# Section 3
# Operation

page contents



**Caution**

The installation and servicing instructions in this manual are for use by qualified personnel only. To avoid electric shock do not perform any servicing other than that contained in the Operating Instructions unless you are qualified to do so. Refer all servicing to qualified service personnel.

# 2200 Controls and Meters

## 2200 Front Panel

**Screen Display** labels the four soft key buttons and provides control setting information.

> Screen Saver feature: The screen has a built-in screen saver that turns off the backlight after approximately one hour. The screen turns back on when any front panel control is touched. Note that buttons don't perform their normal function when the screen is blank. Similarly, the control knob's first turn is not read, until it stops for a second or so.

**Contrast Button** adjusts the optimum viewing angle of the screen display. Press this button to cycle through four contrast settings for the screen display.

**Four Soft Key Buttons** provide access to all 2200 functions and controls. The functions of the buttons change with each screen according to the labels at the bottom of each screen. Push a button:

> **To select options** (always identified on the screen by all-capital-letter words surrounded by left and right vertical bars), press the button directly below the option.
>
> **To change a parameter setting** (always identified by lower-case letters or numerals), hold down the button directly below the parameter setting, turn the control knob to scroll through choices, and release the button to set the parameter.

**Control Knob** is used for changing data in one of three methods.

> To scroll through submenu choices: Presets (on Recall Preset screen), FULL CONTROL parameters (on Modify Processing FULL CONTROL screen) and 8 Remote Interfaces (on System Setup REMOTE INTERFACE screen).
>
> To change a parameter setting, by ***simultaneously holding down a soft key***. The parameters being changed take effect immediately, except for the following system level controls: MODE (on test screen), MODE (on Stereo Encoder screen), INPUT, AO PRE-E, DO PRE-E, DO RATE, DO SYNC and XTLK TEST. The setting for these controls do not take effect until the soft key is released.
>
> To adjust the LESS-MORE control. Adjusting this control changes the sound immediately.

**Escape Button** returns the user to the previous screen; pressing this button repeatedly will always return you to main screen, which shows the on-air preset name.

**Recall Preset Button** brings up a screen that displays the current on-air preset and next preset (which can be changed by turning the control knob). To put a different preset on-air, turn the control knob to find the preset desired, then press the RECALL NEXT soft key.

> When the button's yellow LED is lit, the Recall Preset screen is displayed.

**Modify Processing Button** brings up a screen to modify parameters for the current on-air preset. For Two-Band presets: LESS-MORE, EQ and FULL CONTROL. For the Protection preset, DRIVE and 30HzHPF.

When the button's yellow LED is lit, the Modify Processing screen (or one of its submenus) is displayed.

**System Setup Button** brings up a screen to modify system settings (such as I/O levels). There are four System Setup submenus: I/O CALIB, STEREO ENCODER, REMOTE INTERFACE, TEST.

When the button's yellow LED is lit, the System Setup screen (or one of its submenus) is displayed.

**HF Limiting LEDs** light when the high-frequency content of audio is being limited by the very fast high-frequency limiters. These LEDs indicate when greater than 0.5dB HF limiting is occurring.

**Gated LED** indicates gate activity, lighting when the input audio falls below the threshold set by the gate threshold control (Modify Processing screen GATE THRS control). When this happens, the compressor's recovery time is drastically slowed to prevent noise rush-up during low-level passages.

**Composite Meter** is a 10-segment bargraph showing the stereo encoder's composite output level before the composite level controls.

**Function Button** selects which of three functions are displayed in the Function meters: Enhance, L/R Input or L/R Output.

**Function LEDs** indicate which function is currently displayed by the Function meters: Enhance, L/R Input or L/R Output. Press the Function button to toggle between the three functions.

**Function Meter** indicates level of Enhance, L/R Channel Input or Output, as selected with Function button. The meters operate over a –27dB to 0dB range. Input meters are referenced to clip level. Output meters are referenced to 100% modulation level. HF Enhance meter shows the active amount of enhancement activity. Since the HF Enhancement is program-dependent, it will vary with source material and the HF parameter. Note: HF Enhance is displayed only on the left-hand meter, below "HF."

Stereo Encoder Screwdriver-Adjustable Controls

Orban supplies a special green-handled flat-blade screwdriver (Xcelite R3323) to adjust the stereo encoder controls.

**Comp 1** sets the output level of Composite Output 1.

**Comp 2** sets the output level of Composite Output 2.

# Introduction to Processing

## Some Audio Processing Concepts

**Loudness** is increased by reducing the peak-to-average ratio of the audio. If peaks are reduced, the average level can be increased within the permitted modulation limits. The effectiveness with which this can be accomplished without introducing objectionable side effects (such as clipping distortion) is the single best measure of audio processing effectiveness.

