

9100A OPTIMOD-AM



MONO OR STEREO

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RADICALLY IMPROVED.

OPTIMOD-AM:

An integrated audio processing system for AM radio, including compressor, program equalizer, multiband limiter, clipper, and transmitter equalizer

Performance Highlights

- Supplies very high average modulation (loudness), exceptional fidelity, uncanny naturalness, and freedom from processing artifacts to yield an FM-like sound from *typical* auto, portable, and table radios.
- Designed for universal application in domestic or international LW, MW, and SW services; easily adaptable to relevant government standards.
- Compensates for receiver high frequency rolloff with statistically-derived, adjustable equalizer to extend perceived bandwidth at the receiver without introducing midrange response anomalies or receiver tuning difficulties.
- New six-band limiter with distributed, distortion-cancelled multiband clipper yields at least 3dB increase in RMS modulation levels compared to old Model 9000A.
- Consistent output level and equalization texture over a 25dB input level range.
- Versatile and simple setup controls let you quickly arrive at the sound you really want.
- Improved transmitter equalizer corrects tilt and ringing in older transmitters and antenna systems for maximum modulation.
- Outputs for two transmitters with independent output level control and full remote control switching for TX1/TX2 and DAY/NIGHT status: i.e., four sets of TX EQ adjustments available, all remote-selectable.
- Sum-and-difference stereo or mono versions available; mono unit fully ready for stereo processing by simply plugging-in additional circuit cards.
- Urban-quality construction, documentation, support, and service.

Why A New OPTIMOD-AM?

Strangely enough, because of the successful new OPTIMOD-FM Model 8100A.

Some of the innovations introduced in it turned out to be highly applicable to AM processing. Specifically, the FM unit introduced a simpler, more economical, and more elegant means of realizing the now-patented distortion-cancelling clipper first introduced in the old 9000A OPTIMOD-AM. And the FM unit features a distributed crossover with embedded clipper (now patented, too). This concept, extended to six bands and combined with the distortion-cancelling filter, is the key to the higher loudness and astonishingly improved naturalness of the new 9100A OPTIMOD-AM.

A Smarter "Smart Clipper"

In the previous AM unit, the outputs of the six bands in the six-band limiter are combined, fed through a voltage-controlled amplifier, and then applied to a distortion-cancelled clipper. A complex circuit we call the "Smart Clipper"[™] controls the gain of the VCA by estimating the amount of *audible distortion* caused by the clipping process, and reducing the VCA gain until such distortion is no longer objectionable.

This, alas, is a *wideband* control process, and must therefore not be over-used if its operation is to be inaudible. In the quest for ever-higher loudness, many Model 9000A users have chosen to operate the "Smart Clipper" with so much gain reduction that its operation is audible. It therefore became clear to us, as designers, that it would be far better to eliminate the need for *any* wideband gain reduction between the output of the multiband section and the final safety clipper. That way, wideband modulation effects would never occur.

This is more easily said than done. In the previous AM unit, the "Smart Clipper" control circuitry is absolutely necessary to avoid either unacceptable loudness loss or unacceptable distortion on certain program material. The key turned out to be *multiband* clipping combined with distortion cancellation, using our patented techniques in concert with some new developments.

The Bottom Line: FM-Like Performance

The exciting result of such processing is that the combined output of the bands can be fed to a safety clipper *without* interspersing wideband gain control — provided that almost 100 internal parameters are correctly "tuned" in the design process! However, the payoff is worth it: a dramatically open, effortless, multiband sound with literally *no* audible processing on virtually any radio likely to be in the hands of your audience. A sound which is "FM-like" not only in terms of frequency response, but also in terms of "punch", "depth", "openness", and "definition". And a sound which, on a true RMS meter, averages about 3dB higher than the previous unit for the same peak modulation. In short a *loud* yet unbelievably natural sound which, we think, stands the best chance yet of winning back an audience becoming more and more attracted to FM.

AM Stereo

The 9100A is available as a stereo processor, or as a stereo-convertible mono processor. Stereo conversion is achieved simply by plugging in circuit cards — no "accessory chassis" is required except for the stereo generator.



