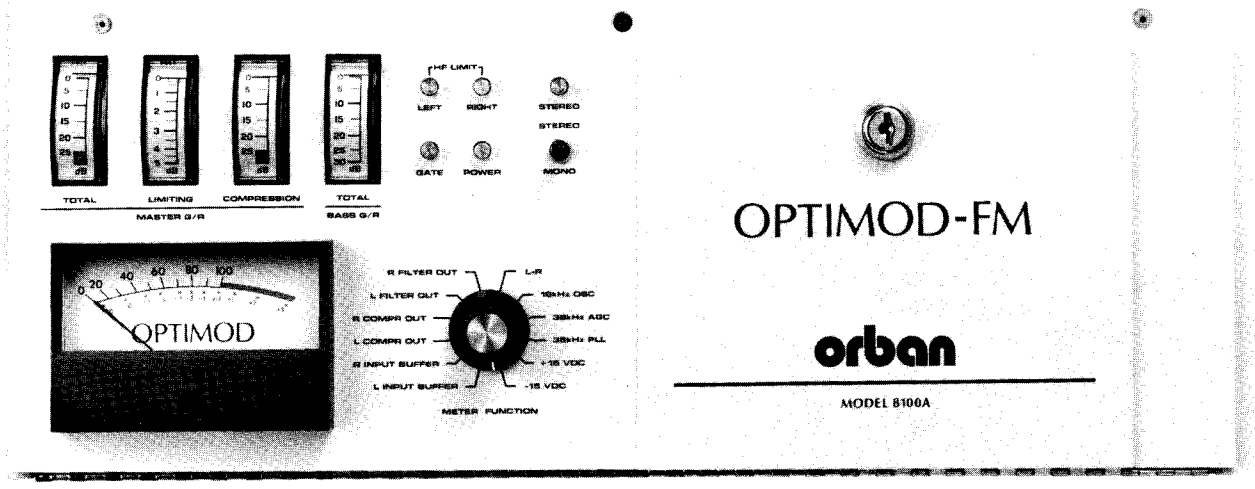
Operating Manual

OPTIMOD-FM®

MODEL 8100A1



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95039-000-06 600-IP-8/90

Important Note:

The name of your OPTIMOD-FM unit and references to it in the manual may not match. Refer to the list below.

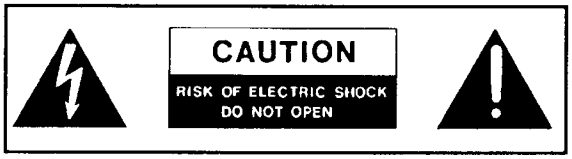
If you purchased:	Manual References Include:
8100A1/U75	8100A/1
8100A1/U75F	8100A/1 & ACC 22
8100A1/J50	8100A/1, MVM 21, OPT 11
8100A1/J50F	8100A/1, MVM 21, OPT 11, ACC 22
8100A1/E50	8100A/1 230V, OPT 21, OPT 11
8100A1/E50F	8100A/1 230V, OPT 21, OPT 11, ACC 22

This manual is part number 95039-000-06.

600-IP-8/90

Orban, division of AKG Acoustics, Inc.,
1525 Alvarado Street, San Leandro, California 94577 USA
Tel 415/351-3500 Fax 415/351-0500

Safety Instructions



CAUTION: TO REDUCE THE RISK OF ELECTRICAL SHOCK, DO NOT REMOVE COVER (OR BACK).
NO USER SERVICEABLE PARTS INSIDE. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL.

WARNING: TO REDUCE THE RISK OF FIRE OR ELECTRICAL SHOCK, DO NOT EXPOSE THIS APPLIANCE TO RAIN OR MOISTURE.

This symbol, wherever it appears, alerts you to the presence of uninsulated dangerous voltage inside the enclosure — voltage that may be sufficient to constitute a risk of shock.

This symbol, wherever it appears, alerts you to important operating and maintenance instructions in the accompanying literature. Read the manual.

Notice For U.K. Customers
WARNING: THIS APPLIANCE MUST BE EARTHED.

The cores in the mains lead are coloured in accordance with the following code:

GREEN and YELLOW - Earth BLUE - Neutral BROWN - Live

As colours of the cores in the mains lead of this appliance may not correspond with the coloured markings identifying the terminals in your plug, proceed as follows:

The core which is coloured green and yellow must be connected to the terminal in the plug marked with the letter E, or with the earth symbol, (⏚), or coloured green, or green and yellow.

The core which is coloured blue must be connected to the terminal marked N or coloured black.

The core which is coloured brown must be connected to the terminal marked L or coloured red.

Detailed Safety Instructions

All the safety and operating instructions should be read before the appliance is operated.

Retain Instructions: The safety and operation instructions should be retained for future reference.

Heed Warnings: All warnings on the appliance and in the operating instructions should be adhered to.

Follow Instructions: All operation and user instructions should be followed.

Water and Moisture: The appliance should not be used near water (e.g., near a bathtub, washbowl, kitchen sink, laundry tub, in a wet basement, or near a swimming pool, etc.).

Ventilation: The appliance should be situated so that its location or position does not interfere with its proper ventilation. For example, the appliance should not be situated on a bed, sofa, rug, or similar surface that may block the ventilation openings; or, placed in a built-in installation, such as a bookcase or cabinet that may impede the flow of air through the ventilation openings.

Heat: The appliance should be situated away from heat sources such as radiators, heat registers, stoves, or other appliances (including amplifiers) that produce heat.

Power Sources: The appliance should be connected to a power supply only of the type described in the operating instructions or as marked on the appliance.

Grounding or Polarization: Precautions should be taken so that the grounding or polarization means of an appliance is not defeated.

Power-Cord Protection: Power-supply cords should be routed so that they are not likely to be walked on or pinched by items placed upon or against them, paying particular attention to cords at plugs, convenience receptacles, and the point where they exit from the appliance.

Cleaning: The appliance should be cleaned only as recommended by the manufacturer.

Non-use Periods: The power cord of the appliance should be unplugged from the outlet when left unused for a long period of time.

Object and Liquid Entry: Care should be taken so that objects do not fall and liquids are not spilled into the enclosure through openings.

Damage Requiring Service: The appliance should be serviced by qualified service personnel when:
- The power supply cord or the plug has been damaged; or
- Objects have fallen, or liquid has been spilled into the appliance; or
- The appliance has been exposed to rain; or
- The appliance does not appear to operate normally or exhibits a marked change in performance; or
- The appliance has been dropped, or the enclosure damaged.

Servicing: The user should not attempt to service the appliance beyond that described in the operating instructions. All other servicing should be referred to qualified service personnel.

Gerät nur an der am Leistungsschild vermerkten Spannung und Stromart betreiben.

Sicherungen nur durch solche, gleicher Stromstärke und gleichen Abschaltverhaltens ersetzen. Sicherungen nie überbrücken.

Jedwede Beschädigung des Netzkabels vermeiden. Netzkabel nicht knicken oder quetschen. Beim Abziehen des Netzkabels den Stecker und nicht das Kabel enfassen. Beschädigte Netzkabel sofort auswechseln.

Gerät und Netzkabel keinen übertriebenen mechanischen Beaspruchungen aussetzen.

Um Berührung gefährlicher elektrischer Spannungen zu vermeiden, darf das Gerät nicht geöffnet werden. Im Fall von Betriebsstörungen darf das Gerät nur Von befugten Servicestellen instandgesetzt werden. Im Gerät befinden sich keine, durch den Benutzer reparierbare Teile.

Zur Vermeidung von elektrischen Schlägen und Feuer ist das Gerät vor Nässe zu schützen. Eindringen von Feuchtigkeit und Flüssigkeiten in das Gerät vermeiden.

Bei Betriebsstörungen bzw. nach Eindringen von Flüssigkeiten oder anderen Gegenständen, das Gerät sofort vom Netz trennen und eine qualifizierte Servicestelle kontaktieren.

On s'assurera toujours que la tension et la nature du courant utilisé correspondent bien à ceux indiqués sur la plaque de l'appareil.

N'utiliser que des fusibles de même intensité et du même principe de mise hors circuit que les fusibles d'origine. Ne jamais shunter les fusibles.

Eviter tout ce qui risque d'endommager le câble seceur. On ne devra ni le plier, ni l'aplatir. Lorsqu'on débranche l'appareil, tirer la fiche et non le cäble. Si un cäble est endommagé, le remplacer immédiatement.

Ne jamais exposer l'appareil ou le cäble ä une contrainte mécanique excessive.

Pour éviter tout contact averc une tension électrique dangereuse, on n'oouvrira jamais l'appareil. En cas de dysfonctionnement, l'appareil ne peut être réparé que dans un atelier autorisé. Aucun élément de cet appareil ne peut être réparé par l'utilisateur.

Pour éviter les risques de décharge électrique et d'incendie, protéger l'appareil de l'humidité. Eviter toute pénétration d'humidité ou fr liquide dans l'appareil.

En cas de dysfonctionnement ou si un liquide ou tout autre objet a pénétré dans l'appareil couper aussitôt l'appareil de son alimentation et s'adresser à un point de service aprésvente autorisé.

Hacer funcionar el aparato sòlo con la tensiòn y clase de corriente señaladas en la placa indicadora de caracteristicas.

Reemplazar los fusibles sòlo por otros de la misma intensidad de corriente y sistema de desconexiòn. No poner nunca los fusibles en puente.

Proteger el cable de alimentaciòn contra toda clase de daños. No doblar o apretar el cable. Al desenchufar, asir el enchufe y no el cable. Sustituir inmediatamente cables dañados.

No sometar el aparato y el cable de alimentaciòn a esfuerzo mecànico excesivo.

Para evitar el contacto con tensiones eléctricas peligrosas, el aparato no debe abrirse. En caso de producirse fallos de funcionamiento, debe ser reparado sòlo por talleres de servicio autorizados. En el aparato no se encuentra ninguna pieza que pudiera ser reparada por el usuario.

Para evitar descargas eléctricas e incendios, el aparato debe protégerse contra la humedad, impidiendo que penetren ésta o liquidos en el mismo.

En caso de producirse fallos de funcionamiento como consecuencia de la penetraciòn de liquidos u otros objetos en el aparato, hay que desconectarlo inmediatamente de la red y ponerse en contacto con un taller de servicio autorizado.

Far funzionare l'apparecchio solo con la tensione e il tipo di corrente indicati sulla targa riportante i dati sulle prestazioni.

Sostituire i dispositivi di protezione (valvole, fusibili ecc.) solo con dispositivi aventi lo stesso amperaggio e lo stesso comportamento di interruzione. Non cavallottare mai i dispositivi di protezione.

Evitare qualsiasi danno al cavo di collegamento alla rete. Non piegare o schiacciare il cavo. Per staccare il cavo, tirare la presa e mai il cavo. Sostituire subito i cavi danneggiati.

Non esporre l'apparecchio e il cavo ad esagerate sollecitazioni meccaniche.

Per evitare il contatto con le tensioni elettriche pericolose, l'apparecchio non deve venir aperto. In caso di anomalie di funzionamento l'apparecchio deve venir riparato solo da centri di servizio autorizzati. Nell'apparecchio non si trovano parti che possano essere riparate dall'utente.

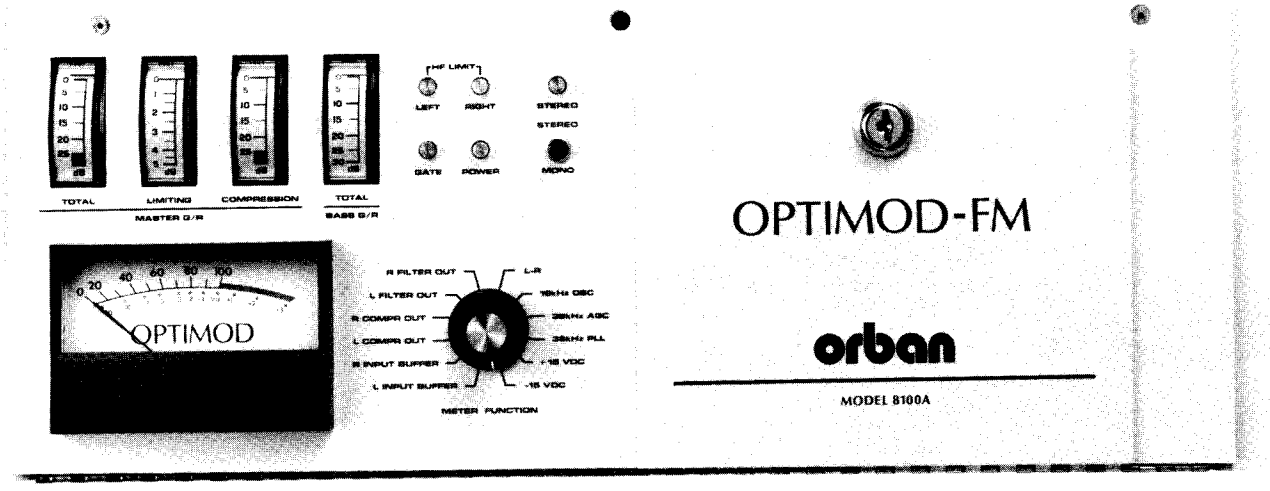
Per evitare scosse elettriche o incendi, l'apparecchio va protetto dall'umidità. Evitare che umidità o liquidi entrino nell'apparecchio.

In caso di anomalie di funzionamento rispettivamente dopo la penetrazione di liquidi o oggetti nell'apparecchio, staccare immediatamente l'apparecchio dalla rete e contattare un centro di servizio qualificato.

Operating Manual

OPTIMOD-FM®

MODEL 8100A1



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95039-000-06 600-IP-8/90

FIRST EDITION Issue 4 (revised August 1990)

This manual is for use with all OPTIMOD-FM® Models 8100A/1 to date. It is not directly applicable to the 8100A/1's immediate ancestor, the Model 8100A.

The Model 8100A/1 processor differs from the Model 8100A in that it has been modified for use with other Orban products such as:

8100A/XT Six-Band Limiter Accessory Chassis
which is used to obtain improved source-to-source consistency and/or presence on smaller radios and in cars.

Cards #5, #6, and #8/9 have been reconfigured in the Model 8100A/1 to allow use of the optional Model 8100A/XT Six-Band Limiter Accessory Chassis. The motherboard has been changed, and a prewired Accessory Port has been included to interface the Accessory Chassis.

In the current revision of this manual, references to the Dolby® 334 Noise Reduction Processor (including the interface information formerly contained in **Appendix G**) have been deleted. Please contact Customer Service for Dolby 334 interface information. References to FM quadraphonic broadcasting have also been deleted.

A new **Appendix G** gives information on changing the unit's preemphasis for those countries with a preemphasis standard different from the one used in the USA.

