Audio Processing in Amateur Transmitters

Reviewing the W2IHY range of audio products

INTRODUCTION. The purpose of using a speech processor, or tailoring the audio frequency response, is to improve the readability of the signal under difficult conditions. When this is correctly carried out, the results can make an unreadable signal perfectly readable. However, judging by some of the sounds one hears on the bands, there is much work to be done!

It is strange how seemingly identical transceivers can sound so different. Manufactures spend a lot of time in development to ensure good speech quality, yet many operators 'improve' on this and make their signals far worse! The idea that the more audio you pile on the better is completely wrong. A high quality speech audio signal will always be better. However, there are genuine ways to improve things when condition are poor or in the presence of QRM.

Before any 'improvements' are tried you must ensure that the 'normal' settings are correct. This is easy to do with modern transceivers. Almost all have an Automatic Level Control (ALC) circuit. This is used to prevent the peak power output of the transmitter being exceeded and causing severe splatter into nearby channels. To check your 'normal' setting, first turn off any speech processor and/or audio frequency response tailoring. Switch the meter on the transceiver to indicate the ALC level. Then, speaking in a normal voice and about 5 to 10cm from the microphone, increase the microphone gain until the ALC is just indicating on the meter. It should only be a small movement of the meter. Remember that when the ALC circuit comes into operation, it reduces the peak power output. There is nothing to be gained by 'talking it up'.

Human speech and hearing is very complex. The human ear does not respond in a uniform way to sounds of different intensity or frequencies. Research carried out by Fletcher and Munson as long ago as 1933 showed that the sensitivity of the ear to low and high frequencies diminishes as the sound intensity is lowered. At low sound levels, the difference at 200Hz can be 20dB lower than the range 500Hz to 5000Hz. The ear behaves like a filter. At normal sound levels the maximum sensitivity is between approximately 300Hz to 5000Hz.

You can test this effect next time you are listening to a noisy weak signal. Turn the RF gain to the minimum required to maintain the signal and then reduce the loudspeaker volume until it is just audible. You will find that the signal is easier to copy than when you had a higher volume level. The effect is even more noticeable when using headphones.

From this we can see that one way of improving readability is to tailor the audio response to match that of the human ear. Making a response that rises steadily from 1kHz to around plus 6dB at 3kHz will help. Also, perhaps surprisingly, a small boost at around 200 to 300Hz also of 6dB will balance the audio and make it sound more natural. However, this increase in levels will affect the ALC and a reduction in microphone gain to compensate may be needed. This is, of course, without any compression or clipping circuits being used.

A further improvement in readability can be made by using speech clipping or compression (normally called a speech processor). By limiting the peaks of our audio signal, we can increase the average level. Once the peak level is 'clamped', the microphone gain can be increased. A 6dB increase will make your 100 watt transmitter equal to a 400 watt one with respect to the strength of the audio. A 12dB increase will make it sound like a 1.6 kilowatt rig using 'normal' modulation levels. More than 12dB increase is not recommended as distortion and noise can begin to make the signal less readable. Remember, the increase in microphone gain will increase any noise (fans, etc) by the same amount!

THE W2IHY RANGE. The W2IHY 8 Band Audio Equalizer and Noise Gate is supplied with all leads (you have to specify which transceiver you are using), instructions and circuit diagrams. It also has a list of over 80 different microphone/transceiver basic settings to help you get started.

On air tests showed that the claims made are genuine. There is not space here to consider all the combinations (see **Table 1**) but with the unit set up for a rising treble and bass response relative to the middle frequencies, reports from stations received included 'easier to read', 'stronger audio', 'more punch' and 'readable through the QRM'. There are many different audio responses that can be set up and a little experimenting 'on air' will quickly show which arrangement is best for you. The ability

to adjust the audio response can be used to greatly improve poor quality microphones. It can also be used to compensate for your voice, for example, if you have a deep voice you can compensate by boosting the treble. This will make your signal more readable. Some operators prefer a signal with 'lots of top' however, don't over do this. Signals that are 'all top' are difficult to tune in correctly and readability can be made worse by excessive top.

Aim for a balanced response by using a steady rise of around 6 to 8dB at 400Hz and 3kHz. This will give a signal with good quality and 'punch' (even more 'punch' if you also use the W2IHY Processor). The unit also has a 'Noise Gate'. This is a very useful feature as it enables the removal of ambient noise (noisy fans, etc.).The Noise Gate has an adjustable threshold control and also variable delay. When in use, reports were that the signal was cleaner and easier to read. A little time spent experimenting with the settings will be well rewarded.

