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Inovonics Omega_FM processor

Introducing Rev. 3 software – April 2004

Rev. 3 software for our flagship Omega-FM digital audio processor has been a long time (eighteen months) in the making. Martin Spencer, one of our UK-based designers, talks us through the processing techniques that make Omega-FM sound so wonderful, and considers some other important new features along the way...

Reliability, Reliability, Reliability.

There is no more important attribute of any piece of Radio equipment than this, and the need for reliability is greatest when the kit is in the all-important program path twenty four hours a day. Unreliability costs the operator threefold! Once in lost listeners, twice in the manpower required to service the fault, and a third time, in lost morale.

Inovonics understands the importance of reliability. Omega's impressive track record speaks for itself, and for Rev. 3 we also improved the way user data is stored and carried out extensive testing to confirm that our software is the most stable and reliable you can get.

Sampling Rate.

Orban and Omnia have had a very public disagreement about sampling rates. What's the Inovonics line?

The first point to make is that any sensibly-designed audio processor will use all sorts of different sample rates internally. The output rate is most often dictated by the exciter or STL that the processor is feeding. So the question of sample rates really boils down to what sample rate is required at the input.

Questions about DSP processing horsepower really belong in the past, where first-generation digital audio processors such as the Orban 8200 and Omnia.fm had an issue to contend with. Modern DSP, including Omega's Intel and the Motorola range used by other manufacturers, all have plenty of number-crunching power available.

Our opinion is that using 32kHz sampling at the input does subtly erode audio quality. 32kHz is a lower sample rate than the ubiquitous music distribution platform, the CD. And the CD, good as it is compared to the reduced bit-rate of widely-accepted MP2 and MP3, is only a consumer format after all.

One theoretical reason 32kHz sampling might not be a good idea is that essential anti-alias filtering can introduce significant phase shifts in the 8 to 15kHz range of the audio spectrum, leading to subtle 'muddying' of the stereo image and high frequency spectrum. And with 32kHz sampling, there can be no chance of conveying any audio between 15kHz and 20kHz, and no choice of low-pass filtering options. Some radio systems (such as Eureka 147 'DAB' and HD radio) can pass the audio above 15 kHz.

Omega's 48kHz input sample rate overcomes all the above limitations, allowing a choice of input low-pass filtering and keeping phase shift out of the audio passband. But going beyond 48kHz, for example to 96kHz, would be nothing more than a marketing gimmick and a waste of resources for a device that will undoubtedly be fed with 44.1 kHz sampled audio at best.

RMS versus Peak control.

Earlier versions of Omega-FM used peak-based level detection exclusively. RMS-based control has the advantage of exceptionally transparent sound free from any obvious artifacts – more aggressive level control can be performed before it starts to create audible problems. However, there's a drawback. Signals processed exclusively by RMS means may sound wonderfully consistent, but they will still have a wildly varying peak amplitude, because RMS control is 'blind' to the peaks of a signal. In fact, it is this insensitivity to peaks that makes RMS control sound so good – the ear also responds to the power (RMS) value of a sound waveform, whatever the peak value may be. To put it another way, peak-based control tends to sound 'unnatural' to the ear, because it is responding to a variable, which is only loosely related to the human perception of volume.

There is also an incidental benefit here. The selection of time constants in a peak-based system becomes a very tricky task for an expert, whereas in an RMS-based system the time constant is far less critical. It can therefore be chosen more or less on the basis of preference and a quick listen, without fear of the sometimes-horrendous consequences that might (and do) occur on-air if such a cavalier approach were used to adjust the time constants in a peak-based system.

In Rev. 3, Omega combines RMS and Peak-based techniques to obtain the cleanest, loudest sound possible with no unnecessary compromises.

AGC

The AGC stage is now primarily RMS-based for transparent control of long-term levels. 'Advanced' AGC functions such as 'Fast Attack' are, however, based on peak response as well, so that the following multiband stages only have to deal with a limited range of peak levels. The balance between RMS and Peak control in the AGC is fully adjustable via threshold controls in the 'Advanced' menu.

Leveler

The leveler section of Omega-FM has been completely redesigned 'from the ground up'. It now features pure RMS control with a simplified time constant structure so that Leveling is now naturally more closely attuned to the natural dynamics of music and other program elements.

