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**Technical Manual**

**Model CLD-2504**

Composite Distribution Amplifier

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## Chapter 1 <sup>3</sup>/<sub>4</sub> Introduction

### 1.1 General

The Modulation Sciences CLD-2504 composite distribution amplifier will transmit stereo composite baseband (including SCA channels) over ordinary coaxial cable without degrading signal quality.

With the CLD-2504, you can:

- Drive existing coaxial lines with improved stereo separation and signal-to-noise ratio.
- Distribute composite baseband signal to testing and processing equipment within the studio or transmitter plant.

### 1.2 Background

FM composite baseband is a complex signal with a bandwidth greater than audio, yet requiring signal-to-noise figures considerably better than video. As a result, transmission over distances greater than six feet is difficult. With conventional drivers, low capacitance cable such as RG-62 extends the maximum transmission line length to about twelve feet, but this is often inadequate.

Fiber optics, video distribution amplifiers, and new stereo generators with low output impedance have all been tried as composite line drivers, but none of these solutions have proven entirely satisfactory. With fiber optics, the drivers and receivers degrade signal quality. Video DAs offer fine high frequency response, but their low frequency roll-off causes poor separation and they are usually too susceptible to 60 Hz hum and RF interference.

Although the low output impedance of some new stereo generators may extend the maximum coaxial transmission line length somewhat, output impedance is not the only limiting factor for a composite line driver. To drive a long line at high frequencies, an amplifier must have both a high slew rate and sufficient output current to charge and discharge the capacitance of the entire length of cable. The longer the transmission line, the greater the output current required.

Ground loops present another problem in composite transmission. Ground potential differences between the ends of an unbalanced coaxial line can produce substantial hum. A few stereo generators and exciters provide "floating" inputs or outputs, which does help somewhat, but not grounding the shield at one end can create

severe RF interference problems, especially from AM broadcast energy. Here too, the longer the transmission line, the greater the problems.

The CLD-2504 can drive the longest possible unbalanced lines, limited only by the unavoidable noise pickup inherent in unbalanced transmission. For cable runs longer than 20 or 25 feet, the balanced CLD-2500 system, which can drive lines up to 10,000 feet (!), is recommended.

### **1.3 Operation**

The CLD-2504 features a high-current, high slew rate driver. An isolated, single-ended test output is provided on the front panel.

In order to ensure that the CLD-2504 will never be the weak link in the air chain, it was designed to provide phase and frequency linearity sufficient to support stereo performance well in excess of that which can be achieved by the best existing equipment. Distortion and noise figures are likewise superior even to those of the most advanced systems.

For more detailed, specific information, see Sections 2.1 (Characteristics) and 5.1 (Principles of Operation).

## Chapter 2 $\frac{3}{4}$ Specifications

<b>SIZE:</b>	1 $\frac{3}{4}$ x 19" (44.45 mm x 482.6 mm) rack panel with 1 $\frac{3}{4}$ H x 12" W x 5 $\frac{3}{4}$ D (44.45 mm H x 304.8 mm W x 146.05 mm D) rear housing	
<b>POWER:</b>	95 to 130 VAC, 10 watts max. 190 to 260 V option available.	
<b>TEMPERATURE RANGE:</b>	0° to 50° C.	
<b>RF PROTECTION:</b>	All inputs and outputs RF suppressed and shielded from main circuitry.	
<b>GAIN:</b>	Unity to all outputs (bridging load) ( <i>Note 1</i> )	
<b>POWER INDICATOR:</b>	Green LED	
<b>CONNECTORS:</b>	<b>INPUT:</b>	Floating BNC Connector
<b>LEVELS:</b>	1 to 10 V P-P	
<b>IMPEDANCES:</b>	15 k $\Omega$	
	<b>TEST OUTPUT:</b>	BNC connector 1 to 10 V P-P 200 $\Omega$
	<b>MAIN OUTPUTS:</b>	4 BNC 1 to 10 V P-P Impedance 50 $\Omega$
<b>MAXIMUM LINE LENGTH:</b>	Limited only by noise pickup (Typically 20 to 25 feet)	

*Note 1:* The CLD-2504's main outputs can drive either a 50 $\Omega$  or a 75  $\Omega$  load. Gain will be less than unity due to the unit's 50  $\Omega$  output impedance. With a 50  $\Omega$  load, gain is -6.0 dB. The test output is intended to drive bridging loads only. Gain to the test output is always unity, regardless of main output loading.