**Compression** reduces the difference in level between the soft and loud sounds to make more efficient use of permitted peak level limits, resulting in a subjective increase in the loudness of soft sounds. It *cannot* make loud sounds seem louder. Compression reduces dynamic range relatively slowly in a manner similar to riding the gain: limiting and clipping, on the other hand, reduce the short-term peak-to-average ratio of the audio.

**Limiting** increases audio density. Increasing density can make loud sounds seem louder, but can also result in an unattractive busier, flatter, or denser sound. It is important to be aware of the many negative subjective side effects of excessive density when setting controls that affect the density of the processed sound.

**Clipping** sharp peaks does not produce any audible side effects when done moderately. Excessive clipping will be perceived as audible distortion.

## Distortion in Processing

In a competently-designed processor, distortion occurs only when the processor is clipping peaks to prevent the audio from exceeding the peak modulation limits of the transmission channel. The less clipping that occurs, the less likely that the listener will hear distortion. However, to reduce clipping, you must decrease the drive level to the clipper, which causes the average level (and thus, the loudness) to decrease proportionally.

**The FM pre-emphasis curve** introduces further complications. Pre-emphasis boosts the treble at 6dB/octave starting at 2.1kHz (for 75μs countries) or 3.2kHz (for 50μs countries). This reduces the headroom available at high frequencies, and makes it difficult to achieve a bright sound. This is because bright sound requires considerable high-frequency power to appear at the output of the receiver's de-emphasis filter, and thus requires a *very large* amount of high-frequency power to be transmitted so that a sufficient amount will survive the de-emphasis process.

Without very artful processing, the pre-emphasis will radically increase the level of the peaks and force you to decrease the average level proportionally. Orban's high-frequency limiting and distortion-canceling clipping systems greatly ease this trade-off, but cannot entirely eliminate it. Therefore, you can only increase brightness by reducing average modulation (loudness) — unless you accept the increased distortion caused by driving the final clippers harder.

### Loudness, Brightness and Distortion.

In processing, there is a *direct trade-off* between loudness, brightness, and distortion. You can improve one only at the expense of one or both of the other two. Thanks to Orban's psychoacoustically-optimized designs, this is less true of Orban processors than of any others. Nevertheless, all intelligent processor designers must acknowledge and work within the laws of physics as they apply to this trade-off.

Perhaps the most difficult part of adjusting a processor is determining the best trade-off for a given situation. We feel that it is usually wiser to give up ultimate loudness to achieve brightness and low distortion. A listener can compensate for loudness by simply adjusting the volume control. But there is *nothing* the listener can do to make an excessively-clipped signal sound clean again, or to undo the effects of excessive high-frequency limiting.

If processing for high quality is done carefully, the sound will also be excellent on small radios. Although such a signal might fall slightly short of ultimate loudness, it will tend to compensate with an openness, depth, and punch (even on small radios) that cannot be obtained when the signal is excessively squashed.

If women form a significant portion of the station's audience, bear in mind that women are more sensitive to distortion and listening fatigue than men. In any format requiring long-term listening to achieve market share, great care should be taken not to alienate women by excessive stridency, harshness, or distortion.

### OPTIMOD-FM — from Bach to rock

OPTIMOD-FM can be adjusted so that the output sounds as close as possible to the input at all times (using the Protection Limiter Structure), or so that it sounds open but more uniform in frequency balance (and often more dramatic) than the input (using the Two-Band Structure). The loudness/brightness/distortion trade-off explained above applies to any of these setups.

You will achieve best results if Engineering, Programming, and Management go out of their way to communicate and cooperate with each other. It is important that Engineering understand the sound that Programming desires, and that Management fully understand the trade-offs involved in optimizing one parameter (such as loudness) at the expense of others (such as brightness, distortion, or excessive density).

Never lose sight of the fact that, while the listener can easily control loudness, he or she cannot undo excessive high-frequency limiting or make a distorted signal clean again. If such excessive processing is permitted to audibly degrade the sound of the original program material, the signal is irrevocably contaminated and the original quality can never be recovered.

# About the Processing Structures

In the 2200, a *processing structure* is a program that operates as a complete audio processing system. Only one processing structure can be active at a time.

There are two processing structures in the 2200:

Two-Band

Protection/Limiting

Unlike an analog system, where creating a complete processing system involves physically wiring its various components together, the 2200 realizes all of its processing structures as a series of high-speed mathematical computations made by Digital Signal Processing (DSP) integrated circuit chips. So the 2200 can be changed from one structure to another by loading new software from high-speed semiconductor memory within the 2200.

