldn't worry it one bit.

With a 50W transmitter output, it's powerful enough to reach those distant repeaters, and a sensitive receiver makes sure it can hear the less-powerful transceivers it's in communication with. You can switch in 'Low' and 'Mid' transmitter power levels for communication in closer quarters, and built-in CTCSS and 1750Hz tone encoders are fitted for repeater access.

Size isn't everything

It's not a miget set, although its DIN-size specification means that it'll happily fit into your car radio slot aperture if you want. Its toughness comes from being built on a solid die-cast chassis, together with a large finned transmitter heatsink rather than a small fan-assisted type, no 'moving parts' to go wrong here.

For use on the move, the set's LCD gives a very large readout of the channel frequency you're using. If you're in 'memory channel' mode, you can if you wish also assign a four letter alphanumeric 'tag' to each channel. Your club channel can be



called 'CLUB', your local chat channel as 'CHAT', 145.500 as 'S20' and so on. An LCD backlight lets you easily see the display at night, and as well as having a manual 'dimmer' control, the set can automatically dim this for you depending upon the amount of ambient light around.

Controls

The set was designed to be very simple to use, and there isn't the vast array of confusing tiny knobs and buttons you find on some other

transceivers. Hinge down a small flap on the front panel and you'll find extra control function buttons to 'play' with, but for most of the time I found I could get along fine with the set by just using the volume, channels, and microphone buttons, nothing else.

For slightly more 'complex' use the set has all the usual channel scanning facilities with 28 memory channels to choose from, plus further "Lower' and 'Upper' frequency range scan limit channels, and a quick-access 'call' channel. Each of these can store repeater shift or individual transmit and receive frequencies, CTCSS status, and the like. For selective calling, you can add internal plug-in options such as the FTS-17A CTCSS unit for sub-tone decode as well as encode operation, or the FRC-6 pager unit for DTMF controlled code squelch and paging, which uses the



three-digit DTMF calling method common to most Japanese rig manufacturers.

On the air

I'd already had experience using of the FT-2400 from Yaesu, which was the FT-2500's predecessor, and this set was just as easy to use. Plug in, switch on, tune to '145.500' with the main click-step knob, and I was operating on that channel. Tune to the output of one of my semi-local 2m repeaters on 145.775MHz, and I was operating there, the set already knew this was the repeater section of the 2m band in Europe and had put in the correct -600kHz transmitter shift in for me. Who needs an instruction manual? Well, I did, at least to show me how to program the alphanumeric names I wanted into the memory channels!

On the move, the set operated faultlessly. There was an ample amount of clear receiver audio from the set's internal speaker, plugging in a forward-facing external speaker gave even better audio for the times I was travelling at high speed with all the car windows open. My reported transmit signal was described as crisp and clear, and the high transmit power when needed was very useful in getting a flutter-free signal into any of the three 2m repeaters that,



from my village, I'm usually always on the fringe coverage areas of.

Taking the set home and operating it during extended periods in the shack showed that it could get hot, very hot, on long transmit periods. So hot that I certainly couldn't touch the heatsink. The review period did however coincide with a rather hot spell of weather, for Britain at least, with my shack temperature usually around 27-30 deg C which didn't help this! On a better note, even with an external 2m colinear and beam system connected, I experienced no problems at won the rig from the many other strong VHF signals in my locality, something other sets I test often suffer from very badly.

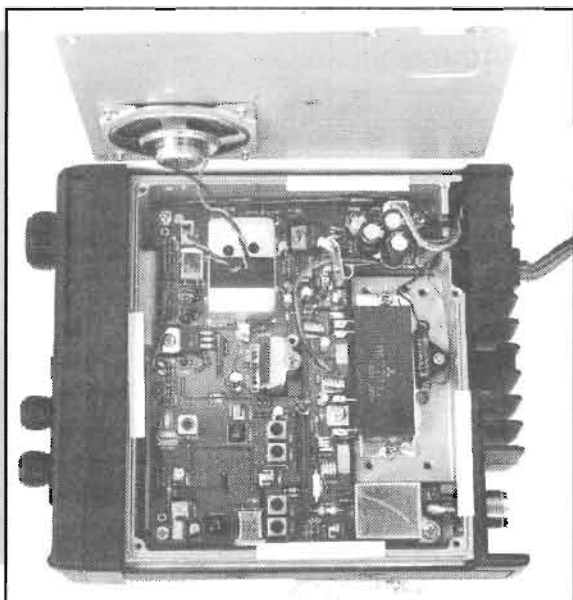
Technicalities

The measured lab results confirmed the technical performance is just as good as the quality of construction of the set. The receiver was very good both in terms of sensitivity (to pull in weak, wanted signals) and in rejection of strong, unwanted signals. The transmitter was well regulated, and the harmonics were extremely well suppressed, reflecting the set's obvious 'professional rig' parentage.

Conclusions

The FT-2500M should stand up to virtually any knocks you may like to throw at it. It's tough, it works well on the air, and it's simple to use. If you want a tiny midget-sized set that you can slip into your inside pocket when you leave the car, you'll need to look somewhere else, but for something to bolt onto a solid dashboard that performs like it's appearance suggests, you'll have to look hard to find something to match it.

The FT-2500M is currently priced at £359 including fist mic and mobile mounting bracket, and my thanks go to Yaesu (UK) for the loan of the review transceiver.



RECEIVER

Sensitivity

Input level required to give 12dB SINAD;

144MHz;	0.17µV pd
145MHz;	0.17µV pd
146MHz;	0.17µV pd

Squelch Sensitivity;

Threshold;	0.11µV pd (4dB SINAD)
Maximum;	0.27µV pd (21dB SINAD)

Blocking;

Increase over 12dB SINAD level of interfering signal modulated with 400Hz at 1.5kHz deviation to cause 6dB degradation in 12dB SINAD on-channel signal;

+100kHz;	92.1dB
+1MHz;	96.7dB
+10MHz;	95.4dBa

Adjacent Channel Selectivity;

Measured as increase in level of interfering signal, modulated with 400Hz at 1.5kHz deviation, above 12dB SINAD ref. level to cause 6dB degradation in 12dB on-channel signal;

+12.5kHz;	45.0dB
-12.5kHz;	31.9dB
+25kHz;	80.4dB
-25kHz;	81.1dB

Maximum Audio Output;

Measured at 1kHz on the onset of clipping, 8 ohm load;

2.51W RMS

Intermodulation Rejection;

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

25/50kHz spacing;	75.1dB
50/100kHz spacing;	74.6dB

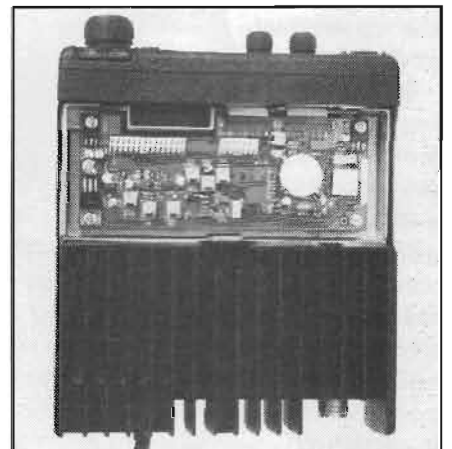
Image Rejection;

Increase in level of signal at first IF image frequency, over level of on-channel signal, to give identical 12dB SINAD signal;

97.7dB

S-Meter Linearity;

Reading	Sig. Level	Rel. Level
S1	0.35µV pd	-21.8dB
S3	0.60µV pd	-17.1dB
S5	1.11µV pd	-11.8dB
S7	2.00µV pd	-6.7dB
S9	4.32µV pd	0dB ref
S9+	9.44µV pd	+6.8dB



TRANSMITTER

Peak Deviation;

5.15 kHz

Frequency Accuracy;

-30Hz

Toneburst Deviation;

4.40 kHz

Harmonics

2nd Harmonic;	<-90dBc
3rd Harmonic;	-86dBc
4th Harmonic;	-89dBc
5th Harmonic;	<-90dBc
6th Harmonic;	-89dBc
7th Harmonic;	<-90dBc

TX Power and Current Consumption;

Freq.	Power	10.8V Supply	13.2V Supply	15.6V Supply
144MHz	High	30.3W/8.05A	47.5W/10.1A	48.2W/10.0A
	Mid	23.8W/7.00A	23.8W/7.05A	23.8W/7.00A
	Low	4.67W/3.45A	4.80W/3.55A	4.80W/3.55A
145MHz	High	31.9W/8.20A	48.2W/10.1A	48.5W/10.1A
	Mid	23.9W/7.05A	23.9W/7.00A	23.9W/7.05A
	Low	4.80W/3.50A	4.80W/3.50A	4.80W/3.55A
146MHz	High	32.1W/8.35A	48.5W/10.2A	48.5W/10.1A
	Mid	24.1W/7.05A	24.1W/7.05A	23.9W/7.10A
	Low	4.87W/3.45A	4.80W/3.50A	4.80W/3.50A

Getting Started In Listening

Bill Robertson guides the newcomer in getting started, what receiver to choose, and what to avoid

Maybe you've just picked up this copy of HRT, thinking 'I'd like to have a go at this'. You're not alone, as one of the most common questions I'm asked in the monthly *Scanners* section of HRT, which tries to cover all aspects of communications listening, is "How do I get started and what receiver would you recommend?". This of course could fill an entire book! However the choice of 'which set' is usually helped by the many reviews carried out on receivers and scanners in HRT. You'll see a complete list of these periodically in the magazine, and if one hasn't been published recently then an SAE to the HRT Editor will get you a complete list.

But which type is the right one for you? It depends on what you want to listen to!

Choices

If you're primarily interested in VHF and UHF (Very High Frequency and Ultra High Frequency) listening, such as aircraft and marine communications, radio amateurs using handhels and mobiles, often through their local 'repeater' stations, and so on then a low-cost scanner would be an ideal starting point. If this don't hold any excitement for you, and instead you're primarily interested in world-wide HF (High Frequency) broadcast and 'utility' communication (international ship-shore, world news data broadcasts etc.) listening, then a purpose-designed short wave receiver is the

type to go for. You can of course combine the two, as many 'top of the range' scanners include short wave coverage, although a purpose-designed HF receiver at the same or even lower price will virtually always give far better results. Let's expand on this a little;

Short Wave

Also known as 'HF', typically covering 2-30MHz this used to be the 'classic' start in listening in the old days, and is the reason that traditionally-minded radio hams often refer to all listeners as 'SWLs', meaning 'Short Wave Listeners'. It still is, in many cases, the most fascinating way to start. The bulk of international broadcasting is carried out on various short wave bands, and



Some handheld scanners cover a very wide frequency range

a simple receiver with just a short aerial will allow you to tune into a vast variety of these. If you're looking for good reception quality though, try the radio carriers from Astra on your domestic satellite receiver instead, the broadcasts you receive on HF will usually be accompanied by interference and fading, and you'll need to tune to different frequencies depending upon what time of the day and season it is. However, because of the truly international nature, you can often gain many different viewpoints on a given news story, even if some of these are blatant propaganda from certain countries' governments!

Utility listening on HF, i.e. the reception of non-broadcast stations, can be quite a specialized interest. Many listeners start out by tuning into the international HF ham bands (such as 14.0-14.35MHz), or even couple up a data decoder between their receiver and computer to receive and display news transmissions and weather fax maps and pictures. For non-broadcast HF reception, you'll need a receiver with Single Sideband (or SSB, including USB or LSB) reception capability, as well as AM which is mainly used for broadcast stations. Tuning in such stations also requires care and patience until you get the 'hang' of it.

A purpose-designed HF receiver is normally always the best here, even something like the Sangean ATS-803A plus its many other names, at under £100 gets you a keypad entry digital readout set with SSB capability.

VHF/UHF

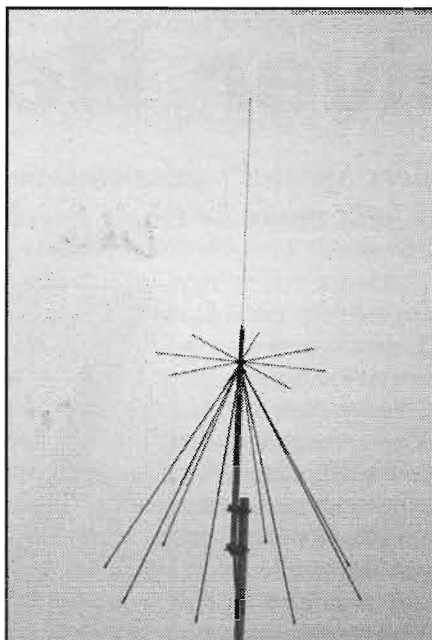
Many people like to combine hobbies of aircraft spotting and the like with listening to the 'going-on' on VHF AM (118-137MHz) between pilots, control towers, and so on. They may also want to tune into what's happening in their locality on the ham bands, e.g. on FM typically between 145.2-145.8MHz on VHF and 433-433.6MHz on UHF, plus the various other communications bands. Active boating enthusiasts will know of the great usefulness of the VHF marine band for safety, this is also used for coordinating yacht races, marina berthing, and other various ship-shore communications.

There are a very wide range of 'scanner receivers' available for this frequency range, although some of the more 'basic' models you'll find in the high street (rather than specialist hobby communications dealers) are designed for the US market with odd frequency steps (i.e. 5kHz rather than 12.5kHz on VHF) and no AM receive facility apart from airband. Beware also the simple and low cost '10 channel scanner' in its varying forms, with no 'search' facility. This is quite OK if you know which *exact* frequency you want to listen to, rather than which *band*, as you can't tune around or search for activity with this type. You need to key in up to 10 frequencies you want to listen to, and that's what you get. Fine as a '2nd receiver', for portable use for example, but not ideal for the beginner.

Many scanners also include HF coverage, some top-range models even have SSB reception facilities for ham and utility listening. This is best regarded as an 'added bonus' on the lower cost sets, although it can be a fascinating introduction to what happens on the lower frequencies.