Processing occurs in the "sum-and-difference" mode, which is most appropriate for AM stereo because the AM modulation component represents the sum (L + R) of the channels to assure compatibility with mono receivers. Internal straps determine if the output is to be in L + R and L - R mode, or in L and R mode, yielding complete versatility in matching it to the stereo generator.

The standard bandwidth of the 9100A is limited to 12kHz by means of highly selective filters, enabling it to comply with

AND LOUDER, NATURALLY.

the occupied bandwidth requirements of FCC 73.40.a.12 with arbitrary program material and processing adjustments. An optional plug-in filter card, provided at extra cost, (which fully interfaces with the DAY/NIGHT remote control) permits you to limit the bandwidth of the L-R channel to 5kHz, controlling potential IM distortion which can be introduced by high-energy high frequency information in some of the AM stereo systems.

This card also has straps which permit realization of virtually any combination of 12kHz and 5kHz bandwidths in the sum and/or difference channels, in DAY and/or NIGHT modes, enabling broadcasters to limit mono or stereo bandwidth to 5kHz at night (to control interference to other stations), or to operate at 5kHz at all times to meet EBU or other international specifications.

Stereo or Quality: What Really Attracts Listeners?

Despite the fact that the 9100A is well-equipped for stereo, we suspect that this may not be as important as some people think.

A very popular local FM station lost its separation — but not its pilot, so listeners' stereo lights did not go out. The result? In three days, one listener called to complain — and only because he noticed the problem on the vector scope in his expensive tuner. None of the staff noticed anything awry. The station's contract engineer finally noticed the problem and quietly fixed it.

So what? Compared to attaining FM-like audio quality, AM stereo *sound* (as opposed to a little light on someone's radio saying "stereo") just might be a secondary consideration for achieving audience satisfaction. The 9100A is unique in its ability to make you *sound good*, whether in mono or stereo. And we think that *sounding good* is what is going to bring listeners back from the FM band. Judge for yourself!

The 9100A: Designed For The Real World

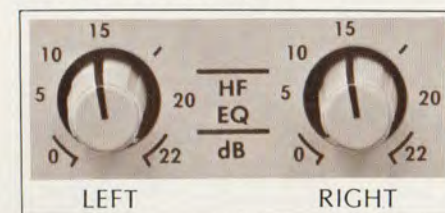
Operator Gain-Riding: A classic problem of multiband compressors is their sensitivity to input levels. Incorrect operator gain riding can change frequency balances and equalization textures in a disturbing way.

Because of this, the 9100A has a newly-designed AGC amplifier ahead of its six-band limiter. It is designed to do as little as possible to the sound except to slowly gain-ride over a 25dB range. Accordingly, despite its being a wideband device, it does not make nasty wideband sounds. And it relieves the operator of the requirement of reading a complicated array of flashing LED's just to determine if the processor is being driven correctly!

