Review

Xiegu GNR 1

Digital Noise Reduction and Filter

Audio filtering and noise reduction technology has changed significantly over recent years, thanks to the availability of ever faster and more affordable processors.

The new Xiegu GNR 1 digital noise reduction and filter unit delivers the latest digital signal processing (DSP) techniques in a stand-alone unit that's ideal for use with older rigs. The GNR 1 is an audio device with adjustable low-pass and high-pass filtering that can be combined to create sharp, narrow-band filters. In addition, it features a continuously variable noise reduction system that's optimised for the reception of speech signals.

The Xiegu GNR 1 digital noise reduction and filter.

Connections

The Xiegu GNR 1 was supplied with a small instruction booklet, a European 2-pin plug-top power supply and a 1.5m screened cable fitted with 3.5mm stereo plugs. Whilst the GNR 1 is a single channel, ie mono device, all connections use stereo jack sockets with the left and right channels linked internally. For this reason, it's essential only to use stereo plugs for all connecting leads. Using a mono plug will cause the sleeve to short-circuit the audio. The included 2-pin European plug-top power unit provides the 12V, 1 amp power requirement but the shack 12V DC supply is also suitable.

The unit has a single 3.5mm input jack, but this is switchable to provide a high or low impedance (16Ω) load, **Photo 1**. The preferred audio feed is the line-level audio that's usually available on the rear panel of many rigs. This feed provides a constant level that bypasses the rig's volume control, but that's not a problem because the GNR 1 includes both input and output level controls. To help prevent overloading the input circuitry, the unit provides a helpful clipping LED on the front panel. This LED flashes if the incoming signal is too high (greater than 1.5V RMS in the review model). The switchable low impedance termination allows the GNR 1 to be fed from a speaker or headphone output where necessary. The Xiegu GNR 1 provides 3 watts of audio output to drive an external speaker via phono or a 3.5mm stereo jack on the rear panel. Additionally, a 3.5mm stereo headphone jack on the front panel provides up to 100mW for driving headphones with an impedance range of 16 to 64Ω. When using the headphone jack, the external speaker output is automatically muted.

Inside the Xiegu

As you can see from the photos, the Xiegu GNR 1 employs a sturdy steel case, and the internal construction is very tidy. There's no circuit description available so I did some crude reverse engineering to spot the main components. I identified a Texas Instruments TLV320 audio CODEC device that handles the digital/audio conversions. Linked to the CODEC was an STM32F405 processor that handled the DSP filtering and noise reduction tasks. The only other significant device was

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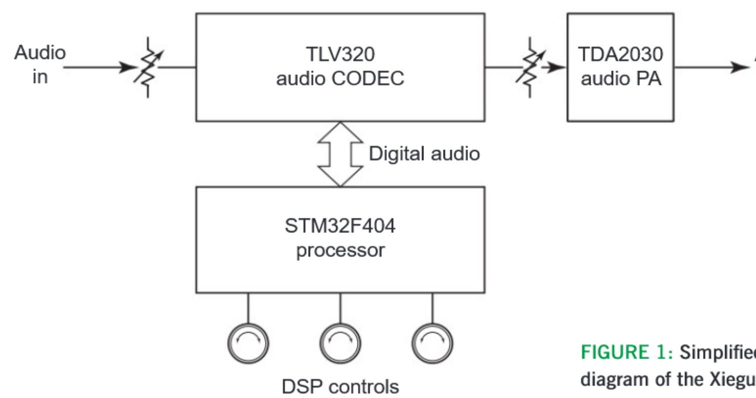

FIGURE 1: Simplified block diagram of the Xiegu GNR 1.

PHOTO 1: Front panel of the Xiegu GNR 1.

PHOTO 2: Rear panel of the Xiegu GNR 1.

the TDA2030 audio power amplifier chip. I've shown a simplified block diagram in **Figure 1**. Before moving on to use the GNR 1 on air, I thought it might be helpful to make a few audio measurements to see how the signal processing performed.

