radio

orban

audio processing

OPTIMOD-FM
8600

To win, FM broadcasters need clarity, brightness, and punch that competes with digital media —

FM unveiled the new clear starts here.

overview

OPTIMOD-FM 8600 is Orban's flagship processor and the next step beyond the OPTIMOD-FM 8500. Featuring versatile five-band and two-band processing for both analog FM transmission and digital media, the 8600 provides the industry's most consistent sound, track-to-track and source-to-source. This consistency allows you to create a sonic signature for your station with the assurance that your signature will stay locked in, uniquely branding your sound.

Dramatically improved peak limiter technology decreases distortion while increasing transient punch and high frequency power handling capacity. Compared to the FM-channel peak limiter in OPTIMOD-FM 8500, the new peak limiter typically provides 2.5 to 3 dB more power at high frequencies, which minimizes audible HF loss caused by pre-emphasis limiting. Drums and percussion cut through the mix. Highs are airy. "Problem material" that used to cause audible distortion is handled cleanly.

In the toughest competitive environment ever, a winning strategy includes OPTIMOD-FM 8600.

While this design offers about the same loudness as 8500 processing, its main goal is to make FM analog broadcasts more competitive with the cleanliness, punch, and open high frequencies of the digital media against which FM analog transmissions now battle. The FM loudness wars represent 20th-century thinking; in the 21st century, the new competition is digital media. Thanks to its fresh, crisp sound, the 8600 helps level the playing field between analog FM and its ever more aggressive digital-only competitors.

The 8600 offers 8500-style processing too. This allows broadcasters to run favorite 8500 presets if they wish. Because the input/output delay of the new peak limiter is too long to permit talent to monitor off-air on headphones, 8500 processing is useful for remotes and outside broadcasts where off-air headphone monitoring is desired and the 8600's low-delay monitor output cannot be brought to the talent.

details

Two-band AGC with window gating rides gain without unnecessary increasing density.

Versatile multiband compressor can be adjusted to be punchy and loud or open and transparent, all while maintaining the industry's best source-to-source consistency.

There are two separately adjustable multiband compressors, one for the FM analog and one for the digital radio processing.

Headphone jack offers plenty of drive to overcome ambient noise at transmitters.

Headphone volume control.

Built-in stereo encoder offers excellent technical specifications and Orban's patented, second-generation "Half-Cosine Interpolation" composite limiter.

Easy-to-use user interface makes navigation and adjustment effortless.

The 8600 provides stereo enhancement, equalization, AGC, multiband compression, low-IM peak limiting, stereo encoding, and composite limiting — everything that even the most competitive major market station needs to stand out on the dial.

Processing for digital media like netcasts and HD Radio is supplied standard. The FM and digital media processing paths split after the 8600's stereo enhancer and AGC. There are two equalizers, multiband compressors and peak limiters, allowing the analog FM and digital media processing to be optimized separately. The bottom line? Processing that optimizes the sound of your FM channel while punching remarkably crisp, clean, CD-like audio through to your digital channel audience.

More than 20 excellent sounding, format specific factory presets get you started. You'll find all of your favorite 8500 presets, plus new "MX" presets designed by Bob Orban and Greg Ogonowski to exploit the exciting possibilities inherent in the 8600's new peak limiter technology. Although the factory presets are fully competent "out of the box", you can customize them with easy one-knob LESS-MORE control or with more than 60 advanced controls whose versatility will satisfy even the most finicky on-air sound designer.

New MX presets exploit the 8600's **improved peak limiting technology**

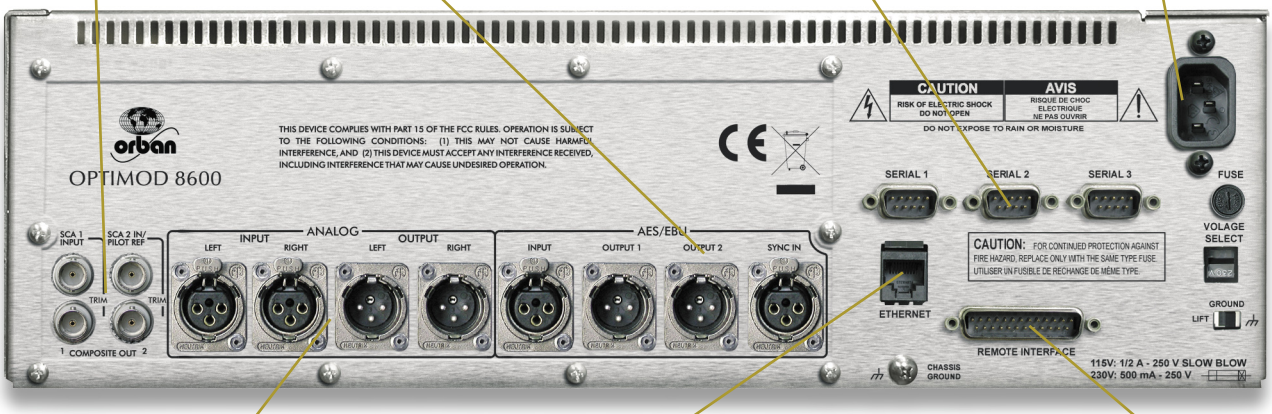
If you have created custom presets for OPTIMOD-FM 8500, 8400, 8300, 5500 or 5300, you'll find that they import perfectly into the 8600, retaining your carefully crafted sound.

