

<b>1. INTRODUCTION.....</b>	<b>2</b>
<b>2. CONTROLS AND DISPLAYS.....</b>	<b>4</b>
2.1 FRONT PANEL DISPLAYS:.....	4
2.2 REAR PANEL CONNECTIONS.....	7
<b>3. INSTALLATION AND SETUP.....</b>	<b>9</b>
3.1 PRELIMINARY INSTALLATION AND SETUP:.....	9
3.2 SETUP WITH THE MODULATION SCIENCES STV-784 BTSC STEREO GENERATOR:.....	10
3.3 BESSEL NULL PROCEDURE FOR USE WITH SPECTRUM ANALYZER:.....	10
3.4 BESSEL NULL PROCEDURE FOR USE WHEN NO SPECTRUM ANALYZER IS AVAILABLE:.....	11
<b>4. THEORY OF OPERATION.....</b>	<b>14</b>
4.1 INPUT .....	14
4.2 METERING.....	14
4.3 PEAK FLASHER .....	14
4.4 DIGITAL DISPLAY AND STATUS LIGHTS.....	15
<b>5. SPECIFICATIONS .....</b>	<b>16</b>
<b>6. WARRANTY .....</b>	<b>18</b>
6.1 THREE YEARS ON PARTS AND LABOR .....	18
6.2 MSI WARRANTY POLICY SUMMARY.....	18
6.3 MSI WARRANTY POLICY .....	20
<b>7. PARTS LIST.....</b>	<b>21</b>

## 1. INTRODUCTION

### What is TV ModMinder?

**TV ModMinder** is an accurate device for displaying total TV aural modulation and injection of the stereo pilot, SAP, and PRO subcarriers.

### What does it do?

**TV ModMinder** provides a complete visual display of the modulation of the aural RF carrier by the wideband composite BTSC\* audio signal.

**TV ModMinder** automatically sets the definition of 100% peak modulation to correspond to the correct deviation for any possible combination of subcarriers. This is important in BTSC operation because the definition of 100%, in kHz of peak deviation, changes with the mode of operation.

**TV ModMinder** gives you the status of all subcarriers at a glance. It makes these indications available to remote control systems, as well as readable from the front panel. A row of push buttons lights up to show the presence of each subcarrier. Press any lighted button and the meter displays the injection level for that subcarrier.

**TV ModMinder's** large, easy-to-read analog meter has colored boxes to display each subcarrier's injection range.

A bright, redundant, long-life, incandescent lamp peak flasher warns of overmodulation, while an LED indicator informs you if the peak flasher bulbs have burned out. Interface to a conventional broadcast remote control system is provided through relay contacts and a varying DC signal.

### What are some of TV ModMinder's Unique Features?

- **Autoranging** - TV stereo has a characteristic that uniquely sets it apart from FM radio stereo. In FM radio, each added component of the stereo signal (pilot and Left minus Right subcarrier) **subtracts** from the total modulation peak deviation of  $\pm 75$  kHz. So, in FM radio, 100% modulation remains at  $\pm 75$  kHz deviation regardless of stereo or

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\* Broadcast Television Systems Committee

other subcarriers. (Under some conditions of subcarrier operation, the FCC permits modulation of up to 110%, but the definition of 100% still does not change.) In TV stereo, each component of the stereo signal **adds** total modulation. Thus, for a monaural TV station, 100% percent modulation is a peak deviation of  $\pm 25$  kHz. When the same station goes stereo, 100% modulation becomes a deviation of  $\pm 55$  kHz. With SAP and PRO added, peak deviation for 100% modulation is  $\pm 73$  kHz. See table 4.1 for a list of all possible combinations that can equal 100% modulation.

**TV ModMinder** senses which subcarriers are present and automatically adjusts its internal definition of 100% accordingly. **TV ModMinder** displays this information in two ways. First is on a series of three push buttons that light up to show, respectively, the presence of stereo pilot, SAP, and PRO. Second, a numeric display shows the number of kHz deviation that equals 100% modulation.

Autoranging applies to both the modulation meter and the peak flasher light.

- **Flexible Composite Input** - Because TV Modminder is not burdened with a built-in RF demodulator, it can derive its input signal from a wide variety of sources: any aural demodulator providing an accurate wideband signal, by bridging the input to the aural exciter, the output of a wideband composite STL, or by bridging the output of the stereo generator.

### How well does it work?

**TV ModMinder** is highly accurate. Typical monitors have a peak flasher accuracy of  $\pm 5.0\%$ . **TV ModMinder** delivers a peak flasher accuracy of  $\pm 1.0\%$ . TV ModMinder is far more accurate than traditional modulation monitors and, because it works with any source of accurate wideband aural, it is much less expensive.

### How is it driven?

**TV ModMinder** will most often be driven by the wideband aural output of a precision visual demodulator, such as Modulation Sciences' msi 320 Precision Video Demodulator, or the (now discontinued) Tektronix 1450-1. It can also accommodate other sources of BTSC composite, such as the Modulation Sciences PRO-II Pro Channel receiver, the composite input of an aural exciter, or the output of a composite STL receiver. To make connection to these varied sources of signal easy, TVMM input impedance is high impedance (bridging).

## 2. CONTROLS AND DISPLAYS

### 2.1 Front Panel Displays:

**Overmod:** This dual bulb amber lamp lights each time the 100% modulation limit is exceeded. Once triggered, the OVERMOD indicator will stay on for two seconds.

**Lamp Failure:** This red LED lights if both bulbs in the OVERMOD indicator burn out.

**Modulation Meter:** The top scale reads the percentage of total modulation of the baseband. It autoranges so that the 100% modulation indication is correct for all possible combinations of subcarriers. The middle scale shows pilot injection when selected. The lower scale shows the injection for the SAP or PRO subcarrier, whichever is selected.

**100% = XX kHz Deviation:** This LED display indicates the peak deviation of the baseband in kiloHertz (kHz) corresponding to 100% modulation for any possible combination of modes (monaural, stereo, SAP and/or PRO) in use.

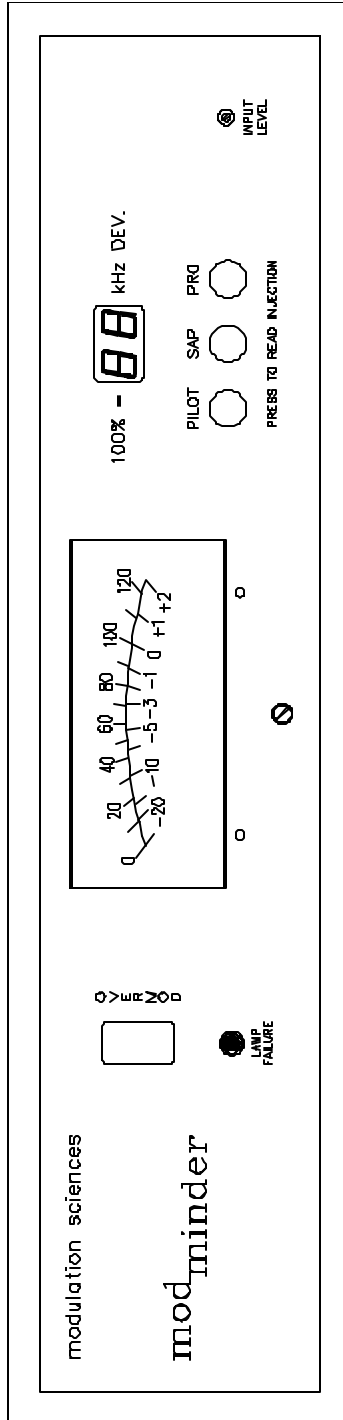
**Pilot:** This illuminated push button lights up when the BTSC stereo pilot at 31.468 kHz (twice horizontal sync) is present. Pressing this push button displays the injection (deviation of the main carrier in kHz) of the pilot. The reading is displayed in a tolerance window on the middle scale of the meter.

