

Operating Manual

OPTIMOD-FM Six-Band Limiter

MODEL 8100A/XT2

An Accessory for OPTIMOD-FM Model 8100A/1

orban



APPARENT MODULATION OF PILOT IN THE 8100A

by Robert Orban
Chief Engineer
Orban Associates, Inc.

Apparent modulation of the pilot is often observed on a stereo monitor which is monitoring an 8100A-processed signal. This modulation may be real, or it may be a measurement artifact-- it is almost always the latter.

To accurately indicate pilot level, the pilot must be extracted from the baseband signal by means of a highly selective bandpass filter in the monitor. The pilot is typically 21dB below 100% modulation. When bright program material is encountered, the combination of the 8100A's excellent high frequency power handling capability and the 75us pre-emphasis curve will result in energy close to 100% modulation in the frequency range immediately adjacent to the pilot. If the monitor's pilot extraction filter is insufficiently selective, enough of the program energy can leak into the filter to cause apparent modulation of pilot level when observed on the monitor's meter. This is a linear effect, and is caused solely by inadequate filtering.

A similar problem can occur if a spectrum analyzer is used. The spectrum analyzer uses a selective swept filter. If the selectivity of the filter is adjusted too broadly, then the filter will be insufficiently selective to distinguish the pilot from the immediately adjacent high-level program material. In general, this is caused by attempts to use an excessively fast sweep rate.

Using a Tektronix 5L4N Spectrum Analyzer in our laboratory, this phenomenon was observed at faster sweep rates. At a sweep rate of 10kHz/sec, it was possible to narrow the selectivity of the filter to the point where the pilot was clearly seen to be some 50dB above any actual program material in the 19kHz region. This is such a great degree of separation between pilot and interfering signal that the maximum amount of effective modulation of the pilot would be approximately $\pm 0.3\%$ of the pilot injection, or $\pm 0.027\%$ modulation. Since pilot injection is permitted by FCC rules to vary within 8 to 10% modulation, this tiny amount of modulation is entirely trivial. However, it must again be stressed that this can only be measured with a correctly operated spectrum analyzer: the bandpass filters in typical stereo monitors or in a fast-sweeping spectrum analyzer are insufficiently selective.

Non-linear effects in other parts of transmission or measurement system can result in modulation of the pilot which cannot be eliminated by correct filter bandwidth. Exciter non-linearity is suspect; narrowband RF amplifiers and antennas and/or excessive VSWR can also cause problems.

cont'd.

In addition, any off-the-air pilot modulation measurements are themselves suspect because intermodulation between the pilot and high-energy high-frequency program material is very sensitive to multipath--even in amounts which do not cause the customary multipath indicators to respond. Therefore, the FCC cannot accurately monitor this parameter off-the-air. It must be done from the monitor sample point of the transmitter using a highly linear demodulator and a slow-sweeping spectrum analyzer.

In summary: The extra high frequency energy permitted by 8100A processing may reveal limitations of customary pilot measurement techniques. Spectrum analysis in our laboratory has confirmed that the pilot in the 8100A is more than adequately protected, provided that the filter circuitry in cards #8 and #9 is operating according to specifications. While real modulation of the pilot can be caused by non-linearities in exciters and the RF path following, the probability is high that measurement techniques are at fault.

RO:kt

Date: 4-15-87 S/N: 986123
Technician: DDM

8100A/XT2 SIX-BAND LIMITER FINAL TEST

1. OVERALL DEEMPHASIZED FREQUENCY
RESPONSE, 35-15k Hz

Left: +.41, -.36dB / Right: +.45, -.50dB

2. TOTAL DEEMPHASIZED HARMONIC DISTORTION
(Measured in TEST mode @100% modulation
and in OPERATE mode with controls per
NOTE 2 (below))

LEFT			RIGHT	
FREQ.	TEST	OP	TEST	OP
50	.057%	.095%	.035%	.091%
100	.059%	.066%	.040%	.061%
400	.047%	.039%	.052%	.039%
1000	.031%	.038%	.024%	.040%
5000	.081%	.045%	.037%	.045%
10000	.051%	.059%	.048%	.058%
15000	.068%	.066%	.066%	.064%

3. NOISE (deemphasized; dB below 100%)
Left: -82.8dB Right: -83.6dB

NOTE 1: Measurements made through
Hewlett-Packard 8903A
Computerized Audio Analyzer

NOTE 2: Control Settings For Operate-Mode THD Test

MAIN CHASSIS:

L&R INPUT ATTENS: 0
CLIPPING: +2
RELEASE TIME: 10
BASS COUPLING: 10
GATE THRESH: 0
HF LIMITING: 5

XT CHASSIS:

BASS EQ (L&R): 0
DENSITY: 5
CLIPPING: -4
PRESENCE EQ 0
BRILLIANCE EQ 0

BOARD SERIAL NUMBERS:

Board #A 1 : 986001
Board #A 2 : 986017
Board #A 3 : 986009

Section 1

General Information

In this section:

1. How to Use This Manual	(Table of Contents)	this page
2. Registration, Warranty, Feedback		page 1-2
3. Index		1-3
4. The XT2 Six-Band Limiter		1-4
5. Simplified Description of the 8100A/1 + XT2 System		1-5
6. Interface with OPTIMOD-FM		1-6

1. HOW TO USE THIS MANUAL

This manual has six sections:

Section 1: General Information
Section 2: Installation
Section 3: Operating Instructions
Section 4: Maintenance and Calibration
Section 5: Troubleshooting
Section 6: Technical Data

Each section has a Table of Contents. In addition, a comprehensive INDEX (on page 1-3) covers the entire manual.

This **GENERAL INFORMATION** section provides an overview of the product and its application. For complete installation instructions, see the **INSTALLATION** section.

Performance verification procedures are in the **MAINTENANCE AND CALIBRATION** section. See the **TROUBLESHOOTING** section for information on technical support, factory service, and shipping.

The **TECHNICAL DATA** section contains specifications, circuit descriptions, parts lists, and schematics. Throughout the circuit descriptions, keywords are highlighted to help you quickly locate the information you need.

In this manual "XT2" is used to mean "8100A/XT2 Six-Band Limiter Accessory Chassis". "OPTIMOD-FM" and "8100A/1" are used interchangeably to refer to the "OPTIMOD-FM Model 8100A/1" (or "OPTIMOD-FM Model 8100A modified with Retrofit Kit RET-27 to function as an OPTIMOD-FM Model 8100A/1") except where the context clearly indicates otherwise. Together the OPTIMOD-FM and XT2 form the "8100A/1 + XT2 System".

This manual is intended to be used in conjunction with the Operating Manual for the OPTIMOD-FM® Model 8100A/1.

2. REGISTRATION, WARRANTY, FEEDBACK

Registration Card

There are two good reasons for returning the Registration Card shipped with this product:

- 1) It enables us to inform you of new applications, performance improvements, and service aids which may be developed, and
- 2) It helps us respond promptly to claims under warranty without having to request a copy of your bill of sale or other proof of purchase.

Please fill in the Registration Card and send it to us today. If it is lost (or you have purchased this unit used), please photocopy the duplicate below, fill it in, and send it to Orban at the address on the title page.

Model # _____	Serial # _____
Name or Title _____	
Organization _____	
Street _____	
City/State/Country _____	
Zip or Mail Code _____	
Purchased from _____	City _____ Date of Purchase _____
Nature of your application _____	
How did you hear about it? _____	
Comments: _____	

Warranty

The warranty, which can be enjoyed only by the first end-user of record, is stated on the Warranty Certificate on a separate sheet packed with this manual. Save it for future reference. Details on obtaining factory service are provided in Section 5.

User Feedback Form

We are very interested in your comments about this product. Your suggestions for improvements to either the product or the manual will be carefully reviewed. In the back of this manual, a postpaid User Feedback Form is provided for your convenience. If it is missing, please write us at the address on the inside of the front cover. Thank you.

3. INDEX

8100A 1-6, 2-2
 8100A/1 1-1, 1-6, 2-2, 6-3
 8100A/1 + XT2 System 1-1
 8100A/ST 1-6, 2-2, 2-6, 2-12, 4-2

ACC-22 FM Filter Card 1-5, 3-7, 3-9
 accessory port 2-8, 6-3
 automatic gain control (AGC) 6-6

brightness 3-4
 brilliance 1-4, 3-7

circuit cards
 access to 4-1
 #A1 6-5, 7, 6-10, 6-12
 #A2 6-9, 6-24
 #A3 4-9, 6-7, 6-26
 #PS 2-7
 #5 2-4, 2-8, 5-5, 6-30
 #6 2-4, 2-10, 6-5
 #8, #9 2-5, 2-11, 6-5, 6

circuit description 6-3
 clipping 3-6, 7, 6-9
 main clipper defeat 6-5
 safety clipper 6-5
 compression 3-6, 6-3
 connections 2-5
 consistency 1-4
 crossovers 6-2, 6-7, 6-10
 controls 3-1, 6-3, 4, 5, 6-9
 recommended settings 3-5
 customized settings 3-6
 customer service 5-6

de-installation 4-14
 density 3-6, 6-4
 dimensions 6-2
 distortion 1-5, 3-4, 3-7, 8, 5-3, 4, 6-2, 6-4, 6-8
 -cancellation 4-7, 6-4, 6, 6-10
 N&D 4-5
 sibilance 5-3
 THD 6-2
 VCA 4-10

dual-band compressor 6-3

equalization
 automatic 1-4
 bass 1-4, 3-8, 6-2, 6-3, 6-5
 dynamic re- 3-6
 high-frequency 1-4, 3-7

FCS Overshoot Compensator 6-3, 6-5, 6
 field alignment 4-9
 field audit of performance 4-2
 FM Filter Card ACC-22 1-5, 3-7, 3-8
 format 1-4, 3-4
 frequency response 4-5, 6-2
 frequency balance 5-3
 functional description 6-3

HF filter 6-5

installation 2-3
 de-installation 4-14

intelligibility 6-4
 intermodulation 6-4, 6-10

jumpers 2-3

limiting 3-6, 6-2, 6-3, 6-6, 6-9
 loudness 1-4, 3-4, 3-6, 7, 6-4

maintenance 4-1
 meters 3-2, 4-7, 6-3
 modulation 6-6
 mounting 2-5

noise 5-4, 6-2
 noise reduction modification 5-5

openness 3-4
 OPERATE mode 4-6, 6-6
 OPTIMOD-FM 1-1

parts list 6-12
 ordering parts 6-12
 performance 4-6, 6-2
 verification 4-2
 power requirements 6-2
 presence 1-4, 3-7
 product overview 1-4, 5
 PROOF mode 6-3, 6-5
 pumping 5-4

registration card 1-2, 2-5
 retrofit RET-27 instructions 1-6, 2-6
 removing XT2 from operation 4-14

service 5-7
 shipping
 damage 2-3
 instructions 5-7
 six-band limiter 3-6, 6-2, 6-3, 6-6, 6-9
 sound quality problems 5-3
 sound texture 3-4
 source material 3-8, 6-4
 specifications 6-2
 Studio Chassis 1-6, 2-2, 2-6, 2-12, 4-2

technical support 5-6
 telephone speech 6-4
 THD 4-5, 4-6, 6-2
 time constants 6-3
 troubleshooting 5-1

user feedback form 1-2

VCA 6-5
 calibration 4-12
 gain control 6-7
 thump null 4-12, 6-8

warranty 1-2

XT2 1-1, 1-4

4. THE XT2 SIX-BAND LIMITER

The Orban Model 8100A/XT2 Six-Band Limiter Accessory Chassis was designed for those stations that need a "louder" or more processed sound than that provided by an OPTIMOD-FM used alone and in the recommended manner. The XT2 provides the means to fine-tune your on-air sound through precise control of bass and treble sound texture, program density, and program dynamics.

The XT2 is designed to give you:

- Increased loudness for a given level of audible processing side-effects (compared to an unmodified 8100A/1).
- Improved consistency from source to source, due to the "automatic equalization" effect of the six-band limiter.
- Increased presence and intelligibility on smaller radios and in autos.
- Control of bass and high-frequency equalization.

The XT2 is particularly well-suited for highly competitive pop music formats, such as AOR, CHR, AC, and Urban Contemporary. Oldie and Beautiful formats can also benefit from the improved consistency that the XT2's "automatic equalization" can provide. Because it has been specifically "tuned" to the OPTIMOD-FM, it produces less processing side-effects than do complex processing systems that use OPTIMOD-FM cascaded with other processors. (The XT2 cannot be used with other audio processors or as a stand alone unit.)

In general, the 8100A/1 + XT2 System will be only slightly louder than an 8100A/1 alone, operated with very fast release times and large amounts of clipping. This is because the loudness capabilities of an audio processor system are primarily determined by the design of the peak-limiting system, and the XT2's peak-limiting system is very similar to the highly sophisticated, patented system used in the 8100A/1.

Any loudness increase produced by the XT2 results from two characteristics: 1) the XT2 can automatically re-equalize dull program material, increasing energy in the frequency range to which the ear is most sensitive, and 2) XT2 processing reduces voice level by comparison to music. Since the clipping level in a processor system must often be set to avoid audible voice distortion, the XT2 permits the processor to be adjusted to produce higher loudness on music before voice distortion becomes objectionable.

Because of the XT2's "automatic equalization" of program material, there is some material (notably "heavy metal" with extreme amounts of 3kHz energy) which will actually be *quieter* through the XT2 than through the 8100A/1 alone because the amount of 3kHz energy (to which the ear is maximally sensitive) will be reduced by the XT2.

The primary advantages of the 8100A/1 + XT2 System are improved consistency, increased brightness on naturally dull program material, and reduction of audible processing side effects — all while retaining or slightly exceeding the high loudness capabilities of an aggressively operated 8100A/1.

5. SIMPLIFIED DESCRIPTION OF THE 8100A/1 + XT2 SYSTEM

The 8100A/1 and the XT2 combine to form an integral system. Functionally, the XT2 adds bass equalization, six-band limiting, high-frequency equalization, and multiband distortion-cancelling clipping to the 8100A/1.

In the 8100A/1 + XT2 System, the 8100A/1's dual-band compressor is used to maintain constant levels into the XT2's six-band limiter. This prevents *excessive* six-band limiting (which can result in unpleasant increases in density), while ensuring that desirable amounts of limiting occur consistently. The 8100A/1's RELEASE TIME control adjusts the speed of the dual-band compressor's response. Settings toward SLOW cause the compressor to ride gain like a "slow hand on the pot", not affecting short-term density or texture. Settings toward FAST result in a more consistently loud sound with increased density.

The dual-band compressor is also used as a dynamic bass equalizer to control the "warmth" of the sound. The 8100A/1's BASS COUPLING control adjusts this broadband bass equalization. In addition, the XT2 gives the signal a bass boost to compensate for the increased brightness often added by the six-band limiter. The boost frequency has been chosen to create very "punchy" bass, particularly on speakers with reasonably extended bass response. BASS EQ controls adjust the amount of bass "punch" the XT2 adds to each channel.

The XT2 divides the signal into six bands by a set of filters. Separate PRESENCE and BRILLIANCE controls adjust the drive levels into the two highest bands, enabling use of the XT2 as a dynamic high-frequency equalizer.

The use of six bands of limiting permits significant correction of midrange frequency balances and production of a more consistent, intelligible, and pleasing sound. Individual limiters for each of the six bands make the XT2 capable of far more *fast* gain control without audible side effects than would be possible with the dual-band compression used in the 8100A/1.

Loudness is increased by reducing the peak-to-average ratio of the audio, so the average level can be increased within the modulation limits permitted. The peak-to-average ratio of the six-band limiter's output is reduced by distortion-cancelling clipping and filtering. This also allows the signal to be applied to a final safety clipper (in the 8100A/1) without the need for further broadband gain control, which could introduce pumping and modulation effects.

The output of the safety clipper is returned to the 8100A/1's stereo generator, which produces the stereo baseband signal.

(If maximum loudness combined with improved spectral protection of the SCA region of the baseband is desired, the safety clippers in the 8100A/1 can be replaced with the optional FM Filter Card, available as Accessory Kit ACC-22.)

For a more detailed description of XT2 circuitry, see Section 6.

For more information about 8100A/1 circuitry, see the 8100A/1 Operating Manual.

6. INTERFACE WITH OPTIMOD-FM

The XT2 interfaces with the Model 8100A/1 OPTIMOD-FM through a cable which connects to the 8100A/1's Accessory Port #2. The XT2 receives its power from the host 8100A/1, and should always be mounted immediately beneath the host. To reconfigure the 8100A/1 for operation with the XT2, it is only necessary to move plug-in jumpers on certain circuit boards (see Section 2). Reconverting an 8100A/1 to operate without the XT2 is as simple as repositioning those jumpers (see Section 4).

The earlier Model 8100A can be easily converted to accept the XT2 by installation of Retrofit Kit RET-27, available from dealers or from the factory. This kit includes a prewired 25-pin connector, a replacement Card #5, and other parts. RET-27 installation instructions are included in Section 2. Instructions for reconverting an 8100A for use without the XT2 are given in Section 4 (some soldering is required).

The 8100A/ST Studio Accessory Chassis (used to implement the "split" studio/transmitter configuration) is fully compatible with the XT2.

Section 2

Installation

In this section:

1. WHAT TO DO	Read this first!	page	2-2
2. Installation Instructions			2-3
1) Unpack and inspect.			2-3
2) Reposition jumpers on OPTIMOD-FM Cards.			2-3
Fig. 2-1: Jumper Positions, Card #5			2-4
Fig. 2-2: Jumper Positions, Card #6			2-4
Fig. 2-3: Jumper Positions, Cards #8 and #9			2-5
3) Mount and connect XT2.			2-5
4) Return Registration Card.			2-5
5) Set 8100A + XT2 System Controls.			2-6
3. Retrofit Instructions			2-6
1) Open the OPTIMOD-FM's front panel, remove subpanel.			2-6
2) Check, add resistors on OPTIMOD-FM Card #PS.			2-7
3) Install accessory port in OPTIMOD-FM.			2-8
4) Check, replace OPTIMOD-FM Card #5.			2-8
Fig. 2-4: Accessory Port #2 Installation			2-9
5) Check, rework the OPTIMOD-FM Card #6.			2-10
Fig. 2-5: Card #6 Rework			2-11
6) Check, rework OPTIMOD-FM Cards #8 and #9.			2-11
4. XT2 with the Studio Chassis Accessory			2-12
Fig. 2-6: Studio Chassis Jumper Positions, Card #5			2-13

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)

1. WHAT TO DO

READ THIS FIRST!

If you are installing an **8100A/ST Studio Chassis**, read **XT2 WITH THE STUDIO CHASSIS ACCESSORY** at the end of this section *before* installing either unit.

The XT2 itself merely needs to be mounted in a rack and connected to the host OPTIMOD-FM Audio Processor. However, certain jumpers on the host OPTIMOD-FM's circuit boards must be repositioned to configure the unit for operation with the XT2. In addition, older OPTIMOD-FM Audio Processors may require simple reworking of some of their circuit boards and/or installation of an accessory port.

If your OPTIMOD-FM is **Model 8100A/1 with a serial number of 699000 or above**, you need only follow the **INSTALLATION INSTRUCTIONS**.

(The model and serial number of your OPTIMOD-FM are shown on a rear-panel label.)

If your OPTIMOD-FM is **Model 8100A/1 with a serial number below 699000**, you must first perform steps 1 and 2 of the **RETROFIT INSTRUCTIONS**.

If your OPTIMOD-FM is **Model 8100A (serial number below 638000)**, you must follow all of the **RETROFIT INSTRUCTIONS** before installing the XT2.

2. INSTALLATION INSTRUCTIONS

Read "WHAT TO DO" on the preceding page before continuing.

Allow about an hour for installation.

(Installation must be done with the OPTIMOD-FM off-the-air.)

The XT2 should not be installed until the OPTIMOD-FM Audio Processor has been installed and thoroughly tested on the air.

1) Unpack and inspect.

If you ever re-ship the XT2 (e.g., for servicing), it is best to ship it in the original packing materials since these have been carefully designed to protect the unit. Make a mental note of the method of packing and *save all packing materials*.

Packed with the 8100A/XT2 are:

- 1) Two 1.8-ohm resistors (for step 2 of RETROFIT INSTRUCTIONS)
- 2) Four 10-32 x 3/4" screws (for rack mounting)
- 3) Two keys for front-panel door
- 4) Final Factory Qualification Test Results for this unit
- 5) This Operating Manual

Perform a general inspection of the contents of the package 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.

IMPORTANT: Before continuing, you *must follow the RETROFIT INSTRUCTIONS* in this section if the serial number of your OPTIMOD-FM is below 699000 (see WHAT TO DO on the preceding page). When the retrofit is complete, return to this step.

2) Reposition jumpers on OPTIMOD-FM Cards #5, #6, #7, and #8.

- a) Open the OPTIMOD-FM's front panel, remove subpanel.

Jumpers may be reset from the front of the chassis while the unit is in the rack, once the front panel has been opened and the subpanel removed.

Remove the three hex-socket screws at the top of the front panel with a 5/64" hex wrench (provided with unit). Tilt the hinged front panel downward to reveal the interior. Set the AC POWER switch to OFF. Loosen the four DZUS fasteners on the subpanel by turning each one-quarter turn counterclockwise with a long 3/16" or 1/4" flat-blade screwdriver. Taking care not to stress the flat cables beneath it, tilt the top of the subpanel outward and to the left to clear the upper chassis lip and the door support rail at the right.

CAUTION

To avoid trauma to circuit card components, be sure the AC POWER switch (located behind OPTIMOD-FM's front panel) is set to OFF before removing or inserting any of the printed circuit cards.

- b) Remove Card #5. Move each of jumpers A, B, and C to the "6-BAND LIMITER ACCESSORY CHASSIS" position (see Fig. 2-1). Reinstall Card #5.

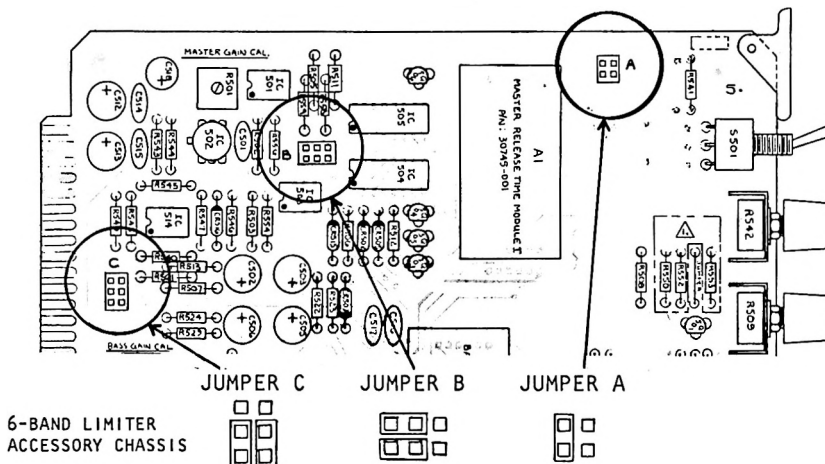


Fig. 2-1: Jumper Positions, OPTIMOD-FM Card #5

(For Card #5, part numbers 30741-000-03 and above only — if your card looks different, see Appendix J of your OPTIMOD-FM Operating Manual for jumper locations.)

- c) Remove Card #6. Move the two links at jumper C to jumper B (see Fig. 2-2). DO NOT MOVE jumper A. Reinstall Card #6.

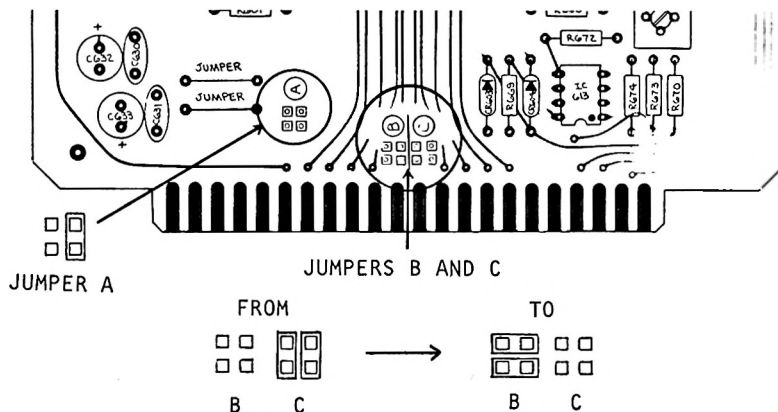


Fig. 2-2: Jumper Positions, OPTIMOD-FM Card #6

(For Card #6, part numbers 30461-000-03 and above only — if your card looks different, see Appendix J of your OPTIMOD-FM Operating Manual for jumper locations.)

- d) Remove Cards #8 and #9. On each of Cards #8 and #9, move the link at jumper B to the "ACCESSORY CHASSIS" position (see Fig. 2-3). DO NOT MOVE jumper A on either card. Reinstall the cards.

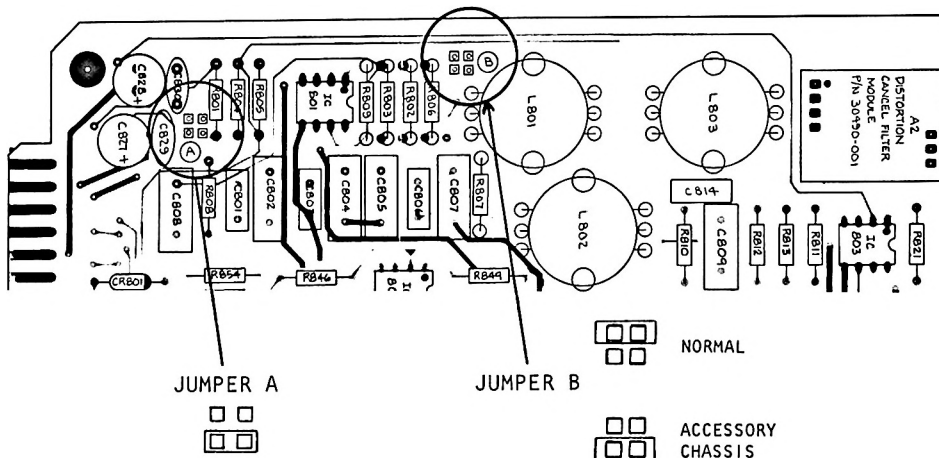


Fig. 2-3: Jumper Positions, OPTIMOD-FM Cards #8 and #9

(For Cards #8/#9, part numbers 30481-000-04 or above only — if your cards look different, see Appendix J of your OPTIMOD-FM Operating Manual for jumper locations.)

- e) Reinstall the OPTIMOD-FM's subpanel and close the front panel.

Taking care not to stress the flat cables beneath it, tilt the top of the subpanel inward and to the left to clear the upper chassis lip and the door support rail at the right. The DZUS fasteners turn only 1/4-turn. Don't force them, lest they be damaged in a way that is very time consuming to repair. The subpanel should always be replaced since it is an integral part of the chassis RFI protection.

Set the internal AC POWER switch to ON. Raise the front panel and fasten the three screws that secure it in place. If the unit was removed from the rack, remount it. Ground the unit and connect AC power.

3) Mount and connect XT2.

- a) Mount the XT2 in a rack immediately *below* the OPTIMOD-FM.

The XT2's connecting cable will not reach the connector on the OPTIMOD-FM unless the XT2 is mounted directly below the OPTIMOD-FM.