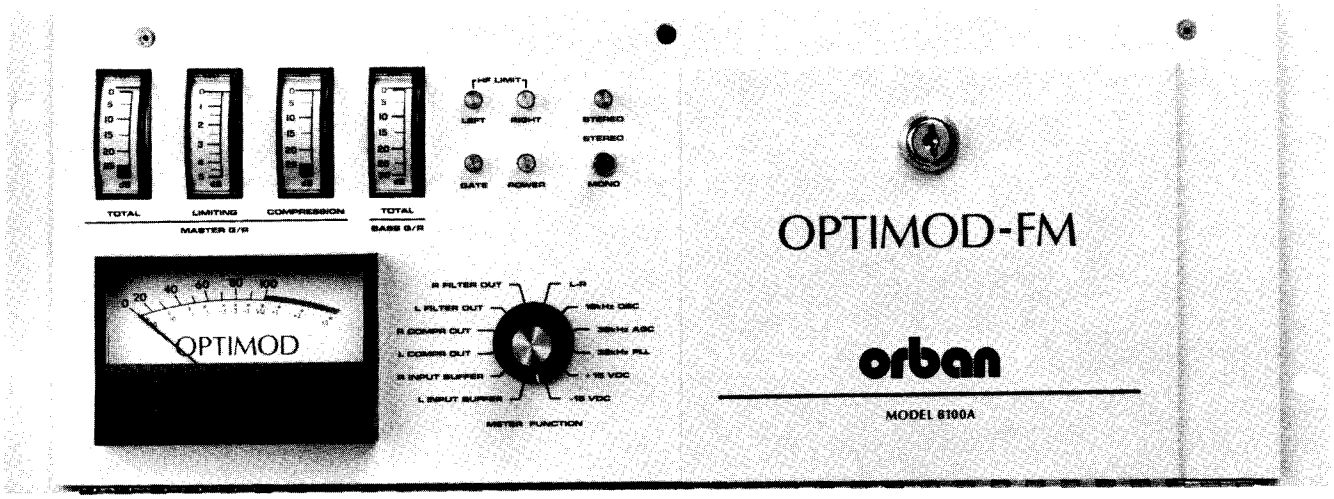
New information on the FM filter Card (#0) has been added. Appendix K (Audio Quality Considerations in FM Plants) has been deleted from the manual and now exists as a separate document shipped with your unit. References to FCC regulations have been updated.

Part 5 (Operating Instructions) has been extensively updated and revised.

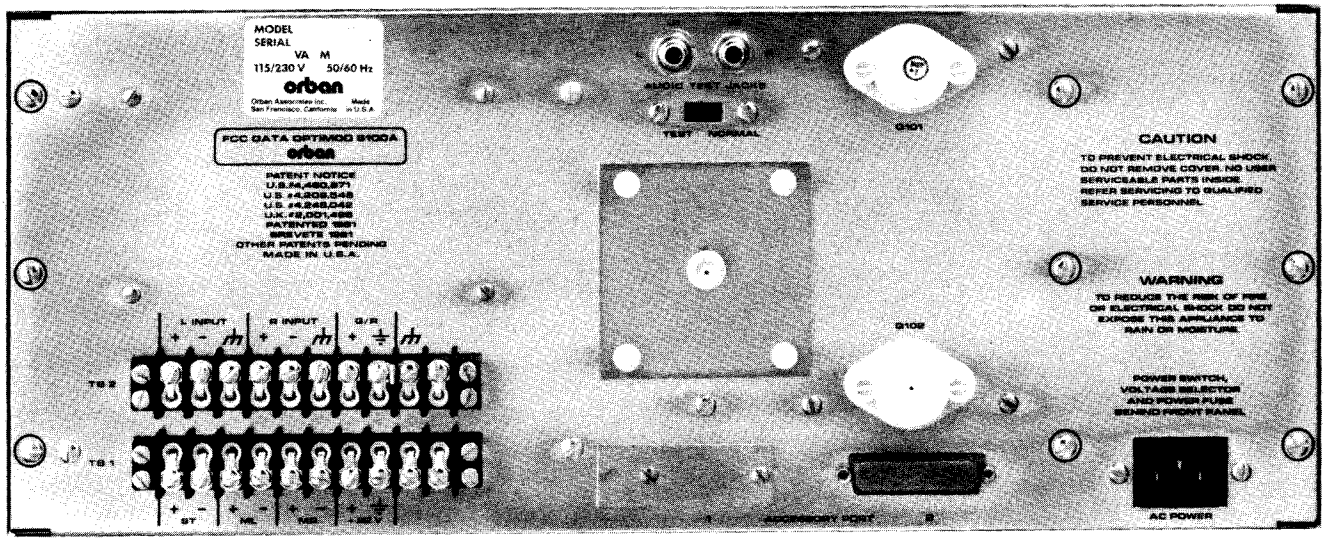
CAUTION

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

(per UL 813)



Front Panel



Rear Panel

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APPENDIX L: SPECIFICATIONS

APPENDIX M: FUNCTIONS OF JUMPERS ON PC CARDS

Preface

This Manual is organized into two major sections. The first contains information on how to plan your installation, how OPTIMOD-FM^R interfaces with other station equipment, how to set up and adjust OPTIMOD-FM, how to do an in-system performance verification, and brief comments on routine maintenance. You should read Parts 1, 2, and 3 before attempting to install OPTIMOD-FM.

The second section contains Appendices which provide useful information that you may need at some time during the life of OPTIMOD-FM. This is primarily reference material, and you do not need to digest it to install, set up, or operate your unit.

There is no Index, so the TABLE OF CONTENTS should be used to help you find the information you want. The TABLE OF CONTENTS provides an overview of the organization of the manual, and lists in some detail the topics discussed.

Registration Card: The original purchaser should have received a postpaid Registration Card packed with this manual.

Registration is of benefit to you because it enables us to tell you of new applications, possible performance improvements, service aids, etc., which may be developed over the life of the product. It also provides us with the date of sale so that we may more promptly respond to possible claims under Warranty in the future (without having to request a copy of your Bill of Sale or other proof of purchase).

Please fill in the Registration Card and return it to us.

If the Registration Card has become lost or you have purchased the unit used, please photocopy the image of the card reproduced on the following page and send it to us in an envelope. Use the address shown on the title page.

Do not allow your Dealer to submit the card for you. If he forgets, you can miss important future mailings and may be delayed in obtaining Warranty service.

Packing Material: The carton in which your OPTIMOD-FM was shipped was carefully designed to prevent damage from the stresses ordinarily encountered in commercial shipments. SAVE THE CARTON AND ALL PACKING MATERIAL in case you ever have to ship the OPTIMOD-FM chassis back to the factory for service.

User Feedback Form: We are very interested in your comments about this product. Your suggestions for improvements to either the product or this manual will be carefully reviewed. A User Feedback Form is provided for your convenience. If it is missing, please write us at the address on the title page. Thank you.

FCC Filing (U.S.A): A verification has been filed with the Commission that the stereo generator section of OPTIMOD-FM Model 8100A/1 meets all requirements of FCC 73.322 when used with a direct-FM exciter originally designed with sufficient bandwidth to accept a stereo generator. As of this writing, there is no requirement that the FCC be notified that you have changed stereo generators.

Security (Keys and Locks): To control access to the setup controls, the access door is fitted with a lock. Two keys are supplied. These can be duplicated as desired.

The dealer from whom your 8100A/1 was purchased can supply additional keys, as can the factory. In either case, your Registration Card must be on file at the factory, and you must supply your serial number to obtain replacement keys.

If all keys are lost, you can obtain access by removing the three hex-socket screws from the top of the main front panel with a 5/64" hex wrench (one was supplied with the unit).

If you wish to make the unit's adjustments more secure, obtain similar splined-socket or aircraft tri-point screws (and tools), and use these in place of the hex-socket screws supplied. (Tools for these are not commonly found in hardware stores or other places D.J.'s might frequent.) The screws are 6-32 x 3/8" 82° flathead, nickel-plated steel.

Registration Card

Model # _____ Serial #_____ Purchase Date_____

Your name_____ Title _____

Company_____ Telephone _____

Street_____

City, State, Mail Code (Zip), Country_____

Nature of your product application _____

How did you hear about this product?_____ Purchased from _____

Comments_____

_____

Which magazines do you find the most useful to your job?

___ Audio	___ Broadcast Engineering	___ Broadcast	___ dB Magazine
___ Electronic Musician	___ EQ	___ Millimeter	___ Mix
___ Post	___ Pro Sound News	___ Radio & Records	___ Radio World
___ RE/P	___ Sound & Communications	___ S & VC	___ TV Broadcast
___ TV Tech	___ _____	___ _____	
	___ _____	___ _____	

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Duplicate Registration Card

PART 1:

Introduction

1

Function of OPTIMOD-FM: OPTIMOD-FM is an integrated signal-processing system which replaces conventional compressors, limiters, clippers, and stereo generators. Each part of the OPTIMOD-FM system has been precisely engineered to be compatible with all other parts to achieve optimum performance.

OPTIMOD-FM should be fed unprocessed audio. NO OTHER AUDIO PROCESSING IS NECESSARY, OR DESIRABLE.

Briefly, the OPTIMOD-FM system performs the following functions:

1. It rides gain over a range of as much as 25dB, compressing dynamic range and compensating for gain riding errors on the part of operators. The amount of dynamic range reduction ordinarily produced is adjustable. When OPTIMOD-FM is operated with an optimum release time setting, gain riding and compression are virtually undetectable because of advanced program-controlled time constants and multiband compression.

2. It prevents aliasing distortion in the stereo generator by means of bandwidth-limiting 15kHz lowpass filters. Full overshoot compensation is provided for these filters. OPTIMOD-FM thus provides extremely tight control over peak modulation, preventing overmodulation and controlling the baseband spectrum simultaneously.

3. When OPTIMOD-FM's dual-band compressor is operated in "independent" mode, OPTIMOD-FM can make audio quality more consistent by correcting frequency balances between bass and midrange material. When operated in "wideband" mode, OPTIMOD-FM will preserve frequency balances and will produce an output which sounds almost precisely like its input.

4. OPTIMOD-FM prevents peak overload and overmodulation due to the effects of the FM preemphasis curve.

5. OPTIMOD-FM generates a stereo baseband signal with outstanding separation, low crosstalk, and vanishingly low distortion and spurious components.

Optional accessories for the OPTIMOD-FM provide for separate studio and main chassis (8100A/ST), six-band limiting (8100A/XT), and special filtering (Accessory Kit 22). These accessories are discussed in greater detail at the end of this part of the Operating Manual.

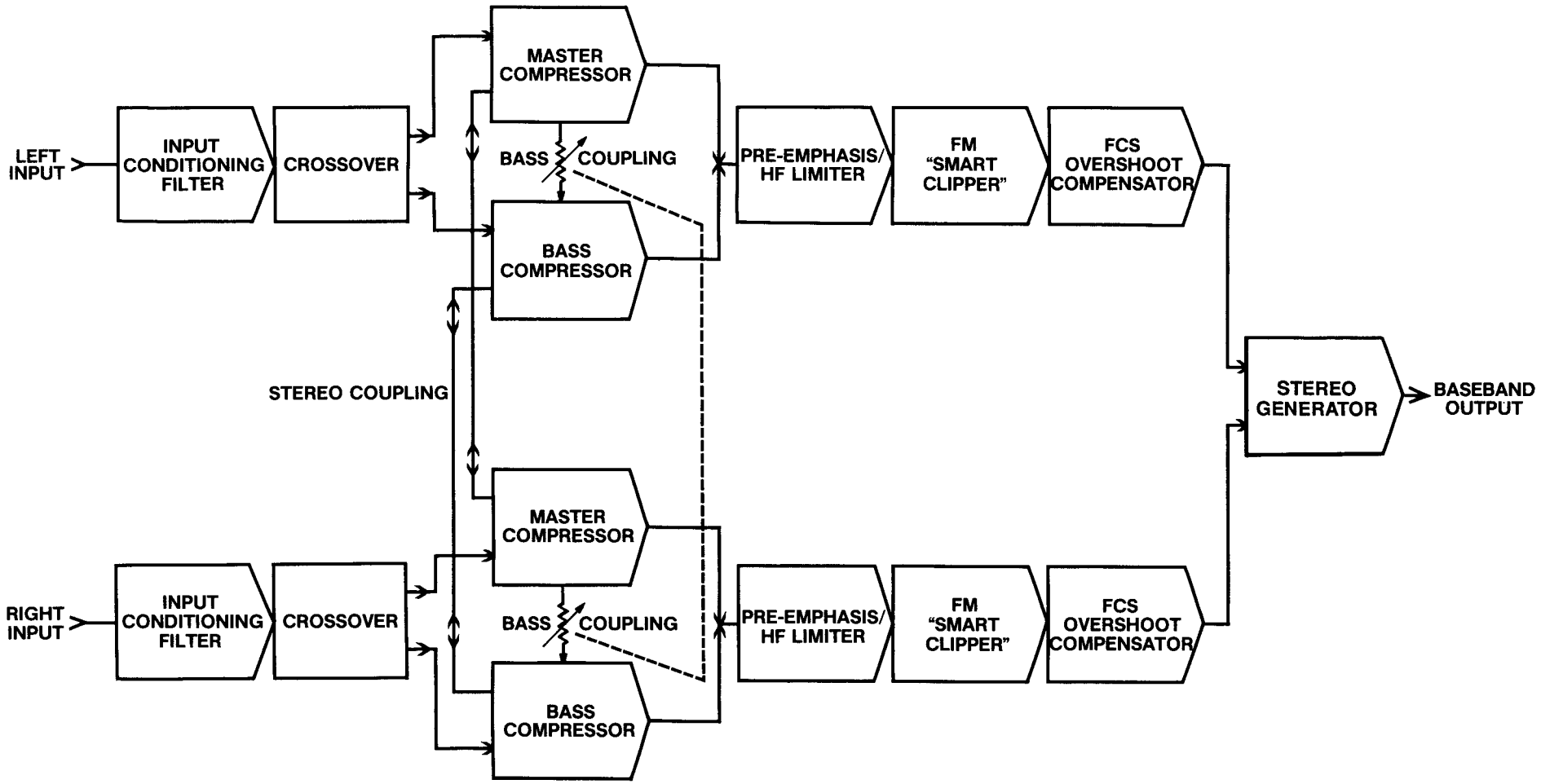

Fig. 1-1: OPTIMOD-FM Model 8100A/1 Signal Flow Diagram

SIMPLIFIED SYSTEM DESCRIPTION

OPTIMOD-FM Model 8100A/1 consists of six basic blocks. See cover and figure 4-5 for illustration of controls.

1. Input Conditioning Filter: This consists of 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. Even if an AFC doesn't unlock, it can attempt to "track" subsonic information, thus producing IM distortion. The 30Hz highpass filter can be defeated (although we have purposely made it slightly inconvenient to do so); the phase scrambler is an essential part of the system and is non-defeatable.

2. Dual-Band Compressor: This consists of two compressors in parallel: "Bass" which processes audio below below 200Hz (12dB/octave crossover), and "Master" which processes above 200Hz. A BASS COUPLING control adjustable by the user determines if the two bands will operate discriminately ("independent" mode), or if the "Bass" band will be forced to track the "Master" band ("wideband" mode), thus preserving frequency balances. Intermediate partial-crosscoupling settings are also available.

Even in "wideband" mode, the bass control loop is still active. Therefore, heavy bass will cause a momentary reduction in the gain of the "Bass" band rather than forcing gain reduction of the entire signal (as in a true wideband system), thus avoiding pumping.

Time constants and other parameters of the Dual-Band Compressor have been adjusted so that the summed and preemphasized output of the two bands can be connected directly to the FM Smart Clipper™. No further gain reduction is required for distortion control, and maximum naturalness is preserved.

The threshold of limiting is adjustable over a 6dB range by the CLIPPING control. This determines the output level of the compressor, and thus the amount of HF limiting and clipping which occur later in the system.

The release time of the "Master" band only is adjusted with the RELEASE TIME control, thus permitting loudness/fatigue tradeoffs according to format requirements.