**SAP:** This illuminated push button lights up when a SAP (Second Audio Program) subcarrier is detected. Pressing this push button displays the injection (deviation of the main carrier in kHz) of the SAP. The reading is displayed in a tolerance window on the middle scale of the meter.

**PRO:** This illuminated push button lights up when a PRO subcarrier is detected. Pressing this push button displays the injection (deviation of the main carrier in kHz) of the PRO. The reading is displayed in a tolerance window on the bottom scale of the meter.

**Input Level:** This recessed screwdriver adjusted control calibrates the input level of the **TV ModMinder** to the source of composite baseband signal. See the calibration section of this manual.

FIGURE 2.1: FRONT PANEL -- TVMM-1



## 2.2 Rear Panel Connections

**Stereo:** These are low current form “A” (normally open) relay contacts that close when the stereo pilot is detected.

**SAP:** These are low current form “A” relay contacts that close when the SAP subcarrier is detected.

**PRO:** These are low current form “A” relay contacts that close when the PRO subcarrier is detected.

**Overmod:** These are low current form “A” relay contacts that close when a baseband modulation peak in excess of 100% is detected.

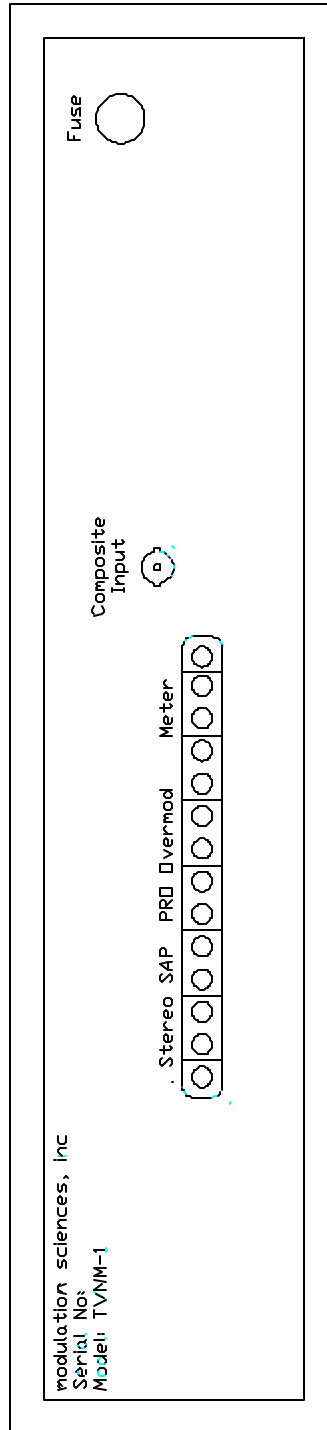
***CAUTION: These low current DIP relay contacts are for controlling low-voltage items, such as remote control interfaces or low-voltage/low-current pilot lamps. DO NOT ATTEMPT to switch 115 VAC with them!***

**Meter:** These terminals provide a DC signal that follows the modulation of the baseband. This sample can drive a remote meter (available from Modulation Sciences).

**Composite Input:** A BNC connector which accepts BTSC composite signal from a wideband demodulator, stereo generator, or any other source of composite. Input impedance is bridging.

**Fuse:** The **TV ModMinder** uses a 0.3 A. slow blow fuse. *Do not replace with a higher amperage or severe damage may result.*

**FIGURE 2.2: REAR PANEL--TVMM-1**



### 3. INSTALLATION AND SETUP

#### 3.1 Preliminary Installation and Setup:

1. Rack mount the TV ModMinder. If the composite source is to be bridged by the TV ModMinder, connect it to the source of composite using not more than ten feet (3 m) of cable. If the source of composite can be terminated in 75 ohms, much longer lengths of cable are possible. The Modulation Sciences msi 320 demodulator and the Tektronix 1450-1 and 1350 demodulators have a wideband composite aural output that can drive a 75 ohm load. If 75 ohm termination is needed, a BNC "T" adapter with a standard 75 ohm video termination must be used.

Be aware that many inexpensive video demodulators have aural outputs that are called "wideband" or "composite" that **are not** baseband composite signals. These are usually 4.5 MHz intercarrier aural outputs not suitable for driving the **TV ModMinder**.

2. Before applying power to the unit, mechanically zero the meter using the adjustment on the meter itself. Apply power and allow the **TV ModMinder** to warm up for at least one hour.
3. Adjust the transmitted signal for exactly  $\pm 25$  kHz deviation using the Bessel null calibration method described in Section 3.3 of this manual. **NOTE:** *Do not use a modulation monitor for calibrating your TV stereo generator or the TV ModMinder. The Bessel null method is far more precise than any modulation monitor could ever be.* This calibration is the same regardless of whether the TV ModMinder is being driven from an off-air or off-line signal.
4. If you are using a Modulation Sciences msi 320, set it to QP (quasi-parallel) aural detection. For a Tektronix 1450-1 demodulator, set it to the SPLIT sound mode. If you are using a Scientific Atlanta 6250 demodulator, it must have the pulse-count audio module and the synchronous video demodulation option. The switches on the Servo Loop Amplifier must be set to SYNCHRONOUS and DIRECT. For all demodulators, video must be black with no color burst when the following calibration is performed.

5. When exactly  $\pm 25$  kHz aural deviation has been achieved using the Bessel null procedure, adjust the INPUT LEVEL trimpot on the front of the **TV ModMinder** so that the meter reads 100%. Then press any two adjacent buttons on the front panel of the unit, either PILOT and SAP or SAP and PRO. While holding these buttons, adjust the INPUT LEVEL trimpot for a meter null. Release the buttons. The meter should now read exactly 100%. If it is not at exactly 100%, adjust the meter trimpot for a reading of 100%. This control is accessible through the small hole on the left of the front panel directly under the ModMinder logo. This will calibrate the meter and peak flasher for all operating conditions and all combinations of subcarriers.

### 3.2 Setup With the Modulation Sciences STV-784 BTSC Stereo Generator:

If you have the Modulation Sciences STV-784 BTSC Stereo Generator, refer to Sections 3.4-3.6 of the STV-784 manual. Then calibrate the **TV ModMinder** per the instructions in the previous section of this manual.