Aerials

You need an aerial for your receiver, if you don't have one it won't receive much, if anything. Most



An outdoor discone aerial is useful on VHF and UHF

scanners come supplied with a set-top aerial, or a short whip that plugs into the back of a desktop model. These are fine for portable use and to 'get you started' at home. But you'll hear a *lot* more if you connect an suitable outdoor type. For VHF/UHF, a discone is a popular choice, a less unsightly aerial is an amplified wideband type, usually contained within a fibreglass tube for outdoor mounting. On HF, a simple outdoor 'long wire' aerial, away from sources

of electrical interference and as long as you can make it within reason (e.g. 5-50m in length), will literally bring your receiver to life. If you can't get an outdoor aerial up, try one in your loft space if you have one, or for HF even a wire around the picture rail is better than nothing. With a short set-top whip you're very unlikely to hear anything on HF apart from extremely local or very powerful broadcast stations.

A word to the wise

At the moment, in the UK you're not allowed to deliberately listen to anything apart from authorized broadcast stations, licensed radio amateurs, CB operators, and while at sea, coastguard broadcasts. It's an offence to tune into anything else, and if you then disclose what you've heard to someone else it's a further offence. Although for example airband reception is openly carried out and this practice is indeed encouraged in the windows of many high street TV and radio shops, it's technically illegal. Mind you, I've been told that until recently it's been illegal for adult men not to do their government-stipulated period of archery practice each day, with a fine for each day of neglect. You've been warned!



A purpose-designed HF receiver is usually best for short wave listening

AOR AR-8000

Receiver Review

A fitting review for our 'Listeners Special'; this small powerhouse of a feature-packed receiver is held down by Chris Lorek G4HCL

I'd seen it advertised, I'd studied the specifications, I thought I knew what to expect. When it arrived, I found it was even better. You really *do* need to handle and *use* the AR-8000, if just for a few minutes, to get even a small grasp of how powerful and yet how easy to use it really is.

It's a feature-packed handheld receiver, capable of receiving anywhere between 500kHz to 1900MHz. In fact it'll tune right down to 100kHz if you fancy trying a bit of long wave listening. As well as the 'usual' AM, Narrowband FM, and Wideband FM modes, you can also select USB, LSB and CW for communications monitoring on HF and indeed on the VHF/UHF amateur bands for 'DX' and contest listening. You can tune in any step size you select from 50Hz up to 999.995kHz, and if you're not too sure which mode and tuning step is the best for the frequency you want to listen to, don't worry. Just select 'Auto' mode and the AR-8000 will decide for you and switch in the right parameters for you each time!

For example, on the 2m amateur band it will select CW with 50Hz steps from 144.000-144.150, then USB with 50Hz steps to 144.500, then FM with 25kHz steps to 144.825, then USB with 50Hz steps to 145.000, then FM with 25kHz steps up to 145.800, then USB with 50Hz steps up to 146.000MHz. Someone's certainly been doing their homework, and they've put it to good use!

The other thing that makes the AR-8000 'stand out' is its large alphanumeric dot-matrix display above the keyboard, which gives a user-friendly text display when programming. In receive mode this shows the frequency and mode, an optional text description of what's in

the memory channel or search bank you've selected, a bargraph S-meter, even a simple 'band scope' if you wish to show activity on channels either side of the one you're tuned to. In '2VFO' mode it'll display the contents of VFOs 'A' and 'B', which you can quickly switch between with a single button push. There are quite a number of possibilities for this very handy function!

The set has 1000 memory channels, arranged into 20 banks of 50 channels each, with each channel capable of storing frequency, mode, a short line of text, attenuator status, and the like. You can if you wish 'hide' 500 of these (those stored in the 'upper banks') with a four-digit password protection, which you need to key in each time you switch the set back on in order to access them. Again, I can think of a number of possibilities for this!

AOR tell me the set comes fitted with an independent filter for SSB use, and that USB, LSB and CW use true carrier re-insertion with a correctly calibrated frequency readout, rather than this being offset by 1.5kHz. For 'LF' listening on Medium wave, there's even a built-in ferrite rod aerial in addition to the supplied set-top wideband helical.



Many listeners will know a short helical isn't too good for MW reception! At the other end of the scale, a software-selectable 10dB attenuator can be switched in when needed, to help against strong signals overloading the set.

The set will scan through your selected channels, or frequencies in 'search' mode, at around 30 increments a second. You can set it to stop either when the squelch raises, or when it finds audio along with the signal, or when the 'S-meter' reaches your desired level of



signal strength, and you can scan in various combinations including a 'mode scan' (where only memories with your selected reception mode are scanned). 20 search banks are available to help you find new active channels, these also being capable of having an 'text' message alongside them to remind you of what they are. The UK version of the AR-8000 comes ready programmed with useful banks, such as the Civil and Military airbands, VHF Marine band, the 2m, 70cm and 23cm amateurs bands, and so on, which you can of course alter or re-program if needed. Up to 50 'frequency pass' channels in each search bank are available for you to lock out unwanted channels, such as 'dead carriers' or data/paging channels, and a 'select scan' gives you a quick search of up to 100 of your favourite channels. An 'auto-store' mode can even be used to automatically program up your memory channels with active frequencies across a given search bank.

In other words it can do a lot of

things in scan and search modes, it's very fast, and you shouldn't miss much.

Hard Facts

Measuring 153mm (H) x 69mm (W) x 40mm (D), it weighs in at around 350g with its supplied set of 4 AA nicads. It also comes supplied with an AC mains nicad charger, a DC lead with car cigar lighter plug, belt clip, carrying strap, and a very comprehensive operating manual packed with examples and screen illustrations. In fact, there's no less than 115 pages worth of manual! A good job too, because getting to know how to operate the AR-8000 to its fullest extent needs something like this. Fortunately, there's also a double-sided A4 sized 'quick reference guide' to the receiver's most-used functions, which I must say I found invaluable. As supplied, the AR-8000 comes up in a 'NEWUSER' operation mode to start with, which you can change to 'EXPERT' mode to open up more functions once you've got the hang of the 'basics'.

In Use

Yes, I did start in 'NEWUSER' mode! Although I was initially rather overwhelmed with the many things I could program the set to do, the dot-matrix display usually guided me through as to what to enter at each step. It even came up with a message of 'Welcome to the world of AR8000 receiver' each time I switched it on. So I didn't get confused in programming it, well not *too* often.

On the air, it worked quite well. It picked up plenty of signals across the VHF and UHF ranges with its short set-top whip, showing good sensitivity here, coupling in my rooftop wideband aerial systems brought in plenty more from far and wide. Here, I didn't find too many problems from other strong signals

on the bands, although these did make their presence felt occasionally in which case I switched in the internal 10dB attenuator to help out a little.

I found casual 'tuning around' using the top panel mounted click-step rotary knob very handy, even more so after entering a frequency in a given band and letting the AR-8000 set up the correct mode and tuning step for me. The receiver was light enough and just about small enough to carry around in my shirt pocket, and a handy key-lock button on the side panel stopped any inadvertent key operations. A further button on this panel switched in a superb backlight, which as well as lighting up the large LCD panel also shone through all the front and side-mounted operation buttons, complete with their key logos; superb for night-time use. I found the backlight could also be switched in to operate continuously, for example for mobile use, the set's internal voltage regulator being suitably rated for this continuous operation.

Attaching my outdoor HF multiband dipole brought in plenty of signals on short wave. Broadcast, amateur, utility, you name it, the AR-8000 received it. I found the SSB bandwidth rather wide though, with typically a fair amount of interference on a crowded amateur band being received from adjacent signals. Not surprisingly, I found I usually needed the attenuator switched in at all times on HF to prevent overload from signals on other bands. However, being able to at last tune in, and happily resolve, weak signals from around the world on a tiny receiver such as this was still a 'marvel'.

In trying to 'extend my horizons' a little at the upper end of the set's frequency coverage, I tried tuning in to a couple of the 1695MHz Geosat weather satellites, using both my 1.6m prime-focus dish with dipole feed and my JVL 1695MHz loop yagi. No luck, the set unfortunately wasn't sensitive enough up there without an in-line preamp. It did seem to pick up

plenty of wideband PCN FM data around 1800MHz though with a rooftop log-periodic aerial connected, this probably coming from 'Orange' phone network operating in my area.

An optional RS-232 remote control lead is available for the AR-8000, and with suitable software running on a PC this would make a very, very powerful system indeed. The same remote port on the set can also be used to 'clone' all or selected data between one AR-8000 and another - even password-protected memory data may be transferred if you wish.

In case you forget your password 'lock code' at any time, I found that, by performing a 'hard microprocessor reset', the set's memory channel data was completely retained, including the 'password protected' channels, but the 'password' number facility was disabled and reset back to '0000'. This could of course be either useful or not depending on who wants to access the data in your AR-8000!

Technicalities

Opening the set up shows a very neat circuit arrangement, without a mass of interconnecting wires between boards, all of which should make the AR-8000 stand up well against mechanical shocks like the occasional drop!

On the laboratory test bench, the set's performance in terms of strong signal handling was quite respectable, in fact in my opinion it was very good indeed for a small receiver such as this. The rejection of 12.5kHz spaced signals on narrowband FM was better than some 2m amateur transceivers I've measured! The SSB selectivity was a little disappointing though, the lab measurements confirming the rather poor on-air performance I'd seen here. The sensitivity across HF, VHF and lower UHF was quite acceptable, although at the 'top end' above 1GHz it fell off, again as found on air.

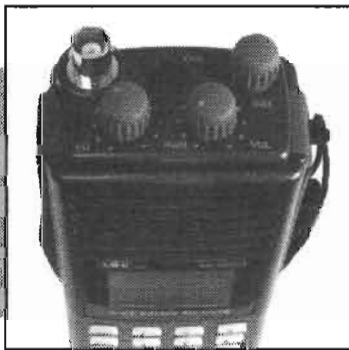
The image rejection, which many, many handheld scanners fall down on badly, was excellent with this set, no 'double signal' interference

problems at all here. The bargraph S-meter on the set always gave an indication of the first two bars regardless of signal level, although I understand this was just a limitation with the early factory model supplied for test. Note that all measurements used the set-top BNC connector for signal input, below 2MHz the set's internal ferrite rod aerial also comes into use so the 'real' sensitivity will be improved here.

Conclusions

AOR have got a winner with the AR-8000. I was extremely impressed with the set's versatility and easy-to-use operating system, this was especially useful with the set being capable of so many operating modes. It performed very well on air considering its size and price, and in this respect I cannot recommend it highly enough. As for myself, I'm saving up, I'm saving up!

The AR-8000 is currently priced at £449, and my thanks go to AOR (UK) Ltd. for the loan of the review samp



LABORATORY RESULTS:

All measurements carried out on 145.000MHz NFM with attenuator off unless stated.

Adjacent Channel Selectivity;

Measured as increase in level of interfering signal, modulated with 400Hz at 1.5kHz deviation, above 12dB SINAD ref. level to cause 6dB degradation in 12dB on-channel signal;

+12.5kHz;	38.3dB
- 12.5kHz;	41.6dB
+25kHz;	47.5dB
- 25kHz;	49.3dB

Sensitivity;

Input signal level in μV pd required to give 12dB SINAD;

Freq.	Signal Level	
500kHz	30.7 (AM)	
1MHz	15.8 (AM)	
2MHz	4.79 (AM)	1.08 (SSB)
4MHz	0.75 (AM)	0.47 (SSB)
6MHz	0.60 (AM)	0.33 (SSB)
8MHz	0.55 (AM)	0.36 (SSB)
10MHz	0.53 (AM)	0.31 (SSB)
15MHz	0.32 (AM)	0.21 (SSB)
20MHz	0.33 (AM)	0.22 (SSB)
30MHz	0.25 (AM)	0.21 (SSB)
50MHz	0.16 (NFM)	0.16 (SSB)
70MHz	0.17 (NFM)	0.22 (SSB)
100MHz	0.79 (WFM)	
125MHz	0.37 (AM)	
145MHz	0.19 (NFM)	0.28 (SSB)
170MHz	0.22 (NFM)	
250MHz	0.57 (AM)	
350MHz	0.56 (AM)	
435MHz	0.32 (NFM)	0.36 (SSB)
450MHz	0.26 (NFM)	
550MHz	1.13 (WFM)	
750MHz	0.81 (WFM)	
950MHz	0.32 (NFM)	
1300MHz	0.89 (NFM)	1.46 (SSB)
1600MHz	2.89 (NFM)	
1800MHz	3.59 (NFM)	
1900MHz	5.26 (NFM)	

Blocking;	
<i>Measured as increase over 12dB SINAD level of interfering signal modulated with 400Hz at 1.5kHz deviation to cause 6dB degradation in 12dB SINAD on-channel signal;</i>	
+100kHz;	60.8dB
+1MHz;	68.9dB

Intermodulation Rejection;	
<i>Measured on as increase over 12dB SINAD level of two interfering signals giving identical 12dB SINAD on-channel 3rd order intermodulation product;</i>	
25/50kHz spacing;	73.8dB
50/100kHz spacing;	62.6dB

SSB Selectivity	
<i>Single carrier reception bandwidth, measured on 21.4MHz USB;</i>	
-3dB	5.3kHz
-6dB	6.3kHz
-20dB	7.6kHz
-40dB	9.0kHz
-60dB	19.5kHz

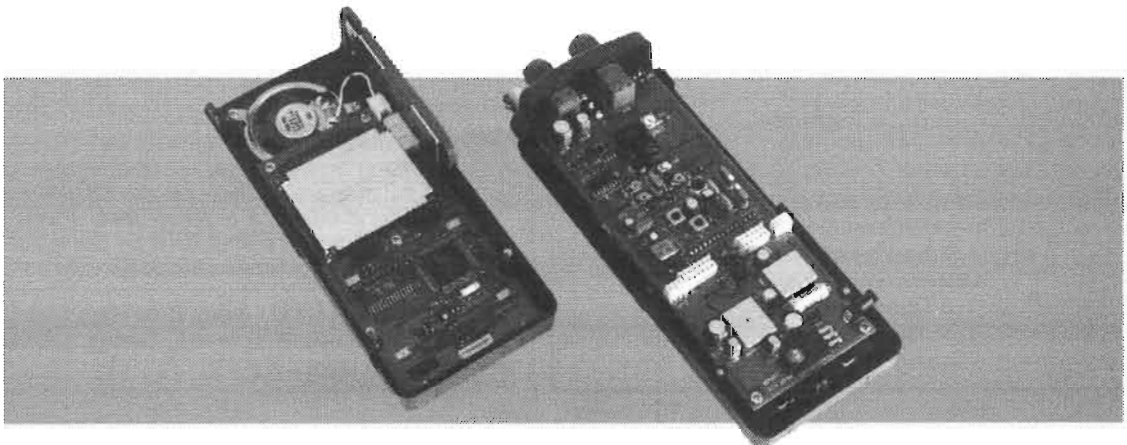
Image Rejection	
<i>Measured as difference in level between unwanted and wanted signal levels, each giving 12dB SINAD on-channel signals, of 45.050MHz IF image (455kHz IF images all blocking limited);</i>	
10MHz;	Blocking limited
145MHz;	Blocking limited
435MHz;	66.7dB
1300MHz;	Blocking limited
100MHz WFM (10.7MHz IF);	74.1dB