**TWO-TONE IM DISTORTION:**

INPUT LEVEL: 4 V P-P  
LOAD: 50  $\Omega$

Any frequency 50 Hz to 53 kHz,  
1:1 at 4 V P-P: Total -70 dB

Any frequency 53 kHz to 100 kHz,  
10:1 at 4 V P-P: Total -70 dB

**BROADBAND NOISE** (20 Hz to 100 kHz): 85 dB below 4 V P-P

**FREQUENCY RESPONSE** (DC to 53 kHz):  $\pm 0.01$  dB

**STEREO SEPARATION** (50 Hz to 15 kHz):  $> 60$  dB

## Chapter 3 <sup>3</sup>/<sub>4</sub> Installation and Setup

### 3.1 Cable Selection

In a very “hot” RF environment, we recommend foil-shielded coax such as Belden 9266. Foil provides much better attenuation of unwanted signals than does any type of braided shield.

Otherwise, use any type of coax ordinarily used for composite signal connection. Low capacitance cable is not required. Cable impedance is not critical, since even a 100 foot (30.82 m) cable is not long enough to behave as a transmission line at 100 kHz.

### 3.2 Level Adjustment

The input level to the Composite Line Driver should be as high as possible up to a maximum of 6 V peak-to-peak. Where possible, use the input controls of the equipment being driven to reduce the level as required.

In most cases, the CLD-2504 will be driving a high impedance load, since most FM composite inputs are bridging. The cable should **not** be terminated when driving a bridging load. The CLD-2504 can also drive 50  $\Omega$  or 75  $\Omega$  loads with slightly reduced gain. See Section 2.1, “CLD-2504 Distribution Amp Specifications”. The test output is intended to drive bridging loads only. Gain to the test output is always unity, regardless of the main output load.

Adjustments necessary to optimize system performance should be made by observing the signal from your modulation monitor and adjusting the stereo generator in the normal fashion.

*Note:* See also Section 4.1, “Monitoring Performance”.

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## **Chapter 4 $\frac{3}{4}$ Maintenance**

### **4.1 Monitoring Performance**

The single-ended test output on the front of the unit provides a convenient means of observing performance. The test jack is driven by a separate differential amplifier which directly monitors the outputs.

### **4.2 Factory Service**

Each Composite Distribution Amplifier is subjected to an extensive multi-stage test procedure, including a minimum 48-hour burn-in, before leaving the factory. Should any problems arise which cannot be corrected by simply replacing a defective op-amp (all of which are socketed for easy replacement), the unit should be returned to the factory for service after first determining that the problem is not in some other piece of equipment. If you have any doubt as to the cause of any problem that may be associated with the CLD-2504, the MSI engineering staff will be glad to respond to telephone inquiries. Our toll-free telephone number is (800) 826-2603. Or, you may inquire via e-mail at [tech\\_support@msi.com](mailto:tech_support@msi.com).

In order to ensure proper handling when returning your unit for service, be sure to enclose a letter describing the nature of the malfunction and your company name and shipping address.

In general, any failure due to defects in materials or workmanship during your first three years of ownership should be covered by our warranty. For full details, see Section 7.1, "Modulation Sciences, Inc. Standard Warranty".

### 4.3 Field Repair

As mentioned above, MSI recommends that defective units be returned for factory service. If you must attempt field service, the following points should be kept in mind:

1. Some of the CLD-2504's components are specially tested and/or matched to extremely tight tolerances. (See parts lists, Section 6.3, for details). Replacing any of these components by an untested equivalent may result in severely degraded performance. It is especially important that matched components be replaced in groups rather than singly. MSI will be happy to supply sets of matched components for a nominal cost, should you require them.
2. When replacing components, care should be taken not to overheat traces during de-soldering. For ease of removal, we suggest cutting component leads flush with the top of the board before attempting de-soldering from the bottom.
3. The above information and any other material relating to servicing is provided as a courtesy to those who feel that they must do their own repairs. MSI assumes no liability for damage or other problems arising from attempts to service units in the field. Any attempt at user servicing will void the warranty on that unit, although MSI will, of course, continue to provide non-warranty service at prevailing rates.

The following sections provide information on the CLD-2504's operation. We will be glad to respond to phone inquiries for additional information relating to particular problems that may arise.

## Chapter 5 <sup>3</sup>/<sub>4</sub> Principles of Operation

### 5.1 General

The drive amplifiers are power integrated circuit amplifiers. The CLD-2504 driver provides four independent outputs plus an isolated test output. Each cable may be of virtually any length (limited only by hum pickup) and still maintain performance equal to that of the best stereo generator.