For these tests, I used the excellent and free REW software suite. Although primarily designed to aid the measurement and equalisation of room acoustics, the software works very well as a general-purpose audio analyser using your computer soundcard to generate and measure the audio signals. I used a Focusrite Scarlett 2i2 USB audio interface as this is a very high-performance unit with a flat frequency response, low noise floor and extremely low distortion. During the configuration of the REW software, I created a calibration file to calibrate-out any minor deficiencies in the Focusrite soundcard. The first test was to check the overall frequency response with the low-pass filter set to minimum and the high-pass to maximum. This would give the broadest overall response. As you can see from **Figure 2**, the frequency response was flat from 52Hz to 7kHz with a rapid cut-off outside those frequencies. I then repeated the test but first with the high-pass set to minimum and then with the low-pass set to maximum. The results of these sweeps are shown in **Figures 3 and 4** and you will see that the filters overlap. This is a useful feature as it brings the opportunity to create a narrow peaking filter by carefully adjusting the high and low-pass controls around the desired frequency. I've shown an example of the best 800Hz peak I could achieve in **Figure 5**. The benefits of DSP are evident in the very steep sides of all the filter responses.

Moving on to noise reduction, I wanted to see if I could make any useful measurements of its effectiveness. This proved to be very difficult as the noise reduction algorithm is clearly designed to let speech through whilst suppressing wideband noise. As a result, I reverted to on-air testing of the Xiegu GNR 1.

On air with the Xiegu GNR 1

As the Xiegu GNR 1 is likely to be most beneficial with older, non-SDR rigs, I used a Yaesu FT-897 for the review. I had leads available to extract the audio from the rear panel sockets but also tried using the headphone jack on the front panel and the

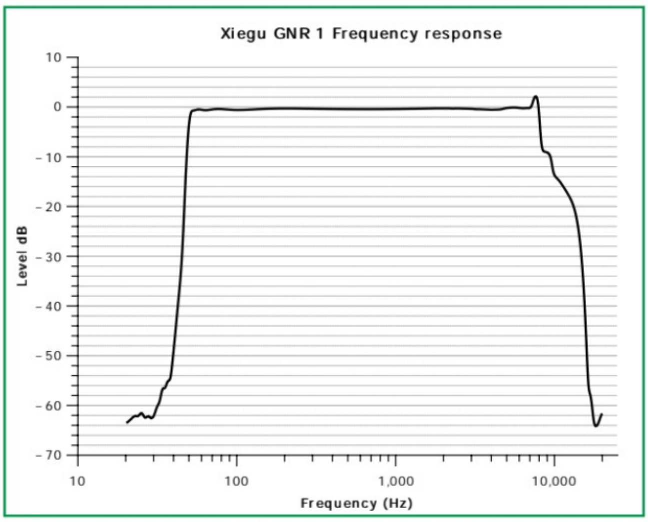

FIGURE 2: Frequency response of the Xiegu GNR 1 with filters set to their widest.

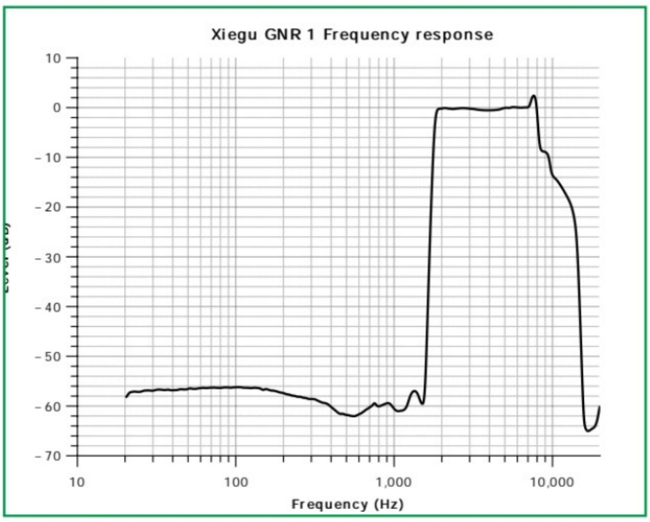

FIGURE 3: Xiegu GNR 1 with maximum LF cut.