Current Consumption	
Scanning, no signal;	106mA average
Receive, mid volume;	164mA
Receive, max volume;	171mA

Maximum Audio Output	
<i>Measured at speaker/earphone socket, 1kHz audio at the onset of clipping (10% distortion), 8 ohm resistive load;</i>	
98.3mW RMS	

Squelch Sensitivity;	
<i>Level of signal required to raise receiver squelch</i>	
<i>Threshold; 0.10µV pd (5dB SINAD)</i>	
<i>Maximum; 0.35µV pd (22dB SINAD)</i>	

S-Meter Linearity				
S-Meter reading	10MHz SSB		145MHz FM	
	Sig level	dB rel.	Sig level	dB rel.
1	-	-	-	-
2	-	-	-	-
3	0.86µV pd	-30.1dB	0.30µV pd	-31.4dB
4	1.21µV pd	-27.1dB	0.43µV pd	-28.4dB
5	2.04µV pd	-22.6dB	0.78µV pd	-23.2dB
6	3.76µV pd	-17.3dB	1.64µV pd	-16.6dB
7	9.04µV pd	-9.6dB	3.94µV pd	-9.1dB
8	27.3µV pd	0dB ref	11.2µV pd	0dB ref



SCANNERS

Bill Robertson wonders when digital decoders will come as standard on receivers

The HRT Editor recently gave me a chance to have a quick 'play' with the new AR-8000 wideband handheld from AOR, which is the subject of a full technical review elsewhere in HRT. I must say I was very impressed! The large alphanumeric LCD is superb at letting you know what the set's up to, and I found the 'auto mode' switching very handy, especially when 'tapping frequencies in' to see what was around. I'm saving up my cash!

Your PC as a receiver?

Digital decoding requires processing power of course, and in many cases a PC can handle this, at least from a fixed monitoring position. PC based programs requiring just a simple interface (like a 741 op-amp) are readily available for decoding FAX, RTTY, Packet and so on. There's even been a program widely circulated for a Videocrypt 'Season 7' satellite TV decoder, using a PC for the 'data processing' side. There's now a plug-in PC card with a wideband receiver 'on board' which can fit inside your PC, with all the controls on your screen. Variable bandwidths, mode switching, spectrum analysis, decoding, and database are all done by software and digital circuitry. This is the 'SoftWave' DSP system from the US firm of ComFocus, and is distributed in the UK by Lowe Electronics at £1495.

But even sets such as the AR-8000 can be linked to the RS-232 port of a PC for control. If you're an airband enthusiast, wouldn't it be novel to have an airfield display on your screen, the aircraft identification 'squawks' being decoded for you and shown together with visual positions, your hard disk being used as a voice message storage of signals received.

Is this just fantasy or could it be possible? Why not write in to me, c/o the HRT Editor, and share your thoughts through these pages with other readers? I'll be very pleased to give you a mention. If you have a novel receiving set-up, or maybe an unusual aerial arrangement to get better signals than a simple discone or whatever, how about sharing your ideas on this with others as well?

The US company of *Radio Shack*, who are the equivalent of the UK's *Tandy*, have now launched two new scanners, the 100 channel PRO-2027 base scanner and the 200 channel PRO-51 handheld scanner, each covering the 'usual' US segmented bands up to around 960MHz. They also have a receiver DSP add-on filter unit available at a very low price (around the equivalent of £60). I'm certainly hoping to take a look at one of these shortly with a view to scanner and HF listening use - watch this space!

New frequency guide from the ISWL

This new 25 A4 sized page publication from the International Short Wave League contains all the necessary data enabling immediate access to standard frequency and time signal information. As such it can be an invaluable reference work in your shack, for determination of immediately usable frequency communication paths and on occasions even for the calibration of your station equipment. Compiled by ISWL member Roger Marshall G-20226, the information has been extracted from a variety of sources, that which proved the most up to date being the regular monthly reports which appear in the League magazine's feature 'The Broadcast Bands'.



INTERNATIONAL SHORT WAVE LEAGUE

STANDARD FREQUENCY
AND
TIME SIGNAL STATIONS
OF THE WORLD

The ISWL Frequency and Time Station Guide

The chapters cover (a) an explanation of the various time systems; (b) transmission systems used; (c) standard frequency and time signal stations in frequency order from 16 to 22536 kHz and from 95 to 171.3MHz; (d) callsigns in alphabetical order, including location and frequencies; and (e) countries from Argentina to Venezuela in alphabetical order with frequencies, transmission times, addresses, systems used and QSL card policies.

All in a most useful reference work which is obtainable direct from the HQ at £2.50 or 4 IRCs post paid. Postage stamps to the value of £2.50 are also acceptable, being cheaper than a postal order. The address of the ISWL is; International Short Wave League, 10 Clyde Crescent, Wharton, Winsford, Cheshire CW7 3LA, UK.

Final

Bill Robertson invites letters and questions from readers on any aspects of listening, which he'll answer through these pages each month. Write to; *Bill Robertson, c/o HRT Editor, ASP, Argus House, Boundary Way Hemel Hempstead, Herts HP2 7ST*

Trio TK-701S Ex-PMR Conversion

Dave Coomber G8UYZ shows how to get the Trio TK-701S VHF ex-PMR transceiver going on 2m in this follow-up article to the HRT TK-801S conversion

The VHF 'sister set' to the Trio TK-801S UHF mobile (featured in the May 94 issue of HRT) is the TK-701S, which can be modified to run on 2m. There is also rumoured to be a TK-601S on about 4m, but these have not often been seen in the UK and response to a WWW on packet radio has yet to indicate anything different anywhere else.

The conversion requires the careful installation of extra ceramic capacitors (size = 2.54 pitch), on parts of the TX/RX board. It may also be possible to change the existing capacitors, replacing with the correspondingly higher value. Board construction (and your skills), may make this a bit difficult. Tuning up is basically the same procedure as for the TK-801S, it is important you have the tuning details of the 801S to hand.

Before converting your rig, make sure the set is working and that the IFs and discriminators are aligned as they should be if the set has come out of service. If this is not the case, align or repair the set on its existing frequencies before carrying out any modifications.

Removing the TX/RX board

This is not an easy board to remove (there are several active devices bolted to the chassis, which

also forms part of the heat sink). You should have a multi-section box in which to keep *all* the screws (they are *not* all the same).

Remove the front panel, complete, then remove the diecast cover from the TX/RX board (watch where there are *long* screws). Remove the screws in the PCB and the ones retaining the active devices; IC U17, U16, Q3, Q4 and Q6. Double check these as it is very easy to break something! Remove the screws retaining the aerial output socket, then unsolder and remove the aerial connector (keep these!). Disconnect J21 and J22. Lift the board out, keeping it straight up for at least 12mm before moving forward, as there are multiple connectors connecting to the PLL board. See the components list for details of component changes.

The MON and AUX switches

Now is a good time to look at the connections to the MON switch. Remove Q25 (between the switches). Ensure that JU2001 is open circuit. Cut the earth track on the centre contact of the inside change-over set (you can use it to switch the earth on the repeater LEDs, in which case, check that it is a good solid earth connection, it may require an extra wire).

Re-fitting the PCB

When re-fitting the board, make sure that the connectors are in alignment. The board should be a good fit to the diecast case *before* you do any screwing down! Warning: PA transistors are not cheap (some of the ICs are tricky to get as well). Don't forget to re-fit the aerial connector (you can fit either an 'N' type or an SO239, both will fit the chassis). If the board has gone in smoothly, re-fit all the screws. You may now think about doing the tuning up.

Tune-up procedure

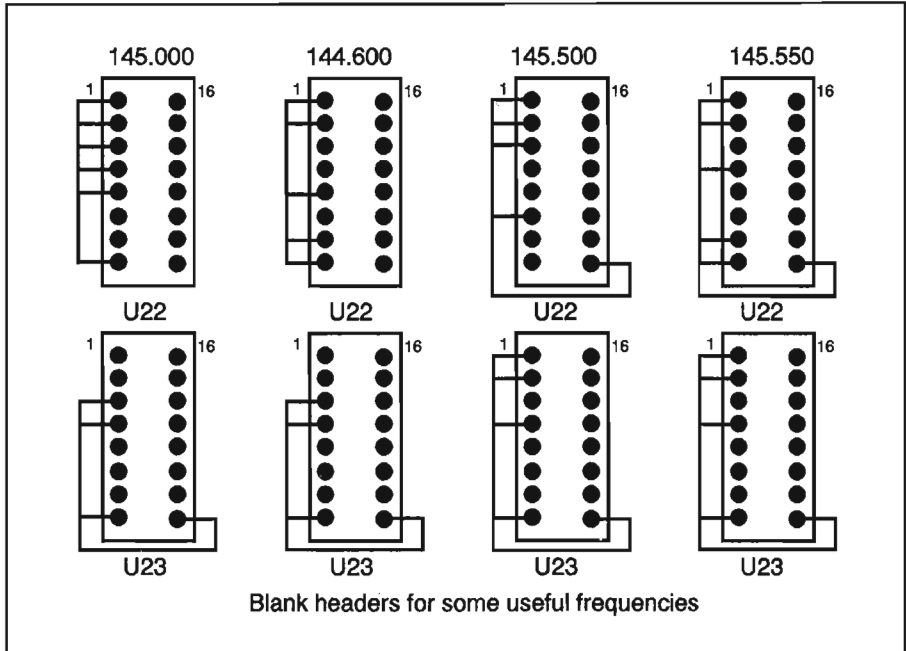
The PLL is set up the same way as for the TK-801S, with the following exception: TX PLL C903 should be adjusted for the lowest voltage consistent with operation at both ends of the band, i.e. about 3 - 3.5V (you might get it down to 2.5V, but it may depend upon how good you are at installing the extra components!). The RX PLL is exactly the same.

Receiver alignment

The tools and requirements are exactly the same procedure; set for a channel in the middle of the band.

Tune for maximum received signal strength, tuning in the following order; L20, L21, L23, L24, L25, L18, L19. Reduce the signal generator input and repeat, several times, until no further improvement can be heard. Adjust L30 for best signal to noise figure.

This bit is only needed if the AF response leaves a bit to be desired; adjust L32 for maximum AF output, L29 and L26 for minimum distortion, in that order. You should get better than 0.5µV for 17dB (0.2µV is not impossible). The squelch threshold is adjusted the same way as for the TK-801S.



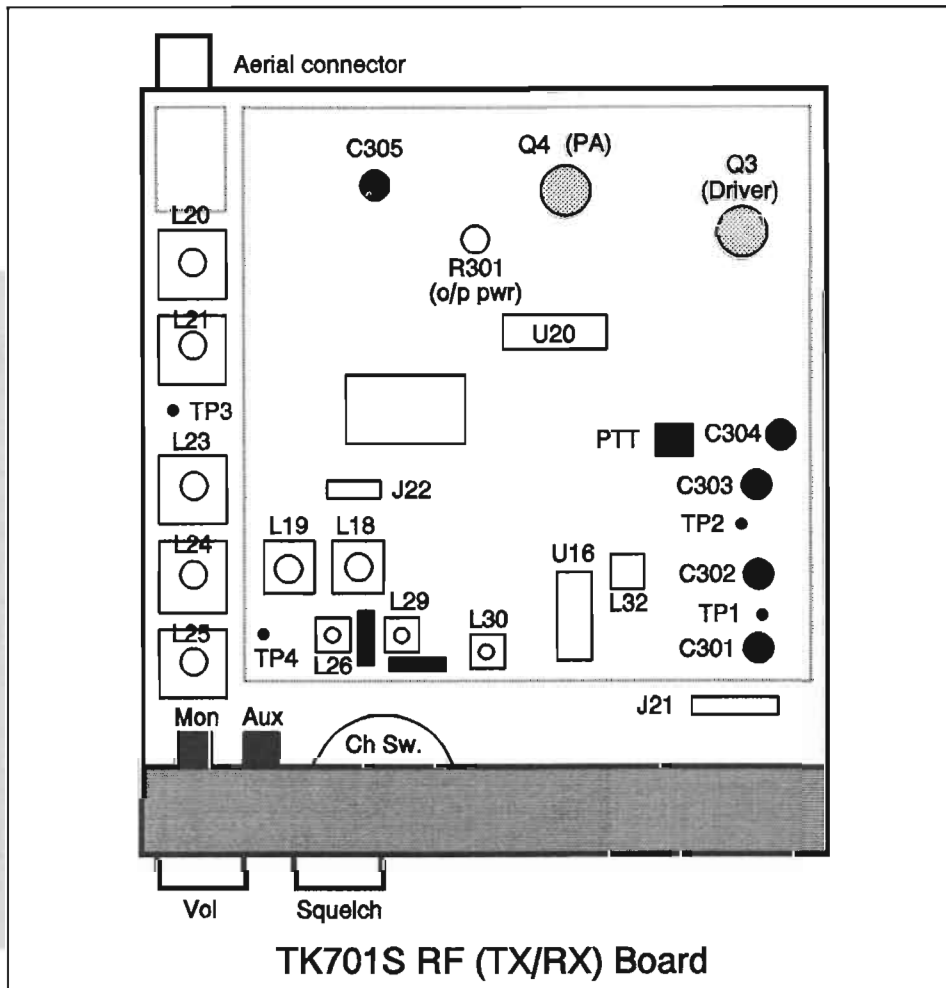
Transmitter alignment

I assume that the radio worked before you started modifying it! You will need the same equipment as for the TK-801S, but the tuning tool is

hexagonal.