If you choose to use the 8600's superb DSP-based stereo encoder and composite limiter, be assured that they deliver an FM analog signal that is always immaculately clean and perfectly peak limited, with full spectral protection of subcarriers and RDS/RBDS regardless of the amount of composite limiting.

patented composite limiter protects subcarriers

We haven't forgotten pure analog FM broadcasters. An 8600FM model without digital radio processing is available at lower cost. Moreover, we offer an upgrade kit for 8500 and 8500FMs that is easily installed in the field by replacing the DSP board and CPU module. The upgrade requires no soldering or special tools.

details



Two composite outputs with independently adjustable output levels, plus two SCA inputs with trimmable gains.

One AES3 audio input, two AES3 outputs, and one AES11 sync input.

Three RS232 serial connectors for computer control, simple ASCII remote control, and future developments.

AC Power passes throgh an IEC-standard main connector and an RF filter designed to meet the standards of all international safety authorities.

High dynamic range analog inputs and outputs.

100 Mbps Ethernet facilitates network control.

Eight optically isolated GPI inputs for contact-closure remote control.

Ethernet connectivity is standard, as is an easy to use PC remote control application that runs on Windows 2000 and higher and that can control many 8600s on a TCP/IP network. In addition, programmable contact-closure (GPI) control plus ACSII terminal control via the 8600's RS232 serial and Ethernet ports and give you total freedom to interface the 8600 with your facility's remote control infrastructure, whatever it might be.

User interface improvements round out the package. We started with the 8400's easy-to-use joystick, knob and button navigation system and added a bright, active-matrix color LCD that makes it easier to program the 8600 from its front panel. The panel's eye-catching new metallic blue styling makes the processor look as great in your rack as it sounds on the air.

easy-to-use user interface

For our European customers, a second generation 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. New for the 8600 is the ability to apply MPX power gain reduction after the clippers so that the texture of the processing can include more "clipper sound" when desired. Regardless of how you adjust the multiplex power controller, you can be sure that you will always meet the BS 412 requirements flawlessly.

improved ITU BS.412 multiplex power controller

Processing for HD RADIO

The HD Radio system generates a digital carrier that shares a given station's allocated bandwidth with the normal analog FM carrier. The receiver crossfades between the analog and digital channels to minimize the effect of RF dropouts. This scheme requires audio processing for the two channels to be closely matched in texture to ensure that the receiver's crossfades are seamless.

Optimum peak limiting for the two channels is very different. The analog channel requires state-of-the-art pre-emphasis limiting to achieve competitive loudness and minimize pre-emphasis-induced high frequency loss. This usually implies use of sophisticated distortion-cancelled clipping. The digital channel, on the other hand, has no pre-emphasis but is heavily bit-reduced with the HDC perceptual codec. The highest available rate is 96 kbps and many broadcasters are now multicasting with two 48 kbps channels.

This limited bitrate creates an entirely different set of requirements: the peak limiting must not use clipping because there is no bit budget available to encode clipping-induced distortion products. However, pre-emphasis limiting is unnecessary. The best technology for peak limiting the digital channel is look-ahead limiting, which can perform very clean peak reduction on flat channels, but which is unsuitable for pre-emphasized channels.

OPTIMOD-FM 8600 is an excellent solution to his dilemma because its AGC and stereo enhancement are shared between the two channels while equalization, multiband compression/limiting and peak limiting are independent.

The analog FM path provides the 8600's improved peak limiter, overshoot compensation, stereo encoding, and composite limiting using Orban's patented "Half-Cosine Interpolation" algorithm.

The limiting is anti-aliased and uses samplerates as high as 512 kHz. Meanwhile, the HD output receives low-IM look-ahead peak limiting, which we improved in the 8600 to exploit some of the same new technology we designed for the FM analog processing chain. This look-ahead limiting is optimized to make the most of the limited bitrate codecs used digital radio and netcasting channels. By eschewing any clipping, the HD processing prevents the codec from wasting precious bits encoding clipping distortion products, allowing the codec to use its entire bit budget to encode the desired program material.

For convenience, it is possible to couple the equalizer, HF enhancer and multiband compressor/limiter setup controls of the two paths, allowing them to be matched easily. This is convenient in HD Radio™ installations where the station's goal is to minimize the audibility of analog/digital crossfades at the receiver. However, the ability to adjust the analog FM and digital radio paths separately allows users more latitude to fine-tune their audio. For example, a broadcaster who believes that selling the advantages of HD Radio™ to the public requires an obvious, audible difference between the analog FM and digital channels can generate this "wow!" factor. Dual-path processing also allows the digital media processing to be independently tuned to minimize artifacts in low bitrate codecs, like those used in netcasting and HD Radio™.

A built-in diversity delay of up to 16 seconds in the analog processing path simplifies installation in HD Radio facilities, freeing you from the need to use the delay line built into the HD Radio exciter.

This allows you to use the 8600's built-in stereo encoder and composite limiter to drive the analog FM transmitter, ensuring no-compromise analog-channel loudness. The diversity delay can be applied independently to any output emitting the analog-FM processing signal, so some outputs can be delayed while others are not.

The 8600's 64 kHz base samplerate allows it to provide up to 20 kHz audio bandwidth at its HD output. The HD bandwidth is user-settable between 15 and 20 kHz to optimize the processing for the codec employed in the digital chain. Many low bitrate codecs operate better when fed 15 kHz audio because this enables them to use their available bit bandwidth most efficiently. This is particularly true for low rates, like 32 kbps. However, at higher samplerates, full 20 kHz bandwidth provides the same bandwidth as typical source material, so the user may prefer to use it for these higher rates.