- b) Plug the flat cable from the XT2 into the OPTIMOD-FM's ACCESSORY PORT #2 and attach the connector with the retaining screws.

Both power and signals for the XT2 are supplied through this cable.

4) Complete the Registration Card and return it to Orban (please).

5) Set 8100A + XT2 System controls.

The OPTIMOD-FM and XT2 work together in a system. The controls on one unit affect the performance of the other. See Section 3 for recommended control settings and for information on customizing your audio processing.

If you are using an 8100A/ST Studio Chassis, set *its* controls to the settings recommended for the 8100A in Section 3.

3. RETROFIT INSTRUCTIONS

IMPORTANT: Skip these instructions if the serial number of your OPTIMOD-FM is 699000 or above.

If your OPTIMOD-FM is Model 8100A/1 with a serial number below 699000 but not below 638000, follow steps 1 and 2 only.

If your OPTIMOD-FM is Model 8100A (serial number below 638000), follow steps 1 through 6.

Materials: Retrofit Kit RET-27 (available from the factory) contains the parts needed in steps 3 through 6. The resistors specified in step 2 are supplied with the XT2.

These retrofit modifications are simple and require only common circuit board repair skills, appropriate tools, and a careful, systematic approach. However, to save time and avert errors, we suggest that you read through each step in these instructions with board in hand before beginning work.

The drawings in Appendix J of your OPTIMOD-FM Operating Manual show component locations. (If you have the older 8100A unit, see Section 6 of the this manual for Card #5 drawings.) Advice for reworking printed-circuit cards is given in Appendix F of the OPTIMOD-FM manual.

1) Open the OPTIMOD-FM's front panel, remove subpanel.

Remove the three hex-socket screws at the top of the front panel with a 5/64" hex wrench (provided with unit). Tilt the hinged front panel downward to reveal the interior. Set the AC POWER switch to OFF. Loosen the four DZUS fasteners on the subpanel by turning each one-quarter turn counterclockwise with a long 3/16" or 1/4" flat-blade screwdriver. Taking care not to stress the flat cables beneath it, tilt the top of the subpanel outward and to the left to clear the upper chassis lip and the door support rail at the right.

2) Check, add resistors on OPTIMOD-FM Card #PS.

Allow about 45 minutes for this step.

- a) Check the values of resistors R103 and R104 on the OPTIMOD-FM Card #PS, the power supply regulator card. If the values of R103 and R104 are already 0.62 ohms (blue-red-gold-gold), or if "piggyback" resistors of 1.8 ohms (brown-gray-silver) have been added in parallel to existing 0.91-ohm resistors, skip to step d.

Card #PS is mounted on the inside of the rear panel. These large resistors can be seen by opening the front panel, removing the subpanel, then looking in the rear interior of the unit to the left of Card #3. A flashlight will be necessary.

- b) Remove the OPTIMOD-FM from the rack, place it on a bench, and carefully open the rear panel.

Set the unit on a pad with the rear panel facing you and about 6" (15cm) back from the edge of the bench. Make certain the power cord is unplugged. Remove the screws which attach the top and bottom covers to the rear panel (eight screws on each cover). There is no need to remove the other cover screws. Remove the nine screws circled in black on the rear panel. Very carefully and slowly pull the rear panel out about 3/4" (2cm), then tilt the top edge down until the rear panel is horizontal.

CAUTION

Watch for snags in the internal wiring and for any stress on the ceramic capacitors on the divider wall or input filter box. These capacitors are very fragile and difficult to replace.

- c) Connect a 1.8-ohm resistor in parallel with R103. Connect another 1.8-ohm resistor in parallel with R104.

Two 1.8-ohm (brown-gray-silver-silver or brown-gray-silver-gold), 1-watt wirewound resistors are supplied with the XT2. Bend each lead at right angles (about 1/8" from the resistor bodies), then "piggyback" the new resistors onto the old on the component side of the board. To avoid heat damage, solder the leads together as far away from the resistor bodies as practical. We suggest you mark these changes on the power supply schematic. The net value of each resistor pair is now approximately 0.62 ohms.

- d) If your OPTIMOD-FM is a Model 8100A (with a serial number below 638000), skip to step 3.

If you have a Model 8100A/1 (serial number 638000 or above), close the rear panel (but not the front panel) if open, remount the unit in the rack, skip the rest of the RETROFIT INSTRUCTIONS, and follow the INSTALLATION INSTRUCTIONS on page 2-3.

When replacing the rear panel, make sure that no wires are pinched under the flanges.

3) Install accessory port in OPTIMOD-FM (Only in Model 8100A, S/N below 638000).

Allow about one hour for this step.

- a) **If a connector is installed in Accessory Port #1**, remove the metal plate covering Accessory Port #2 and discard the plate and its fasteners.

If no connector is installed, remove the metal plate covering both Accessory Ports. Save the fasteners, and discard the plate. Install the metal plate from the Retrofit Kit over Accessory Port #1, using the fasteners from the discarded plate.

- b) Install the connector in the rear-panel hole marked "ACCESSORY PORT 2" with the hardware provided (see Fig. 2-4). Note the orientation of the connector. Dress the wires as shown, adjusting the cable ties as needed. Connect each wire to the motherboard as indicated in the table in Fig. 2-4.

With only moderate force, use a #6 (3/16") hex nutdriver (a 5mm nutdriver will also work) to tighten the small screws.

The wire lengths have been chosen to provide enough slack to enable other service operations on the rear panel to be performed. It would be unwise to shorten the wires. The routing shown should be followed to avoid possible crosstalk.

It is safe to tack-solder to the motherboard with the circuit cards in place except in very high RF fields, in which case all cards should be removed. In any case, we recommend using a soldering iron with a grounded tip to minimize possibility of circuit damage. Avoid using excessive amounts of heat or flux at the motherboard, since the connectors could be damaged by tempering of the contacts through excessive heat or by creeping flux.

Because some of the motherboard traces are close together, inspect your work very carefully to be sure that you have not created solder bridges between traces or pads.

- c) Re-attach the rear panel by reversing the disassembly procedure.

When replacing the rear panel, make sure that no wires are pinched under the flanges.

4) Check, replace OPTIMOD-FM Card #5.

Allow about 5 minutes for this step.

In this and the following two steps, you will be instructed to set cards aside rather than reinstalling them. This is to save you from removing them again to set jumpers as directed in the INSTALLATION INSTRUCTIONS.

CAUTION

Be sure OPTIMOD-FM's internal AC POWER switch is set to OFF before removing or inserting any of the printed circuit cards.

WIRE SCHEDULE				
FROM	TO	FUNCTION	COLOR	LENGTH
AP-1	AP-14	15V PROOF	—	.25 IN
AP-2	AP-15	+15V	—	.25 IN
AP-3	AP-16	-15V	—	.25 IN
AP-4	AP-17	CHASSIS GND	—	.25 IN
AP-5	AP-18	DIRTY GND	—	.25 IN
AP-6	AP-19	CLEAN GND	—	.25 IN
AP-12	J9-M	RISKY FILTER	BLK	14.5 IN
AP-13	J9-P	R22 KHZ FILTER	WHT	14.5 IN
AP-14	J9-F	15V PROOF	VIO	15.5 IN
AP-15	P5-6	+15V	BLU	9 IN
AP-16	P5-8	-15V	GRY	7.5 IN
AP-17	GND LUG	CHASSIS GND	BLK	2.5 IN
AP-18	P5-7	DIRTY GND	DLK	7.5 IN
AP-19	P5-7	CLEAN GND	BRN	7.5 IN
AP-20	J6-3	LIMITER OUT	WHT	12.5 IN
AP-21	J6-5	R LIMITER OUT	GRY	12 IN
AP-22	J8-M	L15 KHZ FILTER	RED	14 IN
AP-23	J8-P	L22 KHZ FILTER	ORN	14 IN

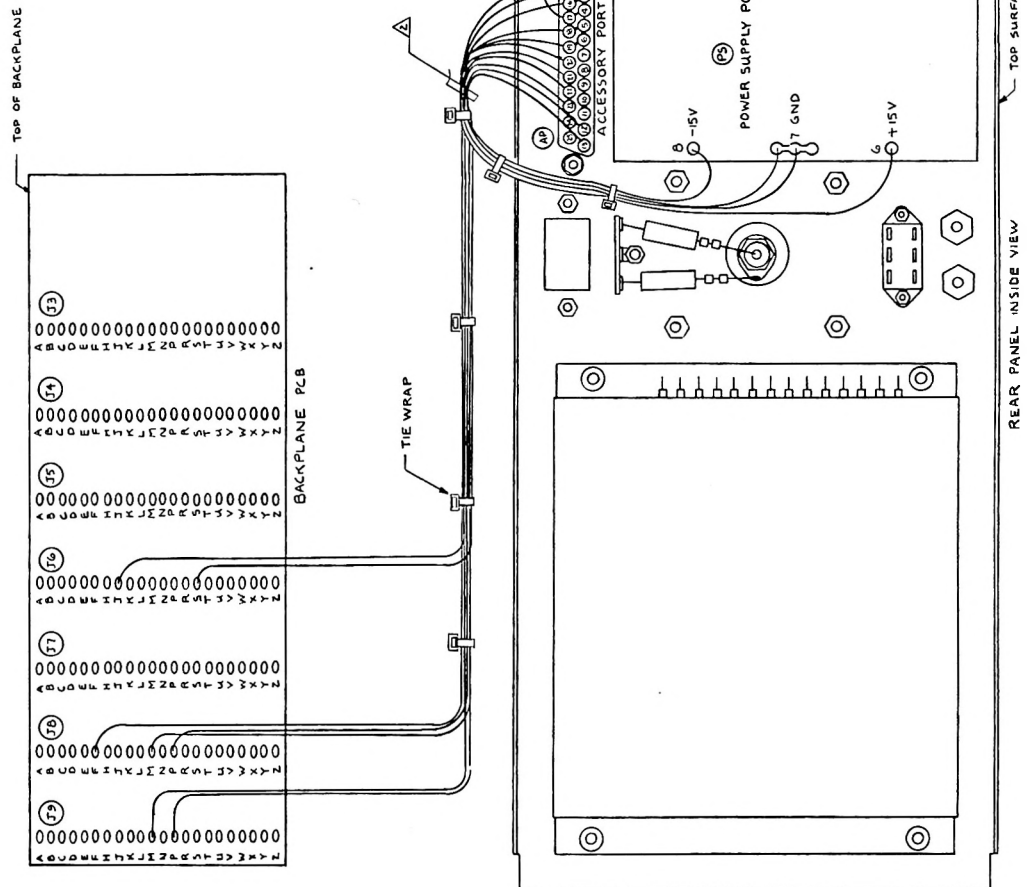


Fig. 2-4: Accessory Port #2 Installation

- a) Remove Card #5 and check the part number etched on the solder side.

If the part number is 30741-000-03, the card you have is the correct one for use with the XT2. Set the card aside (do not reinstall it yet) and skip to step 5. You may return the Card #5 included with the Retrofit Kit to the factory for credit.

To do this, contact Orban Customer Service at one of the numbers at the front of this manual to get a Return Authorization number. We will need to know the serial number of your OPTIMOD-FM and the six-digit serial number stamped on the card itself. Only the Card #5 included with the Retrofit Kit (not the one that was already in your unit) will be accepted for credit. The duplicate Card #5 must be returned to us within 60 days of the date of its shipment to you.

Upon receipt of your duplicate Card #5, we will mail a refund to the organization represented as the owner on the Registration Card. If the Registration card is not on file, other proof of ownership will be required.

If the part number is 30451-000-nn (where -nn is any number) or 30741-000-02 or -01, use the Card #5 provided in the Retrofit Kit (which will have an etched number of 30741-000-03 or higher) instead of the old card. Do not install the new card yet — set it aside, taking care not to confuse it with the old card.

The old card is not returnable, but can serve as an emergency spare (although you may hear more processing artifacts with it).

5) Check, rework the OPTIMOD-FM Card #6.

Allow about one hour for this step.

The rework in this step enables the XT2 to defeat the OPTIMOD-FM's high-frequency limiters and soft clippers, and it redirects the output of Card #6 to the accessory port installed in step 3.

- a) Remove Card #6 check the part number etched on the solder side.

If the part number is 30461-000-05 or above, the card you have is the correct one for use with the XT2. Set it aside and skip to step 6.

If the part number is 30461-000-04 or below, continue to step b.

- b) Remove all the solder from both sides of the foil pad connected to the center terminal of toggle switch S602 with a vacuum desoldering tool. Use fairly strong diagonal cutters to *gently* clip the center leg of S602, leaving a stub on the switch long enough to later solder two wires to (1/8" will do). Remove and discard the portion of the leg formerly soldered to the card. Gentle wiggling with chain-nose pliers may help release it.
- c) Solder the banded (cathode) end of a glass 1N4148 diode to the pad where the center leg of S602 was attached.
- d) Desolder the non-banded (anode) end of glass diode CR603 with a vacuum desoldering tool. Bend the diode upward so that the free end is pointing toward S602. Using the long wire from the kit, connect the free end of CR603 to the center terminal of S602. Also connect the free end of the 1N4148 diode installed in step c to this terminal. Carefully solder both diodes to the terminal. Avoid excess heating and excess solder or flux (which could creep into the switch).

- e) Locate and mark pins J and S on the edge connector. On the *component side* of the card, cut both of these traces as close as convenient to the pads near the card edge with a sharp razor knife. Remove about 1/8" of each trace to avoid possible shorts.

Note that not all letters are used, and that pin J is therefore the 8th pin from the top and that pin S is the 15th from the top.

- f) Working on the solder side of the card, solder the two short jumpers supplied in the Retrofit Kit to the pads indicated in Fig. 2-5.

Because these pads are so small, there is a risk of shorts. After soldering, it would be wise to remove all flux with a cotton swab moistened with flux remover (Energine® Fireproof Spot Remover works well) and to examine the area for solder slivers.

- g) Reset the two jumper links (located on the component side of the board, opposite the switch) so that they each contact only one pin.

This "storage" position retains the links so that they can be used to restore the card to its normal configuration should this be necessary in the future.

- h) Carefully recheck *all* work done in step 5, then set the card aside.

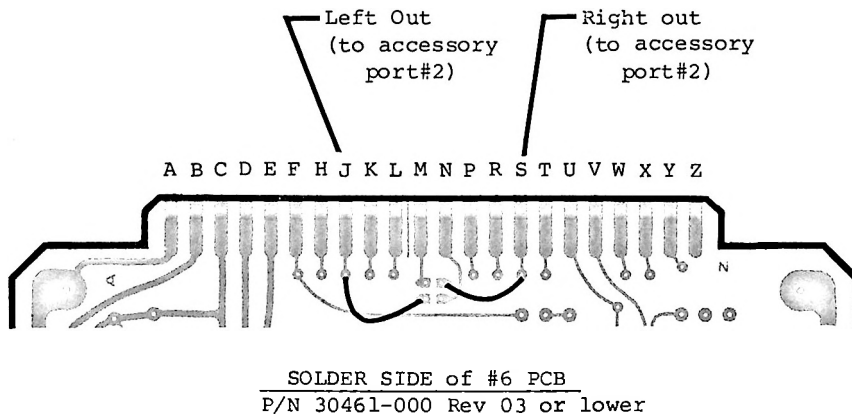


Fig. 2-5: Card #6 Rework

- 6) Check, rework OPTIMOD-FM Cards #8 and #9.

Allow about 30 minutes for this step.

The rework in this step disconnects the input of each distortion-cancelling low-pass filter from other circuitry. These inputs will now be driven from the XT2.

- a) Remove Cards #8 and #9 and check the part number etched on their solder sides (both cards should have the same part number).

If the part number is 30481-000-04 or above, the cards you have are the correct ones for use with the XT2. Set the cards aside and skip to step d.

If the part number is 30481-000-03 or below, continue to step b. Rework *both* cards.

- b) Using a vacuum desoldering tool, desolder and lift those leads of R804 and R805 which are closest to the card's upper edge. Do not desolder the opposite ends. After the leads have been freed by bending the resistors upward, clear the holes of solder for possible future use.

The two resistors should be positioned so that the free leads cannot accidentally come in contact with other circuits or with each other. A small piece of tape over the holes may be helpful.

- c) Carefully recheck *all* work done in step 6, then set the cards aside.
- d) Follow the INSTALLATION INSTRUCTIONS on page 2-3.

4. XT2 WITH THE STUDIO CHASSIS ACCESSORY

If you are using the 8100A/ST Studio Chassis, we recommend that the Studio Chassis and the OPTIMOD-FM levels be matched to each other before the OPTIMOD-FM is configured for use with the XT2. See the 8100A/ST Operating Manual for complete instructions.

Leave the covers off the Studio Chassis following level-matching to facilitate your replacing Card #5. If you have an "old" Card #5 (part number 30741-000-01 or -02 or any part number beginning 30451), use it during the alignment between the Studio Chassis and the 8100A/1. If you only have a "new" Card #5 (part number 30741-000-03), set its jumpers as shown in Fig. 2-6 and use it during the alignment.

Please note that accurate level alignment between the OPTIMOD-FM and the Studio Chassis is much less critical when the XT2 is in use, because a stage of gain reduction has been placed between the input of the OPTIMOD-FM and its clippers to protect the clippers from being overdriven in the event of gain errors. But if the above suggestions are followed, the STL will be correctly aligned for the OPTIMOD-FM with Studio Chassis even if the XT2 is removed from the system.

Note also that when Card #5 is strapped for XT2 operation, it no longer produces a "standard level" of +3.6dBm at the Studio Chassis output, nor does it cause the OPTIMOD-FM's VU meter to read "0VU" in the L or R COMPR OUT positions. Instead, its output is reduced approximately 5dB, causing the "standard level" test to produce -1.4dBm and the VU meter to read "-5VU". This is because Card #5's limiting threshold is reduced to compensate for the increased attack time (which increases overshoots on program material) and so maintain approximately the same program peak levels and STL peak modulation.

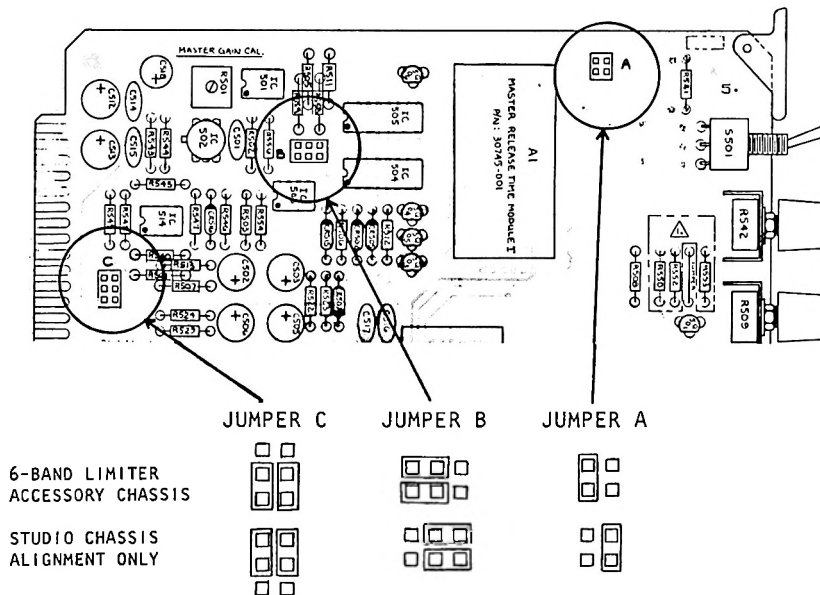


Fig. 2-6: Jumper Positions for Studio Chassis Alignment, Card #5
(Part number 30741-000-03 or above.)

2-14 Installation

Notes:

Section 3

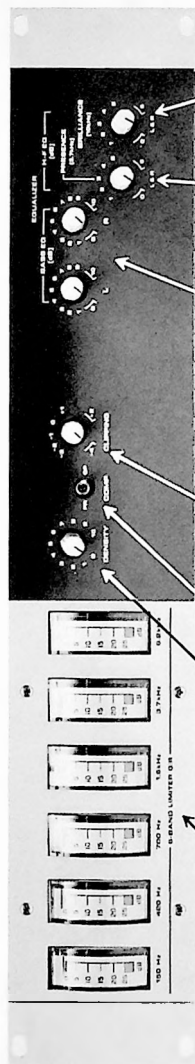
Operating Instructions

In this section:

Fig. 3-1: XT2 Controls and Meters	page	3-2
Fig. 3-2: 8100A/1 Controls		3-3
1. Recommended Settings for the Best Sound		3-4
Fig. 3-3: Recommended Control Settings		3-5
2. Customizing the Settings		3-6
1) Some audio processing concepts.		3-6
2) Compression, density, and loudness.		3-6
3) Clipping, loudness, and distortion.		3-7
4) High-frequency equalization: presence, brilliance, and loudness.		3-7
5) Bass equalization.		3-8
6) More on distortion.		3-8

All XT2 controls are located behind the access door on the front panel of the XT2. This access door may be locked with the supplied key. There are no user adjustments on the circuit cards.

XT2 Controls and Meters



H-F Equalization controls boost high-frequency response by up to 6dB:

BRILLIANCE control increases the gain (prior to limiting) of the 6.2kHz-to-15kHz band. Produces an audibly attractive effect with increased "air" and "transparency" (similar to that of a "psychoacoustic exciter").

PRESENCE control increases the gain (prior to limiting) of the 3.7kHz band. The 3.7kHz band limiter will resist such gain increase to prevent introducing excess stridency into material with excessive presence energy.

BASS Equalization controls adjust the amount of bass boost. Separate controls for left and right channels (all other controls affect both channels) provide a peaking boost to achieve solid, punchy bass from most consumer radios without exciting the mid-bass dashboard resonances in cars. Range is 0dB to +10dB; center frequency is 65Hz; "Q" is 1.4 (approximately 1 octave).

CLIPPING control adjusts signal level going into the multiband clippers and therefore determines the amount of peak limiting done by clipping. Range is -4dB to +2dB. This control governs the trade-off between loudness and distortion.

COMPRESSOR switch disables the limiters and clippers when set to PProof (used for testing).

DENSITY control adjusts signal level going into the six-band limiter, and therefore controls density of output audio by determining the amount of gain reduction in the six-band limiter. The resulting sound texture can be open and transparent, solid and dense, or somewhere in between. Range is 20dB.

6-BAND LIMITER G/R meters show the amount of gain reduction for each of the six limiter bands. Note that the gain reduction in the 6.2kHz band is controlled by, and is always identical to, the gain reduction in the 3.7kHz band.

Fig. 3-1: XT2 Controls and Meters

8100A/1 Controls

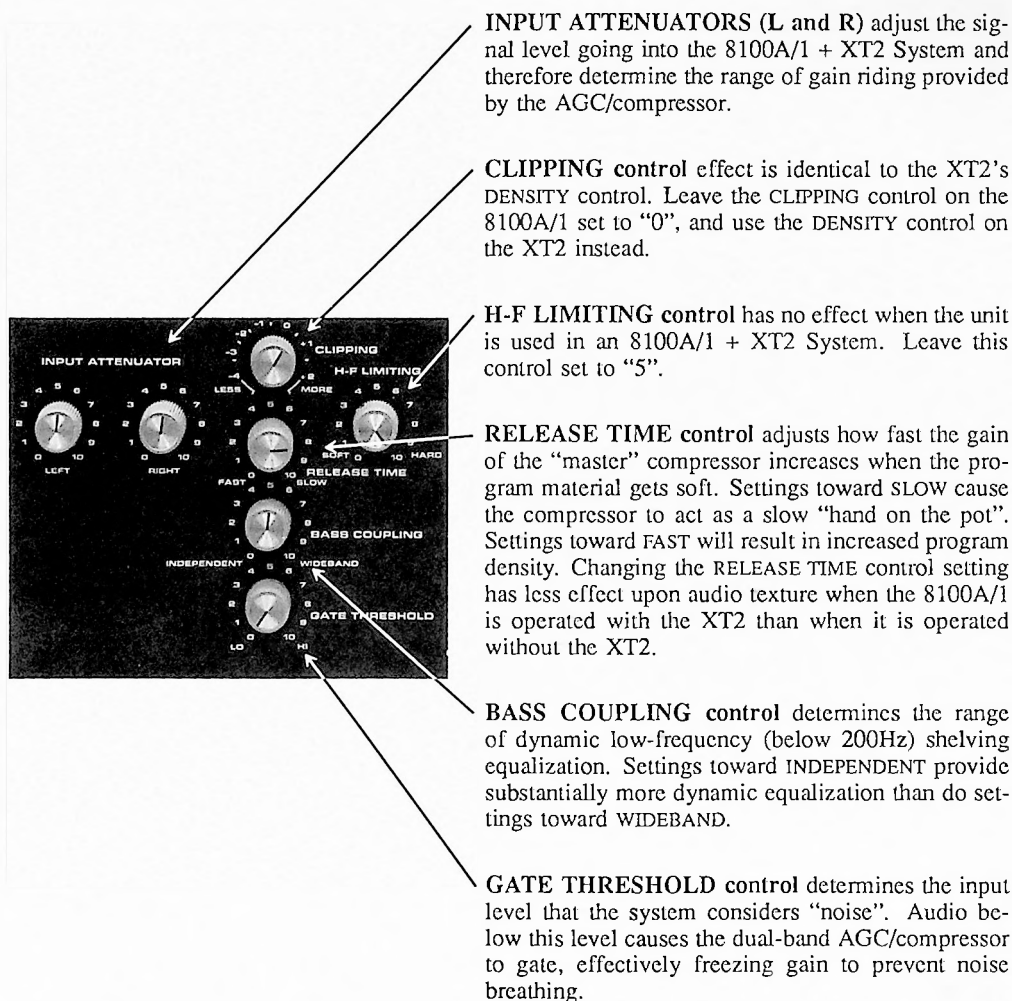


Fig. 3-2: 8100A/1 Controls
Used in Adjusting the 8100A/1 + XT2 System

1. RECOMMENDED SETTINGS FOR THE BEST SOUND

The 8100A/1 + XT2 System is very flexible, enabling you to fine-tune your air sound for your target audience and desired market position.

Figure 3-3 details four 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, customize your sound using the information in "Customizing the Settings", which follows.

The four sounds produced by the recommended settings are:

OPEN An "unprocessed" sound with a nice sense of dynamic range. With these settings, the XT2 provides gentle "automatic equalization" to keep the frequency balance consistent from record to record (especially those recorded in different eras). And for "background music" formats, these settings ensure that your sound doesn't lose its highs and lows.

Formats: Beautiful Music, Light Pop.

TALK Processing for this sound keeps the levels of announcers and guests consistent, pulls low-grade phone calls out of the mud, and keeps a proper balance between voice and commercials. Voice is the most difficult audio to process, but these settings result in a most favorable trade-off between consistency, presence, and distortion.

Format: Talk.

SMOOTH The sound texture for the station that values a clean, easy-to-listen-to sound with a tasteful amount of punch, presence, and brightness added when appropriate. This is an "unprocessed" sound that sounds just right on music and voice when listened to on small table radios, car radios, portables, or home hi-fi systems.

Formats: Album-Oriented Rock, Adult Contemporary, Modern Country, Oldies, Talk.

COMPETITIVE This is the major market "competitive" sound, emphasizing loudness as well as clean audio. The sound from cut to cut and announcer to announcer is remarkably consistent as the "texture" of music is noticeably altered to a standard. Bass has an ever-present punch, there's always a sense of presence, and highs are in perfect balance to the mids, no matter what was on the original recording.