Connect the PSU, ammeter (if external), the dummy load/Wattmeter and the microphone. Set RV301 fully clockwise before

continuing. Tune the following, in this order; C301, C302, C303, C304 and C305 for maximum RF output. Repeat several times, finally tuning for the 'dip' in consumed current



Some useful channel codes

Ch	Freq.	N	Binary N	A	Binary A
28	144.5000	461	1011001110	40	000101
2A	144.5250	461	1011001110	46	011101
2C	144.5500	461	1011001110	52	001011
2E	144.5750	461	1011001110	58	010111
30	144.6000	462	0111001110	0	000000
31	144.6125	462	0111001110	3	110000
32	144.6250	462	0111001110	6	011000
33	144.6375	462	0111001110	9	100100
34	144.6500	462	0111001110	12	001100
35	144.6625	462	0111001110	15	111100
36	144.6750	462	0111001110	18	010010
37	144.6875	462	0111001110	21	101010
38	144.7000	462	0111001110	24	000110
50	145.000	463	1111001110	32	000001
52	145.025	463	1111001110	38	011001
54	145.050	463	1111001110	44	001101
56	145.075	463	1111001110	50	010011
58	145.100	463	1111001110	56	000111
5A	145.125	463	1111001110	61	101111
5C	145.150	464	0000101110	4	001000
5E	145.175	464	0000101110	10	010100
60	145.200	464	0000101110	16	000010a
62	145.225	464	0000101110	22	011010
64	145.250	464	0000101110	28	001110
66	145.275	464	0000101110	34	010001
68	145.300	464	0000101110	40	000101
6A	145.325	464	0000101110	46	011101
6C	145.350	464	0000101110	52	001011
6D	145.3625	464	0000101110	55	111011
6E	145.375	464	0000101110	58	010111
6F	145.3875	464	0000101110	60	001111
70	145.4	465	1000101110	0	000000
71	145.4125	465	1000101110	3	110000
72	145.425	465	1000101110	6	011000
73	145.4375	465	1000101110	9	100100
74	145.45	465	1000101110	12	001100
75	145.4625	465	1000101110	15	111100
76	145.475	465	1000101110	18	010010
77	145.4875	465	1000101110	21	101010
78	145.5	465	1000101110	24	000110
79	145.5125	465	1000101110	27	110110
7A	145.525	465	1000101110	30	011110
7B	145.5375	465	1000101110	33	100001
7C	145.55	465	1000101110	36	001001
7D	145.5625	465	1000101110	39	111001
7E	145.575	465	1000101110	42	010101
7F	145.5875	465	1000101110	45	101101
80	145.6	465	1000101110	48	000011
81	145.6125	465	1000101110	51	110011
82	145.625	465	1000101110	54	011011
83	145.6375	465	1000101110	57	100111
84	145.65	465	1000101110	59	110111
85	145.6625	465	1000101110	62	011111
86	145.675	466	0100101110	2	010000
87	145.6875	466	0100101110	5	101000
88	145.7	466	0100101110	8	000100
89	145.7125	466	0100101110	11	110100
8A	145.725	466	0100101110	14	011100
8B	145.7375	466	0100101110	17	100010
8C	145.75	466	0100101110	20	001010
8D	145.7625	466	0100101110	23	111010
8E	145.775	466	0100101110	26	010110
8F	145.7875	466	0100101110	29	101110
90	145.8	466	0100101110	32	000001

commensurate with maximum RF output power (50W out, about 10A consumption, they get greedy and hot at 60W out!).

Reduce RV301 fully anti-clockwise and adjust C303, C304 and C305 *only* for the maximum output RF power, tuning for the 'dip' in consumed current commensurate with the required RF output power. It should be possible to adjust between 15W and 55W output, using RV301. I found that 25W is ideal for most operations, including packet radio. Note that the duty cycle is rated at 20% for transmit on full output, so reducing and careful tuning will improve this figure. Tune L15 for the exact required transmit frequency. Adjust RV901 for correct deviation and RV902 for appropriate microphone gain (usually well up).

EPROM conversion

The EPROM conversion to these sets is exactly the same as the TK-801 (although the data in the EPROMs is of course different). If you'd like a ready-made source of EPROMs for the TK-701, contact Kev Graham G8ZWU, 670 Stafford Rd., Fordhouses, Wolverhampton WV10 6NW for details, please don't forget to enclose a stamped addressed envelope for reply.

If you have any queries on this conversion 'follow-up', you may contact the author, enclosing an SAE for reply, to; *Dave Coomber G8UYZ, 14 Francis Green Ln., Penkridge, Staffs ST19 5HF.*

Capacitor Additions Required;

Receiver

<i>C61, 63, 65, 69, 76, 80, 83</i>	+2p2
<i>C38, 41</i>	+10p
<i>C40, 43</i>	+4p7
<i>C42</i>	+5p6

Note; the above should all be fitted directly underneath the PCB, with the shortest possible leads, and should be soldered to lie flat .

Transmitter

<i>C6, 20, 38, 41</i>	+10p
<i>C12</i>	+12p
<i>C18, 42</i>	+5p6
<i>C23, 24, 28</i>	+33p
<i>C29</i>	+18p
<i>C30, 40, 43</i>	+4p7

Note; The above may all be soldered on the component side, across existing components mounted vertically, again use the shortest possible lead lengths.

Hustler 6-BTV Aerial Review

Chris Lorek G4HCL gets his spade out and plants a multi-band HF vertical

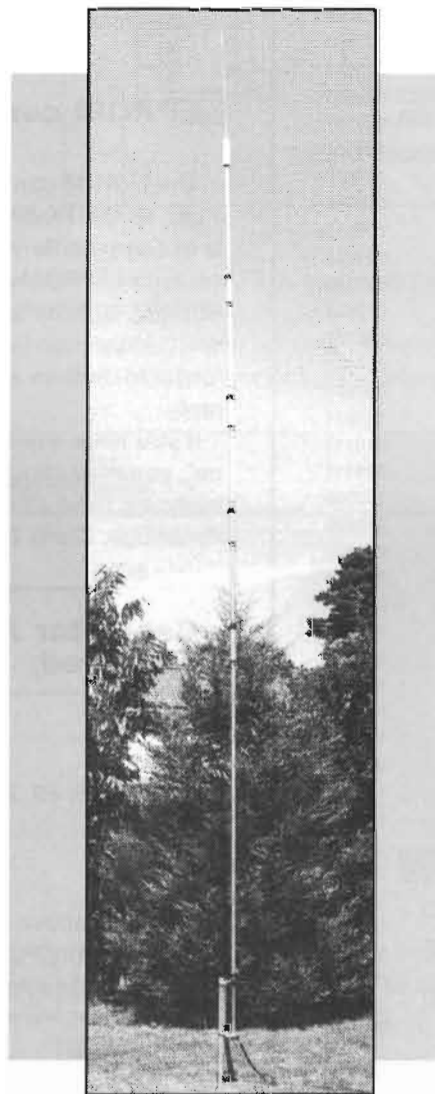
Many amateurs choose a trapped quarter wave vertical aerial for the HF bands, for a number of reasons. One is that a resonant quarter wave vertical, if used with a good ground plane, can give very good low angle radiation properties - which is often essential for DX working. Another is that there's no need for an aerial rotator, because a vertical is essentially omnidirectional. But often the main reason is that of space and aesthetic limitations. A ground mounted vertical, i.e. using good conductivity ground itself as the 'ground plane', can be just a long thin pole, which doesn't need a large 'turning circle' or a large area of garden space.

A simple quarter wave is of course just a resonant piece of wire or tube. For multi-band operation, you can have a number of such lengths, another way is to use RF 'traps' along the length of an element to achieve perfect resonance on each band of interest. This is the idea behind the Hustler 6-BTV, which uses resonators along its length to provide operation on the 10m, 15m, 20m, 30m, 40m and 80m amateur bands.

Construction

If you're spending money on an aerial, you'll want it to stay up. The old (and totally stupid and extremely irresponsible in my opinion) adage of "If it stayed up during the winds it wasn't big enough" belongs only in 'old wives tales' sayings in my opinion, usually best ignored and forgotten.

After taking the 6-BTV out of its



The Hustler 6-BTV, ground mounted

box and looking at the construction, I was pleased to see a very thick walled bottom section, which is usually the bit that takes the 'brunt' of leverage due to wind forces. "This should stay

up for a while" I thought! Unlike my Hy-Gain 18AVT-WB which lost its 80m and 40m capabilities after the first high winds it encountered. However upon reading the assembly instructions, I was a little disappointed to note that the manufacturers stated the 6-BTV must be guyed, just above the 20m trap. On contacting the UK suppliers, Coastal Communications, they said that guying the aerial is unnecessary. I'll leave this one up to you!

Putting it together

The supplied instructions were extremely clear and concise, following these I had the aerial assembled in less than half an hour. For my initial tests I used Hustler's suggested pole length of 1.2m hammered into the ground, with 450mm protruding to mount the aerial on. With the various element length adjustments set to Hustler's recommendations, I was again pleased to find these worked almost 'straight away' on the 40-10m bands in my particular mounting arrangement. The VSWR plots I achieved on these bands are shown in the accompanying graphs. On 80m, I found the aerial was resonant far too low. To be fair it has quite a high 'Q' on this band with resultant narrow bandwidth, and of course it's affected by any surrounding objects, like other houses in my particular case. Cutting the 80m resonant 'rod' as instructed did give me resonance on the 80m band, albeit rather low in frequency, and it only took me around 20 minutes to then get it 'spot on'. A typical 80m VSWR plot I achieved after adjustment is also shown.

On the air

Yes, it worked. Using the 6-BTV on the air, in comparison with my other HF aerials, showed that it worked as I would expect. By this, I mean that low-angle signals from unobstructed paths (due to neighbouring houses etc. with the aerial ground mounted) came through very well. TV line timebase 'hash' from neighbouring houses, including mine, also came through quite well of course! My HF horizontal dipole arrays (a trap dipole for 80m and 40m plus individual dipoles for 20m-10m, all at around 10m agl) did give better signals from otherwise obstructed paths, so no surprises here. I have around 2km of earth wire buried beneath my garden, connecting this as a ground plane to the 6-BTV gave me an improvement in performance on transmit, which I'd have expected, although it hardly shifted the resonant point of the aerial apart from on 80m, even here it only moved around 40kHz.

Raising the 6-BTV to above the level of neighbouring houses using my Strumech Versatower got over the 'screening effect' of course, with good signals coming in from all around. Using a compact HF radial arrangement with one short loaded 'radial' for each band, I found my transmission efficiency was rather lacking, very much so on the lower bands. However adding full-sized radials for each band to the bottom of the vertical provided very good signals on both transmit and receive. Again no surprises.

Conclusions

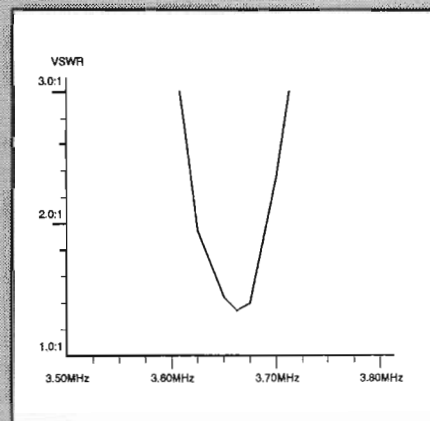
The Hustler 6-BTV in my opinion is very well made, it looks like it should certainly stand up to a few high winds when other aerials wouldn't (as I've found in the past, despite 'wind survivability claims!'). I've used several commercial trapped verticals over the years, and the 6-BTV worked just as well, if not better, than others. When ground mounted, it gave good performance over unobstructed paths, but remember you'll need to add

some form of ground plane arrangement when mounting it aloft. The provision of 10MHz coverage could I feel be of great interest to amateurs now the sunspot cycle is declining.

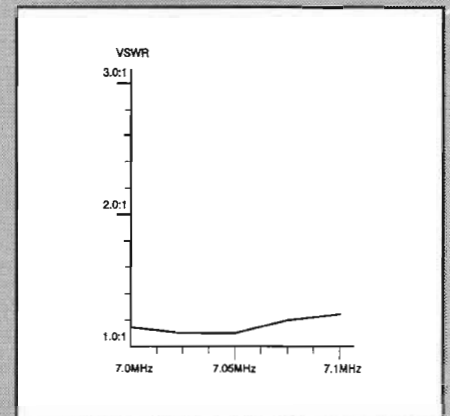
'Gain' is very hard to judge on HF, and trap losses of a fraction of a dB can't be seen 'on air' in real terms. All I can say is that I wasn't disappointed at all with this aerial. It worked as I expected, it was sturdy and didn't

blow down. What did surprise me was the relatively low price, for the quality of construction I found this to be very reasonable indeed. If you're in the market for a compact ground-mounted HF multi-band vertical, I wouldn't hesitate in recommending the 6-BTV.

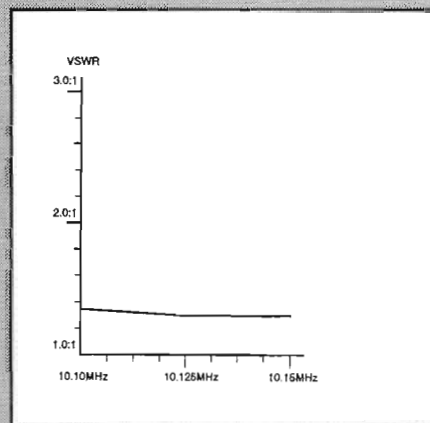
My Thanks go to Coastal Communications (Tel. 0255 474292) for the loan of the review aerial sample, which is currently priced at £160.95.



