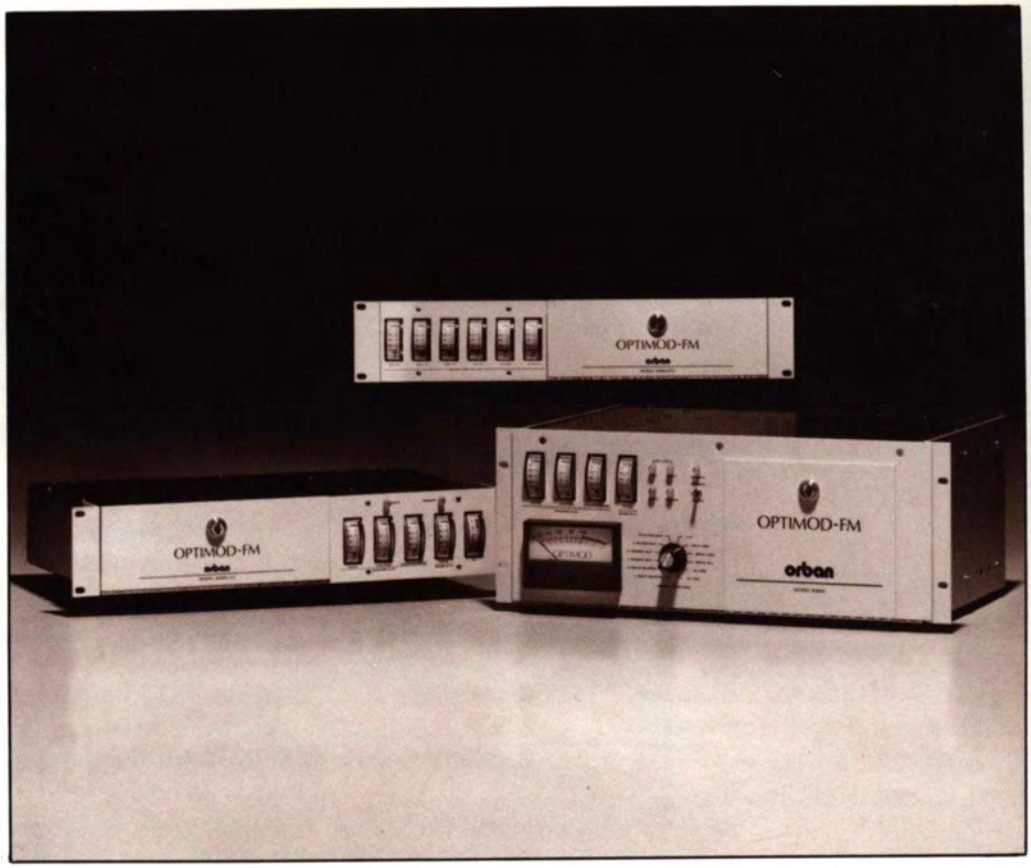
OPTIMOD FM

AUDIO PROCESSING SYSTEM



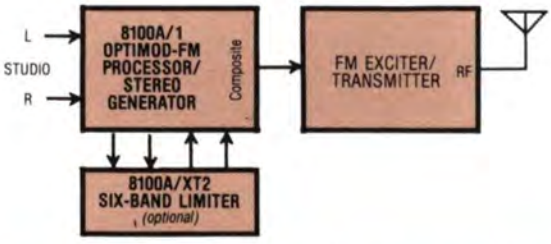
orban

THE OPTIMOD-FM SYSTEM

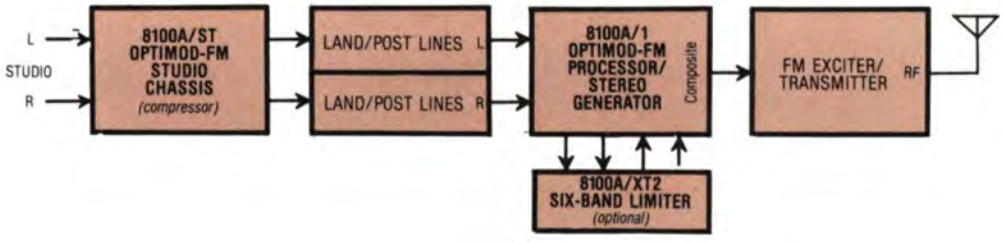
A complete family of audio processing equipment for FM broadcast. Start with the OPTIMOD-FM Audio Processor; add complementary accessories to meet your specific requirements.

All mains powered items are 115/230V, 50/60Hz. They are shipped wired for 115V unless otherwise specified.

COMMON SYSTEM CONFIGURATIONS

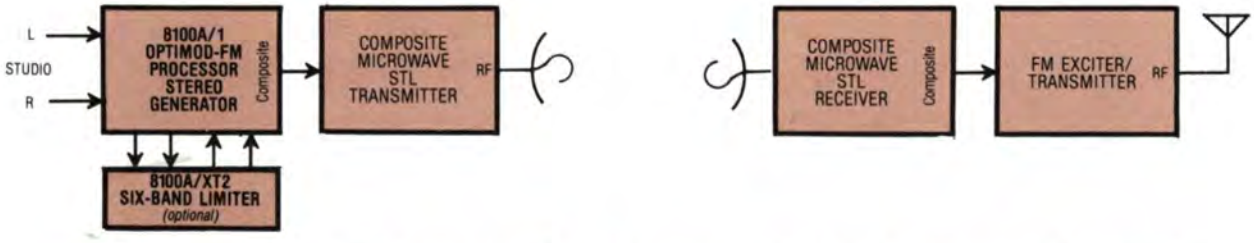


Co-located studio and transmitter



Program feed from studio to transmitter via land lines (analog or digital)

Program feed from studio to transmitter via discrete left/right STL (analog or digital)



Program feed from studio to transmitter via composite STL

OPTIMOD-FM AUDIO PROCESSOR

Model 8100A/1: A complete audio processing system with integrated stereo generator.

- ❑ An integrated compressor, limiter, peak controller, and stereo generator.
- ❑ Replaces conventional compressors, AGCs (automatic gain controls), limiters, and clippers.
- ❑ Provides louder, cleaner, and brighter audio — applicable to any format.
- ❑ Rides gain over a 25dB range.
- ❑ Transparent, natural sound quality meets the highest subjective standards — free from the audible distortion typical of many processing methods.
- ❑ Advanced technical features help you make most efficient use of the available carrier deviation while preventing overmodulation.
- ❑ Excellent stability and reliability — proven by the thousands of OPTIMOD-FM units on the air throughout the world.

The Industry-Standard FM Audio Processor

OPTIMOD-FM was designed to serve both the broadcaster and the listener by combining previously independent level control functions into an integrated audio processing system for FM broadcast. The result is an *open* and *natural* sound — whether used merely for light control over levels, or for the heavier processing often desired for youth-oriented formats. It's a sound with a uniquely favorable combination of impact, clarity, loudness, and brightness, no matter how you choose to operate it.

OPTIMOD-FM is considered by many to be the *industry standard*, with many thousands of units on the air — not only in the United States but also in many other countries — on stations that play loud rock music, soft popular music, classical music, talk programs, or a mixture of all!

Stations using OPTIMOD-FM stand out with a strong, solid, high-quality signal that is likely to attract and hold an audience.

OPTIMOD-FM — The Sound That Successfully Competes

Most FM stations exist in a competitive environment. Even public broadcasters realize that they compete with the private stations for listeners. OPTIMOD-FM gives your station a powerful competitive tool to better serve your audience.

OPTIMOD-FM is highly versatile. It can be easily set up to maintain the highest fidelity to the source material — or to achieve improved consistency with varying source material while still maintaining the texture of the original — or to create a sound that is loud and dense, but with remarkable freedom from unpleasant artifacts.

Pop and rock music stations often desire a sound that attracts listeners by being louder than other stations. OPTIMOD-FM accomplishes this easily.

Mixed format stations can set OPTIMOD-FM to provide a dramatic high-impact sound for popular music, and to maintain consistent levels on talk programs, and to sound extremely open and uncompressed on classical music, all without changing control settings on the processor.

Classical format stations face a unique dilemma: The dynamic range of modern recordings is often so wide that, when listening levels are adjusted for comfortable loudness on loud passages, the softer passages are impossible to hear in the car or on portable and table radios. Yet it's that wide dynamic range that contributes to the *impact* of the music — conventional compressors squash classical music and make it sound dull and lifeless.

OPTIMOD-FM can reduce the effective dynamic range while maintaining the intended artistic *impact* of the crescendos. During the day, when listening is more casual, OPTIMOD-FM maintains consistent levels for easy listening. And in the evening, backing off levels on the console reduces the compression, to give the wider dynamic range preferred by serious listeners in quiet home environments.

OPTIMOD-FM Audio Processing At Work

OPTIMOD-FM provides four level control functions: (1) slow gain riding, (2) adjustable control of dynamic range, (3) automatic control of bass-to-midrange balance, and (4) precise peak control to prevent overmodulation and to compensate for the effect of the pre-emphasis curve.

Gain riding — by OPTIMOD-FM instead of your operator: levels are artfully controlled over a 25dB range, compensating for varying input levels, while maintaining a consistent loudness on the air.

OPTIMOD-FM controls dynamic range: Set its compression slow, for a subtle smoothness that makes it difficult to distinguish the air sound from the processor's input. Set it faster to produce a louder air sound. Or set it for heavy processing that produces a sound that seems to *jump out of the radio.*

Some program material suffers from too much or too little bass: When desirable, OPTIMOD-FM's dual-band AGC (automatic gain control) can be set to provide automatic bass equalization, increasing bass on thin-sounding source material, and reducing it when heavy bass comes along.

Conversely, OPTIMOD-FM can be operated "wideband" — the frequency response remains flat except during extremely heavy bass material that would otherwise cause audible spectral gain intermodulation between bass and midrange.

If even greater consistency is desired than that provided by OPTIMOD-FM alone, add the 8100A/XT2 Six-Band Limiter. It employs six bands (instead of two) to provide more detailed "automatic equalization" throughout the audio spectrum. See page 7 of this brochure.

Peak control without the "peak limiter" sound: To prevent overmodulation, peaks must be strictly controlled, especially at high frequencies due to the increase in peak level created by pre-emphasis. But if the peak-control processing affects the average level, its action will be unnatural and irritating (the ear is very sensitive to changes in average level).

So we have included our exclusive distortion-cancelling clipper and FCS (Frequency-Contoured Sidechain) Overshoot Compensator — sophisticated and patented circuitry that controls peaks precisely without affecting the average level and without introducing audible distortion.

With OPTIMOD-FM, the high-frequency power limitation of the pre-emphasis/de-emphasis process is almost never audibly apparent. OPTIMOD-FM's high-frequency limiter and distortion-cancelling clipper operate as a system to permit much more subjective brightness (without audible distortion) than traditional variable-emphasis high-frequency limiters.