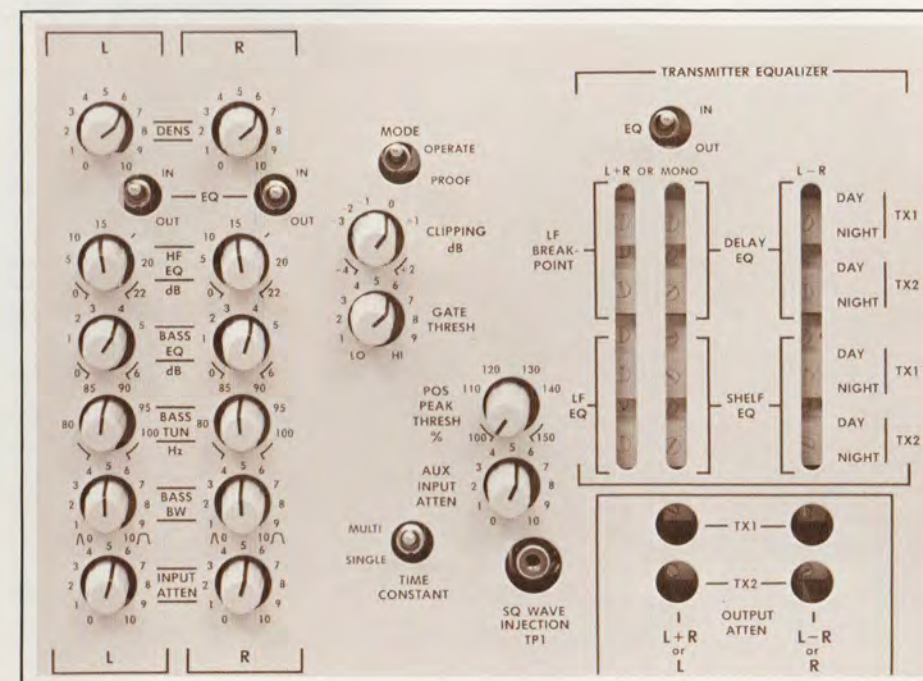


Receiver Equalization: We carefully measured the frequency response of fifteen of the most common real-world AM radios. We then averaged the curves, and did a statistical analysis to make sure that our procedure meant something. Finally, we mathematically synthesized an inverse (preemphasis) curve which can correctly equalize the radios flat up to a -3dB point of 6kHz. We took this curve and designed an equalizer circuit which could create it, or any part of it. So broadcasters who don't wish to equalize out to the full 6kHz (which requires *lots* of high frequency boost) can equalize out to 5kHz, 4kHz, 3kHz, or whatever — all without introducing midrange coloration, as offsetting the top band on a conventional triband processor inevitably does when you try to equalize for radio rolloffs.

The result is a *one-knob* high frequency equalizer that can produce *nothing but correct equalization curves!* Much easier to use than the three-knob H-F equalizer on our previous AM processor. And much more accurate, too!



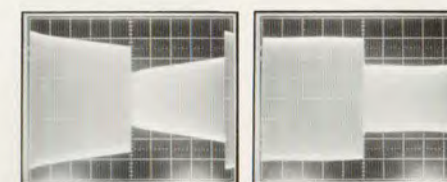
We then complemented this unique H-F equalizer with a versatile *parametric* bass equalizer which can tune bass response to your format and target audience.



SUBPANEL SETUP CONTROLS

Finally, to keep D.J.'s happy, we synthesized a passive monitor rolloff filter with an H-F ROLLOFF control to match it to the processor H-F EQ setting you've chosen. This filter can be inserted between your mod monitor output and your monitor amplifier input to produce a big, high-fidelity sound even on large studio monitor speakers. The filter is included standard with every 9100A.

Transmitter Equalization: Not everyone is fortunate enough to operate a state-of-the-art transmitter with its negligible tilt and overshoot. Older plate-modulated transmitters can have enough tilt and/or overshoot to substantially compromise the accuracy with which they can reproduce a highly-processed signal like the output of the 9100A. And even state-of-the-art transmitters can ring into high "Q" antenna systems. Often, average levels must be reduced to accommodate the peak level increases introduced by such inaccuracies.



WITHOUT TILT CORRECTION WITH TILT CORRECTION
LOW FREQUENCY SQUARE WAVE

Our previous processor was equipped with a transmitter equalizer to "tune out" tilt and overshoot — this equalizer proved very useful in practice. The 9100A includes an augmented version of this circuit which adds yet another refinement to the tilt equalizer. This allows you to control the amount of very-low-frequency correction introduced, permitting you to match the equalization to the transmitter as accurately as possible while simultaneously avoiding saturation of the modulation transformer (or other circuitry) in transmitters which cannot take the full correction.

Protecting STL's: Unlike our current OPTIMOD-FM and -TV, the 9100A system cannot be split into separate studio and transmitter sections to provide compression before the STL. To accommodate those who need overload protection for their STL's, we recommend the use of an Orban 422A (mono) or 424A (stereo) compressor/limiter/de-esser at the studio side of the STL.