# Factory Programming Presets

Factory Presets are our "recommended settings" for various program formats. These presets were designed by our experienced engineers as good starting points for the program format. In many cases, the sound of the factory preset will suit your needs without the need for further adjustment.

There are eight factory presets:

**Classical-Protect**
**2B General Purpose**
**Talk**
**Music-Light**
**Music-Medium**
**Music-Heavy**
**Music+Bass Medium**
**Music+Bass Heavy**

**Classical-Protect** produces a very clean, open sound that is ideal for stations whose success depends on attracting and holding audiences for very long periods of time. It uses the Protection/Limiting structure. All other presets use the Two-Band structure.

**2B General Purpose** provides an average amount of processing;

**Talk** provides processing for Talk format stations that primarily feature news, call-in shows, interviews, and other voice material. TALK keeps the levels of announcers and guests consistent, and keeps a proper balance between voice and commercials.

**Music-Light** produces a very open, unprocessed sound. This is a sound that is easily listenable for many hours without fatiguing listeners.

**Music-Medium** provides processing that is between Music-Light and Music-Heavy. This is a good choice for many stations.

**Music-Heavy** provides aggressive processing for stations that want to maximize on-air loudness, and that do not assume that a listener will listen to the station for hours at a time.

**Music+Bass Medium** produces a very punchy, clean, open sound.

**Music+Bass Heavy** provides aggressive processing with additional bass punch.

Start with one of these presets. Spend some time listening critically to your on-air sound. Listen to a wide range of program material typical of your format, and listen on several types of radios (not just on your studio monitors). Then, if you wish, customize your sound using LESS-MORE, EQ and FULL CONTROL.

**To recall a preset:**

Press Recall Preset Button. Turn the control knob to scroll through preset list and stop when you find a desired preset. Press RECALL NEXT soft key button.

It is normal for the audio to mute for about a second when switching between a preset based on the Two-Band structure and a preset based on the Protection/Limiting structure. This gives the 2200 time to download the appropriate code to its DSP chips.

# Customizing the 2200's Two-Band Sound

The subjective setup controls on the 2200 give you the flexibility to customize your station's sound. But, as with any audio processing system, proper adjustment of these controls consists of balancing the trade-offs between loudness, density, brightness, and audible distortion.

When you start with one of our Two-Band factory presets, there are three levels of subjective adjustment available to you to let you customize the factory preset to your requirements:

LESS-MORE

EQ

FULL CONTROL.

## LESS-MORE

After selecting a factory preset, LESS-MORE is the next level of adjustment.

As you go from less to more, the air sound will become louder, but (as with any processor) processing artifacts will increase. The single LESS-MORE control changes many different processing controls at the same time.

Many users will never need to go beyond the LESS-MORE level of control, because the combinations of subjective setup control settings produced by this control have been optimized by Orban's audio processing experts on the basis of years of experience designing audio processing, and upon hundred of hours of listening tests.

**To adjust Less-More**:

Press Modify Processing Button, then press LESS-MORE soft key button. Hold the LESS-MORE button down while turning the control knob to change LESS-MORE setting. When you find a setting you like, release the LESS-MORE button.

## EQ

After LESS-MORE, EQ is the next level of adjustment. It gives you equalization control independent of the LESS-MORE control. EQ provides a 30Hz High-Pass Filter, Low Bass (boost) control and HF Enhancement. We give a detailed description of the EQ controls on page 3-11 (Two-Band Processing Control Details.)

**To adjust EQ control**

Press the Modify Processing Button, then press the EQ soft key button. From the EQ display, hold down the soft key button for the EQ control you want to change, turn the control knob to scroll through choices and release the button when you find a desired setting.

### FULL CONTROL

With FULL CONTROL you can modify any subjective processing control to create a sound exactly to your taste. Use LESS-MORE to get as close as possible to your desired sound. Then use FULL CONTROL to make small changes to get the sound you want.

To adjust FULL CONTROL settings:

Press Modify Processing Button, then press the FULL CONTROL soft key button. From the FULL CONTROL display, hold down the soft key button for the control you want to change, turn the control knob to scroll through choices and release the button when you find a desired setting.

### Saving Your Custom Settings

To save a custom setting:

Press Escape button until the on-air screen is displayed. Press SAVE CHANGES soft key button, then turn the control knob to choose one of the eight USER PRESET names. Press the SAVE CHANGES button to save custom setting.

# Two-Band Processing Control Details

The Two-Band Structure is an improved version of Orban's classic 8100A OPTIMOD-FM, but with increased high frequency clarity and more features (Gated AGC, Bass Equalizer, High Frequency Enhancer).

Depending on how it is adjusted, it can produce an open, easy-to-listen sound that is similar to the source material, or it can produce a highly processed very loud sound that will never "get lost on the dial."