Although the 8600's new peak limiter technology has narrowed the gap, the 8600's digital output still sounds cleaner and more open than its FM output, particularly in the high frequencies — the analog channel is inevitably handicapped by the standard 50 and 75 microsecond pre-emphasis curves, which compromise its high frequency headroom. Using program material, we've measured as much a 9 dB difference in favor of the digital channel at high frequencies! Even after the processed passes through the codec, a significant amount of this audible superiority remains.

Most HD Radio exciters require 44.1 kHz AES/EBU audio streams for both their analog-FM and digital inputs. The samplerates for both streams must be identical and must be locked to an external reference. This requires two AES/EBU outputs from a single-box processor. Because the output samplerate on either or both of the 8600's AES3 outputs can be locked to either the 8600's sync reference input or to its AES3 input, the 8600 fully meets the requirements. Moreover, because of the 8600's built-in diversity delay on the analog-FM channel, it is possible (and usually desirable) to entirely bypass the analog-FM side of the iBiquity exciter and to use the 8600's built-in stereo encoder and composite limiter to drive the analog FM exciter directly.

features & benefits

USER-FRIENDLY INTERFACE	
Large (quarter-VGA) **active-matrix color liquid crystal display** (LCD)	Makes setup, adjustment and programming of the 8600 easy. Navigation is by a miniature joystick, two dedicated buttons and a large rotary knob. The **LCD shows all metering functions** of the processing structure in use.
Locate **joystick**	Used **to navigate through a menu** that lets you recall a preset, modify processing (at three levels of expertise), or to access the system's setup controls.
ABSOLUTE CONTROL OF PEAK MODULATION	
Universal transmitter protection & audio processing for FM broadcast	The 8600 provides universal transmitter protection and audio processing for FM broadcast. It can be configured to interface ideally with any commonly found transmission system in the world, analog or digital.
Pre-emphasis limiting	The 8600 provides **pre-emphasis limiting** for the internationally used pre-emphasis curves of 50 µs and 75 µs. Compared to its predecessor, its new clipping/pre-emphasis-control technology preserves 2.5 to 3 dB more frequency energy while significantly reducing audible clipping distortion at all frequencies. This produces a clean, open sound whose subjective brightness more closely matches the original program.
Tight **peak control** at all its outputs	The 8600 achieves **extremely tight peak control** at all its outputs — analog, AES3 (for both the analog FM and HD channels) and composite baseband.
Stereo encoder integrated with audio processing	Eliminates the overshoot problems that waste valuable modulation in traditional external encoders.
Two outputs	The stereo encoder has **two outputs** with independent level controls, each capable of driving 75 Ω in parallel with 47,000 pF, (100 ft / 30 m of coaxial cable).
Stereo encoder	By integrating the **stereo encoder** with the audio processing, the 8600 eliminates the overshoot problems that waste valuable modulation in traditional external encoders.
Bandwidth limiting & overshoot compensation	The 8600 prevents aliasing distortion in subsequent stereo encoders or transmission links by providing **bandwidth limiting and overshoot compensated** 15 kHz low-pass filters ahead of the 8600's audio outputs and stereo encoder.
Internal DSP-based stereo encoder	The 8600 has an **internal, DSP-based stereo encoder** (with a **patented "half-cosine interpolation" composite limiter** operating at 512 kHz samplerate) to generate the pilot tone stereo baseband signal and control its peak level. The composite limiter is a unique, "you can only do this in DSP" process that beats composite clippers by preserving stereo imaging while **fully protecting the stereo pilot tone, RDS/RBDS and subcarriers**.
FLEXIBLE CONFIGURATION	
Analog & AES3 digital inputs & outputs	OPTIMOD-FM 8600 is supplied with **analog and AES3 digital inputs and outputs**. The digital input and the two digital outputs are equipped with samplerate converters and can operate at 32 kHz, 44.1 kHz, 48 kHz, 88.1 kHz and 96 kHz samplerates. The pre-emphasis status and output levels are separately adjustable for the analog and digital outputs. Each output can emit the analog FM processed signal, the analog FM processed signal with diversity delay applied, the digital radio processed signal or the low-delay monitor signal.
Two independent equalizers, multiband compressors and peak limiters	The 8600 has **two independent equalizers, multiband compressors and peak limiters for the FM analog and digital media processing channel**s, allowing you to separately optimize the processing for each.
Defeatable diversity delay	A defeatable **diversity delay** can delay the FM analog processing output up to **16.2 seconds**. Delay can be trimmed in intervals of one sample of 64 kHz to **match the analog and digital paths** in the HD Radio system, eliminating the need to use the delay built into the HD Radio exciter and **permitting the 8600's internal stereo encoder and composite limiter to drive the analog FM exciter**. Both the 8600 and 8600FM offer this feature, making it convenient to use the 8600FM in dual-processor HD installations where the digital channel receives independent processing from a processor like Orban's OPTIMOD-DAB or OPTIMOD-PC. Each output (Analog, Digital 1, Digital 2, Composite) can be **independently configured to emit the delayed or undelayed signal**.