With these settings, your sound is getting farther away from the balance and texture of the original recording. We think that this is as far as processing can go without causing noticeable listener fatigue.

Formats: Adult Contemporary, Contemporary Hit Radio, Oldies, Modern Country, Urban.

	SOUND TEXTURE			
	Open	Talk	Smooth	Competitive

8100A/I Controls:

INPUT ATTENUATORS

Adjust to produce no more than the indicated gain reduction on typical program material, as shown on the OPTIMOD-FM's TOTAL MASTER G/R meter:

G/R Meter:

	0-5dB	5-10dB	5-10dB	10-15dB
CLIPPING	0	0	0 0	0 0
H-F LIMITING	5	5	5 5	5 5
RELEASE TIME	8	7	3 6.5	4 3
BASS COUPLING	8	7	5 7	6 2
GATE THRESHOLD	0	2	4 4	4 2.5
PILOT	ON	ON	ON	ON
CROSSTALK TEST	OPERATE	OPERATE	OPERATE	OPERATE
COMPRESSOR	OPERATE	OPERATE	OPERATE	OPERATE
LIMITER	OPERATE	OPERATE	OPERATE	OPERATE

XT2 Controls:

DENSITY

Adjust to produce no more than the indicated gain reduction on typical program material, as shown on the XT2's 700Hz and 1.6kHz meters:

Meters:

	2-3dB	2-3dB	2-3dB	3-4dB	4-5dB	3
CLIPPING	+1	0	+1	0	+0.5	0
BASS EQ (L & R)	2	2	3	1.5	3	5
PRESENCE	2	2	2.5	3	3	2.8
BRILLIANCE	3	2	4	5	4	2.0
COMP	OPERATE	OPERATE	OPERATE	OPERATE	OPERATE	OPERATE

DENSITY 5.05

0

5.2

1.0

1.1

Fig. 3-3: Recommended Control Settings

2. CUSTOMIZING THE SETTINGS

The controls in the 8100A/1 + XT2 System give you the flexibility to customize your station sound. But as with any audio processing system, proper adjustment of these controls requires proper balancing of the trade-offs between loudness, density, brightness, and audible distortion. The following provides the information you need to adjust the 8100A/1 + XT2 System controls to suit your format, taste, and competitive situation.

1) 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 modulation limits permitted. 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 dynamic range in a manner similar to "riding the gain"; limiting and clipping reduce the short-term peak-to-average ratio of the audio.

Compression reduces the difference in level between the soft and loud sounds to make more efficient use of permitted peak level limits, resulting in a subjective increase in the loudness of soft sounds. It *cannot* make loud sounds seem louder.

Six-band 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 very 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, however, will be perceived as audible distortion.

The 8100A/1 + XT2 System is designed to allow you to make maximum use of compression, limiting, and clipping, while minimizing the associated processing artifacts. It is important, however, to remember that *there is a fundamental trade-off between loudness, brightness, density, and distortion.*

2) Compression, density, and loudness.

The compression which takes place in OPTIMOD-FM makes audio levels more consistent without significantly altering texture. The XT2's six-band limiting audibly changes the density of the sound and dynamically re-equalizes it as necessary (booming bass is tightened; weak, thin bass is brought up; highs are always present and consistent in level).

The various combinations of *compression* and *density* offer great flexibility:

Light compression + light limiting yields a wide sense of dynamics, with a small amount of automatic re-equalization.

Moderate compression + light limiting produces an open, natural quality with automatic re-equalization and increased consistency of frequency balance.

Light compression + moderate limiting gives a more "dense" sound.

Moderate compression + moderate limiting results in a "wall of sound" effect which may cause listener fatigue.

Adjust OPTIMOD-FM to produce the desired amount of compression, and then fine-tune the limiting and clipping with the XT2's controls.

The RELEASE TIME control on OPTIMOD-FM affects the amount of compression (reduction in dynamic range) by the dual-band compressor in OPTIMOD-FM. Lower (faster) settings result in a more consistently loud output, while higher (slower) settings allow a wider variation in dynamic range. To avoid objectionable pumping, do not set this control below "4".

The DENSITY control on the XT2 affects the relative amount of six-band limiting. Adjust it to your taste and format requirements. Used lightly, the limiter produces an open, re-equalized sound.

The DENSITY setting is *critical to sound quality* — listen carefully as you adjust the controls. There is a point beyond which increasing density will no longer yield more loudness, and will simply degrade the punch and definition of the sound.

We recommend no more than 5dB gain reduction as shown on the meters for the 700Hz and 1.6kHz bands. More than 5dB will often create a "wall of sound" effect that many find fatiguing.

3) Clipping, loudness, and distortion.

The CLIPPING control on the XT2 determines the primary loudness/distortion trade-off. The CLIPPING control adjusts the threshold of limiting for all limiters simultaneously. This means that as the CLIPPING control is turned down, the average level of the audio going into the clippers is decreased as a result of the amount of six-band limiting's being *increased*.

For a given setting of the CLIPPING control, perceived clipping distortion will increase as the DENSITY control is advanced, and the CLIPPING control may have to be turned down to compensate.

When using moderate amounts of limiting, we recommend that the CLIPPING control on the XT2 be set to "0". Conversely, if you are operating with light amounts of limiting (2–3dB in midrange), it is often possible to turn up the CLIPPING control without suffering from excessive distortion.

If the OPTIMOD-FM's VU meter (set to L or R FILTER OUT) consistently indicates peaks higher than about –2VU (–1VU if the optional ACC-22 FM Filter Card has been installed), some audible distortion is likely, and we recommend operating in this manner only if your competitive situation absolutely demands it.

4) High-frequency equalization: presence, brilliance, and loudness.

Controls are provided on the XT2 to increase the presence and brilliance of program material. It is important to understand how these controls interact with other 8100A/1 + XT2 System controls.

The PRESENCE control boosts the 2–6kHz region. Turning up the PRESENCE control can increase loudness substantially.

The audible effect of the PRESENCE control is closely associated with the amount of gain reduction in the 3.7kHz band. With low levels of gain reduction, the effect is an actual boost in the level of energy in the presence region. As gain reduction in the 3.7kHz band is

increased (by turning the DENSITY control up or the CLIPPING control down), the PRESENCE control will have progressively less audible effect. The limiter for the 3.7kHz band will tend to reduce the effect of the PRESENCE boost (in an attempt to keep the gain constant) to prevent excessive stridency in program material which already has a great deal of presence energy. So with large amounts of gain reduction, the density of presence region energy will be increased more than will the level of energy in that region.

Nevertheless, if less than 5dB gain reduction is used in the 3.7kHz and 6.2kHz bands, the PRESENCE control will have a significant audible effect almost all of the time. Use the PRESENCE control with caution. Excessive presence boost tends to be audibly strident and fatiguing. And the sound quality, although loud, can be very irritating. A maximum of 3-4dB boost is suggested, although 6dB can be achieved.

The BRILLIANCE control boosts the region centered at 10kHz. In general, a brilliance boost is audibly attractive — similar to the effect produced by a “psychoacoustic exciter”.

Unlike the PRESENCE control, the BRILLIANCE control will have an audible effect at all times. Interestingly (because the 3.7kHz band limiter controls the gain reduction in the 6.2kHz band also), turning up the PRESENCE control may *decrease* energy in the 6.2kHz band, since you will be increasing the gain reduction in *both* the 3.7kHz and 6.2kHz bands. You may wish to compensate for this effect by turning up the BRILLIANCE control.

Excessive brilliance boost can also increase the noticeability of tape hiss and distortion in program material that is less than perfectly clean. We suggest no more than 4dB boost as a practical maximum, unless source material is primarily from compact disc.

5) Bass equalization.

The 8100A/1 + XT2 System's three bass equalization controls give you separate control of “warmth” and “punch”. Because the XT2 often increases the brightness of program material, some bass boost is usually desirable to keep the sound spectrally well-balanced.

Adjustment of bass equalization must be determined by individual taste and by the requirements of your format. Be sure to listen on a wide variety of radios — it's possible to create a very muddy sound in certain cars by over-equalizing the bass. Be careful!

The OPTIMOD-FM's BASS COUPLING control influences the amount of “warmth” added to bass-shy material by using the dual-compressor as a dynamic low-frequency (below 200Hz) shelving equalizer. Setting the BASS COUPLING control toward INDEPENDENT will increase the average amount of bass boost, while setting it toward WIDEBAND will result in less bass boost.

The XT2's BASS EQ controls provide a peaking boost (at 65Hz) to achieve a solid, punchy bass from most decent consumer radios. We recommend a +2 to +3dB boost for most formats.

6) More on distortion.

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 STL. If the source material is even slightly distorted, that distortion can be greatly exaggerated by the XT2 — particularly if a large amount of gain reduction is used. If objectionable distortion is heard when the OPTIMOD-FM's VU meter (set to L or

R FILTER OUT) is indicating -2VU or less (-1VU or less if the optional ACC-22 FM Filter Card has been installed), source quality is the most likely cause. See Appendix K of the OPTIMOD-FM Operating Manual for a discussion of how to improve source quality.

Notes:

Section 4

Maintenance and Calibration

In this section:

1. In-System Performance Verification	page	4-2
2. Field Audit of Performance		4-2
Fig. 4-1: Pink Noise Generator		4-3
Table 4-1: OPERATE Mode THD and Output Level		4-6
Table 4-2: Expected XT2 G/R with Pink Noise		4-7
Fig. 4-2: Distortion Cancellation — Band 5		4-8
Fig. 4-3: Distortion Cancellation — Band 6		4-9
3. Field Alignment Procedure		4-9
Table 4-3: VCA DISTORTION, THUMP Test Points and Trimmers		4-11
Table 4-4: VCA GAIN and BALANCE Trimmers		4-14
4. Removing the XT2 from Operation		4-14

No routine maintenance of this product is required.

See Section 6 for locations of test points.

To access circuit cards, remove all screws holding the appropriate cover in place, then lift that cover off. Remove the *top cover* for access to Card #A1 (Crossovers and Bass Equalizer) or Card #A2 (Limiter Control Circuitry). Remove the *bottom cover* for access to Card #A3 (VCAs). When replacing the covers, be sure to replace all screws and secure them tightly to maintain RFI suppression.

If you look at the top of the chassis with the meters are on the lower left-hand side, Card #A1 is to the right and Card #A2 is to the left. Card #A3 is located on the bottom side of the horizontal metal plate which divides the two sections of the chassis. All three cards are mounted on standoffs with #6-32 screws. If you wish to access the bottom of the card for troubleshooting, remove the screws and tilt the cards backwards, being careful not to accidentally short-circuit the metallic traces on the cards to the chassis. To completely remove a card from the chassis, you must also unplug all ribbon cables connected to that card (note the orientation of the plugs for later reconnection).

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 U.L. 813)

1. IN-SYSTEM PERFORMANCE VERIFICATION

The FCC (USA) has eliminated requirements for periodic Proof-of-Performance measurements. However, those performance standards still 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 XT2. Instructions for bench-top verification of XT2 performance outside of the transmission system are given in Section 4.2, "Field Audit of Performance".

Doing an in-system performance verification with the XT2 in use is very similar to doing one with a "stock" 8100A/1. It would be wise, for future reference, to annotate the beginning of Part 6 of your 8100A/1 Operating Manual with the words: "For performance verification with the 8100A/XT2 Six-Band Limiter Accessory or the 8100A/ST Studio Accessory Chassis installed, please see additional information in the manuals provided with those units."

- 1) Set the XT2's COMP switch to PR.
- 2) Note the positions of the XT2's controls.
- 3) Turn all of the XT2's controls, *except* CLIPPING, fully counterclockwise.

This makes the frequency response of the XT2 flat and optimizes system signal-to-noise ratio.

- 4) Follow the instructions in Part 6 of the 8100A/1 Operating Manual.

If you have followed the instructions in steps 1 through 3 here, the XT2 will act as a flat amplifier in the signal path of the 8100A/1, and performance verification can be performed exactly as specified in Part 6 of the 8100A/1 Operating Manual.

In PROOF mode, all active elements remain in the signal path. While measured performance will not be as good as that of an 8100A/1 alone (because of the extra crossovers and VCAs introduced in the signal path by the XT2), performance will still be excellent: noise will typically be -70dB below 100% modulation, and THD will be less than 0.1%. Sufficient headroom has been provided to modulate above 100% at all frequencies.

- 5) When you are finished, return the XT2's COMP switch to OP, and return the controls changed in step 3 (above) to their original settings.

2. FIELD AUDIT OF PERFORMANCE

These are instructions for checking the performance of a total 8100A/1 + XT2 System. Because the XT2 circuitry is embedded within the 8100A/1 circuitry, it is not practical to test it independently of the 8100A/1 in the field.

(If the 8100A/ST Studio Accessory Chassis is in use and you are certain that the fault is not within the 8100A/ST, it is possible to test only the 8100A/1 + XT2 combination by applying test signals to the input of the 8100A/1. Bear in mind that no broadband compression will be produced since this function resides in the 8100A/ST.)

This procedure is a starting point for detecting and diagnosing a problem that you have pinpointed to the 8100A/1 + XT2 System. It is also useful in maintenance, and can be used

to check routine equipment performance. By its nature, it is limited in scope to discovering *static* problems. A dynamic problem in the AGC circuitry (caused by the failure of a timing module on Card #A2, for example) would not tend to be discovered in the course of these tests. For this reason, measurements must always be complemented by listening. If you are well-acquainted with the "sound" of OPTIMOD-FM as adjusted to your tastes, then faults that develop will ordinarily be readily detectable by ear.

Perform procedures in order without skipping steps.

Equipment required:

– Audio oscillator

An ultra-low-distortion type like the Sound Technology 1710B is preferred. However, a Heathkit or similar oscillator can be used to obtain approximate results, provided that the residual distortion has been verified to be below 0.1%.

– Noise and distortion test set

Again, a high-performance type like the Sound Technology 1710B is preferred, but not required.

– General-purpose oscilloscope

DC-coupled, dual-trace, with at least 5MHz bandwidth.

– Pink noise generator

A suitable circuit is shown in Fig. 4-1.

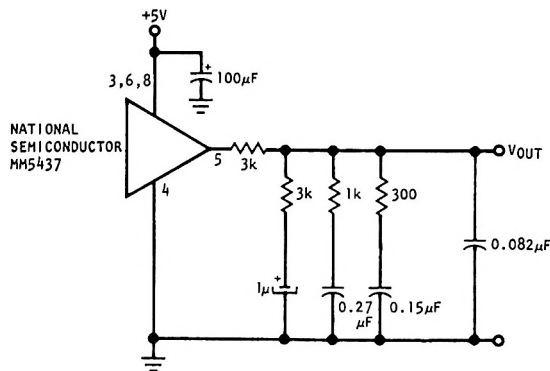


Fig. 4-1: Pink Noise Generator

4-4 Maintenance and Calibration

It is often more convenient to make measurements on the bench, away from high-RF fields which might otherwise affect results. For example, it is very difficult in a high-RF field to accurately measure the very low THD produced at most frequencies by a properly-operating 8100A/1 + XT2 System. However, in an emergency situation (is there any other kind?!), it is usually possible to do measurements that reveal the grosser faults even under high-RF conditions.

The audio processing can be measured independently of the stereo generator by connecting the measuring instruments to the 8100A/1's rear-panel AUDIO TEST JACKS. The following procedure assumes that all test excitations are applied to the 8100A/1's rear-panel audio INPUT terminals, and that all responses are measured at the 8100A/1's AUDIO TEST JACKS.

TEST PROCEDURE:

1) Set controls as shown below.

BUT FIRST, record the normal settings of the controls so that they can be reset after the measurements have been completed.

8100A/1:	INPUT ATTENUATOR (L and R)	0
	COMPRESSOR	PROOF
	LIMITER	PROOF
	CLIPPING	0
	H-F LIMITING	5
	RELEASE TIME	10
	BASS COUPLING	10
XT2:	GATE THRESHOLD	0
	DENSITY	0
	COMPRESSOR	PR
	CLIPPING	0
	BASS EQ (L and R)	0
	PRESENCE	0
	BRILLIANCE	0

2) Perform a "skeleton proof" on both the left and right channels.

- Connect a low-distortion audio oscillator to the 8100A/1's (L or R) INPUT.
- Set the oscillator frequency to 15kHz.
- Adjust the oscillator output level to produce 3.3V RMS (an internal level corresponding to 100% modulation) at the appropriate (L or R) AUDIO TEST JACK.

This is most easily done by adjusting the oscillator output level until the 8100A/1's VU meter reads "+3" when R or L FILTER OUT is selected (select the channel you are testing).

- d) Connect the input of the N&D test set to the appropriate AUDIO TEST JACK through a de-emphasis network, such as the one shown in Appendix D of the 8100A/1 Operating Manual).

Use the de-emphasis network as shown if your test set has an input impedance of 1 megohm or greater (for 75 μ s de-emphasis). If your country's standard is 50 μ s, substitute a 4.99K \pm 1% resistor (if unavailable, use a 5.1K \pm 5% resistor) resistor for the 7.50K resistor.

If your test set is one of the many with a 100K input impedance, the 7.50K resistor should be changed to an 8.06K, \pm 1% resistor (for 75 μ s); use a 5.23K, \pm 1% resistor for 50 μ s.

- e) Measure the frequency response by plotting on a standard pre-emphasis graph the increase in oscillator output (over the reference level set in step c) required to produce 3.3V RMS at the appropriate AUDIO TEST JACK (or to make the VU meter read "+3") at 50, 100, 400, 1000, 5000, 10,000, and 15,000Hz.

Measure the THD at 100% modulation at the same time that you measure frequency response.

Doing both tests on each frequency before moving on to the next should be more convenient since the frequency response test requires you to readjust the oscillator output level at each frequency to produce 100% modulation at the 8100A/1's output.

If you are using the the N&D test set's AC voltmeter in the frequency response test, remember that you must connect the de-emphasis network to the N&D meter input for the *THD measurements only*; the de-emphasis network *must not* be used for the frequency response measurements.

The results of these tests will be valid only if the XT2 controls have set as specified in step 1 (above).

Frequency response should be within \pm 1.0dB of the standard pre-emphasis. To obtain more reliable results, it is advisable to measure the frequency response at several points between these frequencies.

The de-emphasized THD should not exceed 0.15% at any frequency. In many cases, results will be determined entirely by the quality of oscillator and distortion analyzer available, and/or by the presence of RF fields which might affect the instruments.

Frequency response errors which develop in the field are usually caused by incorrect quiescent VCA gains. The system first breaks the audio into two bands with a crossover at 200Hz (this occurs in the 8100A/1). Following pre-emphasis in the 8100A/1, the signal is divided into six bands in the XT2. Frequency response errors are most likely to be introduced at this point.

The Block Diagram in Section 6 provides a "road map" through the system. By tracing the signal through the entire system from input to output and measuring the frequency response as you proceed, it is possible to discover which stage introduces the error. (A sweep generator greatly speeds the measurement process.) If the error is not due to a misaligned VCA, then crossover filter failure must be suspected. If the error is due to a misaligned VCA, be aware that there may be drift in the VCA or its associated exponential converter that must be repaired to achieve stable frequency response.

A more complete frequency response evaluation can be performed by sweeping the system with a test set like the Tektronix 5L4N Spectrum Analyzer/Tracking Generator. If the station has such equipment, see paragraph 6.c of Appendix E in the 8100A/1 Operating Manual.

- f) Short both of the 8100A/1's inputs, and measure the noise at the output of the 8100A/1 through the de-emphasis network. Noise should not exceed -53dBm (corresponding to -70dB below 100% modulation).

Note that hum or buzz due to test equipment grounding problems and/or high RF fields may result in falsely high readings. If the output of the N&D set is monitored with a scope, problems like this should be immediately apparent.

3) Measure OPERATE mode performance.

These measurements evaluate certain static characteristics of OPTIMOD-FM in its normal OPERATE mode. Typical measurements given herein are provided for service guidance only, and are not guaranteed.

As with the PROOF mode measurements in step 2, these measurements should be repeated for both left and right channels.

- a) Reconnect the audio oscillator to the 8100A/1 (L or R) INPUT.
- b) Set the 8100A/1's COMPRESSOR and LIMITER switches to OPERATE and the XT2's COMP switch to OP.
- c) Verify that the other operating controls are set as specified in step 1.
- d) Set the oscillator frequency to 1kHz.
- e) Adjust the oscillator output level to produce 10dB gain reduction as read on the 8100A/1's MASTER G/R meter.
- f) Adjust the XT2's DENSITY control to produce 10dB gain reduction as indicated on the XT2s 700Hz G/R meter.
- g) Measure the output level and THD for each frequency indicated in Table 4-1, and compare your results with the typical readings given in the table. **Output level should be within ± 2 dB ($\pm 26\%$) of values provided.**

THD can vary substantially, but should not exceed 0.5% at any frequency. THD is highly dependent on the setting of the XT2's CLIPPING control, because this control can move the sine-wave level above or below the thresholds of the band clippers.

Frequency (Hz)	THD (%)	Output (V RMS)
50	0.25	0.78
100	0.25	1.05
400	0.08	0.91
1000	0.08	0.93
2500	0.08	1.15
5000	0.08	1.52
7500	0.20	2.05
10000	0.10	2.35
15000	0.15	2.40

Table 4-1: OPERATE Mode THD and Output Level

- h) Connect a pink noise generator to the 8100A/1's (L or R) INPUT.
- i) Adjust the pink noise generator's output level until the 8100A/1's TOTAL MASTER G/R meter reads "-10". DO NOT change any settings on the XT2.
- j) Verify that the readings of the XT2's G/R meters match the expected readings given in Table 4-2.

A reading outside of tolerance can indicate a problem with the control circuitry of a given band-limiter. Because of the non-periodic nature of pink noise, certain failures in the control circuitry dynamic response may also be indicated in these tests. Such failures ordinarily require return of the XT2 to the factory for diagnosis and repair.

Band	Hz	G/R (dB)
1	150	5
2	400	5
3	700	5
4	1600	8
5	3700	10
6	6200	10

Table 4-2: Expected XT2 BAND LIMITER G/R Meter Readings
with Pink Noise Excitation (Tolerance = ± 3 dB)

- k) Disconnect the pink noise generator from the 8100A/1.

4) Verify distortion-cancellation performance.

If the system has passed the tests above, the XT2 may be considered to be correctly interfaced to the 8100A/1 in all respects but one: those tests do not indicate whether the output of the XT2's distortion-cancelling sidechain is correctly connected to the input of the 8100A/1's distortion-cancelling filter.

The following tests verify that the distortion-cancellation system is operating correctly. If, after installation of the XT2, you hear consistent "thickening" and distortion of sibilance (i.e., if "esses" sound more like "effs"), these tests should be performed. Otherwise, they may be considered optional because they are somewhat inconvenient, as they require that the covers of the XT2 be removed to access internal test points, and that a sweep generator or frequency response test set like the Tektronix 5L4N be available.

In these tests, correct operation of the distortion-cancelling sidechain is indicated by sharp selectivity in the band 5 and 6 traces. All test points are located on Card #A1.

- a) Connect the output of the 5L4N tracking generator (or the sweep generator) to the cathode of CR8 to test the left channel of band 5.

See assembly drawing in Section 6 for location of component.

4-8 Maintenance and Calibration

- b) Connect the input of the 5L4N (or an oscilloscope) to the 8100A/1's left AUDIO TEST JACK.
- c) Verify that the trace resembles that in Fig. 4-2.
- d) Connect the output of the 5L4N tracking generator (or the sweep generator) to the cathode of CR10 to test the left channel of band 6.
- e) Verify that the trace resembles that in Fig. 4-3.
- f) Connect the input of the 5L4N (or an oscilloscope) to the 8100A/1's right AUDIO TEST JACK.
- g) Test the right channels of band 5 (at the cathode of CR18) and band 6 (at the cathode of CR20).
- h) Reassemble the XT2 (see page 4-1).

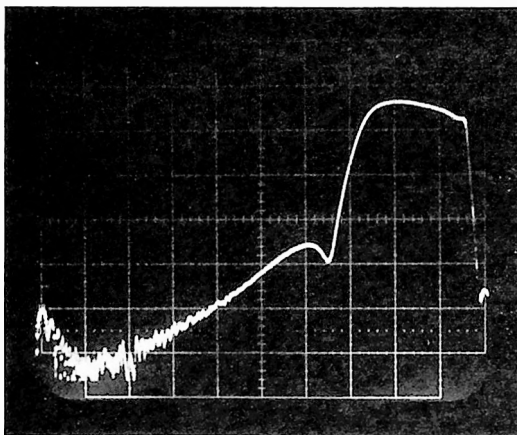


Fig. 4-2: Distortion Cancellation — Band 5

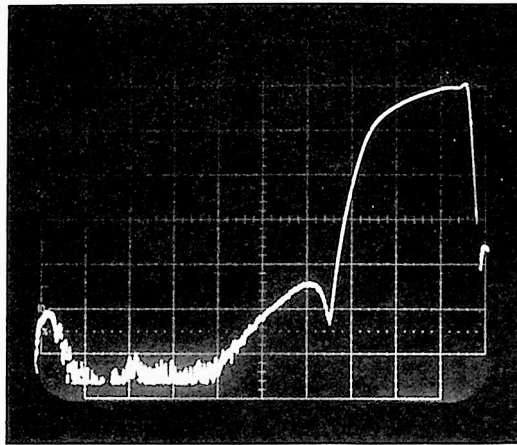


Fig 4-3: Distortion Cancellation — Band 6

(The photos in Figs. 4-2 & 4-3 were taken from the 5L4N with a 20–20kHz log sweep and 10dB/division vertical sensitivity.)

3. FIELD ALIGNMENT

The following describes how to align and calibrate the XT2 in the field. It is included primarily for purposes of reference. Routine alignment is neither necessary nor desirable, due to the high stability of the circuitry.

Before commencing alignment, remove both the XT2 and 8100A/1 from their normal rack-mounted location and place them on the test bench *away from RF fields*. Jumper the chassis and circuit grounds together on the rear-panel barrier strip. Note the normal positions of the set-up controls and of the jumpers on the cards to aid reinstallation.

To minimize probability of RFI, the connecting cable between the XT2 and the 8100A/1 is very short — too short to allow operating the XT2 upside-down on top of the 8100A/1, which is a more convenient arrangement for troubleshooting. But sufficient slack to do this can be obtained by removing four screws (two on the cable clamp inside the XT2 and two below the cable on the outside of the rear panel) and then pulling the cable into the chassis and routing it back out over the rear panel. To facilitate reinstallation, note how the cable is installed before you remove it.

Perform procedures in order without skipping steps.

Equipment required:

[It is assumed that the technician is thoroughly familiar with the operation of this equipment.]

- Digital Voltmeter
Accurate to $\pm 0.1\%$.
- Oscilloscope
DC-coupled, dual-trace, triggered-sweep, with 5MHz or better vertical bandwidth.
- Ultra-low distortion sine-wave oscillator
- THD test set
- AC VTVM
Sound Technology 1700B or 1710B, or equivalent.
- Low-frequency spectrum analyzer with tracking generator
Tektronix 5L4N plug-in with 5111 Bistable Storage Mainframe, or equivalent. A sweep generator with logarithmic sweep capabilities can be substituted for the 5L4N; if so, it is used with the oscilloscope (in X/Y mode) in a manner described in the manufacturer's instructions.
- One 10.0K, $\pm 1\%$, 1/8-watt metalfilm resistor
Actual wattage not critical.
- One short test lead
With miniature alligator or E-Z Hook[®] clips on both ends.

