

**INO** *mini*  
**223**

## Multimode Audio Processor

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### Installation & User Guide



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## Section I

### INTRODUCTION

#### Product Description

The INOmini 223 is a compact, DSP-based audio processing system for multiple broadcast applications. It is selectively applicable to NRSC-compliant and all other AM broadcasting, TIS 'roadside information' transmissions, monaural FM service, analog SCA subcarriers, and a full-bandwidth Studio mode for microphone and general production processing.

The 223 features gain-riding AGC, a 3-band compressor with adjustable crossovers and EQ, and a 'lookahead' peak controller. Pre-emphasis and output filtering are individually and specifically tailored to the service selected.

#### Product Features

Features of the INOmini 223 include:

- Easy no-compromise processing for US/NRSC AM, Worldwide AM, Shortwave, US/Euro Monaural FM, TIS, analog SCA, and general-purpose studio chores.
- Fast menu / jog-wheel setup from the front panel.
- Performs gated and windowed 'gain-riding' AGC, 3-band dynamic range compression, tight peak control and output low-pass filtering specific to the selected application.
- Intuitive user-adjustable compression, EQ, limiting and program density (loudness) adjustments.
- DSP 'lookahead' limiting offers tight peak control without waveform clipping.
- Flashing front-panel alarms warn of audio loss and program inputs outside the range of AGC capture.
- USB port enables fast firmware updates in the field.

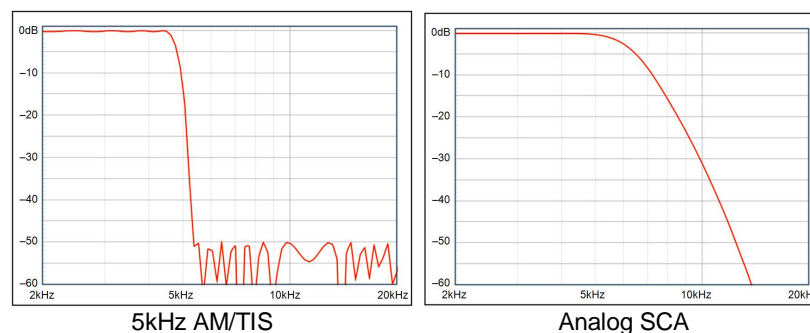
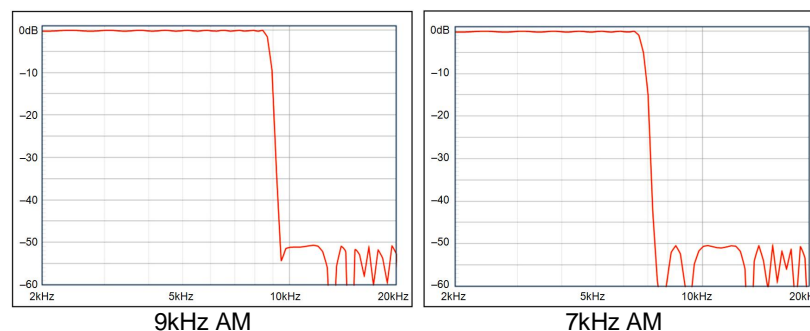
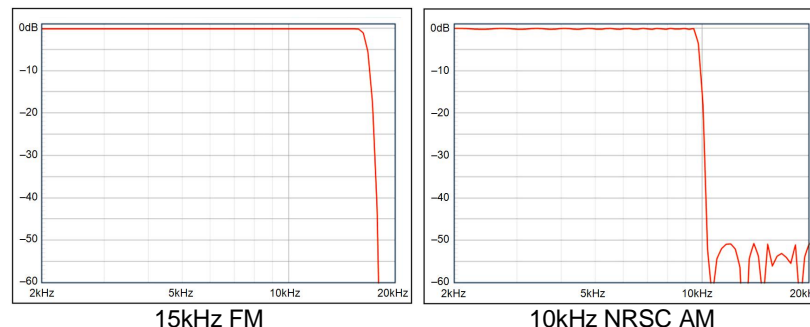
#### Product Specifications

**Frequency Response:** 20Hz-20kHz,  $\pm 0.1$ dB in PROOF and in Studio Mode; low-pass characteristics graphed below.

**Distortion:**  $< 0.02\%$  THD in PROOF mode.

**Noise:** Better than 72dB below the limited output level in normal operation, measured through an appropriate de-emphasis network.

#### Output Low-Pass Filter Characteristics:



## Application Matrix (choices available for each application):

INomini223 Application	Low-Pass Filter	Pre-Emphasis	Low Band Crossover Hz	High Band Crossover kHz
AM – NRSC	10kHz	75µs-T*	50/80/130/200	1 / 2 / 4
AM – 9kHz	9kHz	75µs-T*	50/80/130/200	1 / 2 / 4
AM – 7kHz	7kHz	75µs-T*	50/80/130/200	1 / 2 / 4
AM – 5kHz	5kHz		50/80/130/200	0.5 / 1 / 2
TIS	5kHz		200	0.5 / 1
FM – US	15kHz		50/80/130/200	1 / 2 / 4
FM – Euro	15kHz		50/80/130/200	1 / 2 / 4
SCA	5kHz		50/80/130/200	0.5 / 1
STUDIO	N/A	N/A	50/80/130/200	1 / 2 / 4

\* -T indicates the 'truncated' 75µs NRSC pre-emphasis characteristic

**Program Line Input:** Active-balanced (XLR) analog input, accepts nominal line levels between -20dBu and +20dBu.

**Program Line Output:** Active-balanced (XLR) analog output delivers levels between -15dBu and +12dBu corresponding to 100% modulation; 200-ohm resistive source. A switch under the top cover inserts a 20dB pad in the output for transmitters requiring a low level input (see Page 7).

**Headphone Jack:** front-panel (TRS) 3.5mm

**USB Port:** Front-panel connection for firmware updates.

**Alarms:** Flashing front-panel indication of audio loss and AGC out-of-range.

**Power Requirement:** 12VDC at 200mA (2.1mm x 5.5mm coaxial). A universal inline 'brick' switchmode mains power supply is provided with the INomini 223.

