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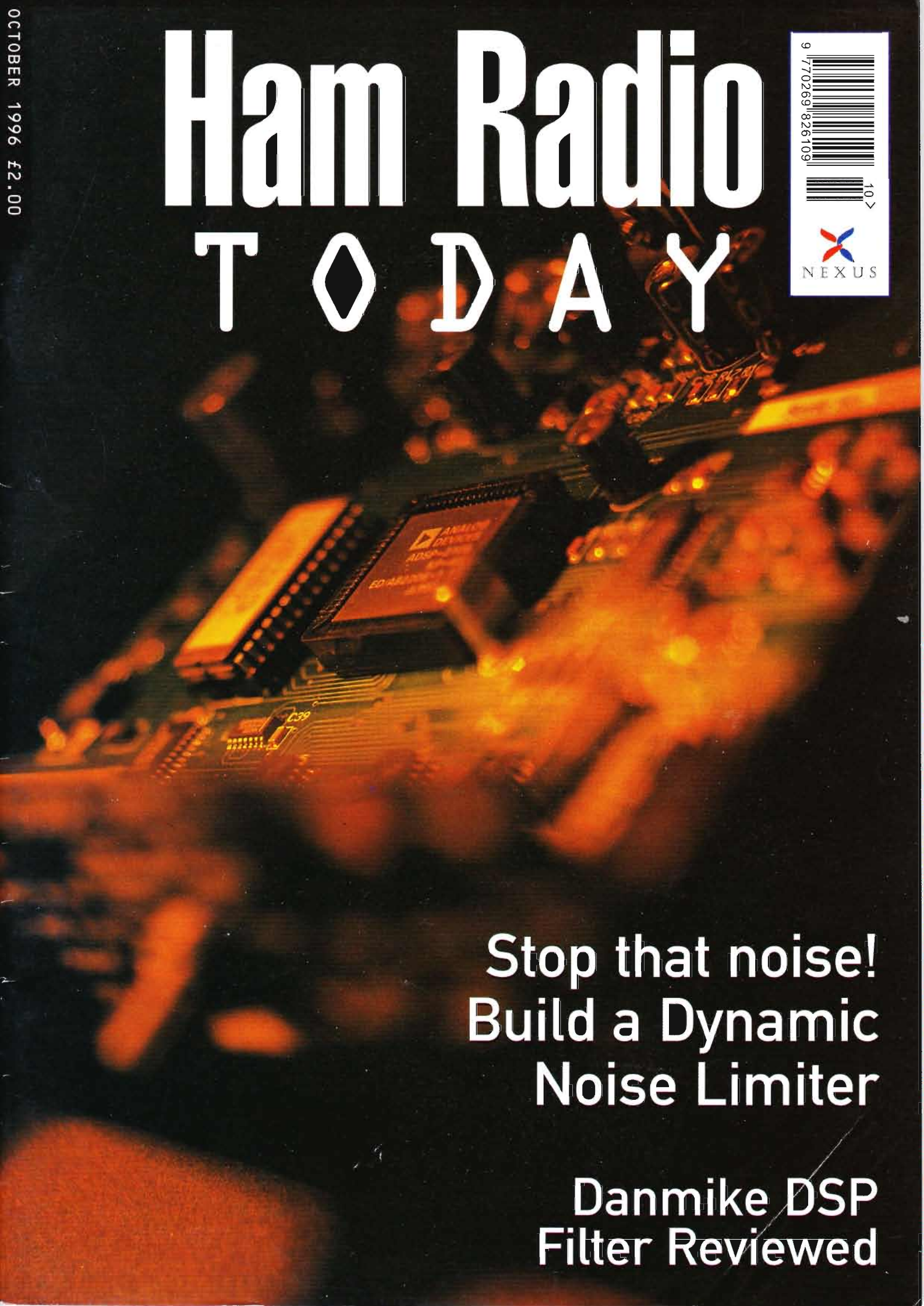


Stop that noise! Build a Dynamic Noise Limiter

Danmike DSP Filter Reviewed

Ham Radio TODAY

HAM RADIO TODAY VOLUME 14 NO.10 OCTOBER 1996

REGULAR COLUMNS

REVIEWS

CONSTRUCTION PROJECT

FEATURES

NEWS AND VIEWS

Build a Dynamic Noise Limiter to help receive those noisy DX signals

CQ from G8IYA Editorial

New life for old frequencies?

In this month's issue you'll find a review of one of the latest the latest Digital Signal Processor units to hit the amateur market. It makes a change from yet another black box transceiver, doesn't it? Also, space allowing, you'll find a construction article for a dynamic noise limiter, complementing the receiver audio processor project in last month's issue.

Such receiver and transceiver 'add-ons' are of course very popular, and I'm sure you'll have seen the 'new breed' of HF rigs with DSP filtering already built in as standard. Reading Don Field G3XTT's *HF Happenings* column this month shows that, in the 70's, the 'death' of HF was forecasted. This was because professional users were progressing to communication modes that required higher quality paths with usually greater bandwidths, and were increasingly progressing to data. All of which HF wasn't very good at in coping with at the time. Skilled operators were the 'norm' for HF, in being able to achieve communication in very trying conditions. Then came the microprocessor.

Nowadays if the QRM gets a bit too much, or the band noise starts coming up and masking the signal, we can just flick a few switches on our DSP unit, or for a longer-term solution run the propagation program on our PC (which is possibly also coupled to the rig's RS-232 port), and the communications quality often gets rather better.

This again is somewhere where amateurs can continue to 'show the way' in achieving communication in difficult conditions. HF QRM effects can be coped with to a greater extent, and we can often achieve 'solid' communications that don't rely on artificial means, such as repeaters and satellites, in communication over distance. Are you listening, professional users?

Meet the man

If you'd like to hear a little more about the use of DSP in amateur gear, from the 'man himself', then Ham Radio Today's Consultant Technical Editor will be presenting an illustrated talk on "Digital Signal Processing in Modern Amateur Radio Equipment" at this year's International HF Convention, which takes place over the weekend of the 5th and 6th of October. You'll find more details in the 'Rallies' section of the magazine, and the talk is planned for the Sunday (6th Oct), in the morning with the talk ending just before lunchtime. I'm sure Chris will also be pleased to answer questions on the many items of ham radio equipment he's reviewed in the past, as well as offering a glimpse of what the future could very well bring. As usual, I'm hoping that I'll again be able to provide another selection of Ham Radio Today give-away 'goodies' for Chris to hand out to attendees at the talk.

Less HF gear in the future?

It's been reported that one of the major Japanese amateur radio manufacturers have been losing out on some of their HF transceiver models, with less and less sales in the Worldwide amateur market. Other manufacturers have been finding a continued interest, particularly in their small, lower-cost HF transceivers. Take the Icom IC-706, and the Alinco DX-70 for example, both of these offer multimode transceive facilities on HF and VHF, in a tiny box and at a relatively low cost compared to radios of yesteryear. The traditional 'mid-level' rigs appear to be the equipment that's suffering, but virtually anything with DSP at the 'top end', at what used to arguably be 'mid-level' prices a while ago, is still selling well. For example, the TS-870 and FT-1000MP are two popular choices, for those who can afford such sets. Is this an indication of the future?

Satellites

As well as HF, another way in which amateurs are again acting as pioneers are in low-cost satellites, for use with relatively simple and low-cost 'ground station' equipment. In other words, with typical *amateur* gear on the ground. The near future should be rather exciting, with the planned launch of the AMSAT Phase 3D satellite. You'll no doubt have read updates on this in the *Satellite Rendezvous* column each month in Ham Radio Today, but for the uninitiated, think of satellite communication with normal non-steered aerials, or on the move from your mobile rig, maybe even from your handheld. It'll also offer great opportunities for experimentation with higher frequencies.

But AMSAT need the help of amateurs, to 'get it off the ground'. If you're not an AMSAT member, then *do* consider sending them a donation towards the costs. Remember, these AMSAT guys are people who are working away for *your* interests, for the future of *your* hobby. You'll find their details in every month's issue, and if you're a PC user and you've asked for the Oscar-13 disk recently from the software service, you'll have found plenty of Phase-3D information on it as well. Without your help, the future of Phase-3D might not be all that rosy.

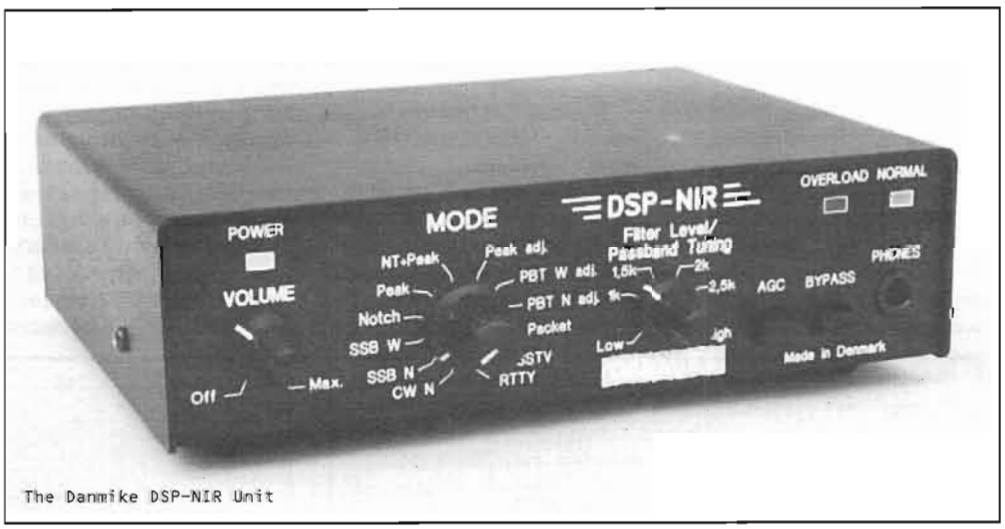
Cover-mounted PCB next month

You'll find a small PCB attached to the front cover of next month's Ham Radio Today. It's to let you build a simple interface for receiving Fax, SSTV, RTTY, AMTOR, CW etc. when plugged into the back of your PC. Yes, it's a 'HamComm / JVFAX' type interface, which with just one op-amp and a few low cost components, coupled to your receiver you use it to decode a wide variety of operation modes, on HF and VHF/UHF. Even a beginner should be able to build it in less than an hour. If you already have or use one, then why not pass it onto to a budding beginner to the hobby? Take a look at the March 95 issue of Ham Radio Today, and you'll see what the board is like. I hope you'll agree that it's another pioneering move, and it makes a change from a front-cover mounted disk!

Danmike DSP-NIR Unit

Chris Lorek G4HCL reduces his aural noise intake and finds HF SSTV pictures are even clearer

What's the secret of working DX, either on HF or VHF/UHF? A good aerial system is certainly high on the list, together with a good receiver and enough power output on transmit. But a skilled operator, who can extract the DX signal under conditions of noise and interference, is also rather important! Typical amateur phases we've heard in past years in this respect are "a good set of ears" and "if you can't hear them, you can't work them!". But we can give our ears a bit of help nowadays.



The Danmike DSP-NIR Unit

In the noise

Being able to hear a weak SSB or CW signal 'through the noise', in conditions that otherwise could have proved impossible, have been the 'hallmark' of many an experienced operator. In my early days as an SWL, on visiting other amateurs' shacks, I sometimes wondered how the operator actually understood what his QSO partner had said - to me the signal just seemed to be obliterated by QRM. This was often down to limited crystal filters, and in 1973 my first 'decent' amateur band receiver (I'd saved up hard!) with its switched crystal filters opened up a new world of QRM-free listening to me.

Things have progressed a lot since then, and besides 'traditional' processing and filtering at RF and IF, sophisticated processing at AF, initially analogue but now commonly digital, is with us.

The DSP-NIR unit reviewed here comes from the Danish firm of Danmike. The model name stands for Digital Signal Processing - Noise Interference Reduction unit, and it's due to sell for £329.95 in the UK. Not cheap, but then it's not the most expensive type around either. The manufacturers claim it has been developed and optimized for professional shortwave reception and amateur radio, and with its impressive line-up of features I'm tempted to agree.

It has fourteen different filter functions, for SSB, CW, Packet, SSTV, RTTY, and no doubt plenty of other modes with its pass-band tuning ability. It uses 16-bit DSP technology to give linear phase filtering with up to 60dB audio stop-band attenuation, plus a fast-acting 'notch' ability to null out multiple interfering audio tones. A 'peak' setting is used to provide noise reduction, and a variable filter level potentiometer lets you adjust the amount of filtering to suit the band conditions at any time.

The unit is housed in a sturdy black painted metal case, 60mm H x 193mm W x 155mm D, and weighs 1.4kg. Audio connections are at receiver speaker audio level, so you'd typically place the unit in-line between your receiver's external speaker output and the speaker itself. The unit has a built-in audio amplifier giving 1.8W into 8 ohms, and for data decoding or recording use, the unit also has a 'line' out, all rear panel audio connections being phono type. There's also a standard 6.35mm headphone jack on the front panel for stereo headphone use, this disconnecting the external speaker when in use. The unit needs a 12V DC supply at 1A, a DC coaxial socket being fitted on the rear panel for this.

Filters

Down to the 'nitty gritty', filters provided in the unit are;

CW; 200Hz bandwidth, with jumper-selected 400Hz, 600Hz or 750Hz centre frequencies.

SSB; 150-1800Hz (SSB-N) and 150Hz-2700Hz (SSB-W) bandwidths.

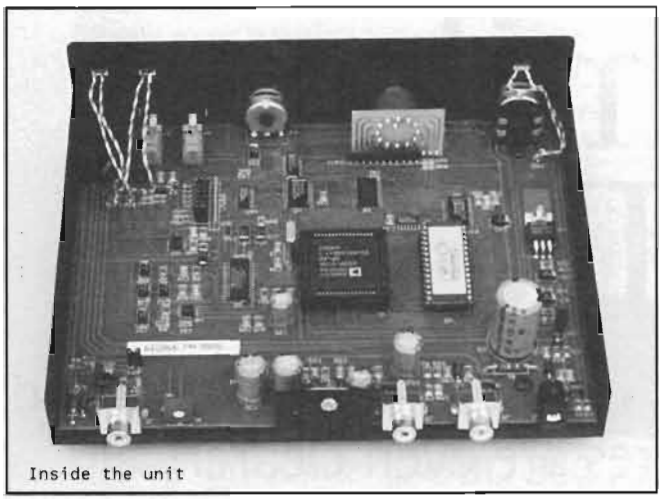
Packet; 540Hz bandwidth, 2210Hz centre frequency.

SSTV; 1050-1350Hz and 1460-2350Hz passbands.

RTTY; 270Hz bandwidth, 2210Hz centre frequency.

Notch; 150Hz-2700Hz filter range with less than 10mS reaction time.

Peak; 150Hz-2700Hz filter


Inside the unit

range, again with less than 10mS reaction time, plus 10-20dB attenuation of 'white noise'.

Pass Band Tuning; 300Hz (PBT-N) or 2100Hz (PBT-W) bandwidths, centre frequency variable in 62.5Hz steps within the 300-3200Hz range.

You'll see from the typical filter passband plot(s) here the extremely good shape factor provided by the filters.

How's it done?

The unit first converts incoming audio signals using an ADC (Analogue to Digital Converter), it's then passed to an ADSP-2105 chip which does all the 'hard work' in processing. By changing the processor software, which stored in a plug-in 27C256 EPROM, the system can be updated or improved so that newly developed DSP filter 'types' can be used in the future.

The passband filters are designed as equi-ripple filters and make use of the decimation / interpolation technique. In 'simple' language this means the filters have very sharp edges, they're also 'linear phase' type which gives filtering without a lot of 'ringing'. This also means that the signal isn't significantly distorted for any subsequent data decoding, i.e. SSTV, packet, etc.

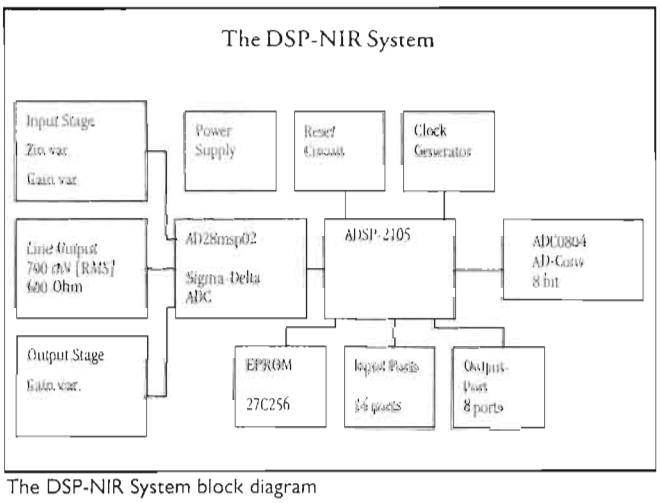
The 'notch' mode uses a correlation technique on the input signal, correlation being a statistical value which indicates how often a given frequency component appears in the frequency spectrum. When a fixed 'pure' sound is completely correlated, and the speech is less correlated, it's possible to distinguish the pure sounds from the speech signal, and thus intelligently filter them.