The driver input connector is a floating BNC connector. A grounded, isolated BNC output is provided on the front panel for test purposes. A separate differential amplifier is used to drive this output so that the signal may be monitored after the output amplifiers.

BNC connectors are used for the main outputs as well. J1A and J2A are in phase with the input signal. J1B and J2B are inverted relative to the input.

### 5.2 CLD-2504 Distribution Amplifier Circuit Description

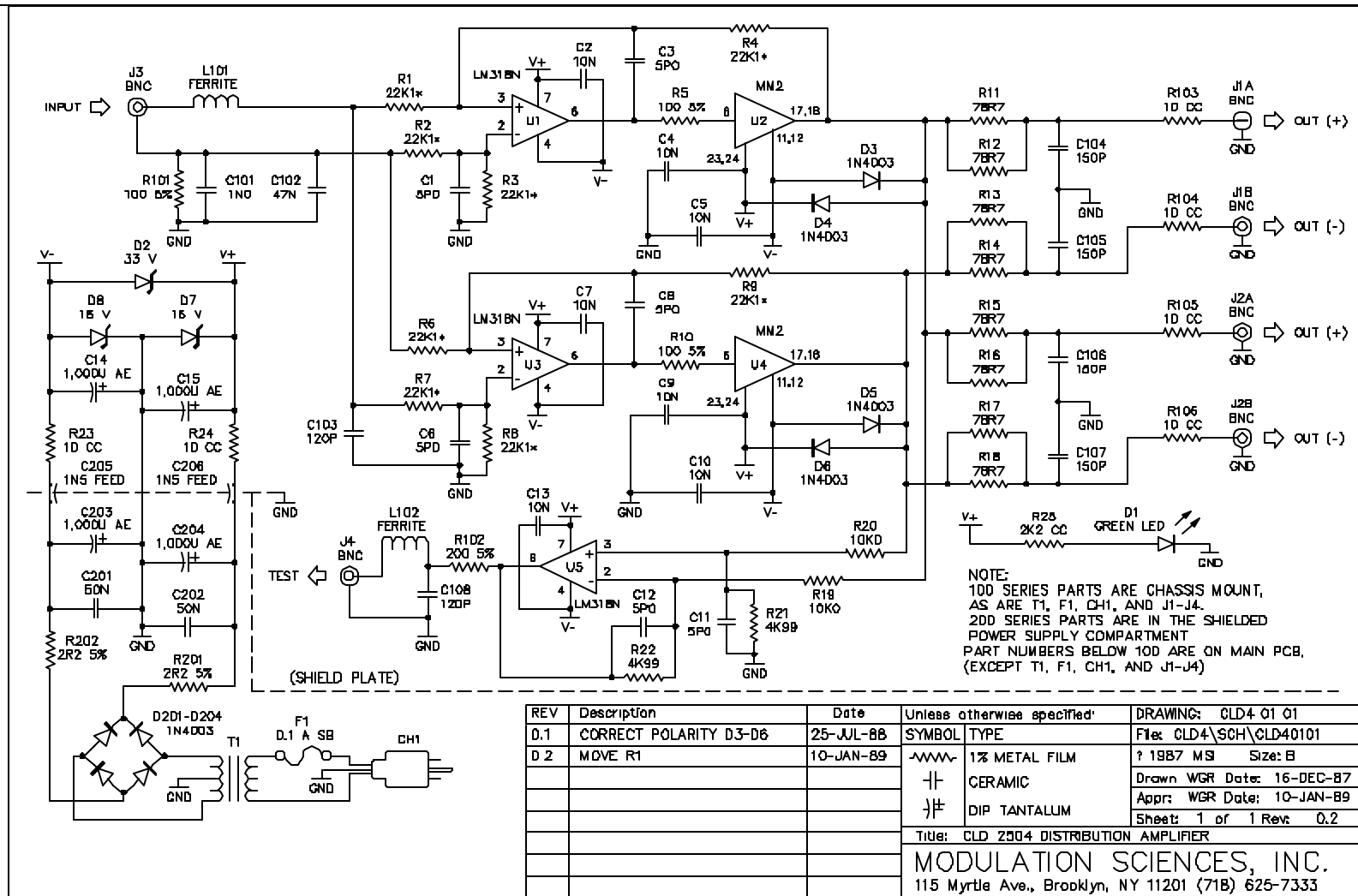
Input jack J4 floats, its shell isolated from ground by R4. RF bypassing is provided by capacitors C101 through C103. Input amplifiers U1 and U3 drive output amplifiers U2 and U4. Precision 0.1% matched resistors set gains to both phases of the outputs, J1 and J2. Test output amplifier U5 monitors the main output through resistors R19 and R20, providing an isolated, grounded output to the front test jack, J4. There are no trimpots, resistors selected on test, or any other form of trimming in the driver.