**Mounting Options:** An optional rack adapter accepts up to three INomini modules in a 1U, 19-inch rack space. The INomini 223 may also be fastened to any convenient surface with two small screws.

**Size and Weight:** 1.6"H x 5.5"W x 5.5"D; 4 lbs. shipping weight.

## Section II

### INSTALLATION AND CONNECTION

#### Unpacking and Inspection

Inspect for shipping damage immediately upon receipt of the equipment. If damage is found or suspected, notify the carrier at once, and then contact Inovonics.

We recommend setting aside the original shipping carton in case you need to return the unit for Warranty repair. Shipping damage sustained as a result of improper packing for return may invalidate the Warranty!

#### Warranty Registration

Please register your Warranty. Not only does this assure coverage of the equipment under terms of the Warranty (inside the back cover of this manual), but you will receive any specific service instructions and firmware updates. Register online at:

[www.inovonicsbroadcast.com/product-registration](http://www.inovonicsbroadcast.com/product-registration)

#### Mounting

The INomini 223 is packaged in a compact 'clamshell' chassis that defines the INomini series of products. The 223 may simply be placed atop existing rack-mounted equipment, as long as at least 1U of panel space is left open above the rack-mounted 'host' to access the unit. Alternatively, a pair of mounting holes on the chassis base allows the 223 to be fastened to the inside of an equipment rack cabinet with two #4 screws.

An optional rack-mount kit is available for the INomini 223. The rack kit can hold up to three INomini modules and comes with blanking panels for unused spaces, and with two 'daisy-chain' power cables so that two or three INomini modules may share a single power supply.

#### AC Mains Power

The 'brick' mains supply provided with the 223 is an efficient switchmode supply. The actual power consumed by

the INOmini 223 is 200mA at 12 volts DC. A second, paralleled DC connector on the rear panel allows ‘daisy-chaining’ INOmini modules. This means that two or more units may be fed from the same AC supply, but with the obvious caution that the total input power specification of a given assortment of INOmini modules must not exceed the current rating noted on the power supply label.

### **Radio Frequency Interference (RFI)**

Although we have anticipated that the 223 Audio Processor will be used in the vicinity of broadcast transmitting equipment, please do practice reasonable care in locating the unit away from *abnormally* high RF fields.

### **The LCD Display and Menu Knob**

The front-panel MENU knob scrolls the LCD through the various menus; push the knob to enter menus for setup options. Section III of this manual explains the easy setup and various operating preferences of the INOmini 223.

### **Headphone Jack**

The front-panel PHONES jack will accommodate a standard stereo headset of virtually any impedance with a 3.5mm stereo plug. When headphones are plugged in, the LCD menu will automatically go to the `HeadPhone Vol:` screen, and the front-panel knob will adjust the listening level. Once you set the volume to a comfortable point, push the knob to return to the previous menu.

### **Rear Panel Connections**

PROGRAM LINE INPUT	This XLR female accepts a monaural program audio feed referenced to any “zero-VU” level between -20dBu and +20dBu. Input sensitivity is adjusted on the <code>Input Gain:</code> menu, which also gives a quasi-peak-responding display of the program signal envelope.
PROGRAM LINE OUTPUT (& Range Switch)	This male XLR connector presents a balanced feed to the transmitter or exciter. In asymmetrical AM service, pin 2 should be considered ‘hot’ and connected to the + input of the transmitter.

+12VDC  
POWER I/O

The output is normally adjusted from the `Out. Lvl:` menu in 0.1dB steps from -15dBu to +12dBu. A slide switch under the top cover inserts a 20dB pad to re-scale the output level range, from -35dBu to -8dBu. This accommodates low-power transmitters that require a much lower input signal than traditional broadcast transmitters. The slide switch is marked 0dB / -20dB on the circuit board and is located about an inch behind the PROGRAM LINE OUTPUT connector. Setting this switch to the -20dB attenuated position automatically changes the level scaling on the `Out. Lvl:` menu and displays the word `PAD` on that menu as well.

Two paralleled connectors allow ‘daisy-chaining’ INOmini modules mounted in the optional rack-mount adapter. Two short ‘pigtail’ cables are included with each rack adapter, along with blanking panels to cover unused positions.

The 223 Audio Processor draws 200mA from the 12-volt source. Check the rating on the label of the power supply to make sure that it can safely power all the modules that it feeds.

The rear-panel coaxial power connectors are not a locking type, and the mating plugs do pull-out rather easily. A Ty-Wrap® will secure the cables to the plastic anchor above the jacks if this proves a problem.

## Section III

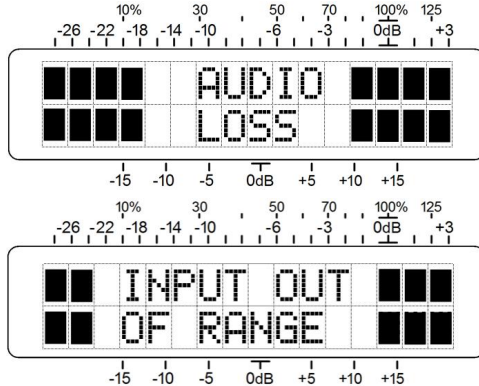
### PREPARING FOR SETUP

This section of the manual covers aspects of INOmini 223 setup that must be addressed before the unit is placed in actual operation.

#### Flashing Alarms

The INOmini 223 has two front-panel flashing alarms that indicate program audio fault conditions. You may encounter these alarms early in your setup of the unit.

**AUDIO LOSS** will flash on the LCD display when the peak value of the program signal drops and remains 25dB below its normal level for 30 seconds or more. Also when AGC is enabled, **INPUT OUT OF RANGE** will flash when AGC gain approaches either end of its capture range.