The Result

The listener enjoys a satisfying, attractive sound that is ideally processed for the format, and so is pleasant and easy to listen to for long periods of time.

The broadcast engineer achieves a strong signal that can maximize modulation without risk of over-deviation.

The station management makes best use of its overall technical resources to serve the largest possible area and attract the desired audience.

OPTIMOD-FM's Integral Stereo Generator (Coder)

Typical stand-alone stereo coders include pre-emphasis networks and low-pass filters.

The pre-emphasis boosts high frequencies to either the 75µs or 50µs standard curve; the low-pass filters protect the 19kHz pilot and prevent distortion caused by aliasing-related non-linear crosstalk. Unfortunately, these networks and filters are rarely compensated to achieve ideal group delay characteristics, so they distort the intended *shape* of the waveform as it passes through, producing overshoots which unnecessarily cause overmodulation.

In conventional (non-OPTIMOD-FM) installations, the audio processor and peak limiter are placed before the stereo coder. Since the low-pass filters in a conventional coder add overshoots (3dB is typical), the carefully peak-controlled audio at the output of the peak limiter doesn't stay peak-controlled by the time it reaches the output of the coder. (Some program material can cause overshoots of up to 6dB!) To prevent spurious overmodulation by these peaks, the output of the processor must be reduced by a complementary amount, which also reduces your average loudness!

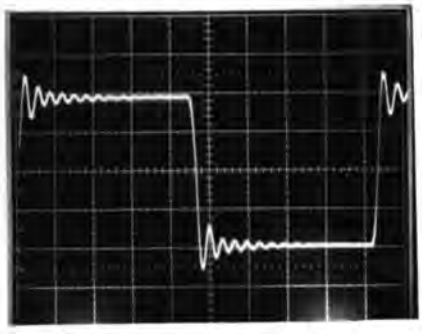


Figure 1
Typical response of uncompensated low-pass filter (as used in conventional stereo coders), showing significant overshoot.
(1 kHz square wave)

OPTIMOD-FM's integrated system concept permits a different approach.

The pre-emphasis networks and low-pass filters are placed *before* the final peak protection circuitry. There's nothing between the peak protection circuitry and the stereo coder to change the shape of the waveform. And the low-pass filters are group-delay equalized and overshoot compensated so that the final safety clippers rarely have to work.

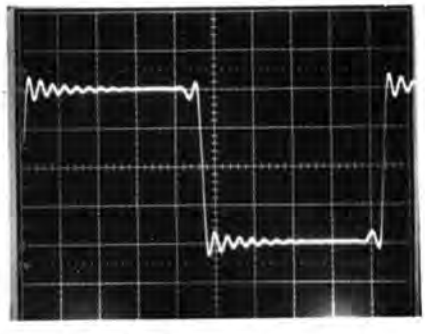


Figure 2
Group delay compensation applied to filter in Fig. 1 reduces but does not eliminate overshoot.
(1 kHz square wave)

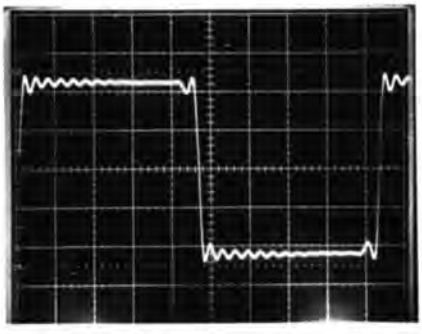


Figure 3
OPTIMOD-FM's overshoot compensated filter shows negligible overshoot compared to the filter in Fig. 1 or 2.
(1 kHz square wave)

The OPTIMOD-FM System integrates the stereo coder with the audio processor to achieve the highest average *and* peak modulation levels with the least amount of audible compression and peak limiting, compared to any other FM processor/coder system.

SIX-BAND LIMITER

Model 8100A/XT2: An optional accessory chassis that improves loudness, brightness, and consistency compared to OPTIMOD-FM processing alone.

- ❑ Increases loudness without audible side-effects.
- ❑ Improves spectral consistency from source to source.
- ❑ Increases presence and intelligibility on auto and table radios.
- ❑ Provides control over bass, presence, brilliance, density, and clipping.
- ❑ Compatible with any 8100A-series OPTIMOD-FM.

Audio Processing For Position

The 8100A/XT2 Six-Band Limiter provides added power to fine-tune your air sound to your target audience and market position through precise control of bass and treble sound texture, program density, and program dynamics.

It is for those stations that desire a *louder* or more processed sound than that provided by a "stock" OPTIMOD-FM set according to our recommendations — a *louder* sound with *fewer* processing artifacts.

And it's an *all-Orban, all-OPTIMOD* system, so that all parts work together harmoniously.

It's more powerful than processors sold to be put in front of an OPTIMOD-FM. The XT2's circuitry resides in the *middle* of the OPTIMOD-FM, to give you *loudness, brightness,* and *clarity,* without the inevitable side-effects that result when other external processors are added.

The XT2 Sound

Suppose you have a "barefoot" OPTIMOD-FM on the air, set to its recommended settings. You're listening in your control room, comparing board program to your air sound. You'll notice that air sound is louder, the level more consistent. But the basic sonic *texture* is similar to the original program material. That's what OPTIMOD-FM is famous for.

Now you add the XT2. The sound is suddenly *louder* and *brighter,* yet still remarkably open. The bass has punch, impact. The mids are clean, clear, and smooth, with a dramatic sense of presence. The highs are in perfect balance to the mids and lows, always present, but never brittle.

Your **music sound** has a remarkable consistency from cut to cut, from a golden oldie to the latest CD release. Never boomy or bass-shy, never shrill or dull.

Your **announcer's voice** has increased presence and intelligibility, without even a *hint* of processing distortion.

Your **news actualities** from low-grade telephone calls are much more intelligible.

That's the sound of the 8100A/1 + XT2 System — clean, crisp, and consistent.

Now compare your sound to your over-processed competitors. You're as loud or louder. You're probably cleaner. But most importantly, your sound is comfortably listenable for long periods of time. With the XT2, there's no listener fatigue to drive your listeners away.

A Competitive Weapon

When to mobilize it: The XT2 is at home with those formats that demand that "big-time, show-business" gloss in their sound: mass-appeal highly competitive pop formats, such as Contemporary Hit Radio, Album Oriented Rock, Adult Contemporary, Country, and Black/Urban. But the XT2 may not be appropriate for a format that demands a sound that's strictly faithful to the original recording — the "barefoot" OPTIMOD-FM does this beautifully.

Even so, the XT2 (when used lightly) works surprisingly well for some Beautiful Music formats. Such stations are often used as background music, and music played softly tends to lose its highs and lows. The XT2 can correct this to maintain a consistent frequency balance from cut to cut.

And the XT2's consistency helps to make the widely-varying spectral balances of records from different eras more listenable. Used lightly, it can usually augment any live disk operation.

Talk formats can similarly benefit from the XT2's consistency. It's invaluable in pulling low-grade telephone calls and field recordings out of the mud, in real time, without operator intervention.

For the Engineer

The XT2 consists of a six-band limiter cascaded with Orban's patented multi-band distortion-cancelled clipper. Functionally, the XT2 replaces the high-frequency limiter within the 8100A/1. When the XT2 is in use, the OPTIMOD-FM's dual-band compressor is converted into a slow averaging AGC in front of the six-band limiter to permit the XT2 to always operate in its "sweet spot."

The result? Almost any operator gain-riding error is corrected, and the six-band limiter acts as an intelligent "automatic equalizer" that gives your station a consistent, easy-to-listen-to sound, source to source and cut to cut.

Why six bands?

The OPTIMOD-FM already has a dual-band compressor that works well as long as it is not pushed to produce large increases in program density. But when you *do* try to get such density with the OPTIMOD-FM alone, the sound may become fatiguing — certain program material produces audible and disturbing "spectral gain intermodulation." That is, instruments in one frequency range can cause audible changes in the loudness of instruments in another frequency range: the dominant instrument modulates the loudness of the others.

To eliminate this problem, the 8100A/1 + XT2 System achieves most of its density increase in the XT2's six-band limiter. Because each band in the XT2 processes only a fraction of the total spectrum, the XT2 is virtually free from spectral gain intermodulation. The outputs of the individual bands are applied to their own individual peak clippers, which are then followed by filters to reduce out-of-band harmonic and IM distortion.

This arrangement is far more effective than a cascaded system consisting of an OPTIMOD-FM preceded by a compressor — wide-band or multi-band.

The XT2 cannot make a station any louder than an 8100A or 8100A/1 OPTIMOD-FM driven with very bright program material and operated with fast release time and substantial gain reduction. (No other add-on can do that either!) But the XT2's multi-band processing allows you to achieve those very high levels of loudness *without the processing artifacts* that cause listening fatigue.

Getting the sound you want

The XT2 sounds superb on both music *and* voice. This is a particularly important point when comparing the XT2 to other add-ons. Any add-on that goes in front of an OPTIMOD-FM relies on the OPTIMOD-FM's circuitry to avoid clipping distortion and to provide most of the density increase. And wide- or dual-band compression after multi-band compression cannot help but sound strained and pumpy on some program material (spectral gain intermodulation again!).

When setting up the OPTIMOD-FM for maximum loudness, a station is usually limited by how much live-voice distortion is tolerable — music will tolerate more clipping than voice. The 8100A/1 + XT2 System controls live voice levels better than an 8100A/1 alone. Therefore, it is usually possible to set up the processing to get the same high loudness on music as a very heavily operated 8100A/1 — without the increase in voice distortion that almost always accompanies such heavy operation. Any add-on which goes in front of the OPTIMOD-FM cannot control voice distortion nearly as well.

The XT2 sounds best when its multi-band limiters are driven lightly — the sound is loud, bright, clean, easy to listen to. When driven hard, the sound gets more dense, but, surprisingly, it doesn't get much louder. (Some like it that way, so the XT2 provides both options.)

Installation

The XT2 can be used with any 8100A-series OPTIMOD-FM, in both single and dual chassis configurations. It always resides at the main OPTIMOD-FM chassis, and talks to its host through a multi-pin connector and a short interconnecting cable. It requires two rack units.

The Model 8100A/1 is ready to accept the XT2 without modification. **The earlier Model 8100A** requires field-conversion to accept the XT2. The conversion consists of mounting a pre-wired multi-pin connector in an existing port in the rear panel, and soldering the wires to appropriate locations on the mother board. One plug-in circuit card is replaced with an updated version that allows the multi-band compressor to be used as a slow AGC. Very minor modifications must be made to other cards. All parts and easy-to-follow conversion instructions are supplied in Orban's Retrofit Kit RET-027.

Precise Control to Fine-Tune Your Sound

The XT2 includes all the sound-tailoring adjustments that most station engineers desire to get the sound that's just right for the format. And the EQ controls do not affect the midrange sound that is so critical (and so hard to get right with most of the other multi-band units).

