Free audio signal generator and analyser software

If you want an audio signal generator that runs on a computer, you can use the free Audacity software (siliconchip.com.au/link/aaxk). This is available for Windows, macOS, GNU/Linux and other operating systems. Download and install the version that suits the operating system on your computer. Once installed and running, select Generate -> Tone and then set the waveform to sine, frequency to 1kHz and volume to maximum (ie, set the level value to one). You can also set the duration over which the tone is generated. Press the play button for the audio to start.

Another good, easy-to-use option is WaveGene (siliconchip.com.au/link/aaxl).

For spectrum analysis, you could use WaveGene in combination with WaveSpectra (siliconchip.com.au/link/aaxl). See the setup instructions at: siliconchip.com.au/link/aaxm

We used Visual Analyser, available from siliconchip.com.au/link/aaxn, mainly because this allows the actual measured waveform to be seen as a 'scope' view, along with the output spectrum.

Once you have installed the signal generator and spectrum analyser software, it's a good idea to use it to analyse the performance of your computer sound interface. That can be done with a cable with 3.5mm stereo jack plugs at each end, with one end plugged into the sound input and one into the sound output.

To do this with Visual Analyser, on the main screen, then select "floating windows mode" and then the Scope, Spectrum and Wave need to be opened from the top row of selections.

Select a 1kHz sinewave for the Wave generator, select interlock (that causes both A and B channels to change together) for the output levels and bring up the output level on the waveform generator. Then press the on/off button below the output level slider.

The on/off selection at the top left of the main screen also needs to be selected so that the analyser measures the signal. Both will show "off" when the signal is generated and measured. You can choose to view the A channel (left) or B channel (right), or both, in the main settings channel selection.

We chose to use a 16,384 sample FFT window and a sampling rate of 44.1kHz in the main menu. Output gain (adjustment along the top row at right) was set just below maximum, yielding the lowest distortion figure of 0.0626%.

In our case, noise is mostly more than 80dB below the fundamental (see Fig.11). That indicates that this is not a particularly good sound card, but good enough to evaluate the distortion from the Nutube Preamplifier.

Now the Nutube Preamplifier can be connected between the computer sound input and output. Adjust signal levels using the volume control and/or the signal generator level so that the waveform is not clipped (ie, so the top of the sine wave is not plateauing) and instead showing a clean sinewave.

In the main menu, you can select the left channel (A) and adjust trimpot VR2 for the lowest distortion reading, with minimal harmonics – see Fig.12. This shows the waveform as a clean sinewave, with the analyser showing the main 1kHz fundamental at 0dB level and the second harmonic (2kHz) at around -70dB. The third, fourth and sixth harmonics are at a similar level.

Once you've finished tweaking VR2, select the right Channel (B) and adjust VR3 for the lowest distortion reading.

VR4 can then be adjusted while viewing in the A channel of the analyser, so that fundamental level is the same as that in the B channel.

Fig.13 shows the waveform and spectrum when the grid bias (with VR2) is adjusted incorrectly. The top half of the sine waveform is very rounded, and the second harmonic is only 10dB below the fundamental. The distortion reading is around 30%.

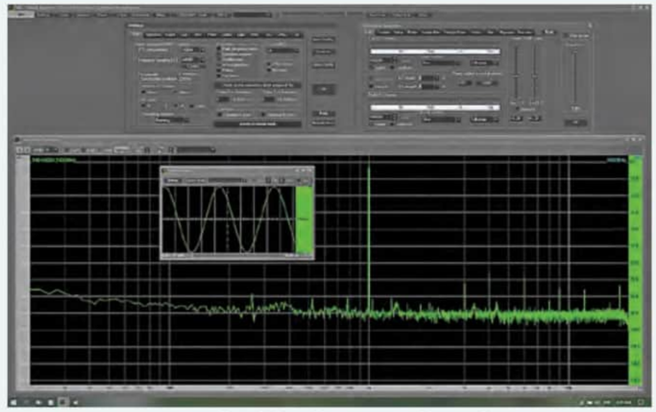

Fig.11: a screen grab of the free Visual Analyser PC software performing a 'loopback' test, with the sound card output fed directly into its input. This lets you analyse the distortion inherent in the system. In this case, the reading is 0.0626% THD+N at 1kHz. You therefore won't get a reading lower than that when measuring the performance of external devices like the Nutube preamp.

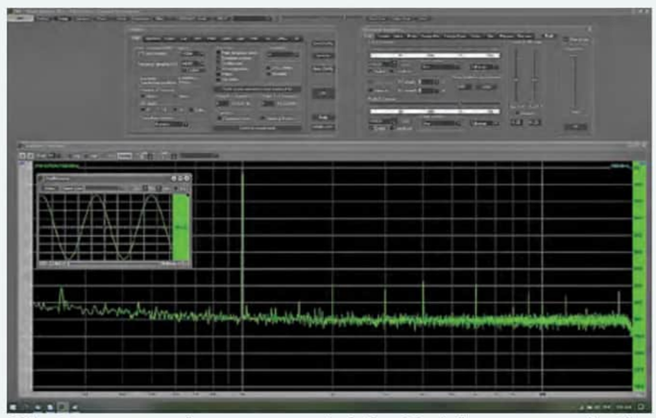

Fig.12: now we have connected the Nutube preamp 'in the loop' between the sound card output and input, using two stereo jack plug to red/white RCA plug cables. The output levels have been set to 41% full-scale, which corresponds to around 250mV RMS, The distortion reading has only risen slightly, to 0.07%, because the Nutube preamp and sound card distortion figures are similar.

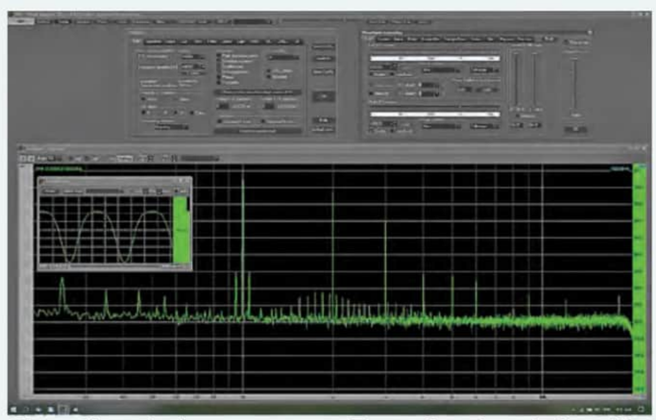

Fig.13: here is the same test as Fig.14, but the triode grid bias voltage adjustment is completely wrong. You can see the heavily distorted sinewave in the "Oscilloscope" window, with many harmonics in the spectrum analysis. The THD reading is 30%. This is about as bad as it gets; more realistically, a slightly misadjusted grid bias voltage can lead to distortion levels in the 0.1-1% range.