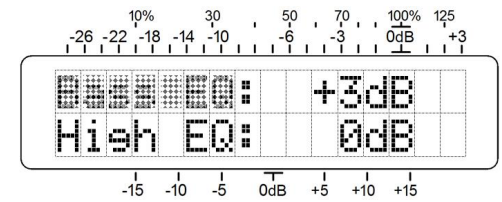
Both these alarms are valid only when the INOmini 223 is placed in actual operation. Nonetheless, both alarms are valid indicators of 'something wrong' with the audio signal feeding the processor. This should not remain a problem, however, once the unit is adjusted for proper operation as detailed in the next manual section.

Pushing or turning the knob will interrupt flashing for about 40 seconds. This will allow you to navigate through the menus and complete setup.

#### Menu Navigation Basics and 'Blinking'

You may already have figured out the menu tree for yourself, it's actually quite intuitive, you simply *turn* the knob to navigate among the various setup menus. If you then *push* the knob in a particular menu, any item that can be edited

(changed) will 'blink' at a rapid rate. (Don't confuse blinking callouts, like the one illustrated here, with the flashing alarms introduced earlier.) Next *turn* the knob one way or the other, either to enable an option or to set a level or other value. Finally, *push* the knob again to accept your selection and to return the knob to menu navigation. If you forget to *push* the knob after making a change, the change will be accepted automatically after a 30-second "are you sure?" waiting period.

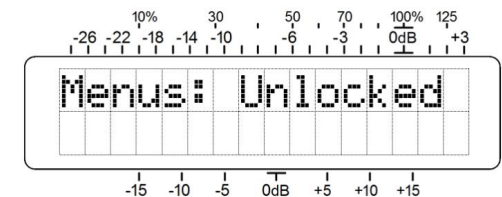


To recap, in all the setup menus, any parameter that can be edited will begin blinking when you push the knob. Blinking indicates that a different option or value may be selected. Rotate the knob if you want to make a change, and then push it once again to accept that selection and write it to non-volatile memory. If a menu has two line-items that can be edited, you need push the knob a second time to release the menu whether you make a change to the second item or not.

The various menu screens will soon be discussed in order, except that the very last menu is discussed first, as it could be a show-stopper.

#### Locked Menus

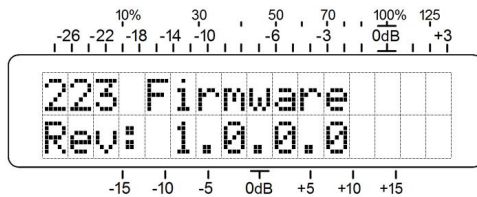
To guard against accidental menu editing or casual tampering, the very last menu in the normal sequence locks the knob out of the editing mode. If you push the knob and nothing happens, scroll all the way to very last menu screen. Push the knob and the word **Menus:** will begin blinking. Turn the knob to select **Menus: Unlocked**. Push the knob again to accept this selection, and then navigate back to whichever screen you were trying to edit. You may relock the menu in the same manner when setup is finished.



## Hidden Menus

The INOmini 223 is a 'Multimode' Audio Processor, applicable to a wide variety of broadcast chores. But rather than offering a myriad of processing setup options in the everyday menu tree, the 223 is instead pre-configured for a particular application through a choice of the available operating modes. This makes setup for each application much easier.

To enter the 'hidden' menu tree, hold the knob down for a full 5 seconds, until whatever was showing on the LCD display changes to a readout of the resident firmware version.



## Alarm Options

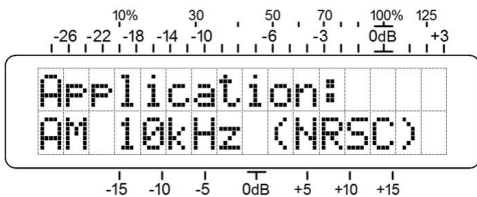
Now turn the knob to the next menu item, **Alarms:**. Here you may turn the flashing alarm function off with a **NO**, if that's your choice; otherwise leave it active with **YES** showing.

## The 'Proof' Mode

The next menu, **Operate/Proof**, lets you bypass the active processing stages of the INOmini 223, leaving input and output level adjustments the only active controls. All audio processing, equalization and filtering will be out of the signal path. The **Proof** mode is for test purposes only; the normal selection in this menu is **Operate**.

## Selecting the Application

The next hidden menu is **Application:**. Here the user selects among the various operating modes offered by the INOmini 223. Scroll through the options and you'll find five modes strictly for AM broadcast, three for FM, and a full, 20kHz 'Studio Mode' suitable for microphone processing and general production work. These are listed at the top of the next page.



## AM Broadcasting Modes

10kHz ('Full Fidelity' NRSC)  
9kHz (European)  
7kHz (Compromise)  
5kHz (Short-Spaced / Shortwave)  
TIS (Roadside Information)

## FM Broadcasting Modes

Monaural FM (Americas)  
Monaural FM (Europe)  
SCA (Analog Subcarriers)  
**Plus:** 20kHz Studio Mode

These nine modes have functions and user presets appropriate to each, individually, which will be detailed in the next section of this manual.

## Factory Defaults

The last hidden menu, **Load Defaults YES / NO**, simply returns all setup adjustments to factory-default values.

**WARNING:** whenever a different mode is called-up; that is, when you select a different option from the **Application:** menu, factory-default values are automatically assigned to the new mode. No user adjustments 'carry over' from one **Application:** to another, or are 'remembered' when switching-back to a previous mode. If you change the **Application:** choice at all, you will have to go through the INOmini 223 setup procedure for that mode all over again!

## Restoring the Main Menu

To get back to the main INOmini 223 menu from the hidden menu sequence, turn the knob to the left until the **223 Firmware** screen appears, and then push the knob.

## Section IV

### SETUP COMMON TO ALL MODES

This section of the manual details the functionality and set-up of processing parameters that are basic to operation regardless of the selected application.

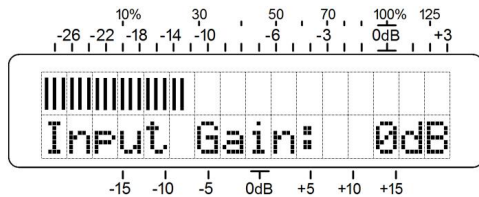
Nevertheless, do access the hidden `Application:` menu and select the mode for the intended service before proceeding with these initial setup steps.