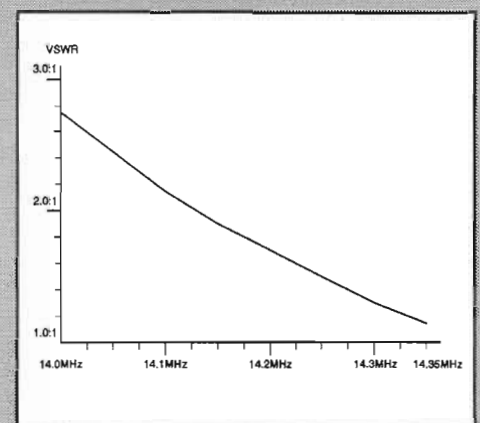
80m VSWR after adjustment



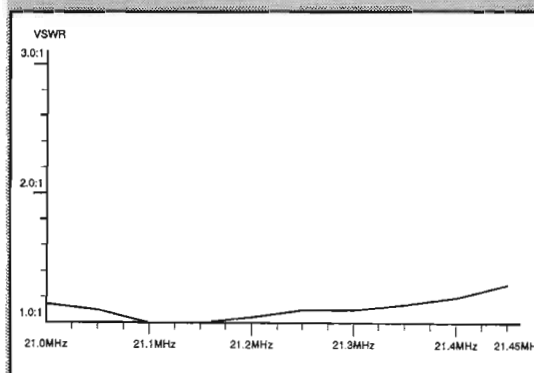
Initial 40m VSWR



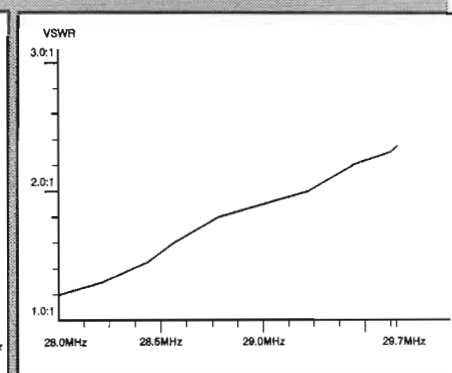
Initial 30m VSWR



Initial 20m VSWR



Initial 15m VSWR



Initial 10m VSWR

What, No QSY?

Jack Hum G5UM offers a few thoughts about calling channels on the VHF and UHF amateur bands

It seems unbelievable today that, in the early metrewave era, there were no calling channels. After making a CQ an operator would say "tuning the entire band for any possible call". The then-joke was "tuning for any impossible call", such was the low occupancy of the VHF/UHF bands as recently as three decades ago. It isn't like that any more. As metrewave occupancy increased, bandplans became necessary to enable an operator to tune a particular frequency segment of 'Two' or 'Seventy' or wherever, rather than laboriously over the whole band.

With bandplans came calling channels. To engage a distant station on 144.3MHz is to receive the immediate suggestion to QSY off this calling frequency to leave it free for the next person to make his CQ call. In the upper meg of 'Two', any call initiated on the 145.5MHz, S20, spot will evoke the prompt request "shall we try S18 (or whichever channel is checked as clear)?" Similarly a 70cm general call on 433.5MHz will bring the short and sweet reply "SU18 if okay by you". And it usually is.

Ditto on 'Six', though an anomaly exists here: occupancy of the upper meg of the 50-52MHz band is so low that there is a case for 'hogging the calling channel' of 51.51MHz in the hope that **someone**, somewhere will be listening on it and QSO to eventuate. Even so, etiquette suggests that a QSY be made. Full details of bandplans and related calling frequencies are in the RSGB Callbook, the metrewave person's second best friend after their licence.

What of 'Four'?

So much for 'Six', 'Two' and 'Seventy'. But what of 'Four', that other available band in the lower frequency metrewave spectrum? Once upon a time, the calling frequency for all modes was 70.26MHz. Now it is 70.45MHz, where

FM and most of the band's occupancy have their place. A majority of operators, upon being contacted on this frequency, will suggest a move. But there is still a minority who don't. There are several reasons why this antisocial phenomenon persists. Let's take a look at some of them in more detail.

First of all, much 4m activity is localised very often in tight knit nets. Rudimentary aerials seem to be widely used, and in consequence the station's performance is seriously impaired. The chances of detecting any activity outside these tightly knit nets are minimal, but not vice versa. Now read on..

Secondly, many of the transceivers used with poor aerials are themselves inadequate. Many are ex-PMR (professional) devices, owned by operators who either lack the will to tweak them to optimise them on 'Four', or do not have the test equipment to enable them to do so. Apropos which, it is good to see that an increasing number of 70MHz factory-built transceivers, aimed specifically at the amateur market, are beginning to appear. But back to transceivers of low sensitivity working into inadequate aerials. The operator about to start on 'Four', having heard much about its particular delights, will think "Oh, all I need for this ex- PMR heap is a crystal for the calling frequency of 70.45MHz and that'll do me fine for local chats. Nobody beyond will hear me". Not true.

Distant operators using better transceivers and aerials than the 'basic boys' become dismayed at the apparently permanent occupancy of 70.45MHz by distant stations and, largely unidentifiable, clobber those seeking to make a contact on the frequency and then to move off it, to continue the QSO. A number of operators questioned about failure to QSY on 'Four' come up with two excuses: Either they say that the cost of crystals to give them additional channels on the band is prohibitive,

or, "point four five does me well enough for my local chats". This entirely ignores the fact that the additional crystals may cost £10 or less, according to the size of the order. The sum is chicken feed when an operator relates it to the many hundreds of pounds blithely thrown to the winds for complete rigs for other bands.

Accepting then, that expenditure on more crystals is worthwhile, what channels should be chosen? This turns very much on the operator's tuning habits, whether close spacing or wide spacing of channels is preferred. The latter seems to be the norm at 25kHz spacing. This suggests ordering crystals for, say, 70.425, 70.4, 70.475, or even dear old 70.26MHz. It also suggests that a home built VFO, feeding its output into the 'transmit' crystal on the transceiver, will perform the same function with the added advantage of conferring complete flexibility in frequency selection. It might be cheaper too, if you have the bits to hand.

Another thought: while ordering pairs of crystals for the send and receive functions of that venerable PMR throwout, why not order a 'receive' crystal for 70.000MHz, to permit reception of the band-edge beacon at Buxton, GB3BUX, with its virtually nationwide range? The addition of a small transistor oscillator within the PMR box to be switched in when 70.000MHz is selected, will afford CW facilities with which to resolve GB3BUX as a CW signal. Often, even this refinement is unnecessary, you can detect GB3BUX by its squelch breaking thumps if you have a crystal for 70.000MHz receive.

Finally, an extract from 'The Amateur's Code' (invented by the Americans in the Twenties, as true today as it was then); "At all times be considerate to your fellow operators". Pondering this, the calling channel hoppers might be inclined to mend their ways.

Novice Notes

Ian Poole G3YWX discusses nicad batteries

Rechargeable batteries are now commonplace. They provide a source of power which is portable and very convenient. As such, they are widely used within amateur radio circles for a variety of portable receivers and transceivers. Although several types of rechargeable battery are known, the sort which is used virtually universally for portable electronic equipment is the NiCad.

Characteristics

In many respects a NiCad appears to be very similar to standard zinc carbon or alkaline type of batteries, which are widely available in the shops for powering everything from transistor radios to torches and motor driven toys. First of all, they are nominally the same size. NiCads are available in all the standard sizes; C, D, AA, AAA etc. and can be physically fitted in as a direct replacement. However I've found

NiCads are sometimes very slightly larger, and if the normal cells are a tight fit then it may be worth checking that the new NiCads will fit before buying them!

Apart from the size, the voltage which they produce is also nearly, but not, the same. Normally a zinc carbon or alkaline cell will give very nearly 1.5V when new. A NiCad will give slightly less at 1.2V, but this is not a problem in most instances. However, one difference occurs in the discharge characteristic. In a standard cell, the voltage will gradually fall as power is removed from the cell. In the case of a NiCad, it retains its voltage until it is nearly discharged, its voltage then falls off quite rapidly.

One other point to note about NiCads is that they will hold less charge than a standard cell, so it will be necessary to change a NiCad more often. This can be particularly important if long periods of use are envisaged and no charging capability

is available.

NiCads have a very low internal resistance and can provide very large currents. This can be noticed in many instances. One example is that flash guns which can take both normal and rechargeable cells will be ready for operation much quicker if NiCads are used.

Do's and Don'ts

If treated properly a NiCad should be able to give good service over several hundred charge/discharge cycles. However to achieve this sort of life the cells must be treated well and not abused.

First of all they must *never* have a short circuit placed across them. As NiCads have a low internal resistance and can give a very high current placing a short circuit across them can be quite dangerous.

The extent to which a NiCad should be discharged is also quite

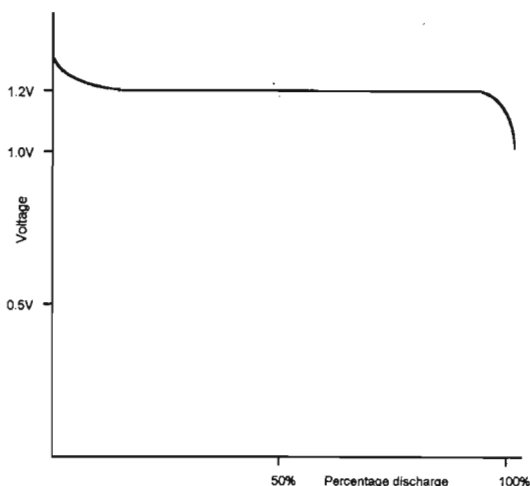


Fig. 1 Discharge characteristics of a NiCad

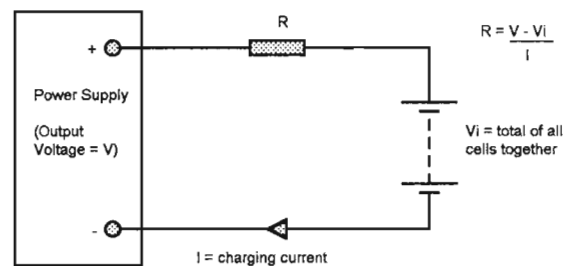


Fig. 2 Charging NiCads

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important. If at all possible they should not be discharged any further after the voltage across each cell reaches 1.0V. Fortunately, once they have reached this voltage virtually all the charge is removed and there is little point in trying to use them anyway.

Care must also be taken to ensure that a NiCad cell is never *reverse charged*. The most common way for this to happen is when a battery (consisting of several cells in series) is completely discharged. As all the cells will hold a slightly different amount of charge, those which are discharged first will become reverse charged by the others. In order to avoid this, batteries like the PP3 (*and transceiver NiCad packs - Tech Ed*) should *never be completely discharged*. Also if it were ever necessary to discharge a set of individual cells, then this should be done for each cell *individually*. This for example might be needed to have a known amount of charge in the

cells before giving them a full charge.

It is also necessary to charge the cells correctly. Charging must be accomplished by using a constant current source. A simple example of one is shown here. The resistor limits the current and its value can simply be calculated as shown. The charge rate and time is also important. Normally this is stated on the cell itself and generally it is around C/10, where C is the full amount of charge which can be stored in the cell in Ampere hours. It is also important not to charge the cells for too long. A moderate amount of overcharging does not cause much noticeable degradation of the cells, however if this is done for an extended period then it can cause the output voltage to be reduced once the cell is in operation. Fortunately this effect can sometimes be reduced if the cell is given a few complete discharge/charge cycles.

Whilst it is not advisable to overcharge NiCads it is perfectly

admissible to trickle charge them at less than the full rate of charge.

The temperature also has a considerable effect on NiCads. If at all possible they should be used at around room temperature. If they are cold then they will lose a lot of their capacity - possibly 50% or more at zero degrees C. However they do recover once they are warmed up again.

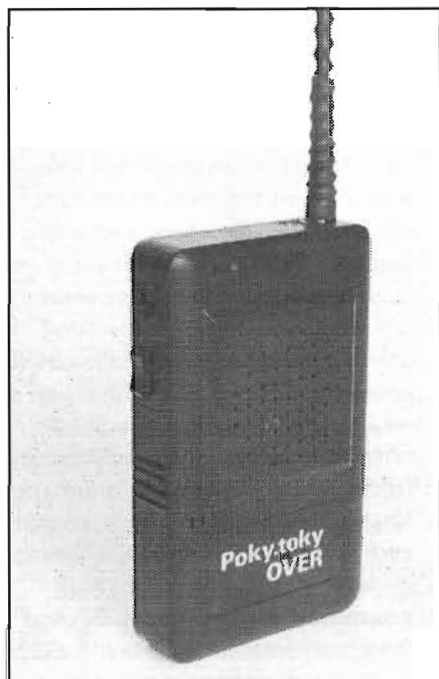
Summary

NiCads are an ideal source of power for portable applications. However as they are more expensive to buy than conventional batteries it is worth taking a few extra precautions to ensure that the best is obtained from them.

(If you fancy building your own NiCad charger, HRT featured a fast NiCad charger project in the August 94 issue, which can charge suitable NiCads in around an hour - Ed).