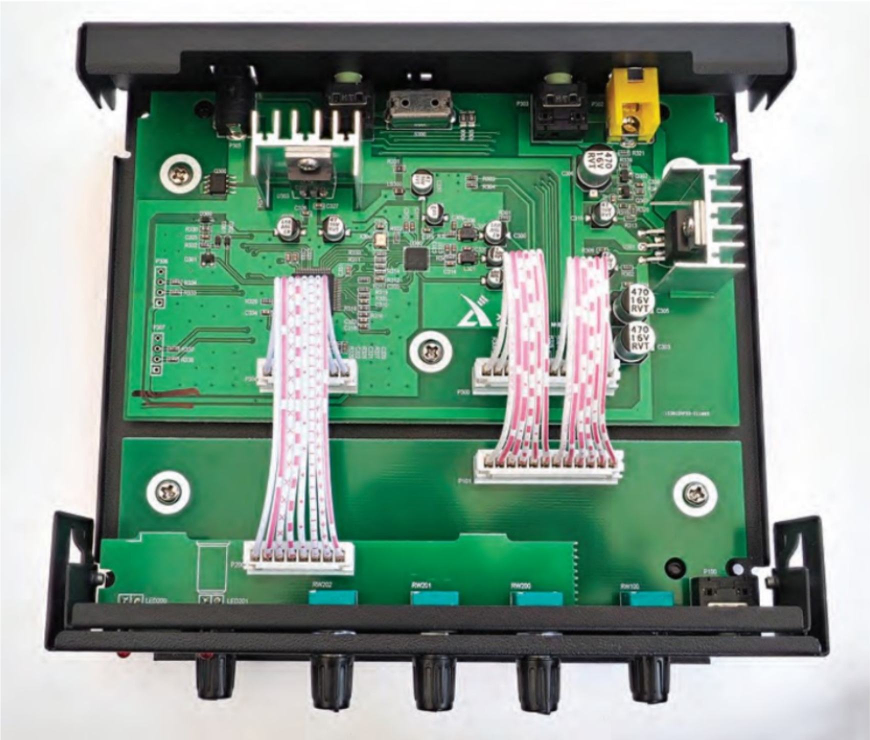

PHOTO 3: Inside view of the Xiegu GNR-1.

external speaker jack. All options worked fine, and the switchable HI/LO impedance on the rear of the GNR 1 was helpful as it provided a 16Ω termination for matching low impedance speaker/headphone jack. When switched to HI, the input impedance increased to around 10kΩ, which is ideal for line-level inputs. The provision of an input level control and associated Clipping LED worked well and gave the GNR 1 the ability to deal with a wide range of input levels. For the listening tests, I used my 70Ω Sennheiser HD-25 headphones, and I found plenty of audio power available. I also tried a few other headphones I had in the shack. These ranged from 16Ω to 100Ω impedance, and all were ok.

The only problem occurred when I tried to use my mobile phone earbuds and Bose headphones. Both were fitted with a four-band jack plug with tip, ring1, ring2 and sleeve connections. This didn't align properly with the GNR 1 stereo jack, resulting in reduced-level audio. If you have headphones with this type of jack, you will need to make or buy a conversion jack.

The next step was to see how the noise reduction and filtering performance could be used to improve the reception of real signals. There are a couple of primary situations where the Xiegu's noise reduction and filtering might be helpful. The first is to improve what I would call armchair listening, as you might do on the local club net or maybe the RSGB GB2RS News broadcast. In these situations, the signals are often quite strong, but noise reduction and filtering can be used to improve the clarity of the resulting audio. I tested this performance aspect on one of the many 40m morning nets. I found that the noise reduction kicked in as soon as the control was moved from its counter-clockwise rest position. This produced a noticeable signal level drop and a significant drop in background hiss. The hiss reduction continued as the control was rotated clockwise and the processing artefacts were well controlled. In many digital noise reduction systems, you often encounter distinctly watery artefacts, but these were well controlled in the Xiegu GNR 1. My next step was to adjust the audio bandwidth using the low and high pass filter knobs. This also worked well and cut out interfering signals at either end of the audio passband. I think it was the steep-sided digital filtering that made this so effective.