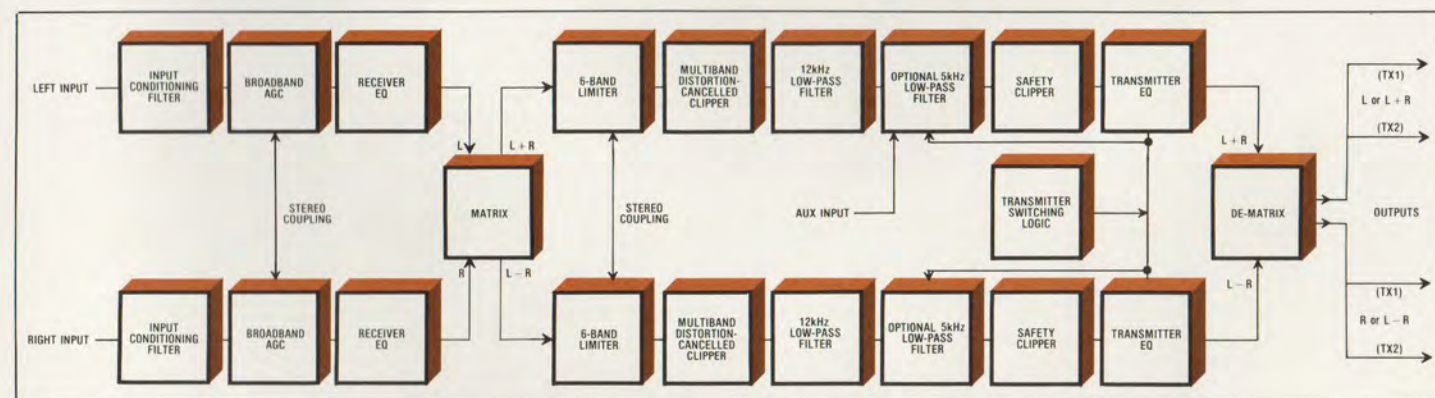
THE 424A

These economical, high-quality units are well-matched to the 9100A, costing no more than a "9100A Studio Accessory Chassis" otherwise would.

Auxiliary Input: A separate input is provided after all processing except the safety clipper and transmitter equalizer. Located in the L + R (or mono) channel, this provides a convenient input for injecting EBS tones, subsonic telemetry, and the like. It also provides a convenient point into which the output of a separate voice-processing audio chain can be mixed for those stations desiring independent voice/music processing.

Packaging and Maintenance: The 9100A is packaged in the form of plug-in cards, significantly facilitating maintenance. The cards plug into a rugged chassis with effective, field-proven RFI shielding, making the system operable in almost any EMI environment without difficulty.

Loaner cards are available from the factory, and suspected field defects are preferably verified by replacing a questionable card with one known to be good. Those wishing to do in-house maintenance of the 9100A system will be greatly aided by an outstandingly complete operation and maintenance manual which contains detailed circuit descriptions, standard curves, and other helpful data.



SYSTEM BLOCK DIAGRAM (STEREO CONFIGURATION)



Asymmetry And Polarity Followers

A lot of careful listening has convinced us that several of our colleagues in audio processor design and manufacture are right: symmetrical *is* cleaner. Any processor which uses aggressive amounts of clipping for peak limiting will produce only odd-order harmonic and IM products when clipping symmetrically. Asymmetrical clipping produces *both* odd- and even-order products, sounding somewhat brighter, significantly dirtier, and only slightly louder.

The 9100A incorporates a phase scrambler early in the system to make peaks as symmetrical as possible. Operated symmetrically, the 9100A will produce an extremely loud and silky-clean sound, free from midrange "grit" so often associated with the sound of soft-clipping asymmetrical AM processors. You really *can* hear the absence of even-order IM in the midrange! However, for those broadcasters desiring the loudest possible sound, a POSITIVE PEAK LEVEL control permits you to adjust asymmetry to beyond +125% modulation.



The choice is yours, and will depend on format, target audience, and other programming considerations.