Density Increase in the 8100A/1 + XT2 System is achieved by dual-band compression followed by six-band limiting. Moderate and subtle 8100A-style density increase coupled with light multi-band limiting achieves an open sound without compromising loudness or consistency.

RELEASE TIME (on the 8100A/1) varies the AGC from a slow "hand on the fader" to a density-augmenting dual-band compressor. Either way, the multi-band limiters in the XT2 are always driven in their "sweet spot."

DENSITY controls the amount of multi-band limiting, and lets you vary the texture from open and transparent to solid and dense — or anywhere between. Even the "solid and dense" sound is free from pumping and spectral gain intermodulation.

CLIPPING affects the loudness/distortion trade-off by controlling how hard the clippers are driven. With Orban's patented multi-band distortion-cancelling clipper, very effective reduction in peaks is achieved without the distortion build-up typical of other clippers.

BASS COUPLING (on the 8100A/1) controls the amount of "warmth" added to bass-shy material, using the dual-band compressor as a dynamic low-frequency shelving equalizer below 200Hz.

BASS EQ provides a peaking boost at 65Hz to achieve solid, punchy bass from most consumer radios — while avoiding the excitation of mid-bass dashboard resonances in cars.

The Bass Equalizer gives you separate control of "warmth" and "punch." Because the XT2 often increases the brightness of program material, some bass boost is usually desirable to keep the sound spectrally well balanced.

PRESENCE boosts the 2-6kHz region to achieve presence and loudness increases as desired. Yet its location "within the limiter" prevents excessive stridency with program material already having a great deal of presence energy.

BRILLIANCE boosts the region centered at 10kHz to provide an audibly attractive effect, increasing the "air" and "transparency" (similar to a psycho-acoustic exciter). The six-band limiter is configured so that it doesn't fight brilliance boosts — the XT2 can achieve exceptional brightness if you want it.

The High-Frequency Equalizers are carefully integrated into the design of the top two bands of limiting. This avoids the problem of "fixed" equalizers that sound just right on some program material and horribly wrong on others. Together, the PRESENCE and BRILLIANCE controls let you achieve the precise high frequency balance you want — no simple outboard treble equalizer can sound this good.

8100A/XT2 Six-band Limiter Operating Controls (access door removed)

OPTIMOD-FM ACCESSORIES

Studio Chassis

Model 8100A/ST: An optional accessory that splits OPTIMOD-FM into two sections, so that the compressor can be located at the studio to protect land lines or microwave links and to make best use of available STL S/N ratio.

- ❑ Provides level control and compression before the STL — without adding additional audio processing.
- ❑ Designed to drive land lines and microwave STLs directly, controlling levels to prevent distortion due to overload.
- ❑ Moves most subjective operating controls to the studio.
- ❑ Extensive metering assures easy set-up and maintenance.

The STL Problem

Control of audio levels feeding a microwave "Studio-Transmitter Link" or land line is most important. These links are usually the weakest in the audio chain — they typically have limited headroom and barely adequate signal-to-noise ratio. If audio levels are reduced to prevent overload, low level signals will get too close to the noise. At the transmitter, the AGC will increase audio level and the noise with it.

OPTIMOD-FM Audio Processing was designed to offer complete audio control. If additional processing were added prior to the STL, it would simply degrade your sound.

Additionally, many station engineers like to have the subjective audio processing controls at the studio, where monitoring systems are usually better.

The OPTIMOD-FM Solution

The OPTIMOD-FM Studio Chassis lets you relocate the AGC/compressor circuit cards from the main OPTIMOD-FM chassis (located at the transmitter) to the Studio Chassis (installed in the studio just before the microwave transmitter or land lines).

Improves STL performance and prevents overload: Level control prior to the STL allows you to maximize use of the available dynamic range. The Studio Chassis can be set-up to guarantee that peaks do not exceed a specified maximum level.

Control the station "sound" at the studio: Relocating the AGC circuit cards also relocates the controls that most affect the sound of the station: RELEASE TIME, GATE THRESHOLD, BASS COUPLING, RELEASE SHAPE, and CLIPPING. (The H-F Limiting control remains at the transmitter end.)

Self-contained, easy to install: The Studio Chassis has its own power supply, balanced output line drivers, and metering.

FM Filter Card

Model ACC-022: An optional accessory that increases loudness, reduces SCA noise.

- ❑ Increases average modulation level — 6% is typical.
- ❑ Reduces SCA audio noise and data errors caused by main-channel program-induced splatter.
- ❑ Factory-installed when ordered with a new Model 8100A/1 OPTIMOD-FM; Field Retrofit Kit for existing Models 8100A and 8100A/1 OPTIMOD-FM.

OPTIMOD-FM and SCA

OPTIMOD-FM uses overshoot-compensated low-pass filtering to assure that it meets government regulations regarding crosstalk into the SCA region. However, when heavy processing and clipping are employed, there is a small amount of "splatter" into the SCA region caused by operation of the safety clippers. When SCAs are used only for limited dynamic range background music or voice, a small amount of "splatter" is usually tolerable. However, some SCA users seek better performance for transmitting data, paging, and wide dynamic range audio.

The FM Filter Card card reduces clipping "splatter" into the SCA region of the baseband by about 25dB, which significantly reduces noise on audio material and error rates in data.

Loudness

In FM, loudness is limited by the requirement that peaks may not cause the carrier to deviate beyond 100% modulation.

The FM Filter Card reduces peak overshoots by about 6% (0.6dB), resulting in 6% additional average modulation capability and a commensurate *increase in loudness* with no additional compression, limiting, or clipping — and no increase in processing artifacts. In addition, broadcasters report that with some transmitters their on-air sound with the FM Filter Card is cleaner.

Composite clipping has been used by some stations in an attempt to clip overshoots and thereby increase loudness. Unfortunately, such clipping even when used lightly dramatically increases trash in the SCA region. And as clipping is increased to "bite" into program material below the overshoots, significant audible distortion is produced. For L+R material, the distortion increase is *identical* to that produced by simple audio clipping. To make matters worse, live voice (almost always pure L+R) is most vulnerable to added clipping, even in small amounts. Increases of fractions of a dB of composite clipping can cause baseband "trash" to increase by 10dB or more! Furthermore, composite clippers are expensive.

The additional modulation capability provided by the FM Filter Card can achieve loudness within *about 0.3dB* of that produced by composite clipping (an inaudible difference) *without any of the drawbacks*. With the FM Filter Card installed, overshoots are virtually eliminated — additional composite clipping can do nothing but add audible distortion and SCA trash.

Recommended Applications

All stations using SCA.

All stations using the 8100A or 8100A/1 who wish to improve loudness without suffering the side effects of composite clipping.

A word of warning: Multipath in composite STLs introduces its own trash in the SCA region which could mask benefits expected of the FM Filter Card.

Composite Isolation Transformer

Model ACC-025: An optional accessory to permit OPTIMOD-FM to feed more than one exciter, to permit longer cable runs, and to eliminate ground loops between OPTIMOD-FM and exciter if they occur.

- ❑ Enables one OPTIMOD-FM to feed more than one exciter.
- ❑ Permits longer cable run from OPTIMOD-FM to exciter — up to 50 feet (15 meters).
- ❑ Installs adjacent to the FM exciter.

The Stereo Generator/Exciter Interface

Ground loops are a problem in some transmitter plants. A ground loop among OPTIMOD-FM and one or more exciters may occur, causing an increase in hum and noise.

Some installations may require long cable runs between OPTIMOD-FM and the exciter. OPTIMOD-FM ordinarily requires a cable length of not more than six feet (two meters).

Some stations must drive more than one exciter. Often, exciters have different input sensitivities and impedances, and may not have individual composite input level controls. OPTIMOD-FM has only one COMPOSITE OUTPUT with one OUTPUT LEVEL control.

The Composite Isolation Transformer provides the solution. Designed to be installed adjacent to each exciter, it provides ground loop isolation between the OPTIMOD-FM composite output and the exciter, and presents OPTIMOD-FM with a balanced floating load. When used with the Composite Isolation Transformer, OPTIMOD-FM is easily modified to provide a very low source impedance that can drive longer cables. Adjusting modulation levels on each of several exciters can be easily achieved since each ACC-025 has its own level control. Use one ACC-025 at each exciter.

Stereo Spatial Enhancer

Model 222A: An effective and affordable tool that enhances the spatial definition of audio for broadcast, and increases the brightness, impact, and transient definition of stereo music.

Using an exclusive, patent-pending technique, the 222A detects and enhances psychoacoustic directional cues which are present in all stereo program material. Enhancement is achieved without increasing multipath distortion, and without exaggerating reverberation or vertical tracing distortion in disc playback.

The 222A complements OPTIMOD-FM without changing the "sound" created by the audio processor.

See the separate brochure.

TECHNICAL DETAILS
OPTIMOD-FM SYSTEM

1 Input conditioning filter: An all-pass phase scrambler makes peaks more symmetrical to reduce clipping distortion and allow better control of loudness. A 30Hz 18dB/octave high-pass filter prevents subsonic information from disturbing the operation of the audio processor or the exciter's AFC.

2 Dual-band AGC: The dual-band design divides the audio into two bands with a 200Hz crossover that feeds a master band compressor and a bass band compressor.

The BASS COUPLING control determines if the two compressors operate independently (INDEPENDENT) making audio quality more consistent by correcting frequency imbalances between bass and midrange, or if the bass band will track the master band (WIDEBAND) preserving frequency balances. Settings in-between allow you to tune to suit your programming characteristics.

Even in WIDEBAND, the bass control loop is activated. Extreme bass will not force gain reduction of the entire signal as would a single-band system. This, along with program-controlled attack and release time-constants, eliminates audible "pumping" and gain modulation.

The RELEASE TIME control determines how fast the gain of the master band compressor recovers when the program material falls below the compression threshold, and is adjustable over a wide range. It affects the *density* of the sound and the short-term dynamic range. When the control is set towards SLOW, the AGC acts as a gentle gain riding device, offering an open sound with no audible compression.

The gating function prevents noise rush-up, offers additional control over the sound of OPTIMOD-FM, and makes the 25dB gain reduction range fully usable. The GATING control adjusts the level below which the AGC freezes gain. A high gating level preserves long-term dynamic range by preventing quiet passages in wide dynamic range audio from being increased unnaturally.

When the XT2 Six-Band Limiter is used, the dual-band AGC acts a slow "hand on the fader" to keep average levels into the six-band limiter constant.

3 Low-pass filter and pre-emphasis: The low-pass filter prevents intermodulation between in-band and out-of-band frequency components in the clipper, and prevents out-of-band components from affecting the operation of the high-frequency limiter. This filter is followed by the pre-emphasis network.

4 High-frequency limiter *(not operational when the optional XT2 is used):* The high-frequency limiter is controlled by high frequencies only, eliminating any possibility of modulation of high-frequency content by low-frequency material. When the XT2 Six-Band Limiter is used, high-frequency limiting is performed by the upper bands of the six-band limiter.