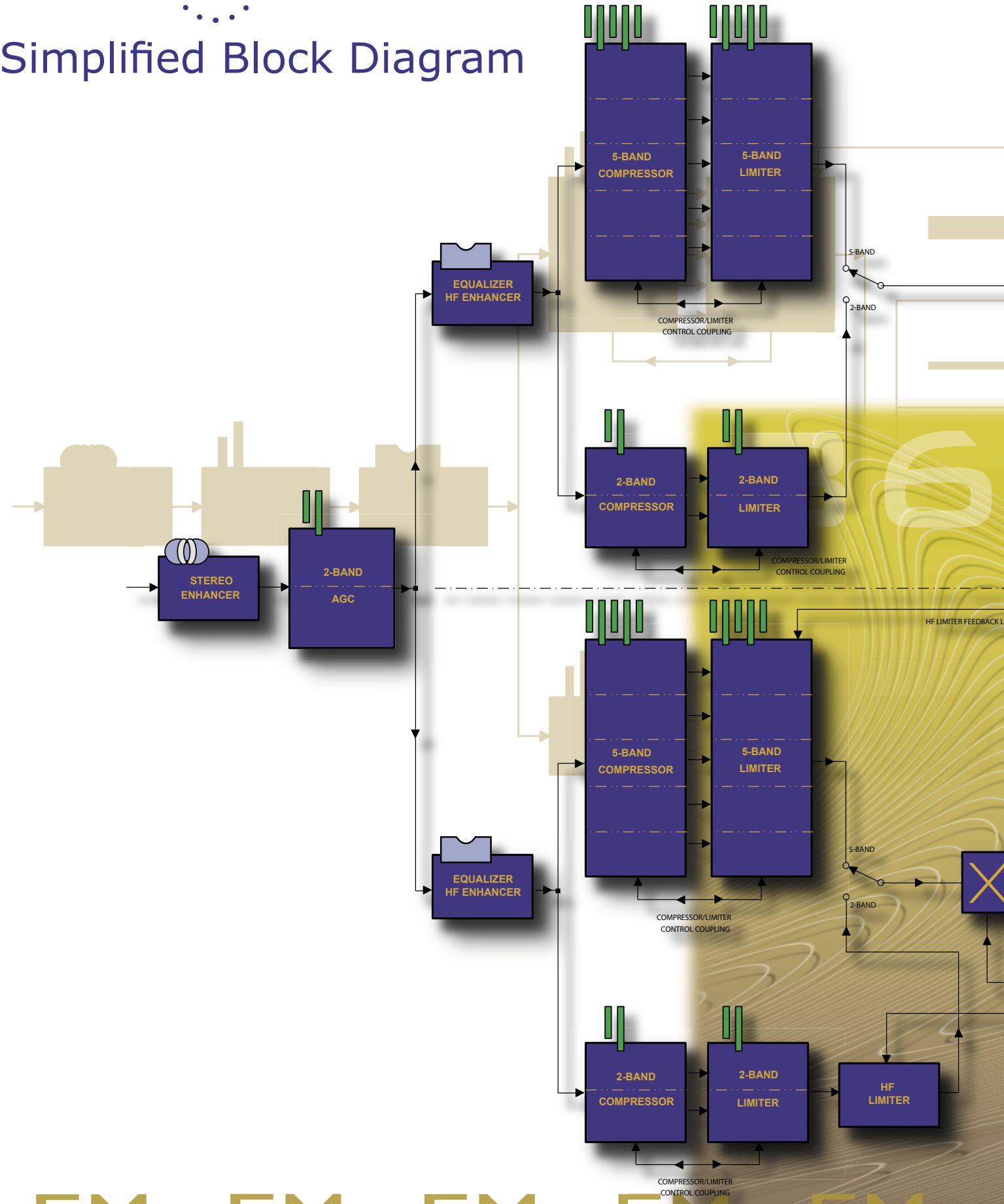
features & benefits

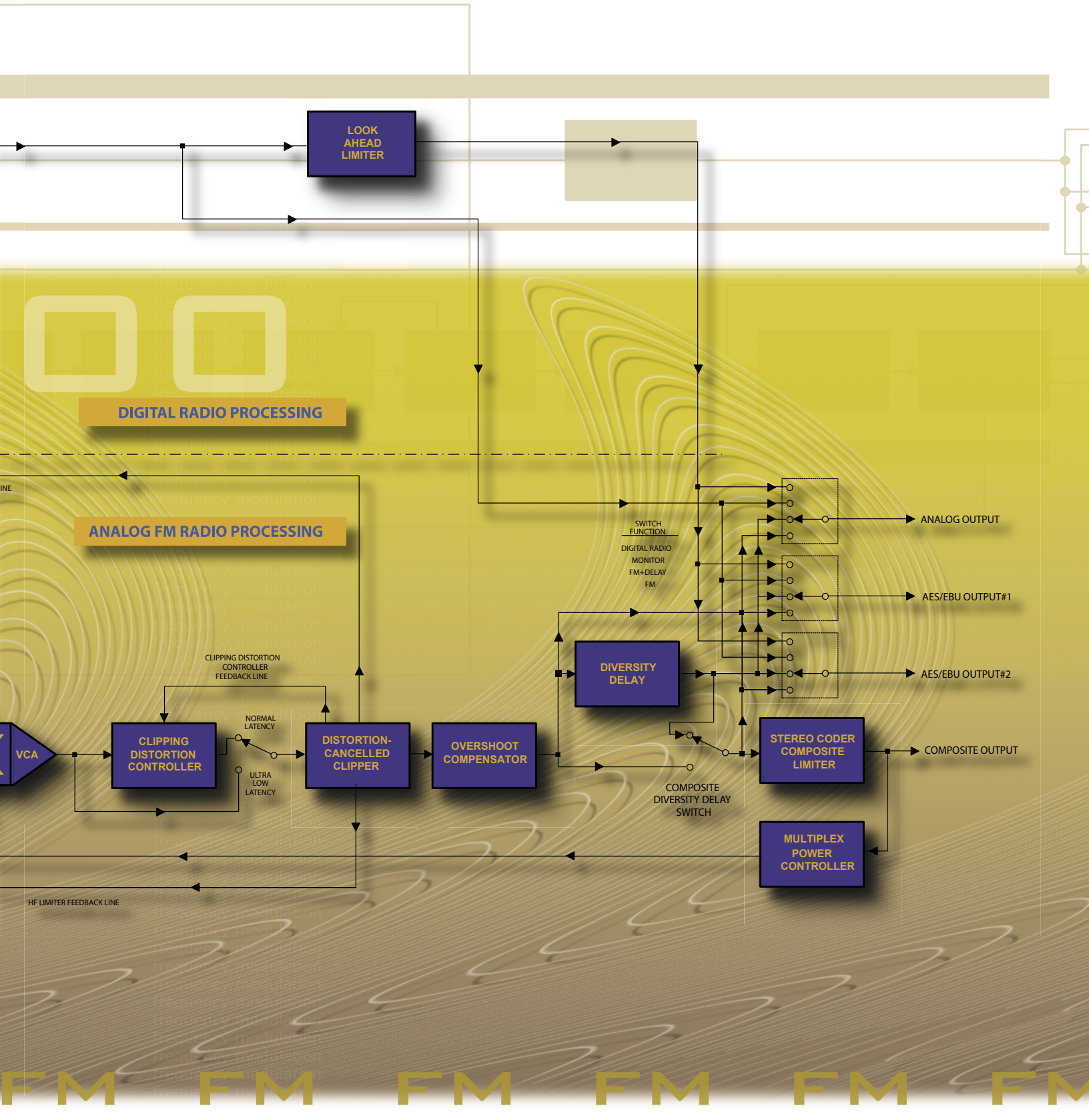
FLEXIBLE CONFIGURATION *(continued)*	
AES11 sync input	An **AES11 sync input** allows you to synchronize the output samplerate of either (or both) AES3 outputs to this input. You can also **synchronize the outputs to the AES3 digital input or to 8600's internal clock**. The sync source of each AES3 output is independently selectable.
Transformerless, balanced 10 kΩ instrumentation-amplifier circuits	The analog inputs are **transformerless, balanced 10 kΩ instrumentation-amplifier circuits**. The analog outputs are transformerless balanced and floating (with 50 Ω impedance) to ensure highest transparency and accurate pulse response.
Two independent composite baseband outputs	The 8600 has **two independent composite baseband outputs** with digitally programmable output levels. Robust line drivers enable them to drive 100 feet of RG59 coaxial cable without audible performance degradation.
Two subcarrier inputs	The 8600's **two subcarrier inputs** are mixed with the output of the 8600's stereo encoder before application to the composite output connectors. One input can be re-jumpered to provide a 19 kHz pilot reference output. Both inputs have internal level trims to accommodate subcarrier generators with output levels as low as 220 mV.
Precise control of the audio bandwidth	The 8600 precisely **controls the audio bandwidth** of its **analog FM processing** to 16.5 kHz. This prevents significant overshoots in uncompressed digital links operating at a 44.1 kHz-samplerate or higher and prevents interference to the pilot tone and RDS (or RBDS) subcarrier. The bandwidth of the 8600's **digital radio output** is adjustable in 1 kHz increments between 15 kHz and 20 kHz.
Defeatable multiplex power limiter	The 8600 has a defeatable **multiplex power limiter** that controls the multiplex power to ITU-R BS412 standards. An adjustable threshold allows a station to achieve maximum legal multiplex power even if the downstream transmission system introduces peak overshoots into the 8600-processed signal. Because this