

Audio levels for digital modes on FM

Analog SSTV modes are generally tolerant of incorrect audio levels. The reason this is so is that only one audio frequency is generated at any one time. The optimum audio level into the TX is just a little below what would give maximum deviation (about 3 KHz is good). This is the balance between there being insufficient audio recovered by the receiver and added noise due the receiver I.F filter removing some of the significant RF sidebands. Inputting excessive audio into the TX in most cases does not significantly degrade the result. Digital modes using AFSK (Audio Frequency Shift Keying) are similarly tolerant. The reason for this is that the only distortion products are audio harmonics which are outside the receiver bandpass.

The newer digital modes are not nearly as tolerant. The popular DIGTRX program uses 8 simultaneous audio carriers and each of them uses Phase Shift Keying. To say the least the resulting waveform is quite complex. When there is distortion on such a signal there are not only harmonics but also intermodulation products. These IMD (InterModulation Distortion) products fall inside the the audio band being decoded. IMD increases rapidly as TX audio input is increased beyond a threshold. The result is the loss of data as the decoder at the receiver struggles to recover the original data that was sent. A degree of error detection and correction is available as an inbuilt part of the program. (This was because the program can be also used on HF.) However it is best to minimise any errors in the first place. This also reduces decoding times.

Having access to calibrated test equipment is ideal for setting up the best levels but not many of us have this to hand. All testing is based on comparisons with a reference. The reference we all have available is the unmuted (unscelched) noise from an FM receiver. Proceed as follows:

Set the volume of your receiver to a comfortable level so that the audio is not distorted on the loudest audio you receive (ie from the guy with the loudest audio). Then with no RF received signal, listen to the unmuted noise. Check that this is also not too loud. Now feed this signal into your sound card (line input). Run DIGTRX and note the RX level indicator in the program. Go to "setup" , "Sound card", "Sound Card input control RX" and and set the slider for the selected input so that the RX level indicator is as close as possible to 0 dB. You have now set up your receiver and should not change these settings.

Get another station to send to you. Initially the 2 tone test. If the level received is greater than -10dB (ie -7 or such) then the other station is sending too high a level. Have a look at the left hand side of the Scope screen and check the IMD figure. To have any chance of decoding easily this needs to be lower than about 10 dB. A small reduction in TX audio input from this point will result in a rapid improvement of IMD to - 20dB or better. This will ensure very accurate decoding. Note that the RX level should not disappear entirely (somewhere between -10 and - 20 dB is a fair level although even down to -30 dB seems to work well). Remember at this stage do NOT change any settings at the receive end. Only adjust at the TX end. The TX settings are accessed in DIGTRX from "setup" , "Sound card", "Sound Card output control TX". Adjust the sliders for "Wave" or "Volume control".

Now get the station to send a file or picture. Watch the waterfall display for the 8 PSK carriers. When the carriers are seen check the RX level. It may be slightly higher than the previous 2 tone test but this is ok. If it peaks above about -10dB you will probably be getting some IMD though the figure in the IMD box is not a reading of this signal.

The procedure above is just one way to set up levels for DIGTRX transmission. getting the IMD good on the 2 tone test is really what matters. Good luck! Bruce Jones VK4EHT

