OPTIMOD-TV 8182A



MONO OR STEREO

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Function of OPTIMOD-TV:

Model 8182A is Orban's second-generation TV audio processor: It is an integrated signal-processing *system* which replaces conventional compressors, limiters, and clippers to precisely control audio modulation without introducing audible artifacts. Based on the popular OPTIMOD-FM Model 8100A, the 8182A offers the TV broadcaster the same superb quality that has made the 8100A so popular among FM radio broadcasters, plus Loudness Control and Hilbert-Transform clipping—features which tailor it perfectly to the unique requirements of television audio.

The 8182A is also ideally suited for conditioning signals prior to satellite uplinks, as well as for audio processing in other specialized communications applications where extremely high audio quality is desired, the audio spectrum must be limited to a 15kHz bandwidth, and the channel peak overload point is abrupt and must not be exceeded.

This brochure provides a technical description. However, it can't adequately describe the most important feature of the 8182A: its natural *sound,* and its ability to handle typical television audio feeds—from master tape to 16mm optical film—smoothly and gracefully without introducing processing artifacts. These days, consumers are accustomed to good sound, and OPTIMOD-TV helps you provide audio quality which augments the video quality you have worked so hard to achieve.

Briefly, the OPTIMOD-TV system performs these functions:

☐ It rides gain over a range of as much as 25dB, compressing dynamic range and compensating for gain-riding errors. Gain riding and compression are virtually undetectable because of advanced program-controlled time constants, level-dependent gating, and multi-band compression.

☐ It controls excessive perceived loudness by means of a complex loudness estimating circuit (which can be enabled and defeated by remote control). This circuit, licensed from CBS Technology Center, incorporates the results of their second major loudness research project (1978-1980). On-air tests of the controller have resulted in a substantial reduction or elimination of viewer complaints regarding excessively loud commercials.

☐ It controls potential interference to video and/or future stereo services by means of bandwidth-limiting 15kHz lowpass filters incorporating full overshoot compensation. OPTIMOD-TV thus provides extremely tight control over peak modulation, preventing overmodulation and controlling its output spectrum simultaneously.

☐ The OPTIMOD-TV compressor is a dual-band design which can be operated with the bands independent of each other ("independent"), or such that the bands are coupled and ordinarily track each other ("wideband"). When operated in "independent" mode, OPTIMOD-TV makes audio quality more consistent by correcting frequency balances between bass and midrange material. When operated in "wideband" mode, it will preserve frequency balances and will produce an output which sounds like its input.

☐ It prevents peak overload and overmodulation due to the effects of the preemphasis curve.

An accessory port is included to interface the noise reduction encoder required for TV stereo. In addition, an external TV stereo generator will be needed.

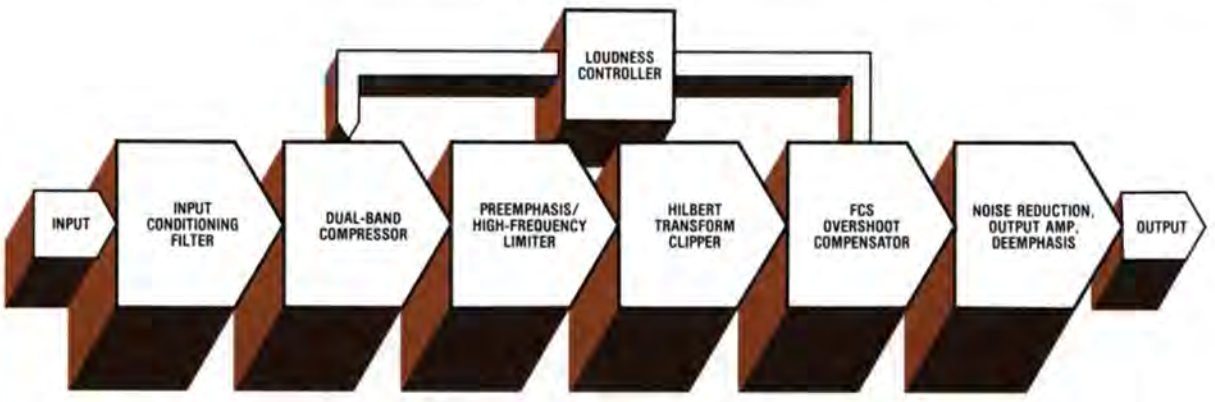
Internal jumpers determine if the active-balanced ±10dBm outputs are to be flat or preemphasized and whether they are to be in conventional left/right or in sum-and-difference form.