ALIGNMENT PROCEDURE:

[These adjustments are done on Card #A3. See page 4-1 for card location and access instructions; see schematics and assembly drawings in Section 6 for locations of components.]

In the following procedure, the second-harmonic distortion and control-voltage feedthrough of each VCA is nulled. Then VCA gains are set. The entire 8100A/1 + XT2 System is swept, and the gains of the band VCAs are adjusted to achieve the flattest frequency response from each channel.

Each of the VCAs employed in bands 1 through 5 is designed to have +26dB minimum (i.e., with the DENSITY control set to "0") nominal gain. The left and right channel band 6 VCAs have +31dB minimum nominal gain to permit the them to take up to 30dB of gain reduction. Further loss is incorporated into certain VCAs by adding resistors in series with the VCAs' inputs.

1) Null VCA distortion.

- a) Set controls as shown on the following page.

BUT FIRST, record the normal settings of the controls so that they can be reset after the measurements have been completed.

8100A/1:	INPUT ATTENUATOR (L and R)	0
	COMPRESSOR	PROOF
	LIMITER	PROOF
	CLIPPING	0
	H-F LIMITING	5
	RELEASE TIME	10
	BASS COUPLING	10
XT2:	GATE THRESHOLD	0
	DENSITY	0
	COMPRESSOR	PROOF
	CLIPPING	0
	BASS EQ (L and R)	0
	PRESENCE	0
	BRILLIANCE	0

- b) Connect the output of the oscillator in series with a 10.0K $\pm 1\%$ resistor to a short jumper lead with a miniature alligator clip or E-Z Hook test lead at its other end.

If you cannot find a $\pm 1\%$ resistor, you can use a 10K, $\pm 5\%$ carbon film resistor, although this will slightly (but not fatally) compromise the accuracy of the gain trim adjustments in step 3.

- c) Set the oscillator output to 1kHz at +5dBu.

0dBu = 0.775V RMS. The dBm/600-ohm scale commonly found on test instruments can be read as dBu for this application.

- d) Connect the test clip to the "input resistor" for the left channel of band 1.

Table 4-3 identifies the "input resistor" for each band and channel. Connect the test clip to the resistor lead that is physically nearest to the rear of the XT2 chassis. The clip may also be connected to pin 6 of the corresponding opamp.

Band	Hz	Channel	Input Resistor	VCA Opamp	Output Capacitor	DISTORTION NULL Trim	THUMP NULL Trim
1	150	left	R1	IC1	C2	R3-b	R3-a
		right	R19	IC2	C5	R3-d	R3-c
2	400	left	R29	IC3	C7	R31-b	R31-a
		right	R47	IC4	C10	R31-d	R31-c
3	700	left	R57	IC5	C12	R59-b	R59-a
		right	R75	IC6	C15	R59-d	R59-c
4	1.6K	left	R89	IC7	C24	R91-b	R91-a
		right	R107	IC8	C27	R91-d	R91-c
5	3.7K	left	R117	IC9	C30	R119-b	R119-a
		right	R135	IC10	C34	R119-d	R119-c
6	6.2K	left	R145	IC11	C37	R147-b	R147-a
		right	R163	IC12	C41	R147-d	R147-c

Table 4-3: VCA DISTORTION and THUMP Test Points and Trimmers

4-12 Maintenance and Calibration

- e) Connect the N&D meter to the output of the band 1 left channel VCA.

The output of the VCA is available at pin 1 of the VCA opamp or (perhaps more conveniently) at the "output capacitor" lead that is nearest the "Orban" name on the left side of the board. See Table 4-3.

- f) Verify that the VCA's output level is approximately +10dBu.

- g) Adjust the DISTORTION NULL trimmer for the left channel of band 1.

- h) Repeat steps d through g for each channel of each band.

When measuring the band 6 VCAs, use a 0dBu oscillator level (instead of +5dBu) to compensate for the 5dB extra gain in these VCAs.

2) Null VCA thump.

NOTE: Before thump can be nulled, distortion must be nulled. The corresponding THUMP NULL trimmer must be nulled if the any DISTORTION NULL trimmer is readjusted.

- a) Verify that the oscillator is set to 1kHz, and that the oscillator, 10K resistor, and test clip are connected together as described in step 1b.

- b) Set the oscillator output level to -20dBu.

- c) Connect the test clip to the R88 lead nearest the rear of XT2 chassis.

This modulates the VCA bias current for bands 1, 2, and 3 at a 1kHz rate.

- d) Connect the N&D meter to the output of the band 1 left channel VCA.

The output of the VCA is available at pin 1 of the VCA opamp or (perhaps more conveniently) at the "output capacitor" lead that is nearest the "Orban" name on the left side of the board. See Table 4-3.

- e) Adjust the THUMP NULL trimmer for the left channel of band 1 until the 1kHz level observed on the N&D meter is minimized.

Connecting a 75 μ s de-emphasis network between the VCA output and the N&D meter will facilitate this procedure by reducing noise that would otherwise mask 1kHz the feedthrough being nulled.

- f) Repeat steps d and e for the right channel of band 1 and for each channel of bands 2 and 3.

- g) Disconnect the test clip from R88 and connect to the R175 lead nearest the rear of the XT2 chassis.

This modulates the VCA bias current for bands 4, 5, and 6 at a 1kHz rate.

- h) Repeat steps d and e for each channel of bands 4, 5, and 6.

3) Calibrate VCA gain.

- a) Verify that the oscillator is set to 1kHz, and that the oscillator, 10K resistor, and test clip are connected together as described in step 1b.

- b) Set the oscillator output level to +5dBu.

- c) Connect the test clip to the “input resistor” for the left channel of band 1.

See Table 4-3. Connect the test clip to the resistor lead that is physically nearest to the rear of the XT2 chassis. The clip may also be connected to pin 6 of the corresponding opamp.

- d) Connect the N&D meter to the output of the band 1 left channel VCA.

The output of the VCA is available at pin 1 of the VCA opamp or (perhaps more conveniently) at the “output capacitor” lead that is nearest the “Orban” name on the left side of the board. See Table 4-3.

- e) Adjust GAIN trimmer R17 until the N&D meter indicates a VCA output level of +10.6dBu.

- f) Repeat steps c through e for the right channel of band 1, adjusting BALANCE trimmer R28 to achieve a +10.6dBu output level.

You have now set a *reference gain* for band 1. The settings of R17 and R28 **MUST NOT BE CHANGED** in the following steps!

- g) Disconnect the test clip.

- h) Connect the output of the sweep generator (or 5L4N tracking generator) to the L INPUT of the 8100A/1.

- i) Set the sweep generator's controls for a logarithmic sweep from 30 to 15,000Hz (or set the 5L4N to its 20–20kHz log sweep mode at 2dB/division).

- j) Set the 8100A/1's VU meter selector to L FILTER OUT.

- k) Adjust the 8100A/1's LEFT INPUT ATTENUATOR control and/or the sweep generator's (or 5L4N tracking generator's) output level until the maximum reading on the 8100A/1's VU meter is approximately “0VU”.

This assures that clipping will not occur in any circuitry. The maximum will occur as the swept frequency passes through 15kHz (the highest part of the pre-emphasis curve).

- l) Connect the vertical input of the scope (or the input of the 5L4N) to the 8100A/1's L AUDIO TEST JACK through a de-emphasis network, such as the one shown in Appendix D of the 8100A/1 Operating Manual.

Use the de-emphasis network as shown if your test set has an input impedance of 1 megohm or greater for 75 μ s de-emphasis. If your country's standard is 50 μ s, substitute a 4.99K \pm 1% resistor (if unavailable, use a 5.1K \pm 5% resistor) for the 7.50K resistor.

If your test set is one of the many with a 100K input impedance, the 7.50K resistor should be changed to an 8.06K, \pm 1% resistor for 75 μ s; use a 5.23K, \pm 1% resistor for 50 μ s.

- m) Connect the horizontal input of the scope to the sweep ramp of the sweep generator (if used).

- n) Adjust the VCA GAIN trimmers for bands 2 through 6 to achieve a maximally flat response during the 30–15,000Hz sweeps (20–20kHz if you are using 5L4N).

See Table 4-4. A response better than \pm 1dB throughout the range of 30–15,000Hz should be achievable. DO NOT ADJUST band 1 GAIN trimmer R17, as it is the reference gain against which the other bands are measured. (You are observing the swept response of the *entire* left channel of the 8100A/1 + XT2 System.)

4-14 Maintenance and Calibration

- o) Move the output of the sweep generator (or 5L4N tracking generator) to the 8100A/1's R INPUT.
- p) Connect the vertical input of the scope (or the input of the 5L4N) to the 8100A/1's R AUDIO TEST JACK through the de-emphasis network.
- q) Adjust the VCA BALANCE controls for bands 2 through 6 to achieve a maximally flat response, during the 30–15,000Hz sweeps (20–20kHz if you are using 5L4N).

See Table 4-4. A response better than $\pm 1\text{dB}$ should be achievable. **DO NOT ADJUST band 1 BALANCE trimmer R28.**

Band	GAIN Trimmer	BALANCE Trimmer
1	R17	R28
2	R45	R56
3	R73	R84
4	R105	R116
5	R133	R144
6	R161	R172

Table 4-4: VCA GAIN and BALANCE Trimmers

4) Reinstall the chassis.

Return all set-up controls to their original positions (as recorded in step 1a).

4. REMOVING THE XT2 FROM OPERATION

If the XT2 will be removed from the system for servicing or any other reason, its host 8100A/1 can be easily restored to "stock" condition. These are concise instructions for such restoration.

There are alternate procedures for Cards #6, #8, and #9, depending on whether the card is a converted "8100A-type" card or if it is a newer "8100A/1-type" card. Make notes on which procedure you are following to facilitate reinstallation of the XT2, if desired.

[Refer to the assembly drawing for Card #5 in this manual, and to the assembly drawings for Cards #6, #8, and #9 in the 8100A/1 (or 8100A) Operating Manual for card and component locations.]

- 1) Remove power from the 8100A/1.

- 2) Remove Card #5 from the 8100A/1 (follow the circuit card access instructions given in Appendix C of the 8100A/1 Operating Manual).
- 3) Place the links on jumpers A, B, and C in the "NORMAL" positions (see the Card #5 assembly drawing in Section 6 of this manual).
- 4) Examine Card #5 to see if resistors R552 and R533 are installed. If so, the card should be restored to "stock" condition for use without the XT2.

The presence of these two resistors indicates the "Gated Mode Noise Reduction Modification" described in Section 5.3 has been performed. Follow the procedure given there in reverse order to restore the card.

- 5) Remove Card #6 from the 8100A/1.
- 6) If there is a diode soldered between the center terminal of the LIMITER switch (S602) and the PC board foil, you will see two jumper links stored on only *one* pin each. Place each jumper link on *both* of its associated pins, as shown in the Card #6 assembly drawing in the 8100A/1 Operating Manual.

This will be seen only in units with serial numbers below 638000.

If the switch is soldered to the board normally, remove the two links from jumper B, and place them on jumper C in the "NORMAL" position.

Note that the links' "NORMAL" orientation on the jumper C pins is turned 90° from their "NORMAL" position on the jumper B pins.

- 7) Remove Cards #8 and #9 from the 8100A/1.
- 8) If only one lead each of resistors R804 and R805 are soldered to the cards with the other lead left "hanging", bend these resistors down and resolder them to their foil pads.

This will be seen only in units with serial numbers below 638000.

If both leads of these resistors are soldered to the board, move the link on jumper B to the "NORMAL" position.

- 9) Replace all cards in their slots, and reassemble the 8100A/1.

The 8100A/1 is now ready to be put back on the air without the XT2.

Notes:

Section 5

Troubleshooting

In this section:

1. Troubleshooting Technique	page 5-2
2. Symptoms and Possible Causes	5-2
3. Gated Noise Reduction Modification	5-5
4. Technical Support	5-6
5. Factory Service	5-7
6. Shipping Instructions	5-7

[See also troubleshooting information in Appendix F of the 8100A/1 Operating Manual.]

When installed, the XT2 becomes an integral part of the 8100A/1's circuitry: the XT2 cannot be used by itself. When troubleshooting, it is therefore important to remember that the XT2 and 8100A/1 are operating together *as a system*. Almost all comments in Appendix F of the 8100A/1 Operating Manual apply to diagnosis of trouble in the 8100A/1 + XT2 System — if you remember that the XT2 is simply an added stage between the 8100A/1's high-frequency limiter (on Card #6) and its peak-limiting system (on Cards #8 and #9). The comments on the first page of Appendix F are particularly applicable.

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)

1. TROUBLESHOOTING TECHNIQUE

In addition to the information on "VU Meter Technique" in Appendix F of the 8100A/1 Operating Manual, note that:

In a system containing the XT2, the L and R FILTER OUT settings of the 8100A/1's VU meter monitor the signal after it has passed through the XT2. Therefore, if the signal is normal with the VU meter selector set to L or R COMPR OUT, but abnormal when set to L or R FILTER OUT, the XT2 may be suspected, as may be the 8100A/1's Cards #6, #8, and #9. The card-swap technique described below can be used to further narrow the possibilities.

The following supplements the discussion of "Card Swap Technique" in the 8100A/1 Operating Manual's Appendix F.

If:

- 1) The problem is observable on the 8100A/1's VU meter with the meter selector set to L or R FILTER OUT, but is not seen with the selector set to L or R COMPR OUT position, and
- 2) Swapping the 8100A/1's Cards #8 and #9 or turning the links on jumper B on the 8100A/1's Card #6 1/4-turn does not move the fault from one channel to the other,

then the XT2 is almost certainly faulty.

There are no card-swap techniques for diagnosing problems within the XT2. However, the bad channel can be compared to the good one by conventional signal-tracing techniques. To do this, drive the left and right system inputs with identical (mono) signals and compare corresponding circuit points in the left and right channels, moving circuit by circuit from the XT2's input to its output until a difference is found. This will locate the problem between the "good" and "bad" points.

Problems common to both channels within the XT2 are almost certainly due to faults in the limiter control circuitry on Card #A2.

2. SYMPTOMS AND POSSIBLE CAUSES

Always verify that the problem is not in the source material being fed to the 8100A/1, or in other parts of the system.

If audio problems develop, many engineers immediately blame their processing. However, as is the case with *any* processing, faults in the audio equipment *preceding* OPTIMOD-FM will be magnified by the action of the processing. When aggressive processing is used, program material that is marginally distorted at the OPTIMOD-FM's input is likely to be unlistenable by the time it emerges from the output — particularly when the XT2 is employed! In addition, be sensitive to possible defects in the monitoring equipment. Verify that a problem can be observed on at least two receivers before pushing the panic button.

1) Problems with subjective sound quality.

[Particularly problems that are not clearly identifiable as simple electronics failures.]

Review the "Catalog of Operating Problems and Solutions" at the end of Part 5 of the 8100A/1 Operating Manual. Also review Sections 2 and 3 of this manual to make sure the problem isn't simply an installation or control setting problem.

2) Output frequency balance doesn't sound like input.

It's not supposed to. The thresholds of the six-band limiter have been adjusted to provide dynamic high-frequency boost with most program material. Conversely, very bright program material will suffer loss of highs due to the unavoidable limitations of the FM pre-emphasis curve. In addition, the six-band limiter will tend to act as an "automatic equalizer", dynamically changing the frequency balance of program material to make it more pleasing and consistent on typical small radios and in cars.

Frequency balance is also affected by the BASS COUPLING, PRESENCE, and BRILLIANCE controls.

The available bass boost is limited dynamically to prevent bass from overdriving the safety clippers in order to avoid excessive IM distortion. While OPTIMOD-FM is capable of producing punchy, well-defined bass which sounds correct and is musically balanced, highly exaggerated bass boost cannot be obtained.

3) Sibilance distortion.

Possible causes:

- a) *Source material* at the 8100A/1's input terminals is distorted.
- b) Failure of the distortion-cancelling sidechain on the 8100A/1's Cards #8 or #9.
- c) Failure of the control circuitry in the XT2's band 5 (3.7kHz). If band 5 is exhibiting no gain reduction, then even a properly-operating distortion-cancelling clipper may generate some audible distortion.

4) Gross distortion.

Possible causes:

(also see Moderate, Subtle, Sibilance Distortion)

- a) Power supply voltage (supplied from the 8100A/1) is low. Check AC power line voltage first.
- b) IC opamp failure. This must be diagnosed by signal tracing.
- c) Failure in clipper-diode bias supplies on the XT2's Card #A1 or the 8100A/1's Card #6. Low bias voltage will cause excessive clipping and will also result in abnormally low modulation. Set the 8100A/1's COMPRESSOR and LIMITER switches to OPERATE and the XT2's COMP switch to OPERATE. Check IC4 and associated circuitry on card #A1 to verify that the output from IC4 is $\pm 1.8\text{V}$ ($\pm 10\%$). Check IC613 and associated circuitry on Card #6 to verify that the output from IC613 is approximately $\pm 4.2\text{VDC}$.

- d) Gross failure of IC803a, IC804a, or IC804b on the 8100A/1's Card #8 or the corresponding ICs on the 8100A/1's Card #9. This will either misbias the main signal path or add distortion to the main signal without causing the main signal to disappear.
- e) Failure of one or more bands in the six-band limiter causing distortion to be injected into the signal path from the defective band. Because other bands are still operating normally, signal passage will still occur, although with strange frequency response due to the missing band(s). Faults can occur in the pre-compressor crossovers on Card #A1, in the VCAs on Card #A3, and in the post-compressor crossover and multiband clipper on Card #A1.

5) Moderate to subtle distortion.

Possible causes:

- a) Distorted program material and/or distortion problems in studio or STL. For more on audio quality in FM plants, see Appendix K in the 8100A/1 Operating Manual.
- b) For moderate deviations from normal parameters, check points listed under "Gross Distortion" (immediately above).
- c) Misadjustment of the XT2's CLIPPING and/or DENSITY controls.
- d) Failure in Card #A2, causing one or more bands in the XT2 to produce modulation control solely by multiband clipping. This is usually indicated by the affected band's G/R meter reading "0" at all times.
- e) Failure in the distortion-cancelling sidechain on the 8100A/1's Cards #8 and #9. This is typically indicated by a "gritty" high end with severe sibilance splatter.

6) Noise is pumped up during very long pauses in material like classical music or radio drama.

Refer to Section 5.3, "Gated Noise Reduction Modification", for a procedure which changes the nominal gain reduction during gating from 0dB to -10dB.

3. GATED NOISE REDUCTION MODIFICATION

If program material containing sections of low-level audio lasting longer than 10 seconds is broadcast, the 8100A/1 + XT2 System can pump up noise to disturbing levels even if the 8100A/1's GATE THRESHOLD control has been adjusted to place such material below the 8100A/1's gating threshold. Such low-level material might be found in classical music or radio drama, for example.

It should be emphasized that we do not expect program material subject to this problem to be broadcast on stations which choose XT2 processing, since normal 8100A/1 processing is usually far more appropriate for such material. Information on this modification is therefore provided primarily for reference — we believe that few XT2 users will actually require it.

The problem occurs because the gating circuitry in the 8100A/1 slows the recovery of the 8100A/1's dual-band compressor instead of "freezing" the gain. This permits the gain to recover to its maximum value if the gate stays on long enough.

The XT2 chassis typically introduces another 5dB of gain beyond that ordinarily produced by the 8100A/1 in its normal, non-XT2 mode. Use of the PRESENCE and BRILLIANCE controls may further exaggerate noise. Thus, noise which was not objectionably increased by the 8100A/1 in its normal mode may well become objectionable when further increased by use of the XT2, unless this modification is performed. The modification forces the gain to slowly move to 10dB gain reduction instead of 0dB gain reduction when the gate is on, thus achieving 10dB less noise during long quiet sections.

Component Required:

- 1 6.2-megohm, 1/4-watt, $\pm 5\%$ carbon resistor

If you cannot obtain this part locally, please contact Orban Customer Service at the address shown on the following page.

CAUTION

To avoid damaging the PC card, please follow the techniques described in the section on "Replacement Of Components On Printed Circuit Boards" in Appendix F of the 8100A/1 Operating Manual.

PROCEDURE:

- 1) Remove Card #5 from the 8100A/1 (follow card access instructions in Appendix C of the 8100A/1 Operating Manual).
- 2) Remove 22-megohm, 1/4-watt, $\pm 5\%$ carbon resistor R550. Set it aside for use in step 3.

This resistor is located in the area behind the RELEASE TIME control (see the Card #5 assembly drawing in Section 6 of this manual).

5-6 Troubleshooting

- 3) Install the 22-megohm resistor removed in step 2 into the holes for R552.

These holes should be empty. You may have to clear the holes of solder with a vacuum-operated desoldering tool before installing the resistor.

- 4) Install a 6.2-megohm, 1/4-watt, $\pm 5\%$ carbon resistor into the holes for R553.

- 5) Replace Card #5 in its slot, and reassemble the 8100A/1.

- 6) Test your work by applying power to the system and verifying that with no input signal applied, the 8100A/1's GATE lamp is lit and the 8100A/1's TOTAL MASTER, COMPRESSION MASTER, and TOTAL BASS G/R meters drift slowly to "-10" (± 2).

The TOTAL BASS G/R meter will drift to "-10" only if the 8100A/1's BASS COUPLING control is set at "10".

4. TECHNICAL SUPPORT

If the above troubleshooting procedures don't help you solve your problem, contact Orban Customer Service. Be prepared to accurately describe the problem, including the results of diagnostic tests you have performed. Know the serial numbers of your 8100A/1 and of your 8100A/XT2.

Telephone: (800) 227-4498 in continental USA, except
from California and Alaska call (415) 957-1067

or Telex: 17-1480

or write: Customer Service
Orban Associates Inc.
645 Bryant Street
San Francisco, CA 94107
USA

5. FACTORY SERVICE

Always contact Customer Service before returning a product to the factory for service. Often, a problem is due to misunderstanding, or is relatively simple and can be quickly fixed after telephone consultation.

In any case, products will be accepted for factory service *only* after Customer Service has issued a Return Authorization number. This number flags the returned unit for priority treatment when it arrives on our dock, and ties it to the appropriate information file.

Please refer to the terms of your Orban Associates Limited One-Year Standard Warranty, which extends to the first end-user. After expiration of the warranty, a reasonable charge will be made for parts, labor, and packing if you choose to use the factory service facility. Repaired units will be returned C.O.D. In all cases, transportation charges (which are usually quite nominal) shall be borne by the customer.

6. SHIPPING INSTRUCTIONS

Use the original packing material if it is available. If it is not, use a sturdy, double-wall carton no smaller than 22" x 16" x 6" (56cm x 41cm x 15cm) with a minimum bursting test rating of 200 pounds. Place the chassis in a plastic bag (or wrap it in plastic) to protect the finish, then pack it in the carton with at least 2" (5cm) of cushioning on all sides of the unit. "Bubble" packing sheets, foam "popcorn", thick fiber blankets, and the like are acceptable cushioning materials; folded newspaper is not. Wrap cushioning materials tightly around the unit and tape them in place to prevent the unit from shifting out of its packing. Close the carton without sealing it and shake it vigorously. If you can hear or feel the unit move, use more packing. Seal the carton with 3" (8cm) reinforced fiberglass or polyester sealing tape, top and bottom in an "H" pattern. Narrower or parcel-post type tapes will not withstand the stresses applied to commercial shipments.

Mark the package with the name of the shipper, and with these words in red:

DELICATE INSTRUMENT, FRAGILE!

Insure the package appropriately. Ship prepaid, *not collect*. Do not ship parcel post. Your Return Authorization number must be shown on the label, or the package will *not* be accepted.

Notes:

Section 6

Technical Information

In this section:

1. Specifications	page	6-2
2. Circuit Description		6-3
1) Overview		6-3
2) High-Frequency Filter, Main Clipper Defeat		6-5
3) Bass Equalizer		6-6
4) Six-Band Limiter, Distortion-Cancelling Multiband Clipper		6-6
5) Pre-Limiter Crossovers		6-7
6) Voltage-Controlled Amplifiers		6-7
7) Six-Band Limiter Control		6-9
8) Post-Limiter Crossovers, Clippers, Distortion-Cancelling System		6-10
3. Parts List		6-12
4. Schematics, Location of Components		6-18

1. SPECIFICATIONS (Supplementary)*

PERFORMANCE

Frequency response (system in PROOF mode): Follows standard 75 μ s pre-emphasis curve ± 1 dB, 50–15,000Hz. 50 μ s pre-emphasis available on special order.

Noise (de-emphasized): –70dB below 100% modulation, 50–15,000Hz maximum.

Total system distortion (PROOF mode, 100% modulation, de-emphasized): Less than 0.15% THD, 50–15,000Hz (0.07% typical). Less than 0.2% SMPTE Intermodulation Distortion (60/7000Hz; 4:1).

CIRCUITRY

BASS EQUALIZER

Shape: Peaking **Range:** 0 to +10dB boost
Tuning: 65Hz **"Q":** 1.4

CROSSEOVERS

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

Filter selectivity: 18dB/octave

Filter topology: Parallel, in "distributed crossover" arrangement (USA Patent #4,412,100).

Static filter combination: Outputs of all filters combine to yield static frequency response ± 0.5 dB throughout the range of 50–15,000Hz.

Dynamic filter combination: Phase interaction between the filters will not cause audible dips in the frequency response.

SIX-BAND LIMITER

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

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

Total harmonic distortion: Does not exceed 0.1% for any frequency in each limiter's pass-band with any degree of gain reduction, provided signal is below multiband clipper threshold.

Noise: Better than 85dB below VCA output clipping level for each limiter.

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

Available gain reduction (DENSITY at "5", PRESENCE & BRILLIANCE at "0"): 20dB

Gain control elements: Proprietary Class-A VCAs.

Indicators: Six G/R (gain reduction) meters, one for each band of the limiter.

INSTALLATION

Power requirements: The XT2 takes ± 15 VDC power from the 8100A/1. When the XT2 is in use, the 8100A/1 requires 115/230VAC $\pm 15\%$, 50–60Hz, approximately 40VA.

Dimensions: 19.0" (48.3cm) wide, 10.0" (27.4cm) deep, 3.5" (8.9cm, 2 rack units) high.

Operating temperature range: 0–50°C (32–122°F)

Humidity: 0–95% RH, non-condensing.

* These specifications describe the performance of an 8100A/1 + XT2 System which has been set up according to the instructions provided in this manual. These specifications supersede identically labelled specifications in the 8100A/1 Operating Manual. The specification in the 8100A/1 Operating Manual applies if a supplementary specification is not given here. All specifications subject to change without notice.

2. CIRCUIT DESCRIPTION

On the following pages, a detailed description of each circuit's function is accompanied by a component-by-component description of that circuit. **Keywords are highlighted** throughout the circuit descriptions to help you quickly locate the information you need.

See the 8100A/1 Operating Manual for detailed information about **8100A/1 circuitry**. The relationship between 8100A/1 and XT2 circuitry is discussed here.

Whenever circuitry is duplicated for the left and right channels, *only the left channel* will be described.

1) OVERVIEW

The BLOCK DIAGRAM in Section 6.4 illustrates the following overview of XT2 functions.

Together, the XT2 and 8100A/1 form an integrated audio processing system. The XT2 adds bass equalization, six-band limiting, and multiband distortion-cancelling clipping between the 8100A/1's high-frequency limiter and its distortion-cancelling 15kHz low-pass filter.