limiter closes a feedback loop around the audio processing, it allows the user to a**djust the processor's subjective setup controls freely** without violating BS412 limits, regardless of program material. The multiplex power limiter acts on all outputs (not just the composite output). In its most common configuration, it reduces clipper drive when it reduces power, simultaneously **reducing clipping distortion**. However, to accommodate customers who **wish to use heavier clipping to achieve a certain sound**, the MPX power controller can be configured to reduce gain after the clippers.
RFI-suppressed connections	All input, output and power connections are rigorously **RFI-suppressed** to Orban's traditional exacting standards, ensuring trouble-free installation.
International safety and emissions standards	The 8600 is designed and certified to meet all applicable **international safety and emissions standards**.
ADAPTABILITY THROUGH MULTIPLE AUDIO PROCESSING STRUCTURES	
Processing structure	A **processing structure** is a program that operates as a complete audio processing system. Only one processing structure can be on-air at a time, although all are active simultaneously to permit mute-free switching between them. The 8600 realizes its processing structures as a series of high-speed mathematical computations made by Digital Signal Processing (DSP) chips.
Featuring six processing structures	The 8600 features six processing structures. Four of these are the same as OPTIMOD-FM 8500: **Five-Band** (or "Multiband") for a consistent, "processed" sound with 17 ms delay (typical), free from undesirable side effects, **Low-Latency Five-Band** (12 ms delay), **Ultra-Low-Latency Five-Band** (3.7 ms delay) and **Two-Band** (17 or 22 ms delay) for a transparent sound that preserves the frequency balance of the original program material. A special Two-Band preset creates a no-compromise "Protect" function that is functionally similar to the "Protect" structures in earlier Orban digital processors.
Phase-linear	The 8600's Two-Band processing structures can be made **phase-linear** to maximize audible transparency.