Another major innovation for Rev. 3 is 'Relative Mode' for the leveler. In this mode, all gain reduction in the bands is referenced to an arbitrarily-assigned reference value of 6dB, and the average gain reduction across all bands is always equal to the reference. This clearly separates the leveling function from the AGC function.

New controls for the leveler include 'Coupling,' which affords the user precise control over how much dynamic re-equalization is allowed, and a simplified time-constant control. Individual band drive controls, which were hidden in previous versions have been

introduced, further refining how the maximum processing activity in each band can be regulated by the user.

The result of all these changes is a more powerful leveler that also seems effortlessly to know when ‘enough is enough’. Specific artifacts like pumping are a thing of the past, and you'll achieve that desirable ‘polished’ sound with far less set-up effort.

Multiband compressor

Past broadcast processors of all varieties tended to suffer from the fault of over-processing certain tracks when set up for competitive loudness beyond a certain point. Markets being what they are, most processors tend to get set for a certain amount of perceived loudness that leaves at least 10-20% of the tracks in that ‘over-processed’ category. Continuing improvements in the state of the art resulted in more on-air loudness, but there was still a stubborn residue of over-processing going on – that wearing, flat, smashed sound on certain tracks that can lead to ‘listener fatigue’ and tune-out.

Whilst the solution is too complex and tedious (not to mention proprietary!) to go into here, we think that if you try Omega Rev. 3, you'll find a most refreshing change and a noticeable absence of that old 'over-processing' chestnut. Rev. 3 is more responsive to the incoming program material than any other processor we have tested, and it doesn't achieve this improvement in consistency at the expense of maximum loudness!

Clipping, Loudness, Miscellaneous Functions and Latency (delay).

Clippers have long been noticeable by their absence in most stages of Omega-FM, and we have no plans to change this! We believe that clipping is a necessary evil that should always be left as late in the chain as possible to minimize audible artifacts.

Omega uses a composite clipper with optional spectrum filtering that affects the composite (FM) output only. Because of this, the discrete Left and Right outputs are still pristine even when the composite clipper is used for competitive loudness on FM.

There are a couple of other features that make Omega an ideal choice of processor for HD radio...

The discrete Left and Right outputs can be set to output a signal that is prior to pre-emphasis HF limiting, so another major source of impairment that is an essential part of the FM chain, can be eliminated from the HD radio signal path even when using a single audio processor.

Omega's Composite output now has an independent, adjustable delay for compatibility with HD Radio. This is capable of delaying the FM signal by up to 10 seconds to match the delay in the HD Radio system. Delay is adjustable in 1-millisecond increments for precise matching of the two signals. This will give seamless blending when radios change between FM and HD, for example when the radio is retuned to a different station or in weak-signal areas where the digital system can’t keep going. This also means that you don’t have to route FM-bound audio via the HD radio exciter, so it is easier to maintain redundancy and reliability in the plant without a complete re-think of the signal path.

Latency (program delay) remains at 10.5 milliseconds, and you can be sure it won’t go any higher in subsequent revisions, at least for the foreseeable future. Boot time is still an industry-leading 3 seconds from power-on to full operation.

Here's a new feature that we believe is unique to Omega_FM. Omega's factory formats have now been created individually for zero pre-emphasis, 50μs and 75μs. The correct bank of formats is automatically loaded when you set the pre-emphasis. This means the factory formats are tailored to sound exactly right, straight out of the box, whatever the emphasis. This will become a major time-saving feature for Omega used with HD Radio in the United States, and means that Omega_FM sounds right straight out of the box in 50μs zones, where other processors can sound rather shrill.

One final feature of note concerns remote control of the processor. Omega's remote control options now include low baud-rate RS232 that will operate even through the 9600-baud auxiliary data port of your STL or audio codec.

In closing I would like to thank all of the many Omega users in all parts of the world who have shared their experiences and thoughts with us, and John Burnill for coding everything as well as continuing innovation in the audio processing field.

All your input has been crucial every step of the way in bringing Rev. 3 to fruition. Enjoy the finished product, and stay in touch!

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