5 FM Smart Clipper *(not operational when the optional XT2 is used):* To preserve naturalness, peak limiting is provided by a carefully-designed clipper that, in conjunction with the other OPTIMOD-FM circuitry, yields minimum perceived distortion. Basic peak control is performed by a clipper that varies its threshold dynamically as a function of the high-frequency energy in the program. A distortion-cancelling sidechain reduces clipping distortion below 2.2kHz by at least 30dB, and is particularly effective for eliminating effects of high-frequency intermodulation such as sibilance splatter. Additional clipping-induced energy is removed by a 15kHz group delay-compensated low-pass filter.

8100A/1 Operating Controls (access door removed)

6 Bass, presence, and brilliance equalizer *(located in the optional XT2):* The bass equalizer provides 0 to 10dB of peaking boost centered on 65Hz, with a Q of 1.4 (approximately one octave). Since the XT2 often increases brightness, some bass boost is usually desirable to maintain spectral balance. The boost frequency has been thoughtfully chosen to create a very "punchy" bass without exciting dashboard resonances in cars.

The presence and brilliance equalizers are located prior to the limiters for the two highest bands.

7 Six-band limiter *(located in the optional XT2):* A set of six parallel filters divides the signal into frequency bands. The highest and lowest bands are low-pass and high-pass respectively; the others are band-pass. Each filter is followed by its own limiter. The characteristics of these limiters strongly influence frequency response and the production of audible artifacts under dynamic program conditions. For this reason, only a few limiter characteristics are user adjustable.

Because it operates in several frequency bands and exploits the "masking effect," the six-band limiter can react far more quickly than the wider-bandwidth compressors used in the 8100A/1, without audible side effects. We call the six-band limiter the *density augmentation section* because the individual limiters operate independently and with fast release times — they substantially decrease the peak-to-average ratio of the signal without the spectral intermodulation effects that would result if only one very fast limiter were used for the entire spectrum.

8 Multi-Band Distortion-Cancelling Clipper *(located in the optional XT2):* The outputs of four of the six bands are routed to their own individual clippers. These clippers are followed by filters to reduce the out-of-band harmonic and/or IM distortion caused by the clipping. The distortion caused by clipping the upper two bands is effectively cancelled below 2.2kHz by a feedforward distortion-cancelling sidechain.

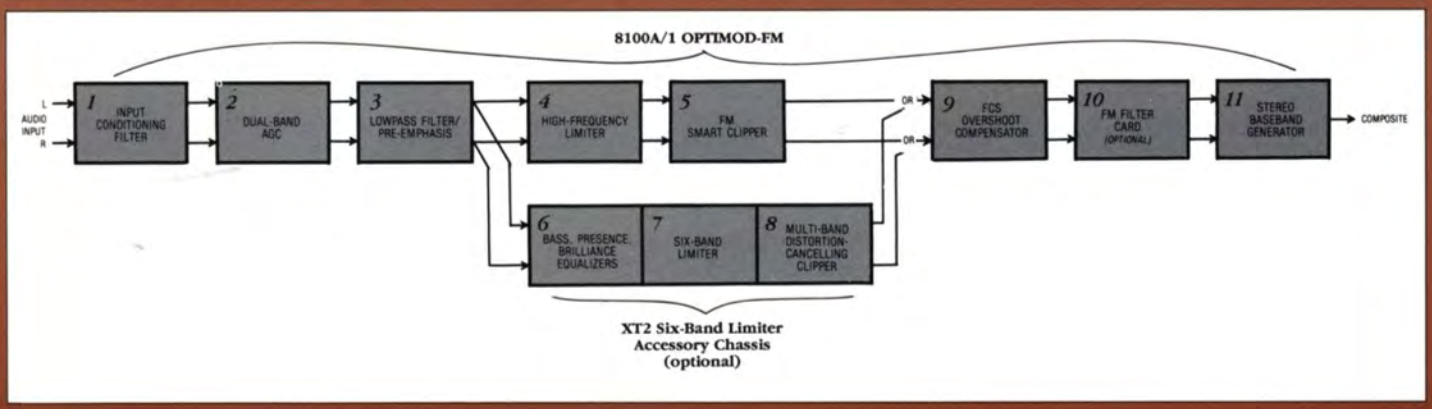
9 Frequency-Contoured Side-chain (FCS) Overshoot Corrector: The output of the FM Smart Clipper or Multi-Band Distortion-Cancelling Clipper contains overshoots due to the addition of the distortion-cancelling signal and overshoots in its integral 15kHz low-pass filter. These overshoots are eliminated in the FCS Overshoot Corrector without adding out-of-band frequency components — the circuit acts essentially as a band-limited safety clipper.

10 FM Filter Card *(optional Accessory):* This card contains two cascaded fifth-order overshoot-compensated low-pass filters that replace the final safety clippers in each channel. These filters reduce overshoots to a maximum of 3%, and reduce program-induced noise above 61kHz to below −75dB (referenced to 100% modulation). Dynamic main-to-sub and sub-to-main crosstalk performance are improved to the static limits of the stereo generator, as is dynamic separation.

11 Stereo baseband coder (generator): The processed, peak-controlled and filtered left and right signals are matrixed into sum and difference signals. The stereo baseband is generated by the matrix technique, using high-stability servo loops to control pilot phase, pilot level, and separation. The coder is distinguished by its high stability with time and temperature, very low distortion, and minimal spurious outputs. Using a highly-linear multiplier, the L−R signal is multiplied by a 38kHz sine wave to form the double-sideband suppressed-carrier subchannel. The subchannel, L+R signal, and 19kHz pilot tone are then summed to form the composite baseband.

This design modulates only the L-R component, and passes the L+R component through to the output without the degradations that occur in switching designs. Since the L+R component almost always dominates, this results in maximum audio quality.

The composite baseband output of the stereo coder feeds the wideband input of the FM exciter.



SPECIFICATIONS

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

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

8100A/1 OPTIMOD-FM

Performance

Frequency response (PROOF mode): Follows standard 75µs (or 50µs) pre-emphasis curve ±0.75dB, 50–15,000Hz.

Noise: −75dB (referenced to 100% modulation), 50–15,000Hz; −81dB typical.

Total system distortion (PROOF mode, de-emphasized, 100% modulation): <0.25% THD, 50–15,000Hz; 0.02% typical. <0.1% SMPTE IM Distortion.

System separation: >50dB, 50–15,000Hz; 60dB typical.

Installation Information

AUDIO INPUT

Configuration: Left and right.

Impedance: >10K ohm load impedance, electronically balanced by means of true instrumentation amplifier. Requires balanced source ≤600 ohms. Common mode rejection >60dB @50 and 60Hz.

Sensitivity: −30dBu to +10dBu to produce 10dB master band gain reduction @1kHz.

Connector: Barrier strip (#5 screw), EMI suppressed.

COMPOSITE BASEBAND OUTPUT

Impedance: 470 ohms, single-ended. When the ACC-025 Composite Isolation Transformer is used, OPTIMOD-FM is modified to 0 ohm source impedance.

Level: Adjustable from 0 to >4V p-p with 18-turn OUTPUT LEVEL control.

Load: 2K ohms or greater. Maximum recommended cable length, 6ft (1.8m) RG-58A/U cable. Where cable runs of greater length (up to 50ft/15m) are necessary, use the optional ACC-025 Composite Isolation Transformer.

Connector: BNC, floating over chassis ground. In most cases, this obviates the need for the ACC-025 Composite Isolation Transformer to suppress ground loops. EMI suppressed.

AUDIO TEST JACKS (L & R)

Samples input of stereo generator following low-pass filter. Switch lifts low-pass filter signal.

Impedance: Output, 0 ohm, unbalanced. Input, 15K, unbalanced.

Level: 3V rms for 100% modulation.

Connector: RCA phono.

INTERCONNECT TO (optional) 8100A/XT2 Six-Band Limiter

See Six-Band Limiter — Installation.

REMOTE CONTROL

Function: Selects STEREO, (MONO LEFT or MONO RIGHT.

Voltage: 6–24V AC or DC, momentary or continuous, optically isolated. 22VDC provided to facilitate use with contact closure.

Connector: Barrier strip (#5 screw), EMI suppressed.

REMOTE GAIN REDUCTION METER OUTPUT

Configuration: Negative DC voltage proportional to total master band gain reduction. Scale approximately −0.33V/dB, source impedance 8.87K ohms.

Connector: Barrier strip (#5 screw), EMI suppressed.

POWER

Requirements: 115/230VAC (switch selectable), ±15%, 50–60Hz; 31VA.

Connector: IEC; detachable 3-wire U-Ground power cord supplied. Leakage to chassis <0.5mA. AC is EMI suppressed.

Ground: Circuit ground is independent of chassis ground; both appear on terminal strip on rear panel for strapping as required.

ENVIRONMENTAL

Operating temperature range 0–50°C (32–122°F). Humidity 0–95% RH, non-condensing.

DIMENSIONS

19 inches (48.3cm) W, 7 inches (17.8cm) H, 12.5 inches (31.2cm) D. 4 rack units.

WEIGHT

26 lbs (12kg) net; 37 lbs (17kg) shipping. Standard packing suitable for international air freight. Order special packing for ocean freight.

Circuit Characteristics

INPUT CONDITIONING

High-pass filter: Third-order Chebychev with 30Hz cutoff and 0.5dB pass-band ripple; −0.5dB @30Hz, −10.5dB @20Hz, −31.5dB @10Hz.

Phase scrambler: All-pass network makes peaks more symmetrical to best utilize the symmetrical peak overload characteristics of the FM medium.

CROSSOVER (US Patent No. 4,249,042)

Control: 6dB/octave, 200Hz.

Program: 12dB/octave, 200Hz, in unique "distributed crossover" configuration.

MASTER BAND COMPRESSOR

Attack time: Approximately 1ms.

Release time: Program controlled; varies according to program dynamics and amount of gain reduction. Process can be scaled fast or slow with continuously variable RELEASE TIME control. Employs delayed release for distortion reduction.

Threshold of compression: Controlled by left and right input attenuators.

Operation: Gains of left and right channels track to avoid stereo perspective shift.

Total harmonic distortion (at VCA output, OPERATE mode, RELEASE TIME control centered): <0.1%, 200–15,000Hz, +10 to −15dB gain reduction.

Available gain reduction: 25dB.

BASS BAND COMPRESSOR

Attack time: Approximately 50ms.

Release time: Program controlled. Employs delayed release for distortion reduction.

Operation: Gains of left and right channels track to avoid stereo perspective shift.

Total harmonic distortion (at VCA output, OPERATE mode): <0.1%, 50–200Hz, +10 to −20dB gain reduction.

Available gain reduction: 30dB.

Bass coupling (US Patent No. 4,249,042): Enables gain of bass band to track gain of master band to any degree, from identical tracking to fully independent operation. Adjustable with BASS COUPLING control.

HIGH FREQUENCY LIMITER

Attack time: Approximately 5ms.

Release time: Approximately 20ms. Employs delayed release for distortion reduction.