### The Two-Band Structure's EQ controls

The Two-Band Structure has 3 equalization controls that work independently of the LESS-MORE control. The EQ controls are as follows:

**30HzHPF (30Hz High Pass Filter) control** determines if the 30Hz high-pass filter prior to the AGC is in or out of the signal path.

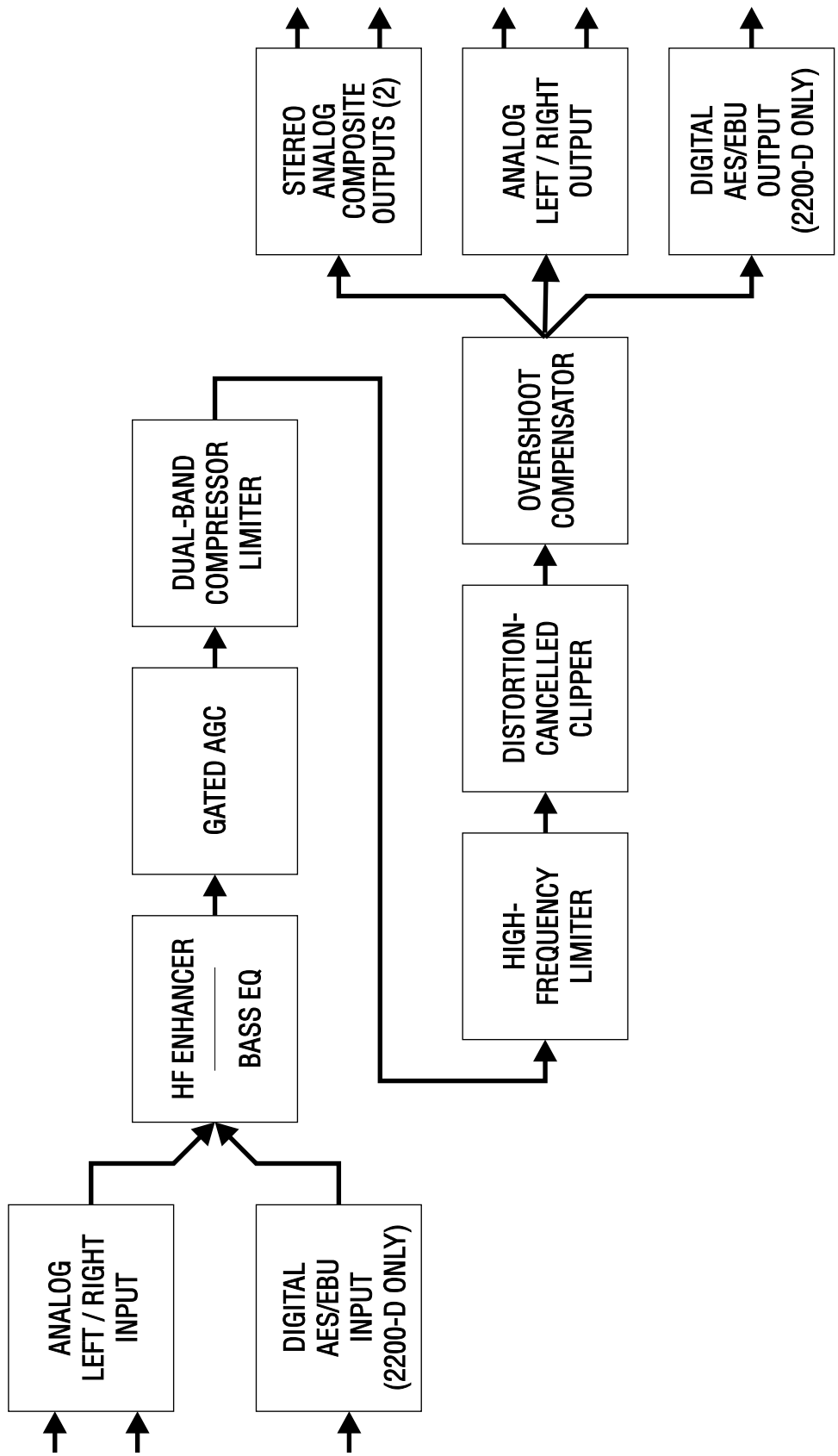
The 30Hz high-pass filter has an 18dB/octave slope, is down 0.5dB at 30Hz, and is located before the gain-riding AGC. It can be switched in or out-of-circuit by the 30HzHPF control.

This filter eliminates modulation-wasting subsonic energy from acoustic and turntable rumble, and removes most of the energy from pops caused by breath blasts into microphones. It prevents any such subsonic energy from modulating the audio processor's AGC and compressor control signals (which could cause unpleasant distortion), and prevents the automatic frequency control loops in FM exciters from introducing modulation distortion into the audio or even becoming entirely unlocked.

