modulation sciences, inc.
12A World's Fair Drive • Somerset, NJ 08873 USA
Voice (732) 302-3090 • Fax (732) 302-0206
Toll-Free in USA (800) 826-2603
Web Site: www.modsci.com
Technical Manual

Model MYB-2

StereoMaxx
Spatial Image Enlarger

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StereoMaxx Manual Addendum

Summary

After extensive field experience, several modifications to the StereoMaxx were found useful. Two additional user adjustments were made available. One permits setting how wide the signal can become before automatic width reduction begins. The other sets the point where StereoMaxx considers a signal to be monaural and ceases to enhance it.

Another modification is a strap option to roll off the high frequency response of the enhancement channel. This makes the StereoMaxx sound more "mellow" to some listeners. Please note, this affects only the enhancement channel and has no effect on the original stereo signal.

In addition, the low frequency response was rolled off somewhat to prevent frequencies that have little impact on the stereo effect from receiving any enhancement.

All StereoMaxx units shipped since March 1988 have these modifications. Anyone owning a unit not modified should notify Modulation Sciences in writing, providing the serial number of their unit. We will provide assistance in upgrading the unit.

Low Frequency Enhancement Roll Off

The value of R26 has been changed from 8.2K to 3.9K. This raises the low frequency crossover on the L-R circuit an octave above its original value, thus raising the lowest frequency that will receive enhancement.

This modification prevents very low frequency such as from a low register organ note or record warp from "capturing" the processor. Because this modification has no undesirable side effects, it is a permanent change.

High frequency Enhancement Roll Off

On some program material the effect of the StereoMaxx sounds "splashy." Installing a jumper at PS12 removes this problem and makes StereoMaxx sound

more “mellow.” Since this problem only affects certain types of program material and some stations may not want the StereoMaxx to sound that “mellow,” this addition was done as a strap option.

