How to...

SPIRENT HELP SHEETS

This help sheet explains the use of the built-in attenuator in the GSS6400 Record Playback Systems.

The sheet covers both:
GSS6400 GPS and GSS6400 GPS/GLONASS systems.

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GPS System

The GSS6400 has an in-built attenuator capable of 1dB increases of attenuation up to a maximum of 31dB. The attenuation is set using the front panel keys, or the Webserver application, and is fully described in the manual.

However it is worth considering how the system works as adding 20dB attenuation from the front panel or Webserver may not mean an exact decrease in the observed CNo as calculated by an attached receiver, of 20dB.

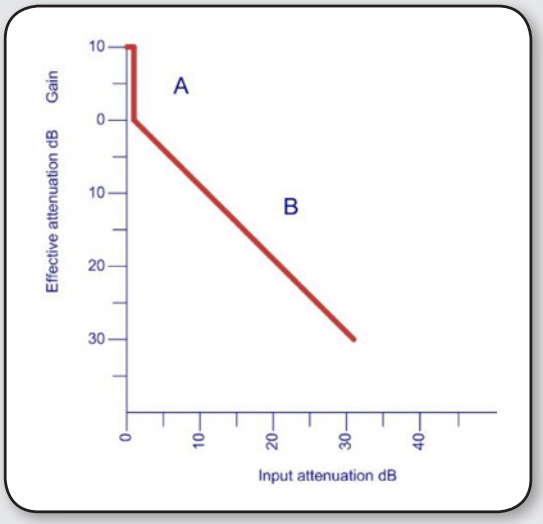

Figure 1

The system operates as follows. Real life spectrum (signals and noise) are stored on the hard drive of the GSS6400 RPS. When the system plays back with no attenuation at all (0dB on the X axis) the spectrum is played back with around 10dB gain, as shown in area A of Figure 1. Because BOTH the signal and the noise are played back high an attached receiver's AGC will compensate for this and modify its thresholds accordingly, preserving the original signal to noise ratio. You will also appreciate there is then an additional noise figure to take into account when played back into an attached GPS receiver's RF front end. By playing back 'hot' you reduce the effect of the receivers RF noise figure. However in storing the signals, due to the quantisation of the data, there is a small loss in signal of around 1dB (2 bits) which cannot be gained back, whatever you do. So a signal recorded at 51dB would theoretically pay back at 50dB.

As soon as you add 1dB of attenuation the GSS6400 actually drops the signal levels by around 11dB, and the system no longer runs 'hot'. Again the AGC in the GPS receiver should compensate for this, and a signal recorded at 51dB will now play back at around 49dB, showing one dB of attenuation over the playback with 0dB of attenuation.

Thereafter a 1dB input attenuation reduces the signal output by 1dB as shown in area B in the figure 1.

Theoretically therefore a signal recorded at a CNo of 51 dB, with no attenuation added will be played back at 50dB despite the fact that the spectrum is being played back 10 dB hot. The 1 dB loss is the quantisation loss. With 1dB of attenuation the output signals will be seen as 49dB.

In reality there are some error sources which modify the performance slightly, as shown in Figure 2.

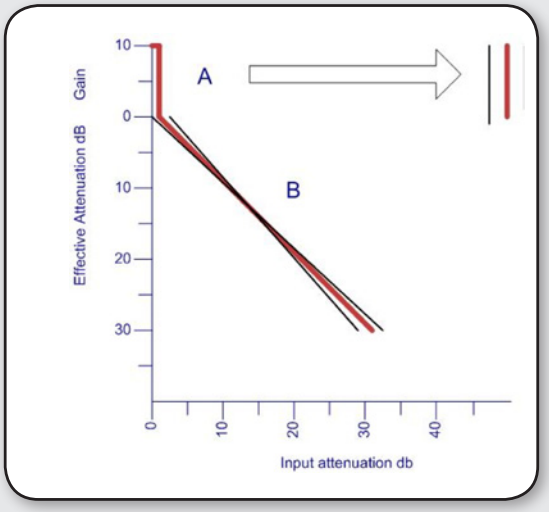

Figure 2

Consider firstly the region A where the one adds just 1dB of attenuation from the front panel or Webserver, but the system lowers the signal by 10dB. Depending on the AGC of the receiver viewing the drop and the RF performance of the receiver under test there will be a margin of error, and a CNo drop which in our theoretical case of Figure 1 was 10dB may be seen by the receiver as a drop of 9 or 11dB.

