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## OPTMOD-FM ITU-R BS.412 Compliance

The ITU-R 412 recommends that the Power in the composite baseband signal (including the pilot tone), integrated over any 60-second interval, not exceed the Power in a sinewave that modulates the FM carrier to  $\pm 19$  kHz (25.3% modulation).

Many European countries are now enforcing this recommendation.

ITU-R 412 requires the "average Multiplex Power" to be limited to a standard value. In most of the country's is this 0 dBr, like Germany others using a range between 0 and +3 dBr.

The OPTIMOD-FM contains since the introduction of the OPTIMOD-FM 8400 in 2001 standard a defeatable Multiplex Power limiter that constantly monitors the Multiplex Power according to ITU-R 412 standards. The design of the OPTIMOD Multiplex Power Controller is patented.

### About the Multiplex Power Controller's Time Constants

Although the BS412 specification calls for a 60-second integration time, the integration time of the OPTIMOD's Multiplex Power Controller is just a few seconds. The problem with making the integration time longer is that the BS.412 standard states that the integrated Multiplex Power in any arbitrary 60-second time period cannot exceed the average Power of the sinewave that produced  $\pm 19$  kHz carrier deviation. In other words, whenever you start measuring, you must not exceed the total integrated Power limit over the following 60 seconds.

This makes it impractical to "bank" power. For example, at first glance one might think that a classical music station could exploit a period of quiet music to allow a crescendo to get louder than it would using the 8600's relatively fast integration time. However, what happens if someone starts an arbitrary 60-second measurement period not at the beginning of the quiet passage but at the beginning of the crescendo? Because an automatic Multiplex Power Controller does not know what is coming after the crescendo, it must reduce the level of the crescendo so that it complies with the Multiplex requirement over with an integration time much shorter than 60 seconds. Otherwise, it might have to dramatically reduce the level of following (as yet unknown) program material in order to ensure that the Multiplex Power limit is not exceeded over the 60-second measurement period in question. This kind of gain pumping would be far worse than the pumping produced by using a relatively short integration time.

### No use of ITU-R 412 Power Control

With no Power control, some of the louder OPTIMOD presets can exceed the ITU standard by as much as 9 dB. This means that the clipper drive must be reduced by as much as 9 dB and this will vary according to the dynamics and spectral content of the input program material.



## How does it work?

The Power Controller automatically reduces the average modulation to ensure compliance. It allows you to set the “texture” of the processing freely, using any preset. If a given processing setting would otherwise exceed the Multiplex Power limit, the Power Controller automatically reduces the drive to the peak limiting system.

## Orban's ITU-R 412 Multiplex Power Control prevents unnatural loudness variations

To prevent unnatural loudness variations, like all other FM audio processors, the OPTIMOD applies a static loss (**preset-dependent** and set by a Multiplex Power Offset Control) before the FM processing chain when the Multiplex Power Controller is activated. This complements the dynamic gain reduction produced by the Multiplex Power Controller.

## ITU-R 412 Multiplex Power Control for all processing structures

The Multiplex Power Controller is operational with all of the Two-Band and Five-Band processing structures. It is not active in Test mode and will not prevent the OPTIMOD's built-in test oscillator from producing illegal modulation. It is the responsibility of the operator to make sure that the test oscillator does not violate the ITU requirements. (To ensure this, never modulate the carrier with a single L+R tone that produces total carrier modulation, including pilot tone, of more than 24%.)

## OPTIMOD Audio Processing and the NEW Multiplex Power Controller

The NEW third generation of OPTIMOD's Multiplex Power Controller reduces Multiplex Power by applying gain reduction after the OPTIMOD's FM peak limiting, and reducing the drive into the clippers. This new design makes the audible action of the Multiplex Power Controller more subtle and much more consistent than the generations before.

## OPTIMOD-FM complying with the standard

The Orban ITU BS.412 Multiplex Power Controller yields the best possible coverage while flawlessly complying with the standard. You can adjust it to maximize loudness within the constraints of the BS.412 standard or to produce less gain change at the expense of slightly lower loudness.

## Frequently Asked Questions about the OPTIMOD-FM ITU-R 412 Multiplex Power Controller

### *Is the Multiplex Power Controller available for all processing structures?*

Yes, the Multiplex Power Controller is operational with all of the Two-Band and Five-Band processing structures. It is also available in the OPTIMOD-FM 5518 and OPTIMOD-FM 5500 standalone Stereo Encoder mode.

### *Can I control the amount of gain reduction of the Multiplex Power Controller to prevent unnatural loudness variations?*

Yes, only the OPTIMOD-FM allows you to prevent unnatural loudness variations, like other sophisticated audio processors. The OPTIMOD applies a static loss (preset-dependent and set by a Multiplex Power OFFSET control) before the FM processing chain when the Multiplex Power Controller is activated. This complements the dynamic gain reduction produced by the Multiplex Power Controller. This feature is also available in the OPTIMOD-FM 5518 and OPTIMOD-FM 5500 standalone Stereo Encoder mode.



***Can I control the amount of gain reduction of the Multiplex Power Controller when the standalone Stereo Encoder mode is activated to prevent unnatural loudness variations?***

Yes, OPTMOD-FM 5518 and OPTIMOD-FM 5500 standalone Stereo Encoder mode applies a static loss (preset-dependent and set by a Multiplex Power OFFSET control) when the Multiplex Power Controller is activated.

***Can I adjust the Multiplex Power threshold to be compliant with the maximum amount of Multiplex Power in my country?***

Yes, the Multiplex Power threshold can be set in steps of 0.1 dB between -2 and +10 dB.

***Is the Multiplex Power Controller available on all Outputs?***

Yes, the Multiplex Power control is applied to all outputs, not just the composite output.

***Does the Multiplex Power Controller effects the OPTIMOD-FM 8300, 8500 or 8600 HD signal processing path?***

No, the Multiplex Power Controller works individual from the HD processing path and is only active in the FM signal processing path.

***Is the Multiplex Power Controller still active if I use the Diversity Delay?***

Yes, when diversity delay is implemented on the composite output the Multiplex Power Controller does not use the output of the stereo encoder as its reference.

Instead, it computes the Multiplex Power directly from the left and right audio signals, the setting of the 19 KHz Pilot level and the setting of the Composite Limiter.

***Is the OPTIMOD-FM 8600 Stereo Encoder in SSB/VSB mode BS.412 compliant?***

Yes, the 8600's ITU-R Multiplex Power Controller does take this into account and will control Multiplex Power accurately in SSB mode.

***Does the OPTIMOD include Multiplex Power measurements?***

Yes, every OPTIMOD-FM includes standard an ITU-R BS.412-compliant Multiplex Power Level Meter plus an indication for the amount of gain reduction produced by the Multiplex Power Controller.

*Thank you for your attention!*