### 3.3 Bessel Null Procedure for Use with Spectrum Analyzer:

1. Set up an audio oscillator on exactly 10,396 Hz. The best and most reliable source of 10,396 Hz tone is a Tektronix 1405 Sideband Adapter, commonly available at most TV transmitter plants. It has a crystal controlled tone generator with a ten-turn attenuator designed for doing Bessel null setups. If a 1405 is not available, try to find some type of crystal controlled, low-distortion synthesized audio signal generator. However, be sure to verify the frequency with a frequency counter of known accuracy before proceeding. Harmonic distortion of less than 0.5% should also be verified. The frequency must remain correct to within one Hertz for the duration of the setup.

It is best to disconnect the stereo generator and all other sources of modulation (such as SAP and PRO generators) from the exciter. Connect the source of 10,396 Hz tone directly to the wideband input of the aural exciter.

If you must use a stereo generator, remove all audio processing, set your stereo generator to the MONO mode, and connect the oscillator per the instructions provided with the stereo generator. If you are not broadcasting in stereo, simply remove all audio processing and connect the oscillator to the audio input of your exciter.

2. The spectrum of the aural signal may be observed on-channel along with the visual signal if a suitable spectrum analyzer is available. However, it may be easier and less confusing to sample the aural signal before it is combined with the visual or even at IF. The accuracy of the measurement is not affected by where it is obtained

in the transmitter chain nor at which frequency it is measured. Connect the analyzer to the aural IF of your TV demodulator, existing monaural modulation monitor, or an RF sample from the aural exciter. A clean 4.5 MHz. aural IF can be obtained from most precision video demodulators such as the msi 320 or Tektronix 1450 (it need not be modified for MTS). The msi 320 demodulator should be operated in quasi-parallel mode, while the Tektronix 1450 or 1350 should be operated in the SPLIT mode.

If you do not have a video demodulator with a 4.5 MHz output, most pre-MTS monaural modulation monitors use intermediate frequencies ranging from 1 MHz to 10.7 MHz depending on the make and model of the monitor. The aural monitor IF can be used to drive a spectrum analyzer.

3. Couple your IF source or exciter RF sample to the spectrum analyzer. Remove all modulation from the aural carrier. Adjust the spectrum analyzer to center the carrier pip on the display. To avoid confusion, the visual carrier should be turned off (if possible) when a sample of the combined TV signal is used. Adjust the resolution of the spectrum analyzer so that each sideband, spaced 10 kHz apart, is clearly visible as an individual component when the 10,396 Hz tone is modulating the transmitter.
4. Slowly increase the level of the tone being fed into the exciter. When the carrier pip in the center of the display nulls for the first time, the aural carrier is at exactly  $\pm 25$  kHz deviation (100% monaural modulation).
5. Proceed with the calibration of the TV ModMinder as described in Section 3.1, Paragraphs 3.1.2 through 3.1.5 of this manual.

### **3.4 Bessel Null Procedure for Use When No Spectrum Analyzer Is Available:**

1. Set up an audio oscillator on exactly 10,396 Hz. The best and most reliable source of 10,396 Hz tone is a Tektronix 1405 Sideband Adapter, commonly available at most TV transmitter plants. It has a crystal controlled tone generator with a ten-turn attenuator, ideal for doing Bessel null setups. If a 1405 is not available, try to find some type of crystal controlled, low-distortion synthesized audio signal generator. However, be sure to verify the frequency with a frequency counter of known accuracy before proceeding. The frequency must be correct to within one Hertz for the duration of the setup.

It is best to disconnect the stereo generator and all other sources of modulation (such as the SAP and PRO generators) from the exciter. Connect the source of 10,396 Hz tone directly to the wideband input of the aural exciter.

If you must use a stereo generator, remove all audio processing, set your stereo generator to the MONO mode, and connect the oscillator per the instructions provided with the stereo generator. If you are not broadcasting in stereo, simply

remove all audio processing and connect the oscillator to the audio input of the exciter.

2. Obtain a general coverage communications receiver with a narrow bandwidth (CW or SSB) filter and an S-meter. The narrower the IF passband the better. A 300 Hz CW filter is ideal, but up to 3.1 kHz will work if it is achieved with a good mechanical or crystal filter.

Determine if the receiver can receive the aural IF of your TV demodulator or existing modulation monitor. A clean 4.5 MHz aural IF can be obtained from most precision video demodulators such as the Tektronix 1450 (it need not be modified for MTS). The demodulator should be operated in the SPLIT mode, as intercarrier aural detection is not a desirable mode in which to perform Bessel null measurements. Most pre-MTS modulation monitors use intermediate frequencies ranging from 1 MHz to 10.7 MHz, depending upon the make and model of the monitor.

3. Couple your IF source to the antenna input of the communications receiver. Set the receiver so that the S meter gives the best indication. Select the filter on the receiver (typically 300-500 Hz CW and 2.3-2.5 kHz for SSB), tune in the unmodulated aural carrier and peak it on the S-meter, reducing the RF gain as needed.
4. Slowly turn up the COMPOSITE LEVEL control on the STV-784 or other stereo generator or turn up the audio level being fed into the exciter in the absence of a stereo generator. When the S-meter reading nulls for the first time, the aural carrier is at  $\pm 25$  kHz deviation (100% monaural modulation).
5. Proceed with the calibration of the TV ModMinder as described in Section 3.1, Paragraphs 3.1.2 through 3.1.5 of this manual.



## 4. THEORY OF OPERATION

**NOTE:** All references to part numbers are for parts on the main board unless otherwise noted.

### 4.1 Input

The composite aural signal enters the TV ModMinder via the COMPOSITE INPUT BNC connector on the rear apron of the chassis. It then passes through a flat amplifier (U1A) and an active bandpass filter (U1B and U2A). From there, the composite aural signal passes through three circuits that detect the presence of stereo pilot (U11-U17), SAP subcarrier (U3-U5, U6A, U7A, U8A **on the S card**), and the PRO subcarrier (U10-U12, U6B, U7B, and U8B,C **on the S card**).

### 4.2 Metering

U18B provides a logic high if pilot is present; U18C does the same for SAP, and U18D for PRO. The output of U18 operates an autoranging circuit for the modulation meter consisting of a composite attenuator (U3 and R5-R13), a DC amplifier (U2B), and switches controlled by the presence or absence of the stereo pilot, SAP and PRO subcarriers (U8, U9). The combinations U5A, D3, D4, U5B, D1 and D2 provide a DC voltage that varies with the total modulation of the baseband. Switches U8 and U9 control the gain of U6, while U7B and U10 drive the meter. U22 provides a regulated +10 volt source which is used by U4B to provide a reference voltage for the metering and peak flasher circuits.

### 4.3 Peak Flasher

The reference voltage from U22 and U4B is fed to the inverting input of comparator U7A. The DC voltage which varies with baseband modulation is fed to the noninverting input of U7A. When a difference voltage is obtained corresponding to a peak of 100% modulation, Q2 turns on and the output of U18A goes high. This high turns on relay driver Q3, activating K1 and closing its dry contacts. The high also turns on Q1 **on the power supply card**, sinking the peak flasher lamp to ground and illuminating it. If the lamp burns out, the emitter of Q2 **on the power supply card** will go low. Q3 **on the power supply card** will then turn on, lighting the LAMP FAILURE LED on the front panel.