In 'peak' mode, atmospheric (white/pink) noise is attenuated by the filter dynamically forming passband filters around the voice signal. The peak filter uses, just like the notch filter, correlation as its filtration criterion. As random noise is completely uncorrelated and speech is more correlated, it is possible to distinguish random noise from the voice signal.

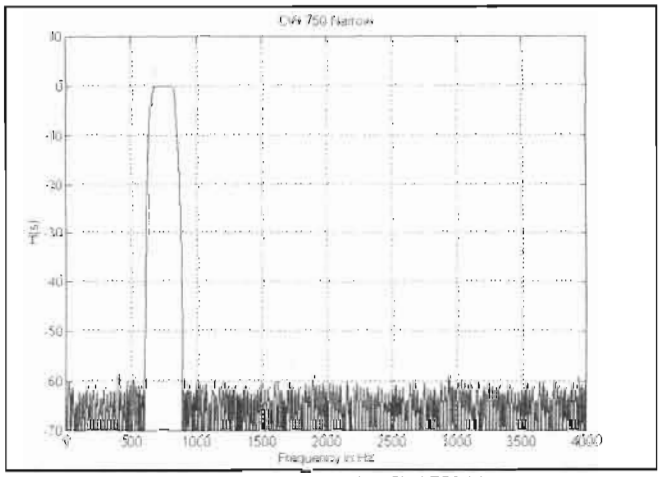
On the air

I used the DSP-NIR unit with a variety of receivers, ranging from one of the latest 'top-of the range' HF transceivers down to a 1970's amateur band receiver. I already use DSP filtering, both internal and external, in my 'normal' station setup (I'm a convert!) so I found it interesting to see how the Danmike unit performed.

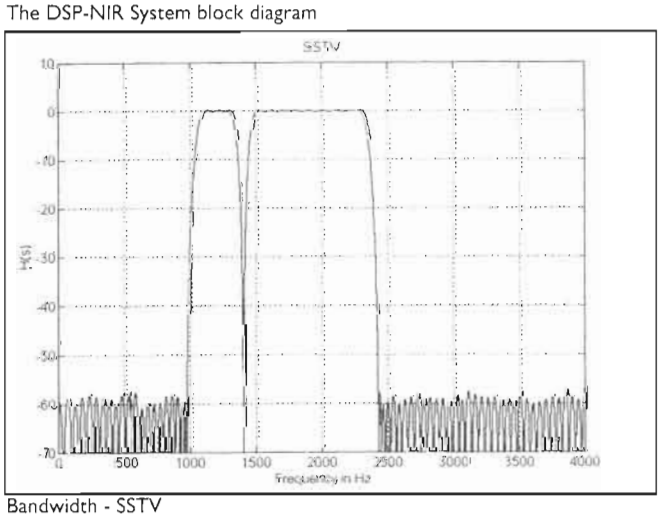
In bandpass filter mode, it cleaned up virtually every signal I tried it on in 'aural' mode, i.e. listening with my 'real' ears. Even with the narrow SSB crystal filtering selected on my



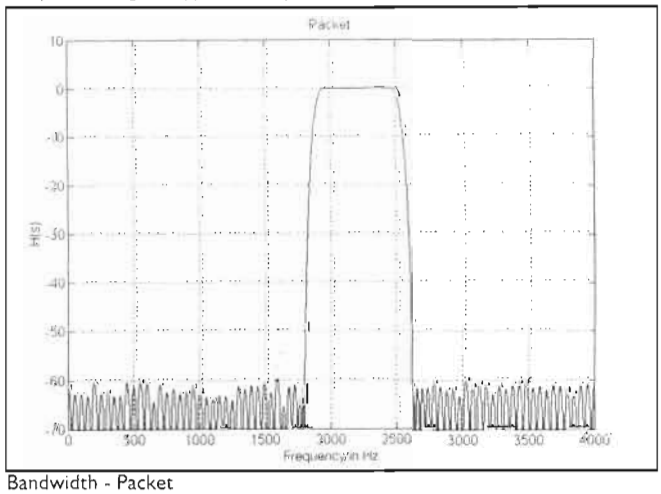
The DSP-NIR System block diagram



Graph showing the typical filter passband - CW 750 Narrow



Bandwidth - SSTV

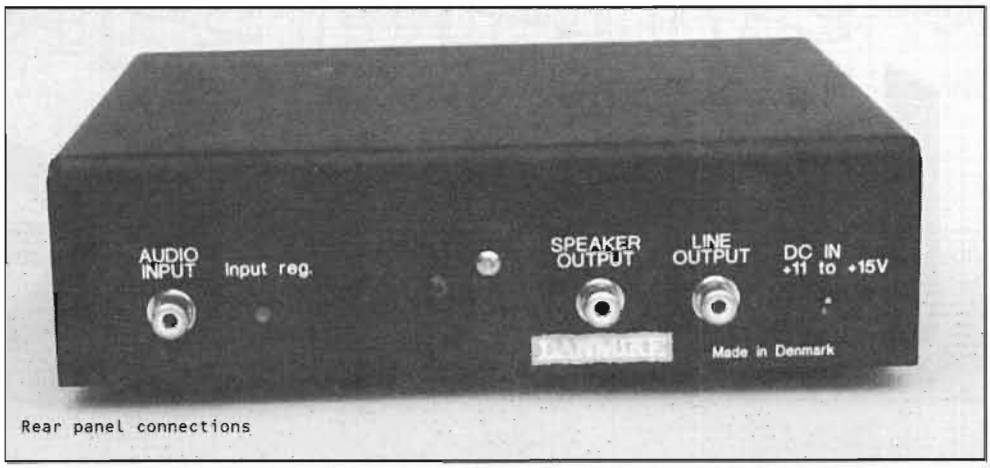


Bandwidth - Packet

receiver, adding the DSP 'SSB-N' filter made the audio that bit much 'cleaner'! Likewise in CW mode, the narrow audio filtering in the DSP unit gave a very clean copy, without the dreaded 'head in a big tin can' ringing effects that often cause me to switch in a wider filter and put up with the QRM for casual listening.

I used the noise reduction mode to a lesser extent, however in conjunction with my transverter system it made 'listening out' on the bands for a weak call, now without the constant background 'hiss', a lot less tiring. For really weak tropo signals it even helped increase readability a bit with its dynamic passband-forming mode. I appreciated variable filtering 'level' potentiometer, as this let me reduce the background noise even more under 'no signal' conditions, adjusting it as needed when signals appeared. However, switching the unit in and out, using the 'bypass' switch, in this mode meant that I constantly had to alter the volume control, the wanted signal being attenuated by quite an amount with the noise reduction peak mode switched in.

In general listening around, I often also made good use of the passband tuning. Here I could tailor the unit's response to the prevailing band conditions, although I found several rough 'clicks' on adjustment, just like a rather noisy potentiometer, due to the digitally-control switching changes.



Rear panel connections

SSTV and Data

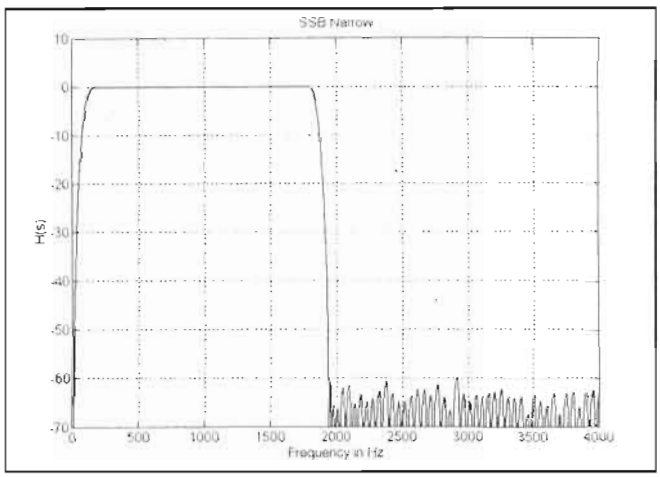
With programs such as JVFAX and HamComm used with an extremely simple audio/PC interface, SSTV and RTTY reception on HF is becoming even more popular. No high-cost terminal node controller or scan converter needed any more. However, the interface usually has very little, if any, audio filtering, so in-band interfering audio can easily degrade the decoded signal. But, add something like the DSP-NIR in line, in 'SSTV', 'RTTY' or 'Packet' mode for example, and the results are quite different. Signals that would otherwise be 'unreadable' came through with no errors whatsoever - superb!

Conclusions

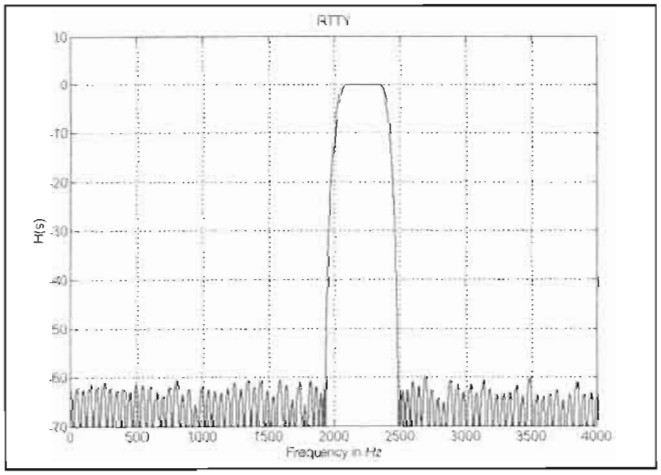
I'm already a DSP 'convert', so when I say I found the Danmike DSP-NIR unit to be a very worthwhile addition to my station, you probably wouldn't be too surprised. If you're a keen DXer with a 'top-of-the-line' station already, this unit should make it better. Simple as that. If you're a lesser mortal like myself, without stacked monoband beams for every HF band, you'll find it improves it even more. It even helps out on VHF/UHF, by making listening to those really weak 'buried in the noise' signals that bit easier.

I'm sure that one day, such a DSP system will be present in virtually every ham rig, because of the great benefits it provides. Until that day, you can easily add one externally, like I did for this review.

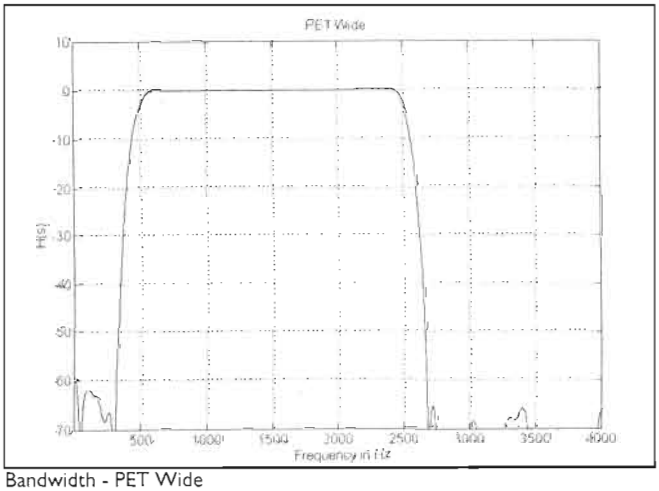
My thanks go to Martin Lynch and Son for the loan of the review DSP unit.



Bandwidth - SSB Narrow



Bandwidth - RTTY



Bandwidth - PET Wide

dynamic noise limiter

Robert Penfold shows how to build a unit to help receive those noisy DX signals

Communications via radio waves tends to be largely about trying to copy weak signals through various types of noise.

I suppose that one of the main attractions of the hobby is, for most of us, the thrill of copying weak DX stations against the odds. Modern communications technology provides many means of combating various types of interference. Some of these involve filtering or other processing of the signal while it is still at a radio frequency, while others operate on the demodulated audio signal. Audio signal processing represents ideal territory for the experimenter, since it is possible to try out various methods without any need to get embroiled with internal modifications to delicate and expensive equipment. The audio processors can simply be 'hooked' onto the 'Tape' or 'Phones' socket of the communications receiver.

Audio signal processing can take numerous forms, ranging from a simple treble-cut tone control to high-tech computer-based systems providing complex real-time digital processing. In general, the more sophisticated the processing, the more successful it is likely to be. However, there is also a strong 'horses for courses' element in any audio processing, and it is a matter of using processing that properly matches the noise you wish to remove.

The unit featured here uses dynamic analogue filtering to combat the high frequency 'hiss' which can be troublesome on any band, but is probably most prevalent when DXing on the HF bands and above. The effect of the filtering is to give a perceived improvement in the signal-to-noise ratio of the audio signal. It is doubtful whether any relatively simple audio processing of this type can directly produce much improvement in the intelligibility of a signal, but there can be definite indirect gains from using a processor such as a dynamic noise limiter or noise gate.

The dynamic noise limiter unit

System Operation

In the DNL unit, the main signal path is through the input buffer stage, the VCF (Voltage Controlled Filter), and the power amplifier stage. Using a small power amplifier at the output of the unit enables it to drive any normal headphones, or a small loudspeaker if preferred. The VCF is a two stage (12dB per octave) lowpass type, and it is this stage that provides the dynamic filtering. It does so in conjunction with a side chain that generates a control voltage which is roughly proportional to the amplitude of the input signal. The higher the input level, the higher the control voltage and cutoff frequency of the VCF.

A front panel control enables the user to adjust the cutoff frequency of the filter. It is actually the cutoff frequency with no input signal that is being set (i.e., the minimum cutoff frequency), and this control effectively sets the degree of noise reduction obtained. The lower the cutoff frequency, the higher the

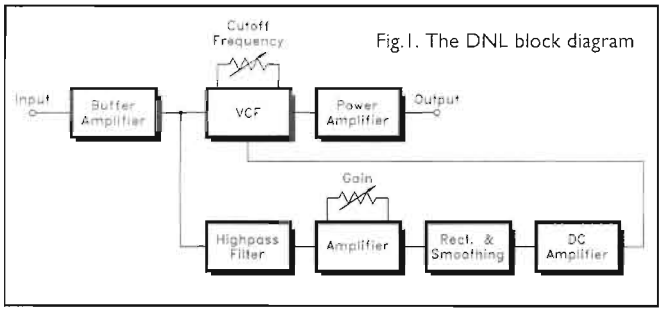


Fig.1. The DNL block diagram

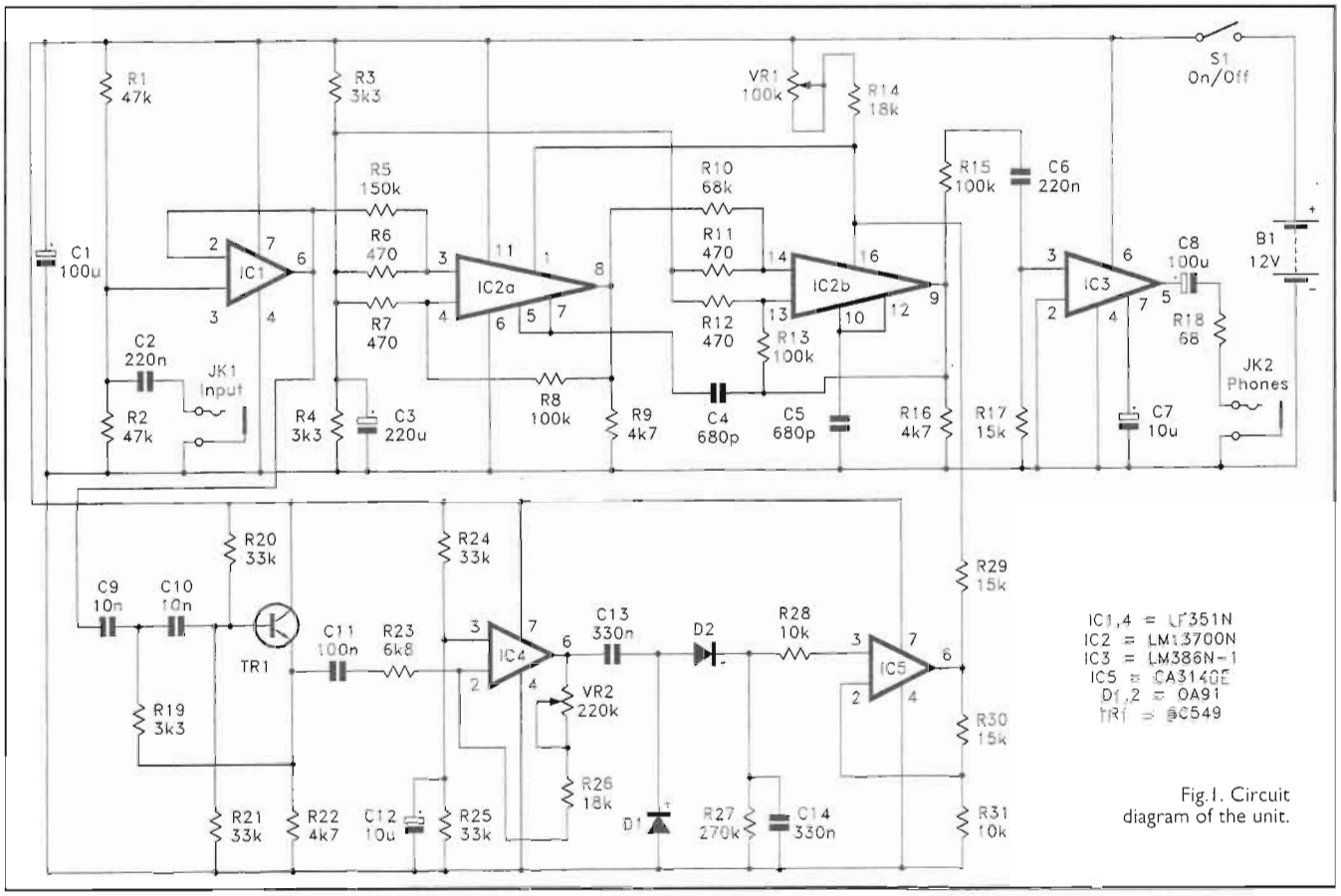


Fig.1. Circuit diagram of the unit.