Ordinarily OPTIMOD-TV should be fed unprocessed audio. Additional compression and/or other audio processing would not be desirable except as might be applied to individual microphone channels in a live production environment or to other sources requiring special processing.

Split Configuration: An alternate, dual-chassis configuration permits the Dual-Band Compressor to be operated separately from the remainder of the circuitry. The Dual-Band Compressor can be placed at the studio side of the STL (telephone line, dual microwave, or FM subcarrier on a video STL) to protect the STL from overmodulation and to put most operating controls at the studio.

This configuration consists of a basic chassis in conjunction with the Model 8182A/ST Accessory Chassis. The 8182A/ST accepts several cards from the main chassis which are replaced by jumper cards.

However we discourage use of the split configuration if the gain of the STL cannot be maintained ±0.75dB. In this case we recommend an Orban Compressor/Limiter (such as the 424A) at the studio side of the STL to protect against STL overload.



SYSTEM BLOCK DIAGRAM
(ONE CHANNEL DEPICTED)

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Simplified System Description:

OPTIMOD-TV consists of seven basic blocks:

1. Input Conditioning Filter: An allpass phase scrambler to make peaks more symmetrical (thus reducing clipping distortion and permitting higher loudness), and a 30Hz 18dB/octave highpass filter to prevent subsonic information from disturbing the operation of the audio processing or exciters' AFC's.

2. Dual-Band Compressor: A "Bass" compressor which processes audio below 200Hz (12dB/octave crossover) in parallel with a "Master" compressor for the remainder. A BASS COUPLING control determines if the two bands operate discriminately ("independent" mode), or if the "Bass" band will be forced to track the "Master" band ("wideband" mode), preserving frequency balances. Intermediate bass coupling settings are also available.

Because of the unique design, the preemphasized output of the compressor can be directly applied to the peak limiting system: No further gain reduction is required for distortion control, and maximum naturalness is preserved.

Gating is provided to prevent noise rush-up during pauses (particularly with noisy 16mm optical sound tracks) and to make the 25dB gain reduction range more useful. The gating circuit is designed so that the gain does not get "stuck" forever in the 0 to 15dB gain reduction region—low-level program material is very slowly and impreceptibly increased in level even when gating is enabled.

The output level of the compressor is set by the CLIPPING control. This control thus sets the drive level to the subsequent high-frequency limiter and clipper, determining the amount of limiting and clipping.

3. Preemphasis And High Frequency Limiter: The output of the Dual-Band Compressor is applied to a phase corrector, 15kHz lowpass filter, preemphasis network, and high-frequency limiter.

The lowpass filter prevents out-of-band components from affecting the operation of the high-frequency limiter and avoids intermodulation between out-of-band frequency components and in-band frequency components in the clipper.