Both "Master" and "Bass" compressors are gated such that the release time is slowed by a factor of approximately 50:1 when the input level drops below a threshold adjustable by the GATE THRESHOLD control. This prevents noise rush-up during program pauses, and makes the 25dB gain reduction range usable. Simultaneously, the gain does not get "stuck" forever, so low-level musical passages are eventually increased in level. Since gain recovery takes over one minute to occur in GATED mode, the gradual increase in level cannot be perceived.

Gain reduction in both "Master" and "Bass" compressors is metered by edgewise-reading meters calibrated with a dB-linear scale. To provide best value, no attempt has been made to make these meters extremely accurate, and their readings may disagree with the actual gain reduction by a much as ±20%. This accuracy is fully adequate for the purpose, since the amount of gain reduction varies widely with variations in program material and operator gain riding.

3. Preemphasis And High Frequency Limiter: The summed outputs of the two compressors are applied to a phase corrector, 24dB/octave 15kHz lowpass filter, preemphasis network, and high frequency limiter. The purpose of the lowpass filter is to prevent out-of-band components from affecting the operation of the high frequency limiter and to avoid intermodulation between out-of-band frequency components and in-band frequency components in the clipper. Phase correction reduces the peak level increase caused by filter ringing and preemphasis to the theoretical minimum, thus reducing the amount of clipping.

The high frequency limiter is controlled by high frequencies only (rather than by the peak level of the preemphasized signal, as in the old Model 8000A), thus eliminating any possibility of modulation of high frequency content by low frequency material.

The threshold of limiting of the high frequency limiter is user-adjustable over a 3dB range, permitting brightness and high frequency distortion to be traded off according to format requirements. Because the FM Smart Clipper incorporates IM distortion cancellation, substantially more clipping can be accomplished without objectionable distortion than in the old Model 8000A, and significantly improved high frequency power handling capability is achieved through the system.

4. FM Smart Clipper: The Smart Clipper provides the peak limiting function, and contains filters to assure that the clipping does not introduce out-of-band frequency components above 19kHz which could cause aliasing distortion.

The output of the HF limiter is applied to a clipper with automatically-varying threshold. This clipper performs the basic peak limiting function. The output of the clipper is subtracted from its input, thus deriving the distortion added by the clipper. This distortion component is lowpass filtered at 2.2kHz (the knee of the 75us preemphasis curve), and then added to the clipped signal. This "smoothing signal" cancels all clipper-induced distortion below 2.2kHz by 30dB or more, and is particularly effective in eliminating the effects of high-frequency IM, such as sibilance splatter.

The 2.2kHz distortion-cancelling lowpass filter has a time delay. To assure proper distortion cancellation, the main clipped signal must be delayed by an equal amount before the main signal and distortion-cancelling signal are added. The main signal is delayed by a phase-corrected 15kHz lowpass filter, which also removes all out-of-band harmonics caused by the clipping process.

5. Frequency-Contoured Sidechain (FCS) Overshoot Corrector: The output of the Smart Clipper contains overshoots due to the addition of the distortion-cancelling signal, and due to unavoidable overshoots in the 15kHz filter. These overshoots must be eliminated without adding out-of-band frequency components. This is done in the FCS Overshoot Corrector.

The FCS circuit first derives that part of the signal exceeding the 100% modulation point by means of a "center clipper". If these overshoots were then subtracted from the input signal, the overshoots would be cancelled -- in fact, doing so would be equivalent to simple clipping. Unfortunately, this can't be done because the overshoots contain out-of-band frequency components which would cause aliasing distortion if applied directly to the stereo generator.

We therefore lowpass-filter the overshoots to eliminate out-of-band components. If the overshoot filter had a flat response to its cutoff frequency, this filtering action would reduce the amplitude of high-frequency overshoots (by removing out-of-band harmonics which make the overshoots "spikey"). This would result in incomplete cancellation of the overshoots after subtraction. The overshoot filter is therefore designed to have a rising response at 15kHz, effectively increasing the gain of the fundamentals of the higher-frequency overshoots and compensating for the fact that their harmonics have been removed. The overshoot extractor and this filter are the "Frequency-Contoured Sidechain".

The overshoot filter has phase shift. Phase shift networks are therefore included in the main path to make sure that the overshoot subtraction process works correctly, and that the overall FCS system has constant time delay.

The rising response of the overshoot filter means that essentially no extra subtraction gain (compared to the system operated without the filter as a simple differential clipper) is required. Any low frequency IM introduced by the FCS circuit is therefore no worse than the low-frequency IM caused by a simple clipper.

Because the FCS circuit is an instantaneous system and uses no gain reduction or dynamic filtering, it causes neither pumping nor dulling of program material.

6. Stereo Generator: The stereo generator accepts the processed outputs from the left and right FCS circuits, and produces the stereo baseband signal. It is characterized by high stability, very low distortion, and minimal spurious outputs. 19kHz oscillator level, pilot phase, and separation are all controlled and stabilized by means of servo loops.

The stereo baseband is generated by the "matrix" technique, as opposed to the more common "switching" design. The "matrix" design modulates only the L-R component, and passes the L+R component through to the output without degradation due to switching. Since the L+R component almost always dominates, this results in maximum audio quality. In addition, no baseband lowpass filter is required. Such a filter would add to system cost, and could compromise separation.

To facilitate adjustment of pilot phase and measurement of main-channel-to-subchannel and subchannel-to-main-channel crosstalk, two special TEST modes are provided. These apply the right channel audio directly to the main or sub inputs of the stereo generator. For testing, these stereo generator audio inputs can be accessed by means of a pair of TEST jacks on the rear chassis apron. This provides an alternate means of measuring crosstalk and other stereo generator performance parameters.

The stereo generator can be operated in STEREO, MONO LEFT, or MONO RIGHT modes. All three modes can be selected by remote control by means of optically-isolated remote control terminals. STEREO and one of the two MONO modes can be selected locally by means of a front-panel switch. An internal strap determines which of the two MONO modes is selected. Another internal strap determines which of the three modes will be entered on powerup.

VU Meter: The front-panel VU meter can monitor the level of the left and right audio at three different points in the circuitry. (See **Block Diagram** [p. J-21] for metering points.) The meter also monitors the difference between left and right channels (L-R) to aid channel balance adjustments.

Three stereo generator parameters are monitored: 19kHz pilot oscillator level, 38kHz AGC control voltage, and 38kHz Phase-Locked Loop control voltage. The latter two readings will vary, and are used to check whether these servo loops are within their ordinary operating range, or whether they are saturated.

Finally, the +15 and -15V power supply voltages are monitored.

Accessories Currently Available:

8100A/ST STUDIO ACCESSORY CHASSIS

(A separate manual is supplied with this unit.)

In some installations, it may be desirable to perform the compression function ahead of the STL to optimize system signal-to-noise ratio by relaxing STL headroom requirements. (STL's are discussed further in **Part 2**). The Model 8100A/ST Accessory Chassis (which performs this function) consists of a chassis shell assembly with a power supply/metering card and three empty card locations. Cards #3, #4, and #5 (the Dual-Band compressor cards) are removed from the Main Chassis and installed in these locations. Dummy cards provided with the Accessory are then installed in the Main Chassis to preserve the signal path.

The Accessory Chassis provides convenient access at the studio to all operating controls except for H-F Limiting and stereo/mono mode switching. It provides the same gain reduction metering as the Main Chassis, and several diagnostic metering functions as well.

More complete information about the 8100A/ST is provided in a separate manual shipped with the unit.

8100A/XT SIX-BAND LIMITER ACCESSORY CHASSIS

(A separate manual is supplied with this unit.)

The optional 8100A/XT Accessory Chassis has been created to provide aggressive multiband processing for stations that desire bright, loud, "highly-processed" audio. Derived from OPTIMOD-AM Model 9100A, 8100A/XT consists of a stereo bass equalizer which drives a stereo six-band limiter cascaded with the exclusive Orban distortion-cancelling multiband clipping system. When added to the basic 8100A/1 system, the 8100A/XT creates a dense, consistent sound without pumping or other obvious processing artifacts.

Functionally, the unit replaces the high frequency limiter within the 8100A/1 and permits the following objectives to be met:

-- For most types of program material, increased loudness for a given level of audible processing side-effects (by comparison to an unmodified 8100A/1 or 8100A);

-- Improved consistency from source to source due to the "automatic equalization" effect of the six-band limiter; and,

-- Increased presence and intelligibility on smaller radios and in autos.

The 8100A/XT is most appropriate for contemporary popular music formats, although its ability to improve consistency and intelligibility can make it useful for talk and news formats as well. It is generally unsuited for "beautiful" or classical formats.

The Model 8100A/1 is prewired to readily accept the 8100A/XT. (Older 8100A's must be converted by means of retrofit kit "RET-27" before they can accept the 8100A/XT.)

The 8100A/XT uses a great deal of the existing 8100A/1 circuitry in the interest of achieving efficiency and economy. The 8100A/XT (which requires two rack units) is mounted directly below the 8100A/1 and is then plugged into a multipin connector on its rear panel. Jumpers on Cards #5, #6, #8, and #9 within the 8100A/1 must then be moved according to instructions in a manual supplied with the 8100A/XT.

The normal positions of 8100A/1 card jumpers when the 8100A/XT is not in use are tabulated in **Appendix M** of this Manual.

The 8100A/XT is fully compatible with the Studio Accessory Chassis Model 8100A/ST, allowing use of the 8100A/XT in either single- or split-chassis installations. In all cases, the 8100A/XT is mounted immediately below the main (8100A/1) chassis.

Full instructions for installing and operating the 8100A/XT are included in the **Operating Manual** for that unit. That Manual also includes a complete discussion of the 8100A/XT's principles of operation, how it relates to the 8100A/1, and other information important to those who plan to use the unit.

ACCESSORY KIT 22: FM FILTER CARD (#0)

(Separate installation and alignment instructions are included in this kit.)

The OPTIMOD-FM Model 8100A/1 has been designed to meet all FCC Rules regarding crosstalk between the main channel and subchannel and vice-versa. However, higher performance than this is sometimes desirable to fully protect SCA subcarriers from interference caused by the operation of the 8100A/1's safety clippers (on cards #8 and #9) on extremely densely-processed program material.

Card #0 replaces each safety clipper with two cascaded overshoot-compensated lowpass filters. This reduces "splatter" in the SCA region of the baseband by 25-30dB compared to the "stock" 8100A, and simultaneously reduces any residual overshoot by about 5%. This processing can achieve loudness within 0.3dB of that produced by composite clipping (an inaudible difference), while protecting the SCA region about 40-50dB better than a composite clipper.

Card #0 is installed in the signal path between the output of the existing cards #8/9 and the input of card #7 (stereo generator). The frequency response of the card is typically +0, -0.1dB, 30-15,000Hz. An 8100A/1 containing this card will therefore perform well within its ±0.75dB specification.

Card #0 has been specifically designed to be used in conjunction with the 8100A/1's existing FCS Overshoot Corrector. Card #0 is therefore unusable with our older Optimod-FM Model 8000A, or with other manufacturers' equipment.

This concludes the **Introduction and Simplified System Description.** The next part of this manual (**Application**) should now be read carefully to assure that your installation produces optimum results.

PART 2:

Application

This Part of the Manual provides essential information on how OPTIMOD-FM fits in with the rest of the equipment at your station. **Appendix K** contains further information on achieving high audio quality.

Studio/Transmitter Links: There are five types of studio/transmitter links in common use internationally in FM stereo service. These are:

1) Analog land-lines (telephone lines)
2) Dual-microwave STL's
3) Composite baseband microwave STL's
4) PCM (Pulse-Code Modulation) links
5) Video STL's with PCM adapters

All except (3) carry both audio channels either directly, or in some encoded form other than the standard 19kHz "pilot tone" stereo baseband. These links are ordinarily fed both left and right audio channels in non-encoded form, and their receiver output is the regenerated left and right channels.

The composite STL (3) carries the standard "pilot tone" stereo baseband, and is therefore fed from the output of a stereo generator like the one in the 8100A/1. The receiver output of the composite STL is the stereo baseband signal, which is applied directly to wideband input of the FM broadcast transmitter's exciter.

In general, highest quality is obtained by use of a composite microwave STL provided that a line-of-sight transmission path of less than 10 miles or so exists between studio and transmitter. If not, RF signal-to-noise ratio, multipath distortion, and diffraction effects can cause serious quality problems.

The dual-microwave system provides more noise immunity. However, problems include gain- and phase-matching of the left and right channels, preemphasis-induced overloads, and requirements that the audio applied to the microwave transmitters be processed to prevent overmodulation.

Land-line quality is extremely variable, ranging from excellent to atrocious. The decision on whether to employ land-lines depends a great deal on the quality locally available. However, even the best land-lines tend to slightly veil audio quality due to line equalizer characteristics, phase shifts, and repeaters of indifferent quality.

PCM links are generally unavailable in the USA as of this writing, although they are widely used in Europe. They achieve good noise performance and consistency at the expense of a very sharp high-frequency cutoff, rapid changes in group delay around cutoff (unless elaborate phase equalization is used), and quantization distortion. At the moment, there is considerable disagreement over how elaborate the coding must be to render quantization distortion inaudible to critical listeners, and no PCM system should be accepted without critical listening tests.

Some stations are sending PCM-encoded audio through a video STL at frequencies above 20GHz. Typically, consumer PCM adapters (from Sony or dbx, for example) are being used. The quality of signal received at the transmitter through this type of STL is high.

OPTIMOD-FM Model 8100A/1 is available in either single- or dual-chassis configurations. The dual-chassis splits the system at a point between the output of the Dual-Band Compressor and the input of the HF Limiter.

The dual-chassis configuration is ordinarily used with STL's of types (1), (2), and (4) of modest performance characteristics. By performing initial compression before the STL input, the dual-chassis version can prevent STL overload and can aid in achieving superior STL signal-to-noise ratio.

The single-chassis arrangement is suited for composite STL's, or for installations where studio and transmitter are at the same site or are connected by short, high-quality lines. Because it is less expensive than the dual-chassis version, the single-chassis version is also suited for use with any STL having extremely wide dynamic range (80dB or better) such that unprocessed audio can be passed to the compressor without danger of noise build-up when the compressor's gain increases towards its maximum.

It is important to note that the compressor section alone does not control peak levels accurately, and does not compensate for overloads caused by preemphasis. (Peak limiting and high frequency limiting are performed later in the system.) It is therefore necessary to allow headroom in the STL to accommodate compressor overshoots. If the STL is preemphasized at 50 or 75us (as is the case with many dual-microwave systems), further headroom must be allowed to accommodate the peak level increases caused by the preemphasis. Precise STL setup recommendations are provided in **Part 4** of this Manual.

If STL preemphasis can be readily modified, use of 25us preemphasis will match headroom to the typical spectral distribution of contemporary recorded material, thus achieving optimum STL signal-to-noise ratio.

Exciters: OPTIMOD-FM will interface with most direct-FM exciters although some older exciters designed before FM stereo standards were adopted may have to be modified to extend their bandwidths. If an input transformer is an essential part of such an older exciter (driving a push-pull input or providing a bias path for the input stage, for example), it may be possible to replace such a transformer with a Western Electric 111C coil. When loaded with 470 ohms, these coils can pass a stereo composite signal such that all requirements in part 73.322 of the FCC Rules are met.

WARNING!
(U.S.A. customers)

Exciter modifications must conform to the requirements of 73.257 of the FCC Rules.

OPTIMOD-FM cannot be used with exciters using phase modulators. Such exciters include Phasotron™ and Serrasoid™ designs.

In general, modern solid-state exciters provide both vastly improved reliability and audible improvements in sound quality when compared to pre-1961 designs, and such older exciters should be retired if at all possible. In fact, the latest generation of exciters provides audibly improved performance over the earlier generation of solid-state units as well.