Because of the phase scrambler, any natural asymmetry in the input material is eliminated and most efficient use is made of the processing. For this reason, no automatic polarity switching is included (or desirable) in the 9100A. Any asymmetry at the output is artificial and is produced by the processing itself as controlled by the user.

Summary

The 9100A is an exciting development in AM audio processing. For the first time, it permits extremely high loudness to be achieved along with the openness and freedom from processing artifacts heretofore only associated with such FM processors as our OPTIMOD-FM Model 8100A. Simultaneously, its circuitry is substantially less complex than that of our previous Model 9000A, resulting in greater value and higher reliability.

While the 9100A is stereo-ready, the mono station will benefit fully from its use. FM's edge is not as much stereo as it is *quality*. Many now feel that AM has been damaging *itself* by being strident, busy, and over-processed. With the 9100A, programmers and engineers now have a friendly, well-honed tool to create a sound which complements

their creative programming: a sound which feels much like FM in its openness, depth, and definition. Early field tests have suggested that ratings will move in the right direction: Fatigue is reduced, so more people listen longer.

For many AM broadcasters — particularly those with music formats — the sound of the 9100A may be the key to recapturing audience and ratings.

Order Items

- 9100A/1 Mono Unit
(later easily convertible to stereo with plug-in cards)
- 9100A/2 Stereo Unit
(can readily be used for mono)
- RET-17 Optional Lowpass Filter Card needed for certain AM stereo systems, European broadcast, and special adjacent channel problems.

(Stereo Generator not supplied)

orban

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Specifications

It is impossible to define 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. These dynamic processes are evaluated at the factory and controlled to close tolerances. The measurements require special test fixtures, cannot be readily duplicated by measurements with standard test equipment in the field, and cannot be described in familiar terms.

Certain specifications are therefore presented here to satisfy the engineer that they are reasonable, to help plan the installation, to help make certain comparisons with other processing equipment, and to verify that OPTIMOD-AM can readily pass a Proof of Performance. In order to facilitate this, all equalization can be switch-bypassed to enable a Proof to be performed under "flat" conditions as required by the FCC (U.S.A.).

INPUT

Impedance: Greater than 10 K ohms, electronically balanced by means of true instrumentation amplifier. RF suppressed.

Sensitivity: Normal operation may be achieved with nominal line levels of -30dBm or greater. Input sensitivity is controlled by means of INPUT ATTENUATOR control, and also by means of a bypassable 20dB pad before the input amplifier.

INPUT CONDITIONING FILTER

Highpass: -0.5dB @50Hz with rolloff exceeding 18dB/octave below that frequency. Includes deep 25Hz notch for automation cues.

Lowpass: Rolls off frequencies above 12kHz at rate exceeding 24dB/octave.

Allpass: Phase scrambler makes peaks more symmetrical to best utilize the capabilities of the processing.

BROADBAND COMPRESSOR

Range of Gain Reduction: 25dB

Compression Ratio: greater than 10:1

Time Constant Mode: SINGLE/MULTI, switch-selectable

Attack Time: approximately 200ms (SINGLE); program-controlled (MULTI)

Release Time: approximately 3dB/second (SINGLE), program-controlled (MULTI)

Total Harmonic Distortion: does not exceed 0.05% at any degree of gain reduction, 50-12,000Hz

Noise: greater than 85dB below output clipping level

Gating: gain will drift slowly to 10dB G/R if input level drops below a user-adjusted threshold

Variable-Gain Element: proprietary class-A VCA

PROGRAM EQUALIZER

Bass: "Quasi-Parametric" second-order peak boost equalizer. "Q" variable from 0.3 to 1.4. TUNING variable from 70 to 110Hz. EQ variable from 0 to +6dB.

High Frequency: Proprietary third-order shelving equalizer (patent pending) matches inverse of "average" (see text) receiver rolloff to a high frequency limit, adjustable from no equalization at all, through any frequency up to 6kHz.

Noise and Distortion are substantially below other elements in the system.

SIX-BAND LIMITER

Filters: 150Hz lowpass; 420Hz bandpass; 700Hz bandpass; 1.6kHz bandpass; 3.7kHz bandpass; 6.2kHz highpass.