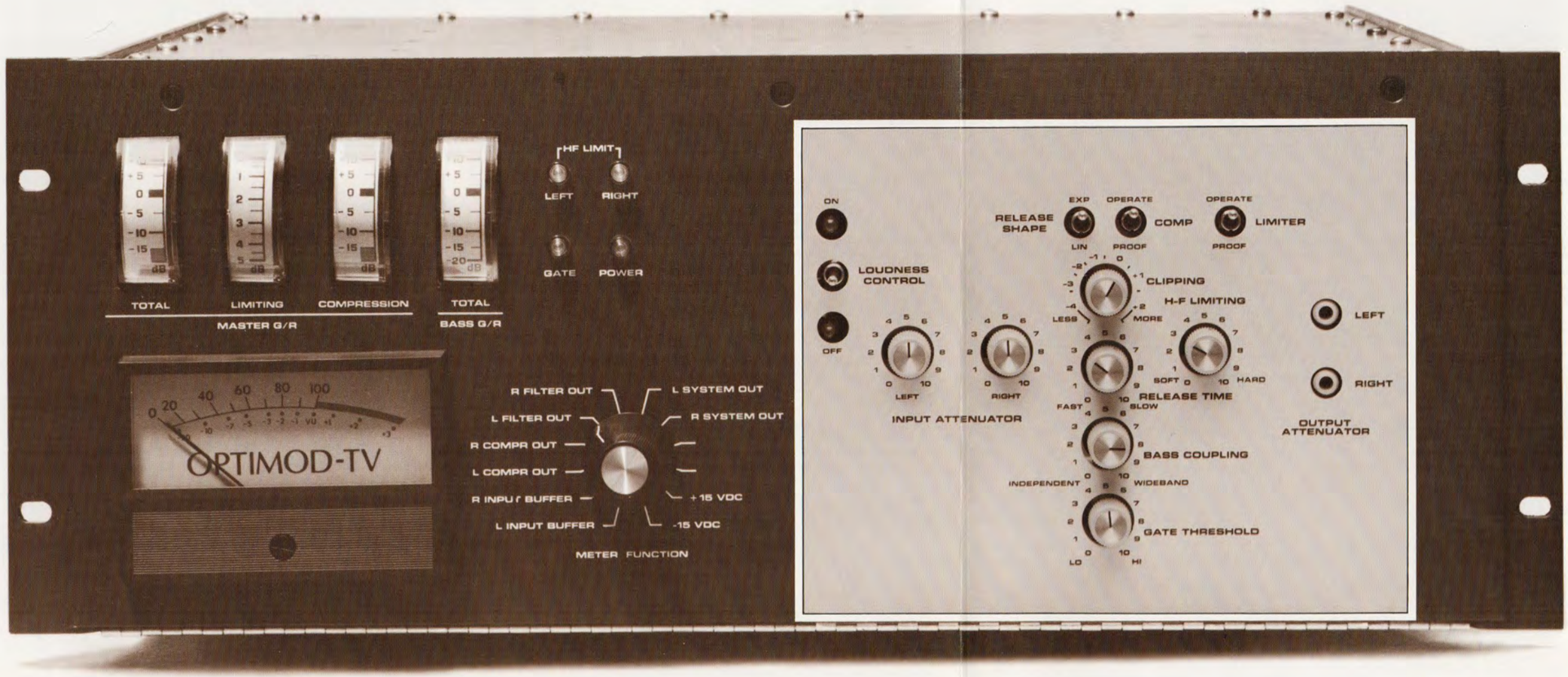
The high-frequency limiter is controlled by high frequencies *only* (rather than by the peak level of the preemphasized signal), eliminating any possibility of modulation of high frequency content by low frequency material. Its threshold of limiting is user-adjustable over a 3dB range, permitting brightness and high frequency distortion to be traded off according to your needs. Because the peak limiting system incorporates IM distortion cancellation, substantially more clipping can be accomplished without objectionable distortion than in conventional systems: Significantly improved high frequency power handling capability is achieved.

4. Loudness Controller: The concept of Loudness is different from the concept of Level. Loudness is *subjective* sound intensity: It is what the listener *perceives in his mind.* Level, on the other hand, can be measured in many objective ways: a VU meter and a PPM are two common level indicators in broadcast. No simple electrical measurement correlates well with loudness.

CBS Technology Center, in 20 years of experiments, has developed a technique of measuring loudness by means of a complex algorithm. This technique provides results which correlate well to loudness as subjectively judged by panels of listeners in extensive tests.

Ordinarily, gain reduction in OPTIMOD-TV is determined by the compressor's control circuitry. However, if the loudness exceeds a present threshold, the Loudness Controller acts to further reduce the gain as necessary. This is the most advanced technique known for measuring and controlling the loudness of broadcast audio.

Because certain sounds in entertainment programming (pistol shots, explosions, or screeching tires, for example) are *supposed* to be loud for dramatic impact, the Loudness Controller can be turned on and off locally or by remote control. ➤



SETUP CONTROLS
(BEHIND ACCESS DOOR)

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(continued from inside)

5. "Hilbert-Transform Clipper": The Hilbert-Transform Clipper provides the peak limiting function and contains filters to assure that the clipping does not introduce out-of-band frequency components above 19KHz. Unlike a conventional audio clipper, its action introduces no harmonic distortion when it processes frequency components below 4kHz. Simultaneously, IM distortion below 2.2kHz is sharply cancelled by an adaptation of the patented Orban feedforward distortion-cancelling filter.

The result is very low perceived distortion on both voice and music. Voice is most severely degraded by harmonic, not IM, distortion. No harmonic distortion is produced in the voice frequency range, keeping voice clean. Sibilance distortion is eliminated by the distortion-cancelling filter. In the frequency range in which music has substantial energy (particularly after preemphasis), IM distortion is minimized, optimizing music reproduction as well.

Because bandlimited voice (from 16mm optical film, for example) is so prevalent in TV audio and because bandlimited voice is exceedingly sensitive to the harmonic distortion introduced by more conventional clippers, the Hilbert-Transform clipper is extremely effective in achieving cleaner sound in day-to-day operations.