To our knowledge, the baseband output of OPTIMOD-FM can be directly connected without additional interfaces to the wideband input of all direct-FM exciters designed after 1963, with the exception of the following:

RCA BTE-15: Obtain a jumper plug directly from Orban.

Gates (Harris) TE-1, TE-3: Obtain the Orban Associates ATE-3F wideband interface panel, which fits in the chassis in place of the TE-3 stereo generator.

Collins 310Z-1: Obtain a factory update from Continental to convert to a 510R-1, and obtain the 785E-1 wideband interface card directly from Continental.

Continental 510R-1 (Collins 310Z-2): Obtain a wideband interface card directly from Continental.

Most wideband inputs are BNC connectors, and require a BNC-to-BNC shielded cable to connect to OPTIMOD-FM. Ordinarily, RG-58A/U cable should be used. (The Collins A830-2 exciter has an RCA phono jack input, and requires a BNC-to-RCA cable.)

Detailed information for interfacing OPTIMOD-FM with the BTE-15, TE-1, TE-3, 310Z-1, and 310Z-2 exciters is found in **Appendix H.**

RF Amplifiers And Antennas: It is important that the RF amplifier and antenna be sufficiently wideband to pass all sidebands of the FM signal without attenuation or phase shift. Ideally, the bandwidth should exceed 500kHz. Narrowband amplifiers and/or antennas may make the highs sound "gritty". This may become particularly noticeable due to the 8100A/1's outstanding high frequency power handling capability.

Any audible degradation can be assessed by using a high-quality FM tuner in "wideband" mode to compare the sound normally produced on the air with the sound produced by picking up the output of the exciter alone. The exciter must be correctly terminated by a resistive 50-ohm load. (If you leave it connected to the transmitter, VSWR resulting from impedance mismatches between exciter and RF amplifier can also cause distortion.) A tuner is specified because many modulation monitors use older design techniques and are unsuited for accurately assessing audio of exceptional quality.

SCA: OPTIMOD-FM operates well with SCA's because OPTIMOD-FM provides excellent baseband spectrum control, thus protecting that part of the baseband occupied by the SCA. No special SCA precautions need be taken; SCA should be implemented according to the instructions of the exciter manufacturer.

Although the 8100A/1 has been designed to meet all FCC Rules regarding crosstalk between the main channel and subchannel, extremely densely-processed program material may make it desirable to more fully protect SCA subcarriers from interference caused by the operation of the 8100A/1's safety clippers. The optional FM Filter Card (available as Accessory Kit 22) replaces each safety clipper with two overshoot-compensated lowpass filters. This processing can achieve loudness within 0.3dB of that produced by composite clipping (an inaudible difference), while protecting the SCA region about 40-50dB better than would a composite clipper.

Older exciters may not have separate SCA inputs. In most cases, one can be added simply by passively summing into the modulated oscillator through a resistor and small capacitor. Note, however, that such older exciters often suffer from narrow RF bandwidths which may cause SCA "birdies" due to intermodulation. Such problems may also occur if SCA injection is not limited to 10% modulation and deviation to ±4kHz.

If you are using a composite STL, be sure to limit SCA modulation to the amount recommended by the STL manufacturer or IM between the SCA and the main program may occur in the STL.

Remote Control Functions: OPTIMOD-FM's three operating modes (STEREO, MONO LEFT, and MONO RIGHT) can be selected by remote control. The MONO LEFT and MONO RIGHT functions are useful in the case of failure of one channel of the STL or one channel of 8100A/1 audio processing. The good channel can be fed in mono, and programming can be continued by selecting the good channel and MONO mode.

The remote control ports are easily interfaced with virtually all commercial remote controls.

A remote TOTAL MASTER GAIN REDUCTION meter can also be fitted to enable the operator to observe the amount of gain reduction his levels are producing.

Details on how to interface the remote functions is provided in **Part 3** of this manual.

DIFFICULT ENVIRONMENTS

1. Where humidity is typically high, the environment should be controlled to prevent moisture from condensing on circuit cards of all plant equipment, including OPTIMOD-FM, as this can degrade performance. Using some of the exhaust from the transmitter to heat the building slightly above ambient temperature is often sufficient to prevent problems.

2. If electrical storms are frequent, it may be advisable to add suitable varistors between each incoming wire (AC, remote control, and audio) and a solid earth ground as indicated by local experience.

3. After a power failure, bear in mind that the stereo generator mode-control logic will come up according to the power-up mode for which it was strapped (see **Initialization Options** in **Part 3**), unless the power interruption was less than one second or so. In this case, the powerup circuitry may not have sufficient time to reset, and an undesired mode may be entered.

PART 3:

Installation

Registration Card: If you have not already done so, please fill out the Registration Card fully and mail it to the factory. (See **Preface.**)

Unpacking And Initial Inspection: You are now ready to proceed with unpacking and installation of your OPTIMOD-FM.

Sometime during the life of your OPTIMOD-FM, you may wish to re-ship or return it. Since it is expensive and heavy, it is advisable to ship it only in the original packing materials which have been carefully designed to protect it. For this reason, it is wise to mentally note the method of packing and to save all packing materials.

If you might be returning it:

--Don't cut the grounding pin from the power cord (use the adapter provided if you must defeat the safety grounding provision);

--Set the unit only on soft, clean surfaces to prevent damage to painted or plated surfaces (a folded newspaper will do);

--Use the nylon-washered rack screws supplied to protect the panel from paint chipping.

Sage advice for repacking and reshipping your unit is contained at the end of **Appendix F.**

Various items are packed with OPTIMOD-FM:

(1) Line Cord
(4) 10-32x3/4" Rack Screws
(1) 3-wire AC Adapter (USA)
(1) Operating Manual
(1) 5/64" Allen Wrench (for front panel screws)
(2) Keys For Adjustment Door
(1) 24" BNC-to-BNC Cable (for composite output)
(2) 620-ohm ±5% 1/4-watt carbon film resistors
(for input termination, where required)
(1) Final Factory Qualification Test Results

Physical Examination: Perform a general inspection of the perimeter of the unit to check for obvious damage.

DAMAGE CLAIMS MUST BE MADE BY YOU AGAINST THE CARRIER IMMEDIATELY UPON DISCOVERY. Save packing and other evidence of damage for the carrier's inspector.

PART 3:

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DAMAGE CLAIMS MUST BE MADE BY YOU AGAINST THE CARRIER IMMEDIATELY UPON DISCOVERY. Save packing and other evidence of damage for the carrier's inspector.

Set the unit on a flat, soft surface. Remove the three hex-socket screws at the top of the front panel using the wrench provided. The front panel, which is hinged at the bottom, will then tilt downward and reveal the interior. Look for IC's or other loose parts which may have fallen out during shipment.

Remove the subpanel through which the controls protrude by twisting the four DZUS fasteners 1/4 turn counterclockwise. Tilt the panel to remove it. This reveals the "card cage".

Various components are mounted in sockets for servicing convenience. It is possible (but improbable) that a component could be dislodged by heavy shocks in shipment.

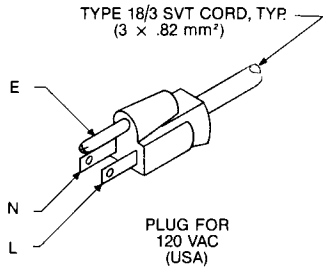
Starting at the left, using the card ejector tabs, carefully remove each card in turn, examine it, and replace it. Make sure that all components are properly seated in their sockets. Check with particular care to make sure that none of the can-type IC's are held in their sockets by one row of leads only.

Power Considerations: OPTIMOD-FM will operate on 115/230V ±15% 50-60Hz AC power. Without applying power to the line cord, turn the power switch ON and check the position of the LINE VOLTAGE SELECTOR switch. Units are shipped with this switch in the "115 Volt" position, unless labeled otherwise on the line cord. Adjust the selector switch so that the appropriate voltage is indicated. (If OPTIMOD-FM is installed within a transmitter, 230V may be the only power available.) Check the fuse, and replace with the following values if necessary:

115 VOLT: 1/2 Amp, 1/4 x 1 1/4 SLO-BLO (or 5 x 20 mm, type T)
230 VOLT: 1/4 Amp, 1/4 x 1 1/4 SLO-BLO (or 5 x 20 mm, type T)

AC connection to the chassis is made through an RF filter with IEC-standard mains connector. This filter is designed to meet the standards of all international electrical safety authorities, and leaks less than 0.5mA to the chassis when operated from 230V mains.

A U.S.A.-standard "U-ground" power cord is supplied to connect to the IEC socket, unless a different cord and connector is ordered. Users in other countries will ordinarily be able to easily obtain a power cord compatible with their country's standard. If you choose to cut the "U-Ground" plug from the cord and replace it with a plug appropriate to your standards, refer to Fig. 3-1 below.



CONDUCTOR		WIRE COLOR	
		Normal	Alt
L	LINE	BROWN	BLACK
N	NEUTRAL	BLUE	WHITE
E	EARTH GND	GREEN-YELLOW	GREEN

Fig. 3-1: AC Mains Cord Detail

In areas where power lines are frequently struck by lightning, it may be advisable to connect voltage-dependent resistors (varistors) between each side of the line and earth, sized according to local experience.

Initialization Options: This section describes how to change certain operating characteristics of OPTIMOD-FM to suit your needs. If your needs correspond to the "factory-standard" characteristics, then no modifications need to be made, and you may skip to **Reassembly** below. **Appendix M** provides a quick summary of all 8100A/1 jumper options.

All modifications are made on the plug-in circuit cards. If the steps regarding physical inspection above have been followed, the cards are now readily accessible.

1) **Powerup Mode:** OPTIMOD-FM is shipped to power up in STEREO mode. To restrap so that it powers up in either MONO LEFT or MONO RIGHT mode, you must move a jumper plug on Card #7 according to Fig. 3-2.

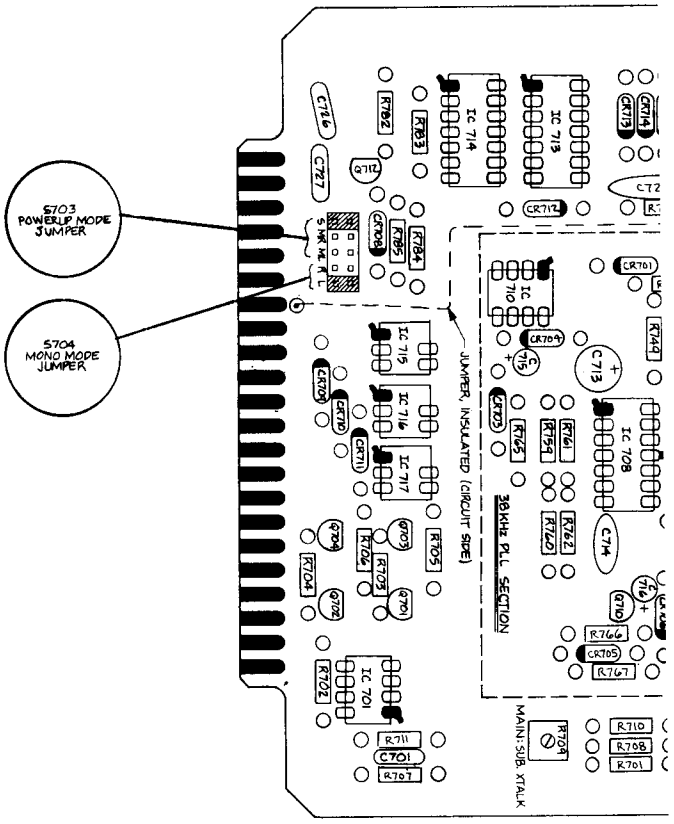


Fig. 3-2: Card #7 Powerup and Mono Mode Jumpers

2) **Mono Mode:** The front-panel STEREO/MONO switch ordinarily forces MONO LEFT mode when MONO is selected by this switch. If MONO RIGHT is desired, move a jumper plug on Card #7 according to Fig. 3-2.

3) **Input Attenuator Pads:** OPTIMOD-FM is shipped with 20dB pads ahead of the input buffer amplifiers. These are located on Card #3 (left channel) and Card #4 (right channel), and are suited for nominal input levels from -10 to +10dBm. If lower input levels from -30 to -10dBm are present, the pads must be defeated. To do this, remove Card #3. Reposition the jumper straps according to Fig. 3-3. Repeat for Card #4, and replace both cards.

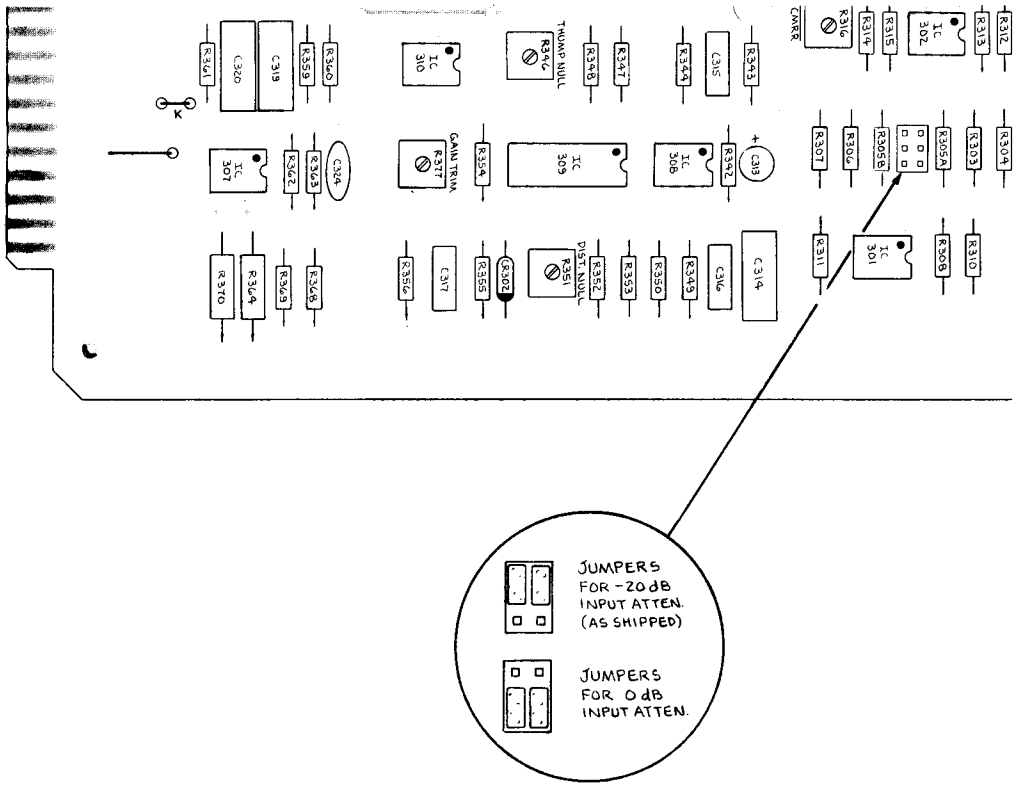


Fig. 3-3: Cards #3/#4 Input Attenuation Jumpers

4) **Defeating The 30Hz Highpass Filters:** There is no formal jumper for defeating these filters because we feel that the overall broadcast system will work better with the filters in for reasons discussed in detail in paragraphs **1.b** of **Appendix A.** We recognize that there are those who will disagree. Those who wish to defeat the filters can do so by connecting a jumper between pins 3 and 7 of IC302 (Card #3) and IC402 (Card #4).