The second scenario for noise reduction is when dealing with weak signals on the verge of being intelligible. For these tests, I moved up to the 14MHz and 21MHz bands to find a few weak signals. When dealing with weak signals, I found the first third of a turn of the noise reduction control to be the most useful. Above that setting, the processing artefacts became more pronounced, and the signal level dropped, reducing intelligibility. Once I'd found the best noise reduction

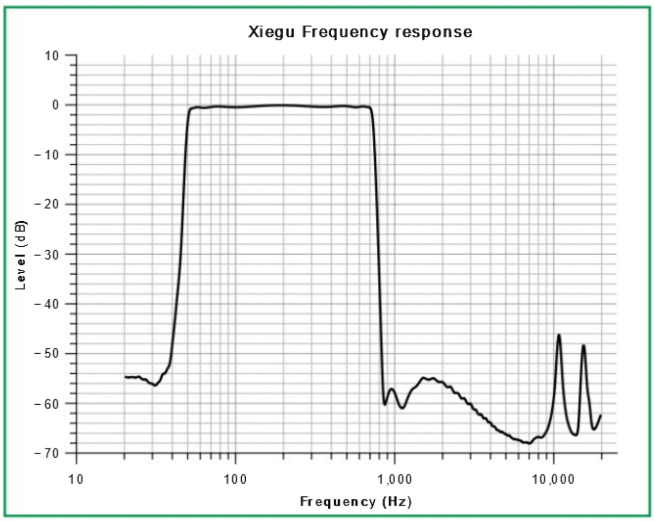

FIGURE 4: Xiegu GNR 1 with maximum HF cut.

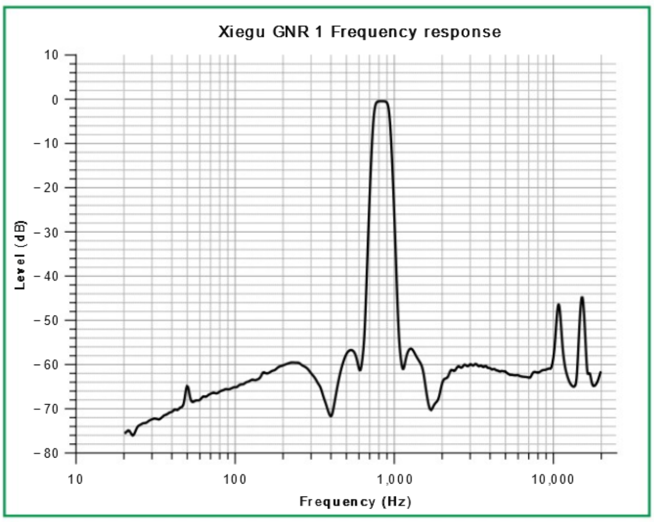

FIGURE 5: Xiegu GNR 1 best 800Hz peak.

setting, I started trimming the filters to remove unwanted signals from the passband edges. This worked well and gave a good improvement in the recovered audio.

The next test was to see if the Xiegu could deal with interfering heterodynes. This is not an advertised feature, but a few noise reduction systems include an automatic notch filter, so it was worth a try. To give some control over the test, I connected an RF splitter in the antenna lead so I could inject an interfering carrier using a signal generator. I set the carrier to be 20dB stronger than the wanted signal and tuned it to give a 2kHz interfering tone. I was pleased to see a useful reduction in the interfering carrier as the noise reduction control was advanced with the most benefit seen near fully clockwise. As an alternative approach, I tried adjusting the filter to see if I could trim out the carrier. This worked extremely well, and I could make the strong carrier completely inaudible with some careful adjustment. This was achieved thanks to the brick-wall-like filter slopes, which meant that I could eliminate the 2kHz carrier with minimal degradation of the wanted signal. Clearly, this is only practical with high or very low frequency interfering carriers positioned at the edge of the speech band.

As a final test, I tried the Xiegu with CW signals, wondering if the carrier suppression I'd observed earlier might adversely affect CW signals. This proved unfounded and the Xiegu GNR 1 provided a good reduction in background hiss whilst maintaining the CW signal at least over the first half of the noise reduction control. I thought the noise reduction artefacts compromised the signal at the higher settings. I also tried using the filters to narrow the audio passband. This worked well but I'm not a fan of the tuned noise effect you get when using very narrow bandwidths. As a result, I found that using the filters in moderation and combined with the noise reduction produced the best overall result for CW signals.