Poky-Toky Range Improvement

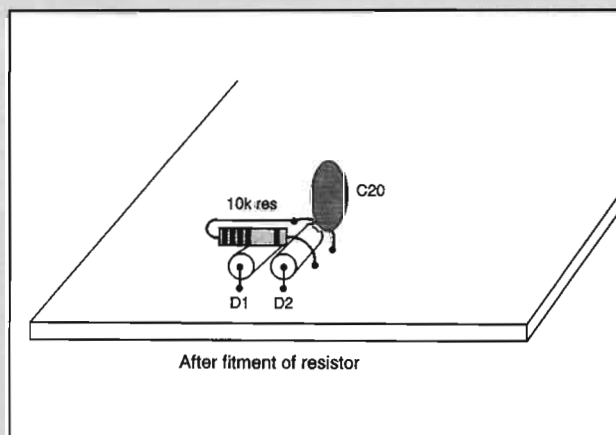
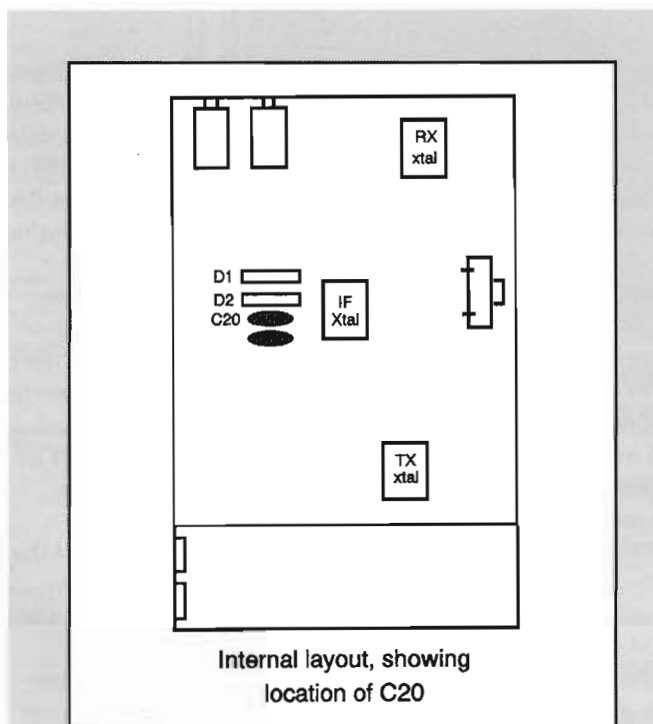
Jonathon Peters GIBAX describes a modification to the Poky-Toky hand held to increase the range



Having obtained a pair of Poky-Toky hand held transceivers, I felt that whilst their range was within the stated specifications (i.e. around 300m), I felt that the squelch threshold, which is preset, was the limiting factor, and not the low RF output. This was confirmed by running a test between one of the Poky-Tokys (which runs 10mW ERP) and a home base 2m transceiver running 2.5W into a quarter wave whip. At a distance of 300m the Poky-Toky squelch began to cut in, breaking up the received signal from the homebase rig. However, in the reverse direction the homebase station was still receiving S9 from the Poky-Toky!

The squelch setting is preset, but can be changed by inserting a resistor in series with capacitor C20. This is a 560pF disc ceramic type below diodes D1 and D2 on the PCB, just to the left of the 10.2450MHz IF crystal. In my units the capacitor is marked 561.

The value of the resistor required may vary from set to set depending



on other component tolerances, but I found 10k to work satisfactorily. Values in the region 12 to 16k will increase sensitivity still further (a larger resistance gives a lower squelch threshold), but operation becomes unreliable as battery voltage decreases, with the squelch jamming open below about 7 volts. Values over 16k are ineffective, and the squelch will be open

Tokys to 600 - 900 metres, making their receive capability comparable with their transmitting distance. Transmit power is now the limiting factor, which I feel is as it should be.

I would like to give due credit to South Midlands Communications Ltd. for sending me a circuit diagram and suggesting the basis for this modification, although all experimental work is my own.

continuously.

This modification very simple, however some care is required as the inside of the rig is extremely crowded. Forget using a chunky 1 Watt resistor from the spares bin! You'll need to find something really tiny (i.e. 0.125 Watt) and bend one pin right back on itself so that the pins are only 2mm or so apart. Then cut one of the pins to C20 and prize the cut ends apart by about this same distance, so that the resistor can be soldered across the gap. It will need to lie flat across diodes D1 and D2 in order for the back of the rig to fit on.

I have found that this modification has increased the range of the Poky-

Packet Radio Roundup



Chris Lorek G4HCL gets a bit agitated with having to switch his system off!

If you're an active packet user in the UK, and have been keeping an eye on the 'goings on' on your local BBS, then by now you may be aware of the major change, and initial controversy, concerning your licence conditions. No? Oh dear! Maybe you didn't read last month's HRT 'Radio Today' section?

For those of you who don't read HRT regularly (shame on you!) and didn't see the announcement, and in case you don't read every issue of the London, Belfast, or Edinburgh Gazettes, then here we go;

The notice!

BR68. Para 2 (5) should now read; *The licensee shall not conduct the Unattended Operation of a beacon or of Digital Communications unless he has given at least 7 days written notice of the location, period of operation, frequency, power (dBW), identity of other users of wireless telegraphy who share the site and shut down procedures to the Manager of the Radio Investigation Service office in whose district the operation is to take place. The Manager may, before the commencement of operation, prohibit the Unattended operation or allow the operation on compliance with the conditions which he may specify.*

This came into effect on Monday 18th July (the day I'm writing this), the RA having announced that it should have been in the Friday, 15th July editions of the Gazette.

Implications

Quite simple really. If you want to leave your packet station switched on while you're not there alongside, you

drop a line giving the required details to the manager of your local RIS office. You'll find their contact details in the October 1992 issue of HRT, or you can find out by ringing the RA's enquiry line of 071 215 2150 during office hours.

The response to this from the RSGB's Data Communications Committee is; Following a number of problems with unattended operation, It has become necessary for unattended digital operation to be notified to the RIS in the same manner as other unattended operation under clause 2 (4) of the licence. Whilst this may seem restrictive, it is important that stations which malfunction and cause interference can be closed down promptly, particularly when these affect safety of life services. The procedures are much less formal than those for a conventional repeater of beacon on a hill top site, and require only agreeing suitable close-down arrangements with the local RIS.

The DCC add that "The above will not affect BBS operation or site cleared nodes". My local RIS office however say they *do* need written notice from BBSs that are not 'site cleared'. Even so, as I write this my other computer is automatically downloading a long message listing, followed by plenty of messages texts I've requested, so maybe not every node or BBS SysOp has heard? Or maybe they're all being run attended? No 7-day shutdown around these parts, at least!

I met with around a dozen local BBS and Node SysOps on the 15th, several of whom were rather stunned with this news. Fortunately through the offices of the HRT Editor I'd managed to get the information slightly in advance of time, and discuss some implications with the

RA, yet still respecting the 'publishing embargo' of the 15th. If you think about it, the procedure is sensible, at least it is in my opinion. If your system has gone into permanent transmit, or worse still is putting spurious out, and is interfering with vital emergency communications such as an ambulance station, the RIS do need to know they can resolve the matter without having to break your house door down just because you're away. Packet is ham radio's fastest growing mode, and a very high proportion of hams use it. But we 'common amateurs' certainly weren't given much notice, were we?

The RSGB have a free 'information pack' available to members and non-members alike on this, contact the RSGB HQ for a copy (contact details in 'Club News' each month). You'll no doubt get a few other enclosures with it if you're not a member, I'd suspect.

CTRL-Z, End of message

News comes from Phil G6DLJ informing us that the high speed south coast to London packet 'Wormhole' should by now be operational, with good links to the LONNY London-new York 'Wormhole'. This also links into the HF gateway run by Phil G3WEG in Chandler's Ford, which links 2m packet in the south with 20m HF packet, for even greater possibilities of worldwide communication. Why not do a bit of 'node hopping' during a period of quiet activity in your area?

Until next month, it's 73 from Chris G4HCL @ GB7XJZ.#48.GBR.EU or you can contact me by post c/o the HRT Editor.

Dick Pascoe G0BPS reveals some new QRP equipment from across the Atlantic

Two years ago I reported to readers that the Heathkit Company of Benton Harbour Michigan had ceased manufacture of the HW series of transceiver kits. I was lucky enough to be at the Dayton Hamvention when they had their final clear-out and managed to buy the very last few HW9s they had, complete with WARC band packs, SWR kits, PSUs etc. Several amateurs were very pleased to benefit from my lucky break!

Although Heathkit have ceased to sell the HW series of radios, they still have large stocks of spares, although they do not have any kits left in stock or packs of SWR kits, WARC band packs or PSU kits. Spare parts and components are however a different matter.

Prices are very fair and the easiest thing to do is quote a credit card number when ordering. But do remember that shipping may well be in excess of the cost of the part, so check in the UK first. One UK company that may be able to help is the Heathkit Spares and Service Centre UK. I'm informed that they have a stock of spares and may be of assistance. Give them a call first on 0242 602402 or call at 12 Isbourne Way, Broadway Road, Winchcombe, Cheltenham. Glos. GL54 5NS.

Ten Tec 'T-Kit'

More news on the kit front is that a new range of kits is now available to replace those from Heath Company. Many readers will be familiar with the name of Ten Tec from the USA. Their "T-Kit division" is the latest section of Ten Tec to provide a range of kits for homebrew enthusiasts. Apparently the engineers and technicians at TT were all lamenting the passing of Heath and eventually the company agreed to step in and provide a limited range of units in kit form.

Ten Tec may be a relatively new

name to many amateurs, but most QRP men are very familiar with the Argonaut series of radios. The Argonaut 515 graced my shelf for several years until a house move forced me choose between my trusty FT707 and the 515. An awful decision to have to make. Needless to say I still have the 707 (for the last 8 years now!)

T-Kits inaugural catalogue carries a broad range of about 25 kits at reasonable prices such as; an "Any band" Direct Conversion SSB/CW Receiver which they describe as "your best buy so far". You can build the receiver for any band you require, 160, 80, 40, 30, 20, 17, 15, 12 or 10m. The kit is supplied without the box but at \$27 (£18) it seems a very good buy, (don't forget the shipping costs though!)

Their six metre transverter looks good too and is again reasonably priced at \$95 (£65 plus p/p). This unit can turn one of many modern HF rigs into a six metre transceiver. Providing the drive can be dropped to below five watts into the unit it will be OK. Just tune the HF rig to the 14MHz band (20m), for example 14.200MHz will give 50.200MHz and as T-Kit say "Now just go for it".

I understand that an SSB/CW HF handheld is on the stocks with a provisional price of under \$100 (£70), a Memory keyer, and a selection of classic test equipment. My own experience of Ten Tec is that if the kits are any way as good as their transceivers they will be very good.

Ten-Tec 556!

At Dayton in 1993 Ten Tec offered a new transceiver to the ham market called the Scout 555. Being a 50 watt output radio put off many potential purchasers in the QRP world, a great shame as that radio had great potential. The ability to be wound

down to under 5 watts was one of the better features. It made, in my opinion a great mobile, holiday, and/or caravan transceiver. My experiments with one proved to be very good although some complaints have been heard.

Readers may remember my comments about a new QRP version appearing. It was promised "in the fall" of last year but knowing Ten Tec I rather expected to see it's first appearance at the 1994 Dayton Hamfest. The Scout 556 is an upgraded and "improved" version of the 555 but with the power amplifier removed. I have yet to try one out on the air (no doubt the Editor will have one for me soon!) I look forward to reporting on the improvements! (see comments below).

The old joke about waiting for a bus for half an hour and then three turning up at once is very like my QRP club magazines. The ones from the VK club, the Michigan club, the Spanish Qu R Pe club and the OK club all arrived on the same day. Lots of very easy reading, but I must say though that none of the above group compares with the UK club's magazine *Sprat*. As an aside, I wondered how many readers are aware of the reason for this particular name. Yes, a sprat is a very small fish and we low power enthusiasts are often called small fry (hi), but it has another meaning too. For many years it has been known as the Small Power Radio Amateur Transmitter. Neat, eh!

The 'QRP Plus'

On Email the Americans have been getting very excited about a new QRP transceiver called the "QRP Plus". It is described as a single conversion receiver incorporating the

Last Month In HRT

'Aerial Special' Projects:

Club Project - Portable Field Mast to support large arrays
Also - a portable aerial support for personal hilltopping!

Reviews:

Icom IC-820H 2m/70cm transceiver
Ham radio book review collection

Features:

Using the Ten-Tec Scout on QRP - Dick Pascoe G0BPS shares his on-air experiences
Getting ready for Contests - Steve Whitstable gives a beginner's introduction
Refilling the Well - Don Field G3XTT describes his DXpedition to Southern Africa

plus

Free ham radio rig modification software copying offer and much more!

If you missed this exciting issue, then back issues for the last 12 months can be obtained by filling in the coupon which periodically appears within the magazine, or by writing to: HRT Back Issues, Argus Subscription Services, Queensway House, 2 Queensway, Redhill, Surrey RH1 1QS. Tel. 0737 768611. The magazines are £2.40 each inc. P&P (£2.20 for each issue over three), cheques payable to ASP.

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SCAF filter, with twenty memories utilising the main tuning knob to change them. Fast tuning is also available plus a very good attenuator. Variable bandwidth is selected by holding the button marked (surprisingly) "Bandwidth", this is then displayed and may be changed from 100Hz to 2400Hz. Facilities are also fitted to work split on frequencies. Running from a 12V supply at 1.5A on transmit at 5 watts of RF out. This could be the answer to the low power enthusiasts' prayers.

What is even more surprising is that this whole QRP HF transceiver fits into a solid box of just 140mm x 100mm x 150mm. It has a substantial feel to it, the strong steel case will give very good protection. Only two are in the country that I know of at time of writing, George G3RJV has one on loan from Index Laboratories and needless to say the other is with Waters & Stanton who will be importing them. Hopefully stocks will be available sometime in

August or September.

Readers will not be surprised to hear that I shall have one in my shack very soon for evaluation and report. I have seen one of these rigs and was VERY impressed. When available, they will be priced at a competitive £649.00. For more details on either of these transceivers contact Waters & Stanton at their Head Office at 22 Main Road, Hockley Essex SS5 4QS.

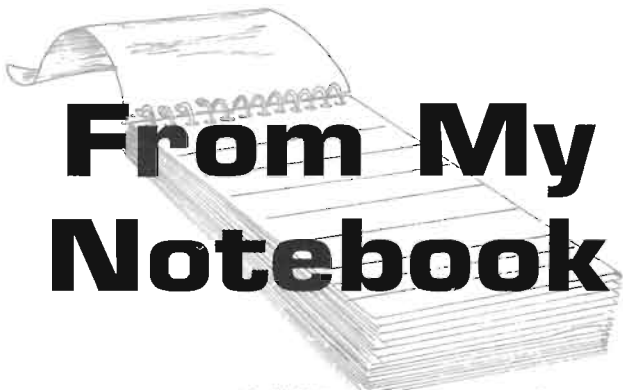


The new 'QRP Plus' transceiver

Circuits

Readers often comment about the small circuits I offer for interest in this column. It will be obvious that, although I have access to many QRP club journals throughout the world (it amazes me at times like this how many QRP clubs I belong to), I do get stuck for ideas. If you have a simple circuit that may be of interest to the low power operators, send it to me at the address below. A rough sketch will do, with components identification and values, I have access to a sophisticated design program for PCBs and also circuit diagrams so making it look pretty is no problem.