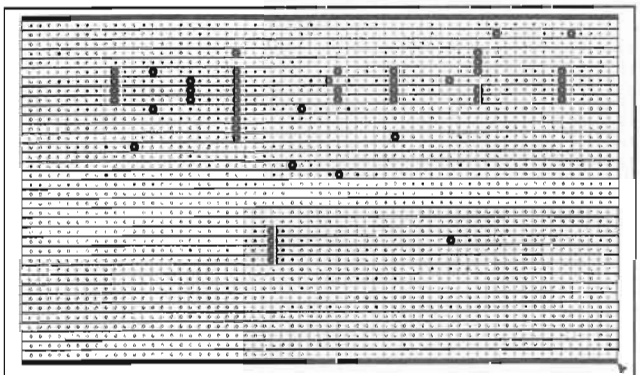
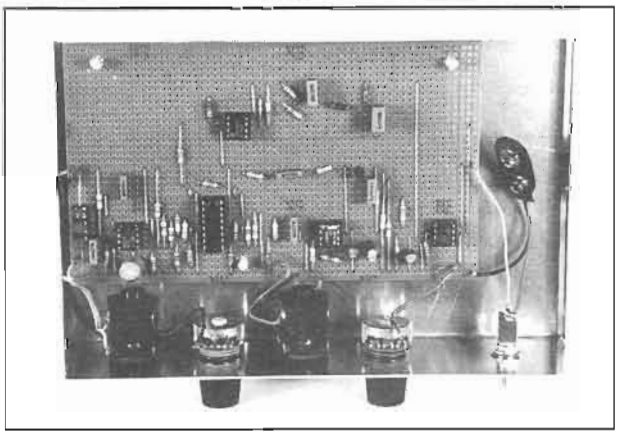


Fig.3. The underside of the component panel (board measures 63 holes x 36 strips)



Inside the unit showing the stripboard panel layout

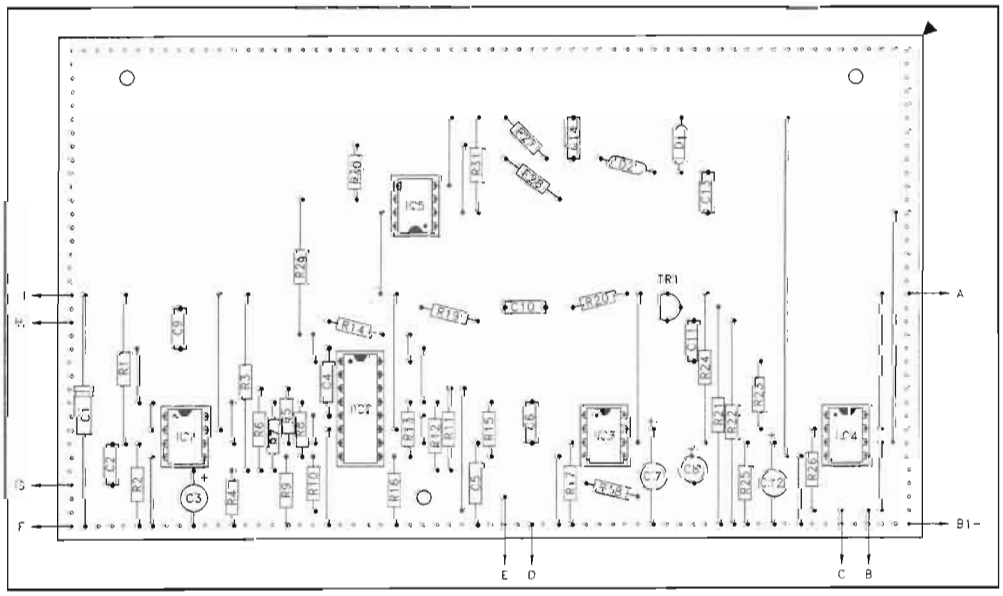


Fig.2.Component layout of the stripboard panel

degree of noise reduction obtained. Setting a very low cutoff frequency could produce problems with inadequate high frequency response, and the action of the DNL becoming apparent. But in practice it is usually possible to obtain a high degree of noise reduction without any major problems.

The first stage in the side chain is a highpass filter. The background 'hiss' is more readily masked by high frequency sounds than by low frequency ones. The highpass filter makes the unit respond less well to low frequency sounds, so that strong low frequency signals that would not mask the noise effectively

do not lift the filtering.

The next stage is an amplifier, and this has a gain control that enables the sensitivity of the circuit to be altered. With high gain, the filtering is removed at a relatively low input level. Low gain results in the filtering only being lifted when the input signal is at its peak amplitude. The ideal setting depends on the prevailing circumstances, and is also a matter of personal preference. The filtered and amplified signal is rectified and smoothed to produce a positive DC signal that is roughly proportional to the amplitude of the input signal. This is used to drive the control input of the VCF, but a DC amplifier first boosts the DC signal slightly, and provides buffering.

The Circuit

IC1 is used in the input buffer stage, this is a standard operational amplifier non-inverting buffer circuit. R1 and R2 set the input impedance at about 23k.

IC2 is a dual transconductance operational amplifier, and it forms the basis of the VCF. A transconductance operational amplifier, like a conventional operational amplifier, has differential (inverting and non-inverting) inputs, but the two types of amplifier have little else in common. A transconductance amplifier is a current-oriented device, and the output current is a function of the differential input current. In practice there are usually series resistors at the inputs, and a load resistor at the output, which effectively gives a conventional voltage operated device.

A transconductance amplifier has an additional input, and the output current is actually a function of the differential input current and the bias current fed to the additional input. This enables a transconductance amplifier to be used as the basis of a voltage controlled attenuator (VCA), or a VCF if a capacitor rather than a load resistor is used at the output. In this case, both sections of IC2 are used as filters, and the two filter capacitors are C4 and C5. The amplifier bias inputs are fed with a current via R14 and VR1, with the latter enabling the quiescent bias current to be controlled. VR1 therefore acts as the cutoff frequency control. The lower it's value, the higher the bias current, and the higher the quiescent cutoff frequency of the filter.

The LM13700N has a built-in buffer stage at the output of each amplifier, and these require discrete load resistors R9 and R16. Each transconductance amplifier has linearising diodes, together with a bias input for these diodes. However, in filter applications these are of little value, and in this circuit the linearising inputs are left unused.

IC3 is the power amplifier at the output of the unit. This is an LM386N-1, which provides more than enough drive current for any normal headphones. In fact it provides too much current for most headphones, and R18 is therefore used to provide a degree of current limiting and attenuation at the output. If preferred, a small loudspeaker can be driven from JK2, but R18 should then be replaced with a shorting link.

The voltage gain of IC3 can be boosted by connecting a resistor and capacitor in series across pins 1 and 8. However, in this case only a minimal amount of voltage gain is required, and IC3's primary role is as a high current buffer stage. The gain control resistor and capacitor are therefore unnecessary in this case. In fact the normal voltage gain of IC3 is slightly too high, making it necessary to provide some attenuation at the input of IC3. This is the purpose of R15 and R17.

TR1 is used as the basis of the highpass filter at the input of the side chain. This filter is a conventional second order (12dB per octave) type, having it's cutoff frequency at about 500 hertz. The amplifier stage uses IC4 as a conventional inverting mode circuit. It's voltage gain can be varied from about 2.6 times with VR2 at minimum gain, to about 35 times with VR2 at maximum value. The rectifier and smoothing circuit is a simple half-wave circuit based on D1 and D2. The attack time of the smoothing circuit is very short, so that the circuit responds almost instantly to increases in the input level. The decay time has to be much longer so that signal does not modulate itself, causing severe distortion in the process. The decay time is still quite short though, so that bursts of 'hiss' during brief pauses in the signal are avoided.

IC5 is used in the DC amplifier, which is almost a conventional non-inverting mode circuit having a voltage gain of 2.5 times. The only unconventional aspect of this amplifier is that it operates with a single supply rail rather than the usual dual supply rails. This is possible because the amplifier only has to provide positive output voltages, and the CA3140E used for IC5 is a type which can operate with it's output at potentials right down to the 0V rail. Note that most other operational amplifiers, including the uA741C, LF351N, TL071CP, etc., will not work properly in the IC5 position of this circuit. The output of IC5 drives the inputs of the VCF via R29. The latter effectively converts the filter from a current controlled type to a conventional VCF.

The current consumption of the circuit is about 16mA from a 12V supply. Eight HP7 cells in a plastic holder are suitable as the power source. The circuit will run from a 9V battery, such as six HP7 size cells in a holder, but the lower supply voltage may produce a slight reduction in performance.

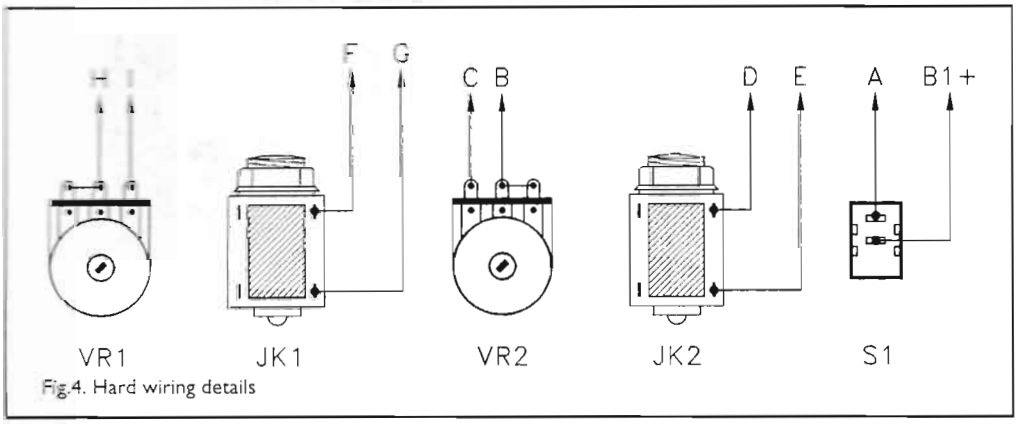


Fig.4. Hard wiring details

Construction

The board has 63 holes by 36 copper strips. Construction of the board is largely straightforward, but there are a number of link-wires and components to be fitted, making mistakes relatively easy. A great deal of care must therefore be exercised when fitting the components. It is not essential to fit the link-wires with PVC sleeving, but some of them are quite long, and they must be quite taut if accidental short-circuits are to be avoided.

Note that the CA3140E used for IC5 has a PMOS input stage, and that the standard anti-static handling precautions should therefore be observed when dealing with this component. Note also that this integrated circuit has the opposite orientation to the other four. It will probably be destroyed if it is used with the wrong orientation! An LM13700N is

specified for IC2, but an LM13600N will work equally well. D1 and D2 are germanium diodes, and these are more vulnerable to heat damage than normal silicon devices. Therefore, take extra care when fitting the two diodes, and complete the soldered joints reasonably quickly.

A metal instrument case measuring about 203 x 130 x 52mm will just about accommodate the circuit board and a 9V battery pack. A somewhat wider or taller case is needed in order to house a 12V battery pack. The gain of the circuit is quite modest, which makes the general layout of the unit far from critical. However, try to find a reasonably practical layout which avoids too much criss-cross wiring, etc.

For stripboard panels I usually find it is better to use 6BA or metric M3 fixings rather than plastic stand-offs. However in this case it is necessary to use plastic stand-offs as these will not short-circuit any of the copper strips to each other, or to the metal case. Mounting bolts and metal spacers can only used if the copper strips are insulated from the spacers using suitable washers. It is the mounting bolt in the vicinity of R16 and C5 that will otherwise give problems with short circuits.

A small amount of hard wiring is needed, as shown, although it is not necessary to use screened leads for any of this wiring. JK1 and JK2 are shown as being insulated (plastic bodied) jack sockets, but open (metal bodied) types are equally suitable. Insulated jack sockets often have two additional tags which connect to switch contacts. The switch contacts are of no value in this case, and the extra tags are simply left unconnected. The connection to the battery pack is made via a PP3 type battery clip.

In Use

JK1 of the DNL unit is fed from the 'Phones' or 'Tape' socket of your receiver via a screened lead fitted with suitable plugs. Where possible it is advisable to use the headphone socket, as this is obtained via the receiver's volume control. This enables the volume to be controlled in the normal way. If the 'Tape' socket is used, there will be no way of controlling the volume unless a volume control is added at the input of the DNL circuit.

If the unit is functioning correctly, VR1 should enable the amount of background 'hiss' to be varied. With VR2 set well in an anticlockwise direction the treble filtering may not be fully lifted, even at high volume levels, giving a rather 'dull' sounding output signal. Advancing VR2 should give a more natural sounding output, but with the 'hiss' level still reduced. A little experimentation with the adjustment of VR1 and VR2 should soon produce settings that give good results with your particular setup. In general, results are best with VR1 set to give quite a low cutoff frequency, and VR2 advanced no further than is absolutely necessary in order to give a reasonable treble content on the output signal.

Although the unit was only designed to combat 'hiss' type noise, it has the potential to reduce any high frequency noise. For example, it can be quite effective at reducing the high frequency SSB 'monkey chatter' found on crowded shortwave bands. The unit is most effective when used with receivers that have something less than the ultimate in IF filtering, giving a wider bandwidth than the minimum necessary for good speech reproduction.

If you have any queries regarding this project please address them to the author c/o the Ham Radio Today address (ensure you write the author's name followed by the Ham Radio Today address so that your letter can then be re-directed), enclosing an SAE if a reply is required.

Any reported updates will be available for at least the next 12 months on the 24hr Ham Radio Today voicebank information line; Tel. 01703 263429

Components list;

Resistors; (all 0.25 watt 5% carbon film)

R1, R2	47k
R3, R4, R19	3k3
R5	150k
R6, R7, R11, R12	470R
R8, R13, R15	100k
R9, R16, R22	4k7
R10	68k
R14, R26	18k
R17, R29, R30	15k
R18	68R
R20, R21, R24, R25	33k
R23	6k8
R27	270K
R28, R31	10k

Potentiometers;

VR1	100k lin carbon
VR2	220k lin carbon

Capacitors;

C1	100µF 16V axial elect
C2, C6	220nF polyester
C3	220µF 10V radial elect
C4, C5	680pF ceramic plate
C7, C12	10µF 25V radial elect
C8	100µF 16V radial elect
C9, C10	10nF polyester
C11	100nF polyester
C13, C14	330nF polyester

Semiconductors;

IC1, IC4	LF351N
IC2	LM13700N (or LM13600N
IC3	LM386N-1
IC5	CA3140E
D1, D2	OA91
TR1	BC549

Miscellaneous;

B1	12 volt (8 x HP7 size cells in holder)
S1	s.p.s.t. mini toggle
JK1, JK2	Standard jack socket

Metal instrument case about 203 x 130 x 52mm (see text)
0.1 inch pitch stripboard having 63 holes x 36 strips
Two control knobs
Four 8-pin DIL holders
One 16-pin DIL holder
Battery connector (PP3 type)
Connecting wire, solder etc.