features & benefits

ADAPTABILITY THROUGH MULTIPLE AUDIO PROCESSING STRUCTURES *(continued)*	
Rides gain	The 8600 **rides gain** over an adjustable range of up to 25 dB, compressing dynamic range and compensating for both operator gain-riding errors and gain inconsistencies in automated systems.
Two new "MX" structures	The 8600's **two new "MX" structures** (five-band and two-band) are similar to their 8500 counterparts except that they use the 8600's new peak limiting technology **to decrease distortion** while achieving substantial improvements in **transient punch and high frequency clarity**. This advanced technology requires more input-to-output delay than the older structures, so it is impractical for talent to monitor these structures off-air with headphones. The 8600 offers a special **low-delay monitor output** for this purpose.
Increase density and loudness	The 8600 can increase the **density and loudness** of the program material by multiband compression, limiting and clipping — improving the consistency of the station's sound and increasing loudness and definition remarkably, without producing unpleasant side effects.
CONTROLLABLE	
Remote control	The 8600 can be **remote-controlled** by 5 - 12V pulses applied to eight programmable, optically isolated GPI (general-purpose interface) ports.
Serial port #1	The 8600 is equipped with a **serial port** to interface to an IBM-compatible computer running Orban's PC Remote software. The connection can be either direct or through an external modem.
Serial port #2	The 8600 has a **second serial port** that allows the user to set up security and communications parameters through a simple ASCII terminal program running on any PC.
Built-in 100 Mbps Ethernet port	The 8600 can be connected through its built-in 100 Mbps Ethernet port to a **TCP/IP network**.
Telnet client	The 8600 includes a **Telnet client** that allows presets to be recalled via batch files using the free PuTTY and Plink applications. The commands are **simple ASCII strings**, facilitating interface to automation systems that can emit such strings through an Ethernet or RS232 serial connection.
Bypass Test Mode	A **Bypass Test Mode** can be invoked locally or by remote control to permit broadcast system test and alignment or "proof of performance" tests.
Software upgrades	The 8600's software can be **upgraded remotely or locally** through the 8600's serial or Ethernet port.
8600 PC Remote software	**8600 PC Remote software** is a graphical application that runs under Windows 2000 XP, Vista and 7. It communicates with a given 8600 **via TCP/IP over modem, direct serial and Ethernet connections**. You can configure PC Remote to switch between many 8600s via a convenient organizer that supports giving any 8600 an alias name and grouping multiple 8600s into folders. Clicking an 8600's icon causes PC Remote to connect to that 8600 through an Ethernet network, or initiates a Windows Dial-Up or Direct Cable Connection if appropriate. The PC Remote software allows the user to access all 8600 features and allows the user to **archive and restore presets, automation lists and system setups** (containing I/O levels, digital word lengths, GPI functional assignments, etc.).
Built-in line-up tone generator	The 8600 contains a **built-in line-up tone generator**, facilitating quick and accurate level setting in any system.
Versatile real-time clock	The 8600 contains a versatile **real-time clock**, which allows automation of various events (including recalling presets) at pre-programmed times. To maintain accuracy, this clock can be automatically synchronized via the Internet to a reference time source.

Simplified Block Diagram




LOOK AHEAD LIMITER
DIGITAL RADIO PROCESSING
ANALOG FM RADIO PROCESSING
SWITCH FUNCTION
DIGITAL RADIO MONITOR
FM+DELAY
FM
ANALOG OUTPUT
AES/EBU OUTPUT#1
AES/EBU OUTPUT#2
DIVERSITY DELAY
CLIPPING DISTORTION CONTROLLER FEEDBACK LINE
NORMAL LATENCY
ULTRA LOW LATENCY
VCA
CLIPPING DISTORTION CONTROLLER
DISTORTION-CANCELLED CLIPPER
OVERSHOOT COMPENSATOR
STEREO CODER COMPOSITE LIMITER
COMPOSITE OUTPUT
COMPOSITE DIVERSITY DELAY SWITCH
MULTIPLEX POWER CONTROLLER
HF LIMITER FEEDBACK LINE

specifications

It is impossible to characterize the listening quality of even the simplest limiter or compressor based on specifications, because such specifications cannot adequately describe the crucial dynamic processes that occur under program conditions. Therefore, the only way to evaluate the sound of an audio processor meaningfully is by subjective listening tests.

Certain specifications are presented here to assure the engineer that they are reasonable, to help plan the installation, and make certain comparisons with other processing equipment.