That's it once more, news and views (plus a few ideas and circuits) to me via the Editor, to GB7RMS or direct to Seaview House, Crete Road East, Folkestone CT187EG. 72 de Dick G0BPS



From My Notebook

Geoff Arnold G3GSR gives some tips on acquiring a secondhand receiver to get you started on listening to the HF bands

Once upon a time, most new recruits to the amateur radio hobby found their way in through listening on the short wave bands of a domestic receiver. First of all, they would have tuned to the broadcast bands, marked out with little black blocks at intervals along the dial. It was usually not long, though, before they strayed into the amateur segments, and wondered where all these strange conversations, technical or personal, were coming from. My own experience followed exactly that pattern.

Since SSB became the mode for voice communications on the HF amateur bands, that entry route has unfortunately been made difficult; now, it's would be a case of 'What on earth is that strange monkey-chatter?'

Although there are a few fairly inexpensive broadcast-type receivers on the market nowadays which incorporate the necessary BFO or CIO to cope with SSB reception, most are fairly disappointing in their performance. So how does the newcomer to listening find the means to expand his horizons? The answer is of course the second-hand market.

Some of the early solid-state communications receivers by such as Yaesu and Trio-Kenwood are now to be had through the small advertisements in places like *HRT*, or on rally 'bring-and-buy' stalls. But many of the offerings on the second-hand market are likely to be of the valved variety, many designed for the professional applications, and some dating from WWII or immediately after.

If you've been studying the glossy adverts for present-day all-singing, all-dancing, push-button controlled synthesised receivers, perhaps even handled one of them at a club or in a friend's shack, you may be somewhat

uncertain of what to look out for in the older, valved receivers. You may even be baffled by the purpose and labels on some of the controls. This month, I hope to give you a few tips to help you in your search.

Simple Superhets

The majority of superhet communications receivers designed up to the end of the 1940s had only a single intermediate frequency, which would have been chosen according to the signal frequency coverage required. Basically, the receiver cannot have a band which includes the IF. That's why broadcast receivers for long and medium waves traditionally used IFs of 450 to 470kHz, which fit neatly between the two bands.

A receiver with an IF around 460kHz, even if it is blessed with an RF stage (i.e. two tuned circuits ahead of the 1st mixer), will provide precious little rejection of image or second channel interference (from signals at twice the IF - around 920kHz - removed from the tuned frequency) by the time you get up to 20MHz. For such a receiver, a preselector or aerial tuning unit is an essential.

If the receiver was not required to tune the broadcast bands, other IFs were used. For shipboard use for example, where coverage of the VLF, LF and MF marine bands was required, IFs such as 85, 560, 690, 700, 1500 or 1600kHz were adopted, all of which lie outside those bands.

Lower IFs mean worse rejection of image interference; higher IFs mean better rejection.

Which IF?

How do you tell what the IF of a particular receiver is? Unless you have access to the technical specification or handbook, it's not easy, but a clue can often be gained from the frequency coverage. There may be a gap where the IF lies, as in the broadcast receiver mentioned above, or perhaps there may be wide, continuous coverage which ceases at some fairly arbitrary point. In the Eddystone 940, for example, coverage is from 30MHz down to 480kHz, few prizes for guessing that the IF is 450kHz. With two RF stages ahead of the 1st mixer, image rejection claimed for the 940 is a moderately respectable 40dB at 20MHz, although the one which I own won't achieve better than 34dB, even after a full realignment.

If there's no gap in the tuning range, suspect that the range-switch also selects different IFs on different bands. In a Marconi Marine 'Atalanta', for example, which covers 15kHz to 28MHz continuously, a first IF of 85kHz is used up to 800kHz, except on the band which includes 85kHz. For that band, and on all above 800kHz, the set becomes a double superhet, with a new first IF of 700kHz ahead of the 85kHz. Incidentally Marconi claim no better than 30dB image rejection above 15MHz.

That mention of the coverage of the 'Atalanta' points out a feature of marine receivers which affects their use for amateur band listening. The official specification for a ship's HF receiver requires coverage only up to 28MHz, so they don't cover the 10m amateur band.

How Many Stages?

If you can look inside the receiver and see the main tuning capacitor, count how many gangs it has. Allow

one for the 1st oscillator and one for the input to the 1st mixer stage. What's left over is one per RF stage - normally! Sometimes you can get caught out by some unusual arrangement, as for example in the army No. 18 Set receiver section, where there is only a 2-gang tuning capacitor, even though there is one RF stage ahead of the 1st mixer. The W.S.18 is a transmitter/receiver, and the input selectivity for the receiver RF stage comes from the output tuned circuit in the associated transmitter, the aerial being fed through the transmitter tank circuit at all times.

A good HF communications receiver will sport a four-gang variable capacitor to tune its two RF amplifier stages plus mixer and 1st oscillator. Counting IF cans to determine the number of IF stages is a rather more hit and miss affair, as tuned circuits for stages such as 2nd oscillators and BFOs are often built into similar-looking cans. Look for a minimum of two IF stages - top-flight designs sometimes have three, even in a single-conversion receiver.

External Drives and Power

That aerial feed arrangement in the W.S.18 is rather unusual, but some other receivers designed for special purposes can draw power or even local oscillator drive from associated transmitters. Independent power supplies are not too difficult to build if you want to use the receiver on its own. The HT supplies will usually be around 110 to 250V DC.

Receivers designed for mobile use, whether in vehicles, ships or aircraft, will frequently draw their supplies in whole or in part from storage batteries of 12 or 24 volts (a nominal 28 volts in aircraft, where the batteries are always being float-charged). In a shipboard receiver you may find the valve heaters wired in series-parallel groups across 24 volts. If, as often, they can equally well run from AC or DC, you can simply use a 24V transformer and avoid having to rewire the heater chains.

Watch out for a potential safety hazard in receivers built so that they could be used from ships' DC mains, in which neither the positive nor negative lines were earthed. The designer will have achieved this either by having all wiring isolated from the chassis, which could then be earthed, or by mounting the chassis on insulating blocks inside an earthed cabinet. In the Marconi 'Atalanta', the entire chassis is mounted on the earthed front panel by means of two enormous Paxolin 'cheeks'. On DC mains, the entire chassis is live, but on AC mains, where an external power unit is used, the chassis can be safely linked to the earthed cabinet.

External oscillator drives are rather more challenging than power supplies. Marconi Marine once produced a receiver - the 'Pennant' - designed solely for use in HF radiotelephone circuits, which always used 'paired' transmit and receive frequencies at the ship and coast station. All the oscillator drives, including IF offsets and the paired frequency offsets, came from the associated SSB transmitter, aptly named the 'Crusader' (the Crusader with his Pennant, OK?). Luckily, this is a most unusual arrangement; generally it will only be used in transceivers, where receiver and transmitter share several stages, and are combined on one chassis.

Can it Cope with SSB?

The difficulty of achieving the frequency stability required for SSB operation meant that its use prior to the 1960s was mostly confined to circuits using specialised point-to-point receivers. Communications receivers from those earlier years will have had BFOs for CW reception, of course, and maybe even selectable bandwidths, but there were no product detectors for optimum SSB demodulation. That doesn't mean you couldn't receive SSB, just that operation was a little more tricky. For one thing, the BFO injection level (millivolts of drive to

re-insert the carrier at the 2nd detector) was lower than desirable.

The usual drill when receiving SSB on the 'CW' position of the mode switch was to turn the AF gain up, and the RF gain down as far as you could whilst maintaining a reasonable audio output level. That way, the amount of IF signal reaching the 2nd detector was reduced, which was equivalent to increasing the level of the BFO.

Another problem could be the rate of tune of the BFO control. To tune the SSB signal on one of these non-SSB receivers, you first adjust the main tuning for maximum sound level, then turn the BFO tuning until the 'squawking' resolves itself into recognisable speech. That calls for the BFO frequency to be within 100Hz of the missing carrier. To produce a recognisable voice, the error should be no more than a few tens of hertz.

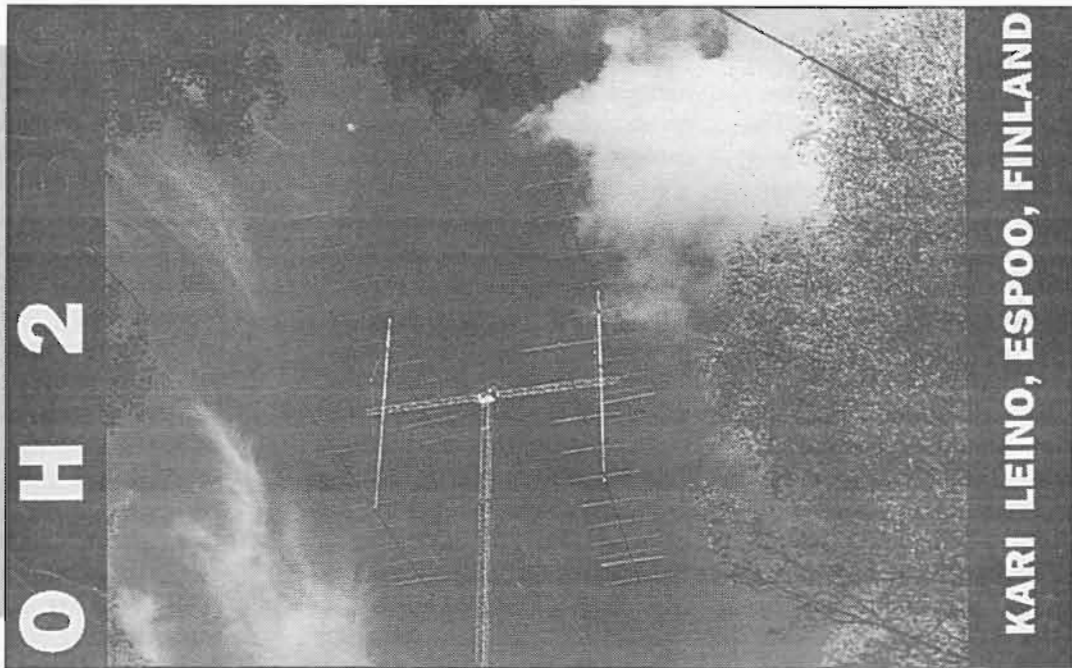
For CW reception, the BFO Tune control would typically vary its frequency by up to plus or minus 3kHz, sometimes more. It's obviously not going to be easy to set it within 100Hz, let alone the desirable 10 or 20Hz, when 3kHz or more of variation is covered by just a 90-degree turn of the BFO knob. Properly designed SSB receivers will have a CIO (carrier injection oscillator, the up-market name for a BFO) control with a range of perhaps plus and minus 500Hz, or maybe 1kHz with a slow-motion drive, which makes life a lot easier. Incidentally, the CIO or BFO control on a professional SSB receiver is often called a 'Clarifier', which effectively describes its purpose.

There are a few SSB receivers around - the Marconi HR22 is one - which do not have any BFO or CIO at all. They were intended for use on point-to-point, reduced-carrier circuits where a pilot carrier at 16 or 26dB below the peak sideband level was transmitted. At the receiver, that pilot carrier was filtered off, reconditioned and amplified for use as the reinserted carrier at the 2nd detector. Such receivers are basically useless on present-day suppressed-carrier transmissions, where the carrier should be more than 40dB below the peak sideband level.

VHF/UHF Message

Geoff Brown GJ4ICD reports plenty of DX for listeners to the recent sporadic 'E' openings

QSL showing the 4 x 11 ele "OH2BC's 50MHz EME array, which made the first European legal QSO across the Atlantic"



June will certainly go down in the record books for 'ES' openings on 6, 4 and 2 metres, unfortunately as I was in Jordan I missed the openings in early part of the month.

The 28 day repeat of the big May opening transpired in mid June, and by the 16th things were really humming on six, the CU beacon was copied for 7 hours in the UK. The 'E' continued to build, and on the 17th 9K2USA and 9K2ZR were worked and monitored for five hours, a distance of around 4600km from my location. That same day ER5OK (KN46, Moldavia) graced many peoples logs for a new one, JY4MB (KM71WX) was also worked at S9+, he was using an Icom 736 with 100W and a vertical aerial.

5T5JC continued to pound the UK with his S9+++ signal on the 17th and 18th. Other new ones on 6m were RA3YO (KO73), EU6MS (KO45), SV9ANK (KM25), EW1AA (KO33), US7CQ (KN59), R3VHF, EH3KU (JN00), and lots and lots of Europeans.

The big surprise came on the 19th as the 'E' continued to build, when FP5EK (St Pierre & Miquelon just off

Canada) was worked in the UK, PA0, and DL. The band was also open to the USA and Canada.

On the 24th/25th my work place started to receive complaints of Italian interference on the 88 to 108MHz band - this meant a possible 144MHz opening. But, the excitement stayed with 50MHz as again there was a widespread European opening to the USA during their field day. The FY beacon was copied at S5 and the Azores 50MHz beacon was S9+ for most of the day everywhere in Europe! I worked Finland, GM, G, SM3, ES and others whilst mobile using a TS60S, all signals were S9+. Signals were very strong from FP, W1, W2, W3, W4, and W5 in central America, but the icing on the cake for most was WB4NFS/VP9 in Bermuda (FM72), a new one for most including your's truly.

Squares logged that day in the USA included EL88, EL87, FN42, FN31, FN32, EL98, EM90, EL97, EM12 and I'm sure lots more. W5HUQ (EM90) stayed on the key for over an hour at 599++.

The next day (26th) things were very dead in the morning, with not a

trace of any ES in Europe. Yes it had done its usual thing of 'burnout' again, but by evening time EA's were heard on the band.

Ela G6HKM had a good month on six. Her catches were EW1AA (KO33), OK2JI (JN89), SO8FHG (KO10) for a new one all on the 2nd. On the 3rd lots of DL's, OK's, OE's and EI2GB (I wish I had that call!) in IO63 and SP7DSB/1 in JO73, the latter two being new ones. On the 9th at 0739z she worked JY7SIX (KM71) for a new country and square followed by DL9USA (JO71), DL2NUJ (JO63), DL1GI (JN38), again all new squares, plus lots of Europeans.