6. Frequency-Contoured Sidechain (FCS) Overshoot Corrector: The output of the Hilbert-Transform Clipper contains overshoots due to the addition of the distortion-cancelling signal and to unavoidable overshoots in its integral 15kHz lowpass filter. These overshoots are eliminated in the FCS Overshoot Corrector without adding out-of-band frequency components: The circuit acts essentially as a "bandlimited safety clipper".

Because this circuit acts instanteously and employs no gain reduction or dynamic filtering, it causes neither pumping nor dulling of program material.

7. Noise Reduction Port, Output Amplifier, And Deemphasis: At the output of the Overshoot Corrector, the signal is peak-controlled and preemphasized. The L and R outputs of the Overshoot Corrector are applied to a matrix which produces L + R and L – R. Jumpers determine whether the OPTIMOD-TV Noise Reduction Port is fed L/R or L + R/L – R signals.

The Noise Reduction encoder can be bypassed by the Noise Reduction IN/OUT switch on the rear panel of OPTIMOD-TV. The output of the switch (which selects either the input line to the encoder or the output line from the encoder) is applied to a balanced transformerless line amplifer with strappable deemphasis.

Best system peak control is obtained by defeating exciter preemphasis and applying the preemphasized signal from OPTIMOD-TV to the flat exciter. In some exciters it is inconvenient to defeat the preemphasis, so the exciter must be supplied with a "flat" (i.e., deemphasized) signal from OPTIMOD-TV, which is readily accomplished by moving jumpers.

The outputs of the line amplifiers are interfaced to the outside world through non-overshooting RFI filters effective from approximately 500kHz to 1GHz.

Summary:

OPTIMOD-TV is an integrated "system approach" to

- ☐ ride gain
- ☐ perform compression as desired
- ☐ control excessive loudness
- ☐ control peaks by high-frequency limiting, distortion-cancelling "Hilbert-transform clipping", and bandlimited overshoot correction.

This optimizes technical parameters to their practical limit while producing a sound at the viewer's ear which is perceived as natural, pleasant, and free from the processing artifacts that often plague other signal processing approaches.

Order Guide:

8182A	OPTIMOD-TV AUDIO PROCESSING SYSTEM
OPT-18	50us preemphasis installed
8182A/ST	Studio Accessory Chassis for "split" configuration
RET-25	Retrofit Kit to convert OPTIMOD-TV Model 8180A to Model 8182A. Requires return to the factory for modification and alignment.
MAN-8	Additional Copy Of 8182A Operating Manual

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Specifications

FREQUENCY RESPONSE
(System in PROOF mode)
Follows standard 75us preemphasis curve ±0.75dB, 50-15,000 Hz. (50us preemphasis available on special order.) Deemphasis jumper on line amplifier card permits flat output ±0.75dB 50-15,000Hz for use with external preemphasis. 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.

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; deemphasized; 100% Modulation)
Less than 0.25% THD, 50-15,000Hz (0.02% typical); less than 0.1% SMPTE Intermodulation Distortion (60/7000Hz; 4:1).
["THD" is defined as the root-sum-square (R.S.S.) sum of all harmonics, 50-30,000Hz. Noise (which is unavoidably included in the reading on a typical THD analyzer) is specifically excluded from this specification.]

"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%, 200-15,000Hz, +10 to –15dB gain reduction.
Available Gain Reduction: 25dB
Metering: Three dB-linear edgewise-reading gain reduction meters—
TOTAL is true peak-reading with electronic acceleration and peak-hold (+10 to –15dB); LIMITING indicates fast peak limiting component of gain reduction (0-5dB); COMPRESSION indicates slow compression component of gain reduction (+10 to –15dB).
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, +10 to –20dB gain reduction.
Available Gain Reduction: 30dB
Metering: single dB-linear edgewise-reading gain reduction meter (+10 to –20dB).
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 Elements: 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.

HILBERT-TRANSFORM CLIPPER CHARACTERISTICS
Nominal Bandwidth: 15.4kHz
Distortion Characteristics: Less than 2.5% THD is produced by individual frequencies 30-4000Hz when driving the Hilbert-Transform Clipper to 6dB beyond its threshold of limiting. With drive frequencies above 4kHz, the characteristics revert to those of a very "hard" conventional clipper. Further distortion cancellation assures that, for any arbitrary input (including program material), distortion components in the frequency range from 0-2.2kHz are cancelled better than 30dB below overshoot compensator threshold (patent pending).
Delay Correction: Fourth-order allpass.
Amount of Clipping: User-adjustable over 6dB range to match format requirements.