PERFORMANCE	*Specifications apply for measurements from analog left/right input to stereo composite output and to FM analog left/right output.*	
	Frequency Response (Bypass Mode; Analog Processing Chain)	Follows standard 50 µs or 75 µs pre-emphasis curve ±0.10 dB, 2.0 Hz – 15 kHz. Analog left/right output and Digital output can be user configured for flat or pre-emphasized output.
	Samplerate	64 kHz to 512 kHz, depending on processing being performed.
	Noise	Output noise floor will depend upon how much gain the processor is set for (Limit Drive, AGC Drive, Two-Band Drive, and/or Multi-Band Drive), gating level, equalization, noise reduction, etc. It is primarily governed by the dynamic range of the A/D converter, which has a specified over-load-to-noise ratio of 110 dB. The dynamic range of the digital signal processing is 144 dB.
	Total System Distortion	(de-emphasized, 100% modulation) < 0.01% THD, 20 Hz – 1 kHz, rising to < 0.05% at 15 kHz. < 0.02% SMPTE IM Distortion.
	Total System Separation	> 55 dB, 20 Hz – 15 kHz; 60 dB typical.
	Polarity (Two-Band and Bypass Modes)	Absolute polarity maintained. Positive-going signal on input will result in positive-going signal on output.
INSTALLATION	***Delay***	
	Defeatable Analog FM Processing Delay	16.2 seconds (maximum), adjustable in one-sample increments at 64 kHz samplerate to allow the delays of the analog and digital paths in the HD Radio system to be matched at the receiver output. The delay can be applied independently to the analog output, digital outputs, and composite output in any combination. However, all outputs configured for delay will have the same amount of delay applied to them. Once set, this delay will remain the same regardless of which processing preset is active.
	Minimum Processing Delay	This is the input-to-output throughput delay when the analog FM processing delay is defeated. It is processing structure dependent. Typically 17 ms for normal latency 5-band, 13 ms for low-latency 5-band, 3 ms for ultra-low-latency 5-band and 17 or 22 ms for 2-band, depending on crossover structure chosen. Approximately 150 ms for 5-band and 2-band "MX" presets, which use the 8600's new peak limiting technology.
	Analog Audio Input	
	Configuration	Stereo.
	Impedance	>10 kΩ load impedance, electronically balanced. No jumper selection available for 600 Ω. Through-hole pads are available on I/O module for user-installed 600 Ω termination.
	Nominal Input Level	Software adjustable from –10.0 to +13.0 dBu (VU).
	Maximum Input Level	+27 dBu.
	Connectors	Two XLR-type, female, EMI-suppressed. Pin 1 chassis ground, Pins 2 (+) and 3 electronically balanced, floating and symmetrical.
	A/D Conversion	24 bit 128x oversampled delta sigma converter with linear-phase anti-aliasing filter.
	Filtering	RFI filtered, with high-pass filter at 0.15 Hz.
	Analog Audio Output	
	Configuration	Stereo. Flat or pre-emphasized (at 50 µs or 75 µs), software-selectable. The output can be set independently to emit the analog FM processed signal, the diversity-delayed analog FM processed signal, the digital radio processed signal, or the low-delay monitor signal.
	Source Impedance	50 Ω, electronically balanced and floating.
	Load Impedance	600 Ω or greater, balanced or unbalanced. Termination not required, or recommended.
	Output Level	(100% peak modulation) Adjustable from -6 dBu to +24 dBu peak, into 600 Ω or greater load, software-adjustable.
	Signal-to-Noise	≥ 90 dB unweighted (Bypass mode, de-emphasized, 20 Hz – 15 kHz bandwidth, referenced to 100% modulation).
	Crosstalk	≤ -70 dB, 20 Hz – 15 kHz.
	Distortion	≤ 0.01% THD (Bypass mode, de-emphasized) 20 Hz – 15 kHz bandwidth.
	Connectors	Two XLR-type, male, EMI-suppressed. Pin 1 chassis ground, Pins 2 (+) and 3 electronically balanced, floating and symmetrical.
	D/A Conversion	24 bit 128x oversampled.
	Filtering	RFI filtered.
	Digital Audio Input	
	Configuration	Stereo per AES3 standard, 24 bit resolution, software selection of stereo, mono from left, mono from right or mono from sum.
	Samplerate	32, 44.1, 48, 88.1 and 96 kHz automatically selected.
	Connector	XLR-type, female, EMI-suppressed. Pin 1 chassis ground, pins 2 and 3 transformer balanced and floating, 110 Ω impedance.
	Input Reference Level	Variable within the range of –30 dBFS to –10 dBFS.
	J.17 De-emphasis	Software-selectable.
	Filtering	RFI filtered.
	Digital Audio Output	
	Configuration	Two outputs, each stereo per the AES3 standard. The outputs can be set independently to emit the analog FM processed signal, the diversity-delayed analog FM processed signal, the digital radio processed signal, or the low-delay monitor signal. The FM processed signal can be configured in software as flat or pre-emphasized to the chosen processing pre-emphasis (50 µs or 75 µs). Each output can apply J.17 pre-emphasis if desired.
	Samplerate	Internal free running at 32 kHz, 44.1 kHz, 48 kHz, 88.1 kHz, or 96 kHz, selected in software. Can also be synced to the AES3 SYNC input or the AES3 digital input at 32 kHz, 44.1 kHz, 48 kHz, 88.1 kHz and 96 kHz, as configured in software.
	Word Length	Software selected for 24, 20, 18, 16 or 14-bit resolution. Optionally, first-order highpass noise-shaped dither can be added; dither level is automatically adjusted appropriately for the word length.
	Connector	XLR-type, male, EMI-suppressed. Pin 1 chassis ground, pins 2 and 3 transformer balanced and floating, 110 Ω impedance.
	Output Level (100% peak modulation)	-20.0 to 0.0 dBFS, software controlled.
	Frequency Response through Digital Radio Processing Chain	For output samplerates of 44.1 kHz and above, the frequency response from input to DR-configured output is ±0.10 dB, 2.0 Hz – 20 kHz; flat or with J.17 pre-emphasis applied. The user may specify low-pass filtering to constrain the bandwidth to 15, 16, 17, 18 or 19 kHz.
	Relative Time Delay between FM and HD Outputs	Depends on setting of analog processing channel delay line. Once set, this delay is constant regardless of processing preset in use
	Filtering	RFI filtered.

