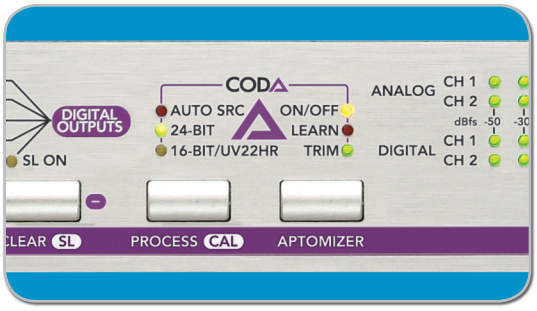
Aptomizer: White paper

Introduction:

The Rosetta 200 will be the first Apogee product to include Apogee's newly developed optimizer: "The Aptomizer". The Aptomizer is a digitally controlled analog process maximizing the recording levels of analog to digital conversion in music and sound recording. The result of the procedure will be an optimal use of the available bit resolution and therefore produce the best possible signal to noise ration and the lowest distortion.



The problem:

The word length of any type of PCM conversion dictates the maximum theoretical dynamic range. For example a 16-bit system allows for 96dB of dynamic range and a 24-bit system for 144 dB. Again, this is the theoretical range; in real life most 24-bit converters do not go beyond 120dB, because of limitations in chip fabrication, analog noise and limited voltage on the power rails. However, music and sound in general hardly ever need such dynamics. For instance: a full orchestra's dynamic range does not go beyond 100dB, not to mention the sound system on which the music is being reproduced.

The catch is not the dynamic range, the catch is in distortion and the signal to noise ratio.

Contrary to analog recording, digital distortion decreases with higher levels. The more bits that are being utilized, the higher the resolution; the lower the distortion, the lower the fixed noise-floor. A good analogy for this phenomenon is digital photography; the resolution of the digital camera determines the detail of the final picture.So an optimal recording level is vital for a high quality recording.
On the other side of the spectrum, the process of PCM recording is very unforgiving with regards to "overs". In other words, when all of the bits have been used and the amplitude of the signal to be converted is higher then the maximum resolution allows, the A/D converter will produce a series of maximum values, which will be perceived as clipping. This results in massive and very unpleasant distortion when reproduced.
Any recording engineer has experienced the art of finding the proper recording level; high enough to keep distortion and noise low and low enough to ensure unexpected peaks will pass the conversion process without clipping. This can be a tedious process, especially when the end product is a production-master requiring the most optimal levels.

Solutions:

- Automatic Gain Control: This is the "low" end solution. The process adjusts the recording level based on the content of the material recorded. The disadvantage is the usually slow response time of this process, resulting in the clipping of peak material and inconsistency in the perceived loudness of the overall recorded material.

- The use of compressors and limiters:This can work effectively, but these devices do affect the dynamics and "sound" of the recorded material and increase distortion.

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- Have a lower recording level and use a digital normalizer or optimizer after conversion: The disadvantage here is that the resolution of the recording is not enhanced. For instance if 20 of the available 24 bits have been used, digital normalizing will “stretch” 20 bits to 24 bit. The result is that the resolution remains the same , but the distortion is even worse since it has been enlarged by the same ratio. Compare this to zooming in on a digital photo. The zoomed in area becomes larger, but the resolution does not change and therefore the picture distortion becomes equally more visible.

- Soft Limit: Soft Limit is a good way of keeping peaks in control and bringing up the overall level However for some material the effect of soft limit is not desired.

The Aptomizer solution:

The Aptomizer circuit makes sure every bit available is being utilized without having “overs” because it is a self-learning process. The stereo balance will not be affected since the relationship between left and right will always be maintained.

The procedure starts by going into the Learn Mode The Aptomizer circuit will keep track of maximum levels as long as this learn mode is engaged. Once this status is left, the Aptomizer circuit will calculate the corresponding analog gain adjustment so that the maximum level measured will be at exactly 0 dBfs. The DA analog circuitry will be adjusted accordingly to assure a true unity gain signal path. It is now up to the user to make artistic decisions about the recording level, leave it as is and have the perfect recording. Alternately go to trim mode, bring down the Aptomizer level to allow some headroom or bring up the Aptomizer level and engage soft limit to avoid “overs”. The last Aptomizer setting will always be stored and retrieved by the Rosetta 200 and only when Learn Mode is engaged will the settings be changed.

Conclusion:

The Aptimizer circuitry will simplify the process of finding the right level for recording. It will enhance the quality of every recording by using the maximum headroom, without the need for any compression, limiting or “bit-zooming”. Leaving distortion and noise to a minimum and maximizing the dynamic range. Needless to say this will be a very useful tool for any recording professional and enthusiast.