The 8100A/1 automatically senses when the XT2 is plugged into Accessory Port #2 and puts the **high-frequency limiter** and **main clipper** in PROOF mode, since these functions are now performed by the XT2. The 8100A/1's dual-band compressor, distortion-cancelling 15kHz low-pass filter, and COMPRESSOR and LIMITER control lines operate differently when the XT2 is in use, as described below. Virtually all other 8100A/1 circuitry remains active and retains its normal function.

To prevent the 8100A/1's **dual-band compressor** from "fighting" the XT2's six-band limiter due to time-constant incompatibilities, the time-constants of the dual-band compressor are altered. The 8100A/1's RELEASE TIME control adjusts the speed of compressor response. Settings toward SLOW retain transient definition and permit the compressor to function as a slow "hand on the pot", riding gain without affecting short-term density or texture. Settings toward FAST result in increased density. The MASTER G/R meters on the 8100A/1 will exhibit less gain reduction and will move more slowly in the 8100A/1 + XT2 System than they would in an 8100A/1 without the XT2.

The input signal (already pre-emphasized by the 8100A/1) is applied to a **bass equalizer**, which can provide 0-10dB of peaking boost with a center frequency of 65Hz and a "Q" of 1.4 (approximately 1 octave). Because the XT2 often increases the brightness of program material, some bass boost is usually desirable to keep the sound spectrally well-balanced. The boost frequency has been chosen to create very "punchy" bass, particularly on speakers with reasonably extended bass response.

The **six-band limiter** follows the bass equalizer. A set of six parallel filters divides the signal into frequency bands. The highest and lowest bands are low-pass and high-pass respectively; the other bands are band-pass.

The XT2's six bands enable significant correction of midrange frequency balances and production of a more consistent, intelligible, and pleasing sound in situations where the frequency balance of the input program material tends to vary uncontrollably. The six-band limiter is especially useful in enhancing the intelligibility of low-grade speech from telephone calls or other actualities.

To permit large amounts of limiting without interaction and pumping, the filters have been designed with 12dB/octave slopes. When the filters' outputs are summed after the multiband clipper (which contains further filtering — see below), the resulting output is typically flat ± 0.25 dB over the frequency range of OPTIMOD-FM. Careful computer-aided design of the filters has eliminated audible "holes" in the frequency response under dynamic conditions.

Each filter (except the 6.2kHz band's filter) is followed by its own limiter. The characteristics of these limiters are extremely critical if proper frequency response and artifact-free operation are to be obtained under dynamic program conditions. For this reason, we have made only a few limiter characteristics adjustable.

The DENSITY control adjusts overall drive level into the limiters. In addition, the PRESENCE and BRILLIANCE controls adjust the drive levels into the two highest frequency bands, enabling use of the XT2 as a high-frequency equalizer. The DENSITY control determines how much gain reduction will be produced for a given setting of the CLIPPING control. The CLIPPING control adjusts the threshold of limiting for all limiters simultaneously, thus determining their average output level and the drive level into the following multiband clipper. Together, the DENSITY and CLIPPING controls determine the amount of multiband limiting produced under operating conditions: turning the DENSITY control clockwise and/or turning the CLIPPING control counterclockwise will produce more limiting.

Because it operates in several frequency bands and exploits the "masking effect", the six-band limiter section is capable of far more *fast* gain control without audible side-effects than are the wider bands used in the unmodified 8100A/1 compressor. We call the six-band limiter the "density augmentation" section because the individual limiters operate with fast release times and substantially decrease the peak-to-average ratio of the signal without the spectral intermodulation effects which would result if only one limiter were used for the entire frequency spectrum.

If input levels are not well-controlled, multiband automatic gain control (AGC) devices can introduce so much gain difference between bands that program material sounds unnatural (due to non-flat frequency response). As the average gain reduction in the multiband section increases, these problems tend to worsen. To avoid such potential difficulties, average levels into the six-band limiter section are controlled by the slow AGC located in the 8100A/1, so that excessive gain reduction never occurs in the six-band limiter.

Finally, the XT2 provides multiband distortion-cancelling clipping. The outputs of four of the six bands are routed to their own individual clippers. These clippers are followed by filters to reduce the out-of-band harmonic and/or IM distortion caused by the clipping. The distortion caused by clipping the upper two bands is sharply cancelled below 2.2kHz by a feedforward distortion-cancelling sidechain that works in parallel with the main 15kHz low-pass filter (both filters are located in the 8100A/1).

The result of the distortion filtering and cancellation is an effective reduction of the peak-to-average ratio of the signal without the expected distortion build-up due to clipping — an unusually favorable trade-off between loudness and distortion. A notable advantage of this

scheme is that the summed outputs of the four clippers can be applied to a **safety clipper** for final peak limiting without the need for further broadband gain control, thereby avoiding potential pumping and modulation effects. In the 8100A/1 + XT2 System, the 8100A/1's FCS Overshoot Compensator serves as a "band-limited safety clipper" to effectively control peak modulation without introducing out-of-band energy which could cause losses of dynamic separation and increases in main-to-sub crosstalk. (This design is protected by US Patents #4,208,548 and #4,412,100.)

For more information about 8100A/1 circuitry, see the 8100A/1 Operating Manual.

2) HIGH-FREQUENCY FILTER AND MAIN CLIPPER DEFEAT

The signal is **pre-emphasized** by the 8100A/1, then sent to the XT2 from the output of the 8100A/1's **high-frequency limiter**. Whenever the XT2 is plugged into the 8100A/1, this HF limiter is forced into **PROOF** mode by a jumper (within the XT2) that completes a connection between the 8100A/1's +15V power supply and its limiter proof bus; this also defeats the **main clippers** on Cards #8 and #9. The $\pm 4.2\text{V}$ supply on the 8100A/1's Card #6 (which activates the 8100A/1's **FCS Overshoot Compensator** and **safety clipper**) is isolated from this jumper by means of a diode, and remains operational unless the 8100A/1's **LIMITER** switch is set to **PROOF**.

Component-level description:

Further information about the **HF limiter** and **main clipper** can be found in the Operating Manual for OPTIMOD-FM.

3) BASS EQUALIZER Card #A1

The input signal to the XT2 is first applied to a **bass equalizer**. This produces a **peaking boost** (i.e., bell-shaped curve) with a center frequency of 65Hz, a "Q" of 1.4, and a boost variable from 0 to +10dB.

Boost is produced by subtracting the output of an inverting second-order band-pass filter from the main signal (resulting in an overall addition).

Component-level description:

A bell-shaped **bass boost** is achieved by subtracting (in IC19b) the output of inverting band-pass filter IC19a and associated components from the filter's input. (Note that IC19b is *inverting* for the main signal and *non-inverting* for the output of IC19a.)

For a discussion of the inverting band-pass filter, see (for example) Chapter 6 in Wong and Ott's *Function Circuits* (McGraw-Hill, New York, 1976).

If the equalizer fails, first check IC19. If this fails to correct the problem, the passive components R70, R71, R73, C23, C24 must then be checked out on an impedance bridge.

4) 6-BAND LIMITER, DISTORTION-CANCELLING MULTIBAND CLIPPER

The six-band limiter is so intimately integrated within the multiband clipper that the two functions must be considered as one. Their overall function is discussed here. Descriptions of component circuits follow.

The signal from the bass equalizer is first divided into six frequency bands by a **pre-limiter crossover filter**. Each crossover filter (except that of the 6.2kHz band) drives its own **limiter**. (The gains of the 6.2kHz and 3.7kHz limiters are *both* controlled by the 3.7kHz limiter, so that the 6.2kHz limiter tracks the 3.7kHz limiter. The PRESENCE and BRILLIANCE controls allow additional adjustment of these bands' gain — see Section 3.) The outputs of the 3.7kHz and 6.2kHz limiters, and the sum of the 150Hz and 400Hz limiters all drive individual **clippers** followed by individual **post-limiter filters**. The characteristics of the pre- and post-limiter filters are such that the final summation of the bands can be made to be very flat (better than $\pm 0.5\text{dB}$.)

These 6dB/octave **post-limiter filters** *following* the clippers provide first-order reduction of clipper-induced distortion. The first-order filtered distortion induced by clipping in the upper two bands is derived by subtracting each clipper's output from its input and then filtering this distortion signal with a filter identical to the **post-crossover filter**. The sum of these filtered distortion signals from the upper two bands is passed through a 2.2kHz low-pass filter.

Meanwhile, the clipped, filtered sum of all of the bands is passed through a **phase-corrected 15kHz filter** with a delay which matches that of the 2.2kHz low-pass filter. (The 2.2kHz and 15kHz filters are located on the 8100A/1's Cards #8 and #9). The outputs of the 15kHz and 2.2kHz filters are summed, sharply **cancelling clipper-induced distortion** below 2.2kHz (the "flat" part of the FM pre-emphasis curve).

It should be noted that it is normal for sine waves to modulate less than 100% when applied to the system in its normal OPERATE mode. There are two principal reasons for this:

- 1) Some headroom is left between the threshold of the multiband distortion-cancelling clipper and the threshold of the subsequent FCS Overshoot Corrector in order to accommodate the normal level build-up due to summation of the bands, and also to accommodate the distortion-corrector signal. A sine wave only occupies one or two bands, and no distortion-corrector signal is produced. Thus, the headroom is not used, and full 100% modulation does not occur.
- 2) Sine waves have a very low peak-to-average ratio and high loudness potential compared to program material of identical peak levels. The audio processing, in order to maintain natural sound quality, pushes sine waves down in level as it would any other similar program material with low peak-to-average ratio. In general, any audio processor which produces 100% modulation on sine waves tends to sound somewhat unnatural because this psychoacoustic factor has not been taken into account.

(This design is protected by U.S. Patent #4,412,100.)

5) PRE-LIMITER CROSSOVERS Card #A1

The crossovers are realized as follows:

Band 1 (150Hz low-pass):	Second-order 420Hz low-pass filter cascaded with second-order 150Hz low-pass filter.
Band 2 (420Hz band-pass):	Second-order 420Hz low-pass filter cascaded with third-order 420Hz high-pass filter.
Band 3 (700Hz band-pass):	Second-order low-pass filter cascaded with third-order high-pass filter.
Band 4 (1.6kHz band-pass):	Two cascaded second-order stagger-tuned band-pass filters.
Band 5 (3.7kHz band-pass):	Two cascaded second-order stagger-tuned band-pass filters.
Band 6 (6.2kHz high-pass):	Second-order 6.2kHz high-pass filter.

Bands 3 through 6 are fed from a first-order all-pass filter which provides phase correction for the crossover summation.

Component-level description:

All filters are built with second-order sections of the type found in any modern text on active filter design (see, for example, Wong and Ott, *op. cit.*). Some filters are of the "multiple feedback" type,

and are basically negative-feedback filters. Others are of the "Sallen and Key" type, and are positive-feedback filters. The two types are mixed as necessary to achieve desired inverting (negative feedback) or non-inverting (positive feedback) responses.

6) VOLTAGE-CONTROLLED AMPLIFIERS (VCAs) Card #A3

The voltage-controlled gain block used throughout the XT2 is a proprietary Class-A VCA which operates as a two-quadrant analog divider with gain inversely proportional to a current injected into the gain-control port. A specially-graded Orban IC contains two matched, non-linear gain-control blocks with differential inputs and current outputs. The first of these is employed in the feedback loop of an opamp to perform the gain control function. The inputs of the first and second gain-control blocks are connected in parallel, and the output of the second block is a distortion-corrected *current* which is transformed into the desired gain-controlled voltage by an opamp current-to-voltage converter.

Component-level description:

This is a general description of the VCA circuitry used throughout the XT2. Only band 1 will be specifically described.

The operation of the VCAs is based on precisely matched pairs of gain control blocks with differential voltage inputs and current-source outputs. The gain of each block is controlled by a control current.

If used alone, one such gain-control block would introduce considerable distortion. Therefore, the first of the two matched blocks (IC13a) is used as the feedback element in an operational amplifier,

IC1a. The second of the matched blocks (IC13b) is then driven by the predistorted output of IC1a.

The output of IC1a is first attenuated by R4, R5 and then applied to the input of the feedback element IC13a. The output of IC1a is pre-distorted as necessary to force the current output of IC13a to precisely and linearly cancel the audio input into the "virtual ground" summing junction of IC1a. This same pre-distorted voltage is also connected to the input of IC13b. Thus, the output of IC13b is an undistorted current, which is converted to a voltage in current-to-voltage converter IC1b, R9, R10, C1, C2. The output of IC1b is the output of the VCA.

Because IC13a is in the feedback loop of IC1a, the gain of the VCA is *inversely* proportional to the gain of IC13a. Thus, if the control current is applied to the control port of IC13a (through R11), then the VCA behaves like a two-quadrant analog divider.

A fixed current is applied to the control port of IC13b through R8 to set the gain of IC13b. R8 is fed by a +1.2V source common to all VCAs on a card: R85, CR4, CR5. The diodes provide temperature compensation.

Second-harmonic distortion is introduced by the differential offsets in either IC13a or IC13b. This distortion is cancelled by applying a nulling voltage directly to the input of IC13b by means of resistor network R3b, R6, R7.

If the VCA is not perfectly balanced, "thumps" due to control current feedthrough can appear at the output. These are equivalent to multiplying the control current by DC. If a correct DC offset is applied to the VCA input, then this equivalent DC multiplication can be nulled to zero and the "thumps" eliminated. Such an adjustable DC offset is provided by R3a, R2.

The **current-controlled gain** of the compressor/limiter is inversely proportional to the control current. This must be transformed into a gain which is proportional to a control voltage in dB. This is done in the **exponential current converter** consisting of IC25a and associated components.

IC29a, IC29d, and associated components form a **log/antilog multiplier** which multiplies the current flowing in R88 by the exponential of the voltage on the base of IC29a. The current gain of the multiplier increases as the voltage on the base of IC29a becomes more positive.

The exponential-converter transistors for all of the VCAs in a given group of bands (1-3 or 4-6) are located within a monolithic array. IC29 serves this purpose for bands 1-3. One transistor within

this array (IC29d) is dedicated to providing a reference for *all* of the exponential converters. The emitters of all the exponential-converter transistors are connected to this common source.

This reference (approximately -0.6V) is produced by forcing a constant current through IC29d. The voltage across R88 is held at 15 volts by the feedback action of IC26a; this determines the current through IC29e and thus its base-to-emitter voltage. C22 prevents IC26a from oscillating, and IC29c protects IC29d from a reverse bias latch-up condition.

The output current of the log/antilog multiplier appears on the collector of IC29a. Since it is the wrong polarity and level to correctly drive IC13a's control-current port, it is applied to a **current inverter** IC25a, Q1, R13, R14, C3. This circuit has a gain of 6.66x, and operates as follows:

A voltage proportional to the current output of IC29a is developed across R14 because of the feedback action of IC25a (C3 stabilizes IC25a against oscillations). Feedback forces IC25a's "-" and "+" inputs to be at the same voltage. Thus, the same voltage which appears across R14 also appears across R13, and current flows in R13 in proportion to the ratio between the values of R14 and R13.

This current flows out of the "+" input line of IC25a into the emitter of Q1. Because Q1's base current is small compared to its emitter current, essentially the same current flows out of Q1's collector into the gain-control port of IC13a.

Since the base of Q1 is grounded, its emitter sits at +0.6V. This forces both "+" and "-" inputs of IC25a to also sit at +0.6V.

CR1 protects Q1 from reverse base-emitter voltage which could otherwise cause junction breakdown and latch-up of the entire current-inverter circuit.

7) SIX-BAND LIMITER CONTROL Card #A2

The output of each band's VCA (except that of the 6.2kHz band) feeds a **voltage divider** which, in turn, feeds a **dual-comparator IC**. If the output of the voltage divider exceeds a positive or negative threshold of 0.5 to 1.0V set by the **CLIPPING control**, the comparator will generate an output pulse which is smoothed by the timing module to produce a **control voltage** which reduces the gain of the VCA. The drive to the clippers following the compressors and pre-emphasis/high-frequency limiters is thus determined by the setting of the **CLIPPING control**, which simultaneously adjusts all **comparator thresholds** (and thus the average VCA output level).

The **timing circuits** process the signal in logarithmic form, and have low-impedance outputs. These drive exponential converters which provide control-current outputs for their respective VCAs. This timing circuitry is proprietary, and is located within sealed modules.

The **DENSITY control** provides a DC control voltage which offsets the logging transistors in the reference logarithmic converters in the VCAs. This control voltage can vary the gains of all VCAs by as much as 20dB while maintaining extremely accurate tracking. Thus, left and right channels remain correctly balanced.

Component-level description:

Other than component values, the control circuits for all six bands are identical — except the 6.2kHz band, which receives the control signal from the 3.7kHz band. Only the control circuit for band 1 (150Hz) will be discussed in detail.

The output of the band 1 VCA is applied to voltage divider R1, R2 which protects IC1 (a 711 dual comparator) from being driven beyond its ratings. IC1 produces a positive-going pulse that is approximately +4.5V if the output of voltage divider R1, R2 exceeds the comparator threshold voltage generated by IC12 (on Card #A1) and associated circuitry. The **threshold of limiting** is thus determined by two factors: 1) the loss in voltage divider R1, R2 (the more loss, the higher the voltage at the VCA output before IC1 turns on); and 2) the threshold voltage applied to IC1. This voltage can be varied from ± 0.5 to ± 1.0 V

by the **CLIPPING control** R160 (on Card #A1), which varies the threshold of limiting (and thus the average output level of the band VCAs) by feedback.

The output of IC1 is applied to unity-gain inverter and level shifter Q1, R5, R7. The waveform at the collector of Q1 consists of pulses which go 4.5V *below* the +12V collector supply voltage. These pulses develop approximately 4V across R6, the emitter resistor of Q2. The current which flows through R6 is essentially identical to that flowing from the collector of Q2 into the timing module. The value of R6 determines the attack time by scaling this current.

The **timing module** integrates this current and produces a voltage which is buffered by unity-gain FET-input opamp IC13a. IC13a's output is a dB-linear **control voltage** which determines the gain of the band VCA (in dB).

8) POST-LIMITER CROSSOVERS, CLIPPERS, DISTORTION-CANCELLING SYSTEM

Card #A1

The upper two bands (3.7kHz and 6.2kHz) are treated differently than the bottom three bands (150Hz, 420Hz, and 700Hz). The 1.6kHz band is unique in that it is not followed by a clipper.

Difference-frequency intermodulation (IM) due to clipping is cancelled below 2.2kHz by a feedforward **distortion-cancelling sidechain** (US patent #4,412,100). The output of each of the two upper bands is applied to two identical filters (one inverting and one non-inverting) with 6dB/octave slopes. The 6.2kHz band filter is high-pass; the 3.7kHz band filter is band-pass.

A **clipper** is located before the inverting filter, so that the inverting filter filters the clipped signal, somewhat reducing out-of-band clipper-induced distortion.

The outputs of the inverting and non-inverting filters are added in the **distortion-cancelling summing amplifiers**. If no clipping occurs, the outputs of the inverting and non-inverting filters will cancel, and no output will be produced by the distortion-cancelling summing amplifiers. If clipping *does* occur, then the output of the distortion-cancelling summing amplifiers will represent the difference between the clipper's input and output as filtered by the inverting filter (i.e., the *distortion added by the clipper*, as filtered through the inverting filter).

Since the upper two bands are handled by the distortion-cancelling summing amp, the output of this amplifier represents the sum of the filtered clipper-induced distortion produced by the two clippers in these bands. This signal is applied to the distortion-cancelling filter (a 2.2kHz low-pass filter with constant delay).

Meanwhile, the outputs of the inverting filters *alone* (containing the clipped, filtered outputs of the upper two bands) are summed by the **band-summation amplifier**. The output of this amplifier is applied to the input of the 15kHz phase-linear low-pass filter.

The outputs of the 15kHz filter and 2.2kHz filter are **summed**. Considering for a moment the case where only *one* band is passing signal, the clipper-induced distortion component contributed by this band to the 2.2kHz filter's output is equal to, and out-of-phase with, the same distortion component in the 15kHz filter's output. Thus, this distortion component is cancelled by better than 30dB within the 2.2kHz bandwidth of the distortion-cancelling filter. Because the summation process and both of the 15kHz and 2.2kHz filters are linear, superposition holds and the distortion component in *each* of the two top bands is cancelled even when more than one band is active.

The three low-frequency bands are not treated by the distortion-cancellation sidechain. Simple **low-pass filtering** of the clipped signal is employed for distortion reduction.

The output of the 150Hz band is applied to a pair of cascaded 6dB/octave low-pass filters before it is **summed** with the rest of the bands in the band summation amplifier. A **clipper** is located between the first and second of these filters. The output of the 420Hz band is applied to this clipper, and then through the second low-pass filter to the **band-summation amplifier**. The clipper thus clips the *sum* of the 420Hz band and the filtered 150Hz band.

The output of the 700Hz band is clipped independently of the two lower bands. The output of the 700Hz clipper is low-pass filtered at 6dB/octave and summed by the band-summation amplifier.

Component-level description:

Since the distortion-cancellation system works almost identically on bands 5 and 6, the description of band 5 (3.7kHz) also applies to band 6 (6.2kHz), which uses a pair of high-pass filters instead of band-pass filters.

The output of the band's VCA is applied to the upper 6dB/octave band-pass filter R16, R17, C6, C7. Clipper diodes CR7, CR8 are embedded between R16 and R17 and clip the output of the band VCA before it is applied to the band-pass filter. The band-passed signal is summed into IC1a (the band-summation amplifier) through R18, and into sidechain summing amplifier IC3a through R19. The output of the band's VCA is also applied to a lower band-pass filter R24, C8, C9. The frequency response of this filter is identical to the frequency response of the filter associated with CR7 and CR8.

The lower band-pass filter's output is summed through R25 into IC3b. IC3a's output (containing the *inverted* contribution of the upper band-pass filter) is summed through R21 into IC3b. When clippers CR7 and CR8 are non-conductive, total cancellation (within the limitation of component tolerances) therefore occurs, because the upper and lower filters are identical and their contributions are summed out-of-phase. Thus, no signal

appears at the output of sidechain summing amplifier IC3b.

When the clippers conduct, all signal is cancelled at the output of IC3b except for the distortion added by the clipping process, as filtered by the upper band-pass filter.

The output of the band 1 VCA is low-pass filtered by R2, R3, C1, and then summed with the output of band 2 in IC1b. The sum is clipped by CR3, CR4, and low-pass filtered again through R6, R7, and C2 before being summed by band-summation amplifier IC1a.

The output of band 3 is clipped by CR5, CR6, and filtered through low-pass filter R11, R12, C3, before being summed by IC1a.

The output of band 4 is not clipped, but is simply summed by IC1a through band-pass filter R13, R14, R15, C4, C5.

The output of IC1a feeds the 15kHz low-pass filter on the 8100A/1's Cards #8 and #9. Meanwhile, the output of distortion-cancelling summing amp IC3b feeds the 2.2kHz low-pass filter on the 8100A/1's Cards #8 and #9. The outputs of these filters are summed, which sharply cancels clipper-induced distortion below 2.2kHz.

3. PARTS LIST

Parts are listed by ASSEMBLY, then by TYPE, then by REFERENCE DESIGNATOR. See drawings in Section 6.4 for location of components. Widely used common parts are not listed; such parts are described generally below (examine the part to determine exact value).

SIGNAL DIODES, if not listed by reference designator in the following parts list, are:

Orban part number 22101-000, Fairchild (FSC) part number 1N4148, also available from many other vendors. This is a silicon, small-signal diode with ultra-fast recovery and high conductance. It may be replaced with 1N914 (BAY-61 in Europe).
(BV: 75V min. @ $I_F = 5V$ I_F : 25nA max. @ $V_F = 20V$ V_F : 1.0V max. @ $I_F = 100mA$ t_{rr} : 4ns max.)

See Miscellaneous list for **ZENER DIODES** (reference designator VRxx).

RESISTORS should only be replaced with the same style and with the *exact* value marked on the resistor body. If the value marking is not legible, consult the schematic or the factory. Performance and stability will be compromised if you do not use exact replacements. Unless listed by reference designator in the following parts list, resistors are:

Metal film resistors have conformally-coated bodies, and are identified by five color bands or a printed value. They are rated at 1/8 watt @ 70°C, ±1%, with a temperature coefficient of 100 PPM/°C. Orban part numbers 20038-xxx through 20045-xxx, USA Military Specification MIL-R-10509 Style RN55D. Manufactured by R-Ohm (CRB-1/4FX), TRW/IRC, Beyschlag, Dale, Corning, Matsushita.

Carbon film resistors have conformally-coated bodies, and are identified by four color bands. They are rated at 1/4 watt @ 70°C, ±5%. Orban part numbers 20001-xxx, Manufactured by R-Ohm (R-25), Piher, Beyschlag, Dale, Phillips, Spectrol, Matsushita.

Carbon composition resistors have molded phenolic bodies, and are identified by four color bands. The 0.090" x 0.250" (2.3mm x 6.4mm) size is rated at 1/4 watt, and the 0.140" x 0.375" (3.6mm x 9.5mm) size is rated at 1/2 watt, both ±5% @ 70° C. Orban part numbers 2001x-xxx, USA Military Specification MIL-R-11 Style RC-07 (1/4 watt) or RC-20 (1/2 watt). Manufactured by Allen-Bradley, TRW/IRC, Matsushita.

Cermet trimmer resistors have 3/8" (9mm) square bodies, and are identified by printing on their sides. They are rated at 1/2 watt @ 70°C, ±10%, with a temperature coefficient of 100 PPM/°C. Orban part numbers 20510-xxx and 20511-xxx. Manufactured by Beckman (72P, 68W- series), Spectrol, Matsushita.

Obtaining spare parts:

Special or subtle characteristics of certain components are exploited to produce an elegant design at a reasonable cost. *It is therefore unwise to make substitutions for listed parts.* Consult the factory if the listing of a part includes the note "selected" or "realignment required".

Orban normally maintains an inventory of tested, exact replacement parts that can be supplied quickly at nominal cost. Standardized spare parts kits are also available. When ordering parts from the factory, please have available the following information about the parts you want:

Orban part number
Reference designator (e.g., C3, R78, IC14)
Brief description of part
Model, serial, and "M" (if any) number of unit (see rear-panel label)

To facilitate future maintenance, parts for this unit have been chosen from the catalogs of well-known manufacturers whenever possible. Most of these manufacturers have extensive worldwide distribution and may be contacted through their local offices. The USA headquarters addresses are given at the end of this parts list.