Secondly the area B may not be exactly linear, but typically would be in a range of 30-32 dB attenuation for a nominal input attenuation of 31 dB (represented by the black lines).

GPS/GLONASS System

Firstly the arguments used above for the GPS system hold perfectly well for the GPS/GLONASS system with some additional considerations (Figure 3).

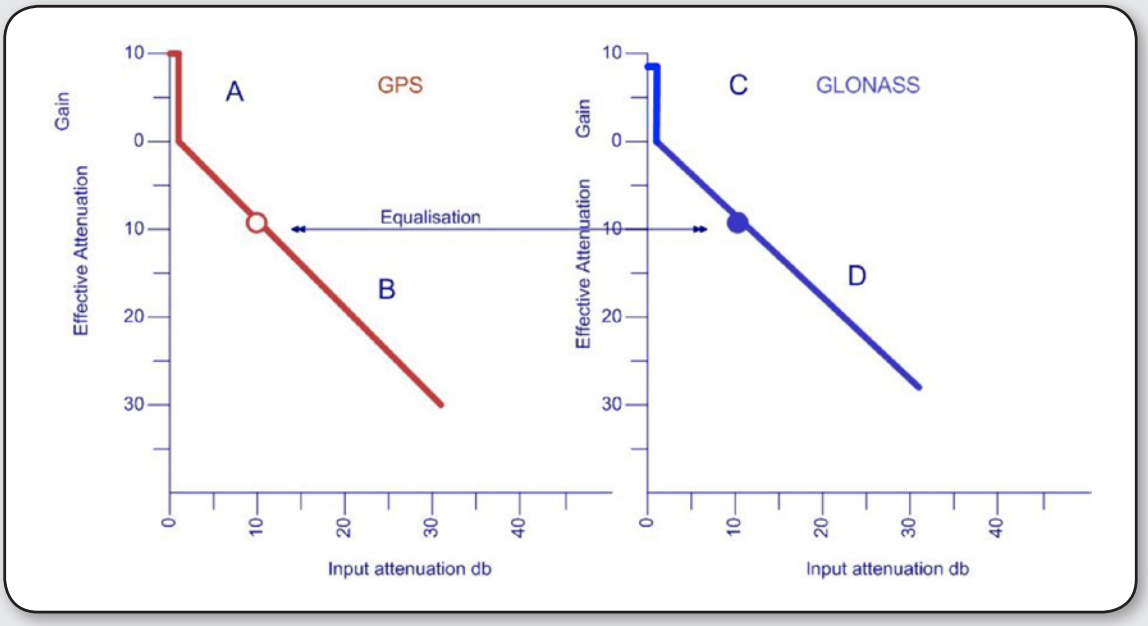

Figure 3

The left hand graph is the GPS attenuation graph, and the right hand that for GLONASS. A single attenuator attenuates the signal on BOTH the GPS and GLONASS signals. The theoretical GLONASS graph is very similar to that for the GPS except for the following:

1) The quantisation of the GLONASS is usually 1 bit, compared to 2 bit for the GPS. This gives around 3dB of signal loss. Therefore with no attenuation the signal plays back 2dB lower than the equivalent strength signal on the GPS (C in Figure 3).

2) The slope of the attenuation curve is not linear (not 1:1), rather it is around a drop of 0.9 dB per 1 dB of attenuation.

So taking the example of the previous section with no attenuation and an input signal of 51dB on both GPS and GLONASS the GPS will playback at 50dB, while the GLONASS will only be 48dB.

In order to minimise these effects the system is set so that when 10 dB of attenuation is added as an input the output is balanced to give a drop of 10dB on the GPS, but only 8 on the GLONASS.

This means that if we start with 51dB signals being recorded on both GPS and GLONASS adding 10 dB of attenuation will give an output signal as viewed by the GNSS receiver of 40dB for both the GPS and the GLONASS. This is shown as the Equalisation point in Figure 3.

We have however seen much more variation in how GNSS receivers calculate their noise floor, and how the AGC works, than with GPS receivers. This makes the use of the attenuation table more variable.

Conclusion

The use of the attenuator in the GSS6400 has been described, and gives a simple way to attenuate the stored signals. CNo's viewed on an attached GNSS receiver may however not be exactly commensurate with the input attenuation because of the way that the GNSS receiver calculates its CNo, and adjusts it AGC.

That being said for a given GNSS receiver the results using the in-built attenuator will be repeatable. Therefore the user should be able to draw up a simple table for a particular receiver of input attenuation against that output and measured using an attached GNSS receiver.

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