Output resistors R11 through R18 and R103 through R106 determine the output impedance.

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# Chapter 6 ¾ Diagrams and Supplementary Information

## 6.1 Schematic Diagram



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## **6.2 Abbreviations Used in Parts Lists**

### **6.2.1 Type Abbreviations**

AE:	Aluminum Electrolytic
CC:	Carbon Composition Resistor
CF:	Carbon Film Resistor
DT:	Dipped Tantalum Capacitor
MC:	Monolithic Ceramic Capacitor
MF:	Metal Film Resistor
MT:	Mount
MY:	Mylar <sup>®</sup> Capacitor
OX:	Oxide Coated
SF:	Stacked Film Capacitor
SM:	Silvered Mica Capacitor
SS:	Solder Socket
WW:	Wire-Wrap Pin

### **6.2.2 Manufacturer Abbreviations**

ALLENBRADL	Allen-Bradley Company
ALPHAWIRE	Alpha Wire, Inc.
AMPHENOL	Amphenol
ARCO	Arco Electronics, Inc.
BELDEN	Belden Corporation
BUSSMAN	Bussmann
CENTRALAB	Centralab, Inc.
DIALIGHT	Dialight
FAIRRITEPR	Fair-Rite Products Corporation
HEYMANMANU	Heyman Manufacturing Company
HHSMITH	Herman H. Smith, Inc. (North American Philips)
KINGS	Kings Electronics Company
LITTELFUSE	Littelfuse
MAGNETCOIL	Magnetic Coils, Inc.
OPTICALELE	Optical Electronics, Inc.
PANA	Panasonic
RCD	Resistors, Coils, Delay Lines
SPRAGUE	Sprague
TEXASINSTR	Texas Instruments
TUSONIX	Tusonix, Inc.
ZIERICKMAN	Zierick Manufacturing Corporation

### 6.3 Parts List

#### Chassis Parts

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUFACT. PART NUMBER
<b>V02-CD4H</b>					
A04-1004SCDG1	1	1 nF 10% DISC	C101	CENTRALAB	CE102
A04-1203UCBG1	2	120 pF DISC	C103,C108	ARCO	CCD 121
A04-1503UCBG1	4	150 pF DISC	C104-C107	SPRAGUE	10TST15
A04-1504XHNI1	2	1.5 nF FEEDTHROUGH	C205,C206	TUSONIX	357-001-X5U0-152M
A04-4705JMCH1	1	.047 pF 100 V MC	C102	CENTRALAB	CZ20A473M
A06-FBEAD0001	2	FERRITE BEAD	L101,L102	FAIRRITEPR	2743002111
A08-D60102001	1	20 V PWR XFMR DUAL 110/230V	T1	MAGNETCOIL	
A09-S3AG10001	1	FUSE, SLOW-BLOW, 0.1 A	F1	LITTELFUSE	313.1
H02-002F00002	5	CONN'R, BNC FEMALE, UG-1094/U	J4	AMPHENOL	31-221
H02-002F00003	1	LONG BUSHING BNC CONN'R	JB1-JB3	KINGS	KC79-46
H04-PN0000001	1	FUSE HOLDER	FH1	BUSSMAN	HKP
H11-CRN160401	1	#6 CRIMP LUG		ZIERICKMAN	A3651 w/0.144" HOLE
H99-001000001	1	PANEL MT BNC GND LUG		AMPHENOL	31-759
J07-P18000001	1	6 FT LINE CORD (1.8 m)	CH1	BELDEN	17237B
J09-T24900001	3	24 AWG TEFLON TUBING		ALPHAWIRE	TFT 200-8
K99-000000002	1	NYLON SHOULDER WASHER		HSMITH	2668
O05-000000001	1	STRAIN RELIEF		HEYMANMANU	5N-4 BLACK
V03-UPSA	1	PWB ASSY, POWER SUPPLY			
Z01-203	1	200 OHM 1/4W 5% CF	R102	VARIOUS	1/4 W 5 % CF
Z07-102	4	10 OHM 5% 1/2 CC EB TYPE	R103-R106	VARIOUS	EB TYPE 1/2 W 5% CC
Z07-103	1	100 OHM 5% 1/2W CC EB TYPE	R101	ALLENBRADL	EB TYPE 1/2 W 5% CC

### Circuit Board Parts

**NOTE:** Some parts in the following list are marked with an asterisk (\*). When this symbol precedes a component, it means that the part has been tested by Modulation Sciences, Inc. and should not be replaced without consulting the factory.