#### 4.4 Digital Display and Status Lights

The voltages provided at the outputs of the pilot, SAP, and PRO detectors are fed into the noninverting inputs of U18B, C, and D, respectively. If pilot is present, the output of U18B will go high, turning on Q7 and illuminating the green PILOT indicator. If a SAP subcarrier is present, the output of U18C goes high, turning on Q8 and illuminating the green SAP indicator. If a PRO subcarrier is being transmitted, the output of U18D goes high, Q9 turns on, and the green PRO indicator lights up. A high at U18B also turns on relay driver Q4, activating K2 and closing a set of dry contacts for operating a remote stereo indicator. A high from U18C turns on relay driver Q5, activating K3 and closing a set of dry contacts for operating a remote SAP indicator. A high from U18D turns on relay driver Q6, operating K4 and closing the set of dry contacts that can operate a remote PRO indicator. Pressing the PILOT, SAP, or PRO push button will cause the appropriate input of U19 to go high. The outputs of U19 operate switches U8 and U9, causing the metering circuit to read the amount of pilot, SAP, and PRO subcarrier injection. U21 is the display multiplex oscillator, while U20 is the display ROM. The output of U20 is routed to the display card. The display will automatically indicate the amount of deviation of the baseband corresponding to 100% modulation for any possible combination of subcarriers.

**TABLE 4.1: COMBINATIONS OF SUBCARRIERS vs. DEVIATION AT 100% MODULATION:**

Mono only	$\pm 25$ kHz
Mono + PRO	$\pm 28$ kHz
Mono + SAP	$\pm 40$ kHz
Mono + SAP, + PRO	$\pm 43$ kHz
Stereo only	$\pm 55$ kHz
Stereo + PRO	$\pm 58$ kHz
Stereo + SAP	$\pm 70$ kHz
Stereo, SAP + PRO	$\pm 73$ kHz

## 5. SPECIFICATIONS

### 5.1 DIMENSIONS:

3.47" H x 16.75" W x 12.5" D / 8.77 cm H x 42.55 cm W x 31.75 cm D.

### 5.2 OPERATING TEMPERATURE:

0 to 50° C.

### 5.3 POWER REQUIREMENTS:

100 to 130 VAC, 50/60 Hz.

### 5.4 POWER CONSUMPTION:

16 Watts.

### 5.5 FUSE:

0.3 A slow-blow.

### 5.6 COMPOSITE INPUT:

BNC connector on rear apron.

### 5.7 INPUT SOURCE IMPEDANCE:

10 K $\Omega$ .

### 5.8 COMPOSITE FREQUENCY RESPONSE:

$\pm 0.3$  dB from 50 Hz to 100 kHz.

### 5.9 COMPOSITE INPUT SENSITIVITY:

0.5 to 4 volts peak-to-peak.

**5.10 RFI SUPPRESSION:**

All inputs and outputs are RFI suppressed. Unit is completely shielded.

**5.11 PEAK FLASHER RESPONSE TIME:**

0.05 seconds.

**5.12 PEAK FLASHER INDICATOR:**

Bright incandescent lamp with red LED lamp failure indicator.

**5.13 STATUS INDICATORS:**

Green LED indicators inside push buttons on front panel.

**5.14 REMOTE STATUS AND ALARM INDICATORS:**

Isolated dry relay contacts brought out to a #5 barrier strip on the rear apron.

**5.15 METERING SIGNAL:**

0-5 volts, brought out to the barrier strip on the rear apron.

## 6. WARRANTY

### 6.1 Three Years on Parts and Labor

Subject to Modulation Sciences, Inc. warranty policy. Annual calibration fee is not included in warranty. However, any repairs needed during calibration are covered for three years.

### 6.2 MSI Warranty Policy Summary

**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 following pages and supersedes warranty information which may be found elsewhere.

#### 6.2.1 *Who receives warranty protection?*

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

#### 6.2.2 *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.

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

MSI's warranty does not cover:

- a) Freight and insurance charges paid by the purchaser in returning the unit for repair.
- b) Defects which result from modifications or repairs to the unit not made by or authorized in writing by Modulation Sciences.
- c) Compensation for incidental or consequential damages resulting from any defect.
- d) Trivial or cosmetic defects which do not affect the unit's ability to function normally.

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

The warranty period begins on the date of delivery.

**6.2.5 What if the unit cannot be repaired or is too expensive to repair?**

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.

**6.2.6 How is warranty service obtained?**

To claim your rights under this warranty:

- a) Contact the dealer or distributor from whom this product was purchased. Describe the problem and ask if there is an easy solution.
- b) If your dealer cannot help, contact Modulation Sciences' service department at (800) 826-2603 or (732) 302-3090 and explain the problem. If the unit requires factory service, you will be given a return authorization number.
- c) 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 THE RETURN AUTHORIZATION AND BE SURE TO ENCLOSE A NOTE GIVING THE FOLLOWING INFORMATION:**
  1. Your company name and shipping address (**not** a P.O. Box).
  2. Your return authorization number.
  3. A copy of your original invoice establishing the starting date of your warranty.
  4. As full a description as possible of the problem(s).

### 6.3 MSI Warranty Policy

**FOR A SUMMARY OF THIS TEXT AND INFORMATION ON OBTAINING WARRANTY SERVICE, PLEASE SEE THE PAGES PRECEDING THIS WARRANTY.**

We warrant the equipment 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. Our sole obligation under this warranty shall be limited to repair or replacement at Our option or any such part or parts of the product which Our examination shall disclose to Our satisfaction to be defective.

If you wish to have warranty services performed at Our facilities, You shall obtain from Us, in advance, permission to return the equipment and shall ship it properly packed with transportation and insurance prepaid. Service performed at Our facilities under this warranty shall include parts plus labor and normal return shipping. It is expressly agreed that Our obligation to repair and replace defective parts is Your sole and exclusive remedy.

**The Warranty to repair or replace defective parts is 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 or merchantability, fitness for particular purpose, as well as all other implied warranties, in law or in equity, and of all obligations or liability on our part. There are no warranties which extend beyond the description hereof.**

Our liability does not include any labor charges for replacement of parts, adjustments, repairs, or any work done outside our factory unless such work is authorized in writing by Us. Our obligation to repair or replace shall not apply to any equipment which shall have been repaired or altered outside Our factory in any way, subject to negligence, misuse, unauthorized alteration or abuse, or damaged in transit.