The KW2000B Transceiver

Some useful modifications and improvements to this classic transceiver, detailed by 'Phosphor'

G4BXD described the KW2000A in the September 1995 issue of Ham radio Today. I am about to describe some features of and modifications to the KW2000B, which are not applicable to the earlier model, and complement those previously described by G3TNO in HRT of 1983 (photocopies can usually be obtained from the Nexus photocopy service, see the rear of this issue for details).

Poor stabilisation of the 150V line

The OA2 gas filled voltage stabiliser, (V20) does not completely remove the effect of the lower HT voltage on transmit. The effect of this is to cause an offset between transmit and receive frequency and a curious flute-like sound to the CW note from the other chap's receiver. To get better stabilisation, replace the essential dropper resistor R96, 2k5 wirewound, on the top middle left of the chassis, by a constant current circuit arrangement, shown in Fig 1 and in the prototype (see photo). The effect of this is to draw a fixed current from the nominal 245V HT line, regardless of its actual voltage, and since the current taken from the 150V stabilised line is the same on transmit and receive, the 150V line will not alter. The IRT and CAL voltages are derived from this line, and so will not alter either.

The KW2000E uses a 150V Zener diode in place of an OA2, but the temperature coefficient and dynamic resistance of the diode used are worse than those of the OA2. I tried using ten 5W 15V 1N5352B diodes in series, in place of the OA2, but the 150V line took 1 hour to stabilise to within 0.1V, whereas the OA2 had similarly stabilised the line in 5 minutes. However, if OA2 is unobtainable, the 10 Zener diodes will be satisfactory, as long as they are mounted on an adequate heat sink. (10 in series gives a better temperature coefficient and dynamic resistance than one 150V diode).

The modification does little to cure the long term drift, due to the VFO heating up, but it does improve the CW note, or so my friends tell me. With battery operation, the improvement in frequency shift with battery voltage is most marked, especially if the resistive dropper and power Zener diode stabiliser for V10 and V11 heater supply is replaced by an integrated circuit voltage regulator. In my DC power unit, the Zener diode was incorrectly connected, and would have supplied the 6.3V heater with the battery voltage minus one (forward) diode drop. Fortunately, I checked the circuit, and fitted an IC regulator before using the DC supply. (A suitable regulator circuit may be found on page 28 of HRT for May 1983, omitting the 4k7 resistor between pins 12 and 7).

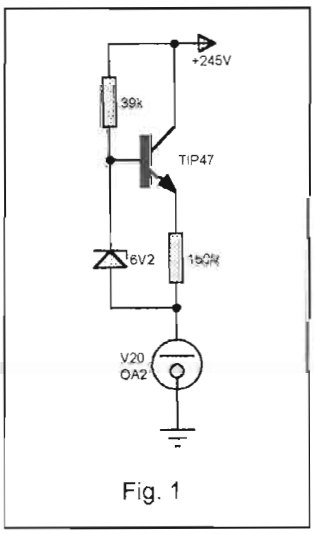
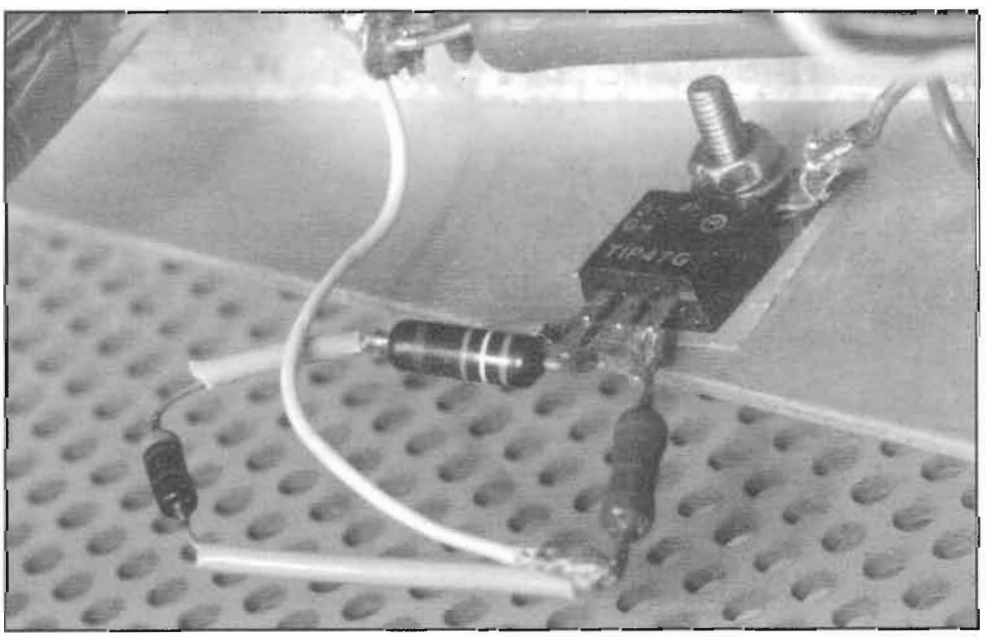


Fig. 1

Fig.1. Circuit of the constant current stabiliser.

Prototype constant current circuit



Send/receive offset

The KW2000B has a 1k variable resistor, (R151) to allow for send-receive offset in the unmodified set, in a rather unusual circuit configuration, drawn out in Fig 2. The resistor is mounted on the IRT switch, above the chassis and no reference to its adjustment is made in issue 2 of the instruction manual. As a result of the above modification, the value must be increased to 4k7, and it is better to fit a multiturn potentiometer.

Adjustment can be done in two ways. The first requires a

frequency counter to measure the VFO frequency at Test Point B (Pin 1 of V19). The procedure is to measure the frequency on receive at the LF end of any band after at least half an hour's warm up (the VFO frequency is not band dependent). Next put the set in transmit mode into a dummy load, on the same sideband and adjust R151 until the frequency is the same as on receive, leaving everything else untouched. That is to say R151 is only effective on transmit, as can be seen from Fig 2.

The other method is to use another transceiver (Set 2) which can be guaranteed to have no send-receive offset. Provide both sets with dummy loads. Put Set 2 into transmission on the appropriate sideband and at the LF end of any suitable KW2000B range, correctly matched into its dummy load. Modulate Set 2 with speech, and tune the KW2000B to give normal sounding speech from Set 2. Put Set 2 into receive, and transmit speech on the KW2000B, having loaded correctly. Adjust R151 until Set 2 reproduces normal speech (do not adjust set 2 to get normal speech).

Accurate netting on CW is easily done by putting the INT/EXT/VOX switch to INT and pressing the Morse key. Nothing will be transmitted, but the nominal 1500 Hz tone will be heard from the speaker. Adjust the RF and AF gains so that the tone and received CW note are of roughly equal loudness. Then adjust the tuning so that zero beat is obtained between these two (do not forget to turn the IRT to off).

Indication of ALC action

The KW2000B has an ALC circuit, operated indirectly by grid current in the PA valves (V8 and V23); this is not fitted in KW2000A. There is no visible means of telling when the ALC is in operation, and this simple modification allows you to see when peaks of speech cause the gain of the transmit amplifier (V3) to be reduced. V3 is an EF183 variable mu pentode, whose anode current will decrease when its gain is reduced. It would be possible to switch the meter to read this valve's anode current, as is done in many hybrid transceivers, but where would you put the switch?

Fortunately the cathode current is of the order of 10mA before the gain is reduced - just right to light an LED. Disconnect the anode and screen decoupling resistor R18 (4k7) from the 245V HT line (three red wires).

Connect the LED by long enough wires to the three red wires on the HT line and to the disconnected end of R18. The anode of the LED goes to HT line, and the connection should be made in a wire helix, just like the other mid-air junctions are, and preferably insulated so that it cannot touch anywhere. The LED can be placed in the corner of the tuning dial window without getting involved in any moving parts. The accompanying photo shows where I put the LED, avoiding any drilling, and also shows another LED in the CAL button. This lights when the IRT switch is away from the off position.

As long as the ALC is inoperative, the (ALC) LED will not flicker with speech. When the ALC threshold is reached, this LED will dim on peaks of speech. It will not dim in the Tune position of the function switch. If an increased effect is needed, a resistor of not less than 220R may be connected across this LED. This will reduce the brightness, but the dimming will be more conspicuous.

The 12V supply for the internal relays is negative to earth in the AC PSU, and positive in the DC PSU. Change the AC PSU by reversing D10 (40266), C5 and C6. You may care to replace these two capacitors by a single 1000µF 40V capacitor, and perform the heater supply modification described in the May 1983 HRT. Having achieved a live

Fig.2. Send/receive frequency offset circuits.

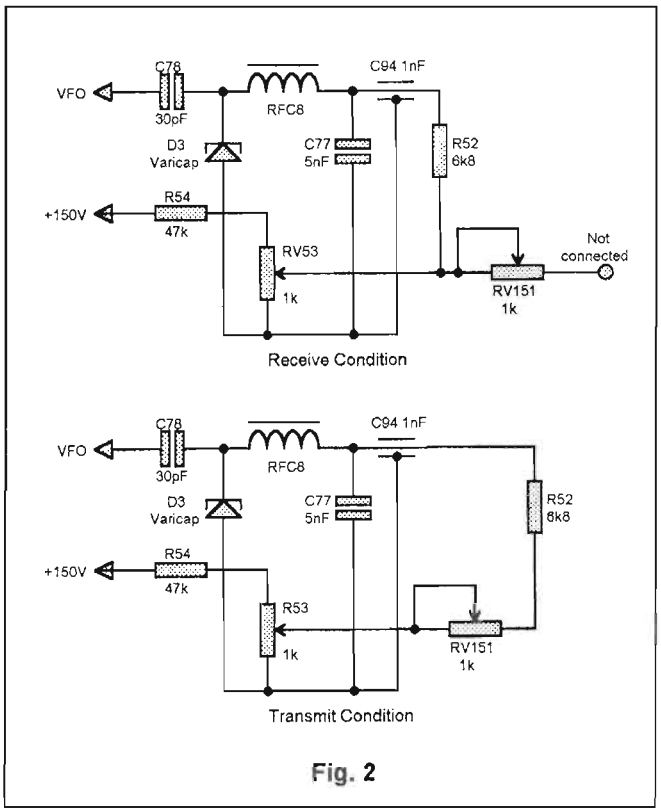
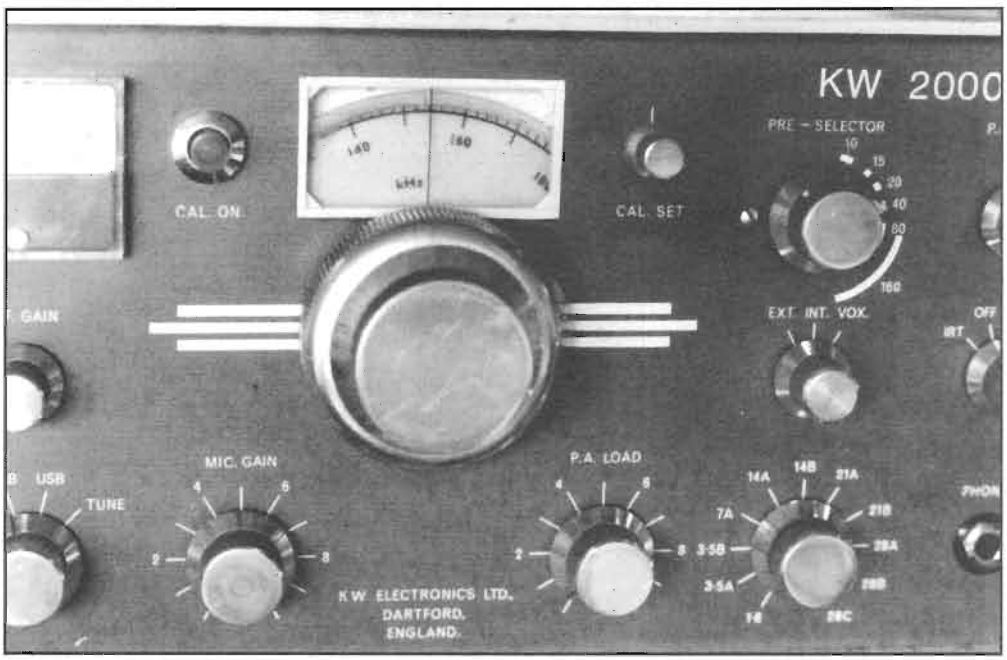


Fig. 2

Front of the KW2000B, showing the ALC LED in the top right hand corner of the tuning dial window.



positive both on AC and DC, the relay supply for Pin 2 on the AC PSU may be stabilised by a 7812 type regulator if so desired. (If this is done, V17 can be replaced by an IC amplifier, with saving both of heater and HT current, but that is another story, as the heater wiring must also be altered).

Pin 2 on the supply plug may now be connected to Pin 8 (unused) on the rear mounted Octal socket (SKT3). This will be available for supplying items such as an electronic keyer, active AF filter, or whatever takes your fancy and needs a low current 12V supply with negative earth.

Cooling Fan

Using this added supply, you can fit a 12V DC fan at the rear of the chassis, on the box containing the PA valves (V8 and V23). If you are really keen on saving current, the fan may be connected across the coil of Relay RL1/4, positive to Pin 14 and negative to Pin 13. This will allow the fan to run only while transmitting, when it is most needed, keeping the internal temperature more constant. Otherwise the fan is connected between supply Pin 2 (positive) and earth (negative).

Further modifications and findings

Replacing V7 by an IC has already been mentioned, and should really await rewiring of the heaters. To place the two PA valve heaters in parallel and the combination in series with some of the other smaller valves is not the best practice, since the 6146 heaters take longer to warm up, and put an overvoltage on the heaters in series with them. (The 6146 and QV06-20 take 1.25A.and 6146B 1.125A of heater current.) So, consider putting the PA heaters in series, as long as the valves are of the same type, and connecting the 12/6V heaters in the 12V configuration; then they can all be wired in parallel. Why not replace V14 (6AL5, EB91) by silicon junction diodes with adequate rating, to save 6.3 times 0.3A worth of heat? Then rewire the heaters, as suggested.

Do not attempt to replace V9 (6BE6), the first RX mixer, by a double triode as is done in the KW2000E. There is not enough HF oscillator injection voltage in the KW2000B to give adequate conversion gain, even if the HT on the mixer portion is reduced; although the receiver dynamic range is undoubtedly improved. I changed the valve holder in order to try it, and had to restore the original circuit as only S9 signals and above gave any reading on the S meter.

Whilst on the subject of the HF oscillator, why did the designer choose to use a 6BA6 for the 100kHz crystal oscillator, and an EF91 for this one? I once had trouble with a 6BA6 as V13. On transmit, V13 and V12 should be cut off, preventing the generation of an AGC voltage. I found that recovery from transmit was taking so long that I was missing the first part of a reply. Investigation showed that although -65V was being applied to the low side of R73 (470k), the grid of V13 was positive, and enough signal was being passed to V12 to overcome the negative bias on its grid. V12 was therefore feeding a large signal to V14, which generated a substantial AGC voltage. Grid emission in V13 was evidently the culprit and replacement of the 6BA6 cured the trouble.

A solid state VFO would be an advantage, and I believe that this has been made. If anyone has a spare VFO, I can carry out experiments, but I am unwilling to sacrifice my only VFO.

If you have any queries regarding these modifications, please write to the author 'Phosphor' c/o the HRT address. Please ensure that you put the author's title followed by the HRT address so that your letter can be re-directed

Any reported updates to this article will be available on the HRT voicebank information line, Tel. 01703 263429 for at least the next twelve months.

SCANNERS

Bill Robertson gives the low-down on a new trunking system

'Traditional' radio communication involves the use of a single 'channel' per radio conversation, and this is still used globally, especially where users need to communicate with each other freely using differing equipments.

Typical examples on VHF are in airband and marine communication. On VHF Airband, a single AM 'simplex' frequency is used per channel for transmission and reception, each radio user taking it in turn to speak. Channels are spaced 25kHz apart, and although there's talk of a change to 8.33kHz channel spacing in the future (that'll be interesting!) the mode of communication isn't likely to change.

On VHF Marine, channels are again 25kHz apart, and FM is used. Some channels are single-frequency simplex, other are two-frequency, where one party transmits on one frequency whilst the other transmits on another, spaced in this case 4.6MHz apart. This allows either 'half-duplex' communication where one party (normally the base station operator) can listen at the same time as speaking, the other party using their radio's press-to-talk switch as needed, or 'full duplex' communication with suitably equipped sets where both parties can talk and listen at the same time - just like a telephone conversation. But again, all conversations take place on a defined and manually selected channel.