Filter Selectivity: 18dB/octave

Filter Topology: parallel.

Filter Combination:

Static: outputs of all filters combine to yield static frequency response ± 0.5 dB throughout the range of 50-12,000Hz.

Dynamic: Phase interaction between filters under program conditions will not cause audible dips in the frequency response.

Limiters:

Range of Gain Reduction: 25dB.

Attack Time: program controlled; adjusted according to band frequency.

Release Time: program controlled; adjusted according to band frequency.

Total Harmonic Distortion (each limiter): does not exceed 0.1% for any frequency in each limiter's passband with any degree of gain reduction, provided signal is below multiband clipper threshold.

Distortion Cancellation: all clipper-induced distortion in upper four bands cancelled better than 30dB below 1.8kHz. Additional distortion reduction provided as function of frequency in each band.

Noise (each limiter): better than 85dB below VCA output clipping level.

Variable-Gain Elements: proprietary class-A VCA's.

OUTPUT FILTER

Filter Characteristics: 12kHz 5th order elliptical is standard. System guaranteed to meet all requirements of FCC 73.40.a.12 regarding occupied bandwidth for arbitrary adjustments of processing controls and arbitrary program material, provided that the transmitter does not add significant high-frequency harmonic distortion to its spectrum.

Optional Filters: Optional plug-in card contains two phase-corrected 5kHz 30dB/octave filters (for L + R and L - R processing). Also contains a delay network which can be inserted in the L + R path to match the delay of the L - R 5kHz filter if 5kHz bandwidth limitation is desired in the L - R path only. Filters are coupled to the system DAY/NIGHT logic. The card may be strapped in any one of four configurations.

OPTIONS	DAY		NIGHT	
	L + R	L - R	L + R	L - R
1	12kHz	12kHz	5kHz	5kHz
2	12kHz	5kHz	5kHz	5kHz
3	12kHz	5kHz	12kHz	5kHz
4	5kHz	5kHz	5kHz	5kHz

TRANSMITTER EQUALIZER

Low Frequency Tilt Equalizer: Proprietary phase/magnitude compensation introduces adjustable positive-slope tilt to the output waveform to cancel normal negative-slope tilt in older-technology transmitters. Independent control of very-low-frequency compensation available to avoid saturation and non-linear effects in transmitters with limited low frequency power handling capacity.

High Frequency Shelving Equalizer: Adjustable breakpoint shelving equalizer creates controlled undershoots in high frequency transient waveforms to prevent RF envelope overshoot due to excessive "Q's" in transmitters, phasors, and/or antenna systems, or due to poor transient response in audio or modulator stages.

High Frequency Delay Equalizer: Introduces added time delay selectively into the spectrum to compensate for non-linear group delay in the transmitter/antenna system, thru optimizing transient response by creating approximately constant time delay at all frequencies within the audio bandwidth.

Controls: Four separate sets of controls are provided which can be independently adjusted for DAY/TX1, DAY/TX2, NIGHT/TX1, and NIGHT/TX2, and can be remotely switched by momentary application of 6-24V AC/DC between the appropriate terminals on the rear-panel barrier strip. Day/Night and TX1/TX2 status is indicated by pairs of LED's on the front panel. A test point is located behind the control access door. Either a sinewave or squarewave oscillator may be used to drive this test point for TX equalizer alignment.

LINE DRIVER

Output Impedance: 290 ohms, electronically-balanced to ground, RF suppressed by means of third-order non-overshooting EMI filter.

Output Level: will drive greater than +20dBm into 600 ohms.

Configuration (mono): Outputs for two transmitters, each with independent TX EQ and 18-turn screwdriver-adjust OUTPUT ATTENUATOR controls.

Configuration (stereo): Outputs for two transmitters (each transmitter having its own stereo generator), each output with independent TX EQ and 18-turn screwdriver-adjust OUTPUT ATTENUATOR control. Outputs can be strapped for L & R, or L + R and L - R depending on the needs of the subsequent stereo generator.