**Our liability hereunder shall not include losses or anticipated profits or special incidental or consequential damages.**

## 7. PARTS LIST

MSI Part Number	Qty	Description	Reference Designators	Manufacturer	Manufacturer's Part Number
<b>V01-MINM</b>		<b>Main Circuit Board</b>			
A02-M204FS001	1	2K 20-T TRIMPOT	RV1	BOURNS	3006P1-202
A02-M204UT001	1	TRIMPOT, 20T 2K00 UR TOP	RV3	SPECTROL	64Y-202
A02-S204FT001	1	2K 1-T FLAT TRIMPOT	RV4	BOURNS	3386P1-202
A02-S205FT001	1	TRIMPOT, 01T 20K0 FS TOP	RV5	BOURNS	3386P1-203
A02-S503FT001	1	500 OHM 1-T FLAT TP	RV2	BOURNS	3386P1-501
A04-1004HMAD1	1	1 nF, 50V, MC, NPO 1%, 5 mm ls	C13	SFETECHNOL	G505BY102F
A04-1006HMCH1	7	.1 uF 50 V 20% MC	C8,C14,C23-C27	MALLORY	C20C104M5UICA
A04-1007HANH1	3	1uF 50V 20%EL 2mmLS	C3-C4,C11	WIMA	MKS4RM10 1UF/5/63 (10MM)
A04-1008FTNH1	1	10 uF 25 V DT	C5	SPRAGUE	199D106X0025CB1
A04-2206HPNF1	2	.22 uF 5% 63 V PY	C7,C9	WIMA	MKS4 0.22/63/5
A04-3305JPNF1	1	33 nF 100V PY 5%	C12	WIMA	MKS4 0.033/100/5
A04-3306KONG1	1	330 nF 10% 160V PP	C6	WIMA	MKP10 0.33/160/10
A04-4705JMCH1	1	.047 pF 100V MC	C15	SFETECHNOL	DB45BX473K
A04-4708BTNH1	2	47 uF 6 V DT	C16-C17	SPRAGUE	199D476X006R3DB1
A04-5001UCBG1	2	5 pF DISC	C1-C2	ARCO	CCD-050
A04-5604JMEG1	1	5.6 nF 100 V 10% MC	C10	CENTRALAB	CW15A562K
A04-6807FTNH1	5	6.8 uF 25 V DT SPRAGUE	C18-C22	SPRAGUE	199D685X0025CB1
		199D685X0025CB1			

## Version 2

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B01-4148	14	GLASS DIODE	D1-D14	VARIOUS	1N4150
B04-F7000	4	LOW POWER MOSFET TO92	Q3-Q6	SILICONIX	2N7000
B04-N3904	1	2N3904 NPN TRANSISTOR TO92	Q2	VARIOUS	2N3904
B04-N4401	4	LOW POWER TRANSISTOR	Q1,Q7-Q9	VARIOUS	2N4401
C01-1F0000005	1	LM310N VOLTAGE FOLLOWER	U6	NATIONALSE	LM310N
C01-2F0000002	3	LF412CN NATL.SEMI DUAL OP AMP	U4,U7,U10	NATIONALSE	LF412CN
C01-2F0000008	4	DUAL JFET OP AMP	U2,U5,U11,U13	MOTOROLA	MC34082P (OR AP)
C01-2F0000009	1	DUAL JFET OP AMP	U1	MOTOROLA	MC34083P
C02-1N501M001	1	-5 VOLT REGULATOR	U23	VARIOUS	LM79M05CT
C02-1P102L001	1	10 V REF	U22	ANALOGDEVI	AD581JH
C03-100000003	1	TIMER	U21	INTERSIL	ICM7555IPA
C04-400000001	1	QUAD COMPARATOR	U18	SGSATES	LM339AN
C12-100000001	1	VOLTAGE-FREQ. CONV	U15	ANALOGDEVI	AD654JN
D01-401610001	1	MM74C161N 4 BIT BINARY COUNTER	U16	SGSATES	HCF40161BE
D01-401750001	1	QUAD `D` FLIP-FLOP	U19	NATIONALSE	CD40175BCN
D01-4051X0001	3	8-CH MULTI/DE-MULTIP	U3,U8-U9	RCA	CD4051BE
D01-4053X0002	2	74HC4053 HI-SPEED 3 X SPDT	U12,U14	RCA	74HC4053E
		ANALOG			
D01-4070X0001	1	QUAD EXCL OR GATE	U17	MOTOROLA	MC14070BCP
D03-000000017	1	256 X 4 PROM	U20 (MUST BE PROGRAMMED)	TEXASINSTR	TBP38L22-35N OR 82S135N
H05-008000001	11	8 PIN EDGE GRIP SS	US1-US2,US4-US7, US10-US11,US13, US15, US21	AMP	2-640463-2
H05-014000002	2	14 PIN FACE GRIP SS	US17,US18	AMP	2-641261-20
H05-016000002	7	16 PIN FACE GRIP SS	US3,US8-US9,US12,	AMP	2-641262-20

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## Version 2

		US14,US16,US17		
H05-020000002	1	20 PIN FACE GRIP SS	US20	AMP 2-641264-20
H08-001PMS001	10	TEST POINTS	TP2,TP4,TP6,TP9-TP10, TP12-TP14,TP18-TP19	EMARK 01-1021
H08-003PMS001	1	MASCON 3-PIN LATCHHEADW/GOLD	PS1	PANDUIT MLSS100-3-CA
H08-009PMS002	2	MASCON HEADER (STR)	PS2-PS3	PANDUIT MLSS100-9-DA
H08-014PFS001	2	14-PIN RT ANGLE JACK	JS1-JS2	SAMTEC SSW-114-03-G-S-RA
H08-014PMS001	1	14-COND SOLDER HEADE	H1	3M 3314-6002
I02-010200203	3	MOM ACT LIGHTED PB S	S1-S3	ITTSCADOW MPXX012UOAN2201 W/LED BRK
I07-001201202	4	SPDT 12VDC RELAY	K1-K4	AROMAT DS1E-S-DC12V
K01-A02COV001	1	20-T TRIMPOT COVER	RVC1	BOURNS H-83-P
K04-1450D	8	4/40 x 3/4" HEX SPACER		KEYSTONE 1450D
L03-PWBSERLAB	1	PWB SERIAL LABEL (KAPTON)		CRITCHELY CR3-KG10F
Z01-104	7	1K 1/4W 5% CF	R5,R25,R28,R92-R95	VARIOUS 1/4 W 5 % CF
Z01-105	5	10K 1/4W 5% CF	R19-R20,R30,R74,R98	VARIOUS 1/4 W 5 % CF
Z01-107	3	1 M 1/4W 5% CF	R1,R29,R35	VARIOUS 1/4 W 5 % CF
Z01-108	1	10 M 1/4W 5% CF	R32	VARIOUS 1/4 W 5 % CF
Z01-153	3	150 OHM 1/4W 5% CF	R84-R86	VARIOUS 1/4 W 5 % CF
Z01-222	1	22 0HM 1/4W 5% CF	R21	VARIOUS 1/4 W 5 % CF
Z01-224	3	2.2K 1/4W 5% CF	R73,R77,R83	VARIOUS 1/4 W 5 % CF
Z01-225	3	22K 1/4W 5% CF	R72,R76,R82	VARIOUS 1/4 W 5 % CF
Z01-227	1	2.2 M 1/4W 5% CF	R57	VARIOUS 1/4 W 5 % CF
Z01-228	2	22M 1/4W 5% CF	R22-R23	VARIOUS 1/4 W 5 % CF
Z01-275	1	27 K 1/4W 5% CF	R64	VARIOUS 1/4 W 5 % CF
Z01-334	1	3.3K 1/4W 5% CF	R69	VARIOUS 1/4 W 5 % CF