FREQUENCY-CONTOURED SIDE CHAIN (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 OPTIMOD-TV processing system is specifically configured to prevent the FCS circuit from audibly degrading the difference-frequency distortion-cancellation properties of the earlier peak limiting system.

SYSTEM SEPARATION
Greater than 50dB, 50-15,000Hz; 60dB typical.

INPUT
Impedance: greater than 10K ohms, electronically balanced by means of true instrumentation amplifier. Requires balanced source ‹ = 600ohms.
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: Barrier strip (#6 screw).

OUTPUT
Source Impedance: 370 ohms, independent of OUTPUT ATTEN setting, balanced.
Recommended Load Impedance: 600 ohms ±20%.
Level: variable –infinity dBm to greater than +20dBm by means of 15-turn OUTPUT ATTEN controls.
Connector: Barrier strip (#6 screw). RF suppressed.

TEST JACKS (for Test use only)
Provides L and R lowpass filter output on RCA phono-type connectors on rear panel. Outputs are unbalanced.

OPERATING CONTROLS
VU Meter Selector: switches ASA-standard VU meter to read:
L or R Input Level (L INPUT BUFFER)
L or R Compressor Output (L COMPR OUT)
L or R Filter Out (L FILTER)
L or R Line Amplifier Output (L SYSTEM OUT)
±15 V Power Supply Voltages

SETUP CONTROLS (front-panel, behind lockable swing-down door—see Fig. 4-5)
Compressor:
- Left and Right Input Attenuators
- "Master" Band Release Time
- Release Shape Switch
- Gate Threshold
- Bass Coupling
- Clipping
- High-Frequency Limiter Threshold

General:
- Left and Right Output Attenuators
- PROOF/OPERATE Switches (to defeat gain reduction, HF limiting, clipping and gating)
- Loudness Controller ON/OFF Switch
- Power ON/OFF Switch
- 115V/230V Selector Switch
- Noise Reduction IN/OUT Switch (real panel)

POWER REQUIREMENT
115/230VAC, ±15%, 50-60Hz, approx. 31VA. IEC mains connector with detachable 3-wire "U-Ground" power cord supplied. Leakage to chassis less than 0.5mA. AC is RF-suppressed.

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

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

WARRANTY
One year, parts and labor. Subject to limitations set forth in our Standard Warranty.

All specifications subject to change without notice.

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ORDERING GUIDE & SUGGESTED LIST PRICES

Revision 3; Effective 2 April 1984
Supersedes Revision 02, July 1983
Changes: Delete 8180A, Add 8182A/ST Price

Broadcast Products
OPTIMOD-TV

Order/ Model #	Description	Suggested List Price
8182A	OPTIMOD-TV AUDIO PROCESSING SYSTEM with CBS Loudness Controller & Hilbert Clipper Optimod-TV tri-band stereo compressor/limiter with safety clippers plus patented* loudness controller May be used for mono or stereo. (Outboard stereo generator required). 75usec defeatable preemphasis. 115/230V, 50-60Hz.	$4,995.00
	OPTIONS AND ACCESSORIES	
8182A/ST (ACC-7)	8182A Accessory Chassis Assembly Chassis assembly to house compressor and loudness control stages of Optimod-TV at the studio location. Used to optimize STL signal-to-noise ratio, or to permit more convenient access to controls. Consists of chassis, power supply, metering, buffers. Not for 8180A. 3 1/2" rack mount with locking access door. 115V/230V, 50-60Hz	$895.00
8180A/ST (ACC-4)	8180A Accessory Chassis Assembly Same as 8182A/ST, except for previous 8180A	$795.00
MAN-8	Additional copy of 8182A Operating Manual (postpaid)	$25.00
OPT-18	50us preemphasis installed (European standard)	N/C
RET-13	Noise Reduction Port Retrofit Kit (Expected to be required for stereo TV)	$45.00
RET-25	8180A to 8182A Conversion Requires return of unit to factory for modification and alignment. Allow approx. 3 weeks after receipt.	$995.00
RET-26	8180A/ST to 8182A/ST Conversion Requires return of unit to factory for modification and alignment. Allow approx. 3 weeks after receipt.	$295.00

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 call
Toll Free (800) 227-4498. In California, (415) 957-1067

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