The 14th brought a good opening to SV, but the 19th brought 5T5JC for another new one, and later that night VE3KKL. Would you believe another new one was worked on the 20th in the shape of Z32BU (KN01) and DL6WT for a new square? The next few days brought more new ones like EH4CAV/P (IM89), EH7DBP (IM66), GM3KBS/P (IO78), and in the big USA opening on the 25th Ela pulled off WA4CHA (EL88), K3QKP/EL98, W1JR and WB2QLP. Ela did not mention hearing the VP9, and



'Out for the evening in Jersey' left, Jukka, OH2BR (operator of the 50MHz 4J1FS expedition) and right, Kari OH2BC 50MHz EMer, centre GJ4ICD

this may show how selective the opening was. Ela also managed a contact with Terick CN8ST, but this time on 144MHz on the 21st. This was a new country, new continent and new square for her.

June 22nd and 24th were also good 'ES' days on 144MHz, many stations in the south of the UK reported good openings to CN, EA7, CT1/4, EA1/3, and IS0.

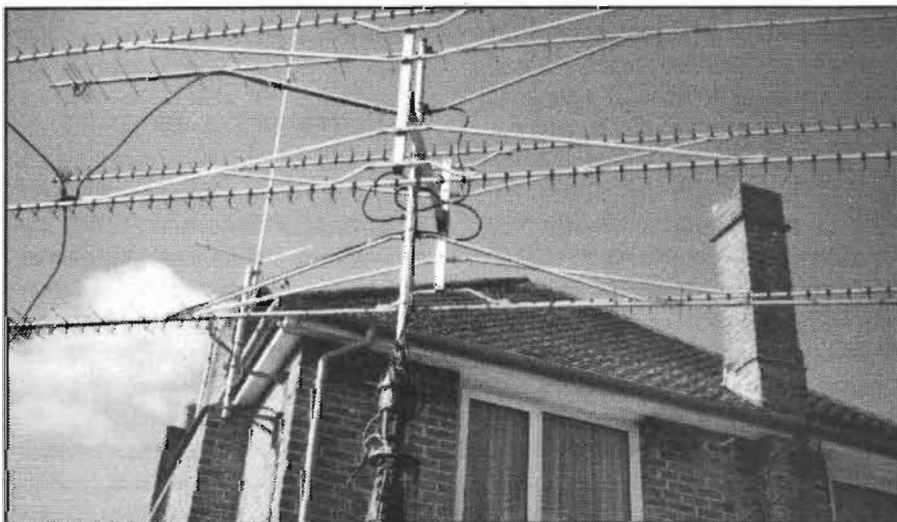
Other News

JY6ZZ is now operational on 50.075MHz from the club station of the Royal Jordanian Amateur Radio

Society. It runs 8W to a vertical and signs JY6ZZ KM71WX. This beacon was built and sponsored by Lawrence GJ3RAX and myself.

UO5OK/ER5OK news now, and, a letter from Dima UT5RP to Neil G0JHC informs us that he is no longer the QSL manager for UO5OK/ER5OK. All QSLs for Mike should be directed to P. O. Box 7, Chadvr-Lunga, 278700, Moldavia, or also via QSL manager I8YGZ.

Oleg R3VHF and Andy RA3TES have received permission to operate on 6m between May 15th and November 1st. Oleg runs 50W to a 5 element in LO16XG and Andy runs 12W to a dipole from LO15JW.



High gain on 23 cm! This high gain array (shown with mast retracted) belongs to Graham G8HVY

R3VHF is awaiting permission to run a beacon on 50.043MHz. QSL both stations is via R3VHF.

A new station to appear on 6m from IM64, Morocco, this summer has been Said, CN8NS. QSL to P. O. Box 6577, Rabat, Morocco. VP9HE has been reported by many US ops during May/June. If you are lucky enough to catch him into Europe QSL via KD8TW.

Corsica, TK/F5HRY appeared on 6m during the middle of May, however, this does seem a little strange as French stations cannot operate portable! QSL via F1HRY - Herve Biraud, 37 Rue Pierre Brossolette, F-91600 Savigny Sur Orge, France.

EU6MS, RC2WBH from KO45 has changed his call to EU6MS, QSL as before to; V. Shchedko, Molodezhnaya 165-143, 211440 Novopolotsk, Belarus, CIS.

CU1EZ, Costa has been enjoying some good Es propagation to North America this summer. In his best opening, 30 stations in VE1/W1/2/3/4/8 were worked on May 17th, between 1922z and 2130z.

Z32BU, Bob made his first 6m QSOs on 16th May 1994. He has been very active on both SSB and CW from KN01. QSL; Box 67, 91000 Skopje, Macedonia.

CIS News, ER5OK in Moldavia has been active this summer, receiving his permit in early June (confirmed by Russian VHF Manager). He has been widely reported in mainland Europe. Mike's first opening to the UK occurred on June 16th, when he was 599 for many hours. His QSL manager is I8YGZ, Pino Zamboli, Via Trieste 30, I-84015 Nocera Super, Italy.

Jimmy, ZB2BL is back on the bands again, he was heard on 50MHz and presumably it was he who put ZB2VHF on 50.035 back on the air. It is not known at present if Jimmy has 70MHz equipment back on the air.

That's it for this month, thanks once again to all for the info and photos, especially the UKSMG. News and views by the 30th of each month please to Geoff Brown, GJ4ICD, TV Shop, Belmont Rd., St. Helier, Jersey. C.I. JE2 4SA or phone/fax 0534 77067 any time.

Satellite Rendezvous



Richard Limebear G3RWL with this month's AMSAT-UK update on our amateur satellites

Dove is still speaking the phrase "Hi, this is DOVE in space" for one minute of every four minutes, although the speech sounds a little 'slurred'. Speech software work continues and the S-band transmitter is presently turned off. The transmitter power is being optimized to maintain a positive power budget. Reception reports are welcome and please send them to PY2BJO. Telemetry is not needed at this time.

LUSAT is still in the recovery mode with digipeating enabled, but the BBS software has not yet been reloaded. Amsat-LU say that if you capture any LUSAT-1 telemetry and send the "raw" satellite telemetry to the satellite control station, you will receive a certificate for your help. These telemetry reports can be sent either via packet radio to LU8DYF @ LU8DYF.BA.ARG.SOAM and LU8DYF @ ANY-ACTIVE-SATELLITE, or via Internet to: lu8dyf@asarin.org.ar. They haven't given a postal address.

AO-27's FM transponder is still operating at weekends when the spacecraft is in sunlight. The transponder uplink frequency is 145.850MHz, and the downlink is on 436.800MHz.

IO-26 also is not yet back. The 435.867MHz transmitter has been heard occasionally but apparently the (normal) 435.822MHz transmitter should be back soon. Amsat-I say that telemetry shows all the vital parameters to be nominal and further tests are to be carried out. Due to the very limited time budget of the command stations, it could be several weeks before normal operations resume.

Oscar 10

It's still operational in Mode-B. Despite good signals from the transponder, there are very few stations using it. Its currently available when in view but *please do not attempt* to use it if you hear the beacon or the transponder signals FMing.

The downlink signals are quite strong from AO-10 but there are

complaints that no users are taking advantage of it.

AO-21

At the time of writing, the beacon on AO-21 was sending this schedule (down 145.987MHz, up 435.016MHz);
min/10 Beacon Mode
0-8 FM Repeater
9 AFSK TLM

Mir Space Station QSLs

For all who have made a contact with MIR and would like to receive a QSL, send your cards to the following address: *RV3DR-Serge Samburov, Space "MIR" QSL Manager Chief of Cosmonaut Amateur Radio Department NPO "Energia" P.O. BOX 73, Kaliningrad-10 city, Moscow Area, 141070, RUSSIA.* RV3DR's packet radio address is as follows: RV3DR@R0MIR-1 or RV3DR @ RK3KP.#MSK.RUS.EU

Fuji-Oscar 20 Problem

In May the FO-20 command station announced that a problem existed in the onboard computer system and consequently the satellite's transponder would remain in the analog mode (JA) until further notice.

AMSAT-NA Space Symposium

The 10th AMSAT-NA Space

Symposium and Annual Board of Directors Meeting will be held this year in Orlando, Florida on October 7, 8, and 9th. The location of the Symposium will be the Holiday Inn near the Orlando International Airport. For further information about the Symposium, please contact AMSAT-NA Headquarters.

Papers covering topics for all amateur satellite disciplines are sought for this meeting, even if you cannot attend the symposium. Author and Title are requested ASAP; compose a short abstract by July 1. Final drafts are requested on or about August 26.

AMSAT-NA's Corporate Secretary announced on June 16 that six nominations for the Board of Directors had been received at AMSAT Headquarters by the June 15th deadline. They were: Keith Baker KB1SF, Tom Clark W3IWI, John Hansen WA0PTV, Andy McAllister WA5ZIB, Lou McFadin W5DID and Bob Myers W1XT.

The Bylaws require that ballots for the election be mailed to all current members by July 15. To be counted, the properly marked ballots must be received at Headquarters by September 15. The three persons receiving the most votes will be declared elected to the Board for a two year period. The two receiving the next largest number will become Alternate Board members until next year's Board is seated at its fall 1995 meeting.

The current Board members who's terms expire this year are: Tom Clark W3IWI, Joe Kasser G3ZCZ and Andy McAllister WA5ZIB. Four other Board members

were elected in 1993 and are scheduled to serve until next year. They are: Junior deCastro PY2BJO, Dick Daniels W4PUJ, Bob Diersing N5AHD and Bill Tynan W3XO.

IARU canvass future satellite needs

The IARU has appointed an ad hoc committee to canvass the opinion of individuals and organizations involved in the

amateur satellite service and to report back to the Administrative Council in early September. The committee wishes to canvass the issues raised by the service, from the point of view of facilities provided, the users and potential users, as well as addressing the benefits and potential benefits to amateur radio in general. The identification of the future needs of the satellite service, particularly spectrum allocation and regulatory aspects is essential.

Two members of this international committee, VE3CDM and ZS5AKV, will have attend the Colloquium and a full discussion, open to all radio amateurs, was planned for Thursday the 28th of July at 7.00pm so that everyone had a chance to air their views.

Amsat-UK news

The Amsat-UK Colloquium will by now have taken place, hopefully you'll be seeing a report on events in HRT soon. The Colloquium this year covered four primary topic areas: Spacecraft Engineering, Future Space Missions, Groundstation and Spacecraft Operations and Associated Amateur Space Activities. The Colloquium is the largest international gathering of amateur satellite enthusiasts and experts in the world and has established a high standard of quality presentations on topics relevant to the amateur satellite community.

Ron G3AAJ now has updated versions of WISP and SatSked; the usual conditions apply for registration (incl. VAT).

For further information about Amsat-UK contact: AMSAT-UK, c/o Ron Broadbent, G3AAJ, 94 Herongate Rd., London, E12 5EQ. Big SAE gets membership info. SWL's are welcome. All new joiners get the USAT-P tracking program on 5-1/4 disk.

KEPLERS			
SAT: OSCAR 10	UoSat 2	AO 13	PACSAT
EPOC: 94161.37059705	94173.06474633	94166.34337152	94174.15857677
INCL: 27.0950	97.7861	57.7884	98.5981
RAAN: 323.3862	187.5613	247.1622	260.0929
ECCN: 0.6022573	0.0010677	0.7213082	0.0010970
ARGP: 185.3079	254.9523	343.7462	170.1818
MA: 163.3129	105.0499	2.0006	189.9580
MM: 2.05878627	14.69223055	2.09724920	14.29901446
DECY: 8.9E 07	1.36E 06	4.05E 06	4.6E 07
REVN: 5467	55102	1447	23045
SAT: DO 17	WO 18	LO 19	FO 20
EPOC: 94174.18230054	94170.23945354	94170.21749238	94169.92864811
INCL: 98.5989	98.5977	98.5981	99.0371
RAAN: 260.4403	256.5458	256.7818	321.4208
ECCN: 0.0011328	0.0011559	0.0011929	0.0541031
ARGP: 169.1131	181.6830	181.8684	335.5902
MA: 191.0302	178.4313	178.2465	22.0420
MM: 14.30040957	14.30014708	14.30110827	12.83225784
DECY: 3.4E 07	2.9E 07	3.9E 07	2.6E 07
REVN: 23047	22991	22992	20435
SAT: AO 21	UO 22	KO 23	KO 25
EPOC: 94173.85683540	94170.22487327	94171.73856331	94170.75009712
INCL: 82.9437	98.4347	66.0787	98.5519
RAAN: 138.5177	244.6813	272.5419	243.7911
ECCN: 0.0037146	0.0007038	0.0014492	0.0011759
ARGP: 68.6256	289.9192	286.1502	164.8772
MA: 291.8858	70.1229	73.7921	195.2762
MM: 13.74541420	14.36919982	12.86286696	14.28057589
DECY: 9.4E 07	5.1E 07	3.7E 07	4.5E 07
REVN: 17036	15337	8724	3806
SAT: IO 26	AO 27	PO 28	RS 10/11
EPOC: 94170.24955337	94170.68921790	94170.75531118	94173.46518979
INCL: 98.8524	98.6530	98.6497	82.9241
RAAN: 246.0735	246.4717	246.6007	324.9389
ECCN: 0.0008442	0.0008021	0.0009625	0.0012694
ARGP: 201.6060	198.3357	185.5514	16.2450
MA: 158.4763	161.7536	174.5560	343.9106
MM: 14.27730782	14.27627002	14.28030137	13.72338600
DECY: 2.1E 07	4.3E 07	5.5E 07	4.1E 07
REVN: 3798	3804	3806	35063
SAT: RS 12/13	Mir		
EPOC: 94173.55362644	94173.46326644		
INCL: 82.9198	51.6451		
RAAN: 7.4681	159.9876		
ECCN: 0.0030653	0.0003094		
ARGP: 92.3538	70.0203		
MA: 268.1127	290.1120		
MM: 13.74042547	15.56388790		
DECY: 3.1E 07	3.227E 05		
REVN: 16338	47686		