## Version 2

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Z01-395	1	39 K 1/4W 5% CF	R88	VARIOUS 1/4 W 5 % CF
Z01-396	1	390 K 1/4W 5% CF	R4	VARIOUS 1/4 W 5 % CF
Z01-473	4	470 OHM 1/4W 5% CF	R47-R50	VARIOUS 1/4 W 5 % CF
Z01-476	3	470 K 1/4W 5% CF	R71,R75,R81	VARIOUS 1/4 W 5 % CF
Z01-563	1	560 OHM 1/4W 5% CF	R89	VARIOUS 1/4 W 5 % CF
Z01-624	1	6.2 K 1/4W 5% CF	R36	VARIOUS 1/4 W 5 % CF
Z01-683	1	680 OHM 1/4W 5% CF	R7	VARIOUS 1/4 W 5 % CF
Z02-1004	3	1.0 K 1/4W 1% MF	R37,R39,R46	VARIOUS 1/4 W 1 % MF
Z02-1005	10	10.0 K 1/4W 1% MF	R3,R27,R31,R33,R43, R55,R62,R70,R78,R80	VARIOUS 1/4 W 1 % MF
Z02-1006	1	100 K 1/4W 1% MF	R87	VARIOUS 1/4 W 1 % MF
Z02-1024	1	1.02 K 1/4W 1% MF	R10	VARIOUS 1/4 W 1 % MF
Z02-1104	1	1.10 K 1/4W 1% MF	R2	VARIOUS 1/4 W 1 % MF
Z02-1106	1	110 K 1/4W 1% MF	R63	VARIOUS 1/4 W 1 % MF
Z02-1183	1	118 OHM 1/4W 1% MF	R13	VARIOUS 1/4 W 1 % MF
Z02-1306	1	130 K 1/4W 1% MF	R58	VARIOUS 1/4 W 1 % MF
Z02-1505	1	15.0 K 1/4W 1% MF	R26	VARIOUS 1/4 W 1 % MF
Z02-1913	1	191 OHM 1/4W 1% MF	R11	VARIOUS 1/4 W 1 % MF
Z02-2004	2	2.0 K 1/4W, 1% MF	R24,R79	VARIOUS 1/4 W 1 % MF
Z02-2005	1	20.0 K 1/4W 1% MF	R97	VARIOUS 1/4 W 1 % MF
Z02-2154	1	2.15 K 1/4 W 1% MF	R8	VARIOUS 1/4 W 1 % MF
Z02-2215	2	22.1K 1/4W 1% MF	R91,R96	VARIOUS 1/4 W 1 % MF
Z02-2554	1	2.55 K 1/4W 1% MF	R14	VARIOUS 1/4 W 1 % MF
Z02-2674	1	2.67 K 1/4W 1% MF	R42	VARIOUS 1/4 W 1 % MF
Z02-3014	2	3.01 K 1/4W 1% MF	R41,R45	VARIOUS 1/4 W 1 % MF
Z02-3323	4	332 OHM 1/4W 1% MF	R53-R54,R59-R60	VARIOUS 1/4 W 1 % MF

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## Version 2

Z02-3483	1	348 OHM 1/4W 1% MF	R9	VARIOUS 1/4 W 1 % MF
Z02-3924	1	3.92 K 1/4W 1% MF	R68	MILITARY 1/4 W 1% MF
Z02-4025	1	40.2 K 1/4W 1% MF	R44	VARIOUS 1/4 W 1 % MF
Z02-4755	2	47.5 K 1/4W 1% MF	R38,R40	VARIOUS 1/4 W 1 % MF
Z02-4994	1	4.99 K 1/4W 1% MF	R34	VARIOUS 1/4 W 1 % MF
Z02-5903	1	590 OHM 1/4W 1% MF	R12	VARIOUS 1/4 W 1 % MF
Z02-6196	1	619 K 1/4W 1% MF	R65	VARIOUS 1/4 W 1 % MF
Z02-6494	2	6.49 K 1/4W 1% MF	R56,R61	VARIOUS 1/4 W 1 % MF
Z02-8663	1	866 OHM 1/4W 1% MF	R6	VARIOUS 1/4 W 1 % MF
Z03-1005	1	10.0 K RN55 1/4W 1% 50 PPM	R16	MILITARY RN55CF
Z03-4994	1	4.99K 1/4W 1% MF RN55 50 PPM	R15	MILITARY RN55CF
Z03-7154	2	7K15 RN55 1% 1/4W 50 PPM	R66-R67	MILITARY RN55CF
Z07-271	1	2.7 OHM 5% 1/2W CC EB TYPE	R90	ALLENBRADL EB TYPE 1/2 W 5% CC
Z14-1005	8	10.0K RN55.1% 1/4W 50 PPM	R17-R18,R51-R52, RN1(4)	MILITARY RN55CF

**V01-MINS****Subcarrier Board**

A04-XXXXXXXXX	1	CAPACITOR SELECTED AT TEST	C49	VARIOUS UNKNOWN
A02-M104FS001	1	TRIMPOT, 20T 1K00 FS SIDE	RV2	BOURNS 3006P1-102
A02-M504FS001	1	5K 20-T TRIMPOT	RV1	BOURNS 3006P1-502
A04-1003JMAF1	2	100pF 100V 5% MC	C27,C47	CENTRALAB CN15A101J
A04-1004HMAD1	8	1 nF, 50V, MC, NPO 1%, 5 mm ls	C1-C5,C8,C12,C20	SFETECHNOL G505BY102F
A04-1005HMGB1	2	.01 uF 50 V 10% MC	C6,C22	CENTRALAB CW20C103K
A04-1006HMCH1	3	.1 uF 50 V 20% MC	C14,C43,C45	CENTRALAB CZ20C104M
A04-1007GTNH1	2	1 uF 35 V DT	C10,C26	SPRAGUE 199D105X0035BB1
A04-1803JMAF1	1	180pF 100V 5% MC	C25	CENTRALAB CN15A181J