#### Setting the Input Gain

The input gain (sensitivity) of the INOmini 223 is easily set with a test tone, but typical music and speech programming is actually better. This factors-in the 'ballistic' (dynamic) response of the 223 to program material.

Apply an input to the INOmini 223 at normal program-line level. Music and speech should drive the console meter consistently to 0VU on peaks, with occasional peaks in the 0VU to +3VU range. A test tone from the console should register a steady 0VU on the console meter.

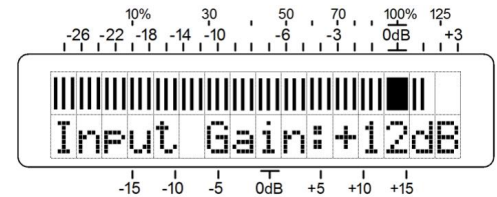
Navigate to the `Input Gain:` menu shown here. In this illustration, gain is at the factory-default value of 0dB, which appears to be the wrong setting for the actual program level.



The scale directly above the bargraph is calibrated such that when `Input Gain:` is set to 0dB, as shown, a 0dBu test tone at the input of the INOmini 223 will bring the bargraph to the 0dB point. Thus a +4dBu studio program line would suggest an `Input Gain:` setting of -4dB.

But in our case above, the input is obviously too low. Perhaps it's coming directly from a CD player or a piece of consumer audio gear.

Push and turn the knob until the bargraph consistently lights the 0dB block on peaks. It can even go one or two dB over the 0dB scale mark every now and then.

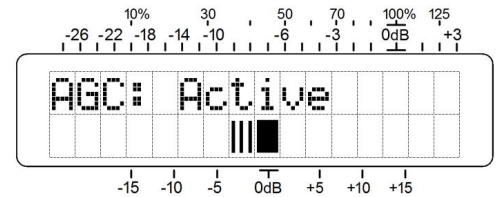


Watch the meter for a bit to verify your setting, and then push the knob to accept it.

#### Automatic Gain Control, or AGC

The first processing block in the INOmini 223 is a slow, 'gain-riding' function. This is analogous to a conscientious board operator watching the VU meter and adjusting a fader very slowly to hold the average level of the program audio constant. The value of AGC is to present subsequent processing stages with a consistent level, maintaining the whole system in its 'sweet spot' as much as possible.

Navigate to the `AGC:` menu. The default setting for this function is `Active`, although `AGC:` can be turned `Off` for testing, or perhaps for a classical music or jazz format.



AGC capture range is  $\pm 15$ dB. AGC gain is displayed on the lower bargraph. In the illustration, the AGC has decreased gain by 3dB, perhaps because `Input Gain:` was set too high in the previous step. If you find that the indicated AGC gain consistently hovers a bit above or below the 0dB block, you can touch-up `Input Gain:` to keep this reading closer to 0dB; say between -5dB and +5dB most of the time.

AGC is 'gated,' meaning that the action is frozen during short pauses in the program to prevent background noise from slowly coming up to full level. This is particularly critical in talk radio and ballgames, for example, where air conditioner or crowd noises want to keep their place below the level of speech, even when that speech pauses.

Gating is indicated by the block above the 0dB mark on the lower scale. When the block is solid, as pictured above, the gate is open, and AGC is following the average level of the



program. During pauses, the solid block will become a hollow rectangle and gain will be frozen. For very long pauses or program signal loss, AGC gain will slowly return to the 0dB resting point.

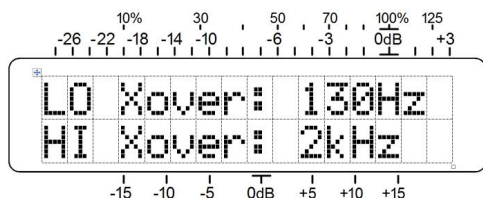
INomini 223 AGC is 'windowed' as well. This means that the AGC makes very slow corrections in the program level when AGC gain is within 5dB of the 0dB point, but it provides faster 'makeup gain' outside this range.

### **Multiband Processing**

The INomini 223 divides the audio spectrum into three discrete frequency bands: a 'bass' band, a 'mid' band and a 'high' band.

Processing audio independently in separate frequency ranges eliminates 'bass pumping,' where heavy bass notes cause the program level to 'duck.' Similarly, a separate high band protects that part of the spectrum that may be subject to pre-emphasis, and also helps maintain 'sparkle' in the program audio. Multiband processing helps maintain a consistent 'sound.'

Navigate to the **Xover** menu screen where the band crossover points are selected. The frequency choices available here will depend on the **Application**: selected.



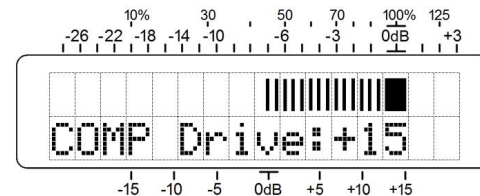
There are no hard-and-fast rules associated with choosing crossover frequencies; this is one parameter you can use to create a unique 'signature sound.' Factory default settings for each **Application**: are good choices and afford a starting point for your own experimentation.

### **Dynamic Range Compression**

An audio program, especially live voice tracks, can have quite wide dynamics. But even though the large part of contemporary pop music is subjected to compression before it is released, there is still a need to restrict dynamic range even more to overcome ambient noise in automobiles and other listening environments.

The degree of dynamic range compression afforded by the INomini 223 is adjusted with the **COMP Drive**: menu.

Push the knob to enter the menu, and then turn it to dial-in a desired degree of compression.



The number shown is the dB-gain inserted between the AGC and the 3-band compressor sections. This is not necessarily an indication of the amount of compression in effect, but is useful as a setup reference.