Threshold of HF limiting: User adjustable over 3dB range to meet user requirements.

Operation: Left and right channels operate independently to prevent high frequencies in one channel from causing audible timbre modulation in opposite channel.

FM SMART CLIPPER

(US Patent No. 4,208,548)

Bandwidth: 15.4kHz.

Amount of clipping: User adjustable over 6dB range.

Distortion characteristics: Clipping distortion (below overshoot compensator threshold) cancelled better than 30dB, 20–2,200Hz (40dB typical).

Delay correction: Fourth-order allpass.

FREQUENCY-CONTOURED SIDE-CHAIN (FCS) OVERSHOOT COMPENSATOR

(Patent No. 4,460,871)

Operation: The FCS circuit is best thought of as a band-limited safety clipper. It operates like a hard clipper, but without producing out-of-band frequency components.

SAFETY CLIPPER:

Operation: Aligned so that it is almost never active.

Crosstalk: The most severe program material never introduces more than −40dB main channel to subchannel or subchannel to main channel crosstalk. The optional FM Filter Card ACC-022 improves this performance by replacing the safety clipper with a complex non-linear filter, limiting spurious dynamic spectrum to better than −75dB (referenced to 100% modulation).

Peak modulation control: Within ±2% on typical program material; ±3.5% worst case.

Sine-wave modulation ability: 93% modulation (0.6dB below maximum overshoot level) at all frequencies.

PILOT

Frequency: 19,000Hz ±2Hz.

Injection: Adjustable, <8% to >10%.

STEREO BASEBAND ENCODER

Noise: <−83dB (referenced to 100% modulation).

Distortion (de-emphasized, 100% modulation): <0.02% THD, 50–15,000Hz; <0.05% SMPTE Intermodulation Distortion.

Stereo separation: >50dB, 50–15,000Hz; 60dB typical.

Crosstalk–linear: <−60dB, main channel-to-subchannel or subchannel-to-main channel (referenced to 100% modulation).

Crosstalk–non-linear: <−80dB, main channel to subchannel or subchannel to main channel (referenced to 100% modulation).

38kHz subcarrier suppression: >50dB (referenced to 100% modulation); 60dB typical.

Supression of 76kHz and its sidebands: >70dB (referenced to 100% modulation).

"PROOF" TEST MODE

Compressor: Defeats master band and bass band gain reduction control.

Limiter: Defeats HF limiter, FM Smart Clipper, FCS Overshoot Compensator, and safety clipper.

8100A/1 OPTIMOD-FM with XT2 Six-Band Limiter

Performance

These specifications describe the performance on an 8100A/1 + XT2 System which has been set up according to the instructions provided in the manual. These specifications supersede identically-labeled specifications for the OPTIMOD-FM alone.

Frequency response (PROOF mode): Follows standard 75µs (or 50µs) pre-emphasis curve ±1dB, 50–15,000Hz.

Noise: <−70dB (referenced to 100% modulation), 50–15,000Hz.

Total system distortion (PROOF mode, de-emphasized, 100% modulation): <0.15% THD, 50–15,000Hz; 0.07% typical. Less than 0.2% SMPTE IM Distortion.

System separation: >45dB, 50–15,000Hz; 60dB typical.

Installation Information

LOCATION

Immediately below main 8100A/1 OPTIMOD-FM chassis.

INTERCONNECT TO 8100A/1

Signal flow: Left and right 8100A/1 compressor out to XT2 equalizer in; XT2 six-band distortion-cancelling clipper out to 8100A/1 filter in.

Connector: Integral flat cable with attached connector (DB-25P).

POWER

±15VDC provided by host (8100A/1) through the cable. When the XT2 is connected, 8100A/1 power consumption is increased to 40VA.

DIMENSIONS

19 inches (48.3cm) W, 3.5 inches (8.9cm) H, 10 inches (27.4cm) D. 2 rack units.

WEIGHT

12 lbs (5kg) net; 16 lbs (7kg) shipping.

ENVIRONMENTAL

Operating temperature range 0–55°C (32–122°F). Humidity 0–95% RH, non-condensing.

Circuit Characteristics

BASS EQUALIZER

Shape: Peaking, Q of 1.4.

Range: 0–10dB boost.

Frequency: 65Hz.

CROSSOVERS (US Patent No. 4,412,100)

Filters: 150Hz low-pass, 420Hz band-pass, 700Hz band-pass, 1.6kHz band-pass, 3.7kHz band-pass, 6.2kHz high-pass.

Selectivity: 18dB/octave.

Topology: Parallel "distributed crossover".

Combined frequency response — static: ±0.5dB, 50–15,000Hz.

Combined frequency response — dynamic: Phase interaction between filters will not cause audible dips in frequency response.

SIX-BAND LIMITER

Gain reduction: 0–20dB, each band.

Attack time: Program-controlled, scaled according to band frequency.

Release time: Program-controlled, scaled according to band frequency. Employs delayed release for distortion reduction.

Distortion cancellation: All clipper-induced distortion in upper two bands cancelled better than 30dB below 2.2kHz. Additional distortion reduction provided as a function of frequency in each band.

8100A/ST Studio Chassis

Installation Information

The specs and circuit characteristics are the same as the host unit (8100A/1), since the unit's function is to house three cards from the host unit.

AUDIO INPUT

Configuration: Left and right.

Impedance: >10K ohm load impedance, electronically balanced by means of true instrumentation amplifier. Requires balanced source of 600 ohms or less. Common mode rejection >60dB @60Hz.

Sensitivity: −30dBu to +10dBu to produce 10dB master band gain reduction @1kHz.

Connector: Barrier strip (#5 screw), EMI suppressed.

AUDIO OUTPUT

Configuration: Left and right.

Impedance: 600 ohm resistive source impedance, balanced to ground.

Level (600 ohm load): Adjustable from −infinity to greater than +3dBu, measured on a VU meter with typical program; corresponds to typical maximum peak level of +18dBu. Designed to correctly interface with +4dBu and +8dBu systems.

Connector: Barrier strip (#5 screw), EMI suppressed.

REMOTE GAIN REDUCTION METER OUTPUT

Configuration: Negative DC voltage proportional to total master band gain reduction. Scale approximately −0.33V/dB, source impedance 8.87K ohms.

Connector: Barrier strip (#5 screw), EMI suppressed.

POWER

Requirements: 115/230VAC (switch selectable), ±15%, 50–60Hz; 31VA.

Connector: IEC; detachable 3-wire U-Ground power cord supplied. Leakage to chassis <0.5mA. AC is EMI suppressed.

Ground: Circuit ground is independent of chassis ground; both appear on terminal strip on rear panel for strapping as required.

DIMENSIONS

19 inches (48.3cm) W, 3.5 inches (8.9cm) H, 11.5 inches (29.2cm) D. 2 rack units.

WEIGHT

12 lbs (5kg) net; 16 lbs (7kg) shipping.

ENVIRONMENTAL

Operating temperature range 0–50°C (32–122°F). Humidity 0–95% RH, non-condensing.

ACC-022 FM Filter Card

Installation Information

LOCATION

Circuit card that plugs into Slot No. 0 in OPTIMOD-FM 8100A or 8100A/1.

WEIGHT

2 lbs (1kg) shipping.

Circuit Characteristics

FILTER

Type: Two cascaded fifth-order overshoot-compensated low-pass filters.

Passband response: Typically +0, −0.1dB to 15,000Hz.

Stopband rejection: To reduce spectrum above 61kHz in stereo baseband to <75dB below 100% modulation.

ACC-025 Composite Isolation Transformer

One required per exciter driven. Slight modification to Card 7 required.

Performance

Frequency response: +0.01, −0.03dB, 30Hz to 53kHz.

Group delay: Deviation from linear phase <±0.3°, 30Hz to 53kHz.

Separation: >50dB, 30–10,000Hz, >45dB, 10–15kHz.

Gain: Adjustable from −infinity to 0dB.

Installation Information

LOCATION

As close to FM exciter as practical.

INTERCONNECT BETWEEN OPTIMOD-FM AND TRANSFORMER

Interface at OPTIMOD-FM: Adapter cable, BNC male to 3-pin XLR-type male cable connector, supplied.

Cable: Two-conductor foil shielded audio cable, Belden 8451 or equivalent. Maximum length 50ft/15m. 3-pin XLR-type male and female cable connectors supplied.

COMPOSITE BASEBAND INPUT

Connector: 3-pin XLR-type, female.

Maximum level: 4V p-p.

COMPOSITE BASEBAND OUTPUT

Connector: BNC, shell insulated from chassis.

INTERCONNECT BETWEEN TRANSFORMER AND EXCITER

Maximum recommended cable length: Approximately 6ft (1.8m) RG-58A/U cable, or similar to avoid excessive RF pick-up on cable. Cable supplied.

Exciter input: 1K ohm or greater; 1000pF or less. Replace 50 or 750km load resistor if present, with 1K resistor, supplied.

DIMENSIONS

7 inches (17.8cm) W, 3 inches (7.6cm) H, 1.72 inches (4.4cm) D.

Warranty

One year, parts and labor. Subject to limitations stated in our Standard Warranty.

All specifications subject to change without notice.

orban

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The Multiband OPTIMOD-FM®

Performance Highlights

- ☐ Multiband compressor/limiter/stereo generator
- ☐ Multiband *or* wideband operation plus versatile setup controls permit precise "tuning" for different formats
- ☐ Freedom from processing artifacts and distortion
- ☐ Optimum voice/music balances
- ☐ Excellent high frequency power handling for brightest sound
- ☐ State-of-the-art stereo generator
- ☐ Overshoot compensator permits full modulation at all frequencies, yet doesn't increase low frequency IM distortion

Plus

- ☐ Dual-chassis (studio/transmitter) option
- ☐ Excellent stability and unit-to-unit uniformity
- ☐ Plug-in card construction for easy maintenance
- ☐ Built-in crosstalk test generator
- ☐ Quad coupling ability
- ☐ Rigorous RFI shielding
- ☐ True VCA gain control
- ☐ True peak-reading gain reduction meter
- ☐ Low stereo generator output impedance permits longer baseband cable runs
- ☐ Orban-quality construction, documentation, and backup support

What It Will Do For Your Sound

The Orban OPTIMOD-FM Model 8100A is ideal for any format, and is the best-sounding FM processor that Orban knows how to make. As will be explained in more detail below, it can be operated in either "wideband" or "multiband" modes. Its advantages will be particularly appreciated in formats that ordinarily use heavy processing and that play recently-recorded program material with large amounts of high- and low-frequency energy. Such stations will find that 8100A "heavy processing" is free from the pumping, gain modulation, distortion, and fatigue that many have associated with such processing in the past.

Stations that prefer lighter processing, but that play music with high transient content (such as rock, soul, disco/dance, or jazz), will find that the 8100A (adjusted for slow release times and "multiband" operation) permits use of much more compression than might be expected. Experience with other processors leads many to associate large amounts of compression with highly audible processing—the 8100A will shatter this preconception! And, whether processing is heavy or light, the super-sophisticated release-time circuitry requires much less accurate D.J. gain riding than virtually any other competitive processing.