The cutoff frequency of this filter is so low that the only common musical instruments producing lower fundamental frequencies are the pipe organ and synthesizer. The bass energy in most pop music occurs above 40Hz. We recommend operating the system with the 30HzHPF control set in.

**LOW BASS (Low Bass Boost) control** is an equalization control designed to add punch and slam to rock and urban music. It provides a shelving boost from 0dB to +12dB in 1dB steps. The equalizer operates at 110Hz and below.

Because the Two-Band Structure often increases the brightness of program material when the HF ENHANCE control is used, some bass boost is usually desirable to keep the sound spectrally well-balanced. Adjustment of bass equalization must be determined by individual taste and by the requirements of your format. Be sure to listen on a wide variety of radios — it is possible to create severe distortion on poor-quality speakers by over-equalizing the bass. Be careful!




TWO-BAND STRUCTURE
(SIMPLIFIED BLOCK DIAGRAM)

The moderate-slope (12dB/octave) shelving boost achieves a bass boost that is audible on smaller radios, but which can sound boomy on high-quality receivers. There are no easy choices here; you must choose the amount of boost you want by identifying your target audience and the receivers they are most likely to be using. In general, we recommend a +1 to +4dB boost for most formats.

**HF ENHANCE (HF Enhancement) control** sets the amount of high frequency energy added to program material. This enhancement is dynamically determined by the program material: Continuous analysis of program material intelligently and automatically determines the amount of equalization necessary at each moment to achieve detailed, defined program material that is never shrill or over-sibilant.

On mixed program material, HF ENHANCE usually produces the best sound if adjusted in the 0 to 5 range; the detail and definition of the program material is improved, yet the material does not sound excessively shrill. Always use your ears and judge how the processing affects the material.

Generally, if the material is very bright to begin with, you will hear little effect; if the program material is dull, you will hear very significant brightening. HF Enhancement works seamlessly with program material that contains previously enhanced tracks, like CD-quality music, because the 2200's enhancement detects that such material already has considerable HF power and reduces its enhancement accordingly.

### The Two-Band Structure's Full Setup Controls

**GATE THR (Gate Threshold) control** determines the lowest input level that will be recognized as program by OPTIMOD-FM; lower levels are considered to be noise or background sounds, and cause the compressor to gate, effectively freezing its gain.

The AGC and the Two-Band gain reduction will eventually recover to their nominal levels. However, recovery is slow enough to be imperceptible. This avoids OPTIMOD-FM's getting stuck with a large amount of gain reduction on a long, low-level musical passage immediately following a loud passage.

It is common to set the GATE THRS control to –40dB. Higher settings are primarily useful for radio drama, outside sports broadcasts, and other non-musical programming that contain ambiance, low-level crowd noise, and the like. Slightly higher settings may increase the musicality of the compression by slowing down recovery on moderate-level to low-level musical passages. When such passages cause the gate to cycle on and off, recovery time will be slowed down by the ratio of the "on time" to the "off time." This effectively slows down the release time as the input gets quieter and quieter, thus preserving musical values in material with wide dynamic range (classical music, for example). The control can be set to off or adjusted over a range from –44dB to –15dB.

**AGC (Automatic Gain Control) on/off control** activates or defeats the slow AGC prior to the two-band compressor. If you are using an external compressor before the 2200 to protect an STL (like the Orban 8200ST OPTIMOD-Studio), set the AGC on the 2200 to off.

**AGC DRIVE control** adjusts signal level going into the slow AGC, and therefore determines the amount of gain reduction in the AGC. This also adjusts the "idle gain" — the

amount of gain reduction in the AGC section when the structure is gated. (It gates whenever the input level to the structure is below the threshold of gating.)

The total amount of gain reduction in the Two-Band Structure is the sum of the gain reduction in the AGC and the gain reduction in the two-band compressor. The total gain reduction determines how much the loudness of quiet passages will be increased (and, therefore, how consistent overall loudness will be). Total gain reduction is determined by the setting of the AGC DRIVE control, by the level at which the console VU meter or PPM is peaked, and by the setting of the 2B DRIVE compressor control, discussed directly below. The range of the AGC DRIVE control is -10dB to +25dB.

**REL TIME (Release Time) control** determines how fast the two-band compressor releases (and therefore how fast loudness increases) when the level of the program material decreases.