Reassembly: When the physical examination, line voltage adjustment, and optional initialization procedures are completed, replace the subpanel. The subpanel, besides carrying knob identification and calibrations and holding the cards in place, also provides RF shielding for the cards. So, all four DZUS fasteners should be engaged by turning 1/4-turn clockwise.

The front panel may now be closed and fastened using the three hex-socket screws. Normally, all access required from now on can be achieved through the smaller access door (equipped with a key lock).

Initial Electrical Checkout: Plug the power cord into an outlet whose voltage corresponds to the setting of the internal LINE VOLTAGE SELECTOR switch. The unit should spring to life. Check to make sure that the following conditions occur:

A) The green POWER LED is illuminated;
B) The red GATE LED is illuminated;
C) The green STEREO LED is illuminated (unless you have restrapped Card #7 for MONO powerup);
D) Both yellow HF LIMIT LED's are off;
E) The VU meter readings are approximately identical to those provided in the "Final Factory Qualification Test Results" supplied separately from this Manual.

If anything is abnormal, repeat the **Physical Inspection** described above to make sure that you didn't miss anything. A preliminary diagnosis should be made, and, if necessary, the factory should be consulted.

If you wish to perform a more rigorous and complete checkout before installation, **Appendix D (Field Audit-Of-Performance Procedure)** provides complete instructions.

Equipment Location: OPTIMOD-FM is supplied in either single-chassis or dual-chassis versions. The dual-chassis version splits the system at the output of the Compressor. The studio chassis may be located in any convenient rack space in the studio. It is important to bear in mind that its RFI suppression is modest because it was assumed that the unit would be operated at a considerable distance from high-powered transmitters.

The main chassis, which is highly RFI-suppressed, is ideally located within 6 feet (1.8m) of the transmitter's exciter or composite STL transmitter. (The BNC/BNC cable supplied is 24" [61cm] long; longer cables must be supplied by the customer.) It requires 4 units (7", 17.8cm) in a standard 19" rack. If it is impossible to locate the OPTIMOD-FM chassis within 15 feet of the transmitter-mounted exciter, we recommend that you remove the exciter from the transmitter and mount it close to the OPTIMOD-FM chassis, rather than attempting to run a long baseband cable in a high RF field. Another advantage of moving the exciter away from the vibration of the transmitter blower is that microphonic effects will be reduced, thus improving signal-to-noise ratio.

If this is totally impractical, the OPTIMOD-FM stereo generator may be modified to drive higher capacitance. To do this, replace IC704 with an Analog Systems (P.O. Box 35879, Tucson, AZ 85740) type MA-332 operational amplifier and replace R739 with a 10-ohm $\pm$5% 1/4-watt carbon film resistor. This will permit OPTIMOD-FM to drive up to 30 feet of RG-58A/U without problems due to capacitive loading. However, RF pickup in a cable of this length may prove problematical. (The MA-332 is pin-for-pin compatible with the stock AD-518 opamp and simply plugs into its socket.)

If the exciter is moved, be sure to use coaxial cable between exciter and IPA which properly matches the exciter output impedance. The IPA grid circuit should be carefully tuned for minimum VSWR between exciter and IPA.

Equipment life will be lengthened if the equipment is operated at moderate room temperatures and humidity, and if the air is reasonably dust-free and non-corrosive.

Although good audio monitor systems seem rare at transmitter sites, such a system which can be clearly heard at the OPTIMOD-FM will facilitate subjective adjustments. An alternative is the relocation of the controls to the studio location by use of the 8100A/ST Studio Accessory Chassis (see **Part 1.**)

Mounting And Grounding: It is important that the OPTIMOD-FM chassis (like all transmission equipment) be properly connected to a good earth ground. Wire is totally ineffective at VHF; the best way to ground the OPTIMOD-FM chassis is to mount it solidly in a well-grounded rack (or the transmitter cabinet). The rack or cabinet must be connected to earth through a wide, thin copper ground strap.

To assure good electrical contact between the OPTIMOD-FM chassis and the rack, it may be necessary to scrape the paint from the rack and/or the OPTIMOD-FM mounting flanges. Measure the resistance between the OPTIMOD-FM chassis and rack, and verify that it is less than 0.5 ohm.

Input Signal Connections: These instructions apply to the audio inputs of single-chassis OPTIMOD-FM's, and to the audio inputs of both studio and transmitter chassis in dual-chassis OPTIMOD-FM's.

In a high RF field, the audio input to OPTIMOD-FM must be fully-balanced, and should be run in 100% foil-shielded cable like Belden 8451. The shield should be connected to earth (chassis) ground at both ends. In addition, you should make sure that the telephone line termination box or STL receiver is properly grounded to earth.

In low-RF environments, the shield should be grounded at one end only, and audio may be run unbalanced over distances of less than 20 feet (6m).

OPTIMOD-FM should be operated with its integral 20dB input pad for levels between -10 and +10dBm, and without the pad for levels between -30 and -10dBm. Instructions for restrapping the pads are found above in **Initialization Options.**

The OPTIMOD-FM input is bridging, and its impedance is 200K with the 20dB pad defeated and 11.2K with the 20dB pad operative. If the source requires a 600-ohm termination (such as a telephone line), connect a 620-ohm ±5% 1/4-watt carbon film resistor across each audio input. Two such resistors are provided for your convenience.

It is important that both left and right audio inputs be in phase. This is ordinarily assured simply by connecting the red and black wires within all shielded cables symmetrically and consistently when wiring the two stereo channels. If a phasing error occurs, it will be indicated in on-air testing by failure of the OPTIMOD-FM L-R meter to null when OPTIMOD-FM is fed mono material, and by the stereo monitor's indicating more L-R than L+R level.

Studio Chassis Output Connections: In the dual-chassis version of OPTIMOD-FM, the output of the studio chassis presents a 600-ohm pure-resistive source impedance, balanced to ground, with a nominal output level of +10dBm when loaded by 600 ohms. It is thus suited for driving a land-line directly, or for driving the balanced input of a microwave STL transmitter.

If you wish to drive an unbalanced input, connect such an input between the studio chassis "+" output and circuit ground. **Do not ground the "-" output;** while no damage will occur, it will short the output of the "-" line amplifier to ground through a 300-ohm resistor.

Composite Output Connection: The composite output is capable of driving greater than 4V p-p into 10K. Its output impedance is 470 ohms, independent of the setting of the OPTIMOD-FM OUTPUT ATTEN control. We recommend that less than 6 feet (1.8m) of RG-58A/U cable be used to connect the exciter to OPTIMOD-FM, lest capacitive loading compromise the stereo performance due to frequency response rolloff and phase shift, or excessive RF pickup occur in the cable.

If a longer cable must be used, a low-capacitance coaxial cable such as RG-62A/U may be used for runs up to 15 feet (4.6m). Alternately, the stereo generator output can be modified as described in **Equipment Location** above. However, we suggest that the exciter be moved instead.

The composite output appears on a BNC connector. It is mounted on a metal plate which is insulated from the chassis by means of a thin polyester film. This assembly forms an RF-bypass capacitor of approximately 1000pF. The shell of the BNC connector is connected to OPTIMOD-FM circuit ground through an RFI filter.

The purpose of this arrangement is to enable unbalanced wideband exciter inputs to be driven without introducing hum-inducing ground loops. Different techniques must be used for interconnection, depending on whether the exciter input is balanced or unbalanced.

1) Balanced Exciter Input: (The most common of these include the Continental 510R-1 (Collins 310Z-2) with Continental 785E-1 Wideband Interface Card, the Gates TE-1 and TE-3 with Gates-supplied transformer-type Wideband Interface, and the Broadcast Electronics FX-30.) Connect the OPTIMOD-FM circuit ground and chassis ground terminals at the rear-panel barrier strip. This will create the required connection between exciter and OPTIMOD-FM circuit grounds.

2) Unbalanced Exciter Input: (This includes the Gates TE-1 and TE-3 with Orban ATE3-F Wideband Interface, and most other exciters. Check your exciter manual to be sure.) OPTIMOD-FM circuit ground will be automatically connected to exciter circuit ground through the shield of the baseband connector coax. Ordinarily OPTIMOD-FM circuit and chassis grounds will not be jumpered, as this will tend to create a ground loop. However, high RF fields often force reconsideration of conventional grounding rules, and if hum is a problem, you should try jumpering OPTIMOD-FM circuit and chassis grounds to see if hum is reduced.

Remote Control: Three sets of remote control terminals for selecting STEREO, MONO LEFT, and MONO RIGHT modes are located on the barrier strip on the OPTIMOD-FM rear panel. These are optically-isolated, RF suppressed, and may be floated ±50V above ground. Mode switching can be effected by applying a pulse as short as a few milliseconds to the appropriate terminals. Either AC or DC from 6 to 24 volts may be used. To use 48 volts, connect a 1K ±10% 2W carbon composition resistor to each terminal for current limiting.

IMPORTANT

The life of the opto-isolators will be somewhat shortened if switching is effected by supplying continuous voltage (instead of a single pulse) to the terminals. If this is the only practical way to operate your particular remote control, we advise adding a series resistor to the remote control terminals to limit current to 10mA. If this is done, a life of many years can be expected.

If the remote control can provide voltage pulses from its internal power supply, this is the simplest means of activating the functions. The current requirement is approximately 1.9mA/volt. If the pulses are DC, be sure to observe the polarity indicated on the OPTIMOD-FM barrier strip.

If the remote control can provide only contact closures, then you can supply the +22V unregulated DC from OPTIMOD-FM through the contacts in the remote control to activate the functions. A suitably current-limited source of +22V is available on the OPTIMOD-FM barrier strip. If you choose this mode of operation, then connect all three "-" OPTIMOD-FM remote control terminals to chassis ground.

WARNING!

Do not apply voltage to more than one set of remote control terminals at a time. Extreme overmodulation can result.

Remote Gain Reduction Meter: A negative voltage approximately proportional to the Total Master Gain Reduction is available between the OPTIMOD-FM rear-panel G/R terminal and ground. The voltage scale is approximately -0.33V per dB of gain reduction, and the source impedance is 8.87K. A standard 0-25dB Orban gain reduction meter can be connected directly between this terminal (-) and ground (+).

The Orban meter has a sensitivity of 1mA f.s. and a DC resistance of 880 ohms. Full-scale corresponds to 30dB G/R. Because only 25dB G/R can be achieved, the last 5dB of the scale is printed in red. The purpose of this is to match the scale to that of the BASS G/R meter, which is capable of, and fully calibrated to, 30dB G/R.

If an external meter with different characteristics is used, it is easy to calculate the required additional multiplier resistor for a 0-30dB scale by the formula: M=(9.75/F)-(8870+R), where:

M is the required multiplier resistor in ohms,
F is the full scale meter sensitivity in amps, and
R is the internal DC resistance of the meter in ohms.

If M is negative, the meter you wish to use is not sensitive enough, or has too high an internal resistance.

If you wish to interface the G/R output to a remote control for telemetry, bear in mind that the input impedance of the remote control will load down the G/R output and reduce the voltage according to the gain factor: G=X/(X+8870), where X is the input resistance of the remote control in ohms. The scaling of the remote control should therefore be -0.33xG volts per dB gain reduction.

PART 4:

Initial Setup Procedure

If you have a single-chassis OPTIMOD-FM, you may skip to **Stereo Generator,** below.

If you have a dual chassis OPTIMOD-FM, you must first align the gain of the STL and transmitter chassis to a standard to assure that both STL and transmitter chassis are driven at correct levels.

Dual-Chassis Alignment: This procedure is repeated twice: once for the left channel and once for the right. It is assumed that the STL is a pair of land-lines, a pair of microwave STL's, or a PCM link.

1) Adjust the operating controls on the studio chassis as follows:

Proof/Operate Switch:	OPERATE
L and R Input Attenuators:	0
Clipping:	+2
Release Time:	10
Bass Coupling:	10
Gate Threshold:	0
HF Limiting:	10
L and R Output Level:	Fully CW (up to 18 turns)

2) Connect an audio oscillator to the LEFT INPUT of the studio chassis. Set its frequency to 1kHz, and its output level to produce 10dB G/R as indicated on the studio chassis MASTER TOTAL G/R meter.

With the L and R OUTPUT LEVELs fully CW, the studio chassis will produce an output level on a 1kHz tone of 1.17Vrms (+3.6dBm) when loaded by 600 ohms. This is equivalent to 0VU in a +8dBm system when fed with program material.

3) Feeding phone lines: With the L and R OUTPUT LEVEL controls fully CW, the output level and impedance of the studio chassis are appropriate for directly driving a USA-standard telephone line requiring a nominal input level of +8dBm and a resistive balanced driving impedance of 600 ohms.

If your phone lines require a lower drive level to prevent clipping of audio by in-line amplifiers, reduce the OUTPUT LEVEL controls accordingly.

4) Feeding microwave systems: The frequency spectrum of audio at the output of the studio chassis approximates a 25us deemphasis. Therefore, an STL system with 25us deemphasis/preemphasis is most appropriate for maximizing signal-to-noise ratio while preventing clipping. Consult the STL manufacturer for information on converting STL preemphasis/deemphasis to 25us.

If the STL is un-preemphasized, or preemphasized at 25us, adjust the OUTPUT LEVEL of the studio chassis and/or the STL's input level to produce a level 9dB below 100% modulation.

If the STL is preemphasized at 50 or 75us, adjust the OUTPUT LEVEL of the studio chassis and/or the STL's input level to produce a level 15dB below 100% modulation.

5) Connect the output of the STL receiver to the LEFT INPUT of the OPTIMOD-FM transmitter (main) chassis. Place the VU meter FUNCTION switch in L COMPR OUT. Adjust the LEFT INPUT ATTEN on the OPTIMOD-FM transmitter chassis to make the VU meter read 100%.

Jumper Cards #3TX and #4TX are shipped with 20dB pads before the input amplifiers. If the reading is too low with the INPUT ATTEN fully CW, and the input pads are strapped for 20dB attenuation, restrap them for 0dB attenuation. This is done by removing Cards #3TX and #4TX from the chassis according to the instructions on p. C-1 of **Appendix C,** and by moving the jumpers according to Fig. 3-5. The cards and subpanel are then replaced.

If the reading is too high with the INPUT ATTEN fully CCW, and the input pads on Cards #3 and #4 in the transmitter chassis are strapped for 0dB attenuation, follow the same instructions to restrap the pads for 20dB attenuation.

6) Repeat steps (2) through (4) for the RIGHT CHANNEL.

Stereo Generator: From this point on, the procedure is identical for single- and dual-chassis units. "OPTIMOD-FM INPUT" means the input of the studio chassis in dual-chassis systems, and the main input in single-chassis systems.

1) Adjust the OPTIMOD-FM operating controls to the positions specified in step 1 of the **Dual-Chassis Alignment** section above. Apply a 1kHz tone to the left OPTIMOD-FM INPUT, and adjust the oscillator output level to produce 10dB TOTAL MASTER G/R.

2) Turn the 15-turn OPTIMOD-FM OUTPUT ATTEN control fully CCW (zero). Turn the OPTIMOD-FM HF LIMITING control to 10. Turn the OPTIMOD-FM PILOT switch OFF.

3) Turn on the carrier. Watch the TOTAL MODULATION meter on your stereo monitor, and turn the OPTIMOD-FM OUTPUT ATTEN control CW until the TOTAL MODULATION meter reads 68%.