COMPLETE SYSTEM (PROOF MODE)

(Note: PROOF mode requires that all control circuitry for compression and limiting be defeated, and that the program equalizer and TX equalizer be switched OUT, leaving all active circuitry other than the equalizers in-line.)

Frequency Response: better than ± 1.0 dB, 50-7500Hz (optional 5kHz filters defeated).

Total Harmonic Distortion: less than 0.2% at 100% modulation, 50-7500Hz.

RMS Noise: better than 65dB below 100% modulation, 30-20,000Hz.

Stereo Separation: better than 25dB, 50-10,000Hz; typically 35dB

PHYSICAL

Dimensions: 19"W x 7"H x 12.5"D (4 EIA rack units); (48.3cm x 17.8cm x 31.8cm).

Shipping Weight: 27 lbs. (12 Kg.) Net; 38 lbs. (17 Kg.) Gross

Operating Temperature: 0-50 degrees C (32-122 degrees F).

EMI Environment: Circuitry shielded against EMI from 500kHz - 1 GHz.

Access: Circuitry (except for power supply regulator) on plug-in cards. All circuitry and user setup adjustments available from front panel without removing unit from rack. Control access door is fitted with a lock to prevent unauthorized adjustments.

Power Requirements: 115/230V AC $\pm 15\%$, 50/60 Hz.

Maximum AC Leakage to Chassis: 0.25mA @ 115VAC; 0.5mA @ 230VAC.

WARRANTY

One year, parts and labor. Subject to limitations set forth in our Standard Warranty Agreement. Factory assistance and service available throughout the life of the product.

Change: Add RET-24; no price changes.

ORDERING GUIDE & SUGGESTED LIST PRICES

Broadcast Products
OPTIMOD-AM

Effective 1 July 1983
Revision 5

Order/ Model Number	Description	Suggested List Price
9100A/1	<u>OPTIMOD-AM AUDIO PROCESSING SYSTEM--MONAURAL</u> Multiband compressor/limiter with safety clippers, dual transmitter outputs with transmitter equalization. Includes Manual, ACC-5 Monitor Rolloff Filter, Accessory Port. Convertible to stereo later by addition of RET-16 below. 115/230V, 50/60Hz.	\$4395.00
9100A/2	<u>OPTIMOD-AM AUDIO PROCESSING SYSTEM--STEREO</u> As above, equipped for stereo; can be used for mono.	\$5295.00

Stations operating phone lines or microwave STL's may wish to optimize S/N of the link by use of the Orban 422A (mono) or 424A (stereo) Compressor/Limiter ahead of the link. Use of this device is compatible with the Optimod and is discussed in detail in the Manual for the Optimod.

ACCESSORIES (Specify host model # if ordered separately from system)

Retrofit Kits (RET-) will be installed and tested at the factory at no charge when ordered with the host system.

RET-16	Stereo Conversion Kit. Converts 9100A/1 (mono) to 9100A/2 (stereo) by installation of 3 additional cards and minor adjustments. Includes one ACC-5 Monitor Rolloff Filter.	\$995.00
RET-17	Lowpass Filter Card Retrofit Kit. (Card 1) Additional card for use where 5kHz LP filter is required in either L+R or L-R channel or both. Recommended for Magnavox and Motorola AM Stereo installations. Other frequencies available on special order. Field installation in card slot #1. Jumper change and minor adjustment required.	\$135.00
RET-24	Highpass Filter Card Retrofit Kit. (Card 1H) Additional card required for Harris AM Stereo installations. Field installed in card slot #1. Jumper change required.	\$95.00
ACC-5	Monitor Rolloff Filter (one channel). Approximates typical receiver rolloff in studio monitoring application from monitors and wideband receivers. One or two are supplied with each Optimod-AM, as appropriate.	\$95.00
MAN-7	9100A Operating Manual. (One is supplied with each Optimod-AM.) Postpaid.	\$17.00

Prices are for domestic U.S. only and are subject to change without notice. Orban Broadcast Products are sold through Authorized Dealers. Call for names of dealers near you or for further information.

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