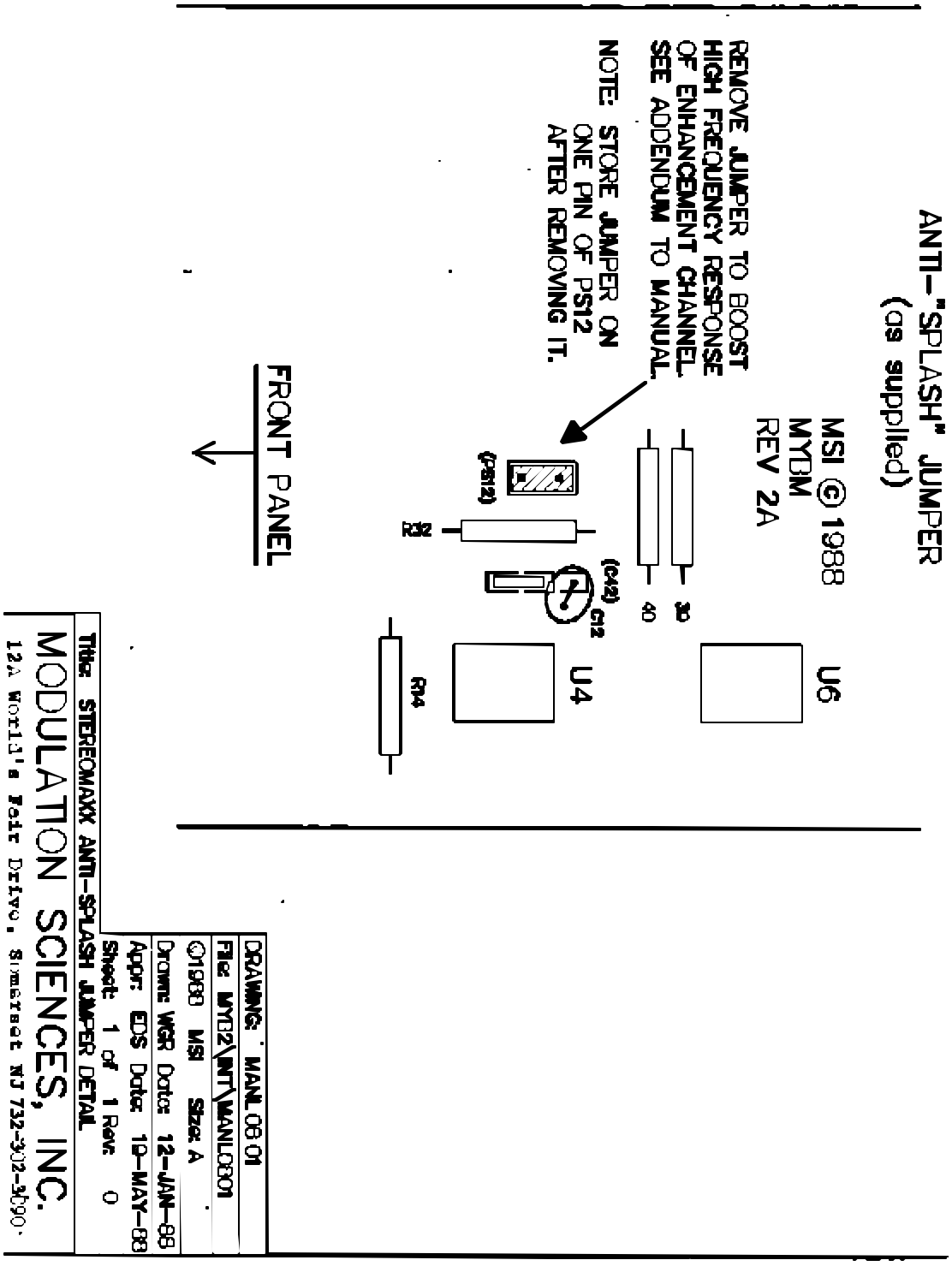
Width Limit Threshold

Some stations want to achieve more StereoMaxx enhancement before the automatic width limiting takes over. A trimmer (RV6), accessible through the top of the unit, provides the factory set width limiting when fully counter-clockwise. As it is rotated clockwise, the point where the automatic width limiting starts taking over increases, thus increasing the maximum amount of enhancement available. The factory set width limiting can always be restored by setting the control full counter-clockwise.

Mono Mute Threshold

When the width indication drops below a certain amount, the StereoMaxx ceases all enhancements. This is to prevent adding unneeded enhancement of a mono source such as a DJ. Monaural sources sometimes appear to be somewhat stereo because of a small, unintended, level or phase imbalance between Left an right channels. The mono Mute Threshold control (RV7) allows for adjusting the point where the StereoMaxx decides that a signal is mono and it should stop enhancing. Counter-clockwise adjustment causes enhancement of material that is more monaural.

Anti-Splash Jumper



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STEP ONE

Here is your Modulation Sciences' StereoMaxx. Please follow the unpacking instructions below:

1. Save all packing materials. You may need them later to ship or move the StereoMaxx.

2. Inspect the StereoMaxx for any sign of damage. If you find any damage to the unit, report it immediately to both the carrier and to Modulation Sciences.

3. Complete the registration card and return it to Modulation Sciences. Registration insures that you will receive any engineering notes on your StereoMaxx and will speed any warranty claims.

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Chapter 1

Introduction

This manual will help you set up and use your StereoMaxx to give your station a big, unique sound and an enhanced stereo image that adds audio excitement to hi-fi stereos, auto radios and portable "boom-boxes". If you are installing a StereoMaxx for the first time, please read the manual completely before starting.

The sections on HOOKUP and PRELIMINARY SETUP will get you on the air with the StereoMaxx quickly and easily.

The section on FINE TUNING will help you adjust the StereoMaxx to your program format.

The final section contains a detailed discussion of the theory of operation, the technical data on the StereoMaxx, and a trouble-shooting guide. In the unlikely event that something goes wrong with your StereoMaxx, information on factory service and warranty is also included here.

If you have any questions not answered by this manual, or comments, please call us on our toll free line: (800) 826-2603.

1.1 Features

The Modulation Sciences StereoMaxx is the first broadcast audio Spatial Image Enlarger. StereoMaxx enhances and enlarges your station's stereo image, for a dramatically bigger, fuller sound.

The SteroMaxx controls provide the flexibility to enhance program material of any format to any taste. The final adjustments are done "by ear" - not to anyone else's preconceived notion of how your station should sound. With the exception of exclusively mono formats, any format can be enhanced. The StereoMaxx is not a loudness processor. It works with any loudness processor you use, for example, Optimod(r), Texar(r), or CRL(r). Spatial image enhancement is a completely different effect from loudness processing. The impact is dramatic on any kind of stereo radio - from large rack systems to portable boom boxes and headphone radios.