4) Turn the OPTIMOD-FM PILOT switch ON, and adjust the OPTIMOD-FM PILOT LEVEL control until the monitor reads 9% on its PILOT LEVEL meter. TOTAL MODULATION should now read 77%. This procedure adjusts the OPTIMOD-FM output level to produce 100% modulation on program material, accurate to within a few percent.

5) Remove modulation, and listen to the demodulated carrier for abnormal hum, buzz or noise. If any of these are present, the problem should be fixed before proceeding further. In a dual-chassis installation, verify that the STL is not causing noise problems. Hints regarding OPTIMOD-FM/exciter interface are found in **Composite Output Connection** in **Part 3 (Installation).**

6) **Separation:** Connect a DC-coupled oscilloscope with at least 5MHz vertical bandwidth and triggered sweep to the WIDEBAND OUTPUT of your FM monitor. DO NOT USE AN ATTENUATOR PROBE; it may compromise the accuracy of the adjustment. Trigger the scope externally from the oscillator.

Turn the OPTIMOD-FM PILOT switch OFF. Continue to modulate the left channel with 1kHz. Adjust the scope's vertical sensitivity and sweep rate to produce a trace similar to Fig. 4-2. Note the flat baseline in Fig. 4-2, indicating ideal separation. Adjust the OPTIMOD-FM SEPARATION (L-R GAIN) control to secure a maximally-flat baseline. The vertical display should be expanded 10x to make the final adjustment.

CAUTION!

Do not adjust separation by observing your stereo monitor. Most monitors are insufficiently stable to accurately indicate separation. The oscilloscope method specified above is the only satisfactory way to make this adjustment!

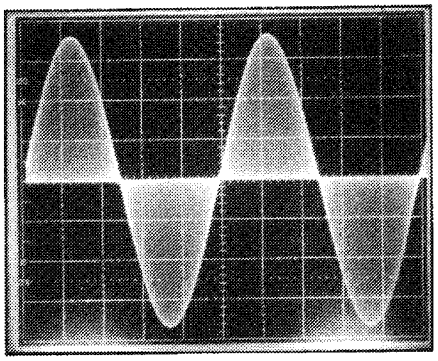


Fig. 4-2: Separation Trace

You should now measure left-into-right and right-into-left separation at 50, 1000, and 15,000 Hz to make sure that adequate separation is achieved through your system. The undriven OPTIMOD-FM input should be shorted or properly terminated to avoid crosstalk.

Separation can be approximately calculated from the scope trace by the formula: $S=20\log(D/P)$, where:

S is the separation (dB)
D is the peak-to-peak deviation of the baseline from flatness (volts)
P is the peak-to-peak level of the total baseband signal (volts)

Most separation problems are due to system problems or measurement error. If you cannot meet separation specifications, you should verify the performance of OPTIMOD-FM alone using the procedure in **a.6** of the **Stereo Generator** section in **Appendix D.**

Dried-out coupling capacitors in your FM monitor can cause failure to correctly measure 50Hz separation because excellent low frequency response and phase linearity are necessary to avoid distorting the signal upon demodulation. Similarly, if you have accidentally left your scope AC-coupled, it will cause measurements to be completely inaccurate at low frequencies.

Real separation problems can be caused by:

a) Incorrect phase adjustments in your exciter Wideband Interface.

b) Insufficiently wide frequency response or inadequate phase linearity in composite STL or exciter.

c) Mistuned or severely narrowband RF amplifiers and/or antenna.

7) **Pilot Phase:** Connect the oscillator to the right OPTIMOD-FM input. Switch the OPTIMOD-FM CROSSTALK TEST switch to SUB-TO-MAIN. Switch the OPTIMOD-FM PILOT switch ON.

You should see a trace on the scope like Fig. 4-3. If pilot phase is correct, the "tips" on this waveform will be perfectly horizontal, as in Fig. 4-3.

Expand the vertical scale of the scope by 10x, and expand the sweep to look more closely at the "tips", as in Fig. 4-4. Adjust the OPTIMOD-FM PILOT PHASE control until the tips are horizontal, as in Fig. 4-4.

Return the OPTIMOD-FM CROSSTALK TEST switch to OPERATE.

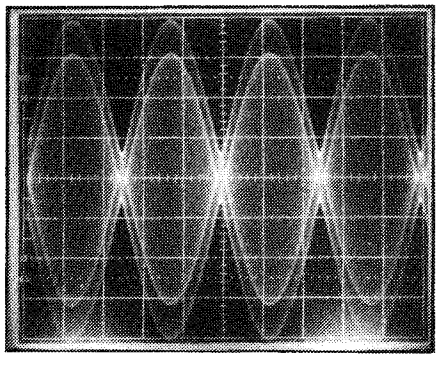


Fig. 4-3: Pilot Phase Trace

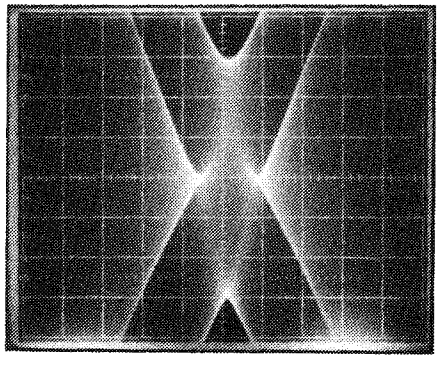


Fig. 4-4: Pilot Phase Trace, 10x

Program Tests: These listening tests are made with OPTIMOD-FM set up according to our recommended initial control settings. They are intended to detect obvious problems with audio quality which must be resolved before final adjustments are made. Once initial listening tests are passed, you can proceed to adjust OPTIMOD-FM setup controls according to format and competitive requirements.

a) Adjust OPTIMOD-FM controls according to Fig. 4-5. DO NOT adjust the OUTPUT ATTEN and INPUT ATTEN controls at this time. If you have a dual-chassis system, DO NOT READJUST THE TRANSMITTER CHASSIS INPUT ATTEN CONTROLS UNDER ANY CIRCUMSTANCES!

b) Play program material typical of your format. Set your console in MONO mode, such that both channels are putting out identical levels. Peak the console VU meters at 0VU.

c) Adjust the OPTIMOD-FM INPUT ATTEN controls (in a dual-chassis unit, on the STUDIO chassis) to "0". Advance the LEFT INPUT ATTEN until the MASTER TOTAL G/R meter reads approximately 10dB G/R.

d) Observe the L-R meter position (or the L-R stereo monitor meter in the case of a dual-chassis unit), and advance the OPTIMOD-FM RIGHT INPUT ATTEN until the meter nulls.

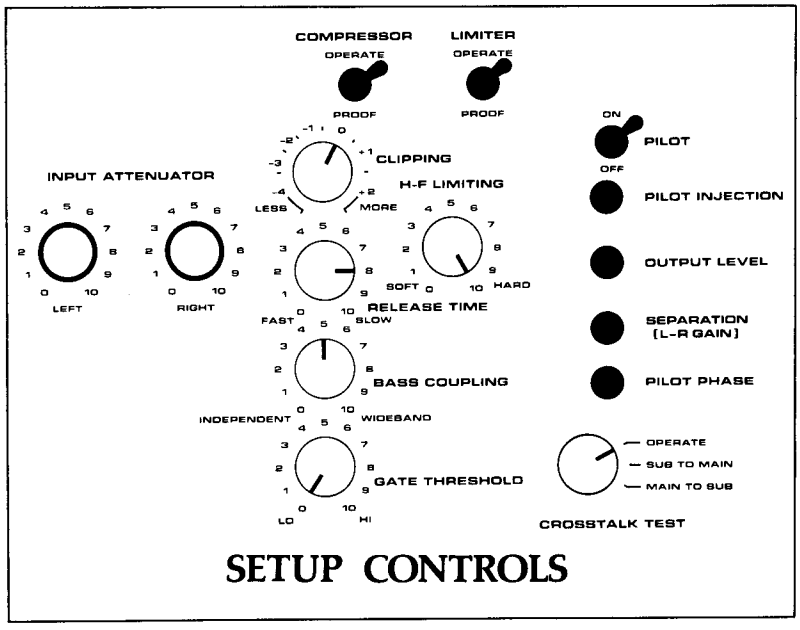


Fig. 4-5: Setup Controls

e) Place the console in STEREO mode. Observe the TOTAL MODULATION meter on the FM monitor. Make slight adjustments to the OPTIMOD-FM OUTPUT ATTEN as necessary to achieve desired modulation levels.

Many FM modulation monitors more than a few years old exhibit problems with low-frequency tilt and high-frequency ringing. The LF tilt is caused by insufficient low-frequency response (LF response should be -3dB at 0.15Hz or below). High-frequency ringing is usually not as much of a problem.

Tilt becomes a problem at the comparators that control the peak flashers. This can cause flashers to turn on when no overmodulation actually exists. LF tilt problems show up when the monitor is measuring program material, resulting in an indication of modulation that is higher than the actual percentage of modulation. This is true even though the monitor reads flat on sine waves from 50-15,000Hz. A 50Hz square wave can be used to test for tilt: you must connect the output of the square-wave generator to the composite input of the exciter to test the monitor. (If the exciter has LF tilt problems, you will see these in addition to any problems in the monitor.)

Additionally, if an RF amplifier is used in the monitoring environment, any multipath picked up in the system will be indicated as additional modulation on the monitor (it probably will show on the peak flasher before it will be seen on the meter).

f) Observe the PILOT LEVEL meter on your stereo monitor, and adjust the OPTIMOD-FM PILOT LEVEL control as necessary to produce 9% pilot injection.

g) Listen to the audio quality of the air sound on a good monitor system, and verify that it sounds natural and free from noise and distortion. Comparing "AIR" and "PROGRAM" may reveal a bass increase in "AIR" due to the "hybrid" operation of OPTIMOD-FM as initially set up.

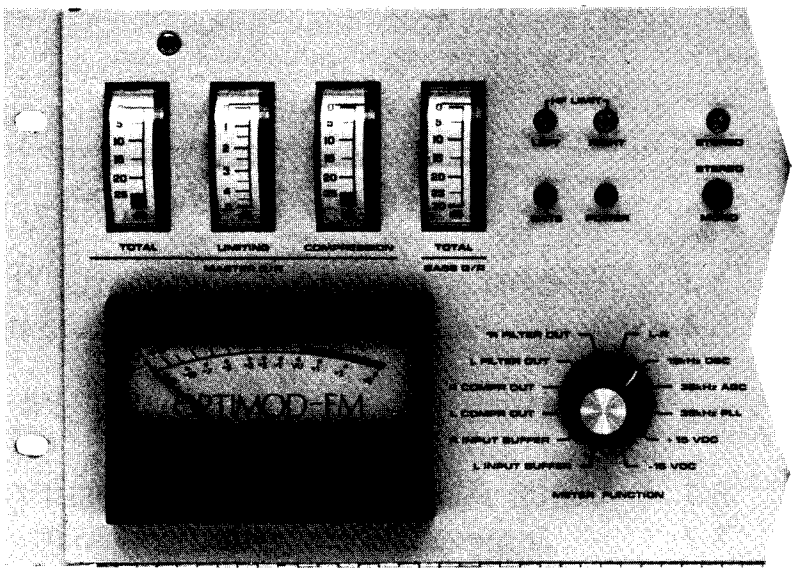
h) You may now proceed to **Part 5 (Operating Instructions)** of this Manual, and adjust OPTIMOD-FM's setup controls to your specific requirements.

Part 5: Operating Instructions

IMPORTANT

If you have installed the optional 8100A/ST Studio Chassis, adjust the controls on that unit, rather than on the 8100A.

8100A Controls and Meters



MASTER G/R meters show the amount of gain reduction in the "master" band compressor, which processes audio above 200Hz:

> **TOTAL** shows the peak value of gain reduction in dB. **LIMITING** shows the amount of fast gain reduction above and beyond that provided by slow compression. 0 on this meter indicates no additional limiting, and 3 (for example) indicates an extra 3dB peak-limiting gain reduction over that indicated by the **COMPRESSION** meter, which shows the amount of gain reduction in dB resulting from slow compression.

TOTAL BASS G/R meter shows the amount of gain reduction in the "bass" band compressor, which processes audio below 200Hz. Because almost all of the bass band gain reduction is effected by slow compression, there is no need for separate limiting and compression meters.

HF LIMIT lamps light when the high-frequency content of audio is being limited by the very fast high-frequency limiters.

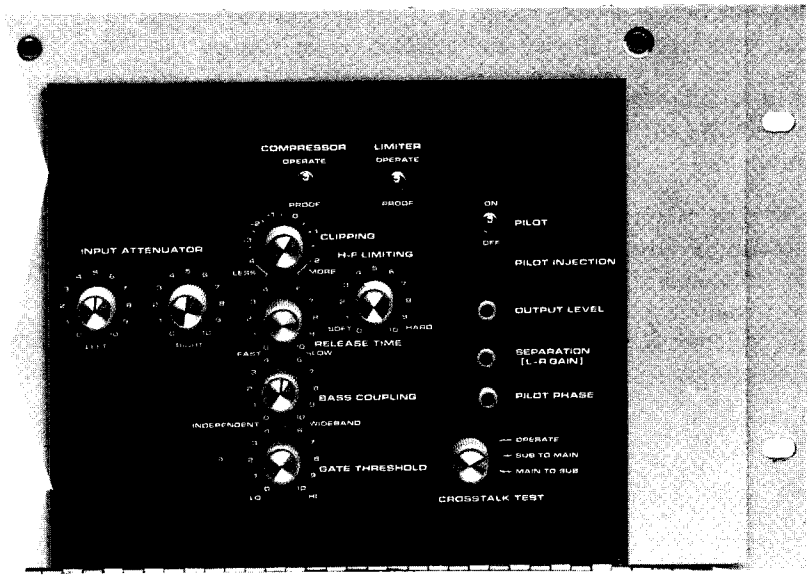
GATE lamp lights when the input audio level falls below the threshold set by the GATE THRESHOLD control. When this happens, the compressor's recovery time is drastically slowed to prevent noise rush-up during low-level passages.

POWER lamp lights when the unit is powered. (It monitors the unregulated −22V DC bus.)

VU meter and selector switch display signal levels at various points in the circuitry (see Block Diagram on page J-20) to aid in diagnosing faults. The meter also displays +15V and −15V power supply voltages (100% corresponds to 15VDC).

INPUT ATTENUATOR controls adjust the signal level driving the 8100A's dual-band compressor. This level determines the relative amount of gain reduction, and therefore the amount of compression and the increase in the loudness of quiet program material.

COMPRESSOR switch is used for testing. When set to PROOF, it disables the dual-band compressor.



LIMITER switch is used for testing. When set to PROOF, it disables the high-frequency limiters, distortion-canceling clippers, FCS Overshoot Compensators, and safety clippers.

CLIPPING control adjusts signal level going into the distortion-canceling clippers, and therefore determines the amount of peak limiting accomplished by clipping. Range is −4dB to +2dB (where 0dB represents our judgment of a setting that provides a high-quality "undistorted" sound without compromising loudness or modulation efficiency). The loudness/distortion trade-off is primarily determined by this control.

H-F LIMITING control determines the amount of high-frequency limiting. When set toward SOFT, the highs are controlled more by limiting, which may reduce brightness. When set toward HARD, the highs are controlled more by clipping, which may introduce some high-frequency distortion.

RELEASE TIME control determines how fast the gain of the master band compressor increases when the program material gets quieter. Settings toward SLOW cause the compressor to act as a slow, subtle "hand on the fader". Settings toward FAST will result in increased program density.

BASS COUPLING control determines the degree to which the bass band of the compressor tracks the master band. Settings toward WIDEBAND produce an air sound that is more faithful to the spectral balance of the source material, while settings toward INDEPENDENT produce bass balances that are more uniform between program segments (often with increased bass).