## Version 2

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A04-2204HMAD1	3	2.2 nF 1% 50 V MC	C7,C19,C28	SFETECHNOL G505BY222F
A04-2703HMAF1	1	270 pF 5% 50V MC	C16	CENTRALAB CN15A271J
A04-2703UCBG1	2	270 pF CER DISC, 2KVDC 10%	C13,C23	SPRAGUE 10TST27
A04-3003RSND1	1	300 pF 1% SM	C21	VARIOUS DM15FD301F03
A04-3301UCBG1	1	3.3 pF DISC	C48	CENTRALAB DD3R3
A04-4708BTNH1	2	47 uF 6 V DT	C24,C44	ITTCAP TAP47M6.3
A04-5603HMAD1	1	560 pF 300V 1% Polypropylene Film 5.9 mm ls	C9	SFETECHNOL G505BY561F
A04-6802JMAG1	1	68 pF 100 V 10% MC	C11	CENTRALAB CN15A680K
A04-6807FTNH1	3	6.8 uF 25 V DT	C15,C41-C42	SPRAGUE 199D685X0025CB1
C01-2F0000002	2	DUAL OP AMP	U5,U12	NATIONALSE LF412CN
C01-2F0000008	3	DUAL JFET OP AMP	U1,U3,U10	MOTOROLA MC34082P (OR AP)
C01-2F0000009	1	DUAL JFET OP AMP	U2	MOTOROLA MC34083P
C02-1P501L001	1	+5 VOLT 5% LOW PWR R	U16	NATIONALSE LM78L05ACZ
C12-200000001	1	DUAL VCO	U6	MOTOROLA MC4024P
D01-4053X0002	2	74HC4053 HI-SPEED 3 X SPDT ANALOG	U4,U11	RCA 74HC4053E
D01-4070X0001	1	QUAD EXCL OR GATE	U8	MOTOROLA MC14070BCP
D01-4520X0001	1	DUAL SYNC UP/DOWN	U7	RCA CD4520BE
H05-008000001	6	8 PIN EDGE GRIP SS	US1-US3,US5,US10, US12	AMP 2-640463-2
H05-014000002	1	14 PIN FACE GRIP SS	US8	AMP 2-641261-20
H05-014000003	1	14 PIN MACH PIN SS	US6	SAMTEC ICA-314SGGL
H05-016000002	3	16 PIN FACE GRIP SS	US4,US7,US11	AMP 2-641262-20
H08-001PMS001	1	TEST POINTS	TP1	OXLEY 040/30P/KP2/L
H08-014PMW001	1	14 PIN WW STRIP	PS1	SAMTEC TSW-114-03-G

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## Version 2

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Z01-104	2	1K 1/4W 5% CF	R31,R45	VARIOUS 1/4 W 5 % CF
Z01-107	1	1 M 1/4W 5% CF	R59	VARIOUS 1/4 W 5 % CF
Z01-337	2	3.3 MEG 1/4W 5% CF	R26,R51	VARIOUS 1/4 W 5 % CF
Z01-471	1	4.7 OHM 1/4W 5% CF	R30	VARIOUS 1/4 W 5 % CF
Z02-1004	1	1.0 K 1/4W 1% MF	R19	VARIOUS 1/4 W 1 % MF
Z02-1005	5	10.0 K 1/4W 1% MF	R7,R16,R20,R23,R48	VARIOUS 1/4 W 1 % MF
Z02-1054	1	1.05 K 1/4W 1% MF	R12	VARIOUS 1/4 W 1 % MF
Z02-1215	1	12.1 K 1/4W 1% MF	R43	VARIOUS 1/4 W 1 % MF
Z02-1334	1	1.33 K 1/4W 1% MF	R14	VARIOUS 1/4 W 1 % MF
Z02-1624	1	1.62 K 1/4W 1% MF	R47	VARIOUS 1/4 W 1 % MF
Z02-1825	1	18.2 K 1/4W 1% MF	R9	VARIOUS 1/4 W 1 % MF
Z02-2004	4	2.0 K 1/4W, 1% MF	R5-R6,R28,R42	VARIOUS 1/4 W 1 % MF
Z02-2005	2	20.0 K 1/4W 1% MF	R27,R41	VARIOUS 1/4 W 1 % MF
Z02-2104	1	2.10 K 1/4W 1% MF	R8	VARIOUS 1/4 W 1 % MF
Z02-2744	1	2.74 K 1/4W 1% MF	R39	VARIOUS 1/4 W 1 % MF
Z02-2874	1	2.87 K 1/4W 1% MF	R1	VARIOUS 1/4 W 1 % MF
Z02-3014	1	3.01 K 1/4W 1% MF	R3	VARIOUS 1/4 W 1 % MF
Z02-3015	1	30.1 K 1/4W 1% MF	R25	VARIOUS 1/4 W 1 % MF
Z02-3244	1	3.24 K 1/4W 1% MF	R10	VARIOUS 1/4 W 1 % MF
Z02-3484	1	3.48 K, 1/4W, 1%, MF	R4	VARIOUS 1/4 W 1 % MF
Z02-3925	1	39.2 K 1/4W 1% MF	R50	VARIOUS 1/4 W 1 % MF
Z02-4024	1	4.02 K 1/4W 1% MF	R13	VARIOUS 1/4 W 1 % MF
Z02-4325	1	43.2 K 1/4W 1% MF	R29	VARIOUS 1/4 W 1 % MF
Z02-4754	1	4.75 K 1/4W 1% MF	R22	VARIOUS 1/4 W 1 % MF
Z02-4755	2	47.5 K 1/4W 1% MF	R21,R46	VARIOUS 1/4 W 1 % MF
Z02-4874	1	4.87 K 1/4W 1% MF	R2	VARIOUS 1/4 W 1 % MF

## Version 2

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Z02-5495	1	54.9 K 1% 1/4W MF	R11	VARIOUS 1/4 W 1 % MF
Z02-5624	2	5.62 K 1/4W 1% MF	R17,R49	VARIOUS 1/4 W 1 % MF
Z02-8254	1	8.25 K 1/4W 1% MF	R24	VARIOUS 1/4 W 1 % MF
Z02-8664	1	8.66 K 1/4W 1% MF	R15	VARIOUS 1/4 W 1 % MF
Z02-XXXX	2	RESISTOR 1% SELECT AT TEST	R18,R40	VARIOUS 1/4 W 1 % MF
Z20-330304S01	2	4 X 330 OHM 1% SIL	RN2,RN4	BOURNS 4608-102-330 (2%)
Z20-100505S01	2	5 X 10K 1% SIL	RN1, RN3	
V05-MINSL1	1	INDUCTOR / POT CORE ASSEMBLY 2.87 mh	INDUCTOR L1	MSI
V05-MINSL2	1	INDUCTOR / POT CORE ASSEMBLY 2.64mh	INDUCTOR L2	MSI