Trunking

The use of 'trunking' isn't new, it's been used on landlines and also for STD (Subscriber Trunk Dialling) for many years. It's use in radio systems however is increasing every day, as it's an efficient means of using a limited number of communications channels. Trunking dynamically allocates a radio channel, usually a two-frequency channel with each end transmitting and receiving on different frequencies, and with at least the 'base' end operating in full-duplex mode. You can read a little more in the Oct 92 issue (pages 30 and 31 - "Simplex, Duplex and Talkthrough"), and in my article on "Trunking - What It's All About" in the Jan 93 issue, pages 30 and 31 - article photocopies are readily available from the HRT Photocopies dept. if you missed these.

Channel 'pool'

Briefly, you'll find that there's a 'pool' of radio channels, these being allocated as and when needed for each individual period of communication. Once this has finished, the channel is released back into the 'pool' to be used again as and when required. This makes better use of the available frequencies, as the 'pool' is shared by all parties in a given communication system, rather than each base station having their 'own' channel. Instead, each can have several channels available if they're not in use by others. Microprocessor-based control boards are used in the portable and mobile stations, which accept off-air data commands from the base stations for individual and group calling, automatic channel change, etc.

Met 'blows the whistle'

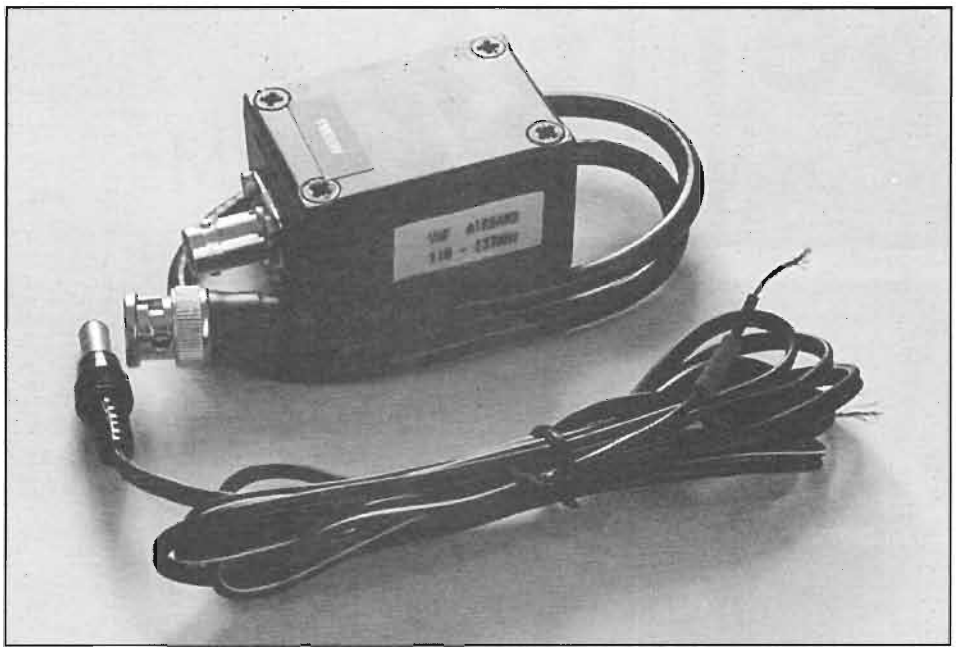
One new user of trunked radio is the Metropolitan Police, who've implemented the first stage of their 'Metradio' project with more than 3,000 police now using a trunked system on UHF. By 1998, it should extend to link all 20,000 operational officers in the force. The system is designed to eventually replace the London Police's VHF system, which has apparently become very busy with 'queues' developing for airtime. It's been reported that the Met say that the Metradio reduces co-channel interference and improves coverage, reduces the opportunity for illegal monitoring of transmissions, makes more efficient use of frequencies and provides a new emergency button fitted to personal radios that automatically opens communication with an officer's control room. The reason it makes it more difficult for 'listening in' is because of the random channel allocation - so you can't just listen on the previously allocated channel for a given area for all communication in that area, as it can happen on any channel in the 'pool'.

It's a fact that many members of the UK public do (illegally) listen into the police, often as an enjoyable hobby pastime using readily-available receivers. But it's unfortunate that some people listen with a professional interest, an interest which is not in line with the safety of other people's property, i.e. thieves. Anything that makes their life harder must be a good thing for the remainder of us law-abiding (well, mostly!) scanner enthusiasts. I also know that some Police Control Room Officers are also scanner enthusiasts, indeed one has reportedly indicated that the introduction of trunking will undoubtedly reduce the number of Christmas cards his control room chaps get each year from scanner listeners!

Discount off scanner accessories

I gave a brief mention last month to the active and passive models of the 'Nomad' portable scanner aerials by Garex Electronics. Coincidentally I'm told that, this month, the Ham Radio Today Ads Dept. have done an exclusive deal with the suppliers for readers to be able to get a 20% discount off the list price of these, with a cover-mounted discount card. Nice one, Garex! Not only that, but Garex have extended the offer to also include their scanner preamps for airband, marine band, and wideband use, plus their scanner notch filter to get rid of unwanted interference. Give them a call direct for more information on 01392 466899.

Garex scanner preamps for airband, marine band, and wideband use at a 20% discount!



Cheap POCSAG receiver?

A message from Clive G6MYT says that he's played with the 'PD' POCSAG paging decoding software and has enjoyed the result. He says that surely he's not the only person who's purchased a Pye PG7 Pager and loaded the crystal of a busy frequency? The result was a very loud audio signal, with plenty of signal level, and he thought he was onto a winner. However, no matter how hard he tried, the interface refuses to see the audio and spin the signal present indicator. Clive found that the TM251E audio output, even the small DIN socket data out line and an Alinco scanner also refused

to offer an audio signal that the POCSAG interface would recognise. However, he found the AOR1000 provided an ideal signal. any ideas from readers?

Hidden signals

I read that a European satellite magazine had recently published a 'hack' of an Intelsat communications satellite. It said that using a satellite scanning device borrowed from a Dutch firm, satellite freaks in Germany had successfully eavesdropped on telephone conversations of businessmen acting as go-between's Saddam Hussein and western firms.

Such eavesdropping can be done on any satellite that carries international communications, said the hackers in the column entitled "Home-Made Espionage". They said it proved that the age of virtual espionage was here.

To find the right satellite for communications out of Iraq they simply used Email to contact a company in Baghdad that leased satellite services. The firm told them the correct transponders on the Intelsat, and they used a 1.5m dish with the receiving equipment to tune into conversations on 'dormant' transponders. Over a five day period they intercepted calls made from go-between's acting as middlemen between Saddam and western companies. The sat-hackers claimed to have intercepted calls from four businessmen staying in hotels in the Iraqi capital. They also intercepted pagers and faxes sent and received. These businessmen placed orders for "medical equipment" and "car parts" that turned out to be for a top missile SAD-16 missile research facility. Orders were also placed for a chemical used in rocket propellant, from a firm in China. The hackers used a feature in the eavesdropping equipment that numerically displayed the dialled DTMF tones, and then found who they were by using a phone directory CD-ROM. The list of businesses, said the sat-hackers, read like a 'Who's Who' of international business.

For around nine years I've used my steerable satellite dish, pointed at various link satellites in geostationary orbit, and have come across what look like scrambled video signals and 'screeching' audio. I fondly remember, around eight years ago, listening to a talk at a British Amateur Television Club Convention in the Midlands, where the lecturer gave precise details on what these were and how to receive the 'hidden' signals.

It's very simple. You take a HF SSB receiver, and plug the aerial connection into the baseband output of the satellite receiver. Tuning through the lower HF spectrum, just like on short wave, reveals multitudes of telephone conversations. Child's play.

MOSSAD Numbers

An Email from Mike G6DHU says that he was browsing this column in the August 1996 issue, and happened on the list of MOSSAD 'Numbers Stations' frequencies and callsigns.

He's suggested a mention of his Internet Numbers Stations pages might be of interest to readers, which can be found at:http://itre.ncsu.edu/radio/numbers.html - indeed these list the very same information!

There, readers will be able to find information on various commonly heard

numbers stations (voice, CW and digital) together with information on books,

magazines and monitoring groups covering the subject.

Rabbit, rabbit

I read with some amusement a paragraph in the June issue of 'Mobile and Cellular' magazine, about the rasping tag-line "Vodafone... you are not alone,". The columnist wondered if there was a hidden meaning for all the analogue phone users out there, adding that it seems listening into cellular calls is rapidly becoming one of the UK's most popular hobbies!

Next month

I was hoping to review the 5th Edition of the new UK Scanning Directory this month, but unfortunately it just failed to make it by post in time for the deadline. It's due to arrive here next week. together with the latest edition of 'Scanner Busters', so I hope to review both of these in next month's column.

Bill Robertson is pleased to hear from readers and will answer queries through this column - address your letters to; Bill Robertson, c/o HRT Editor, Nexus, Nexus House, Boundary Way, Hemel Hempstead, Herts HP2 7ST, or by fax or Email to the Ham Radio Today direct Editorial contact points.

Please remember that reception of some services may not be permitted without appropriate authority. The RA's information sheet on 'Scanners' has full information for the UK.

scanner/receiver reviews In HRT

Missed that review? Here's a list of the very large number we've featured!

Description	Issue
Alinco DJ-X1D handheld receiver	Dec 92
AOR AR-800E handheld scanner	Sep 88
AOR AR-900 handheld scanner	Aug 89
AOR AR-1000 MkII handheld scanner	Scanners Int.Sep 90
AOR AR-1500 handheld scanner	Aug 92
AOR AR 2002 base scanner	Oct 86
AOR AR-2800 base scaner	Jan 92
AOR AR-3000A base scanner	May 92
AR-3000A upgraded	Jul 95
AR-3000A modifications (part 1)	Mar 96
AR-3000A modifications (part 2)	Apr 96
AOR AR-7030 HF receiver	May 96
AOR AR-8000 handheld receiver	Oct 94
Bearcat BC50XLT handheld scanner	Apr 88
Bearcat UBC70XLT handheld scanner	Jul 88
Bearcat BC100XLT handheld scanner	Apr 87
Bearcat BC200XLT handheld scanner	Scanners Int. Nov 89
Bearcat BC580XLT mobile receiver	Sep 88
Bearcat BC700A mobile scanner	Aug 93
Bearcat BC890XLT base scanner	Nov 93
Bearcat BC950XLT mobile scanner	Jul 89
Bearcat DX-1000 HF receiver	Mar 87
Bearcat BC-2000XLT handheld scanner	Jan 89
Bearcat BC-2500XLT handheld scanner	May 94
Black Jaguar BJ200 handheld scanner	Jun 88
Commutech FCR 130 receiver (kit)	Oct 84
DCRX 20m direct conversion receiver (Howes Kit)	Feb 87
DXR10 receiver (Howes kit)	Apr 93
Drake R8E Receiver	Feb 92
Drake SW8 HF receiver	Jul 94
Eddystone 1650 base receiver	Aug 87
Fairmate HP-100E handheld scanner	Apr 90
Icom IC-R1 handheld scanner	Scanners Int.Jun 90
Icom IC-R72 HF receiver	Sep 90
Icom IC-R100 base scanner	Scanners Int.Jun 90
SSB Option	Scanners Int.Sep 90
Icom IC-R7000 comms. receiver	Feb 89
Jandek 20m modular receiver with PSU (kit)	Feb 90
Jupiter MVT-6000 mobile scanner	Jan 90
Kenwood RZ-1 car radio sized mobile receiver	May 88

The Radio Shack DX-394 HF Receiver

The AOR AR-7030 HF Receiver

WiNRADiO wideband scanner plug-in PC card

Realistic PRO-62 handheld

The Bearcat BC2500XLT handheld

Lowe HF-125 receiver	Apr 87
Lowe HF-150 receiver	Sep 92
Lowe SRX-50 portable HF receiver	Oct 92
Maplin reflex receiver kit	Aug 91
Netset PRO-44 handheld scanner	Jul 93
Netset PRO-46 handheld scanner	Jul 93
Netset PRO-2032 base scanner	Mar 94
Radio Shack DX-394 HF Receiver	Sep 96
Ramsey 80m Receiver kit	Oct 93
Realistic PRO-25 Wideband handheld scanner	Jan 96
Realistic PRO-26 wideband handheld scanner	Nov 95
Realistic PRO-27 handheld scanner	Mar 96
Realistic PRO-28 handheld scanner	May 96
Realistic PRO-35 handheld scanner	Feb 92
Realistic PRO-39 handheld scanner	Apr 95
Realistic PRO-43 handheld scanner	Feb 93
Realistic PRO-62 handheld scanner	Jul 95
Realistic PRO-63 handheld scanner	Aug 96
Realistic PRO-2005 base scanner	Sep 89
Realistic PRO-2006 base scanner	Jun 91
Realistic PRO-2025 mobile scanner	Oct 91
Realistic PRO-2035 base scanner	Mar 95
Realistic PRO-2036 base scanner	Jul 95
Realistic PRO-9200 base scanner	Apr 92
Regency HX-2000 handheld scanner	Jan 87
Regency MX-7000 base scanner	Oct 86
Shinwa SR001 mobile scanner	May 91
Sony Air-7 handheld scanner	Sep 87
Sony ICF PRO-80 handheld scanner	Dec 87
Sony ICF-2001D portable receiver	Jan 89
Sony ICF-7600D portable receiver	Jan 87
Standard AX-700 base scanner	Scanners Int.Nov 90
Standard AX-400 (Weltz WS-1000) handheld	Jun 96
Tatung TMR7602 portable receiver	Feb 89
WiNRADiO wideband scanner plug-in PC card	Jul 96
Yaesu FRG-100 HF receiver	May 93
Yaesu FRG-8800 general coverage receiver	May 85
Yaesu FRG-9600 receiver	Oct 85
FRG-9600 (updated) a reassessment	Dec 86
FRG-9600 HF upgrade	Jul 87
Yupiteru VT125 handheld scanner	Aug 91
Yupiteru VT225 handheld scanner	Jul 92
Yupiteru MVT-3100 handheld scanner	Dec 93
Yupiteru MVT-5000 (Jupiter 2) handheld	Nov 89
Yupiteru MVT-7000 handheld scanner	Sep 91
Yupiteru MVT-7100 handheld scanner	Apr 93
Yupiteru MVT-7200 handheld scanner	Jan 96

Scanner/receiver buying guides;

Guide to scanners	Nov 91
Which receiver?	Oct 93
Which Scanner Aerial?	Mar 92

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The AOR AR3000A base receiver

The Yupiteru MVT-7200 handheld

breakthrough solving the real Problem

G. P. Stancey G3MCK gives some helpful advice on the social issues of EMC

Many articles have already been written on the technical aspects of minimising EMC, and this article assumes that you have already taken such precautions. Not only will this reduce the possibility of you having EMC problems with your neighbours, it will also increase your self-confidence by giving you the knowledge that you are operating from a sound base.

However, living in peace with your neighbours is, for the average amateur, what EMC is all about. Yes the technical aspects are important, indeed they are essential, but the reason you are putting in filters etc., is simply to enable you to coexist with your neighbours. This is also arguably the most difficult part of the whole EMC breakthrough problem. The reason is because it involves people and "there's nowt as queer as folk". Remember this also includes you!

Key points to consider

Any successful campaign to defeat breakthrough problems will take due note of the above statements and will build the whole campaign around the fact that the satisfactory resolution of an EMC problem depends on your neighbours being happy. They are the ones you have to please and this may well be a battle for the heart as well as the mind. Military phraseology is deliberately used as you should be aware that you are waging a war.

Victory means you will be able to pursue your hobby in the way you wish. Defeat may mean that you have to cease transmitting. However, having referred to it as being a war, there is no need to be openly hostile to your neighbour, just plan to defeat him and keep the battlefield aspect a secret to yourself. In fact a reasonable attitude and concord are probably two of your most powerful allies.

Tactics

Be civil, reasonable and understanding. Continuing with the military analogy, many of the great commanders have made a point of studying the opposing commander. You should do the same. A technique which is right for one neighbour may be the worst thing you could do with another. In the same vein a personal technique which one amateur may be able to use, may not be one which you can use and vice versa.

Vary your technique to suit the circumstances. How does your neighbour see the problem? The answer to this question is "interference". Make no mistake, we may choose to call it breakthrough, incompatibility of electronic systems, or what have you. But the fact that you are preventing him watching TV is interference in his view. However, that doesn't mean you have to call it interference when talking to him. Choose your words to suit the circumstances.