Digital Sync Input	
Configuration	Used for synchronization of either or both AES3 signals to an external reference provided at this input.
Samplerate	32, 44.1, 48, 88.1 and 96 kHz, automatically selected.
Connector	XLR-type, female, EMI-suppressed. Pin 1 chassis ground, Pins 2 and 3 transformer balanced and floating, 110 Ω impedance.
Filtering	RFI filtered.
Composite Baseband Output	
Configuration	Two outputs, each with an independent software-controlled output level control, output amplifier and connector. The outputs can be delayed by the diversity delay. If so, both outputs will receive the same delay; delay cannot be applied to only one output.
Source Impedance	0 voltage source or 75 Ω, jumper-selectable. Single-ended, floating over chassis ground.
Load Impedance	37 Ω or greater. Termination not required or recommended.
Maximum Output Level	+12.0 dBu (8.72 Vpp).
Minimum Output Level	-12 dBu (0.55 Vpp) for 0.5 dB adjustment resolution.
Pilot Level	Adjustable from 6.0% to 12.0%, software controlled.
Pilot Stability	19 kHz, ±0.5 Hz (10 to 40 °C).
D/A Conversion	24-bit
Signal-to-Noise Ratio	≤ -85 dB (Bypass mode, de-emphasized, 20 Hz – 15 kHz bandwidth, referenced to 100% modulation, unweighted).
Distortion	≤ 0.02% THD (Bypass mode, de-emphasized, 20 Hz – 15 kHz bandwidth, referenced to 100% modulation, unweighted).
Stereo Separation	At 100% modulation = ≥65 dB (30 Hz to 15 KHz).
Crosstalk-Linear	≤ –80 dB, main channel to sub-channel or sub-channel to main channel (referenced to 100% modulation).
Crosstalk-Non-Linear	≤ –80 dB, main channel to sub-channel or sub-channel to main channel (referenced to 100% modulation).
38 kHz Suppression	≥ 70 dB (referenced to 100% modulation).
76 kHz & Sideband Suppression	≥ 80 dB (referenced to 100% modulation).
Pilot Protection	–60 dB relative to 9% pilot injection, ±250 Hz (up to 2 dB composite processing drive).
Subcarrier Protection (60-100 kHz)	≥ 70 dB (referenced to 100% modulation; with up to 2 dB composite limiting drive; measured with 800 line FFT analyzer using "maximum peak hold" display).
57 kHz (RDS/RBDS) Protection	-50 dB relative to 4% subcarrier injection, ±2.0 kHz (up to 2 dB composite processing drive).
Connectors	Two BNC, floating over chassis ground, EMI suppressed.
Maximum Load Capacitance	0.047 µF (0 Ω source impedance). Maximum cable length of 100 feet / 30 meters.
Filtering	RFI filtered.
Subcarrier (SCA) Inputs	
Configuration	Subcarrier inputs sum into composite baseband outputs before digitally controlled composite attenuator.
Impedance	> 600 Ω
SCA Sensitivity (Both Inputs)	Variable from 220 mV p-p to >10 V p-p to produce 10% injection. Two trim pots, adjustable from the rear panel, set sensitivities.
Connectors	Two BNC, unbalanced and floating over chassis ground, EMI suppressed.
19 kHz Pilot Reference	SCA2 input jack can be jumpered to provide a 19 kHz pilot reference output or to serve as a second SCA input.
Remote Computer Interface	
Supported Computer & Operating System	IBM-compatible PC running Microsoft Windows® 2000 (SP3 or higher), XP, Vista or 7.
Configuration	TCP/IP protocol via direct cable connect, modem or Ethernet interface. Suitable null modem cable for direct connect is supplied. Modem and other external equipment is not supplied.
Serial Connectors	RS232 port (3) DB-9 male, EMI-suppressed. Serial Connector 1 uses PPP to provide for direct or modem connection to the 8500 PC Remote application. Serial Connector 2 supports communication to a computer or remote control system via simple ASCII commands for administration and recalling presets. Serial Connector 3 is reserved for future developments.
Ethernet Connector	Female RJ45 connector for 10 – 100 Mbps networks using CAT5 cabling. Native rate is 100 Mbps. Provides for connection to the 8600 PC Remote application through either a network, or, using a crossover Ethernet cable, directly to a computer. Also supports ASCII terminal connections via PPP.
Ethernet Networking Standard	TCP/IP.
Remote Control (GPI) Interface	
Configuration	Eight (8) inputs, opto-isolated and floating.
Voltage	6 – 15 V AC or DC, momentary or continuous. 9 VDC provided to facilitate use with contact closure.
Connector	DB-25 male, EMI-suppressed.
Control	User-programmable for any eight of user presets, factory presets, bypass, test tone, stereo or mono modes, analog input, digital input.
Filtering	RFI filtered.
Tally Outputs	
Configuration	NPN open collector.
Maximum Voltage	30 V DC, reverse-polarity protected.
Maximum Current	30 mA.
Power	
Voltage	100 – 132 VAC or 200 – 264 VAC, switch-selected on the rear panel, 50-60 Hz, 50 VA.
Connector	IEC, EMI-suppressed. Detachable 3-wire power cord supplied.
Grounding	Circuit ground is independent of chassis ground can be isolated or connected with a rear panel switch.
Safety Standards	ETL listed to UL standards, CE marked.
Environmental	
Operating Temperature	32 to 122 °F / 0 to 50 °C for all operating voltage ranges.
Humidity	0 – 5% RH, non-condensing.
Dimensions (W x H x D)	19" x 5.25" x 15.5" / 48.3 cm x 13.34 cm x 39.4 cm. Depth shown indicates rack penetration; overall front-to-back depth is 17.75" / 45.1 cm. Three rack units high.
RFI / EMI	Tested according to Cenelec procedures.
Shipping Weight	28 lbs. / 12.7 kg
Warranty	
Two Years, Parts & Service	Subject to the limitations set forth in Orban's Standard Warranty Agreement.

Because engineering improvements are ongoing, specifications are subject to change without notice.

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