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUFACT. PART NUMBER
<b>V01-CD1M</b>					
A04-1005HMBG1	7	0.01 uF 50 V 10% MC	C2,C4,C5,C7,C9,C10,C13	CENTRALAB	CW20C103K
A04-100AGANH1	2	1000 uF 35V AE 20%	C14,C15	PANA	ECE-B1VGE102
A04-5001UCBG1	6	5 pF DISC	C1,C3,C6,C8,C11,C12	ARCO	CCD-050
B01-4003	4	RECTIFIER DIODE	D3-D6	VARIOUS	1N4003
B02-4752A	1	33 VOLT ZENER DIODE	D2	VARIOUS	1N4752A
C01-1B0000001	2	HYBRID OP AMP	U2,U4	OPTICALELE	OEI9911
C01-1F0000006	3	OP AMP, PLASTIC	U1*,U3*,U5*	TEXASINSTR	LM318P
E01-S50000001	1	GREEN LED	D1	DIALIGHT	521-9270
H05-008000001	3	8-PIN EDGE GRIP SS	US1,US3,US5	AMP	2-640463-2
H05-024000002	2	24-PIN FACE GRIP SS	US2,US4	AMP	2-641266-20
Z01-000	2	0 OHM 1/4 W 5% CF	JUMPER (x2)	VARIOUS	
Z01-103	2	100 OHM 1/4 W 5% CF	R5,R10	VARIOUS	1/4 W 5 % CF
Z02-1005	2	10.0 K 1/4 W 1% MF	R19,R20	VARIOUS	1/4 W 1 % MF
Z02-4994	2	4.99 K 1/4 W 1% MF	R21,R22	VARIOUS	1/4 W 1 % MF
Z04-7872	8	78.7 OHM/CMF-65 78.7 1% T-1 B14	R11-R18	VARIOUS	RN65CF
Z08-102	2	10 OHM EB TYPE 1/2 W 10% CC	R23,R24	ALLENBRADL	EB TYPE 1/2 W 10% CC
Z08-224	1	2.2 K 1/2 W 10% CC	R25	ALLENBRADL	EB TYPE 1/2 W 10% CC
Z14-2215	8	22.1K RN55 0.1% 1/4W 50 PPM	R1*-R4*,R6*-R9*	RCD	MF55C - SORTED

## Chapter 7 <sup>3</sup>/<sub>4</sub> Warranty

### 7.1 Modulation Sciences, Inc. Standard Warranty

*For a summary of this text and information on obtaining warranty service, please see the pages following this warranty.*

SELLER warrants the products sold shall be free from defects in materials and workmanship under normal use and service for a period of three (3) years from the date of delivery when properly installed. SELLER's sole obligation under this warranty shall be limited to repair or replacement, at SELLER's option, of any such part or parts of the products which may prove defective under normal use and service within said three (3) years and which the SELLER's examination shall disclose to its satisfaction to have been defective. If BUYER wishes to have warranty services performed at the facilities of the SELLER, BUYER shall obtain, in advance, permission to return product(s), and shall ship said product(s) properly packed and insured to the address specified. Service performed at the facilities of SELLER under this warranty shall include parts plus labor. Items returned under this warranty must be transportation prepaid unless otherwise agreed by SELLER. It is expressly agreed that SELLER's obligation to repair or replace defective parts is the sole and exclusive remedy of BUYER for breach of this warranty. **Under no circumstances shall SELLER be liable for any other damages, either direct or consequential.**

SELLER may, from time to time, make certain representations concerning the compliance of its products with the Rules and Regulations of particular governmental agencies. No such representation can be a basis of the bargain unless it is in writing by an authorized representative of SELLER. Should this representation be found to be untrue, BUYER's sole remedy is the right of rescission, at BUYER's option. Under no circumstances shall SELLER be liable for any other damages, either direct or consequential.