GATE THRESHOLD control determines the lowest input level that the system considers program. Levels below this are considered noise, and the AGC/compressor gates, effectively freezing its gain to prevent noise breathing during pauses or low-level passages.

Recommended Settings for the Best Sound

The 8100A OPTIMOD-FM offers a wide range of flexibility, enabling you to fine-tune your air sound for your target audience and aesthetic sensibilities.

Fig. 1 shows five sets of recommended settings. Each set produces a different sound texture, and each incorporates a different set of trade-offs between openness, loudness, brightness, and distortion.

Start with one of these sets of recommended settings. Spend some time listening critically to your on-air sound. Listen to a wide range of program material typical of your format, and listen on several types of radios (not just on your studio monitors). Then, if you wish to customize your sound, read the rest of this Addendum — it is important to understand the functions and interactions of the audio processing controls before experimenting with them.

	TYPICAL PROGRAM				
	Classical	**Talk**	**Smooth Popular**	**Competitive Popular**	**Combination**
INPUT ATTENUATORs					
Adjust to produce approximately the indicated gain reduction on typical program material as shown on OPTIMOD-FM's TOTAL MASTER G/R meter:					
G/R Meter:	*0–10dB*	*10–15dB*	*10–15dB*	*10–15dB*	*
CLIPPING	–1	–1	0	1	–1
H-F LIMITING	10	10	10	6.5	10
RELEASE TIME	8	6	6.5	4.5	7
BASS COUPLING	8	8	5	2	8
GATE THRESHOLD	2.5	3	0	0	2.5
COMPRESSOR	OPERATE	OPERATE	OPERATE	OPERATE	OPERATE
LIMITER	OPERATE	OPERATE	OPERATE	OPERATE	OPERATE

* For combination formats, adjust the INPUT ATTENUATORs to produce 10–15dB gain reduction on popular music when the console's VU meters or PPMs indicate your normal peaking level. During operation, adjust console levels to your normal operating level for popular music and talk programs; adjust console levels 5–10dB below your normal operating level for classical music programs.

Fig. 1: Recommended Control Settings
8100A OPTIMOD-FM Audio Processor

The sound characteristics of the recommended settings are:

Classical

For classical, background music formats.

Classical music is traditionally broadcast with a wide dynamic range. However, many broadcasters now realize that the dynamic range of live performances and modern recordings is so great that the soft passages disappear into the noise on most car, portable, and table radios. As a result, the listener hears nothing, or must turn up the volume control to hear all the music. Then, when the music gets loud, the radio blasts and distorts, making the listening rather unpleasant.

Typically, a daytime listener to classical music listens in the home while getting ready for work, listens in the car, or uses the radio as source of background music at work. When adjusted to the recommended Classical settings, OPTIMOD-FM controls the level of the music in ways that are, for all practical purposes, undetectable to this listener. Low-level passages are increased in level by up to 10dB, while the dynamics of crescendos are maintained.

In the evening, when more people may be listening seriously, a wider dynamic range can be achieved by simply reducing the input drive level to OPTIMOD-FM to reduce or eliminate gain reduction. Either set the peak levels lower on the mixing desk, or use an switchable attenuator between the desk and the OPTIMOD-FM inputs.

Talk

For talk, radio drama formats.

Processing for this sound keeps the levels of announcers, presenters, guests, and telephone calls more consistent. And it keeps a proper balance between voice and commercials. Voice is the most difficult program element to process. These settings result in a favorable trade-off between consistency, listening fatigue, and distortion.

Smooth Popular

For popular, Album-Oriented Rock, Adult Contemporary, Modern Country, Oldies, talk formats.

The sound texture for the station that values a clean, easy-to-listen-to sound on the air. This is an "unprocessed" sound that sounds just right on both music and voice when listened to on small table radios, car radios, portables, or home hi-fi systems.

Competitive Popular

For Adult Contemporary, Contemporary Hit Radio, Oldies, Modern Country, Urban formats.

This is the major market competitive sound, emphasizing loudness while retaining clean audio. With these settings, the sound gets farther away from the balance and texture of the original recording. This is as far as we think processing can go without causing noticeable listener fatigue.

Combination

For combinations of the above.

It is of course difficult to optimize the control settings if your your station broadcasts several different types of program material. Fortunately, there is a set of control settings that works surprisingly well in this situation. With these settings: popular music will have the depth and punch that attracts and holds listeners, while still sounding open; classical music won't disappear on soft passages, and it will retain its dynamics and drama on loud passages; and talk programs will sound very natural, but with consistent levels for host and guests.

Getting the Sound You Want

OPTIMOD-FM can be adjusted so that the output sounds as close as possible to the input at all times, *or* so that it sounds open but more uniform in frequency balance (and often more dramatic) than the input, *or* so that it sounds dense, quite squashed, and very loud. The dense, loud set-up will make the audio seem to jump out of car and table radios, but may be fatiguing and invite tune-outs on higher quality home receivers.

In *any* of these set-ups, there is *a direct trade-off* between loudness, brightness, and distortion. You can improve one only at the expense of one or both of the other two. This is true of any processor.

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

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

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

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

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

A high-quality monitor system is essential. To modify your airsound effectively, you must be able to *hear* the results of your adjustments. In too many stations, the best monitor is significantly inferior to the receivers found in many listeners' homes! See *Audio Quality in the FM Plant* (a separate Orban publication included with each unit) for a detailed discussion of how to efficiently create an accurate monitoring environment (and otherwise bring the audio plant up to state-of-the-art quality).

More About Audio Processing

[If you use one of the set-ups recommended in Fig. 1, there is no need to read this section. Read this section only if you really want to understand the operating controls in detail.]

The controls on the 8100A give you the flexibility to customize your station's sound. But, as with any audio processing system, proper adjustment of these controls consists of balancing the trade-offs between loudness, density, brightness, and audible distortion. The following provides the information you need to adjust the 8100A controls to suit your format, taste, and competitive situation.

Some audio processing concepts.

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

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

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

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

Loudness and density.

The amount of **gain reduction** determines how much the loudness of soft passages will be increased (and, therefore, how consistent overall loudness will be). It is controlled both by the setting of the INPUT ATTENUATOR controls and by the level at which the console VU meter or PPM is peaked.

The RELEASE TIME control determines how fast the compressor releases (and therefore how fast loudness increases) when the program material gets quiet. Settings toward FAST result in a more consistently loud output, while settings toward SLOW allow a wider variation in dynamic range. The actual release time of the compressor is determined by *both* the setting of the RELEASE TIME control *and* the dynamics and level of the program material.

Release automatically becomes faster as more gain reduction is applied (up to about 10dB), making the program progressively denser and creating a *sense of increasing loudness*. This preserves some feeling of dynamic range, even though peak levels are not actually increasing. Once 10dB of gain reduction is exceeded, full loudness is achieved — no further increase in short-term density occurs as more gain reduction is applied. This avoids the unnatural, fatiguing sound often produced by processors at high gain reduction levels, and makes OPTIMOD-FM remarkably resistant to operator gain-riding errors.

When the RELEASE TIME control is set between 7 and 10, the amount of gain reduction is surprisingly non-critical. Since gating prevents noise from being brought up during short pauses, and pumping does not occur at high levels of gain reduction, the primary danger of using large amounts of gain reduction is that the level of soft passages in input material with wide dynamic range may eventually be increased unnaturally.

The action of the RELEASE TIME control has been optimized for resolution and adjustability. But its setting is *critical to sound quality* — listen carefully as you adjust the controls. There is a point beyond which increasing density (with faster settings of the RELEASE TIME control) will no longer yield more loudness, and will simply degrade the punch and definition of the sound. And with faster RELEASE TIME control settings (below 4), the sound will change substantially with the amount of gain reduction. This means that operator gain riding is more critical. Decide on the basis of listening tests how much gain reduction gives you the density you want without a creating feeling of overcompression and fatigue. We feel that our recommended setting (8) is clearly optimal, yielding the most natural sound with least detectable compression.

Regardless of the release time setting, we feel that the optimal amount of gain reduction for popular music and talk formats is 10–15dB. If less gain reduction is used, loudness can be lost. For classical formats, operating with 0–10dB of gain reduction maintains the sense of dynamic range while still controlling levels effectively. Since OPTIMOD-FM's density gently increases between 0 and 10dB of compression, 10dB of compression sounds very natural, even on classical music.

Gain reduction metering.

Unlike the metering on some processors, the **red zone** on the OPTIMOD-FM gain reduction meter's scale is a warning that must be observed. When the meter is in the red, it means that the compressor has run out of gain reduction range, that the circuitry is being overloaded, and that various nastinesses are likely to commence.

Because the compressor has 25dB of gain reduction range, the meter should never enter the red zone if OPTIMOD-FM has been set up for a sane amount of gain reduction under ordinary program conditions. But be aware of the different peak factors on voice and music — if voice and music are peaked identically on a VU meter, voice may cause up to 10dB more peak gain reduction than does music! (A PPM will indicate relative peak levels much more accurately.)

Gating.

The GATE THRESHOLD control determines the lowest input level that will be recognized as program by OPTIMOD-FM; lower levels are considered to be noise and cause the compressor to gate, effectively freezing its gain.

The gain reduction will eventually recover to zero even when the compressor is in a gated condition, but recovery is slow enough to be imperceptible. This avoids OPTIMOD-FM's getting stuck with a large amount of gain reduction on a long, low-level musical passage immediately following a loud passage.

It is common to set the GATE THRESHOLD control to 0. Higher settings are primarily useful for radio drama, outside sports broadcasts, and other non-musical programming in which it is undesirable to pump up ambiance, low-level crowd noise, and the like. Slightly higher settings may increase the musicality of the compression by slowing down recovery on moderate- to low-level musical passages. When such passages cause the gate to cycle on and off, recovery time will be slowed down by the ratio of the "on time" to the "off time". This effectively slows down the release time as the input gets softer and softer, thus preserving musical values in material with wide dynamic range (classical music, for example).

Spectral balance.

The compressor processes audio in two bands: a *master band* for all audio above 200Hz, and a *bass band* for audio below 200Hz. The BASS COUPLING control determines how closely the on-air balance between material below 200Hz and material above 200Hz matches that of the program material.

Settings toward WIDEBAND make the output sound most like the input. Because setting the BASS COUPLING control at 10 will sometimes cause bass loss, the most accurate frequency balance will often be obtained with this control between 7 and 10. The optimal setting depends on the amount of gain reduction applied. Adjust the BASS COUPLING control until the TOTAL BASS G/R and COMPRESSION MASTER G/R meters track as closely as possible.

With the RELEASE TIME control set to 8, setting the BASS COUPLING control toward INDEPENDENT will produce a sound that is very open, natural, and non-fatiguing, even

with large amounts of gain reduction. Such settings will provide a bass boost on some program material that is bass-shy.

With fast release times, settings toward WIDEBAND are not appropriate for achieving ultimate loudness. Settings toward INDEPENDENT provide maximum loudness and density on small radios. But such processing may fatigue listeners with high-quality receivers, and will therefore require more careful operator gain riding. In applications where the greatest possible loudness and density are desired, the optional 8100A/XT2 Six-Band Limiter provides more effective control.

High-frequency limiting to reduce distortion.

The H-F LIMITING control determines how the processor avoids high-frequency overloads due to the pre-emphasis curve. When set toward SOFT, the highs are controlled mostly by limiting (a form of dynamic filtering), which tends to soften highs — and this could improve the sound of marginally distorted program material. When set toward HARD, the highs are controlled mostly by clipping, which could potentially distort highs.

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

Because the OPTIMOD-FM clipper cancels distortion at low frequencies, the H-F LIMITING control will have a different effect on clipping distortion than you might expect. Gross break-up (principally sibilance splatter) will not occur — you must listen to the upper midrange and the highs to hear the effect of the clipper. Program material containing highly equalized hi-hat cymbals will clearly demonstrate the effect of adjusting the control.

When the CLIPPING control is set to 0 or below and the RELEASE TIME control is set to 8, it is possible to set the H-F LIMITING control to 10 without producing objectionable distortion (provided that the program material is super-clean). If the CLIPPING control is set above 0 and/or faster release times are used (such that greater level and density is produced), it is usually necessary to readjust the H-F LIMITING control closer to SOFT to avoid objectionable distortion. Fortunately, the high-frequency limiter "knows" that greater density and level have been produced when these other controls are set this way, and most of the necessary increases in high-frequency limiting will occur automatically. In fact, you will clearly hear a loss of highs when you adjust any control to produce greater loudness and density — this is an automatic response to the inherent loudness/brightness/distortion trade-off discussed above.

Peak control.

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

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

Please note that the 0 setting does not mean that no clipping is occurring; rather, it is a suggested initial setting for many formats. In our opinion, when the RELEASE TIME control is set between 7 and 10, the best setting for the CLIPPING control is between −1 and 0. If the program material is clean, this setting produces an output that sounds undistorted even on high-quality receivers.

If faster settings of the RELEASE TIME control are used, or if program material is not always clean, use lower settings of the CLIPPING control. Ultimately, your ears must judge how much distortion is acceptable. But use difficult program material like live voice and piano to make your final decision.

Equalization and "missing controls".

The 8100A is available in two very different configurations. By itself, it is designed to produce an output that is relatively faithful to the frequency balances of the original source material. With the optional 8100A/XT2 Six-Band Limiter, it can produce a highly-processed sound that may be attractive when auditioned without reference to the original source, but which does not attempt to preserve the textures or tonal balance of the source.

If you are accustomed to conventional multiband systems, be aware of the differences between that type of processing and OPTIMOD-FM. Multiband systems usually have *threshold* and *gain* controls on their compressors. The gain controls can be used as fixed equalizers, and the threshold controls determine the average level produced by each band.

Adjusting a conventional multiband threshold control to produce bass that is balanced to your taste involves serious compromises, because it usually results in excessive reduction of heavy bass that is intended to be there to make a musical point. A better solution is the 8100A's BASS COUPLING control, which can control bass balances without unnecessarily reducing bass impact.

Missing from OPTIMOD-FM are attack and release time adjustments for the bass compressor band, and an attack time adjustment for the master band. The reason is simple: there is a clearly optimal choice for these time-constants — making them adjustable would simply be an invitation to trouble.

Finally, there is no high-band gain control that would permit the 8100A to be used as an high-frequency equalizer. The argument for omitting such a control is that the ear is far more sensitive to the frequency balance between midrange and highs than to the balance between midrange and bass. If high-frequency automatic re-equalization is done, it must be done with the greatest care. The 8100A/XT2 Six-Band Limiter has been configured (by use of two high-frequency bands, and by correct choice of crossover frequencies, crossover slopes, and high-frequency limiter characteristics)

to provide powerful control over high-frequency sound texture while minimizing the probability that the processing will cause audibly undesirable side-effects.

The processing required to achieve this goal is complex and expensive — it is not possible to optimize this processing simply. Because of this, and because many may not require such processing, we have taken a modular approach to the design of OPTIMOD-FM. The 8100A therefore has no high-frequency equalizer control, and its high-frequency limiter operates in a way that highs are never increased. If such features are required, the 8100A/XT2 can be readily added to the system.

To achieve a particular sound, some stations boost highs and lows with a parametric equalizer before the audio signal is fed to the 8100A (the Orban 642B Equalizer works well for this). The 8100A handles this well, but we recommend that high-end pre-processing be done in moderation (3 to 4dB equalization) to avoid the further increase in overload distortion and clipping which could result from highly pre-processed material being reprocessed to match the 8100A's pre-emphasis curve.