Operated in "wideband" mode, the 8100A sounds similar to our previous 8000A in formats such as "beautiful music" that ordinarily use light processing and play relatively undemanding program material. The only difference is that processing is even smoother, and no high frequency loss is *ever* apparent on such material. Given the acceptance of the 8000A in such formats, this "family resemblance" assures that use of the 8100A will yield an even more non-fatiguing, audience-pleasing sound—a sound that yields high quarter-hour maintenance and which has resulted in outstanding ratings for so many 8000A "beautiful music" stations.

We are extremely gratified by the 8000A's acceptance among FM broadcasters, and have tried in this design to preserve the 8000A features which accounted for its popularity. We feel that these features include *simplicity of concept, relatively foolproof installation, loud, clean, non-fatiguing sound,* and a "feature" which has little to do with the product per se: a long-term company commitment to quality, reliability, and customer service.

At the same time, we have tried to respond to the demands of the current marketplace to produce a processor which can, when adjusted to do so, produce a "highly-processed" sound which is free from the usual compromises.

The result is a true second-generation overshoot-controlling FM processor. It is at once refined, sophisticated, easy to use, and extremely cost-effective. We believe that, given its versatility and superb sound, it is clearly the best processing investment you can make—and will enhance your quality and ratings now, and in years to come.

We look forward to your giving us the opportunity to show you what the new OPTIMOD-FM Model 8100A can do for *your* station or group.

The following sections describe in some detail the thinking and improvements that went into the new OPTIMOD-FM. We hope that you'll find this information interesting and useful in helping you make decisions about the kind of processing you'll need to stay competitive in the '80's. And we hope to show you how Orban can help you to achieve the ultimate competitive edge.

About the Wideband/ Multiband Compressor

Many variations of the traditional parallel-band triband processor have appeared. In our opinion, they all fail critical listening tests because the high frequency band can increase treble uncontrollably, resulting in a phony-sounding high end. Therefore, the 8100A employs a triband structure with a significant difference. The basic compressor consists of two bands—"Master" (above 200Hz), and "Bass" (below). After those two bands are summed together, the combined signal is preemphasized to follow the FM preemphasis curve, and *then* fed into a high-frequency limiter. Unlike the third band of a typical triband compressor, this limiter is very fast, and works only as hard as necessary to avoid audible distortion in the "FM Smart Clipper" following it (discussed below).

Because the "Smart Clipper" can clip far harder than the 8000A could without audible distortion, much less high-frequency limiting is required—and a new level of brightness and high-frequency power handling capability is achieved. The limitations of the 75us preemphasis curve are almost never apparent—even on very bright program material. In the 8100A, the brass retains its "bite"; the cymbals "sizzle". And the "phony highs" phenomenon is entirely absent.

Our dual-band compressor is unique in that it can be operated discriminately (with the bands independent of each other), or wideband.

The "independent" approach is most appropriate for "Top-40", "AOR", "Black", "Disco/Dance", and other formats emphasizing music containing heavy bass and dominant transient material. Program Directors programming these formats usually demand high loudness, high density, and considerable compression. The "independent" approach is ideally suited to these requirements because the requisite midrange density can be achieved without compromising bass definition and punch.

On the other hand, "Beautiful Music", "Fine Arts/Classical", and even some "MOR" stations cannot tolerate the frequency imbalance resulting from the "independent" approach. They often wish to use small amounts of compression and little or no density augmentation to preserve musical values and to avoid long-term listener fatigue. If the music or other program material typical of these formats contains passages without bass, then rumble and noise can be pumped up to an objectionable extent as the "Bass" band attempts to "fill in" with bass that doesn't exist except as noise.

To fill the needs of such formats, a patented BASS COUPLING control permits the "Bass" band to track the "Master" band at all times, except when extremely heavy bass appears at the input. Rather than causing audible gain modulation (as in a *true* wideband system), such bass momentarily causes the gain of the "Bass" band to fall below the gain of the "Master" band. Thus wideband-mode users have the best of both conventional wideband and "independent" approaches. With ordinary program material, the system operates wideband and frequency balances are preserved. If strong bass comes along, the system momentarily becomes "independent" to avoid wideband modulation effects.

The bass coupling is continuously variable between fully independent and fully wideband (retaining excess-bass control) to suit the needs of your market and tastes.

Regardless of the amount of bass coupling, exceptional smoothness is assured by "Smart" attack- and release-time characteristics in all bands. To complement the sophistication of the release-time characteristic, available gain reduction is 25dB in the "Master" band and 30dB in the "Bass" band—an external compressor is *never* required. To make this range usable without "breathing" or "noise rush-up" during pauses, the compressor is gated and "freezes" its gain when the input drops below an adjustable threshold.

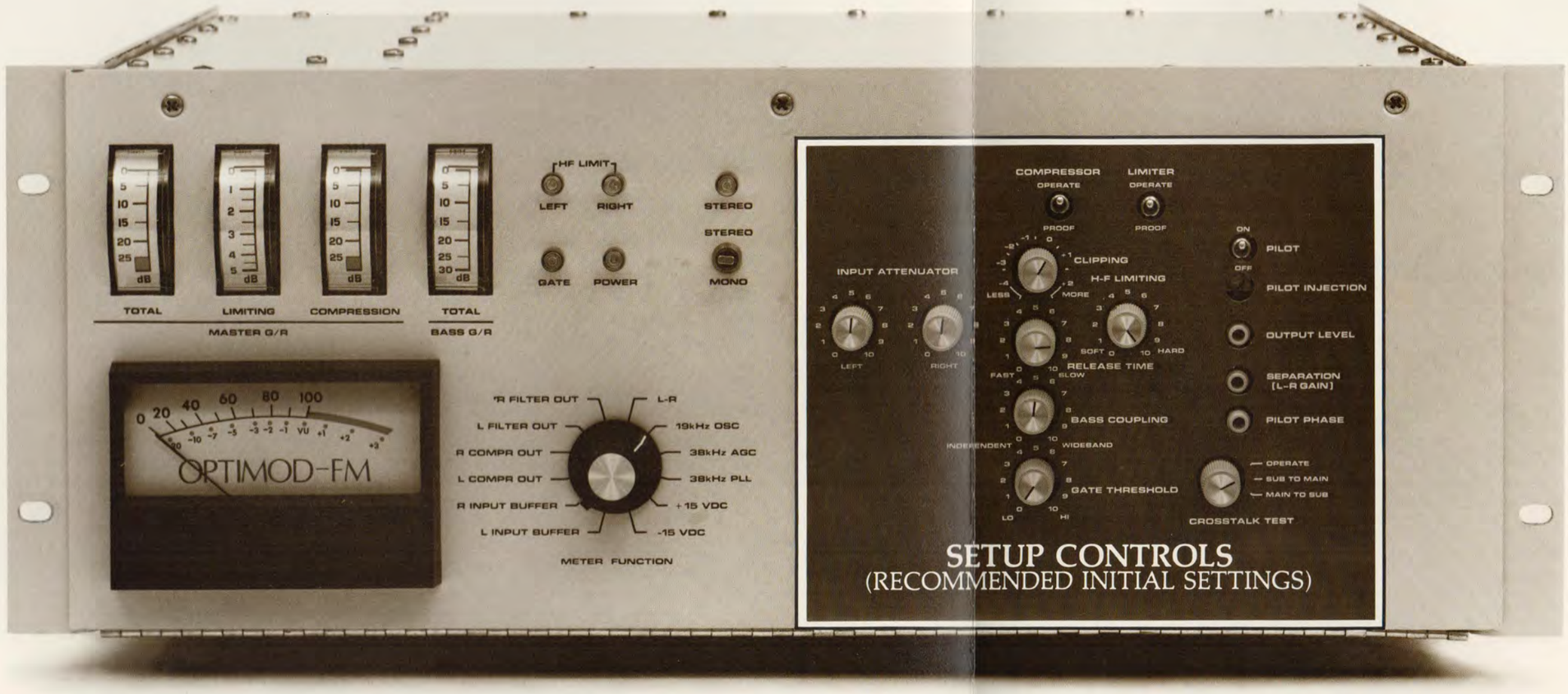
The result is an amazingly natural quality—the sort of sound that can hold a listener quarter-hour after quarter-hour—combined with high loudness, superbly appropriate balances between voice and music, a singular absence of perceived distortion, and a new zenith in brightness and high-frequency power handling capability.

About The FM "Smart Clipper"

Loudness is principally dependent upon the design of the peak limiter, lowpass filter, and overshoot compensator. A delicate balance must be maintained between peak/average ratios attained, perceived distortion, and integrity of the baseband spectrum. The 8100A uses a newly designed peak limiting system in which peak limiting, bandwidth limitation, and overshoot control are all elegantly interrelated.

Unlike the questionable "composite clipper" approach which uses brute-force clipping of the stereo composite baseband signal (with attendant aliasing distortion and compromises in dynamic separation), the overshoot compensation schemes used in all OPTIMOD-FM's (including the original 8000A) maintain total integrity of the baseband spectrum. The processing never introduces nonlinear crosstalk, pilot modulation, or other problems inherent in simpler approaches.

Peak Limiting and Distortion Cancellation: To preserve the naturalness achieved in the multiband compressor, peak limiting is performed by a clipper whose transfer curve has been carefully adjusted to yield minimum perceived distortion in conjunction with the balance of the entire 8100A system. Special circuitry throughout the multiband compressor section assures that the output of the compressor can be applied directly to the clipper—no broadband gain reduction is needed for distortion control. Voice is clean—yet music is loud. And voice/music balances are ideal.



SETUP CONTROLS
(RECOMMENDED INITIAL SETTINGS)

The basic clipper is followed by a 15kHz lowpass filter to assure freedom from aliasing distortion. In addition, difference-frequency distortion below 2.2kHz introduced by clipping is *cancelled* by our patented "Smart Clipper" frequency-dependent distortion-nulling technique. This permits much harder clipping without audible distortion (particularly at high frequencies) than was heretofore possible. The result is dramatically improved high-frequency power-handling capacity.

Frequency Contoured Sidechain (FCS) Overshoot Compensator: While all filter overshoots are minimized by the use of phase correctors (even in the preemphasis network!), the output of the clipper section (including 15kHz lowpass filter and distortion cancellation) contains substantial overshoots due to addition of the distortion-cancellation signal, and to unavoidable overshoots in the lowpass filter. These overshoots must be eliminated without introducing frequency components above 19kHz which would otherwise cause "aliasing" and nonlinear crosstalk in the stereo baseband. The overshoot compensation in the 8000A slightly limits the high frequency power handling capacity of the system. The overshoot compensation system of our major competitor suffers from an inordinate sensitivity to overdrive; it causes *much* more IM distortion than a simple clipper when both are overdriven equally.