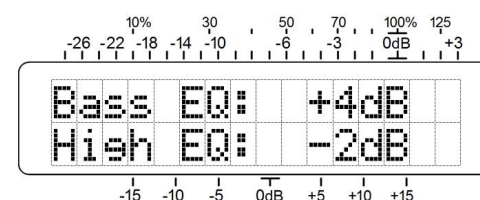
The bargraph, on the other hand, does give a direct, dynamic readout of the amount of gain reduction going on in the middle band of the 3-band compressor. The bargraph relates to the dB scale just above it. The **COMP Drive**: adjustment is made on the basis of how the audio sounds, rather than on a particular amount of indicated compression.

With a multiband processor, generally the more compression you use, the more 'busy,' 'homogenous,' and 'consistent' the program will sound. But too much compression tends to 'smear' the audio. A good rule is to run compression under 15dB, maximum. Typical operation should be in the 6dB to 10dB range. This adjustment must be made using actual program material. A steady-state tone is useless for setting-up compressors and limiters.

### **Equalization**

The 3 bands of dynamic range compression are able to afford fixed equalization for the program signal as well. This does mean, however, that the effect of this equalization is determined in large part by the crossover frequencies selected.

The equalization menu controls both **Bass EQ**: and **High EQ**:. With this menu showing, the first push of the knob gives access to **Bass EQ**:, and turning the knob allows a  $\pm 10$ dB change in the spectrum below the **LO Xover**: frequency.



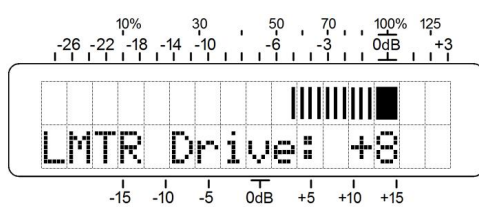
After adjusting **Bass EQ**:, push the knob again to enter **High EQ**: setup. There is a similar  $\pm 10$ dB range for frequencies above the **HI Xover**: frequency.

You can think of these EQ adjustments as “Bass and Treble” controls, except that they are not ‘hinged’ at a common center point. The frequencies affected by these controls are determined by *Xover* choices. This gives more equalization versatility, but you’ll have to experiment to see how these two groups of controls interact within a given application.

### Program Peak Control

A good deal of dynamic range reduction is accomplished in the 3-band compressor. Once the bands are recombined into a full-spectrum signal, additional control is needed to keep the absolute-peak values at a predetermined limit.

The menu for **LMTR Drive:** is much like the compressor menu covered earlier. Again, the numerical value is simply the gain, in dB, between the compressor and limiter sections, with the bargraph giving a dynamic display of limiter action.



The 223 limiter is much faster in operation than the multi-band compressor, and while a compressor works more on the average value of the program waveform, the limiter acts on fast program peaks. While greater **COMP Drive:** makes the program *busier*, increasing **LMTR Drive:** makes the program more *dense*. Program *loudness* is usually attributed to the action of a fast peak limiter.

There are two main controls for the limiter. The first is **LMTR Drive:**, which is adjusted so that the audio program takes the broadcast transmitter to full modulation most of the time. The **LMTR Drive:** setting is usually a bit more conservative than how **COMP Drive:** is set, however; typical figures for maximum limiting are on the order of 6dB, maybe 10dB tops.

You will notice that **COMP Drive:** has a second-order effect on limiter action. As **COMP Drive:** is increased, more program peaks are passed along for the limiter to cope with.

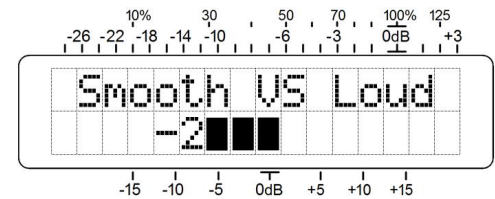
In setup for any application, start with very little limiting and adjust **COMP Drive:** for a sound you like. Then increase **LIMIT Drive:** and listen to the effect that has. It

may take some going back-and-forth to get the two settings balanced.

The other limiter control has to do with the *release* characteristic of the circuit; that is, how quickly it recovers after reducing a program peak to the full modulation point.

The INOmini 223 limiter operates with a release ‘platform’ that has two, interrelated release times: There is a very quick release from a program peak value to an average value of program peak activity, and then a slower release of this average value to full, no-limiting circuit gain.

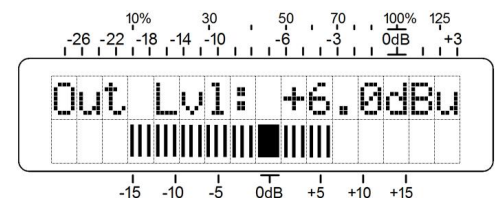
The limiter release platform is programmed through the **Smooth VS Loud** menu. The factory default is a mid-scale ‘zero’ setting, but this can be adjusted in steps between -5 and +5. These are not dB values, simply numbers to keep track of the setting. Higher positive numbers give an increase in program *density* (loudness), and higher negative numbers act to retain the peak-to-average ratio of the program signal (smoothness).



### Setting the Output Level

The INOmini 223 drives transmitter inputs directly, with a balanced output level that can be set in 0.1dB increments between -15dBu and +12dBu. The output has sufficient headroom to handle +140% positive modulation peaks in AM broadcast service; more about that later.

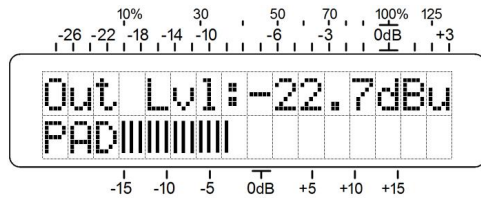
Output level is adjusted using the **Out. Lvl:** menu. Here the numerical value is the actual unloaded balanced output of the 223 in dBu. A static level readout bar on the bottom scale references the dB readings also.



You may take an *unbalanced* output from the PROGRAM AUDIO OUTPUT, using pin 2 as ‘hot’ and pin 1 for ground. The actual output level in that case will be 6dB lower than the number shown on the display.