What does your neighbour want? Strangely enough, the answer may not necessarily be for you to cease your amateur activities! He may be getting at you for some other reason and your transmitting activities are merely a convenient means with which to hit you. A useful concept is that of 'reasonable irritation'. Look around you. Most people live in reasonable harmony with their neighbours even though there are aspects of their living which they would rather they changed. For example, you don't like the colour they've painted their front door, they park their car(s) badly in the road, their garden design is not the one you would choose, children screaming and shouting in their garden when you're trying to relax in your garden, etc, etc. All these instances are of reasonable nuisance. Perhaps the EMC breakthrough is really the last straw which breaks the camel's back. They can't get you for not keeping a tidy garden, but they'll certainly get you for something else.

Be a good neighbour. A good test is to try and think how you would feel if you were living in the house next door. You might see yourself looking at a badly maintained house, a large and messy aerial system which leans at a drunken angle, listening to unintelligible noises which emanate from open windows. In short, you would be living next to a dump. Is this your house? How would you feel, especially if you also thought that these activities were knocking £10,000 off the resale value of your own house? In these circumstances most of us would probably strive very hard to change the situation by any means, and complaining about breakthrough would seem to be as good a way as any.

Look at it from the other side (or know your enemy). Let's now consider a better situation. You see a house and garden that are well kept, well behaved children, aerials whose size are in keeping with the neighbourhood and which look professional. A neighbour who causes minimal nuisance. I'm sure you would feel better disposed towards having this amateur as a neighbour than the former one.

You can't please everyone

However, the point must be faced that no matter what you do and how little (if any) EMC problems are happening, you just won't be able to please every neighbour. This may be sad, but true. In this case you really have to assess what you want and what you are prepared to forego. Of course if things are really bad the authorities may formally vary your licence to restrict your activities. But

let's consider a less extreme situation, one where you are not causing EMC but the neighbour says you are. How much unpleasantness do you want to stand or to have inflicted on your family? If your answer is not much, then you may think that your only choice is to cease operating. But wait, there are other possibilities.

For a start you could try working only mobile or portable. This might in fact cover a high percentage of your present activity and be a reasonable price to pay. On the other hand you could try being sneaky and operate a clandestine station, which means removing all signs of amateur activity from your property.

Use guile and cunning: Start by suppressing all audio emissions, use headphones, don't use a straight key as the mechanical click can carry through the structure of buildings. You should, of course, already have effectively suppressed all EMC, so no further action is needed here apart from making a serious effort to use the minimum power needed to maintain contact - just like your licence says you should. Attend to the visual aspects by hiding or concealing your aerials. If this means dismantling them, then do it in an obvious way. Instal your rig where you cannot be seen operating it. Swear the family to secrecy and prepare a suitable evasive answer in case you are asked any direct questions. At this point if you are genuinely free of EMC your operations should be truly undetectable. If you have minor EMC you will probably get away with it. The average TV viewer tolerates a lousy picture and if he can no longer synchronise the minor ripples on his picture with sound coming from your shack, he probably won't notice anything. The above is rather an extreme line to take and should always only be considered as a last resort.

Here's some examples of other less extreme actions; Running high power only when breaking a pile-up, which could perhaps virtually solve the problem.

Reducing the number of aerials on your property to the minimum you really need would undoubtedly improve the appearance of your property in the eyes of your neighbours. Perhaps using a flag pole would be more acceptable than a guyed pole. It certainly would have less visual impact.

Making a positive effort to win as many of the neighbours to your side as possible. A way of doing this could be by getting them to understand what amateur radio is all about and how much it means to you as a hobby. In this context it could well be profitable to be able to show home constructed gear. This can do a lot to establish your reputation as a man who really knows what he is talking about, rather than appearing to be just a guy who has spent a lot of money. Does anyone like a flash spender? On the other hand it may be a bad thing to do if your shack looks like a junk heap. Remember, suit your tactics to the circumstances.

Isolation

Try isolating the troublesome neighbour. For example, you may have promptly fitted filters (maybe even out of your own pocket) to all the other TV sets, except Mr. Nasty's who won't let you in his house. It is quite possible for another neighbour to tell him he is a fool to his face and he is getting all he deserves! Yes, I personally know a case where this did happen. Mr Nasty was not popular in the area but Mr Amateur was popular. He had promptly fitted filters to all the TVs where he was allowed, and another neighbour revelled in the trouble that Mr Nasty had brought on himself. This can give the amateur in question the support of the neighbourhood in carrying on with his hobby.

Finally, it cannot be stressed too often that you must strictly follow a policy of good EMC practice. Probably the main points to follow are: correctly filtering all leads, and effective earthing and efficient screening, which also means a good quality coax.

When moving house

The above has only looked at the situation which faces an amateur who is already living in an area. But people move house for a number of reasons, one of which may be to avoid an EMC situation. Whilst moving house is traumatic and a balancing act between what you can afford, what you can get, and what you would like, it is worthwhile giving EMC some consideration before you sign up for your new house.

For a start, it would be wise to try and move to an area where TV signal strength is high. Field strengths can vary by tens of dB and that can easily make the difference between an easily solved problem and an intractable situation. Some idea of field strengths may be found by writing to the BBC (BBC, Broadcasting House, London W1A 1AA) or IBA (Engineering Information, IBA, Crawley Court, Winchester SO21 2QA) who publish such data. You should remember that there can be significant variations in any area, and just because the area as a whole enjoys a strong TV signal level, this doesn't guarantee one in your road, you should go and look for yourself. Do the houses have large aerials? Can you see masthead preamps? Neither of these would be good news. Make contact with local amateurs and take their advice, then consider this information when deciding whether to buy that house.

Having moved in, most of us would expect to do very little operating and a lot of decorating! Use this enforced inactivity to good cause. As early as possible, get some masts and aerials up, although it's probably a good idea to exercise moderation and install them gradually. Your neighbours will have got used to them by the time the RF starts flowing, and any slight touches of EMC may well pass unnoticed or unconnected with your aerials. If you start energising them immediately, what is more natural for your neighbour to immediately connect any wobble on his TV with that new contraption in next door's garden? If you can arrange to do the aerial rigging in the winter months, so much the better. People don't spend too much time outside then, the light is poor, and when spring arrives they well have subconsciously come to accept the new intrusion.

Start your operating by carefully feeling your way. The locals should be able to tell you if certain frequencies are more troublesome than others. Keep your power down. As time goes on, you can extend your operations if all is quiet on the EMC front. Of course, you might decide to go clandestine from day one.

The most blatant thing you can do is to erect all your aerials in mid-summer, use gleaming copper wire, run high power, and take the signal on a loud speaker (with the audio well turned up) in front of the open shack window. This is just asking to be noticed, and to be blamed for any problems that beset the neighbourhood.

Another aspect of house moving, which merits very careful thought, is whether the new location is likely to be excessively noisy. In other words, the possibility that you may be the victim of EMC! You should therefore try and avoid buying a house which is near to installations such as overhead power lines, radio (transmitting?) masts, electricity sub-stations, electricity switching sites, electric railway lines, industrial estates, hospitals who may be using RF equipment, garages and boatyards who may well be using welding gear, etc.

These potential sources of EMC are given solely to indicate the sort of things which are best avoided, there are many more. Again the best course of action is to visit the site and visually inspect it with the above list in mind. You should also, ideally, make several visits equipped with a portable receiver so that you can hear the ambient noise level on the bands in which you are, or may become, interested. The visits should be made at different times of the day and on different days of the week, not forgetting weekends. Finally don't forget to ask the local amateurs for advice on this.

Letters

Letter of the month

Dear HRT,

I recently accepted a request from a young 'prospective' amateur to visit my shack. The young person duly arrived, and his eyes nearly popped out of his head when I called a station in Iraq and got a reply. The young lad listened to the QSO with great interest and asked if he could say "Hello" to the other station. Of course I couldn't allow him to, but it did make me think what a pity it was that I couldn't. Here was a perfect opportunity to build on the interest shown by my visitor. As we know, greetings facilities exist to non-licensed people on occasions - JOTA for example, I began to wonder if we could extend this facility, so my idea of a 'provisional' licence was born.

The basis of the idea is very simple. When a prospective amateur enrols for the NRAE, or applies to take the RAE, could they not be issued with a form of provisional licence, which allows them to operate from the normal main station address of a fully licensed amateur who is willing to take part in the scheme?

Willing amateurs could register at a central office and be pared-off with prospective amateurs local to them. They could then reap the benefits of 'hands-on' amateur radio under the strict supervision of the fully licensed 'trainer', who would make the initial call, establish a contact and then be able to hand the microphone or key(!) to his trainee.

As we know, our hobby is crying out for new blood. The JOTA arrangement does indicate the idea of a 'provisional' licence is at least feasible. Anyone interested enough to enrol for the NRAE or RAE, should be encouraged to stick at it. 'Hands on' experience would be beneficial and encouraging. I have already put this idea to local amateurs and via the packet network to a larger audience, the response has been very supportive.

I used a young person as my example, but see no reason why, as with the excellent Novice scheme, older prospective amateurs shouldn't be eligible. Obviously this is a basic outline and it could be changed, but the idea is a good one. I have already written to the RSGB and RA and am awaiting feedback, perhaps through your magazine you could put the idea to your readers.

W.A. Barnett, G0JID

Editorial comment;

We already have the ability to let non-licensed visitors pass a short greetings message from an amateur radio club station, the station we've set up at a local school certainly enjoys this facility and lets the youngsters get a chance to say 'hello' on the air. Our three children also used this 'club station' greetings facility when we successfully contacted Helen Sharman, GB1MIR, who was on board the Mir space station orbiting the Earth. There's talk of this facility being extended to individual amateur stations, however Mr. Barnett's idea goes one step further in allowing 'real' QSOs rather than a simple greetings message with a limited number of countries. What say other readers?

Balanced content

Dear HRT,

Two odd thoughts:

1) I live in a terrace house in a conservation area with one neighbour who incessantly complains of my transmissions. Had it not been for compulsory Morse I would now be living in the country, bothering nobody.

2) The first pointer to Sporadic E is often SSB activity on 27MHz. Listening for this, one has to note that proceedings are more polite than on 14MHz.

Arising from these and a hundred less original thoughts I really enjoyed the letters from G8JNZ and G4OWY (August issue) and offer my hearty endorsement.

As one of your competitors (my subscription to which I have just cancelled) has set out to rubbish the United Kingdom Radio Society, I trust to see a more balanced approach in Ham Radio Today.

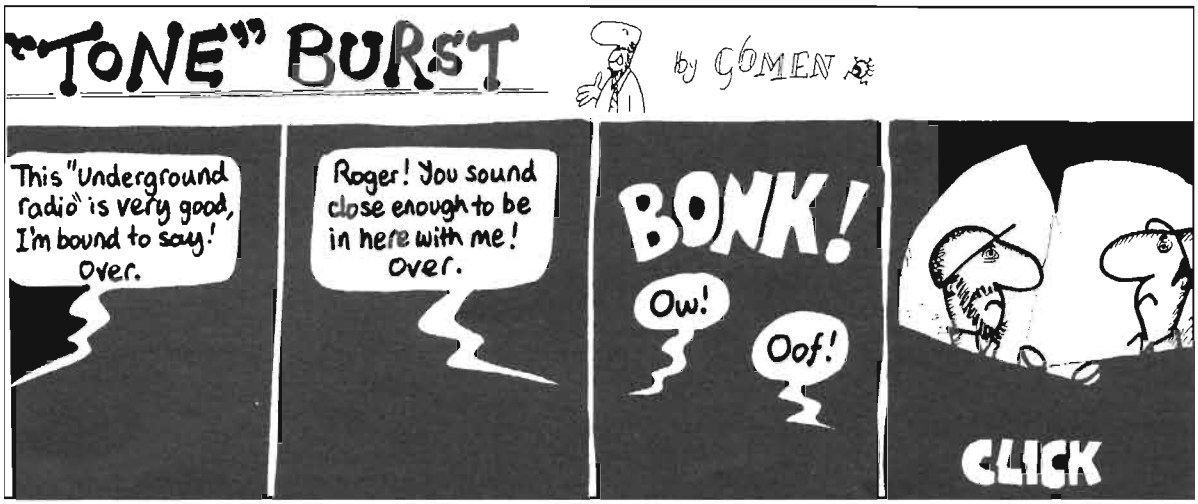
'Sandy' GM0IRZ

Editorial comment;

We try to present the facts, the whole facts, and nothing but the facts. No 'censorship' here when it comes to news of societies, or indeed anything which is of interest to the ham radio community!

£10 for 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 the 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 (normally paid during the month following publication). So write in with *your* views, to; *Letters Column*, Ham Radio Today, Nexus, Nexus House, Boundary Way, Hemel Hempstead, Herts HP2 7ST, or fax your letter direct to the Editor's desk on 01703 263429 (fax letters for publication *only*, for general readers queries please see the 'Readers queries' section in the *'Who's Who and What's What in HRT'* section at the rear of this issue), or Email to hrt@netlink.co.uk. Please keep your letters short, we reserve the right to shorten them if needed for publication. Letters must be original and not have been sent to any other magazines, and must include names and addresses plus callsign if held. Reader's views published here may not necessarily be those of the magazine



Insurance success

Dear HRT,

Earlier this year I wrote to HRT (Feb '96 issue) requesting assistance from other amateurs in support of my insurance claim for a TS-50S and FT-480R stolen from my car when on holiday the previous year. You might recall that my insurance company had turned down the claim on my house contents (personal possessions) insurance policy on the basis that the items did not, in their opinion, meet with their definition of personal possessions; namely "personal items normally worn or carried about the person". As a result I made an appeal to the Insurance Ombudsman, supported by information sent to me by many amateurs, confirming use of similar equipment in every aspect of Mobile/Portable. Photographs were received showing similar equipment being used backpacking, on bikes, in the country etc.

I am pleased to report that thanks to the fantastic support I received, I won my case and the insurance company have now settled the full amount due under the policy, I shall soon be heard mobile HF using the replacement IC-706!

One incident did occur just prior to me hearing from the Insurance Ombudsman. I was mobile using my remaining FT-208R handheld on 2m to obtain directions to another amateur's QTH. On arrival, not risking leaving my FT-208R in the car, I put it in the side pocket of my jacket. I was desperate to use the toilet so my friend directed me quickly to his WC. As I lent over to flush the toilet, there was a 'plop' and there was my FT-208R immersed in the loo! It was quickly retrieved, cleaned and dried out, but the damage was done it no longer functioned at all. My only thought was how on earth was I to tell this to the insurance company, they would never believe it!

Anyway good news, with the Ombudsman ruling that I received a few days later on the stolen equipment, they settled the claim for the handheld also without hesitation.

Thanks to all those amateurs who took the time and trouble to write and send photographs to me. 73.

Ray Oliver, G3NDS

Editorial comment;

I am very glad you managed to get the insurance money on your equipment refunded, thanks to the many amateurs who supported you. I couldn't help laughing when I read the story of the FT-208R, that was bad luck, but at least the insurance company paid up for that as well. Has anyone else a funny or unusual story to tell, please write in and give us all a laugh!

Operators and constructors

Dear HRT,

I would like to heartily endorse the sentiments expressed by G8JNZ in your August issue.

It seems to me that a certain amount of élitism is creeping into our hobby, not only in the operator v. constructor argument but also in connection with the number of countries contacted, or contest points claimed.

Speaking personally, I have done no involved construction work for forty years, have never entered a contest or chased DX, and admit that most of today's technology is a complete mystery to me.

Nevertheless I have always operated within the terms of my licence without annoying others, and done my best to put something back into Amateur Radio over the years, considering myself just as much a radio amateur as the next man.

Some of us must understand that much depends on the finance, time, garden space available, and most important of all, one's individual wishes.

Motorists of my acquaintance do not criticise those who do not carry out their own car repairs - what makes amateur radio so different? Whatever happened to Ham Spirit and "Live and let live"?

E. G. Allen, G3DRN

SSL, yes

Dear HRT,

I have always had good service from SSL. I send my payment when I get the reminder (in case I forget) and it's back within the week. If G4XPP makes them wait two months for payment, he can hardly blame them for making him wait two months for the documents. Maybe they are trying to tell him something? The RAE is in May, so June/July must be a busy time for them.

73, John G4BYV

QRP corner

Dick Pascoe G0BPS reports on his trip to the International rally at Friedrichshafen Germany

Well, the annual trip to Germany to the rally in the beautiful town of Friedrichshafen went very well. Comments about he journey down by coach with the Barnsley Amateur Radio club should best be avoided. No reflection on the company, but a journey of 20 hours in a coach is not my idea of fun.

The show itself was great as usual, with many traders from all over the world attending. Even our own Waters and Stanton was represented by Mark with a good display of equipment. Other UK organisations included Telford Electronics and the RSGB. The flea market was not as good as last year, with prices going up and the amount of rare Eastern Block equipment going down. There were still bargains to be had though, if you were willing to delve into the piles of equipment.