The W2IHY EQplus Audio Processor is supplied with all connecting leads and a manual with full instructions and circuit diagrams. It is easy to connect up and has switched inputs for different microphones and also switched outputs for feeding to different transmitters.

This unit can be used on its own or in connection with the other W2IHY units. The tests were carried out with it used on its own.

As you can see from **Table 2**, there are a lot of features on this unit and it is not possible within this review to deal with all the various combinations. Suffice to say that you will spend many enjoyable hours finding out just what it can do!

Setting up is quite easy but it is important that your microphone has enough output to drive the display to maximum with the process switched out of action. Once this is achieved you only have to follow the instructions in the manual. I found that once the correct settings were established, the transmitter ALC meter peaked to the same level with or without processing. However with processing switched on, the ALC meter stayed at its peak reading for longer periods.

On air tests resulted in very favourable reports. Tests were first carried out with the Noise Gate in the off position. Reports with 50% compression were of increased modulation and good quality. At 100% (plus 20dB) of compression the reports indicated that high background noises had become objectionable.

The tests were done again but this time with the Noise Gate switched on. The reports now were that the audio was much cleaner and even at 100% compression the audio was good quality. Most stations who reported on the signal preferred the 50% compression level but one station, who has a high noise level, reported that at 100% compression the signal was more readable.

This unit clearly increases the effective modulation and would be a great help under difficult conditions. As the unit is also fitted with Bass and Treble tone controls it is possible to 'tailor' your audio frequency response to find the best settings for your particular microphone and transceiver.

This unit can be especially recommended for the transmitters that lack any degree of processing and can be used both on SSB and AM modes with great effectiveness.

Finally, a test made on 17 metres with the band open to the USA resulted in many 'first call' contacts and even when my signal was reported as only S2 or S3, I always got a Q5 report.

Like the other units, the W2IHY iPlus Variable Attenuator and Interface Box comes with full operating instructions. It is mainly intended for use with either the equalizer and/or processor already described. The object is to enable up to three transceivers to be connected up to one audio source. (If you have more equipment you can also use additional iPlus interface units to get more selections).

The output from the EQplus can be switched via the interface through to any one of the three different transceivers. Their speakers and PTT systems will also be switched to a single speaker (or headphones). So by selecting any one, you can use all the facilities of the transceiver and processor. This avoids the need to constantly unplug and reconnect when swapping from one transceiver to another. Once you have initially installed and wired up the Interface Box you never have to waste time doing it again. You can simply switch from one transceiver to another in seconds.

Although the unit is supplied with a number of leads with RCA type (phono) plugs you may have to make suitable leads to suit your equipment, however this is a once-only job.

FINAL TESTS. All the tests so far were carried out either on test equipment or 'On Air' using a Kenwood TS530s and an Icom SM20 microphone.

TABLE 1: W2IHY 8 BAND AUDIO EQUALIZER AND NOISE GATE SPEC.

The front panel controls:
Power On/Off, Power on LED
Equalizer On/Off, Equalizer Controls (8)
Noise Gate On/Off, Noise Gate
LED, Noise Gate Level, Noise Gate
Delay, Mic Gain LED
Rear Panel Controls:
Mic Select, Mic Input (8 pin), Mic Input (XLR)
Mic Input (RCA), Mic Output Select
Mic Output A, Mic Output B
Phones, Power
Bottom Panel Controls:
Mic in, Gain, Mic Output Level
Mic Input Impedance

W2IHY 8 Band Audio Equalizer and Noise Gate, front and back views.

The W2IHY EQplus Audio Processor, front and back views.

The W2IHY iPlus Variable Attenuator and Interface Box, front and back views.

modest specification. Clearly the results from using the W2IHY Equalizer and processor unit enabled a big improvement in the signal and excellent reports were obtained.

However, it was decided to see if the W2IHY units would be any advantage when used with a more recent high specification transceiver. For this, the choice was an Icom 756 Pro 3. This transceiver already has excellent speech processor and audio equalizer built in, so it would present a real challenge to the W2IHY units. The internal processing of the Icom 756 was turned off. 'On Air' tests were made on 17 metres.