1.2 Benefits

Unlike earlier attempts at enhancing the stereo image, StereoMaxx is 100% mono compatible. It causes no phase problems - in fact, it causes no problems at all. StereoMaxx constantly monitors the music to avoid over-enhancing material which is already widely-separated. And it works as well on any stereo broadcast system: AM, FM or TV.

This brings us to what the StereoMaxx will not do: It causes no loss of monaural loudness, no increase in multipath, no image smearing of musical notes, no jet streaming.

The StereoMaxx is not a "black box". It uses fully disclosed, patented technology. This is the newest product from Eric Small and the Modulation Sciences design team. Our CP-803 Composite Clipper is on the air at over 1500 radio stations, keeping them loud, clean and legal. And our Sidekick™ is the industry standard SCA generator.

Chapter 2

Installation Procedure

2.1 Physical Location

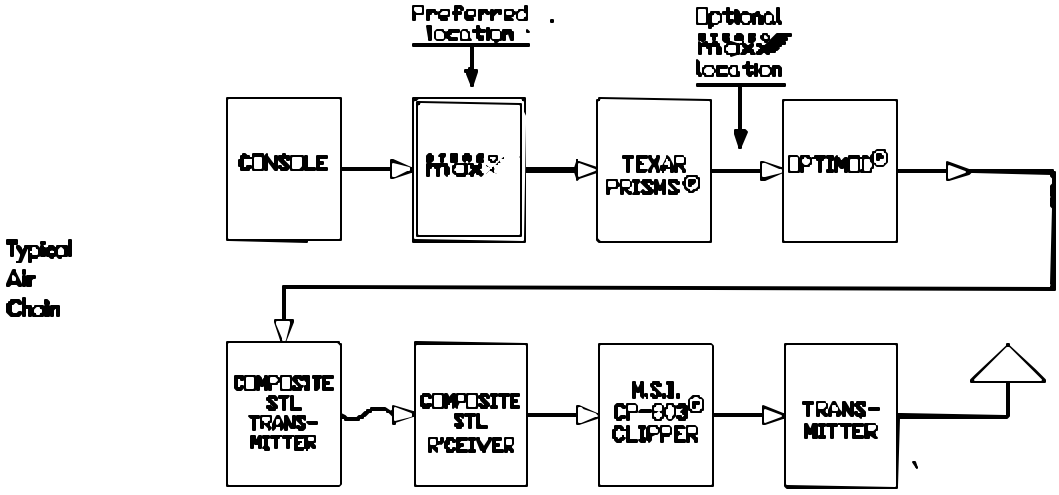
The StereoMaxx will operate over a wide range of temperatures, so physical placement of the unit is not critical. The StereoMaxx is rated for operation from 32 to 122 Fahrenheit (0 to 50 Celsius), and can withstand the rigors of most transmitter rooms.

If you are using an STL, the StereoMaxx can be located at the studio and the signal sent out over a composite or discrete STL.
Wherever you locate StereoMaxx, thoughtful placement will make its setup and adjustment more convenient. The unit is supplied ready to mount in a 19 inch rack. Ideally, it should be mounted at eye level. The environment should be conducive to critical listening. If the location permits monitoring with a variety of receivers, so much the better.

2.2 Placement in the Air Chain

The StereoMaxx will work in any air chain arrangement. As a general rule, the StereoMaxx can be connected anywhere in the chain before the final limiter.

The placement of the StereoMaxx in the air chain is one factor in controlling what sound it produces - though few locations will produce a "bad" sound. Our recommendations are based on what other users have tried and liked. However, feel free to experiment.



The more consistent the levels of the signals driving the StereoMaxx, the easier it is to set up and adjust.

2.3 Special Considerations

2.3.1 Multiband Processors

Stand alone multiband processors such as the Texar Audio Prims® need special consideration when installing and setting up the StereoMaxx. The best solution to the problem of using the StereoMaxx with mulitband processors is to locate the StereoMaxx before the input to the multiband. If the StereoMaxx must be located after the output of a multiband processor, precise adjustment of the processor is needed. This is to prevent the multiband from acting somewhat as a stereo synthesizer and creating L-R signal on monaural programming.