REF DES	DESCRIPTION	ORBAN P/N	VEN (1)	VENDOR P/N	ALTERNATE VENDORS (1)	NOTES
------------	-------------	-----------	------------	------------	--------------------------	-------

BOARD A1

Capacitors

C1	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C2	Polypropylene, 50V, 2.5%; 0.022uF	21702-322	NOB	CQ15P1H223GPP	WES	
C3	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C4	Mica, 500V, 1%; 1500pF	21022-215	CD	CD19-FD152F03	SAN	
C5	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C6	Mica, 500V, 1%; 1500pF	21022-215	CD	CD19-FD152F03	SAN	
C7	Polypropylene, 50V, 1%; 0.01uF	21701-310	NOB	CQ15P1H103FPP	WES	
C8	Mica, 500V, 1%; 1500pF	21022-215	CD	CD19-FD152F03	SAN	
C9	Polypropylene, 50V, 1%; 0.01uF	21701-310	NOB	CQ15P1H103FPP	WES	
C10,11	Mica, 500V, 1%; 1000pF	21022-210	CD	CD19-FD102F03	SAN	
C12	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C13	Polypropylene, 50V, 2.5%; 0.022uF	21702-322	NOB	CQ15P1H223GPP	WES	
C14	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C15	Mica, 500V, 1%; 1500pF	21022-215	CD	CD19-FD152F03	SAN	
C16	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C17	Mica, 500V, 1%; 1500pF	21022-215	CD	CD19-FD152F03	SAN	
C18	Polypropylene, 50V, 1%; 0.01uF	21701-310	NOB	CQ15P1H103FPP	WES	
C19	Mica, 500V, 1%; 1500pF	21022-215	CD	CD19-FD152F03	SAN	
C20	Polypropylene, 50V, 1%; 0.01uF	21701-310	NOB	CQ15P1H103FPP	WES	
C21,22	Mica, 500V, 1%; 1000pF	21022-210	CD	CD19-FD102F03	SAN	
C23-25	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C26	Mica, 500V, 1%; 1000pF	21022-210	CD	CD19-FD102F03	SAN	
C27,28	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C29	Mica, 500V, 1%; 1000pF	21022-210	CD	CD19-FD102F03	SAN	
C30	Alum., Radial, 63V, 33uF	21209-633	SPR	502D 336G063CC1C	PAN	
C31-34	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C35	Mica, 500V, 1%; 1500pF	21022-215	CD	CD19-FD152F03	SAN	
C36-42	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C43-48	Mica, 500V, 1%; 1000pF	21022-210	CD	CD19-FD102F03	SAN	
C49-51	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C52	Mica, 500V, 1%; 1000pF	21022-210	CD	CD19-FD102F03	SAN	
C53,54	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C55	Mica, 500V, 1%; 1000pF	21022-210	CD	CD19-FD102F03	SAN	
C56	Alum., Radial, 63V, 33uF	21209-633	SPR	502D 336G063CC1C	PAN	
C57-60	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C61	Mica, 500V, 1%; 1500pF	21022-215	CD	CD19-FD152F03	SAN	
C62-68	Polypropylene, 50V, 2.5%; 0.01uF	21702-310	NOB	CQ15P1H103GPP	WES	
C69-74	Mica, 500V, 1%; 1000pF	21022-210	CD	CD19-FD102F03	SAN	
C75,76	Alum., Radial, 25V, 100uF	21206-710	PAN	ECE-ALEV101S		
C77-82	Monolythic Ceramic, 50V, 20%; 0.1uF	21123-410	SPR	1C25 Z5U104M050B	KEM	

FOOTNOTES:

- (1) See last page for abbreviations
- (2) No Alternate Vendors known at publication
- (3) Actual part is specially selected from part listed, consult Factory

- (4) Realignment may be required if replaced, see Circuit Description and/or Alignment Instructions

SPECIFICATIONS AND SOURCES FOR
REPLACEMENT PARTS

OPTIMOD-FM MODEL 8100A/XT2
ACCESSORY CHASSIS

BOARD #A1-CAPACITORS

REF DES	DESCRIPTION	ORBAN P/N	VEN (1)	VENDOR P/N	ALTERNATE VENDORS (1)	NOTES
<u>Integrated Circuits</u>						
IC1-3	Linear, Dual Opamp	24206-402	TI	TL072CJG	NAT	
IC4	Linear, Dual Opamp	24206-202	RAY	RC4558NB	MOT, FSC	
IC5-11	Linear, Dual Opamp	24206-402	TI	TL072CJG	NAT	
IC12	Linear, Dual Opamp	24202-202	RAY	RC4558NB	MOT, FSC	
IC13-20	Linear, Dual Opamp	24206-402	TI	TL072CJG	NAT	
<u>Resistors</u>						
R75	Pot, Single, 10K (5050)	20720-000	ORB			Linear
R120	Pot, Single, 10K (5050)	20720-000	ORB			Linear
R160	Pot, Single, 10K (5050)	20720-000	ORB			Linear
R168	Pot, Single, 10K (5050)	20720-000	ORB			Linear
<u>Switches</u>						
S1	Switch, Toggle, Min., DPDT	26037-010	CK	7201SYA		
<u>BOARD A2</u>						
<u>Capacitors</u>						
C1-5	Monolithic Ceramic, 50V, 20%; 0.1uF	21123-410	SPR	1C25 Z5U104M050B	KEM	
C7,8	Alum., Radial, 25V; 100uF	21206-710	PAN	ECE-ALEV101S		
C9-12	Monolithic Ceramic, 50V, 20%; 0.1uF	21123-410	SPR	1C25 Z5U104M050B	KEM	
C13-15	Alum., Radial, 25V; 100uF	21206-710	PAN	ECE-ALEV101S		
<u>Diodes</u>						
CR4	Diode, Zener, 1W; 9.1V	22003-091	MOT	1N4739		
<u>Integrated Circuits</u>						
IC1-10	Dual Comparator	24701-502	TI	UA711CJ	RAY, TI	
IC13-15	Linear, Dual Opamp	24209-202	NAT	LF412CN		
<u>Miscellaneous</u>						
A1-3	Module Assy, Release Time	30665-002-xx*	ORB			*Add suffix printed on part

FOOTNOTES:

- (1) See last page for abbreviations
- (2) No Alternate Vendors known at publication
- (3) Actual part is specially selected from part listed, consult Factory

- (4) Realignment may be required if replaced, see Circuit Description and/or Alignment Instructions

SPECIFICATIONS AND SOURCES FOR
REPLACEMENT PARTSOPTIMOD-FM MODEL 8100A/XT2
ACCESSORY CHASSISBOARD #A1-IC's/SWITCHES
BOARD #A2-CAPACITORS/MISC

REF DES	DESCRIPTION	ORBAN P/N	VEN (1)	VENDOR P/N	ALTERNATE VENDORS (1)	NOTES
<u>Transistors</u>						
Q1	Transistor, Signal, NPN	23202-101	MOT	2N4400	FSC	
Q2	Transistor, Signal, PNP	23002-101	MOT	2N4402	FSC	
Q3	Transistor, Signal, NPN	23202-101	MOT	2N4400	FSC	
Q4	Transistor, Signal, PNP	23002-101	MOT	2N4402	FSC	
Q5	Transistor, Signal, NPN	23202-101	MOT	2N4400	FSC	
Q6	Transistor, Signal, PNP	23002-101	MOT	2N4402	FSC	
Q7	Transistor, Signal, NPN	23202-101	MOT	2N4400	FSC	
Q8	Transistor, Signal, PNP	23002-101	MOT	2N4402	FSC	
Q9	Transistor, Signal, NPN	23202-101	MOT	2N4400	FSC	
Q10	Transistor, Signal, PNP	23002-101	MOT	2N4402	FSC	

BOARD A3

Capacitors

C1	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C2,3	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C4	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C5	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C6	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C7,8	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C9	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C10	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C11	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C12,13	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C14	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C15	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C16,17	Alum., Radial, 25V; 100uF	21206-710	PAN	ECE-ALEV101S		
C18-21	Monolithic Ceramic, 50V, 20%; 0.1uF	21123-410	SPR	IC25 Z5U104M050B	KEM	
C22	Polyester, 100V, 10%; 0.0022uF	21401-222	SPR	225P 22291WD3	PAN,PAK	
C23	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C24,25	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C26	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C27,28	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C29	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C30-32	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C33	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C34,35	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C36	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C37-39	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C40	Met. Polyester, 100V, 10%; 0.1uF	21441-410	WIM	MKS-4100V5.0.1	WES,SIE	
C41	Mica, 500V, +1/2pF -1/2pF; 10pF	21017-010	CD	CD15-CD100D03	SAN	
C42	Polyester, 100V, 10%; 0.0022uF	21401-222	SPR	225P 22291WD3	PAN,PAK	

FOOTNOTES:

- (1) See last page for abbreviations
- (2) No Alternate Vendors known at publication
- (3) Actual part is specially selected from part listed, consult Factory
- (4) Realignment may be required if replaced, see Circuit Description and/or Alignment Instructions

SPECIFICATIONS AND SOURCES FOR REPLACEMENT PARTS

OPTIMOD-FM MODEL 8100A/XT2
ACCESSORY CHASSIS

BOARD #A2-TRANSISTORS
BOARD #A3-CAPACITORS

REF DES	DESCRIPTION	ORBAN P/N	VEN (1)	VENDOR P/N	ALTERNATE VENDORS (1)	NOTES
------------	-------------	-----------	------------	------------	--------------------------	-------

Integrated Circuits

IC1-8	Linear, Dual Opamp	24206-402	TI	TL072CJG	NAT	
IC9-12	Linear, Dual Opamp	24207-402	SIG	NE5532FE	TI,EXR	
IC13-24	Linear, Dual Opamp	24208-303	ORB	CA3280AC		(3)
IC25-28	Linear, Dual Opamp	24209-202	NAT	LF412CN		
IC29,30	Multiple FET	24402-302	NAT	LM3046N	RCA	

Resistors

R3	Trimpot, Quad Dip, 100K	20530-001	BRN	7104D-410-104		Alt:Weston
R31	Trimpot, Quad Dip, 100K	20530-001	BRN	7104D-410-104		Alt:Weston
R59	Trimpot, Quad Dip, 100K	20530-001	BRN	7104D-410-104		Alt:Weston
R91	Trimpot, Quad Dip, 100K	20530-001	BRN	7104D-410-104		Alt:Weston
R119	Trimpot, Quad Dip, 100K	20530-001	BRN	7104D-410-104		Alt:Weston
R147	Trimpot, Quad Dip, 100K	20530-001	BRN	7104D-410-104		Alt:Weston

Transistors

Q1-6	Transistor, Signal, PNP	23002-101	MOT	2N4402	FSC	
------	-------------------------	-----------	-----	--------	-----	--

CHASSISMiscellaneous

M1-6	Meter, Edge, 1mA, Cream/Black, 0 to 25	28009-104	FMI	132D5		950 Ohms
------	--	-----------	-----	-------	--	----------

SUBPANELResistors

R1,2	Pot, Single, 10K (5050)	20720-000	ORB			Linear
------	-------------------------	-----------	-----	--	--	--------

FOOTNOTES:

- (1) See last page for abbreviations
- (2) No Alternate Vendors known at publication
- (3) Actual part is specially selected from part listed, consult Factory

- (4) Realignment may be required if replaced, see Circuit Description and/or Alignment Instructions

SPECIFICATIONS AND SOURCES FOR
REPLACEMENT PARTS
OPTIMOD-FM MODEL 8100A/XT2
ACCESSORY CHASSIS

BOARD #A3-IC's/TRANSISTORS
CHASSIS-MISC/SUBPANEL-RESISTORS

Vendor Codes

AB Allen-Bradley Co. 1201 South Second Street Milwaukee, WI 53204	CTS CTS Corporation 905 North West Blvd. Elkhart, IN 46514	MAL Mallory Timers Company Emhart Electrical/Electronic Gr. 3029 East Washington Street Indianapolis, IN 46206	SAE Stanford Applied Eng. 340 Martin Avenue Santa Clara, CA 95050
AD Analog Devices, Inc. Route 1, Industrial Park P.O. Box 280 Norwood, MA 02062	DIX Dixon, Inc. 287 Twenty Seven Road Grand Junction, CO 81501	ME Mepco/Electra, Inc. Columbia Road Morristown, NJ 07960	SAN Sangamo Capacitor Division P.O. Box 128 Pickens, SC 29671
AM Amphenol North America An Allied Company 2122 York Road Oak Brook, IL 60521	ECI Electrocube 1710 South Del Mar Avenue San Gabriel, CA 91776	MIL J.W. Miller Division Bell Industries 19070 Reyes Avenue P.O. Box 5825 Compton, CA 90221	SCH ITT Schadow, Inc. 8081 Wallace Road Eden Prairie, MN 55343
BEK Beckman Instruments, Inc. Helipot Division 2500 Harbor Blvd. Fullerton, CA 92634	FMI Emco 123 North Main Street Dublin, PA 18917	MOT Motorola, Inc. P.O. Box 20912 Phoenix, AZ 85036	SIE Siemens Components Division 186 Wood Avenue, South Iselin, NJ 08830
BEL Belden Corporation Electronic Division Richmond, IN 47374	ERE Erie Tech. Products, Inc. 644 West Twelfth Street Erie, PA 16512	NAT National Semiconductor Corp. 2900 Semiconductor Drive Santa Clara, CA 95051	SIG Signetics Corporation A Sub. of US Philips Corp. P.O. Box 9052 Sunnyvale, CA 94086
BRN Bourns, Inc. Trimpot Products Division 1200 Columbia Avenue Riverside, CA 92507	EXR Exar Integrated Systems, Inc. P.O. Box 62229 Sunnyvale, CA 94088	NOB Noble Teikoku Tsushin Kogyo Co. Ltd. 335, Kariyado, Nakahara-ku Kawasaki 211, JAPAN	SPR Sprague Electric Co. 125 Marshall Street North Adams, MA 01247
BUS Bussmann Manufacturing Div. McGraw-Edison Company P.O. Box 14460 St. Louis, MO 63178	MAR Marquardt Switches, Inc. 67 Albany Street Cazenovia, NY 13035	OHM Ohmite Manufacturing Company A North American Philips Co. 3601 Howard Street Skokie, IL 60076	STK Stackpole Components Co. P.O. Box 14466 Raleigh, NC 27620
CD Cornell-Dubilier Elec. 150 Avenue "L" Newark, NJ 07101	FSC Fairchild Camera & Instr. Corp. 464 Ellis Street Mountain View, CA 94042	ORR Orban Associates, Inc. 645 Bryant Street San Francisco, CA 94107	SYL Sylvania Conn. Prod. Op. GTE Products Corp. Box 29 Titusville, PA 16354
CH Cutler-Hammer 4201 W. 27th Street Milwaukee, WI 53216	GI General Instruments Optoelectronics Div. 3400 Hillview Avenue Palo Alto, CA 94304	PAN Panasonic Electronic Components Div. P.O. Box 1503 Seacaucus, NJ 07094	TI Texas Instruments P.O. Box 225012 Dallas, TX 75265
CK C & K Components, Inc. 15 Riverdale Avenue Newton, MA 02158	HP Hewlett-Packard 1501 Page Mill Road Palo Alto, CA 94304	RAY Raytheon Semiconductor Div. 350 Ellis Street Mountain View, CA 94042	TRW TRW Electronic Components Connector Division 1501 Morse Avenue Elk Grove Vlg., IL 60007-57
COR Corcom, Inc. 1600 Winchester Road Libertyville, IL 60048	INS Intersil, Inc. 10710 North Tantau Avenue Cupertino, CA 95014	RCA RCA Solid State Division Route 202 Somerville, NJ 08876	WES Westlake 5334 Sterling Ctr Drive Westlake Village, CA 91361
CRL Centralab, Inc. A North American Philips Co. 5757 North Green Bay Ave. Milwaukee, WI 53201	IRC TRW/IRC Resistors 401 North Broad Street Philadelphia, PA 19108	WIM WIMA P.O. Box 2345 Augusta-Anlage 56 D-6800 Mannheim 1 GERMANY	
	LFE Littelfuse A Subsidiary of Tracor P.O. Box 2345 Des Plaines, IL 60016		

4. SCHEMATICS, LOCATION OF COMPONENTS

The following drawings are included in this manual:

BLOCK DIAGRAM

page 6-19

XT2 cards:

Card #A1	CROSSOVERS	Assembly Drawing	30770-000-02	6-20
		Schematic	60078-000-03, 1 of 3	6-21
		Schematic	60078-000-03, 2 of 3	6-22
		Schematic	60078-000-03, 3 of 3	6-23
Card #A2	LIMITER CONTROL	Assembly Drawing	30765-000-04	6-24
		Schematic	60076-000-04	6-25
Card #A3	VCAs	Assembly Drawing	30760-000-03	6-26
		Schematic	60077-000-03, 1 of 2	6-27
		Schematic	60077-000-03, 2 of 2	6-28

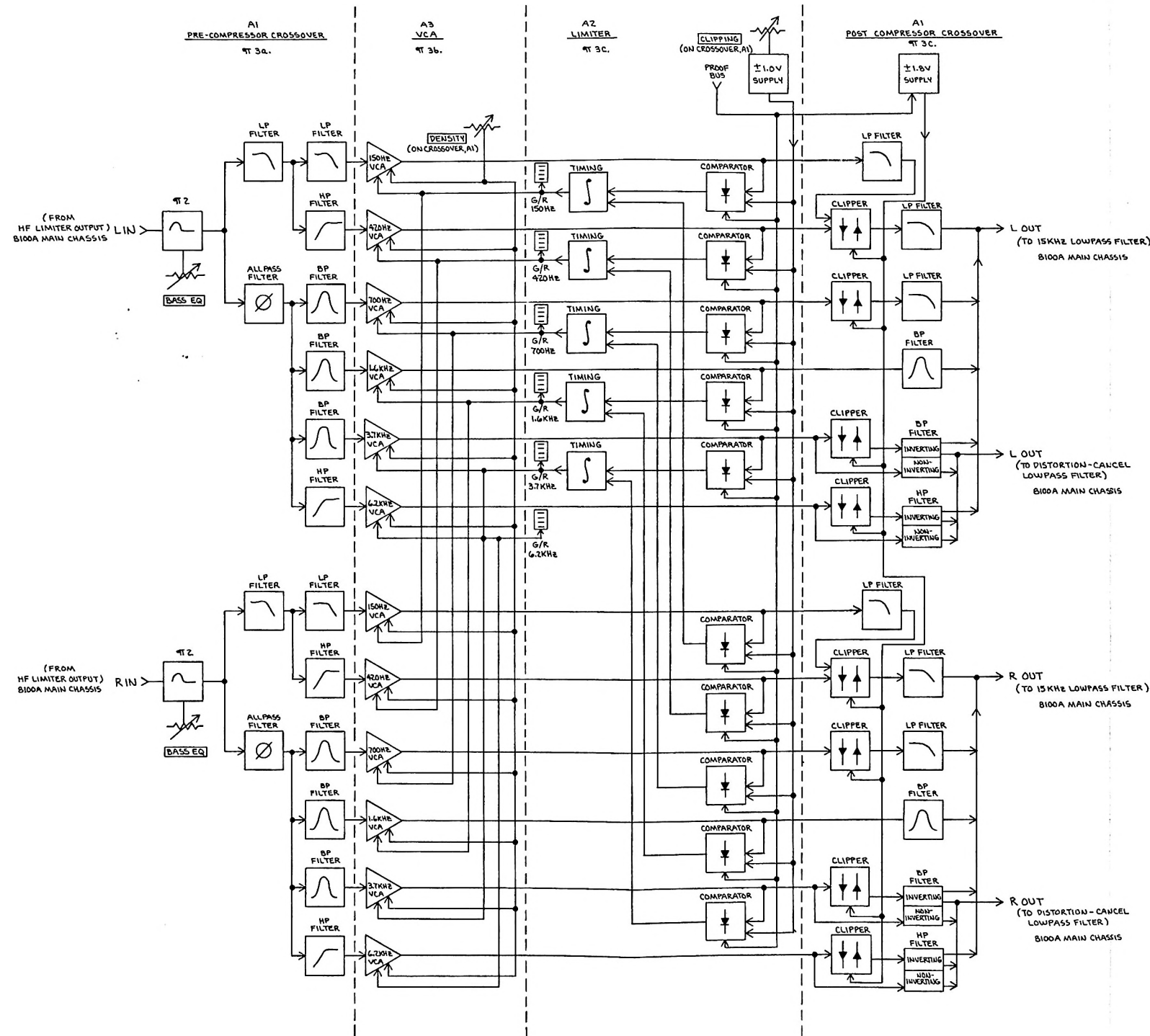
8100A/1 card:

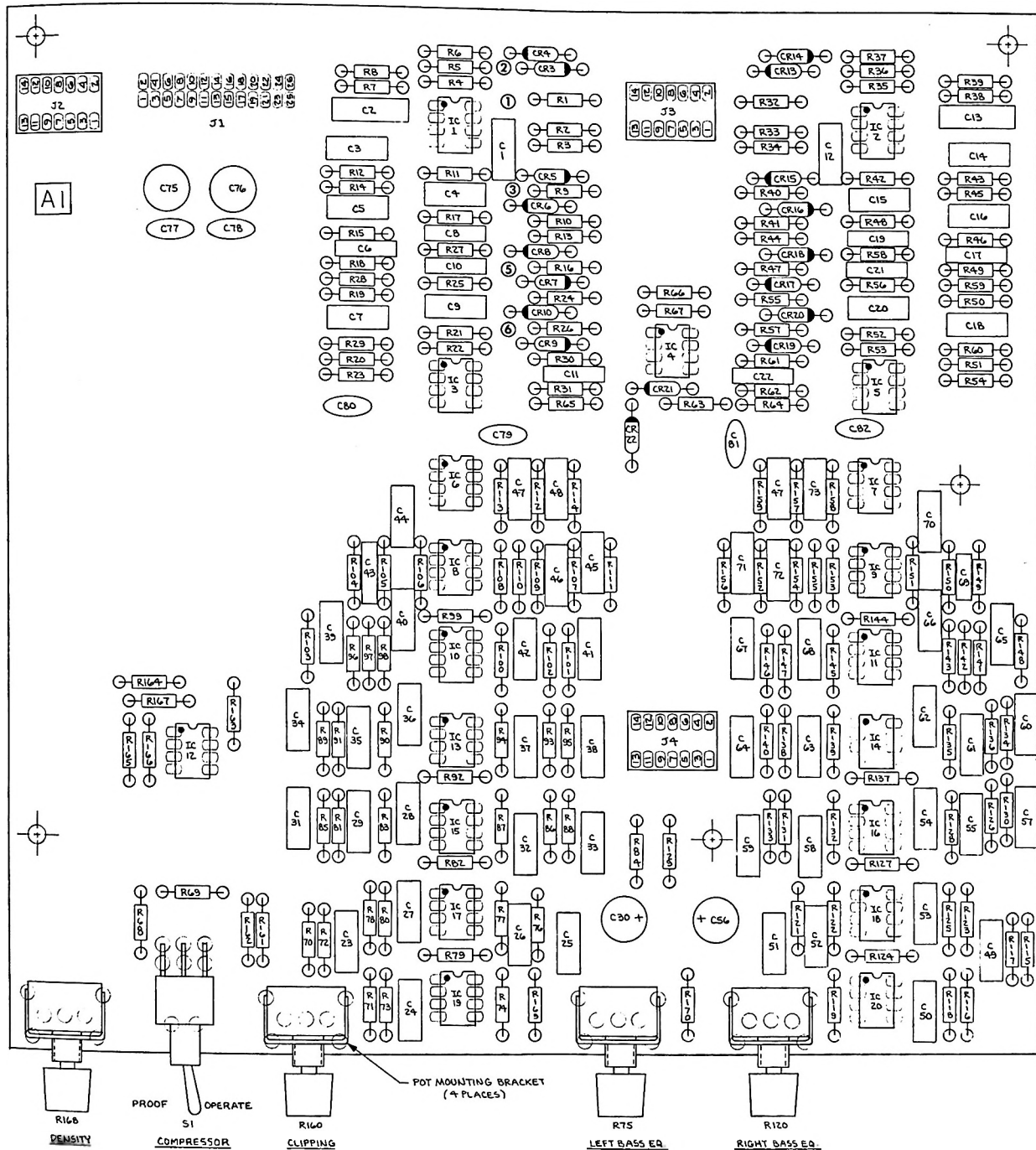
Card #5	COMPRESSOR CONTROL	Assembly Drawing	30715-000-03	6-30
		Schematic	60035-VER-07	6-31

(Card #5 drawings are provided here to support 8100A units which have been upgraded with Retrofit Kit RET-27. 8100A/1 owners should refer to the 8100A/1 Operating Manual for the most current schematics.)

These drawings reflect actual construction of your unit as accurately as possible. If changes are made, they will be described in an addendum to this manual. If there is a discrepancy between these drawings and your unit, it is more likely an error in documentation than an error in the construction of your unit.

If you intend to replace parts, please see the introduction to the preceding PARTS LIST.