First, I connected the EQplus equalizer and set the compression for 50%. Reports were of a 'Punchy' signal and good audio quality. Comparisons were made between the W2IHY and the internal processor of the Icom 756. Not a lot of difference reported but several stations preferred the signal with the W2IHY processor. Next I tried the 8 band audio equalizer. This was set to give a rising response of 8dB at 3.2kHz and 50Hz. Reports were of good readability and good quality. At these settings there was no reported difference between the W2IHY and the internal settings of the Icom 756. Other settings and/or microphones may produce different results.

So far all these units had been tested as 'stand alone' and it was now decided to test a combination of all three with both the Icom 756 and Kenwood TS530 all connected up as given in the W2IHY instructions. The manual that comes with the IPlus Interface box gives very clear diagrams on connecting all the various units together. A selection of made up leads are also supplied but I had to make two extra leads for connecting the speaker outputs from the two transceivers as these used miniature stereo jacks.

Apart from the two made up leads the connection process only took a few minutes thanks to the very clear 'Plug and Play' instruction and leads supplied with the W2IHY units. The internal speakers of each rig are automatically switched off when the jacks are inserted and an external separate speaker is needed that is now common to either transceiver. The Iplus has separate gain controls (on front panel) so the output level can be adjusted for each individual transceiver to match the microphone input.

Once the connecting up was completed I was able (with the Interface Box) to switch between the two transceivers with a single turn of one switch, thus enabling the Equalizer and Processor to be used on either transceiver. As the 8 band equalizer has alternative microphone inputs, it is also possible to select different microphones. Then with the various settings you can tailor the audio response either for a particular microphone or your own personal preferences. With careful adjustment of the 8 band equalizer, a poor microphone can be greatly improved in audio quality.

I also tested a Heil PR781, a high quality microphone, but it was difficult to get comparison reports between all the combination as so much depends on the other stations transceiver response and the operator ears! Suffice to say that reports were always good regarding received audio quality.

To avoid damaging to either rig I was careful to set one on 80 metres and the other on 17 metres using separate antennas.

Overall the various units behaved as expected and no problems with RF or audio instability were encountered. Changing from one transceiver to the other took only a few seconds.

SUMMING UP. The W2IHY 'Plug and Play' units performed well either as 'stand alone' or together. Older more modest specification transceivers stand to gain the most from using these units. The Noise Gates proved very useful in that it removed general shack noise (fans, etc) resulting in clear speech. A word of caution, when you adjust the audio response you should always check that the input to the transceiver is the correct level. If you apply large amounts of boost to a particular band of audio frequencies, these will increase the overall level. Keep the input to the transceiver so that the ALC is only just indicating. If high levels of ALC are created, the results may be misleading.

It's a good plan to arrange with a local station some initial tests; these can be carried out at lower modulation levels below the ALC threshold. Once you are satisfied with the audio results (a recording helps) you can then set up normally.

Remember - good audio quality always wins over excessive levels of poor quality and distorted audio.

The W2IHY range of products are available from Julius Jones, W2IHY Technologies, 19 Vanessa Lane, Staatsburg, NY 12580, USA. E-mail: Julius@w2ihy.com or telephone 001 845 889 4253, www.w2ihy.com.

I would like to extend my thanks to Julius for the loan of the review equipment.

TABLE 2: W2IHY EQPLUS AUDIO PROCESSOR

The front panel controls:
Audio Input Impedance switch
Microphone gain, LED bar graph
Equalizer On/Off Switch, Equalizer Bass, Equalizer Treble,
Compressor/Downward Expander On/Off Switch, Compressor/Downward expander Compressor Control
Compressor/Downward Expander Level Control, Effects Processor
Program Select/Off Switch, Effects Processor Delay Control
Effects Processor Level Control, Output Level Control
Monitor Level Control (for head phones)
The rear panel:
Mic Select Switch, Mic Input socket,
Aux Input Socket, PTT Input,
Output Select, Phone Jack.

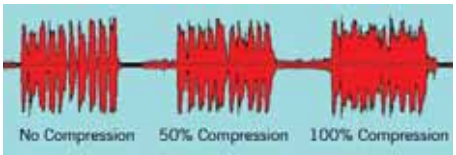

FIGURE 3: These screen shots show the effectiveness of the processor. The average level of modulation increased with the peaks remaining at the same level.

The TS530 transceiver is now about 35 years old and although still working to its original specification (and still using the original pair of 6146s!) it has, by today's standard, a