For the Texar Prisms® “precise adjustment” means carefully following the directions in the Texar manual, paragraph 1.8.3, “Establishing the L-R channel Null.” Other multiband processors should be checked carefully to insure that they can be adjusted to prevent the generation of spurious L-R information in mono.

2.3.2 Optimodâ

If there is an Optimod® in the system, the StereoMaxx should precede it.

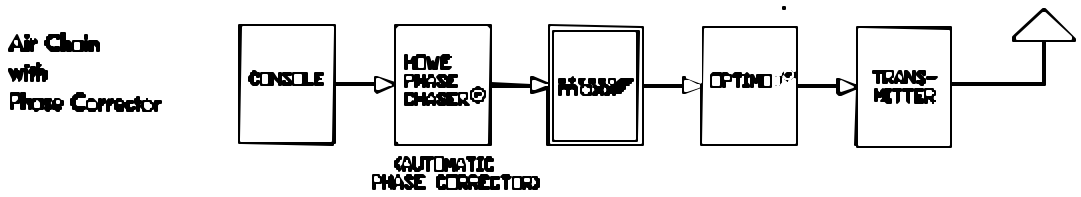
2.3.3 AM Stereo

The StereoMaxx will work with both Kahn and Motorola AM Stereo systems, producing dramatic improvements for listeners who have stereo receivers.

2.3.4 Phase Correctors

The sound that results if the StereoMaxx precedes the input of a phase corrector is rather bizarre and should be avoided. If your air chain includes any automatic phase corrector, such as the Howe Phase Chaser®, the StereoMaxx should be placed following its output.

2.3.5 Air Chain with Phase Corrector



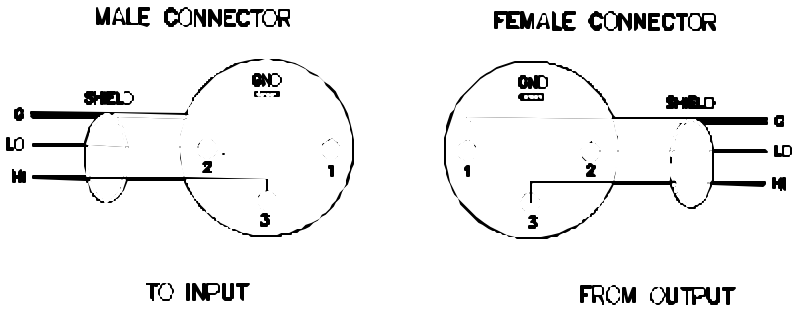
2.4 Hookup

The StereoMaxx is placed in the air chain using two pairs of three-pin XLR-type connectors. These connectors are used instead of a barrier strip for reliability and ease of hookup. No special requirements exist for the input signal except that the level balance between Left and Right channels be within 1 dB

All four connectors should have consistent polarity. In any system, Pin 1 should be Chassis Ground. Pin 2 and pin 3 may be either “signal hi” or “signal low” as long as the wiring pattern is consistent.

2.4.1 Connector Wiring Diagram

Connector Wiring Diagram



The balanced input of the StereoMaxx is supplied from the factory with a 600Ω termination strapped in. Moving jumpers on the circuit board makes the input high impedance bridging.

Instructions for changing this input termination are in the section, INTERNAL JUMPERS.

The input level can range from –10 VU to +10 VU, where 0 VU equals 0 dBm 600Ω for a sinewave. The output is balanced and low impedance, designed to drive a 600Ω load.

2.4.2 Electronic Output

The standard output on the StereoMaxx has high quality Jensen transformers. They produce no measurable degradation of the audio quality while delivering significant advantages. These advantages include output quality that is independent of the balance of the load, RF protection, and lightning protection.

Some broadcasters prefer an all electronic output, so a kit for converting the StereoMaxx to transformerless output is available from Modulation Sciences. The kit consists of two IC's that plug into existing sockets on the main PC board, a new output wiring harness, and detailed instructions.

2.4.3 Gain

The StereoMaxx always has nearly unity gain. In a 600Ω system, the gain is approximately –0.5 dB. In a bridging system, the gain is approximately +0.5 dB. With electronic output, the gain is exactly unity if the output

termination is properly set.