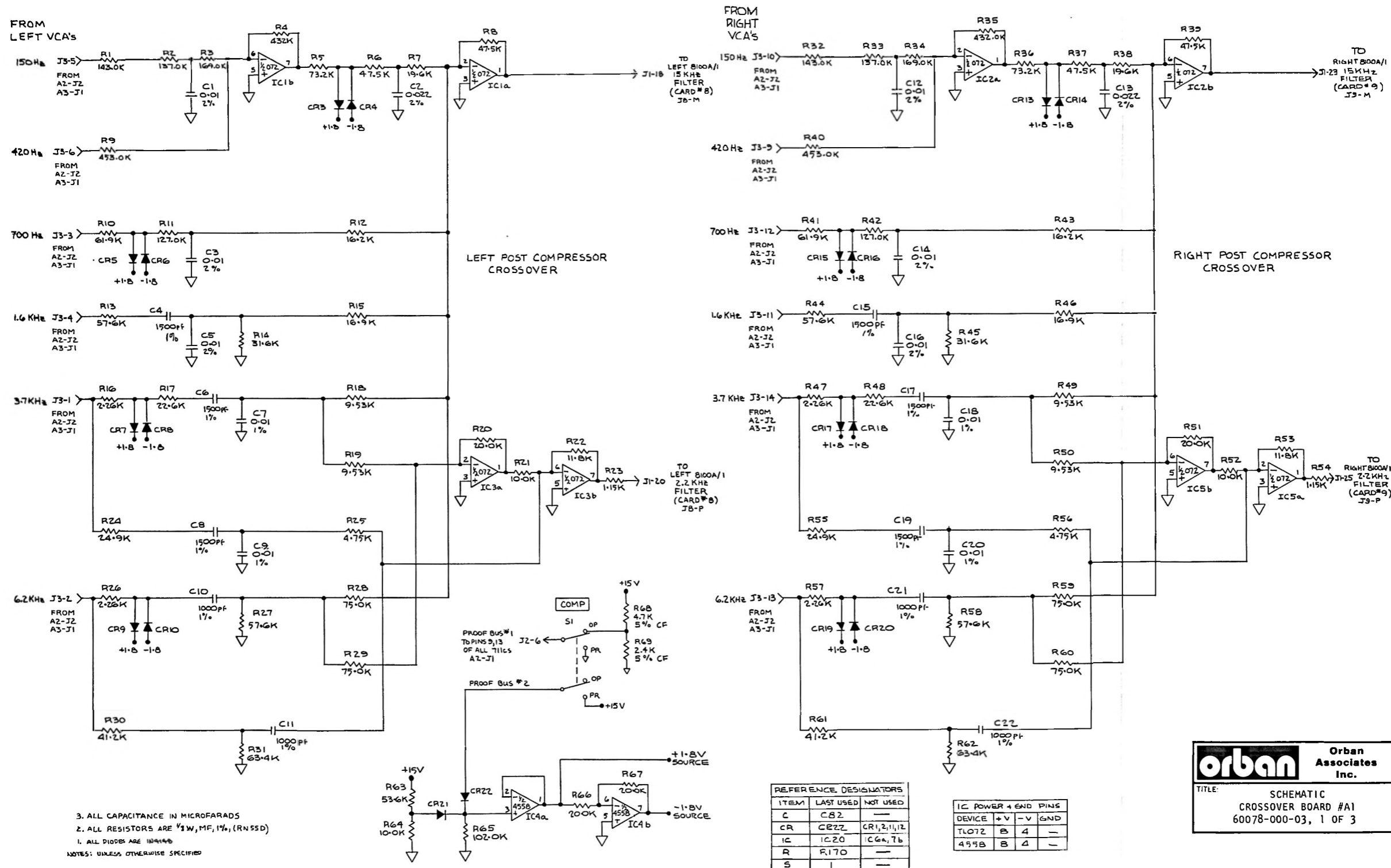


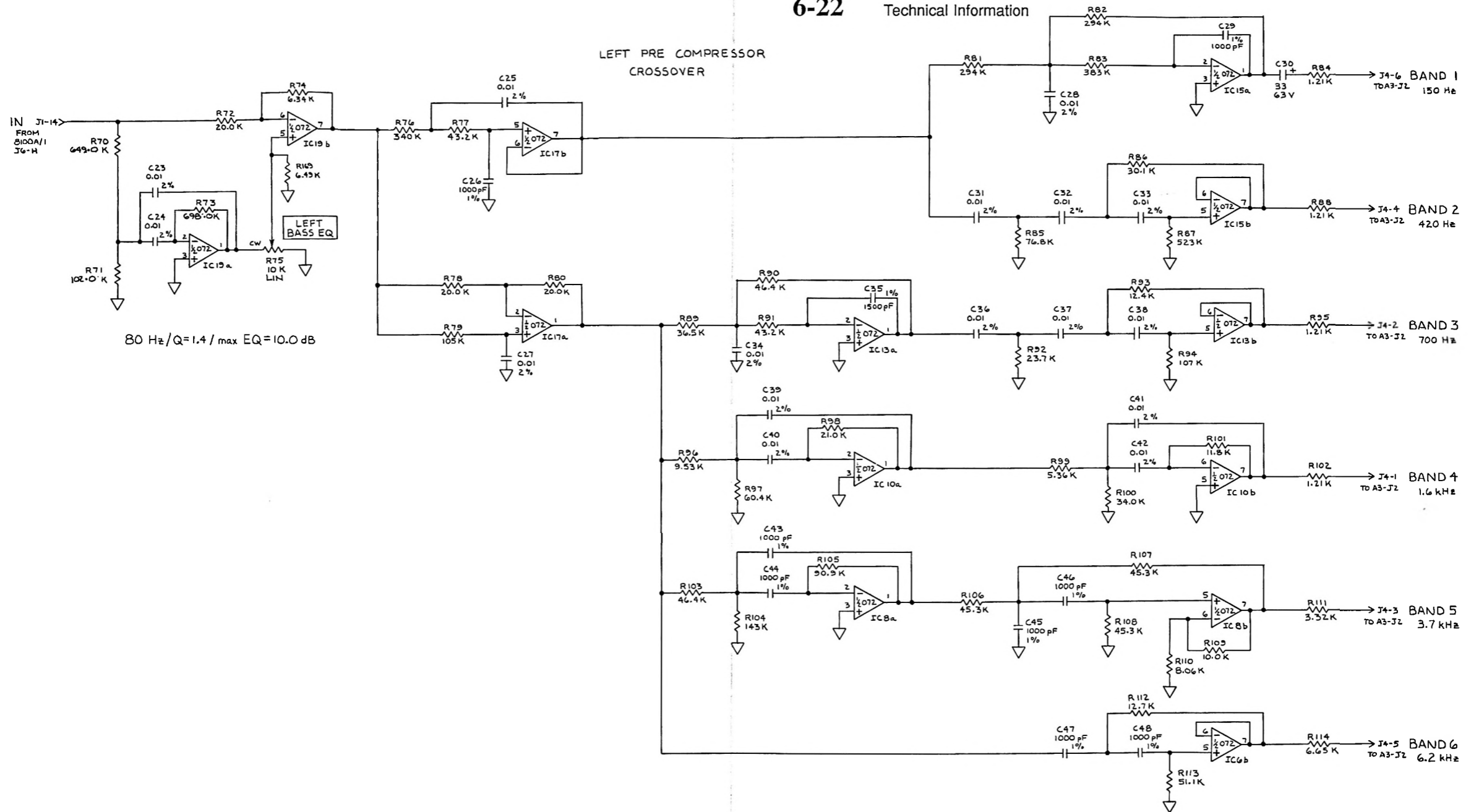
1. TICK MARKS INDICATE PIN ONE OF IC'S, MODULES;
CATHODE OF DIODES; POSITIVE SIDE OF CAPACITORS;
EMITTER OF TRANSISTORS.

NOTES:

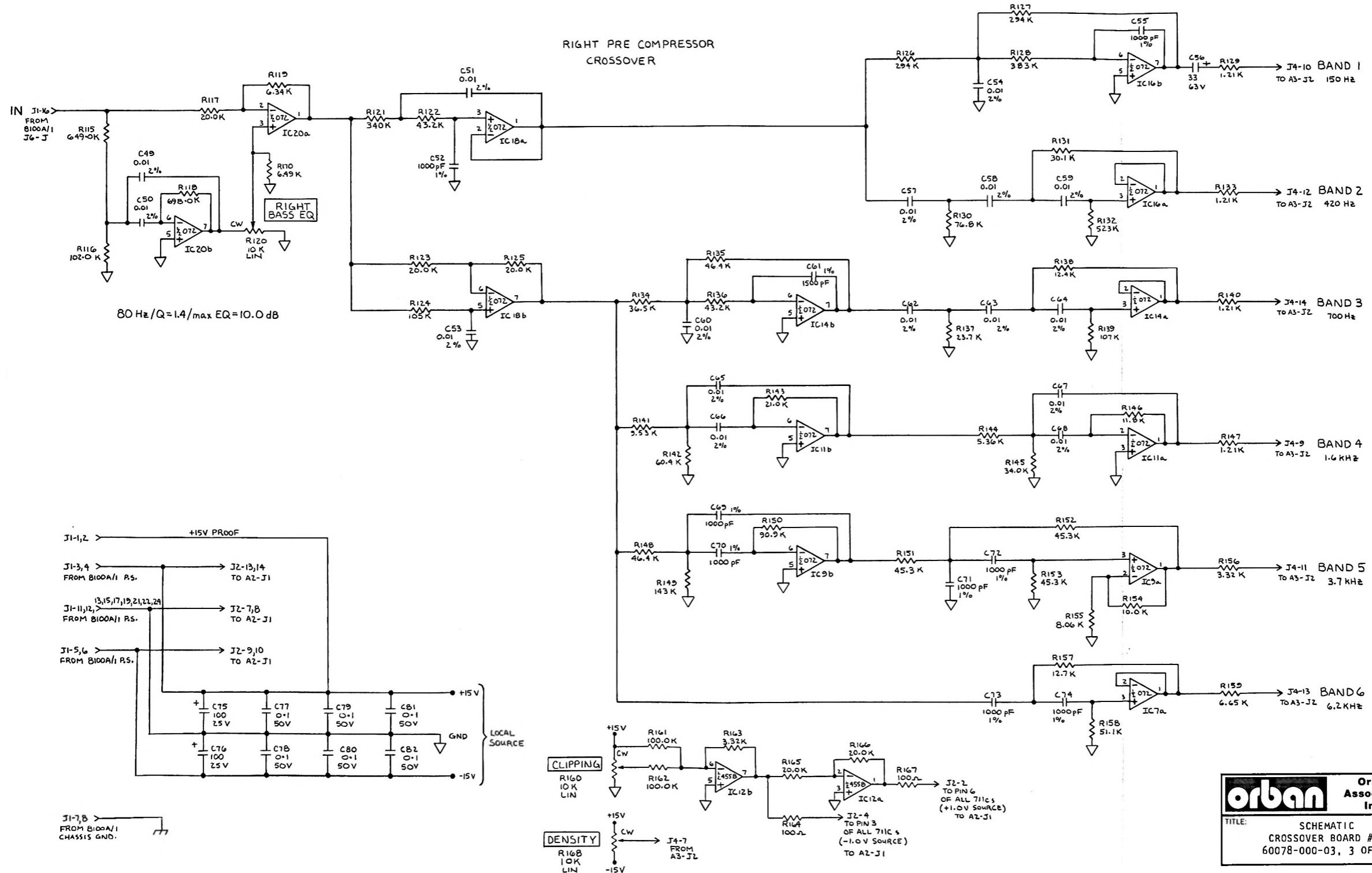
orban
Orban Associates Inc.

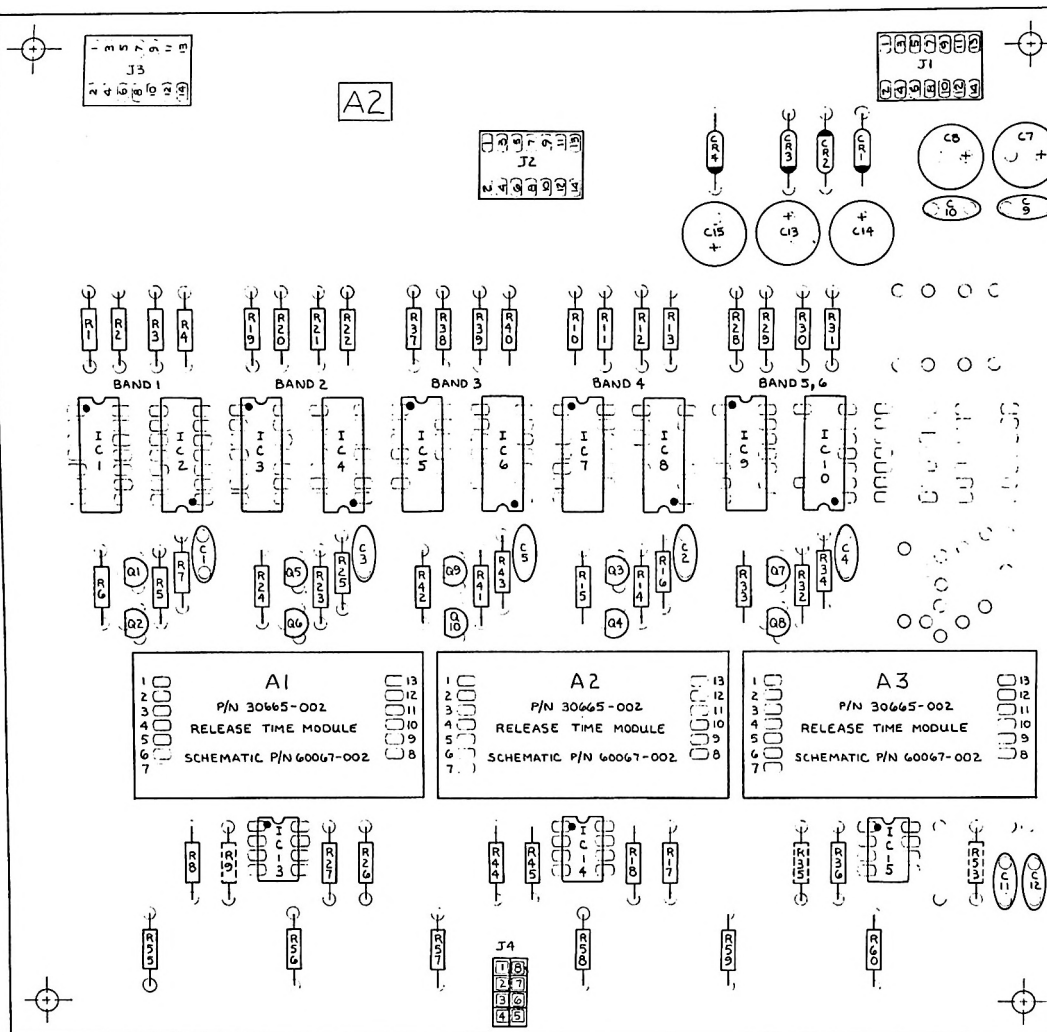
TITLE: ASSEMBLY DRAWING
CROSSOVER BOARD #A1
30770-000-02





RIGHT PRE COMPRESSOR
CROSSOVER

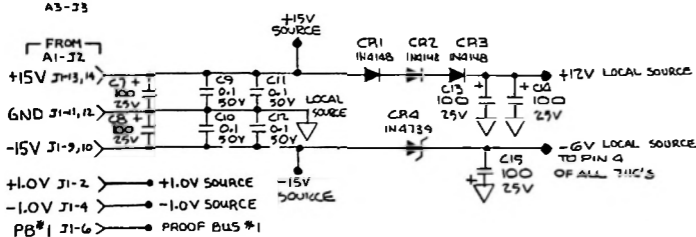
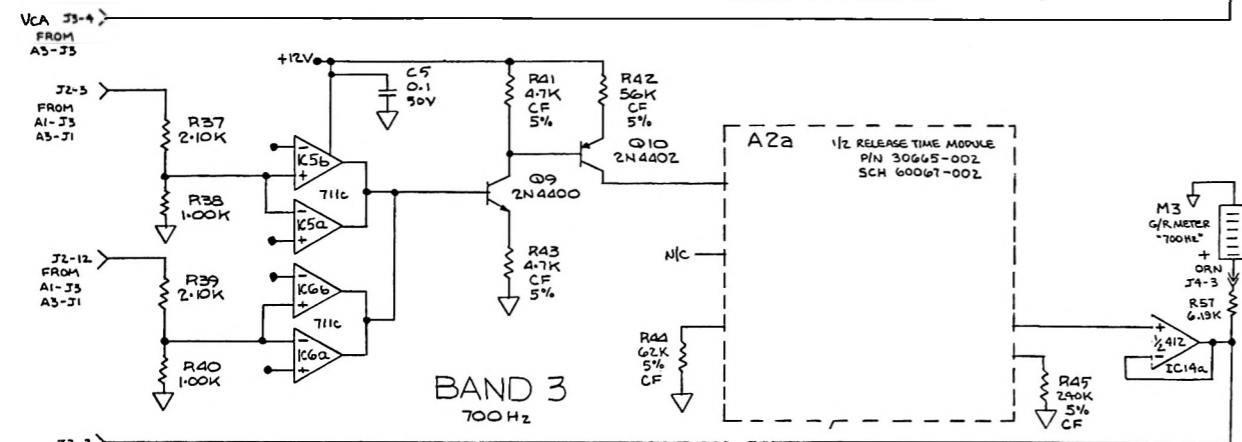
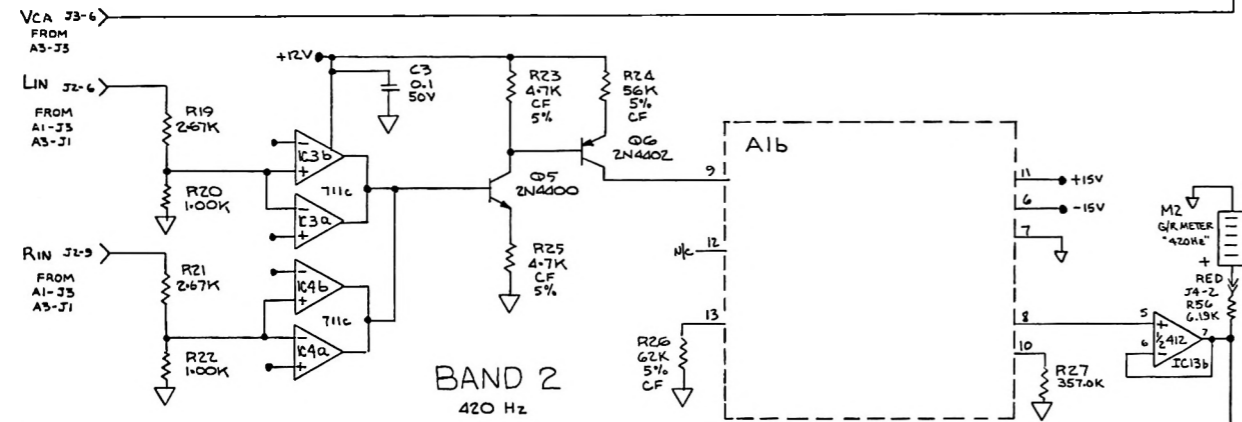
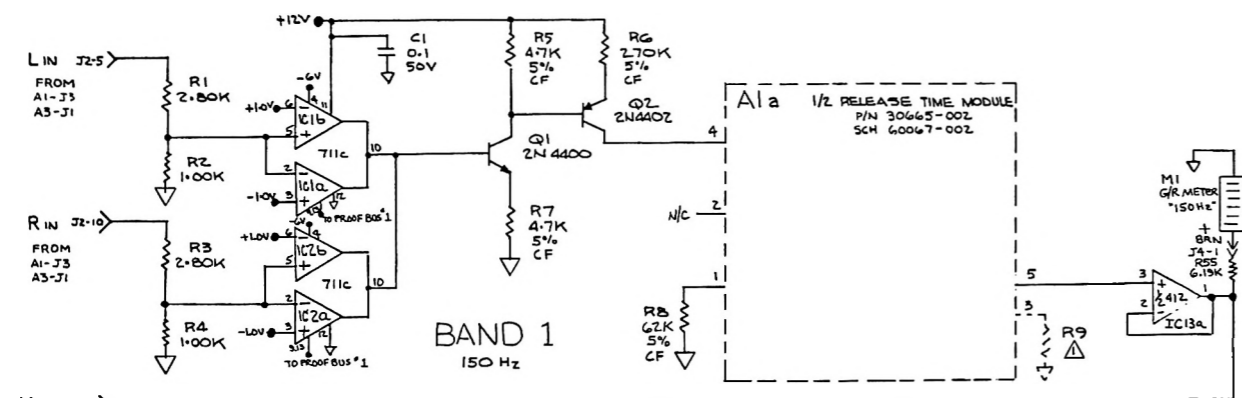




1. TICK MARKS INDICATE PIN ONE OF IC'S, MODULES;
CATHODE OF DIODES; POSITIVE SIDE OF CAPACITORS;
EMITTER OF TRANSISTORS.

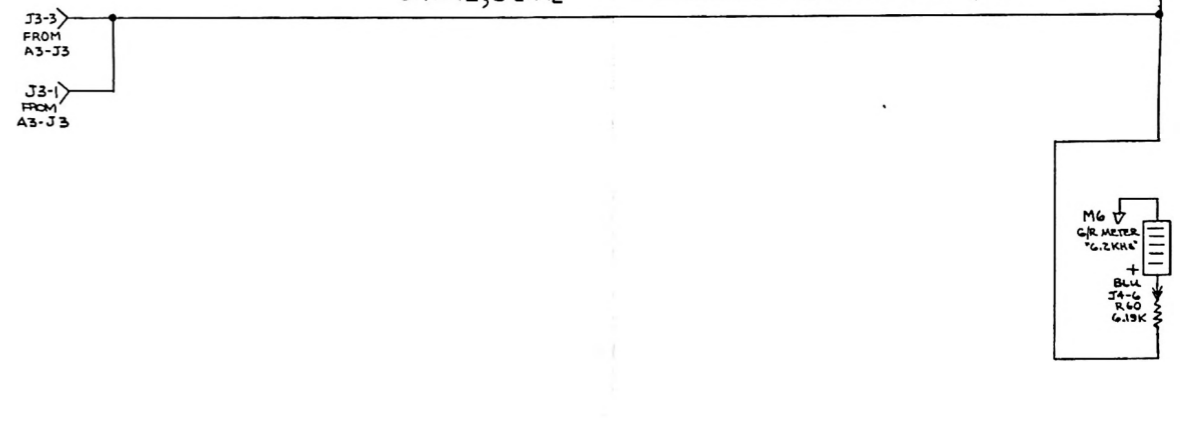
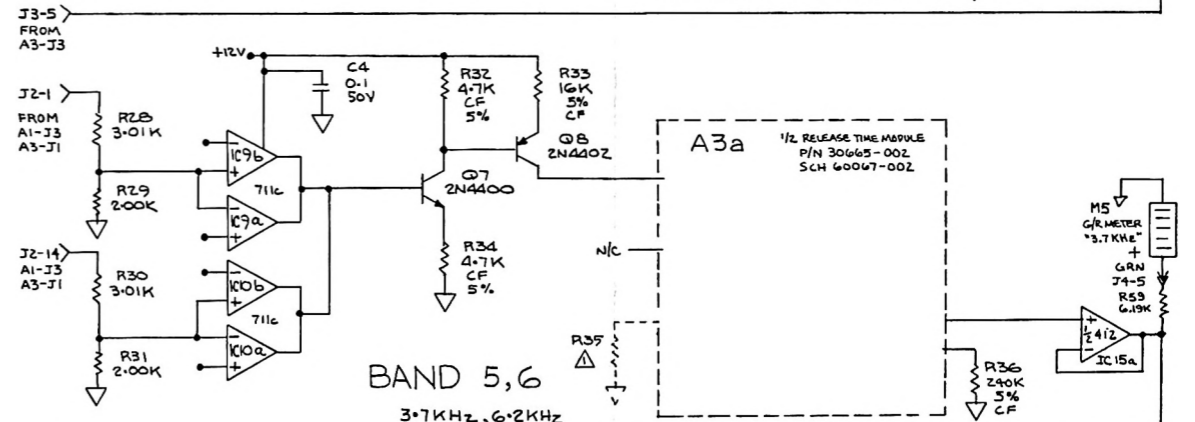
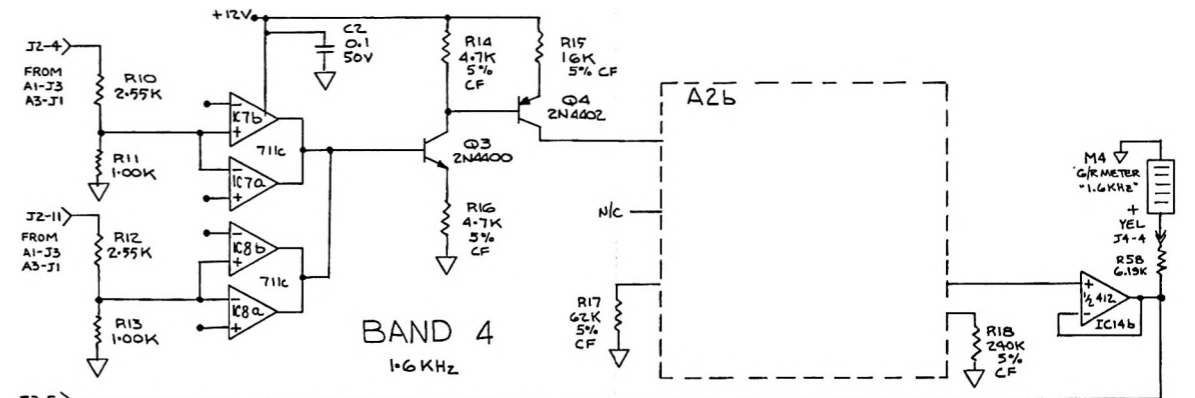
NOTES:

orban	Orban Associates Inc.
	TITLE: ASSEMBLY DRAWING LIMITER CONTROL BOARD #A2 30765-000-05



3. ALL CAPACITORS ARE IN MICROFARADS
2. ALL RESISTORS ARE 1/8W, 1%, (RN55D)

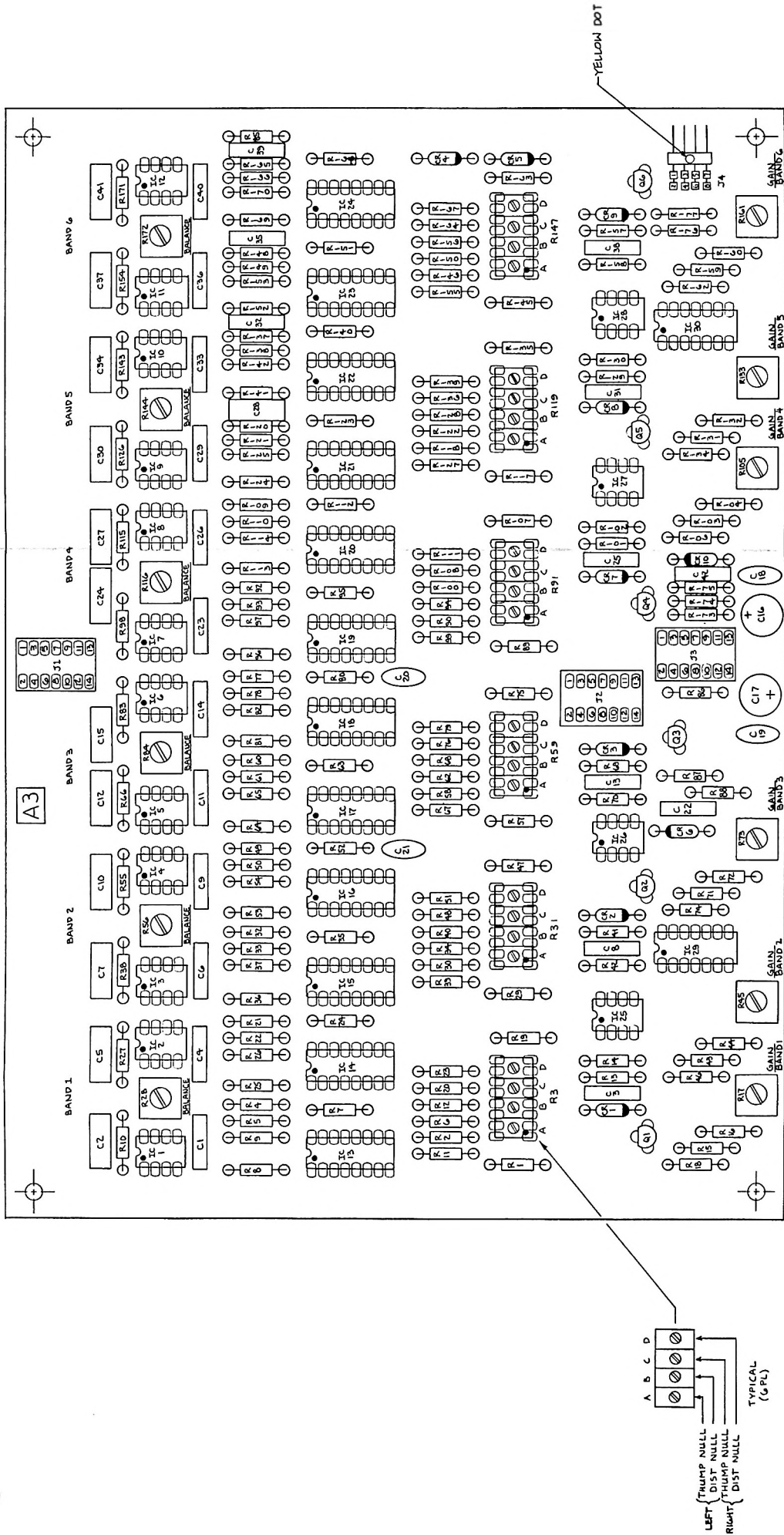
NOTES: ⚠ NOT LOADED



DEVICE	+V	-V	GND
41Z	B	A	-
711C	-	-	-
A1	-	-	-

orban Orban Associates Inc.