We have developed a new "Frequency-Contoured Sidechain" (FCS) overshoot compensator for the 8100A which offers the "best of all possible worlds". It permits high modulation at all frequencies, yet does not suffer from excessive IM (compared to a simple clipper) when overdriven. Simultaneously, it offers extremely good suppression of out-of-band frequency components.

About The Stereo Generator

The stereo generator in the 8100A uses the "matrix" approach to generate the stereo composite signal, as opposed to the more common "switching" approach. It features feedback stabilization of pilot phase, pilot amplitude, *and* separation, optically isolated remote control of stereo/mono function switching, *and* extensive metering.

This high-performance generator features better than 60dB separation (typical), distortion below 0.02%, and superior audio quality because the L+R (dominant in most program material) is not subject to any switching or modulation process, unlike the latest "digital" stereo generators.

Because Part 73.322 of the *FCC Rules* refers to performance requirements for the *stereo generator, exciter, and RF amplifiers,* it is permissible to measure main-to-sub and sub-to-main crosstalk at the input terminals to the stereo generator. The 8100A stereo generator provides internal main-to-sub and sub-to-main crosstalk test modes: a switch permits injecting the output of the right channel processing into either the "main" or "sub" inputs of the stereo generator. An external test box is not required, making verification of crosstalk performance significantly more convenient.

Configuration and Installation

The availability of 25dB of gain reduction range means that the 8100A never needs an external AGC. At stations which install the 8100A at the transmitter and pass audio to the transmitter through an STL with limited signal-to-noise ratio, substantial benefits are achieved by applying compression prior to the STL. For this reason, the compression section of the 8100A can be installed in an Accessory Chassis to permit compression at the studio end.

The Studio Accessory Chassis is low in cost and houses only the dual-band compressor. Its use protects the STL from overload and provides control over most of the processing at the studio. Adjusting the gain between the two chassis is aided by calibrated metering, and requires only an audio oscillator for alignment.

If available, a *composite* STL will allow installation of the entire OPTIMOD-FM at the studio, with the 8100A's baseband connected directly to the STL transmitter.

In either configuration, practical requirements have been carefully considered. Operation is possible with input levels as low as −30dBm, and rigorous RFI shielding is employed. The stereo generator output is held floating over ground to avoid introducing system ground loops when unbalanced exciter inputs are used. An optically-isolated momentary remote switching facility for *stereo, mono-left,* and *mono-right* modes yields maximum versatility and freedom from RFI or ground-loop interference.

To facilitate proofs, a pair of PROOF/OPERATE switches defeat all compression and limiting, yet do not bypass any electronics normally employed in *Operate* mode. To facilitate crosstalk measurements, a NORMAL/MAIN-TO-SUB/SUB-TO-MAIN switch is provided on the stereo generator to establish the necessary test conditions without need for an external test fixture.

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SPECIFICATIONS

The following specifications are presented to satisfy the engineer that they seem reasonable, to help him plan his installation, to help him make certain comparisons with other familiar processing equipment with which he is familiar, to verify that the 8100A can readily pass a Proof of Performance, and to verify that it meets all requirements in the *FCC Rules*.

Years of experience listening to and designing audio processors have convinced us that there are no conventional specifications which correlate well to the listening qualities of a processing system like OPTIMOD-FM. Although it may sound strange to an engineer, we can state with confidence that, given the current state-of-the art in audio measurement techniques, the only way to meaningfully evaluate the distortion introduced by an audio processor is by *subjective listening tests.*

For this reason, no system distortion specifications are presented for the 8100A in *Operate* mode. In this mode, harmonic distortion is highly frequency-dependent, and correlates very well to a listener's actual impression of whether the harmonic distortion test tones emerging from the processor *sound* "distorted" if *listened to* on speakers or phones.

The CCIF Difference-Frequency IM test measures the amplitude of a low-frequency tone produced by the device under test when excited by two high-frequency tones. Because the distortion tone and test tones are far apart in frequency, the distortion tone would not tend to be well-masked by the test tones. Thus CCIF IM is a sensitive indicator of audible distortion—much more so than the more commonly-used SMPTE IM test.

Compared to a simple clipper, the patented distortion-cancelling circuitry in the 8100A "Smart Clipper" is most effective in reducing CCIF IM—thus improving listening quality in a way that does not correlate to more commonly used measurements.

FREQUENCY RESPONSE

(System in *PROOF* mode)
Follows standard 75us preemphasis curve ±0.75dB, 50-15,000 Hz. 50us preemphasis available on special order. All preemphasis networks include a fourth-order lowpass filter and fourth-order phase corrector prior to the high-frequency limiter and clipper to prevent these elements from processing out-of-band program material and to minimize overshoot, thus minimizing the amount of high-frequency limiting and clipping. (NOTE: The Dolby 334 Broadcast Encoder, which is compatible with the 8100A, internally transforms 75us to 25us. Thus broadcasters wishing to use Dolby-B encoding should order standard 75us preemphasis along with the optional Dolby connector.)

INPUT CONDITIONING

Highpass Filter: Third-order Chebychev with 30Hz cutoff and 0.5dB passband ripple. Down 0.5dB at 30Hz; 10.5dB at 20Hz; 31.5dB at 10Hz. Protects against infrasonic destabilization of certain exciters' AFC's, as well as infrasonic gain modulation in the compressor.
Phase Scrambler: Allpass network makes peaks more symmetrical to best utilize the symmetrical peak overload characteristics of the FM medium.

NOISE

−75dB below 100% modulation, 50-15,000 Hz maximum; −81dB typical.

TOTAL SYSTEM DISTORTION

(*PROOF* Mode; 100% Modulation)
Less than 0.05% THD, 50-15,000Hz (0.02% typical); less than 0.05% SMPTE Intermodulation Distortion (60/7000Hz; 4:1).

"MASTER" BAND COMPRESSOR CHARACTERISTICS

Attack Time: approximately 1ms
Release Time: program-controlled—varies according to program dynamics and amount of gain reduction (see text). Process can be scaled fast or slow by means of continuously variable RELEASE TIME control. Employs delayed release for distortion reduction.
Total Harmonic Distortion (measured at VCA output, OPERATE Mode, RELEASE TIME control centered): Less than 0.1%, 50-15,000Hz, 0-25dB gain reduction
Available Gain Reduction: 25dB
Metering: Three dB-linear edgewise-reading gain reduction meters—
MASTER is true peak-reading with electronic acceleration and peak-hold (0-25dB);
COMPRESSOR indicates slow compression component of gain reduction (0-25dB)
LIMITER indicates fast peak limiting component of gain reduction (0-5dB)
Gain Control Element: True VCA. Proprietary Class-A design eliminates crossover notch distortion, modulation noise, and slewrate limiting found in competitive Class-AB designs.

"BASS" BAND COMPRESSOR CHARACTERISTICS

Attack Time: program-controlled; not adjustable.
Release Time: program-controlled; not adjustable. Incorporates delayed-release distortion reduction.
Total Harmonic Distortion (at VCA output, OPERATE mode): Less than 0.1% THD, 50-200Hz, 0-30dB gain reduction.
Available Gain Reduction: 30dB
Metering: single dB-linear edgewise-reading gain reduction meter (0-30dB).
Gain Reduction Element: Proprietary Class-A true VCA
Bass Coupling (U.S. patent #4,249,042): Enables gain of "Bass" band to track gain of "Master" band to any degree, from identical tracking to fully independent operation. Adjustable with BASS COUPLING control.

CROSSOVER CHARACTERISTICS

Control: 6dB/octave @ 200Hz;
Program: 12dB/octave @ 200Hz in unique "distributed crossover" configuration (U.S. patent #4,249,042)

HIGH FREQUENCY LIMITER·CHARACTERISTICS

Attack Time: approximately 5ms
Release Time: approximately 20ms. Delayed release included for distortion reduction.
Mode: Left and right channels operate independently to avoid high frequencies in one channel causing audible timbre modulation of opposite channel.
Control Element: Junction FET
Metering: Two LED's indicate HF limiting in L and R channels.
Threshold of HF Limiting: User-adjustable over 3dB range to meet format requirements

FM "SMART CLIPPER" OUTPUT PROCESSOR CHARACTERISTICS

Nominal Bandwidth: 15.4kHz
Distortion Cancellation: Clipping distortion (below overshoot compensator threshold) cancelled better than 30dB (40dB typical), 20-2200 Hz (U.S. patent #4,208,548).
Delay Correction: Fourth-order allpass
Amount of Clipping: User-adjustable over 6dB range to match format requirements.

FREQUENCY-CONTOURED SIDECHAIN (FCS) OVERSHOOT COMPENSATOR CHARACTERISTICS (patent pending)

System Overshoot: The FCS circuit is best thought of as a "bandlimited safety clipper". It operates like a hard clipper, but does not produce out-of-band frequency components as a simple hard clipper would. Because the audio processing will sometimes limit steady-state material with high average energy (like sinewaves) or with very little high-frequency energy to levels below the threshold of clipping, it is difficult to state a clear and meaningful specification for the *system* overshoot performance of the FCS circuit. The FCS circuit is followed by a safety clipper. The overshoot specification could be slightly improved if this safety clipper were set up to clip more frequently. However, the system is aligned at the factory such that the safety clipper is almost *never* active, thus fully preserving the bandlimiting provided by the FCS circuit. With this safety clipper alignment, the peak modulation will be controlled ±3.5% on arbitrary waveforms clipped to any degree by the FCS circuit (acting as a bandlimited safety clipper); peak modulation will not exceed this level on other material. With typical program material, peak modulation uncertainty is less than 2%.
Sinewave Modulation Ability: 93% modulation (i.e., 0.6dB below maximum overshoot level) at all sinewave frequencies, assuming sinewaves are applied to FCS input.
Dynamic Separation: better than 45dB
Difference-Frequency Intermodulation: FCS circuit causes no more audible IM (such as sibilance splatter) than would a simple hard clipper clipping to the same depth. The entire 8100A processing system is specifically configured to prevent the FCS circuit from audibly degrading the difference-frequency distortion-cancellation properties of the earlier FM "Smart Clipper".

SYSTEM SEPARATION

Greater than 45dB, 50-15,000Hz; 60dB typical

STEREO GENERATOR CHARACTERISTICS

Crosstalk (Main Channel-to-Subchannel, or Subchannel-to-Main Channel): better than −40dB, 50-15,000Hz as measured at input terminals to stereo generator, or using internal crosstalk test mode which applies right-channel audio to either *main* or *sub* stereo generator inputs. Crosstalk representing distortion components (non-linear crosstalk) typically better than −80dB as measured on a baseband spectrum analyzer.
38kHz Subcarrier Suppression: Greater than 40dB below 100% modulation; 60dB typical
Suppression of 76kHz and its Sidebands: Greater than 70dB below 100% modulation
Pilot Frequency: 19.000kHz ±2Hz
Pilot Injection Adjustment Range: Less than 8% to greater than 10% modulation

INPUT

Impedance: greater than 10K ohms, electronically balanced by means of true instrumentation amplifier. Requires balanced source.
Common Mode Rejection: Greater than 60dB @ 60Hz
Sensitivity: −10dBm produces 10dB "Master" Band gain reduction @ 1kHz. Removal of internal 20dB pad permits −30dBm to produce same effect.
Connector: Cinch-Jones 140-style barrier strip (#5 screw).