I helped on the G-QRP Club stand throughout the show as usual. It was run by Rev. George Dobbs G3RJV and we were helped out by Sheldon from Hands Electronics and Roy Lewellen W7EL of Elnec & Eznec fame who was on holiday (sorry - vacation!) at the time. Personal tuition during a visit to my house helped me get to grips with this great antenna analyzer program too.

Such was the 'feeding frenzy' that the club almost sold out of kits on the first day. We had taken the same stock as last year and sold only a few items. It appears that the recession is almost over in Germany, we heard of other traders and groups saying the same thing. Selling out is great, but we needed more stock for the remaining two days and couldn't quickly pop back for more !

A visit to the stand by Tom K2DCY proved interesting, as he is an avid key collector and swapper. His list of over 500 keys available for swap was amazing. Tom also runs a web page for those interested in Morse keys, with pictures of most of his collection available. The URL is: http://www.chss.montclair.edu/~pererat/telegraph.hml He states that he has "500 descriptions , 300 photographs, other collectors, telegraph history and trade lists of keys, old scientific instruments, old radios and microphones. Check it out, as they say.

One other great thing found at the show was a fun thing from the German Society DARC, 'The Wooden Morse Key' with a selection of text to send. You will see from the 'photo that the key was huge and designed to be used with the left foot. A time limit of 1 minute was given to send the given text. Huge fun was had by all that tried.

At the end of the second day, tired and hungry, we saw a welcome glass of champagne for us from the French national society. They obviously took pity on our bedraggled appearance!

Canadian QRP Award

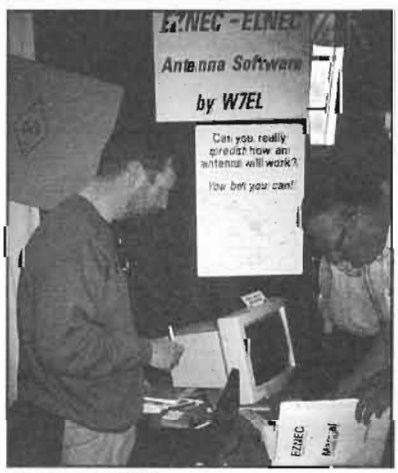
A new QRP Award has just been announced by Jeff Heatherington VA3JFF. The Canadian QRP Award is "designed to encourage QRP operations by recognising the accomplishment of completing two-way QRP contacts with all twelve Canadian provinces and territories."

Power levels are the 'usual' QRP ones and QSL cards are not required for the award. A copy of the log with $C2.00 or 2 IRCs for each certificate is all it takes. Endorsements are available for each band, mode and power level, these are just $C1.00 each

Certificates are printed on 215mm x 300mm paper in full

Mark and John Francis on the Waters and Stanton stand

The DARC left footed Morse key



Roy Lewellan W7EL

The G-QRP Club stand (L-R) Dick G0BPS, Sheldon GW8ELR and George G3RJV

colour, with fully scrolled artwork. These certificates are numbered sequentially as well as being numbered for country, state etc.

No dates or time limits are given, and contacts prior to the announcement can be used to claim the award, which is available from; Jeff Heatherington, 3399 Cardinal Drive, Niagara Falls, Ontario, Canada L2H 3A6. If you're on the Internet, try http://www.geocities.com/colosseum/2572/qrp.html

For those interested, the areas are: Nova Scotia (VE1, CY0, CY9), Ontario (VE3, VA3), Saskatchewan (VE5), British Colombia (VE7, VA7), New Brunswick (VE9, VE1), Prince Edward Island (VY2, VE1), Quebec (VE2, VA2), Manitoba (VE4), Alberta (VE6), North West Territories (VE8), Yukon Territory (VY1) and Newfoundland (VO1, VO2).

2m QRP

I've often asserted that QRP is not the province of only the HF operator, and I recently had great fun on the 2m band. I tend to sit on 144.300MHz and, when called, I usually move to 144.333MHz. Whilst chatting to Hein DJ6JJ, the talk got around to power levels. He got right down to 500mW. The power control on my rig is a small control on the bottom of the front panel of the rig. When I got it to the lowest position (where I couldn't even see any deflection on my meter, although at this power level and didn't know exactly what it was) he was still giving me a 5 and 2 report.

A couple of days later I had the chance to use my milliwattmeter and found that the power level for this contact was just over 700mW. That was for a distance of 402km, not bad under flat conditions. To prove the point yet again, whilst chatting to another local (5 miles away) I was called by F1CPQ in Paris. This was on FM, and conditions again appeared to be flat!

Following on from this, I have just spent Sunday doing the VHF QRP contests, great fun! We used my callsign this time as the other two on the team were on a flying visit from Holland. They came over just for the contest. Harm PA3AQO is a regular visitor for many years to chez moi, Edwin PB0AOE was on his second visit. We had a great time with the contest which was only bettered by the barbecue and the opening to SM, LA and OZ later in the evening. It truly amazes me what can be worked with just 10W of SSB.

By the way, I have a QSL card from a US station, confirming an SSB QSO on 144MHz. Regretfully, the 144.200 was a mistake, it was, as you've guessed, on 14.200 .... sigh.... could have won that award...

Time for the usual mention of the Annual G-QRP Convention at St Aidan's church hall in Sudden in Rochdale. This year the convention has been brought forward to avoid clashing with the popular Leicester Exhibition. The QRP event is to be held on Saturday 12th October with the doors opening at 10.00am for visitors. The entrance fee has been held yet again at -1.00.

Talk-in will be on 144.550 (S22). There is a large social area with a gathering of QRP related traders. No black boxes on show though! There will be as usual a bring and buy, component stands and the kit traders. Food and drink is available all day with the famous meat pie and mushy peas sold at lunch time. This is, without doubt the very best QRP event in the whole of the UK, I agree that Yeovil is good but Rochdale has that extra edge. I hope to see you there.

That's it for this month. Yet again news, views and comments to me either via the Editor, via GB7RMS on packet, Email to Dick@kanga.demon.co.uk or snail mail to Seaview House Crete Road East, Folkestone CT18 7EG.

From my notebook

Geoff Arnold G3GSR discusses the effects of heat on components, and discusses methods of keeping your equipment cool and working

Heat is a by-product of the operation of all radio or electrical equipment, and is usually an unwanted one. Off the top of my head, I can only think of two instances where it is either necessary or desirable. In the first of these, the thermionic valve, it is necessary - no heat, no emission; no emission, no amplification or oscillation. But it is certainly not desirable, unless you are using it to heat your shack in winter! The second, usually found only in military or other professional equipment, is where drying heaters are fitted into the bottom of a cabinet to prevent moisture condensing on components and wiring and causing equipment failure.

If heat is an unwanted by-product, then we generally need some way of safely getting rid of it, so that it does not in itself cause failure of components. Heat can be transmitted from one place to another in any of three different ways - conduction, convection and radiation - and usually a combination of these will be at work.

Conduction

As the name implies, this is where heat is conducted directly through a substance. The physics textbooks tell us that the molecules at the point where heat is applied thrash about violently, and the resulting vibrations are passed along the substance, spreading the heat as they go. A practical example from a slightly different area of electronics is where you are soldering a wire to a terminal tag or pin, holding the wire steady with your spare hand. If the wire is bare - of tinned copper for example - the heat will very quickly reach your fingers, prompting you to drop the wire with a few well-chosen words. Usually, a good conductor of electricity is also a good conductor of heat. If the wire had been covered in insulation (PVC for example), very little heat would have been felt, because a good electrical insulator is usually a good heat insulator, although there are exceptions.

Convection

Conduction takes place in solids, but in gases and liquids the heat transfer mechanism is convection. The molecules here are only loosely bound together, so that there is room for them to move apart when the are heated. As the liquid or gas expands in the region where heat is applied, it becomes less dense and therefore rises. Cooler molecules will move in to replace those that have moved on, and thus a current of the gas or liquid - called a convection current - is produced to carry away the heat.

Liquid cooling is generally encountered only in specialist applications such as very large transmitting valves, as the intricacies of insulation, recirculating the liquid, and keeping the system leak-free are unnecessary complications for anything smaller. Gas convection cooling - usually the gas is simply air - is encountered in just about every piece of radio or electronic equipment, carrying away the heat from transformers, resistors, valves, transistors, etc.

In any equipment producing significant amounts of heat, especially where the components are fairly tightly packed, these natural convection currents are helped on their way by means of a fan. A fan-assisted cooling system can take one of two forms, known technically as forced-draught and induced-draught.

In a forced draught system, the fan draws air directly in from outside the equipment case and blows it around the components. Obviously the air must go somewhere; it is no good trying to push it into a sealed box. The equipment designer will have arranged for holes, slots or grilles to be placed at strategic points in the case to encourage the air to flow past heat-producing or heat-sensitive areas, and then out into the room or other surroundings.

In an induced-draught system, the fan is operating the other way round, sucking air out from inside the equipment. Once again, this will not work if the case is a sealed box; ventilation holes, slots, etc., must be provided in the case through which air can be sucked in from the outside.

No atmosphere (except in a laboratory or factory 'clean room') is totally free of dust, and the currents of air produced by the fan will naturally carry dust particles with them. In the forced draught system, an air filter placed at the fan input should collect a large proportion of the dust, and reduce its build-up inside the equipment.

In the induced-draught system, dust is sucked in along with the air through every opening in the equipment case, and the majority of it will be deposited inside. Where dust forms a layer over components, it will act like a blanket, preventing them from getting rid of their heat so efficiently to the passing air currents.

On this argument, the forced-draught system has to be favourite. The dust will collect on the filter, of course, but at least that gives you just one item needing periodic cleaning, rather than having possibly hundreds of components to dust off, with the risk of damaging something. Despite that, many equipment manufacturers seem to favour the induced-draught option.

Radiation

The final method of transmitting heat from one body to another is by radiation. If we stand in front of an

ordinary electric fire, for example, we can feel its heat. Radiation does not require any conducting medium or convection currents - a thermionic valve contains a vacuum, yet heat still reaches the glass or metal envelope from the heater, causing it to become hot to the touch.

The efficiency with which a surface radiates heat varies considerably, depending on its finish. A dull surface radiates better than a shiny, polished one, the best radiating surface is one which is black anodised, or painted matt black.

In combination

As I mentioned earlier, heat is usually transmitted by a combination of methods. In my example of the electric fire, for instance, there will be some convection as well, with warm air circulating to the rest of the room, but except in the so-called convector heaters, this is largely incidental.

One place where all three methods are at work is in the semiconductor heatsink. Heat generated in the diode or transistor junctions is conducted internally to the case of the device, which is in contact with the heatsink, either bolted or clipped to it, depending on style and type. There may have to be an insulating washer between the device and the heatsink, to prevent short-circuits, but heat is still conducted through the washer.

The heatsink will usually be made of aluminium - not the very best of conductors, but having the advantages of low cost and light weight. Except in its smallest varieties, the heatsink will usually have several fins, increasing both its volume and its surface area, increasing its capacity to conduct heat away from the device and to disperse it by radiation to the surrounding air. The heatsink will often have a matt black finish to increase its radiation efficiency.

Air is not a good conductor of heat, so it is usually arranged for the fins on the heatsink to be mounted vertically, encouraging the surrounding warmed air to move away in a convection current, to be replaced by new cooler air. The precise effect of mounting a heatsink with fins horizontal will depend on its design, but it can reduce the efficiency by anything up to 70 per cent of the manufacturer's rating. If a fan is employed to blow air through the heatsink fins, rather than relying on natural convection, the direction of mounting is unimportant.

Rating heatsinks

If you look in a manufacturer's or component stockist's catalogue you will see that each heatsink is given a rating in deg.C/W (degrees Celsius per watt). This rating is known as its thermal resistance, a measure of the temperature rise above the ambient temperature of the surrounding air when dissipating heat. Thermal resistance figures also apply to the insulating washer or the interface between the transistor and heatsink, and to the device itself, where it is a measure of the temperature drop between the junction and the case.

This latter figure, called the 'intrinsic thermal resistance', is not generally quoted in manufacturer's literature, but can be calculated from other data. The safe operating temperature of the junction itself is usually 150 deg.C for a silicon transistor. The manufacturer's data will quote the maximum power dissipation allowed for the device, and this will be based on a case temperature of 25 deg.C unless otherwise stated. Let's take an example of that old stalwart among NPN power transistors, the 2N3055, which has a maximum dissipation of 115W. The temperature difference between junction and case (150 - 25) is 125 deg.C. Dividing this by the maximum dissipation gives a figure of 125/115 = 1.1 deg.C/W approximately.

Next in the chain between junction and free air comes the resistance of the insulating washer. As well as the traditional type made from mica, there are various other types available, including silicone rubber. For our 2N3055, which comes in what is known as a TO3 package, the thermal resistance of the silicone rubber type is 0.4 deg.C/W.

If no insulation is necessary between the transistor case and the heatsink, the insulating washer is not required, but some means will be needed to provide good thermal contact. The mounting faces of the transistor and the heatsink may look smooth and flat to the naked eye, but under a microscope they would look anything but. The solution is to smear the faces with a silicone grease compound, which has good thermal conduction properties, and will fill all the little surface imperfections to give a better heat transfer. Using silicone grease will virtually halve the 'dry' figure for thermal resistance. Silicone grease is also used with some types of insulating washers, but not with the silicone rubber variety.

So, now we have got the heat from the transistor junction to the heatsink; what happens next? Well, it needs to be radiated to the surrounding air, warming it to trigger off the convection currents which will carry the heat away.

Semiconductor heatsinks come in an enormous variety of shapes and sizes, each one having its own particular thermal resistance rating. For TO3 packages, these range from the simple 'U'-shape channel with a thermal resistance of 14 deg.C/W, to the multi-finned cast aluminium monsters having ratings of 0.5 deg.C/W or less. At one end of the scale, they take up virtually no space at all; at the other, they could occupy something approaching a 120mm cube. What do you need?

First, you will have to do some more calculations, I'm afraid. If you look in the textbooks, you will usually see the problem approached from the point of view that given a particular heatsink, what is the maximum power you can dissipate in the transistor attached to it?

We have a heatsink with a thermal resistance of 2.5 deg.C/W, on which we have mounted our 2N3055 using a silicone rubber washer. The total thermal resistance, which is what governs the temperature difference between junction and ambient, is the sum of the three individual resistances. These are 1.1 + 0.4 + 2.5 = 4 deg.C/W. We'll work on an ambient of 25 deg.C (typical for a heatsink mounted on the outside of an equipment case in reasonably free air).

Maximum power dissipation allowable in the transistor is equal to overall temperature difference between junction and ambient (150 - 25 = 125 deg.C) divided by the total thermal resistance of 4 deg.C/W. The answer is just over 30 watts.

Sometimes, it is more helpful to approach the problem from the opposite end, setting the maximum transistor dissipation allowable and asking what size heatsink do we need. This time, I'll assume that the heatsink is going to have to be mounted inside the equipment case, rather than on the outside. The ambient temperature will be a lot higher, of course, and 70 deg.C would not be an unreasonable figure to use.

This time, we take the temperature difference between junction and ambient (150 - 70 = 80 deg.C) and divide it by the maximum power dissipation for the transistor, to produce the total thermal resistance. I'll use 30 watts again, to highlight the effect of putting the heatsink inside the case, so that works out at 80/30 = 2.66 deg.C/W. Because that's the overall figure, we have to subtract those for the transistor and the insulating washer, so 2.66 - 1.1 - 0.4 = 1.16 deg.C/W.

That's very different to the 2.5 deg.C/W heatsink that we had on the outside of the case, and in fact it would be advisable to choose one with a rating more like 0.75 deg.C/W to be on the safe side.

DATA connection

Ham Radio Today's data SysOp G4HCL looks at the latest radio data software

In five years time, amateur radio will probably still be around. So will computers, and digital communication modes such as the Internet. What were you doing five years ago? If you were an amateur then, which modes did you use? Did you use a computer in your hobby. How about any digital modes? If you weren't an amateur at the time, had you heard of amateur radio then? What was your impression? Did we still have the 'Hancock' image of a bumbling radio ham?

Anyway, that was five years ago. We're now in 1996. What will we be doing in amateur radio once another five years have passed? In my mind, and to mis-quote an advertising slogan, "the future's bright, the future's digital". We didn't have worldwide digitised speech commonly used over the Internet last year (as it is today), although, as I've reported here in the past, we did have this over packet radio in Europe. What will we be doing next year? Hands up all those readers who aren't thinking of getting a modem-equipped PC sometime in the future? Not many, I guess.