Certain low power transmitters require a much lower level than the normal output range of the INOmini 223. An internal 20dB pad may be switched into the INOmini 223 output by removing the top cover and actuating a small slide switch just behind the PROGRAM AUDIO OUTPUT connector. The switch has two positions: 0dB for full rate output, and -20dB to switch the pad into the circuit.

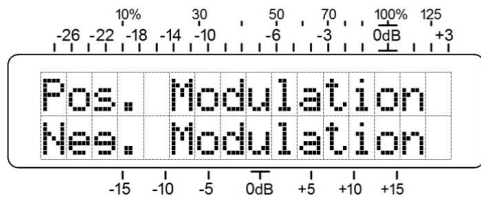
With the internal pad switched in, the word PAD shows in the lower corner of the LCD display, and the numerical readout is scaled to give a proper dBu number as well. However, you'll need to subtract 20dB from the scale below the static bar display.



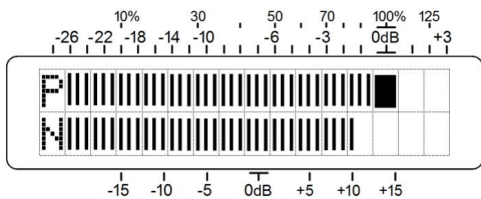
### Output Level Metering

The very first menu in the series is a dynamic peak-responding display of the processor output. This readout is unique in that positive-going output peak levels are shown in the top row and negative-going peak excursions in the bottom one. This split presentation is not meant to confuse, traditional 'peak meters' simply show the higher of the two values. This dual display has relevance in AM broadcasting and will be covered in the related section.

Both rows refer to the panel designations above the display. dB readings and the percent notations relate to full, 100% transmitter modulation, which corresponds to the peak 'ceiling' level of the processor output.



Each time you switch to this modulation display, the image shown above will appear briefly on the LCD as a quick reminder of exactly what is being presented. But after about 2 seconds the readout will revert to the dynamic display of the processor output, with just P and N to identify Positive and Negative peaks respectively.



## Section V

### SETUP FOR AM APPLICATIONS

AM broadcasting applications supported by the INOmini 223 include:

1. 'Full Fidelity' NRSC AM with 10kHz cutoff
2. 'Full Fidelity' European AM with 9kHz cutoff
3. 'Compromise' AM with 7kHz cutoff
4. Restricted 'short-spaced' AM with 5kHz cutoff
5. TIS (Travelers' Info. Svc.) with 5kHz cutoff

Common to these services are:

1. A fixed pre-emphasis (treble boost) specified by a relevant standard for that service.
2. A fixed, very steep high-frequency limit (cutoff) imposed by a relevant standard for that service.
3. The ability to 'supermodulate,' or to allow naturally-occurring asymmetry in speech and music to drive the transmitter above 100% positive modulation.

### Pre-Emphasis

AM broadcasting applications supported by the INOmini 223 employ transmission pre-emphasis as a default, either to complement standardized de-emphasis in the receiver or simply to assist intelligibility through a restricted transmission channel. The pre-emphasis applied is either the specific curve called for by a relevant specification, or was established through test and measurement of representative systems.

The **Pre-emphasis:** menu controls this function. The operational setting for this function is **ON**, but it may be defeated (turned **OFF**) for testing or other provisional reasons.

### Low-Pass (Cutoff) Filtering

Each AM application has a specified high frequency cutoff. The various filters are graphed on Page 4. Audio filtering

prevents generation of transmission sidebands that can interfere with services on adjacent frequencies.

### **Asymmetrical Modulation**

An AM transmitter cannot be modulated in a negative direction below carrier cutoff; that is, below -100%. But if the transmitter has sufficient power headroom, it can be modulated to values in excess of +100%, or twice the unmodulated 'resting' value of the RF carrier.

In preferred broadcasting practice, asymmetrical modulation, also known as 'supermodulation,' is a result of natural asymmetry in the program signal. The INOmini 223 does not generate artificial asymmetry by clipping the negative program waveform, a deplorable practice that invariably generates 'splatter.' Nor does the 223 introduce 'dynamic carrier shift' to offset the modulating waveform in a positive direction. This, also, is bad practice and more often than not is expressly forbidden by broadcast authorities.

In the United States, and in many other countries, positive modulation to a limit of +125% is allowed by the broadcasting authority. The INOmini 223 can deliver positive peaks up to +140%, as may be required to 'supermodulate' a tired old transmitter. This function is programmed through the **Pos Peaks:** menu, with the positive peak value displayed directly in percent.

### **AM Setup Procedure**

1. Connect the 223 to the program audio source. Make sure it's set for the proper AM mode in the hidden **Application:** menu.
2. Monitor the output with an amplifier/loudspeaker, or plug headphones into the front-panel jack. Go through the preliminary setup steps in Section IV. You can always go back and touch these settings up on air, but it's important to have these close to where they should be to complete this part of the setup.
3. Connect the 223 to your transmitter. Check the **Pos Peaks:** menu to make sure it's set at the 99% starting point.
4. Using the **Out Lvl:** menu, gradually increase the output of the 223 until you Mod-Monitor shows

negative modulation peaking between 90% and 95%.

5. From the **Pos Peaks:** menu, increase the level of positive program peaks until they reach +115 to +120% as indicated by the Mod-Monitor.

If increasing **Pos Peaks:** raises the negative modulation instead, you must reverse the wiring between the 223 and the transmitter. If adjusting **Pos Peaks:** makes no difference at all, it may be that the incoming audio program has no asymmetry. This could be the case if programming is delivered by satellite or otherwise has already been peak-limited with a general-purpose symmetrical limiter. It's also possible that the transmitter is not capable of asymmetrical modulation. You can always check the output of the 223 with an oscilloscope to verify an increase in the positive peak value as **Pos Peaks:** is turned up.

## Section VI

### SETTING UP FOR FM & SCA

FM-mode applications that the INOmini 223 supports are:

1. Monaural FM broadcasting in the Western Hemisphere with 75-microsecond pre-emphasis
2. Monaural FM broadcasting to European standards with 50-microsecond pre-emphasis
3. SCA 'narrowcasting' subcarriers transmitted in conjunction with FM programming, with background music, readings for the blind and similar dedicated channels.