**THE WARRANTY TO REPAIR OR REPLACE DEFECTIVE PARTS AND THE REPRESENTATION OF COMPLIANCE WITH GOVERNMENTAL RULES AND REGULATIONS, WHEN GIVEN IN WRITING, ARE EXPRESSLY IN LIEU OF AND HEREBY IN DISCLAIMER OF ALL OTHER EXPRESS WARRANTIES, AND ARE IN LIEU OF AND IN DISCLAIMER AND EXCLUSION OF ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AS WELL AS ALL OTHER IMPLIED WARRANTIES, IN LAW OR EQUITY, AND OF ALL OBLIGATIONS OR LIABILITY ON SELLER'S PART. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION HEREOF.**

SELLER neither assumes nor authorizes any person to assume for it any liability or obligation in connection with the sale of SELLER's products except said repair or replacement of the defective part and, when given, compliance with the applicable governmental agency Rules. SELLER's liability does not include any labor charges for replacement of parts, adjustments, repairs, nor any other work done outside SELLER's factory and **SELLER'S liability does not include any consequential or resulting damage to person, property, equipment, goods, merchandise, profits, goodwill, or reputation arising out of any defect in or failure of SELLER'S products.** SELLER's obligation to repair or replace shall not apply to any product(s) which shall have been repaired or altered outside SELLER's factory in any way, or which shall have been subjected to negligence, misuse, unauthorized alteration, or abuse.

SELLER's warranty runs only to the FIRST END USER and does not extend, expressly or by implication, to any other person. No claim under this warranty will be allowed for materials damaged in transit. Expenses incurred in connection with claims for which SELLER is not liable hereunder will be charged to BUYER. SELLER shall not be responsible for any field repairs performed by BUYER unless such work is authorized in writing by SELLER.

## **7.2 Summary of Modulation Sciences, Inc. Standard Warranty**

**Note:** This is not the warranty. It is a summary of MSI's standard warranty and a description of how to obtain warranty service. The current, actual warranty is printed in its entirety on the preceding pages and supersedes warranty information which may be found elsewhere.

### **7.2.1 Who receives warranty protection?**

Modulation Sciences' standard warranty protects the original end-user purchaser of record, but does not apply to subsequent owners.

### **7.2.2 What does the warranty cover?**

Modulation Sciences agrees to repair or replace, at its expense, any unit which has a defect in materials or workmanship for a period of three (3) years after the date of sale to the original end-user purchaser. This warranty includes all parts, labor, calibration, and packing.

### **7.2.3 What doesn't the warranty cover?**

MSI's warranty does not cover:

1. Freight and insurance charges paid by the purchaser in returning the unit for repair.
2. Defects which result from modifications or repairs to the unit not made by nor authorized in writing by Modulation Sciences, Inc.
3. Compensation for incidental or consequential damages resulting from any defect.
4. Trivial or cosmetic defects which do not affect the unit's ability to function normally.

### **7.2.4 How is the warranty period computed?**

The warranty period begins on the date of delivery to the original end-user purchaser and is in effect for the next three years. The starting date is deemed to be the date on the invoice from Modulation Sciences, its agent, dealer, or distributor to the first end-user purchaser. Do not lose your invoice. It is your way of establishing that your warranty is still in force.

### **7.2.5 What if the unit cannot be repaired?**

If Modulation Sciences decides not to repair or replace a given unit, Modulation Sciences agrees to refund to the first end-user purchaser its full purchase price. Payment of that amount will end MSI's responsibilities and Modulation Sciences may keep the unit.

### **7.2.6 How is warranty service obtained?**

To claim your rights under this warranty:

1. Contact the dealer or distributor from whom this product was purchased. Describe the problem and ask if there is an easy solution.
2. If your dealer cannot help, contact Modulation Sciences' service department at (732) 302-3090 or toll-free at (800) 826-2603 and explain the problem. If that unit requires factory service, you will be given a return authorization number.
3. When you have your return authorization number, you may return the unit. Pack it carefully for shipment, preferably using the original shipping carton and packing materials. **Assume that the box will be dropped several times during shipment. Use UPS or some other private carrier you know to be reliable. Do not use the Postal Service.** The risk of loss is yours. Modulation Sciences will not be responsible for damage or loss until the package is received by Modulation Sciences. **INSURE THE UNIT FOR ITS FULL REPLACEMENT VALUE. SHIP THE UNIT PREPAID TO THE ADDRESS SPECIFIED WHEN YOU RECEIVE YOUR RETURN AUTHORIZATION AND BE SURE TO ENCLOSE A NOTE GIVING THE FOLLOWING INFORMATION:**
  - Your company name and shipping address (not a PO Box).
  - Your return authorization number.
  - A copy of your original invoice establishing the starting date of your warranty.
  - As full a description as possible of the problem(s).