Quality of source material.

As indicated above, a major potential cause of distortion is excess clipping. Another cause is poor-quality source material, including the effects of the station's playback machines, electronics, and studio-to-transmitter link. If the source material is even slightly distorted, that distortion can be greatly exaggerated by the OPTIMOD-FM — particularly if a large amount of gain reduction is used. Super-clean audio can be processed harder without producing objectionable distortion. See *Audio Quality in the FM Plant* (a separate Orban publication included with each unit) for a discussion of how to improve source quality.

SOME HINTS TO HELP YOU ACHIEVE YOUR PROCESSING GOALS

ALWAYS START WITH OUR SUGGESTED INITIAL SETTINGS (SEE FIG. 4-5) AND WORK FROM THERE.

-- To obtain more loudness

1. Operate "multiband" (BASS COUPLING at "0") with fast release times. Turn down CLIPPING and H-F LIMITING as necessary to avoid objectionable distortion.
2. Clean up audio. Super-clean audio can be processed harder without objectionable side-effects.
3. Use SCA Protection Filter (card #0).
4. Use 8100A/XT Six-Band Limiter Accessory Chassis.

-- To obtain more brightness

1. Turn the H-F LIMIT CONTROL fully clockwise. To avoid objectionable distortion with fast RELEASE TIME, you may have to turn down the CLIPPING control. This will further increase brightness at the expense of loudness.
2. Be sure that program material is properly equalized, and that STL is flat to 15kHz (see **Appendix K).**
3. Use Orban **642B** Parametric Equalizer ahead of 8100A/1.

-- To obtain more bass

1. Operate the BASS COUPLING control towards "0".
2. Use Orban **642B** Parametric Equalizer ahead of 8100A/1.

-- To obtain less bass (retaining original program material balance)

1. Operate the BASS COUPLING control towards "10".

-- To make "Air" sound most like "Program"

1. Operate with the BASS COUPLING close to "10". (Adjust the control to make the BASS and COMPRESSOR G/R meters track as closely as possible.)
2. Operate with the RELEASE TIME at "8" (optimum).
3. Use lesser amounts of gain reduction by backing off the INPUT ATTENUATORS.
4. Minimize the amount of clipping and h-f limiting by operating H-F LIMITING at "10" (full hard), and backing off the CLIPPING as far towards "0" as required to avoid audible distortion on difficult material like male voice or piano.

-- To obtain "open" sound with no audible compression

1. Operate the RELEASE TIME control at 8.
2. Do not pre-compress program material in the production studio.
3. Use relatively small amounts of gain reduction. (This may allow you to advance the CLIPPING control to compensate for loudness loss.)

-- To obtain a "heavily-processed" sound

1. Operate the RELEASE TIME control at "0" and the BASS COUPLING control at "0". (You may have to back off the CLIPPING and H-F LIMITING controls to avoid objectionable distortion. D.J. gain riding will also become more critical.)
2. Use 8100A/XT Six-Band Limiter Accessory Chassis.

-- To avoid "noise pump-up"

1. Operate with smaller amounts of gain reduction.
2. Adjust the GATE THRESHOLD more clockwise.
3. Use slower RELEASE TIME.

-- To achieve more subtle gain riding in wide-dynamic range material

1. Critically adjust the GATE THRESHOLD control so that medium- to low-level passages cause the GATE lamp to flash on and off, thus slowing down the release time as the music gets softer.

-- To avoid excessive sibilance (particularly on women's voices)

1. Use an Orban 536A Dynamic Sibilance Controller on the microphone chain only. (While the 8100A/1 will not distort sibilance, its excellent h-f power handling will result in its passing high-energy sibilance present at its input, instead of limiting it.)

PART 6:

System Performance Verification

The FCC (USA) has eliminated requirements for periodic Proof-of-Performance measurements. However, performance standards specified in the FCC Rules must still be met. Many stations will still wish to make periodic equipment performance measurements. The text below provides the general information which is needed to perform measurements verifying the performance of a transmission system including the 8100A/1. Instructions for bench-top verification of 8100A/1 performance outside of the transmission system are found in **Appendix D: Field Audit-of-Performance.**

Mono Performance Verification: This is totally straightforward. Merely enter the MONO LEFT or MONO RIGHT modes, switch both PROOF/OPERATE switches to PROOF, and drive the appropriate OPTIMOD-FM input with test signal. Sufficient headroom is available to modulate well beyond 100% at all frequencies from 50-15,000Hz.

NOTE

OPTIMOD-FM frequency response drops off extremely rapidly above 15.0kHz. If the test oscillator is miscalibrated, OPTIMOD-FM may appear not to meet proof at 15.0kHz. Before blaming OPTIMOD-FM, measure the output frequency of the test oscillator with an accurate counter to make sure that it is actually producing 15.0kHZ, and not some slightly higher frequency.

Stereo Performance Verification: As of this writing, the law does not require that these measurements be made and be on file. However, the station is required to meet these performance specifications, and many stations therefore make these measurements as part of a routine performance verification.

Part 73.322 of the FCC Rules refers to the performance of the transmitter only (starting with stereo generator input terminals), and measurements may be made by connecting the test oscillator directly to the OPTIMOD-FM main audio inputs. All stereo measurements are made with both OPTIMOD-FM PROOF/OPERATE switches in PROOF. Following is an outline of the required measurements and how to perform them.

1) **Main Channel:** The main channel (L+R) must meet all mono requirements for frequency response, total harmonic distortion, and noise. Compliance may be verified by driving both OPTIMOD-FM main inputs in-phase, slightly adjusting the right INPUT ATTEN (studio chassis in dual-chassis versions) to null the L-R meter on your stereo monitor, and then using the L+R meter of your stereo monitor for measurement. If L-R fails to null below -20dB, suspect a differential phase error between the left and right channels. Such an error will also cause L+R and L-R to have poor frequency response, even if the left and right channels have accurate frequency response. Such an error can be caused by certain failures in the phase correctors located on Cards #6, #8, and #9. (See **Appendix F** for troubleshooting information).

If the monitor's 15kHz lowpass filter is inadequate, leakage of the pilot into the monitor output may influence both THD and noise measurements. If this is the case, an external 19kHz notch filter may have to be used before the noise and distortion meter.

2) Subchannel: Mono requirements for frequency response, harmonic distortion, and noise must also be met for the stereo subchannel (L-R). L-R can be generated by reversing the polarity of the oscillator connection to the OPTIMOD-FM right audio input only, and by slightly trimming the OPTIMOD-FM right INPUT ATTEN (on the studio chassis in dual-chassis units) to null the L+R meter on your stereo monitor.

Measuring L-R noise is particularly problematical because most stereo monitors have no provision for applying deemphasis to the L-R meter. Provided that the noise is uncorrelated (i.e., is dominated by hiss, rather than hum or discrete tones), then you can calculate the L-R noise by the formula:

$$S = 10 \times \log(10^{(L/10)} - 10^{(M/10)}), \text{ where:}$$

S is the L-R noise in dB
L is the left or right channel noise in dB
(assuming L and R noise measurements are almost equal)
M is the L+R noise in dB

3) Careful reading of 73.322 reveals that there are no explicit requirements for **frequency response, harmonic distortion,** or **noise performance** of left or right channels. The only requirement specifically applicable to left and right channels is that **separation** must exceed 29.7dB, 50-15,000Hz, left-into-right and right-into-left.

IMPORTANT

Because of the instability of many stereo monitors, the monitor should always be aligned according to the manufacturer's instructions before separation measurements are performed. It is particularly important not to (mis)realign the OPTIMOD-FM stereo generator to compensate for a misaligned stereo monitor. In general, the only stable and reliable way of aligning the OPTIMOD-FM stereo generator for correct separation is the oscilloscope baseline method described in section **a.6** of **Stereo Generator** in **Appendix D** of this Manual.

Pilot phase also affects separation. Pilot phase should be verified according to section **a.7** of **Stereo Generator** in **Appendix D.** This method is more accurate than use of your stereo monitor.

4) Crosstalk: Measurement of main-channel-to-subchannel and subchannel-to-main-channel crosstalk is facilitated by the OPTIMOD-FM's internal CROSSTALK TEST switch. To make these tests, simply drive the OPTIMOD-FM right audio input, switch the OPTIMOD-FM CROSSTALK TEST switch to the appropriate mode, and read crosstalk on your stereo monitor. (The CROSSTALK TEST switch applies the output of the right channel audio processing directly to either the main channel or subchannel stereo generator input, and scales internal gains appropriately in the stereo generator to keep total modulation constant.)

NOTE

Because crosstalk measurements on stereo monitors are usually derived from stable passive filters, these measurements are usually far more stable and reliable than separation measurements.

5) 38kHz Subcarrier Suppression: Using the same setup as in **Crosstalk,** above, enter the SUB-TO-MAIN mode using the OPTIMOD-FM CROSSTALK TEST switch. Modulate the carrier to 100% using 7.5kHz, and read the 38kHz suppression on your stereo monitor.

NOTE

The two CROSSTALK TEST modes in OPTIMOD-FM will cause slight internal offset changes which will translate into somewhat poorer 38kHz suppression than that provided by the normal OPERATE mode. However, the suppression should never deteriorate even close to the -40dB legal limit.

6) Pilot Frequency: This is most conveniently measured by opening the access door and connecting the frequency counter input across two terminals (Fig. 6-1) located on the P.C. card mounted on the rear of the rotary switch to the left of the access door opening.

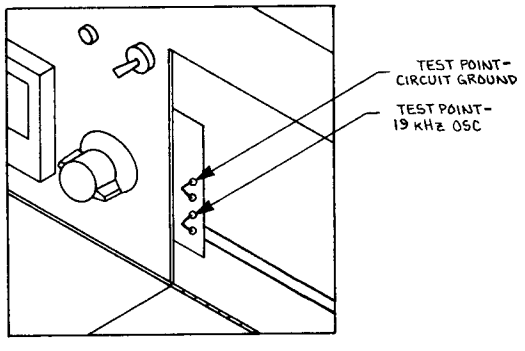


Fig. 6-1: Pilot Test Point

7) Pilot Injection: This is straightforwardly measured on your stereo monitor.

Rear-Panel TEST Jacks: The inputs of the stereo generator are available on the RCA phono jacks on the rear panel of OPTIMOD-FM when the rear-panel NORMAL/TEST switch is in TEST. (When the switch is in NORMAL, the output of the audio processing appears at these jacks.)

These inputs are unbalanced, apply no preemphasis, and require approximately 3.3V rms to produce 100% modulation, including 9% pilot injection.

To produce proper operation of the stereo generator, these jacks must be driven by a voltage source such as that produced by the output of an opamp. The 600-ohm output of a typical oscillator is too high-impedance to produce correct operation. IF THE SIGNAL SOURCE IS CONNECTED TO ONLY ONE JACK, THE OTHER MUST BE GROUNDED TO PRESERVE CORRECT STEREO GENERATOR OPERATION.

Orban Associates Inc., has been providing schematics upon request for construction of a separation-and-crosstalk test fixture for its older model OPTIMOD-FM, the 8000A. If you have already built such a fixture, be assured that it is also appropriate for driving the Model 8100A/1 test jacks. However, the 8100A/1's internal CROSSTALK TEST modes are usually much more convenient to use.

PART 7:

Routine Maintenance

OPTIMOD-FM is a highly stable device which uses solid-state circuitry throughout. Recommended routine maintenance is minimal.

1) Keep the outside of the unit clean. If the panel becomes dirty, it can be washed with a mild household detergent and water. Stronger solvents may damage plastic parts, paint, or the silkscreened lettering, and should not be used.

2) Particularly in humid or salt-spray environments, check periodically for corrosion around metal-to-metal contacts such as the audio and control wiring, and those places where the OPTIMOD-FM chassis contacts the rack.

3) Check for loss of grounding due to corrosion or loosening of rack mounting screws.

4) Familiarize yourself with the normal VU meter readings, and with the normal performance of the G/R meters. If any meter reading becomes abnormal, refer to **Appendix F (Trouble Diagnosis).**

5) A good ear will pick up many failures. Familiarize yourself with the "sound" of OPTIMOD-FM as you have set it up, and be sensitive to changes or deteriorations. But if problems arise, please don't blame OPTIMOD-FM by reflex. Refer to **Appendix F** for systematic troubleshooting instructions which will also help you determine if the problem is in OPTIMOD-FM or is somewhere else in the station's equipment.

ROUTINE PERFORMANCE VERIFICATION

This procedure can be performed very quickly, and provides tests of some of the more important OPTIMOD-FM performance parameters. A much more thorough and rigorous procedure is provided in **Appendix D (Field Audit-of-Performance Procedure).**

Stereo Generator Tests: These tests are made with normal program material, and can therefore be performed in seconds, without seriously interrupting normal programming.

1) **Dynamic Separation:** With bright music playing, suppress one of the two stereo input channels to OPTIMOD-FM, and observe the suppressed channel's meter on your stereo monitor. Ordinarily, the indication will be better than 45dB below 100% modulation.

Restore the suppressed channel, and repeat the test for the other channel.

If the undesired crosstalk into the "dead" channel sounds clean and distortion-free, this probably means that the SEPARATION adjustment on the stereo monitor has drifted, and that the problem is not actually in the transmission system. This should be verified by repeating the test with another monitor or high-quality tuner in WIDEBAND mode. If the problem is observed on more than one receiver, the OPTIMOD-FM stereo generator has probably drifted, and the cause of the drift should be investigated.

If the crosstalk sounds highly distorted (particularly if distortion is worst when considerable high frequency energy is present on the other channel), the distortion may be due to aliasing. If the problem occurs only in one direction (say, left-into-right), then the OPTIMOD-FM FCS Overshoot Corrector circuitry should be investigated. If the problem occurs symmetrically in both directions, check for clipping or severe non-linearity in exciter, composite STL, or the OPTIMOD-FM stereo generator.

2) **38kHz Suppression:** Briefly interrupt programming (or wait for a short pause), and observe the 38KHZ position on your stereo monitor. Verify that suppression is well below -40dB.

3) **Pilot Injection:** Measure this routinely on your stereo monitor and verify that it is between 8% and 10% modulation.

Audio Processing: There are no effective, quick instrument tests that can be made using ordinary program material. Your ear is the best test instrument here.

If a minute or so can be spared from normal programming, the "standard level" test can be made using a sinewave input. This is done as follows:

1) Record the settings of the CLIPPING, BASS COUPLING, RELEASE TIME, and H-F LIMITING controls so that they can be restored when you have completed the test.

2) Set the OPTIMOD-FM controls to the following "standard" settings:

Proof/Operate Switch:	OPERATE
CLIPPING:	+2
RELEASE TIME:	10
BASS COUPLING:	10
H-F LIMITING:	10

3) Drive the OPTIMOD-FM left channel (probably through a console input) with a 1kHz sinewave. Adjust the oscillator level until the OPTIMOD-FM MASTER TOTAL G/R meter reads 10dB G/R.

4) Verify that the OPTIMOD-FM L COMPR OUT VU meter switch position causes the meter to read 0VU, ±0.5VU., and that the OPTIMOD-FM L FILTER OUT meter position causes the meter to read 0VU, ±1.0VU.

5) Repeat steps (3) and (4) for the RIGHT channel.

6) Restore the OPTIMOD-FM setup controls to their normal settings.

Failure to produce these standard levels indicates a failure somewhere within the audio processing circuitry. Refer to **Appendix F (Trouble Diagnosis).**