Chapter 3

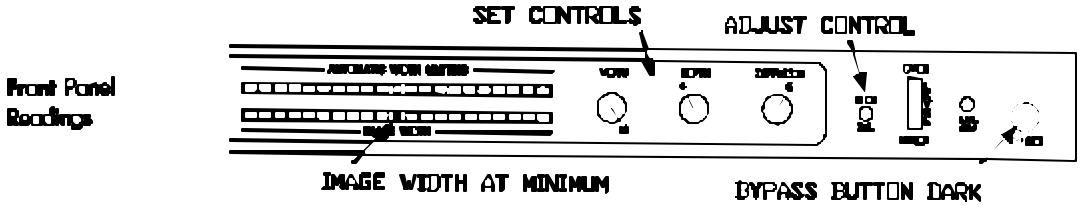
Preliminary Set Up

Once the StereoMaxx is hooked up, you are ready for preliminary set-up.

3.1 Set the Right Channel Balance

The stereo balance adjustment is made with the “R CH BAL” control. This is a critical adjustment, and should be done with care.

Drive the StereoMaxx with a monaural signal (Left = Right) from the console, such as the DJ mike. Place the StereoMaxx in OPERATE (the BYPASS button dark), set the DIFFUSION control to 6, and set the WIDTH CONTROL TO 10 (maximum).



3.2 Front Panel Readings

Adjust the “R CH BAL” control until the IMAGE WIDTH indicator shows a minimum indication (only the center LED lit).

3.3 Set the Level Adjust

The "LVL ADJ" control is not a gain control (the gain remains at near unity) -- it adjusts the operating point of the StereoMaxx for best signal-to-noise ratio, and is therefore not critical.

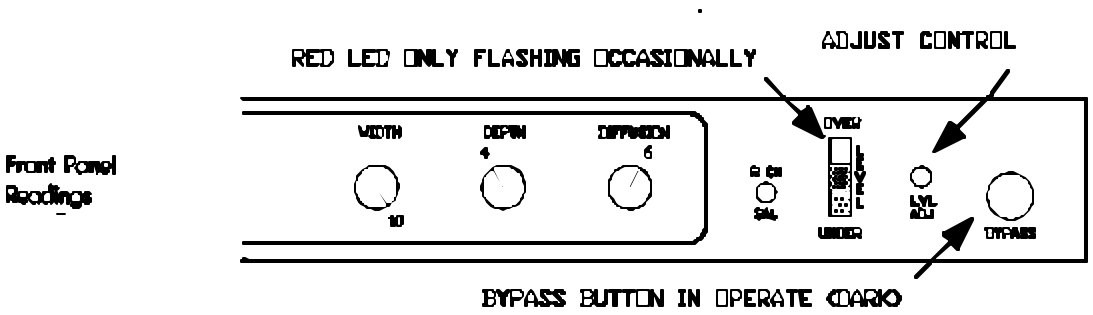
Three level indicators on the front panel provide the indication needed for quick easy setting of this control.

With normal stereo program material driving the StereoMaxx, adjust the "LVL ADJ" until the green LED is on most of the time.

The red LED should only flash occasionally during especially hot program material. The yellow LED should only be on during soft passages.

A dark indication (no LED's on) should be avoided except during long pauses. When none of the LED's are on, the StereoMaxx's enhancement circuits are automatically switched off.

3.4 Front Panel Readings

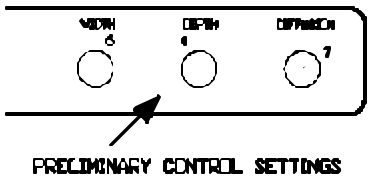


Once the level and balance adjustments are made, the LEVEL LED's should be observed for some time while a variety of program material is played. This will ensure that the level adjustment is a good compromise for all operating conditions.

3.5 Set the Controls

A good starting point for the WIDTH, DEPTH and DIFFUSION controls to get you on the air is:

WIDTH = 6
DEPTH = 4
DIFFUSION = 7



Chapter 4

Final Adjustments and Controls

The adjustment of the operating controls is subjective -- a matter of taste. There is no formula for these adjustments. You need to tinker with them until the StereoMaxx sounds best to YOU.