Summary

The Xiegu GNR 1 proved to be a useful addition to the shack with very well specified variable filters and effective white noise suppression. I recommend using the settings in moderation and taking your time to experiment to obtain optimum results. My only criticism was the drop in audio levels when applying the noise reduction, but that's easily compensated using the input and output level controls. The Xiegu GNR 1 costs £229.95 inclusive of VAT and is available from Nevada Radio (www.nevadaradio.co.uk). My thanks to Nevada Radio for the loan of the review model.

Contest Calendar October 2022

Ian Pawson, G0FCT

RSGB HF Events

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange
Sun 2 Oct	DX Contest	0600-1800	CW, SSB	3.5-28	RS(T) + SN
Mon 3 Oct	Autumn Series CW	1900-2030	CW	3.5	RST + SN
Wed 12 Oct	Autumn Series DATA	1900-2030	RTTY, PSK63	3.5	RST + SN
Sun 16 Oct	RoLo CW	1900-2030	CW	3.5	RST + Locator received
Mon 17 Oct	RSGB FT4 Contest	1900-2030	FT4	3.5, 7, 14	Report + 4-character Locator
Thu 27 Oct	Autumn Series SSB	1900-2030	SSB	3.5	RS + SN

RSGB VHF Events

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange
Sat 1-Sun 2 Oct	Oct 432MHz-245GHz Contest	1400-1400	All	432-245G	RS(T) + SN + Locator
Sat 1 Oct	2.3GHz Trophy	1400-2200	All	2.3G	RS(T) + SN + Locator
Sat 1 Oct	1.2GHz Trophy	1400-2200	All	1.3G	RS(T) + SN + Locator
Tue 4 Oct	144MHz FMAC	1800-1855	FM	144	RS + SN + Locator
Tue 4 Oct	144MHz UKAC	1900-2130	All	144	RS(T) + SN + Locator
Wed 5 Oct	144MHz FT8 AC	1900-2100	FT8	144	Report + 4-character Locator
Tue 11 Oct	432MHz FMAC	1800-1855	FM	432	RS + SN + Locator
Tue 11 Oct	432MHz UKAC	1900-2130	All	432	RS(T) + SN + Locator
Wed 12 Oct	432MHz FT8 AC	1900-2100	FT8	432	Report + 4-character Locator
Thu 13 Oct	50MHz UKAC	1900-2130	All	50	RS(T) + SN + Locator
Sun 16 Oct	50MHz AFS Contest	0900-1300	All	50	RS(T) + SN + Locator
Tue 18 Oct	1.3GHz UKAC	1900-2130	All	1.3G	RS(T) + SN + Locator
Thu 20 Oct	70MHz UKAC	1900-2130	All	70	RS(T) + SN + Locator
Tue 25 Oct	SHF UKAC	1830-2130	All	2.3-10G	RS(T) + SN + Locator

Best of the Rest Events

Date	Event	Times (UTC)	Mode(s)	Band(s)	Exchange (Info)
Sat 1-Sun 2 Oct	Oceania DX SSB	0800-0800	SSB	1.8-28	RS + SN
Sat 1-Sun 2 Oct	IARU 432MHz-245GHz	1400-1400	All	432-245G	RS(T) + SN + Locator
Sun 2 Oct	WAB DX Contest	0500-2300	SSB	3.5-28	RS + SN + WAB area
Tue 4 Oct	IRTS 80m Evening Counties	1900-2000	CW, SSB	3.5	RS(T) + SN (EI & GI also send County code)
Wed 5 Oct	UKEICC 80m	2000-21000	SSB	3.5	6-character Locator
Sat 8-Sun 9 Oct	Oceania DX CW	0800-0800	CW, SSB	1.8-28	RST + SN
Sat 15-Sun 16 Oct	Worked All Germany	1500-1500	CW, SSB	3.5-28	RS(T) + SN (DL also send DOK)
Sun 16 Oct	UKuG 24-76GHz	0900-1700	All	24-76G	RS(T) + SN + Locator
Sat 22 Apr-Sun 23 Oct	UKEICC DX	1200-1200	SSB	3.5-28	RS + SN (UK & EI also sent District code)
Wed 26 Oct	UKEICC 80m	2000-2100	CW	3.5	6-character Locator
Sat 29-Sun 30 Oct	CQ WW DX SSB	0000-2359	SSB	1.8-28	RS + CQ Zone (UK = 14)

For all the latest RSGB contest information and results, visit www.rsgbcc.org