Common to these services are:

1. A fixed pre-emphasis (treble boost) specified by a relevant standard for that service.
2. A fixed high-frequency limit (cutoff) imposed by a relevant standard for that service.

#### Pre-Emphasis

FM broadcasting utilizes pre-emphasis in transmission and complementary de-emphasis in the receiver to reduce audible noise. Standards for this characteristic are specific to regions, notably the Western Hemisphere and Europe, as noted above.

In the United States, SCA subcarriers, transmitted over standard FM broadcast channels, have fixed 150-microsecond pre- and de-emphasis. The proper characteristic is selected automatically when the processing mode is selected under the hidden `Application:` menu.

The `Pre-emphasis:` menu gives control over two interrelated adjustments that demand clear understanding.

The top line of the menu allows pre-emphasis to be defeated. This is an option reserved *only for certain temporary testing purposes*. Any time that FM programming is transmitted, `Pre-emphasis:` *must* be `ON`.

The second menu item requires some knowledge of the transmitter that the INOmini 223 feeds.

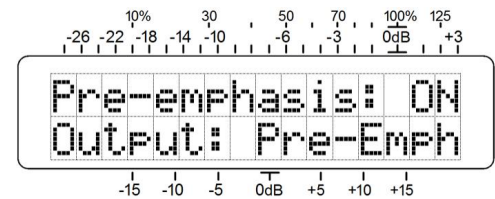
Low-power transmitters or exciters are the usual candidates for use with the INOmini 223 in monaural LPFM or local-radio service. These may have a pre-emphasis network already built-in. Check your transmitter for the following:

1. Does the transmitter have an input clearly labeled AUDIO IN? This is most often a *balanced* input, either an XLR connector or a screw-terminal barrier strip. 'Part-15' and similar hobby transmitters may have an RCA input jack.
2. Does the transmitter have a BASEBAND, WIDEBAND or BROADBAND input? This is where a stereo encoder is normally connected and would likely be a BNC connector. Again, 'Part-15' and other hobby transmitters may have an RCA input jack here too.
3. Or perhaps the transmitter has a multi-purpose input with a switch to accept either AUDIO or BASEBAND inputs. Look for a switch that enables or disables pre-emphasis.

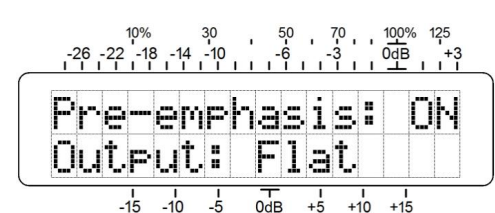
It is very important to determine which type of input you are connecting to. Read the transmitter documentation. If it talks about connecting a stereo-gen/stereocoder to a particular input, that pegs it as a BASEBAND input. If it talks about connecting your mixer, CD player or iPod directly, then it's an AUDIO input.

The INOmini 223 can deliver a properly pre-emphasized output to the BASEBAND input of a transmitter. Take an unbalanced output from

the 223 using Pin 2 of the XLR connector as 'hot' and Pin 1 for ground. Your menu in this case should be set as shown here.



The 223 can also deliver a 'normalized' (flat) output to an AUDIO input. Use a balanced connection if you can, or use Pin 2 of the XLR connector as 'hot' and Pin 1



for ground to an RCA jack. Set the menu this way if you are sure that the transmitter provides the pre-emphasis.

Note that the top line is set: `Pre-emphasis: ON` in both cases. This is essential in any FM processing mode.

Setup for SCA processing is the same as for FM broadcast. Observe the same instructions, depending on whether or not your SCA encoder provides its own pre-emphasis.

### **FM Setup Procedure**

1. Connect the 223 to the program audio source. Make sure it's set for the proper FM/SCA mode in the hidden `Application:` menu.
2. For Steps 2 and 3 only, open the `Pre-emphasis:` menu and set `Output: Flat`. Monitor the output with an amplifier/loudspeaker, or plug headphones into the front-panel jack.
3. Go through the preliminary setup steps in Section IV. You can always go back and touch these settings up on air, but these preliminary 223 settings need to be close to where they should be to complete this part of the setup.
4. Go back to the `Pre-emphasis:` menu and reset `Output:` if you changed it in Step 2. Then Connect the 223 to your transmitter.
5. From the `Out. Lvl:` menu, gradually increase the output of the 223 until you Mod-Monitor shows modulation peaking between 95% and 100%. You may observe local customs that make allowances for overdeviation if your signal includes subcarriers.

## Section VII

### STUDIO APPLICATIONS

#### **Overview**

The INOmini 223 can address audio leveling issues in radio/audio production, recording studios and sound reinforcement. The wide adjustment range of the `COMP Drive:` and `LMTR Drive:` controls allow backing either one out of operation to enable compress-only or limit-only operation. AGC is useful for general leveling, and the multiband aspect of the unit lends consistency to program material from diverse sources.

With the hidden menu set to `Application: STUDIO`, there is no pre-emphasis introduced in the signal path. Likewise, the output filter bank and its attendant overshoot compensator and safety clipper are bypassed, yielding full 20kHz frequency response and phase integrity.

Use the 223 as you would any high-quality studio processor. Patch it into the insert point of a microphone channel to tame live announce. Menus clearly display input, output and gain reduction levels, and the band crossovers and EQ permit a broad range of tonal manipulation.

## Section VIII

### UPDATING THE FIRMWARE

Firmware updates for the INOmini 223 will be distributed by Inovonics without charge whenever new features or performance enhancements become available. Updates may be downloaded from the Inovonics Website, or we can mail them to you on CD-ROM or flash drive at minimal cost if your ISP or IT security procedures forbid a .exe file download.

#### Bootloader Files

The new firmware is 'bootloaded' into the 223 through the front-panel USB connector. You will need a USB cable with a 'male A' on one end and a 'mini-B' on the other as shown in the snapshot here.