The first rule for setting up the StereoMaxx (or any other processor for that matter), is to be able to listen to the air signal while adjusting the processor. It is also important that critical listening be done with a variety of radios, ranging from headphone type radios, to "boom boxes", to auto radios in real cars, and finally, on a good component hi-fi like a studio monitor system.

The better your monitoring system, the more subtle the StereoMaxx effect will be. For this reason, try to make your critical judgements on the types of radios that are typical of what most of your audience listens with.

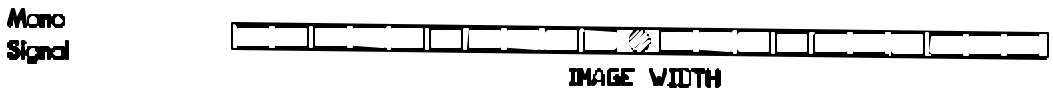
4.1 Reading the Indicators

The IMAGE WIDTH and AUTOMATIC WIDTH LIMITING indicators measure the output signal from SteroMaxx. If the unit is in BYPASS mode, they show the unprocessed signal. When the unit is switched to operate mode, they show the enhanced signal. This is one way to see how much StereoMaxx is enhancing a particular signal.

4.2 The IMAGE WIDTH Indicator

With a mono signal, the IMAGE WIDTH indicator is just a single point in the center of the display (the sound image is centered between the speakers).

4.2.1 Mono Signal



With a fully stereo signal, the indicator is at maximum indication (the sound image is widest).

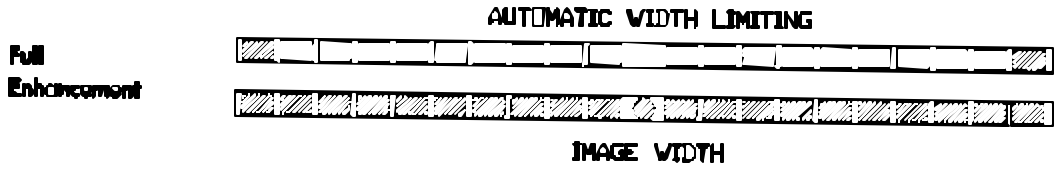
4.2.2 Stereo Signal

The display always lights up evenly on both sides of the center of the indicator without differentiating between sounds all the way to the Left or all the way to the Right. Thus, a full width indication is produced by a signal only on the left channel or only on the right channel.

4.3 The AUTOMATIC WIDTH LIMITING Indicator

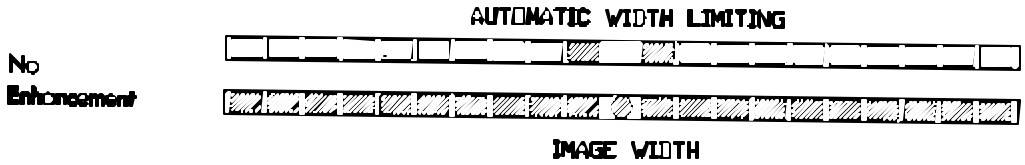
A stereo signal which is already greatly separated should not be enhanced by StereoMaxx. Enhancing such a signal would create more L-R than L + R. Broadcast stereo systems assume that the L-R signal will never be greater then the L + R signal. StereoMaxx contains circuitry to control the L-R level. The action of this circuitry shows no deflection inward, you are getting the full enhancement effect as set by the front panel controls.

4.3.1 Full Enhancement



As StereoMaxx reduces the amount of enhancement to control the L-R level, the indicator shows a pair of dots starting at the outside of the display and moving toward the center. When the dots are at the center, StereoMaxx is producing essentially no enhancement. (This is equivalent to turning the WIDTH control to 0).

4.3.2 No Enhancement



4.4 Control Functions

Any attempt to describe in words what something sounds like is doomed to failure. However, in order to help provide a starting point, we will make the attempt. Please keep in mind that the descriptions are general and only intended to get you started. The *only* way to understand the impact of StereoMaxx on your station is by experimenting with it. Subjectively, the controls interact with one another. Each varies a single electronic parameter of the StereoMaxx, such as delay time or return level. However, these electronic adjustments have a combined effect on the overall " feeling" of the processor. But again, the only way for *you* to understand the range of possibilities of the StereoMaxx is to experiment with it while listening on a variety of receivers and in various environments.