It can be adjusted from 1dB/Second (slow) to 20dB/Second (fast). Settings toward 20dB/Second result in a more consistently loud sound on the air, while settings toward 1dB/Second allow a wider variation of dynamic range. The actual release time of the compressor is determined by both the setting of the REL TIME control and the dynamics and level of the program material. In general, you should use faster release times for mass-appeal pop or rock formats oriented toward younger audiences, and slower release times for more conservative, adult-oriented formats (particularly if women are an important part of your target audience).

The action of the REL TIME control has been optimized for resolution and adjustability. But its setting is critical to sound quality — listen carefully as you adjust it. There is a point beyond which increasing density (with faster settings of the REL TIME control) will no longer yield more loudness, and will simply degrade the punch and definition of the sound.

When the REL TIME control is set between 8 and 1dB/Second (the slowest settings), the amount of gain reduction is surprisingly non-critical. Since gating prevents noise from being brought up during short pauses, and pumping does not occur at high levels of gain reduction, the primary danger of using large amounts of gain reduction is that the level of quiet passages in input material with wide dynamic range may eventually be increased unnaturally. Therefore, when you operate the REL TIME control between 8 and 1dB/Second, it may be wise to defeat the gain-riding AGC and to permit the two-band compressor to perform all of the gain-riding. This will prevent excessive reduction of dynamic range, and will produce the most natural sound achievable from the Two-Band Structure.

With faster REL TIME control settings (above 8dB/Second), the sound will change substantially with the amount of gain reduction in the two-band compressor. This means that you should activate the gain-riding AGC to ensure that the two-band compressor is always being driven at the level that produces the amount of gain reduction desired. Decide on the basis of listening tests how much gain reduction gives you the density you want without creating a feeling of over-compression and fatigue.

Release in the two-band compressor automatically becomes faster as more gain reduction is applied (up to about 10dB). This makes the program progressively denser, creating a sense of increasing loudness even though peaks are not actually increasing. If the gain-riding AGC is defeated (with the AGC control), you can use this characteristic to preserve some feeling of dynamic range. Once 10dB of gain reduction is exceeded, full loudness

is achieved — no further increase in short-term density occurs as more gain reduction is applied. This avoids the unnatural, fatiguing sound often produced by processors at high gain reduction levels, and makes OPTIMOD-FM remarkably resistant to operator gain-riding errors.

**2B DRIVE control** adjusts signal level going into the two-band compressor, and therefore controls the dynamic range of the output audio by determining the amount of gain reduction in the two-band compressor. Depending on the setting of the REL TIME control (see above), the resulting sound texture can be open and transparent (low settings of 2B DRIVE), solid and dense (high settings of 2B DRIVE), or somewhere in between.

Regardless of the release time setting, we feel that the optimal amount of gain reduction in the two-band compressor for popular music and talk formats is 10-15dB. If less gain reduction is used, loudness can be lost.

For classical formats, operating with 0-10dB of gain reduction (with the gain-riding AGC defeated), maintains a sense of dynamic range while still controlling levels effectively. Because OPTIMOD-FM's density gently increases between 0 and 10dB of compression, 10dB of compression sounds very natural, even on classical music.

**BASS COUPL (Bass Coupling) control** is used to set the balance between bass and the rest of the frequency spectrum.

The two-band compressor processes audio in a Master Band for all audio above approximately 200Hz, and a Bass Band for audio below approximately 200Hz. The BASS COUPL control determines how closely the on-air balance of material below 200Hz matches that of the program material above 200Hz.

Settings toward 100% (wideband) make the output sound most like the input. Because setting the BASS COUPL control at 100% will sometimes cause bass loss, the most accurate frequency balance will often be obtained with this control between 70% and 90%. The optimal setting depends on the amount of gain reduction applied. Adjust the BASS COUPL control until the Bass and Master Gain Reduction meters track as closely as possible.

With the Two-Band's REL TIME control set to 2dB/Second, setting the BASS COUPL control toward 0% (independent) will produce a sound that is very open, natural, and non-fatiguing, even with large amounts of gain reduction. Such settings will provide a bass boost on some program material that lacks bass.

With fast release times, settings of the BASS COUPL toward 100% (wideband) do not sound good. Instead, set the BASS COUPL control toward 0% (independent). This combination of fast release and independent operation of the bands provides the maximum loudness and density on small radios achievable by the 2200. But such processing may fatigue listeners with high-quality receivers, and also requires you to activate the AGC to control the average drive level into the two-band compressor, preventing uncontrolled build-up of program density.

**HF LIMIT** control determines how the processor avoids high-frequency overloads due to the pre-emphasis curve. When set toward −4.0dB (soft), the highs are controlled mostly by limiting (a form of dynamic filtering), which tends to soften highs — this could improve the sound of marginally distorted program material. When set toward +2.0dB (hard), the highs are controlled mostly by clipping, which could potentially distort highs.