TITLE: SCHEMATIC
LIMITER CONTROL BOARD #A2
60076-000-05

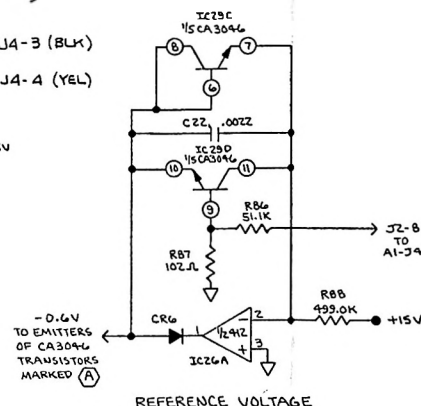
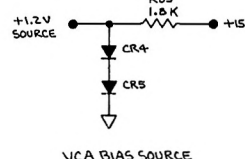
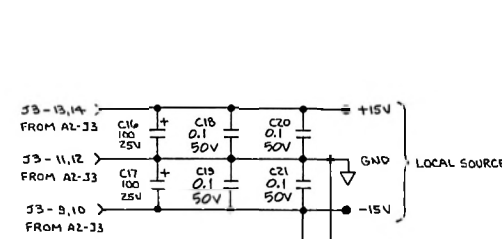
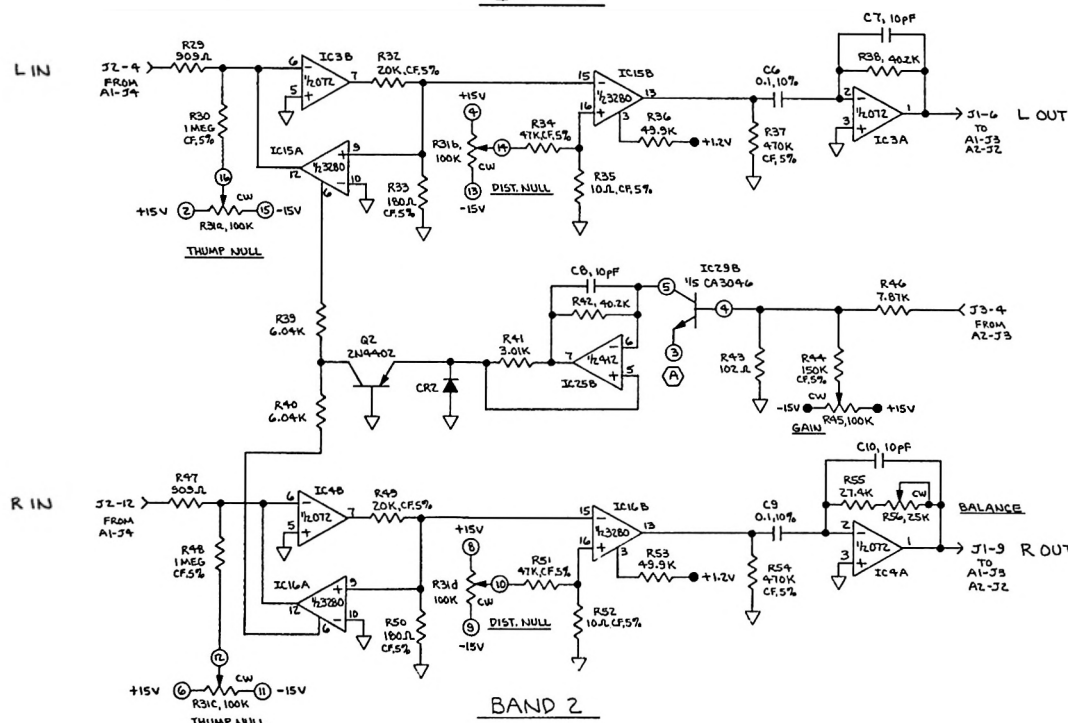
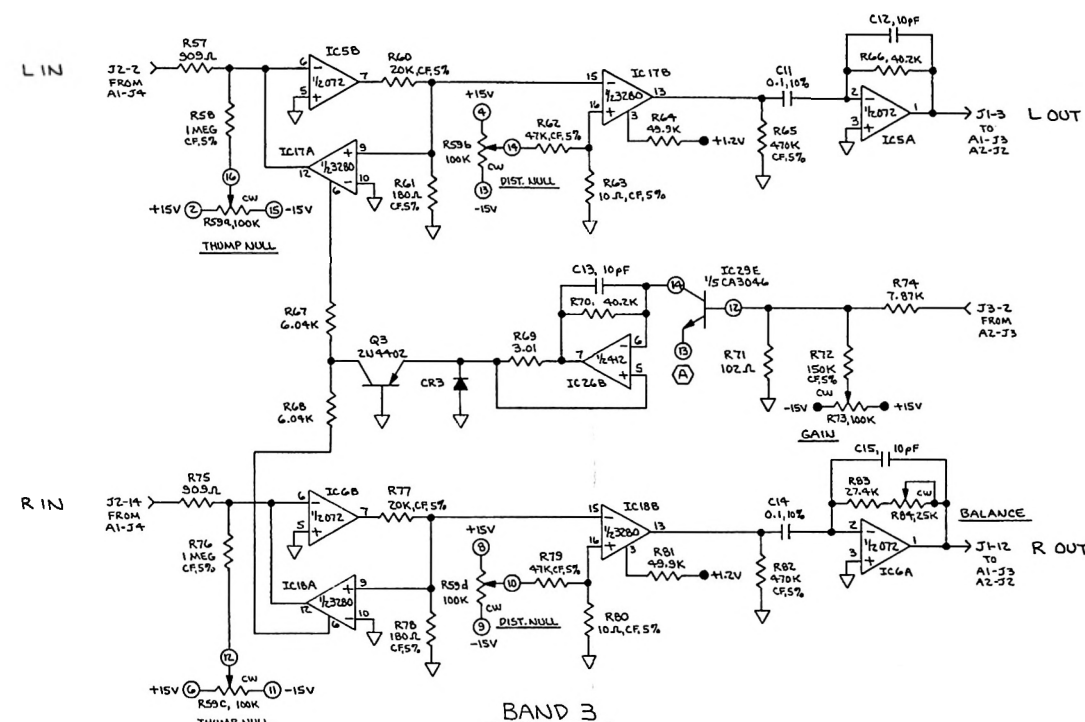
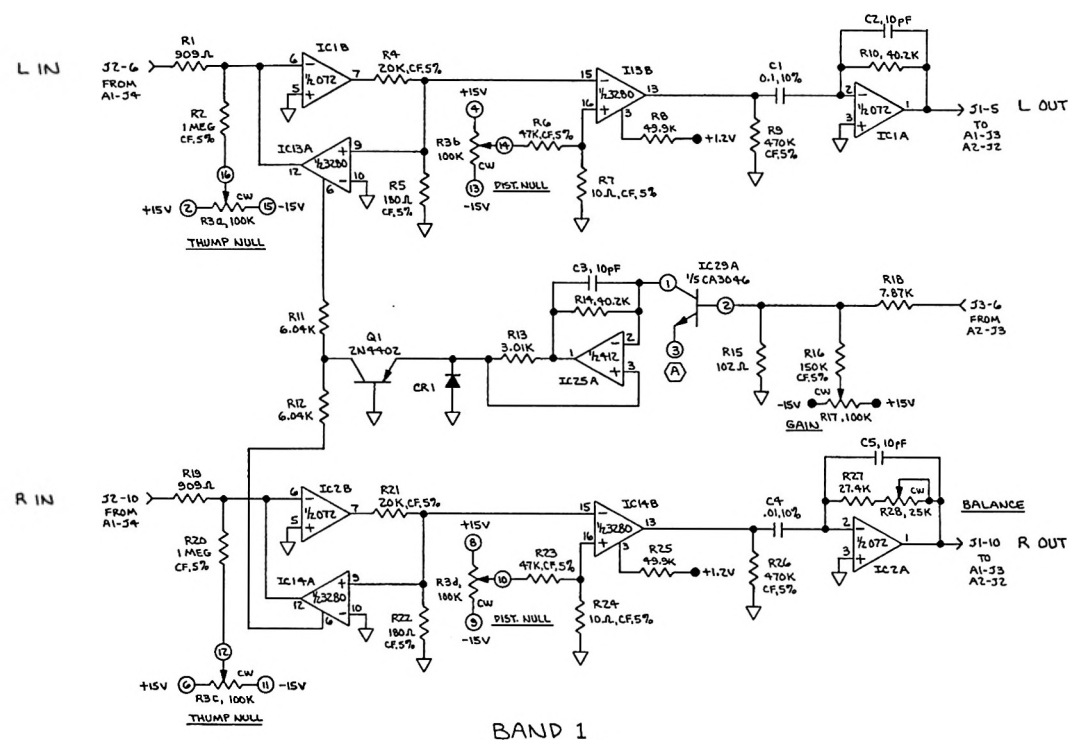


Urban Associates Inc.

ASSEMBLY DRAWING
VCA BOARD #A3
30760-000-03

1. TICK MARKS INDICATE PIN ONE OF IC'S, MODULES;
CATHODE OF DIODES; POSITIVE SIDE OF CAPACITORS;
EMITTER OF TRANSISTORS.

NOTES:



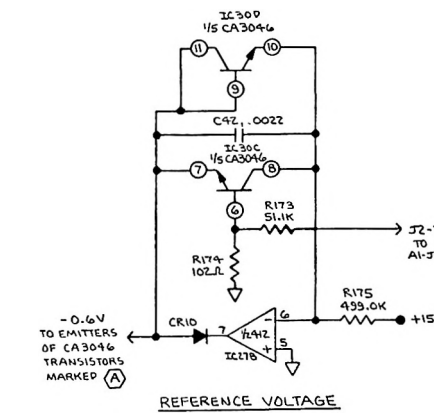
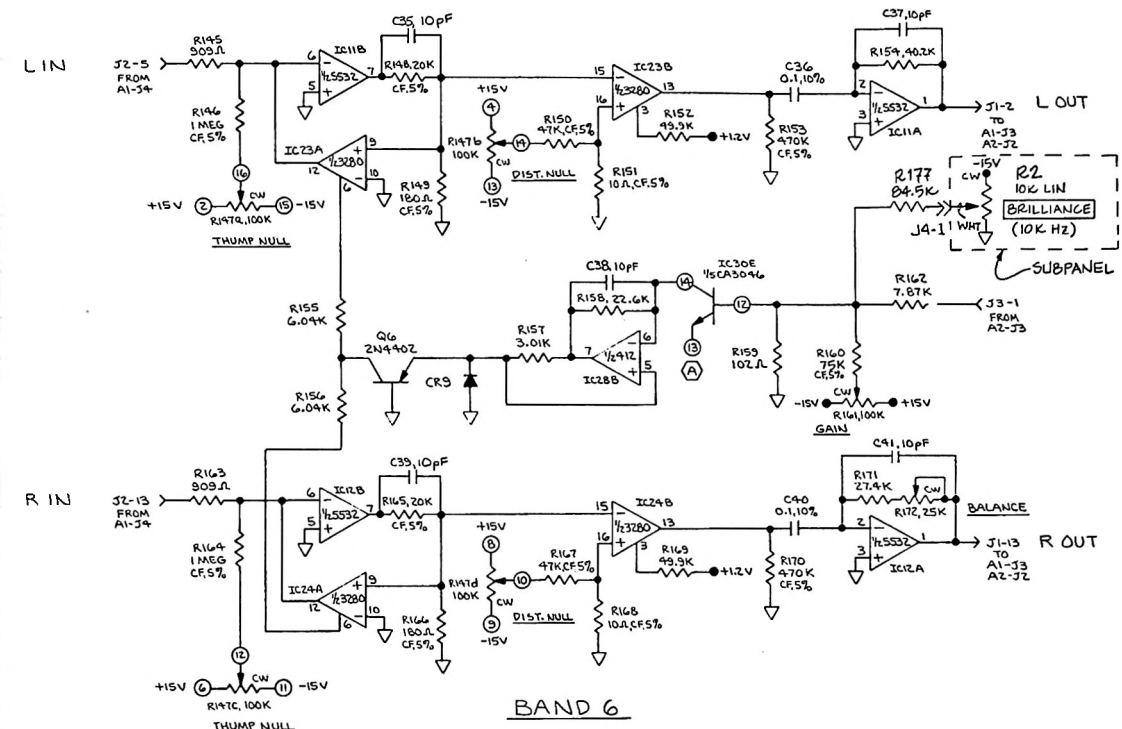
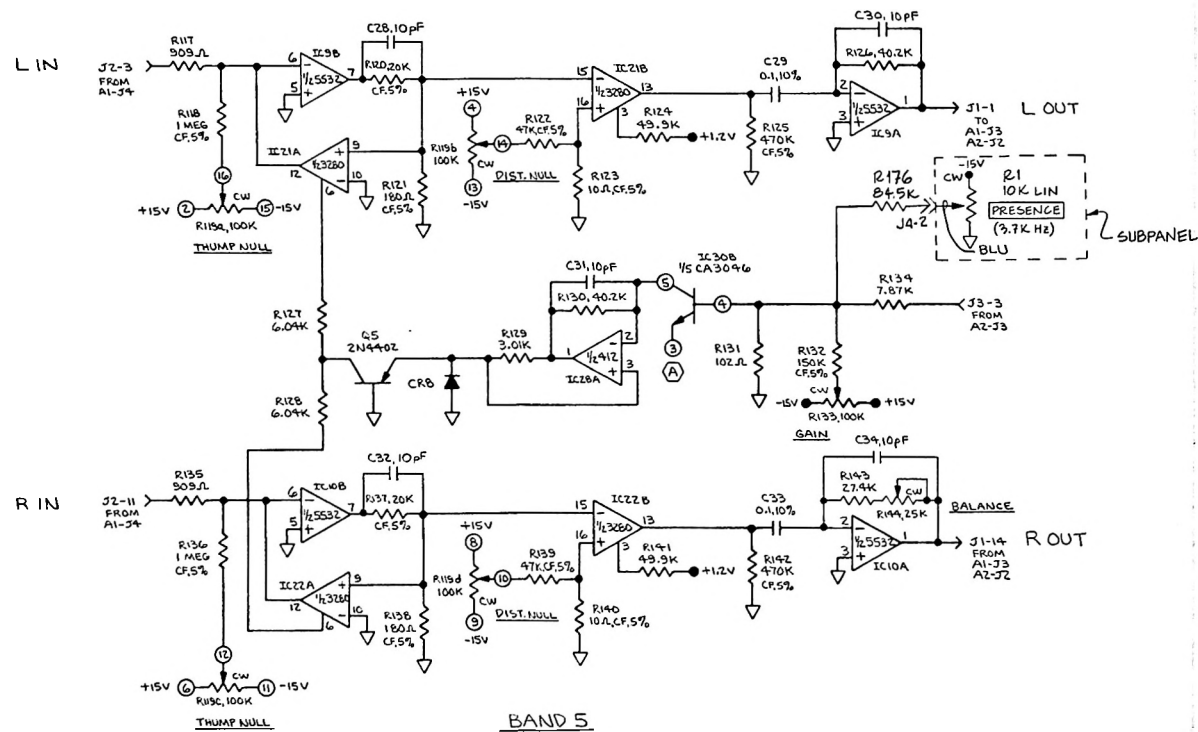
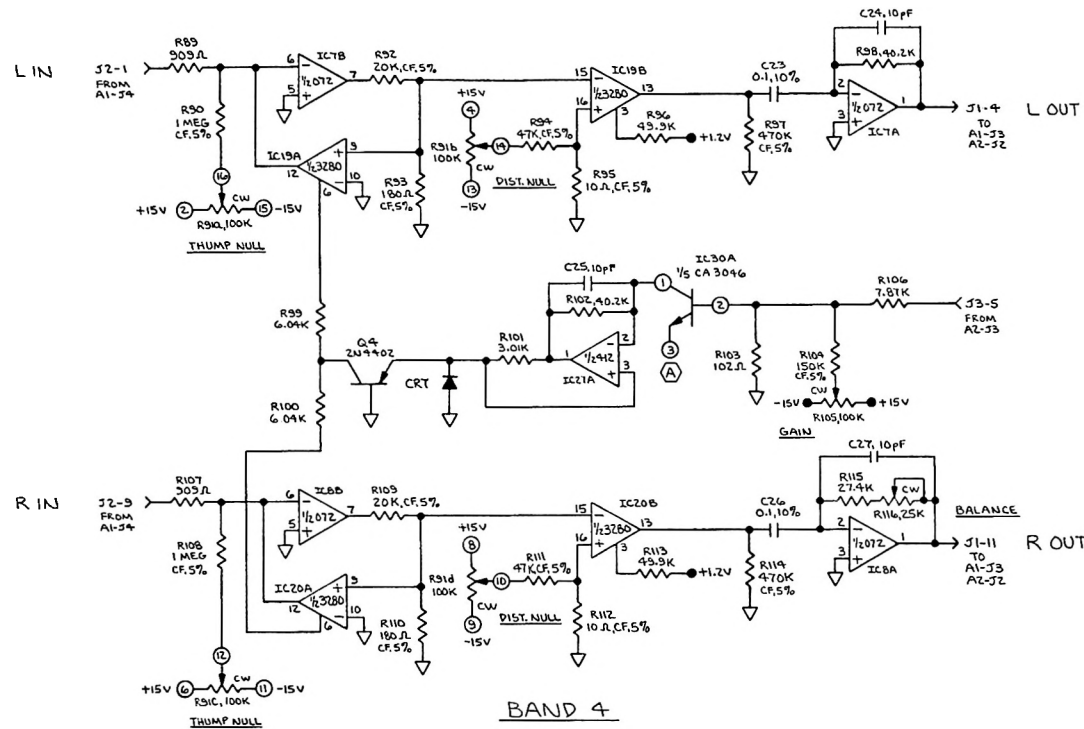
IC POWER & GROUND PINS			
DEVICE	+V	-V	GND
TL072	8	4	—
LF412	8	4	—
5532	8	4	—
3280	11,14	1,4,8	—

REFERENCE DESIGNATORS		
ITEM	LAST USED	NOT USED
R	17S	—
IC	30	—
C	42	—
CR	10	—
Q	6	—

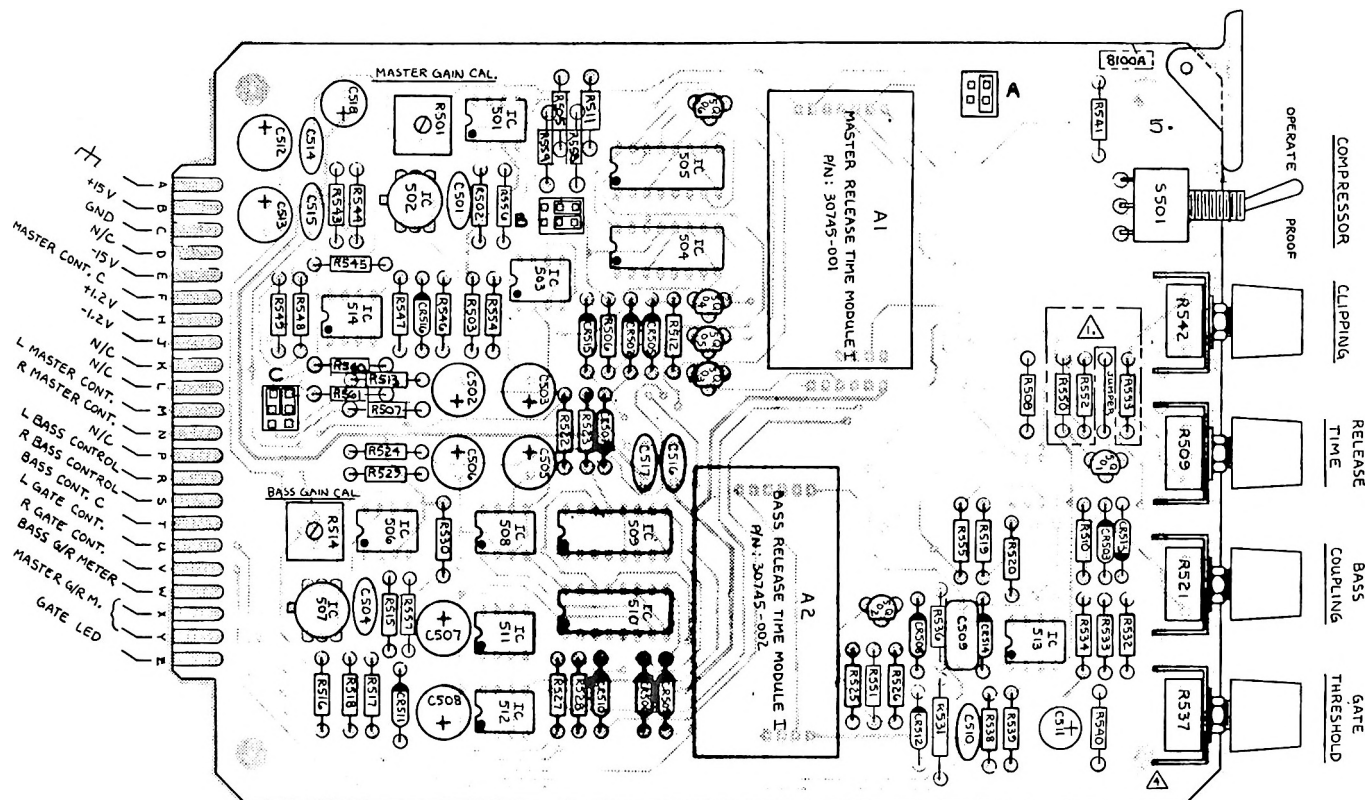
3. ALL CAPS ARE IN MICROFARADS
 2. ALL RESISTORS ARE 1/8W, 1%, (R455D)
 1. ALL DIODES ARE IN4148
 NOTES: UNLESS OTHERWISE SPECIFIED

Orban Associates Inc.

TITLE: SCHEMATIC
 VCA BOARD #A3
 60077-000-03, 1 OF 2



Notes:



6. JUMPERS SHOWN IN NORMAL (AS SHIPPED) POSITION.

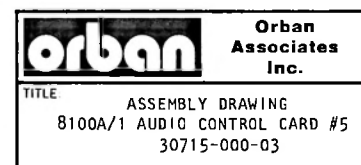
3. REF SCHEMATIC: CARD#S 60035-VER-XX,

2. THIS ASSY. SUPERSEDES ASSY NO. 30450-VER-05.

△ VERSION -001 = OPTIMOD - FM 8100A, OMIT R552, R553, INSTALL R550.
 -002 = OPTIMOD - TV 8100A, OMIT R550, INSTALL R552, R553.

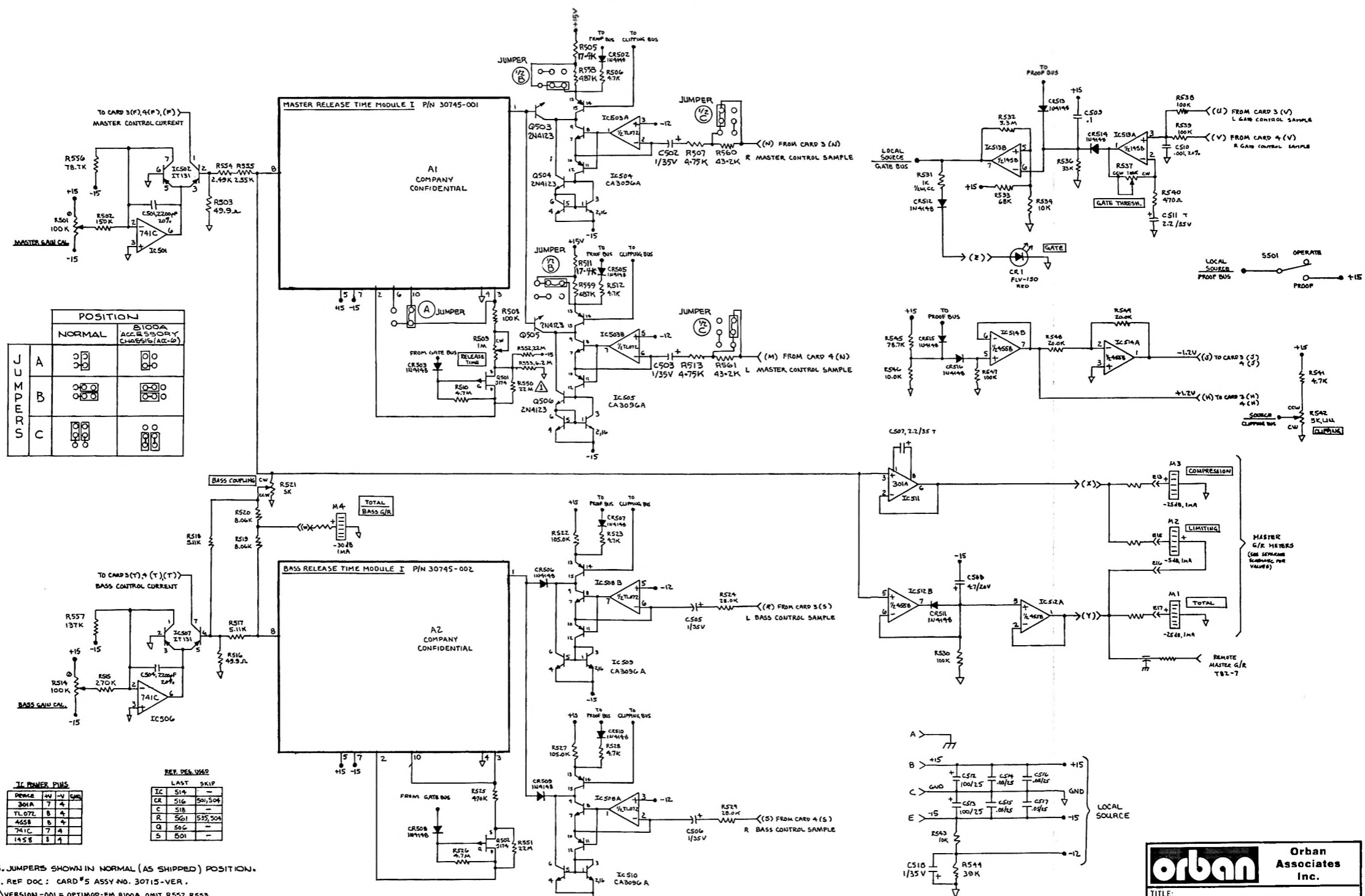
NOTES:

		POSITION	
		NORMAL	8100A ACCESSORY CHARGES (ACC#5)
JUMPERS	A		
	B		
	C		



(Etched P/N 30741-000-03)

Provided for 8100A owners who have converted their units to 8100A/1 via Retrofit Kit RET-27 - See Part 2 of this Manual.



Provided for 8100A owners who have converted their units to 8100A/1 via Retrofit Kit RET-27 - See Part 2 of this Manual.

orban Orban Associates Inc.

TITLE: SCHEMATIC
8100A/1 AUDIO CONTROL CARD #5
60035-VER-07

Notes:

User Feedback Form

Use this form to send us your comments on:

- Potential improvements to the product.
- Corrections or suggested improvements to the manual (include page number).

← Second fold

Cut along this line →

First fold →

Cut out or copy this form. No postage necessary if mailed in USA.

Orban may use or distribute any of the information you supply in any way it believes appropriate, without incurring any obligation for such use. We will not use your name for advertising or promotion. Thank you for your input.

Optional Information:

Model #: 8100A/XT2

Your name: _____

Serial # _____

Organization: _____

Address: _____

Date: _____

City, State, Country: _____

Mail code: _____

◇ Check here to request a reply.

Telephone/Telex: _____

TAPE, DO NOT STAPLE

TAPE, DO NOT STAPLE

BUSINESS REPLY MAIL

First Class Permit No. 19935 San Francisco Calif. 94107

Postage will be paid by:

**Orban Associates Inc.
645 Bryant Street
San Francisco, CA 94107
USA**

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

TAPE, DO NOT STAPLE

TAPE, DO NOT STAPLE