Copy the update file to your computer Desktop. It will resemble the example on the left, except that the Rev (version) number should supersede the version currently resident in your unit. You can check your current version by holding-down the knob for 5 seconds or more.

#### Saving Settings

A firmware update may or may not restore your unit to factory-default settings. This depends on whether the update is a 'minor' or a 'major one.'

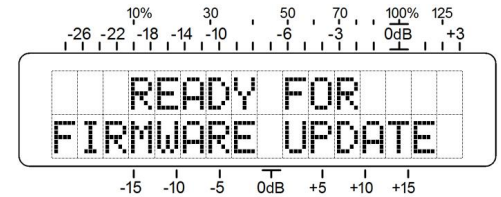
Minor updates are issued to correct firmware bugs. A minor update might take a version from 1.0.0.5 to 1.0.0.6, prompting a change in the *last* digit.

Major updates have more to do with features and their adjustment limits. For example, if we were to change the maximum Bass EQ range from +10dB down to +6dB, or to change one of the Xover frequencies. In this case the version number would bump from 1.0.0.21 up to 1.0.1.0; a change in *other than* the last digit.

A change of this magnitude would most likely purge all user setup information from the INOmini 223. The update would have an accompanying 'Changelog,' which will describe the update and urge you to jot down your settings before installing it. In any case it's always a good idea to go through your setup menus, one by one, and make note of each setting.

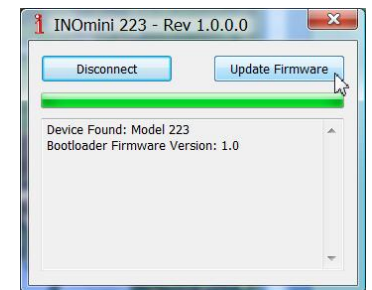
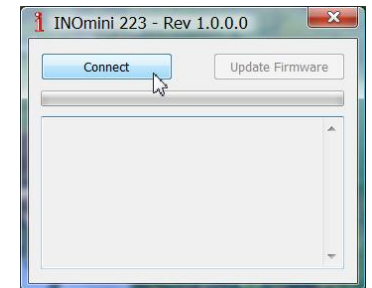
#### The Update Procedure

1. Unplug the DC power connector from the rear-panel jack.
2. Press and hold-down the front-panel knob as you reconnect the DC power. This will pop the FIRMWARE UPDATE menu on to the LCD screen.



**NOTE:** At this point you may escape from the update process by performing a normal power cycle; that is, unplug and replug DC power *without* holding-down the knob.

3. With your computer cabled to the INOmini 223, double-click the bootloader BL.exe file on your Desktop. Trusting us, as indeed you should, click Run when directed. An information box should appear on your screen.
4. Click: Connect, and then click: Update Firmware. The box will display the update process and let you know when the update has completed.



## Section IX

### TECHNICAL MATTERS

#### **Firmware Version**

With the INOmini 223 powered-up, hold the knob down for 5 seconds or so. The menu screen you have been viewing will be replaced by the `223 Firmware` screen. This shows the firmware version installed in your unit, information that may prove important when communicating with the factory. Push the knob again to return to the normal menu sequence.

#### **'Under the Hood'**

The INOmini 223 is compact and sophisticated, utilizing mostly surface-mounted (SMD) components. Many of these are application-specific and/or pre-programmed at the factory, but all of them are impossibly tiny. This makes servicing the unit in the field a difficult proposition at best. For these reasons, and also because of the small format of this manual, we have dispensed with schematic diagrams, servicing instructions and a listing of component parts.

Having said that, our policy has always been one of 'total honesty and full disclosure.' We feel that, unless we are doing something nefarious, or are acting in the interest of national security, there should never be a reason to hide information from the user. With a clear conscience, and upon request, we will cheerfully provide additional documentation and divulge all but the very darkest secrets concerning any Inovonics product.

Because it is so small and lightweight, returning the unit for factory servicing, emergency firmware upgrades, etc. is an option that we encourage. Inovonics has never considered factory repair charges a significant source of revenue, and we are confident that you will be astonished at how reasonable our rates actually are!



NOTES

AND MORE NOTES

# INOVONICS WARRANTY

**I TERMS OF SALE:** Inovonics products are sold with an understanding of “full satisfaction”; that is, full credit or refund will be issued for products sold as new if returned to the point of purchase within 30 days following their receipt, provided that they are returned complete, and in “as received” condition.

**II CONDITIONS OF WARRANTY:** The following terms apply unless amended *in writing* by Inovonics, Inc.

A. The Warranty Registration Card supplied with the product *must* be completed and returned to Inovonics, or the Warranty registered online at [www.inovonicsbroadcast.com](http://www.inovonicsbroadcast.com), within 10 days of delivery.

B. The Warranty applies only to products sold “as new.” It is extended only to the original end-user and may not be transferred or assigned without prior written approval by Inovonics.

C. The Warranty does not apply to damage caused by misuse, abuse, accident or neglect. This Warranty is voided by unauthorized attempts at repair or modification, or if the serial identification tag has been removed or altered.

**III TERMS OF WARRANTY:** Inovonics, Inc. products are warranted to be free from defects in materials and workmanship.

A. Any discrepancies noted within THREE YEARS of the date of delivery will be repaired free of charge, or the equipment will be replaced with a new or remanufactured product at Inovonics’ option.

B. Parts and labor for factory repair required after the three-year Warranty period will be billed at prevailing prices and rates.

**IV RETURN OF GOODS FOR FACTORY REPAIR:**

A. Equipment will not be accepted for Warranty or other repair without a Return Authorization (RA) number issued by Inovonics prior to its return. An RA number may be obtained by calling the factory. The number should be prominently marked on the outside of the shipping carton.

B. Equipment must be shipped prepaid to Inovonics. Shipping charges will be reimbursed for valid Warranty claims. Damage sustained as a result of improper packing for return to the factory is not covered under terms of the Warranty and may occasion additional charges.

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*Serving the broadcast industry since 1972*