Control of highs by limiting tends to slightly dull the sound. Control of highs by clipping doesn't reduce brightness, but the resulting sound can tend towards grittiness and smearing.

> Because the OPTIMOD-FM distortion-canceling clipper does not produce significant distortion at low frequencies, the HF LIMIT control will have a different effect on clipping distortion than you might expect. Outright break-up (principally sibilance splatter) will not occur — you must listen to the upper midrange and the highs to hear the effect of the clipper. Program material containing highly equalized hi-hat cymbals will clearly demonstrate the effect of adjusting the control.
>
> When the CLIPPING control is set to 0.0dB or below and the REL TIME control is set slower than 8dB/Second, it is possible to set the HF LIMIT control to +2.0dB without producing objectionable distortion (provided that the program material is very clean). If the CLIPPING control is set above 0.0 and/or faster release times are used (such that greater level and density is produced), it is usually necessary to readjust the HF LIMIT control closer to −2.0dB (soft) to avoid objectionable distortion. Fortunately, the high-frequency limiter knows that greater density and level have been produced when these other controls are set this way, and most of the necessary increases in high-frequency limiting will occur automatically. In fact, you will clearly hear a loss of highs when you adjust any control to produce greater loudness and density — this is an automatic response to the loudness/brightness/distortion trade-off inherent to all broadcast processing.
>
> We recommend that you examine the factory settings used by the "LESS-MORE" curves (adjust LESS-MORE to a given setting, then enter FULL CONTROL to look at the settings). This will help you learn about the trade-offs.

**CLIPPING control** adjusts signal level going into the distortion-canceling clippers and therefore determines the amount of peak limiting done by clipping. Range is −4.0dB to +2.0dB. This control and the FINAL CLIP control govern the trade-off between loudness and distortion.

OPTIMOD-FM controls fast peaks by distortion-canceled clipping. The CLIPPING control adjusts the level of the audio driving the distortion-canceled clippers, and therefore adjusts the peak-to-average ratio. The loudness/distortion trade-off is primarily determined by the CLIPPING control.

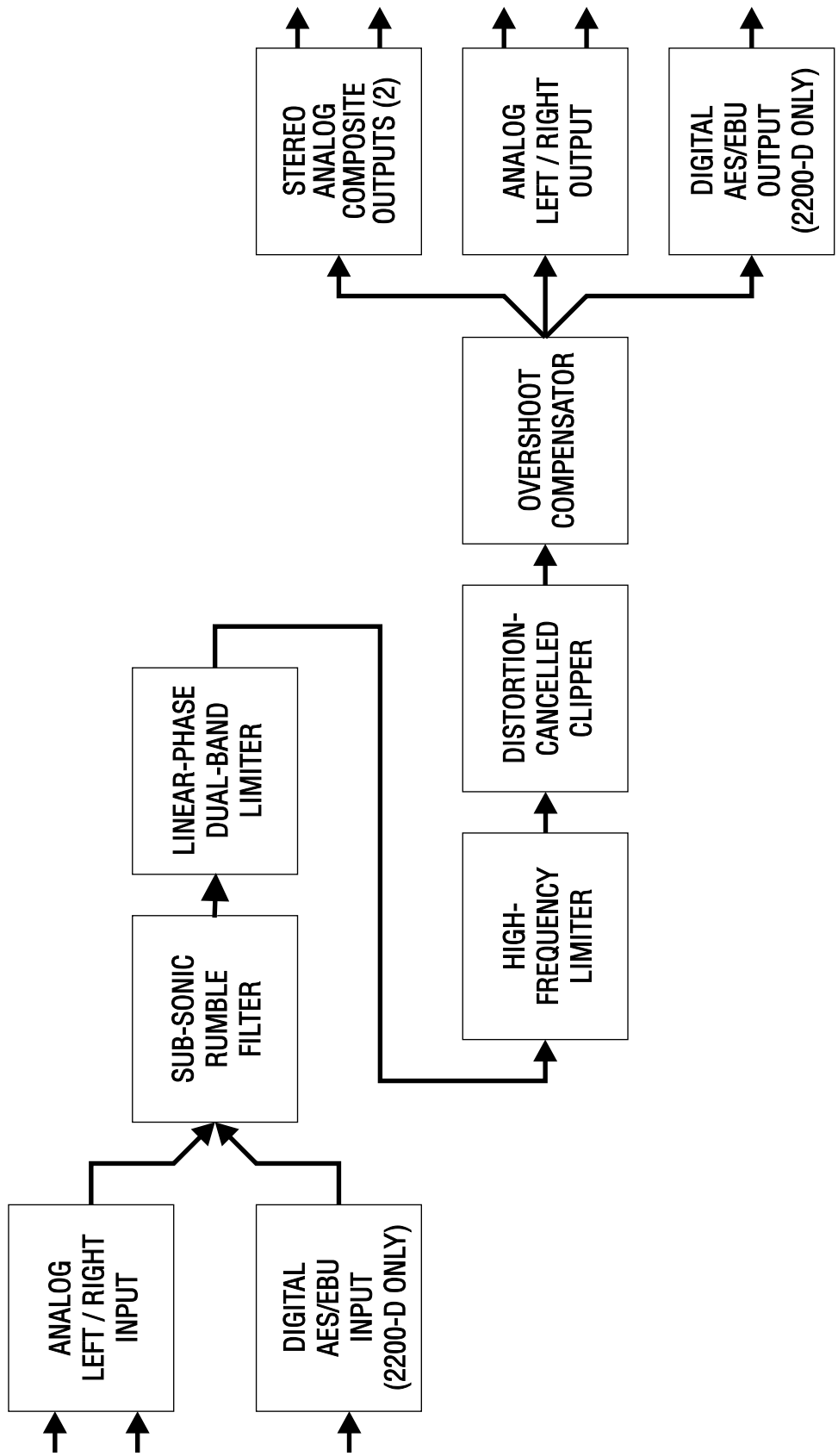
Turning up the CLIPPING control drives the distortion-canceled clippers harder, reducing the peak-to-average ratio, and increasing the loudness on the air. When the amount of clipping is increased, the audible distortion caused by clipping is increased. Lower settings reduce loudness, of course, but result in a cleaner sound and better high-frequency response.