COMPOSITE (BASEBAND) OUTPUT

Source Impedance: 470 ohms, independent of OUTPUT ATTEN setting, unbalanced.
Level: variable 0 to greater than 4V p-p by means of 15-turn OUTPUT ATTEN control
Connector: Type BNC held floating over chassis ground to permit interface to various exciters without need for wideband transformer for ground loop suppression. RF suppressed.
Recommended Maximum Cable Length: 6 ft (1.8m) RG-58A/U

AUXILIARY INPUT/OUTPUT (for Test use only)

Provides L and R lowpass filter output or L and R stereo generator input depending upon setting of rear-apron NORMAL/TEST switch. Connectors are RCA phono-type, unbalanced. Stereo generator requires approx. 3V RMS for 100% modulation, unbalanced, with source impedance of test generator less than 50 ohms.

OPERATING CONTROLS

VU Meter Selector: switches VU meter to read:
L or R Input Buffer
L or R Compressor Out
L or R Filter Out
L-R Level
19kHz Oscillator Level
38kHz PLL Control Voltage
38kHz AGC Control Voltage
±15 V Power Supply Voltages
Stereo/Mono Mode Switch: Momentary front panel switch may be conveniently strapped for either *left* or *right* mono by means of a plug-in internal jumper. Mode may be remote-controlled by application of 6-24 V AC or DC pulses to appropriate rear terminals. Terminals are optically isolated, and may be floated ±50 V above ground. Three pairs of remote terminals will select either *left* or *right* audio inputs in *mono* mode, or *stereo*. Another internal jumper selects which of the three modes will be entered on powerup.

SETUP CONTROLS (front-panel, behind lockable swing-down door)

Compressor:
Left and Right Input Attenuators
"Master" Band Release Time
Gate Threshold
Bass Coupling
Clipping
High-Frequency Limiter Threshold
Stereo Generator:
Pilot Injection
Pilot Phase
L-R Gain (Separation)
Pilot ON/OFF Switch
NORMAL/MAIN-TO-SUB/SUB-TO-MAIN Crosstalk Test Switch (see text)
General:
Output Attenuator
PROOF/OPERATE Switches (to defeat gain reduction, HF limiting, clipping, and gating)
Power ON/OFF
115V/230V Selector Switch

POWER REQUIREMENT

115/230VAC, ±15%, 50-60Hz, approx. 19VA. IEC mains connector with detachable 3-wire "U-Ground" power cord supplied. Leakage to chassis less than 0.25mA @ 115VAC; 0.5mA @ 230VAC. AC is RF-suppressed.

DIMENSIONS

19" (48.3cm)W x 7" (17.8cm)H x 12.5" (31.2cm)D—4 rack units

SHIPPING WEIGHT

35 lbs; 15.9 kg

ENVIRONMENAL

Operating Temperature Range: 0-50 degrees C (32-122 degrees F).
Humidity: 0-95% R.H., non-condensing

All specifications subject to change without notice.

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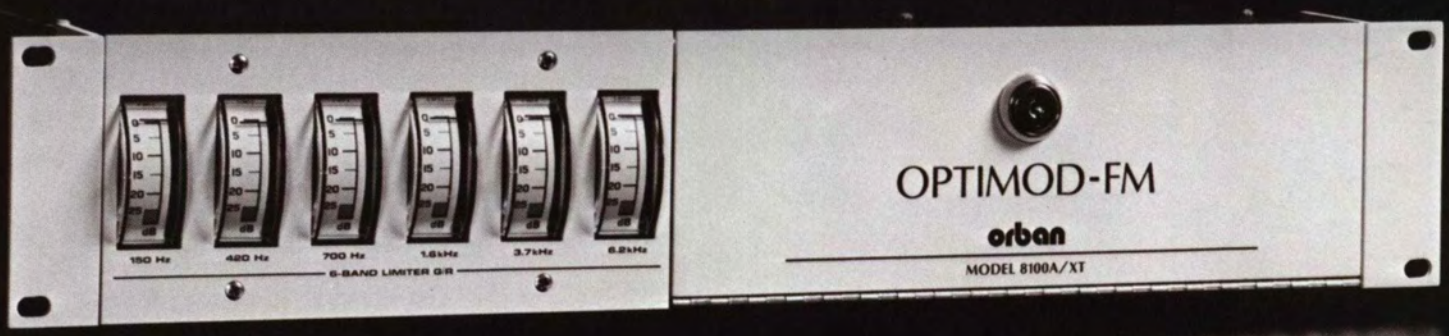
The P.D. Pleaser

Introducing the Orban 8100A/XT

A powerful accessory for OPTIMOD-FM



OPTIMOD®-FM Six-Band Limiter Accessory Chassis

Overview

The new Orban 8100A/XT Six-Band Limiter Accessory Chassis for OPTIMOD-FM (Model 8100A) has been created to provide aggressive multiband processing for stations that desire bright, loud, "highly-processed" audio. Derived from the OPTIMOD-AM Model 9100A, the "XT" consists of a six-band limiter cascaded with the exclusive Orban distortion-cancelled multiband clipping system.

The "XT" is particularly suited for highly competitive pop music formats such as AOR, CHR, AC, and Urban Contemporary. When added to the basic OPTIMOD-FM system, the unit creates a dense, consistent sound without the pumping or other obvious side-effects which often occur when other processors are cascaded with OPTIMOD-FM.

The new unit is interfaced through a multipin connector added to the 8100A. Most of the existing OPTIMOD-FM circuitry is still employed when 8100A/XT is installed. This makes the entire system maximally economical, protecting the investment of the many OPTIMOD-FM Model 8100A owners who feel that they now need more aggressive processing to successfully compete within their formats and markets.

8100A/XT can be added to 8100A's of any vintage. Older units (Model 8100A) can be adapted to accept 8100A/XT by means of retrofit kit "RET-27". Newer units (Model 8100A/1) accept 8100A/XT without modification. (If you have an 8100, check your serial label to see which model: -A, or -A/1 you have.)

It is important to understand that this new multiband limiter is *not for everyone;* it is primarily a tool to provide a highly-processed, highly-competitive sound which jumps out of auto and table radios, but which may sound overly aggressive to hi-fi enthusiasts.

The basic OPTIMOD-FM remains the most advanced processor on the market with or without 8100A/XT, and OPTIMOD-FM users who prefer a more transparent, less aggressive sound should stick with their standard 8100A's. However, if you are operating the RELEASE TIME control of your 8100A at "4" or below, you are probably an excellent candidate for 8100A/XT. Under these circumstances, you will find that 8100A/XT will provide a smoother, more consistent sound with substantially subtler compression and greater immunity to operator gain riding errors.

Please note that OPTIMOD-FM with the "XT" is no louder than the basic OPTIMOD-FM operated with very fast release times and large amounts of clipping. OPTIMOD-FM is *already* a very loud processor. The primary advantages of the "XT" are improved consistency, increased brightness on naturally-duller program material, and reduction of audible processing side-effects—all while retaining the high loudness capabilities of an aggressively-operated 8100A.

Installation And Compatibility

8100A/XT is compatible with both single- and dual-chassis 8100A installations. It resides at the main 8100A chassis and derives its power and signals from it through a connector in the rear panel.

Any older 8100A can be converted to accept the "XT". Conversion ordinarily consists of mounting a prewired multipin connector in an existing hole in the rear panel and soldering the wires to appropriate locations on the motherboard. Minor modifications must be made to Cards #6, #8, and #9. Card #5 is replaced to convert the existing 8100A multiband compressor to a slow AGC, enabling it to ride gain ahead of the "XT" processing.

8100A/XT requires 3½" (2 units) of rack space in a 19" rack. It must be mounted immediately below the 8100A mainframe, and is connected to it by means of a single short cable (to avoid RFI problems).

Ordering Information

8100A/1	OPTIMOD-FM prewired to accept 8100A/XT Accessory Chassis
8100A/XT	Six-Band Accessory Chassis
8100B	Package consisting of 8100A/XT and OPTIMOD-FM 8100A/1 shipped at one time
RET-27	Kit to convert 8100A to accept 8100A/XT Accessory Chassis

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ORDERING GUIDE & SUGGESTED LIST PRICES

Revision 05, Effective 2 April 1984
Supersedes 21 October 1981, Revision 04

Broadcast Products
OPTIMOD-FM

Order/ Model #	Description	Suggested List Price
8100A/1	OPTIMOD-FM AUDIO PROCESSING SYSTEM Tri-band stereo compressor/limiter with safety clippers, and stereo generator. 75us preemphasis. 115/230V, 50-60Hz, (Same as 8100A but equipped with connector for 8100A/XT.)	$4,395.00
8100B	OPTIMOD-FM with Six-Band Limiter Accessory Chassis. (Package deal consisting of one 8100A/1 and one 8100A/XT)	$6,595.00
	OPTIONS	
OPT-11	50us preemphasis installed (European standard)	N/C
	ACCESSORIES	
8100A/ST (ACC-1)	Studio Chassis assembly to house compressor stages of OPTIMOD-FM at the studio location in order to optimize STL signal-to-noise ratio, or to permit more convenient access to controls. Consists of chassis, power supply, metering, buffers. 3 1/2" rack mount with locking access door. 115V/230V, 50-60Hz.	$795.00
8100A/XT (ACC-6)	6-Band Limiter Accessory Chassis. Extends performance of 8100A/1 system when highly competitive, aggressive processing is desired. Mounts beneath host system. Connects through short multipin cable to connector provided on host. 3 1/2" rack mount with locking access door.	$2,295.00
ATE-3F	Interface panel for Harris TE-1 or TE-3 exciter.	$70.00
RCA-1	Shorting connector for RCA BTE-15 exciter.	$7.00

NOTE: For Continental 510R-1, Collins 310Z-2 and 310Z-1 exciters, obtain interface from Continental. Most other direct-FM exciters with broadband inputs do not require special interface.

RET-4	Retrofit Kit to attach Dolby 334 Noise Reduction. Includes connectors and cable assembly.	$45.00
RET-27	Retrofit Kit to convert existing Optimod-FM Model 8100A to accept 8100A/XT shown above. Includes replacement circuit card, prewired connector assembly.	$395.00
MAN-xx	Additional copies of Operating Manuals are available at nominal charge. Specify exact model number (shown on serial label).	$25.00

Prices are F.O.B. San Francisco and are subject to change without notice.
Orban Broadcast Products are sold through Authorized Dealers worldwide.
For names of dealers near you or for further information:
Toll Free: (800) 227-4498. In California, (415) 957-1067.

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