## Version 2

<b>V02-MINH</b>		<b>Housing Assembly</b>		
A01-300101W01	1	300 ohm 190+3800 ppm +- 200ppm		TELLABS SA11%TC+3800
		1/2 watt axial precision resistor		+/-10PPM
A04-1004SCDG1	1	1 nF 10% DISC		CENTRALAB CE102
A04-1203UCBG1	1	120 pF DISC		SPRAGUE 10TST12
A04-1504XHNI1	5	1.5 nF FEEDTHROUGH		TUSONIX 357-001-X5U0-152M
A04-4705JMCH1	1	.047 pF 100V MC		CENTRALAB CZ20A473M
A06-FBEAD0001	1	FERRITE BEAD		FAIRRITEPR 2743002111
A08-1MULTIP01	1	DUAL OUTPUT POWER TR		SIGNALTRAN MT-6-12
A09-S3AG03001	1	FUSE, SLOW BLOW, 3/10 AMP		LITTLEFUSE 313.3
E01-I20000001	1	RED LED		IDI 5100H1
E02-601203001	2	6 V 200MA LAMP		CHICAGO MINIATURE 328
E02-631153001	2	6.3 V 150 MA T-3 1/2		VARIOUS 159
H02-002F00003	1	LONG BUSHING BNC CONNECTOR		KINGS KC79-46
H04-PN0000001	1	FUSE HOLDER		BUSSMANN HKP
H08-003CFW001	3	3 PIN CM END CONNECT W/GOLD PL		PANDUIT CE100F24-3-DA
H08-004CFW001	1	4 PIN CM END CONNECT W/GOLD		PANDUIT CE100F24-4-DA
H08-005CFW001	1	5 PIN END CONNECTOR, GOLD PLAT		PANDUIT CE100F24-5-DA
H08-009CFW001	2	9 PIN CM END CONNECT W/GOLD	J2	
H09-006PR0001	1	6 POS 6/32 SCREW TS		BEAUPRODUC 71706
H09-012PR0001	1	12 POS 6/32 SCREW TS		BEAUPRODUC 71712
H20-FC0000001	8	CM FEM QUICK CONN, I		PANDUIT DNF18-111FIB-M
J07-P18000001	1	6 FOOT LINE CORD, 1.8 METERS		BELDEN 17237B
K05-E02000004	1	DUAL LAMP INDICATOR BASE		DIALIGHT 554-4001-411
K05-E02000005	1	DUAL LAMP CAP W/MULTI COLOR		DIALIGHT 554-4001-411

## Version 2

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K05-E02000003	2	LAMP HOLDER		LEECRAFT 23-74-1
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**V03-MINL****Display Circuit Board**

A04-4708BTNH1	1	47 uF 6 V DT	C1	SPRAGUE 199D476X06R3DB1
B04-P3906	2	LOW POWER PNP TRANSISTOR	Q1-Q2	VARIOUS 2N3906
B05-N15202001	2	MED POWER TRANSISTOR	Q3-Q4	MOTOROLA MPSU05
D04-000000001	1	8-CHANNEL SOURCE DRI	U1	SPRAGUE UDN-2585A
E03-LED0000002	2	7 SEG DISP (YEL) COM	U2-U3	HEWLETTTAC 5082-7663
H05-014000002	2	14 PIN FACE GRIP SS	US2-US3	AMP 2-641261-20
H05-018000002	1	18 PIN FACE GRIP SS	US1	AMP 2-641263-20
H08-014CFC001	1	14 COND CM FEM PLUG	J1	3M 3385-6014
H08-014CMD001	1	14 PIN DIP PLUG	PS1	3M 3406-0000
J06-N016P2801	9	16-COND FLAT CABLE, 100 FT. EA	PS1 (QTY IN INCH)	
Z01-104	2	1K 1/4W 5% CF	R12,R15	VARIOUS 1/4 W 5 % CF
Z01-105	2	10K 1/4W 5% CF	R10-R11	VARIOUS 1/4 W 5 % CF
Z01-273	1	270 OHM 1/4W 5% CF	R13	VARIOUS 1/4 W 5 % CF
Z01-364	1	3.6 K 1/4W 5% CF	R14	VARIOUS 1/4 W 5 % CF
Z01-822	7	82 OHM 1/4W 5% CF	R1-R7	VARIOUS 1/4 W 5 % CF

**V03-MINP****Power Supply Circuit Board**

A02-M204FS001	1	2K 20-T TRIMPOT	RV1	BOURNS 3006P1-202
A04-1006HMCH1	1	0.1 uF 50 V 20% MC	C4	CENTRALAB CZ20C104M
A04-100BDANI1	1	10,000 uF 16 V AE	C3	SPRAGUE 53D103G016HL6

## Version 2

A04-220AGANI1	2	2200 uF 50 V 20% AE	C1-C2	PANA ECE-B1VFS222
B01-5404	4	RECTIFIER DIODE	D1-D4	VARIOUS 1N5404
B03-B10100001	1	DIP BRIDGE RECTIFIER	DB1	VARO VM18
B04-N4401	2	LOW POWER TRANSISTOR	Q2-Q3	VARIOUS 2N4401
B05-E220AB001	1	8 AMP NPN DARLINGTON	Q1	MOTOROLA TIP120
C02-1PVARM002	1	LM317T VOLTAGE REG. ADJ +1.5 A.	U1	TEXASINSTR LM317T
H08-004PMS002	1	MASCON HEAD,4-PIN W/GOLD	PS2	PANDUIT MLSS100-4-DA
H08-005PMS001	1	MASCON 5-PIN HEAD. W/ GOLD	PS1	PANDUIT MLSS100-5-DA
H20-MP0000001	8	PC MT MALE QUICKCONNECTOR	P1-P8	KEYSTONE 1267
K01-A02COV001	1	20-T TRIMPOT COVER	RVC1	BOURNS H-83-P
K02-000000003	2	ELECT. ISOLATING THE		BERGQUIST K4-62
Z01-105	1	10K 1/4W 5% CF	R4	VARIOUS 1/4 W 5 % CF
Z01-225	1	22K 1/4W 5% CF	R6	VARIOUS 1/4 W 5 % CF
Z01-334	1	3.3K 1/4W 5% CF	R8	VARIOUS 1/4 W 5 % CF
Z01-393	1	390 OHM 1/4W 5% CF	R7	VARIOUS 1/4 W 5 % CF
Z01-753	1	750 OHM 1/4W 5% CF	R5	VARIOUS 1/4 W 5 % CF
Z02-1213	1	121 OHM 1/4W 1% MF	R1	VARIOUS 1/4 W 1 % MF
Z02-4993	1	499 OHM 1/4W 1% MF	R2	VARIOUS 1/4 W 1 % MF
Z08-151	1	1.5 OHM EB TYPE 1/2W 10% CC	R3	ALLENBRADL EB TYPE 1/2 W 10% CC

**V03-MINR****Voltage Regulator Board**

A04-1006HMCH1	2	0.1 uF 50 V 20% MC	C1,C3	CENTRALAB CZ20C104M
A04-1007GTNH1	4	1 uF 35 V DT	C2,C5-C6,C8	SPRAGUE 199D105X0035BB1
A04-6807FTNH1	2	6.8 uF 25 V DT	C4,C7	SPRAGUE 199D685X0025CB1
C02-1NVARM001	1	LM337T VOLTAGE REG. ADJ.-1.5 A.	U3	TEXASINSTR LM337KC

## Version 2

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C02-1P501M003	1	LM7805CT MOT.+5V 1AMP TO226	U1	VARIOUS LM7805CT
C02-1PVARM002	1	LM317T VOLTAGE REG. ADJ +1.5	U2	TEXASINSTR LM317KC
Z02-1024	2	1.02 K 1/4W 1% MF	R1,R3	VARIOUS 1/4 W 1 % MF
Z02-1213	2	121 OHM 1/4W 1% MF	R2,R4	VARIOUS 1/4 W 1 % MF

**V03-MINT****Terminal Board**

A04-2703UCBG1 11

270 pF CER DISC, 2KVDC 10%

CENTRALAB DD-271

A06-FBEAD0001 11

FERRITE BEAD

FAIRRITEPR 2743002111

Z07-103 1

100 OHM 5% 1/2W CC EB TYPE

ALLENBRADL EBTYPE1/2W5%CC