Wise words

In his opening speech at the 1996 PACTOR Forum, Phil Sussman KB8LUJ told us "PACTOR-2 is alive and well on the air, especially in Europe. That is a testament to how well it works. Yet the use of PACTOR-1 continues to grow. Today PACTOR is one of the most popular modes for HF digital communication by hams."

"But PACTOR faces two obstacles. The first is the Internet. Internet is a system that ties one computer to another. All you need is a computer and a modem. It does not suffer from propagation woes, it is faster than PACTOR, and is growing rapidly. Connections are common and cheap, or even free! And no ham license is required."

"Internet is a service and Amateur Radio is a hobby. The more we use Internet to make contacts, join news groups, use mail reflectors, exchange messages, or even to work DXCC on 14.4kHz, then the more Internet becomes the hobby and Ham Radio becomes a memory."

"Richard Rogers, N1URO, calls Internet "the 11 meters of computing" and cites a lack of discipline. Internet is not a mode, it is a medium, a conduit. It is a tool that I believe should be used by us to attract people into Ham Radio and not the other way around!"

"The second obstacle is ourselves. I write about PACTOR and think it is the best HF digital mode ever created for Hams. I would take my hat off the inventors at SCS, if I were wearing one."

"But just because someone enjoys PACTOR, it doesn't mean they oppose other digital modes"....."Those operating CLOVER are not our opponents. Neither are users of GTOR, RTTY, or CW. They are our colleagues. Yet we have problems communicating with them"....."Can we start by 'linking' together to adopt one uniform, binary file transfer protocol for PACTOR? Of course we can, if we choose to do so. We must work jointly to solve problems confronting our hobby!"

"All digital operators must collaborate to preserve amateur radio. Toward that end, when was the last time we had a non-ham in our shacks? How much have we done in our communities to excite the curiosity of youngsters in the mystery of radio? Do we talk-up Ham Radio in a positive way? We must indulge in shameless self promotion if digital Amateur Radio is to survive."

Phil gave an excellent conclusion by saying "Here is our challenge. Ten years from now Internet will still be around, but will PACTOR and will Amateur Radio? That's our choice. Let us choose wisely!"

If you're reading this with Internet access, but you're not on PACTOR, you can find the PACTOR News web site at http://www.dhnaco.net/pactor

My thanks go to Phil KB8LUJ for permission to reproduce the above.

HamComm V3.1

A search around amateur radio software sources has revealed that HamComm version 3.1 is now available. This DOS-based PC program works with the very simple interface detailed in the March 1995 issue of Ham Radio Today (an update is available on the Ham Radio Today 'Voicebank' to this - Ed), for receive or transceive use of RTTY (Baudot and ASCII), AMTOR ARQ/FEC, SITOR A/B, NAVTEX, CW and SHIP/SYNOP weather reports. The very same issue of the magazine had a front cover disk with HamComm V3.0 on it, and the changes incorporated in V3.1 include various 'bug fixes' to the AFC, AMTOR ARQ and FEC modes, improvements to the AMTOR Listen mode. In the registered version of the program there's also the addition of a PACTOR Listen mode for decoding PACTOR ARQ/FEC transmissions.

Ship SYNOP reports are included with decoding of cloud group, 55SSS group (sunshine), wind wave height and some "special phenomena" groups like

'max gust'.

Various screen additions have also been added, such as a vertical tune indicator on the left window border, spectrum screen switching, and mouse resizing of the TX/RX windows. The program runs in DOS (not Windows or OS/2), with minimum requirements of 370k free RAM, and a 286 or better PC. It's a shareware program, so you can freely try it to see if you like it, if after 30 days you find you do like it then the registration fee is US$30. I've arranged for this program to be included on this month's 'Software Offer' collection for the benefit of readers.

WinPack V5.53

Many readers will know that my favourite Windows-based packet program is the superb WinPack by Roger G4IDE. This freeware program handles virtually anything you would want it to do in a single-stream packet application, including automatic BBS sessions, DX cluster support, voice prompts from your PC's sound card when a DX 'spot' is received or the program has new mail for you from it's BBS session. WinPack needs at least a 386 running Windows 3.1 or later in enhanced mode, and it works fine in Windows 95. For reasonable performance, a minimum of 4Mb of RAM is recommended.

Roger says that version 5.53 is really only an update, however, he's releasing it as a full system because quite a few files have changed from V5.43. If you are already using V5.4 or V5.43, Roger says you won't find anything earth shattering in it! As well as some minor bug fixes, a number of command line options have been added, and the program can now play MIDI files as well as WAV files. If a bulletin is "unavailable" from the BBS, WinPack doesn't now keep on trying to download it, instead it sends you a 'system' message saying that the bulletin is unavailable. Again, I've arranged for this program to be available from this month's 'Software Offer' service for the benefit of readers, it just about fits onto a 1.44Mb disk.

Digital going's-on this month

If you can't get to the British Amateur Radio Teledata Group's rally at Sandown Park this month (on Sept 15th - I'll be there!), then a number of clubs are having talks on packet and digital communication. For example, this month on Sept 24th the Horndean and District ARC have a talk by John G8OQN on SUNPAC - the Southern Users Packet group.

In the Midlands, for all things digital, MAXPAK - the Midlands AX25 Packet users group, meet on the first Monday each month (when this is a Bank Holiday, the meetings are on the second Monday), 8.00pm, at the Perton Community Centre, Perton, near Wolverhampton. Non-members and visitors are welcome (the non-members is 50p per evening to help cover costs). For more information just contact the Club Secretary, Edward Loach G4ZXS, Tel. 01902 741877 (evenings), or via packet G4ZXS@GB7MAX.

For digital matters of a slightly different kind, I'll be along at the International HF Convention, giving a talk on Digital Signal Processing in modern amateur equipment early next month on Sunday 6th Oct, see you there?

The BARTG's Rally is at Sandown this month

MAXPAK produce a good newsletter and have meetings each month

From the screen

Paul VE7IPM @ VE7KIT.#VANC.BC.CAN.NOAM in Langley, BC Canada, sent me a message which came via the GB7LAN SatGate. He says he enjoyed reading the June 96 'Data Connection', but finds difficulty in getting up-to-date copies of Ham Radio Today magazine, adding that the Canadian postal system is rather slow, Canadian hams calling it "Snail Mail". Well, here in the UK it's called that as well, and recent UK postal strikes have made it even slower. Have any other Canadian readers, maybe also in British Columbia, any tips for Paul - does your newsagent or ham radio dealer stock the mag? Why not drop Paul (or myself) a message.

Chris G0KMX @ GB7STU.#32.GBR.EU in Gravesend, Kent, tells me he noted my comments on Pactor 2 and QRP, and is looking for anything suitable for the Macintosh on the software front for this mode. Chris currently runs a KAM with Ver 6.01 firmware and wonders whether there is a chance of a firmware upgrade for PACTOR-2 for the KAM in the future. Right now I'd say 'no', as PACTOR-2 uses DSP based technology, but then maybe an add-on board is possible? Going back to software-based implementations, PACTOR 'listen' mode is now available with the HamComm V3.1 program for the PC, so maybe something will come about soon for use with, say, a sound card. We'll have to see what the future will bring!

CTRL-Z, end of message

That's it for this month. As always, please do let me know what you're up to in the ham radio data communication side of things, or indeed what your local group are doing. You can contact me either direct via packet, or via post, fax or Email c/o the Ham Radio Today Editor. Until next month, 73 from Chris G4HCL @ GB7XJZ.#48.GBR.EU

Satellite rendezvous

Richard Limebear G3RWL with this month's collation of AMSAT-UK news

Due to constraints of seasonal variation in solar angle, AO-13 was scheduled to be reoriented on June 17th, prior to this year's US Field Day. The associated squint angle would have necessitated the predominant use of the omnidirectional aerial. This would obviously have been sub-optimal for AO-13's final Field Day appearance but circumstances, for once, conspired in our favour. The small amount of drag that AO-13 currently experiences at perigee was acting on the spinning satellite to translate the ALAT slowly upward so they were able to remain at the old attitude for a few extra days.

The drag effects at perigee are causing the ALAT to rise slightly each orbit. The initial orientation for this period will more accurately be ALON/ALAT 220/-10 with ALAT progressively rising during this time period. At the end of this two month session, perigee height will be 170km and re-entry (drag) effects will be even more noticeable.

For a limited time after Sep 02, it *may* be possible to move AO-13 back to the 180/0 orientation but this is likely to be transient at best, with considerable torquing of ALAT around perigee. Maintaining this orientation will become increasingly difficult; if this move takes place, the schedule shown here will be placed in effect.

By October but perhaps earlier, it will become necessary to move AO-13 to ALON/ALAT 90/0 to provide limited protection of the omni aerial from perigee heating and to reduce the drag associated deflection of the ALAT. From this point until the demise of the electronics, AO-13 will be Mode-B only, full-time omni aerial, the same as with AO-10.

The next few months will be an interesting time, and the command team welcomes suggestions to make use of this unique opportunity to observe an amateur spacecraft as it approaches re-entry. (A reminder that the latest AO-13 elements and information are available from the AMSAT Internet site, or as a service to readers, on 1.44Mb PC disk for £1.00 inc. from the monthly software offer service - just ask for the 'AO-13 disk' - Ed)

AO13 Provisional Transponder Schedule 1996 Sept 2nd ???

ModeB	MA 0 to MA 70	
ModeBS	MA 70 to MA 120	
ModeS	MA 120 to MA 122	< S beacon only
ModeS	MA 122 to MA 140	< S transponder; B trsp. is OFF
ModeBS	MA 140 to MA 180	Alon/Alat 180/0
ModeB	MA 180 to MA 256	
Omnis	MA 230 to MA 25	

Oscar 10

It's currently available in mode-B when in view but *please do not* attempt to use it if you hear the beacon or the transponder signals FMing. Generally it seems to close down whenever it goes out of sunlight.

Russian satellites

The 70cm frequencies to be used for communication with the SAFEX II equipment located in MIR's PRIRODA module are shown in the accompanying table. The CTCSS tones required for these modes will published at a later date after equipment testing is complete. The equipment has been heard in *Repeater* mode on 437.950MHz, a voice announces the callsign with the mode; "RR0DL Repeater" repeated every few minutes. Note that the instrument is running in test mode (CTCSS is activated).

Micro/Digital Satellites

AO-27's ransmitter schedule is; 20 minutes after entering the sun, the transmitter turns on normal power. 18 minutes after 'turn on' it shuts off (38 minutes after entering the sun).

To clear up any misunderstanding, the amateur transmitter on board EYESAT-1 known as AO-27 *can* and *does* from time to time run off batteries. The reason for an 18 minute window is a limited power budget for the amateur payload.

EYESAT-1 runs experiments for Interferometrics Inc; there is not enough power left over

70 cm frequencies to be used for communication with the SAFEX II equipment located in MIR's PRIRODA module:

	Mode 1 repeater	*Mode 2 packet*	*Mode 3 QSO*
Downlink	437.950 MHz	437.975	437.925
Uplink	435.750 MHz	435.775	435.725
CTCSS	YES	NO	YES
Speed		9600 baud	

Mode 1: Repeater like a standard FM repeater with CTCSS.
Mode 2: 9600 Baud (G3RUH compatible) Packet Operation.
Mode 3: QSO possibility with MIR Crew, but CTCSS is used.

to run the amateur transmitter full-time. AO-27 is a secondary payload on board EYESAT-1 and the demands on system resources need to go the the primary payload.

In June, the DOVE command team received several reports that DO-17 was no longer being heard on 2m. On June 7 they reset the processor and re-executed the code that had been running. The satellite responded positively and is now again transmitting occasional MBL telemetry on 145.825MHz. They also sent the commands to turn on the S-band transmitter but have not been able to positively confirm that it is on. Any reports of S-band reception would be appreciated. Please send reports to; *wd0e@amsat.org*. Work continues by the command and development team to find the cause of the hardware problem that is preventing the standard *Microsat* software package from running properly.

After about eight months of standby mode, command stations in Italy loaded an improved version of code to 10-26 and started the upload of the high level code. ITAMSAT was successfully returned to full operations on the 1st June and a Whole Orbit Data collection was started to analyze the spacecraft status. The craft has a spin of about 0.5 RPM and is in stable magnetic lock. The internal temperatures are good and the voltage measured on each battery cell show no signs of degradation. Currents produced by the solar arrays indicate no measurable decrease of efficiency. ITAMSAT will collect WOD for a while and the digipeater is *on*. The downlink frequency used is 435.822MHz.

Short bursts

The first Ariane-5 launch took place on 4th June from Kourou in French Guiana. The launcher was carrying the European Space Agency's four Cluster satellites, a science mission to study Earth-Sun interactions.

Following ignition of the solid booster stages and normal lift-off the flight was normal Up to H0 plus 37 seconds (at this time the velocity of the launcher was Mach 0.7, i.e. 857kph and its altitude was 3500m), there then followed sudden swiveling of both solid booster nozzles up to the limit which caused the launcher to tilt sharply, giving rise to intense aerodynamic loads on the launcher structure resulting in breakage. Following loss of integrity, the launcher was destroyed by ground command.

A preliminary analysis of the telemetry data confirmed that the propulsion stages functioned correctly. The direction of enquiry first tended towards the launcher's electrical and software system. A large part of the equipment contained in the vehicle equipment bay has now been recovered and inspected. This has revealed the existence of a malfunction on the inertial platform. An independent enquiry board was set up by ESA and CNES to determine the causes of the failure and to propose corrective action.

P3D will not be insured if we go on flight 502: although there are doubts that insurance would be available at any cost. Anyway, it would probably cost about 30% of the declared cost of the spacecraft, i.e., about $500,000 to $1,000,000. In a way, we do have insurance, it's called *self-insurance*. There exist two additional spaceframes and one SBS. Most of the electronics could be recreated from the existing designs. Solar arrays and batteries are the two high cost items that would be lost in a launch failure. They would amount to between $200,000 and $400,000.

There is a contract between AMSAT-DL and ESA that P3-D should be launched by mid-1997 with either an Ariane-5 or Ariane-4. This decision was made after Arianespace/ESA found a commercial customer for the AR502 flight on which there would not be enough room left for P3-D, although we were contracted for this flight. However, after the 501 failure it looks as if no commercial customer wants to fly on 502 on which ESA's ARD capsule is one of the main experimental payloads. So it could be that only P3-D, ARD and a dummy payload will fly on the 502. Since we are not paying, and never will be able to pay for a real flight, the only likelihood that they will launch us on an Ariane-4 is, *a)* if 502 launches later than mid-1997 or *b)* there is no room left for us on 502. The current gut-feeling is that AR502 will fly with us onboard early in 1997.

New Web sites

The TechSat project - Israel's first Amateur satellite: *http://www.technion.ac.il/~asronen/techsat* and the new french micro satellite project: *http://ourworld.compuserve.com/homepages/amsat_f*

AMSAT-UK news

Some four or five years ago (sounds almost like a life sentence) there was a profusion of keplers on terrestrial packet. Some were weeks, sometimes months, old. A 'reliable' UK service of up-to-date orbital elements was needed; the Amsat-UK committee decided that they should take responsibility for its provision and yours truly volunteered to do the donkey work involving modem downloads from the USA (and latterly internet ftp) and subsequent transmission as packet bulletins (to GBR not WWW).

Recent events have overtaken my service. The previously fairly reliable satellite uploads of keplers from Amsat-NA seem to have disappeared and have sometimes been replaced by an italian station who re-plays the Amsat-NA internet elements; but not reliably. A decision was taken that UoS would upload weekly; it is automated so few problems are expected.

There is now no place for the locally transmitted elements, we don't want to add to the profusion. The UoS elements are downloaded and placed on the UK network by the satellite gateway; if this wasn't done they would filter through from other countries anyway - but late. Putting the UoS elements (which come from Goddard) on the network will, by means of the BID, prevent their later import from elsewhere.

For further information about Amsat-UK contact: AMSAT-UK, c/o Ron Broadbent MBE, 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.

Latest Keplers

A copy of the latest Keplers is available on request by mail or packet; my mailbox is GB7HSN but please note that Amsat-UK Keplers are put out on packet weekly anyway and sent to KEPLER @ GBR.

The latest satellite Keplers as supplied by AMSAT-UK are also available by automatic fax retrieval from the 24hr Ham Radio Today fax-back line. 01703 263429 (use with a personal DTMF, i.e. 'touch-tone', phone/fax keypad - follow the voice menu), request fax document 35 from the satellite voice menu for this month's. You can also get a copy in the post by sending an SAE together with the original corner flash from this column to the Ham Radio Today Editor, marking your envelope 'Keplers' and stating whether you want all amateur satellites (one A4 page) or all satellites (10-15 A4 pages - you'll need an A5 or A4 sized SAE with postage for 100g for this).