> In our opinion, when the REL TIME control is set between 1 and 8dB/Second, the best setting for the CLIPPING control is between −1.0 and 0.0. If the program material is clean, this setting produces an output that sounds undistorted even on high-quality receivers.
>
> If you use faster settings of the REL TIME control, or if program material is not always clean, use lower settings of the CLIPPING control. Ultimately, your ears must judge how much distortion is acceptable. But audition difficult program material like live voice and piano before you make your final decision.

If you are optimizing for live voice, you will probably want to reduce the setting to the −3 to −4 range to eliminate any audible clipping.

**FINAL CLIP (Drive) control** determines the level driving the final clipper that performs protection peak limiting. This clipper follows the distortion-canceling clipper system, and is not itself distortion-canceling.

The effect of adjusting this control is very critical — changes of 0.1dB make clearly audible differences in the amount of distortion produced by the processing. In most cases, we recommend that the user not adjust this control and use the factory preset settings instead; the control has only been made available for experienced, sophisticated users who need to achieve the absolute maximum on-air loudness and who are willing to take the time necessary to listen to many different kinds of program material to verify that nothing falls apart after the clipper drive has been increased. The effect of adjusting this control is very similar to the effect of changing the amount of clipping in a composite clipper, except that in the 2200 (unlike a composite clipper), the SCA region of the baseband spectrum is always perfectly protected from interference.




PROTECTION LIMITER STRUCTURE
(SIMPLIFIED BLOCK DIAGRAM)

# Customizing The Protection Limiter Structure Sound

The Protection Limiter Structure is designed for stations wanting the highest possible fidelity to the source, such as a station broadcasting concert music at night when its audience is likely to listen in a concentrated and critical way. While the Protection Limiter Structure can readily reduce the dynamic range, it is designed to do so without increasing program density, loudness, or the consistency of sound from different sources. Its primary function is to protect the transmitter from over-deviation while preserving the spectral and textured quality of the source material.

There are virtually no user controls — the parameters of the structure have been chosen to make it audibly *undetectable*.

## Protection/Limiting Control Details

There are two parameters for the Classical-Protect preset:

**DRIVE** adjusts signal level going into the compressor, and therefore controls the dynamic range of the output audio by determining the amount of gain reduction in the compressor. The range is 0-25dB.

**30Hz HPF** determines if the 30Hz high-pass filter prior to the limiter is in or out of the signal path.

> The 30Hz high-pass filter has an 18dB/octave slope and is down 0.5dB at 30Hz. It eliminates modulation-wasting subsonic energy from acoustic and turntable rumble, and removes most of the energy from *pops* caused by breath blasts into microphones. It prevents any such subsonic energy from modulating the audio processor's AGC and compressor control signals (which could cause unpleasant distortion), and prevents the automatic frequency control loops in FM exciters from introducing modulation distortion into the audio or even becoming entirely unlocked.
>
> The cutoff frequency of this filter is so low that the only common musical instruments producing lower fundamental frequencies are the pipe organ and synthesizer. The bass energy in most pop music occurs above 40Hz. We recommend operating the system with the 30Hz HPF control set in.

**This Page Intentionally Left Blank!**