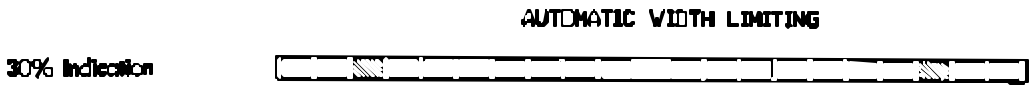
4.5 Getting Started

As you begin to fine-tune the StereoMaxx, we suggest that you take each control fully clockwise then fully counter clockwise, one at a time, to get a feel for the range of each adjustment.

4.6 The WIDTH Control

Of all the controls, WIDTH has the greatest effect on the sound of the station. It is the amount of enhanced signal returned to the Left and Right output channels and directly controls the overall impact of the StereoMaxx. Turning this control all the way down effectively bypasses the StereoMaxx. As the control is advanced, the overall effect increases. Too much WIDTH will cause ringing and a "tinny" sound on "open" program material, such as solo piano. If the AUTOMATIC WIDTH LIMITING indicator always shows a substantial amount of width limiting (deflection inward), you should turn down the WIDTH control. Once this display shows about 30% indication, turning up the WIDTH control will not produce more enhancement. If you want maximum possible enhancement, you should adjust the WIDTH control so that the AUTOMATIC WIDTH LIMITING indicator show 0% to 20% on your **least** separated piece of stereo program material.

4.6.1 30% Indication



StereoMaxx will then automatically adjust the amount of enhancement to produce a maximum width stereo signal.

4.7 The DEPTH Control

The length of time the L-R audio is digitally delayed is called DEPTH. This control has a subtle but important impact on the sound of the station.

The DEPTH control will bring a third dimension to your stereo sound. As the delay time is increased, the sense of depth of the musical image seems to increase. It is as though the instruments had acquired depth as well as width. The impact of this effect depends greatly on the acoustics of the listening room.

Too much delay (towards 10) will produce "doubling" on certain program material. The solution is to reduce the setting of the DEPTH control until the "doubling" effect goes away. The control range allows for more than enough desired effect without any audible doubling.

4.8 The DIFFUSION Control

The DIFFUSION control provides a means to hold the sound image of instruments in place. DIFFUSION is the percentage of direct signal that is bled around the delay. It controls the amount of undelayed difference signal in the output of the unit in order to lock the stereo image in place.

This "wandering" of the stereo image occurs mainly on program material that is recorded in "true" stereo. This is sometimes called "legitimately" miked stereo. Such a recording technique is rare in popular music, where most recording is a multichannel "mike mix". Mike-mixed material is not prone to drifting in position and no direct signal is needed to stabilize it.

The DIFFUSION control provides 100% delayed (no bleed-around) when the control is set at 10 (fully clockwise). At 0 (fully counterclockwise), the signal is all direct,

with no delayed component at all.

Too much undelayed difference signal (toward 0) in the output will sound "tight". Too little (toward 10) will cause the stereo image to de-stabilize or "swim" around on certain recordings. This is most commonly a problem in Beautiful Music, Classical or Easy Listening formats.

4.9 The BYPASS SWITCH

The BYPASS SWITCH serves an important role during setup of the StereoMaxx. It makes possible simple and rapid comparison of processed and unprocessed sound. This is an ideal method for gauging the impact of various control adjustments. The BYPASS SWITCH disables only the enhancement channel, and thus has no effect on the gain of the system. No click is generated when the switch is operated, so comparisons can be made during regular programming.

4.10 In Conclusion

It may take several days of "tinkering" to find the right settings for your needs. But be assured that the effort of finding a set of adjustments that fit your format and market will be rewarded by a unique and attention-getting sound for your station.

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Chapter 6

Common Setup Questions

Because the StereoMaxx is a new concept in audio processing, we have found that some questions arise frequently during initial installations. The following are some of the more common questions and their answers:

1. I punch StereoMaxx in and out, but I don't seem to hear any difference.

Take the StereoMaxx into a production studio, connect it to the monitoring system and play some music off either disc or CD through it. Compare it to the sound of the MSI demo cassette. Depending on the material and the speakers, the effect should be rather dramatic, at least as much so as the cassette. If not, be certain that the input level is sufficient to keep the green LVL LED on most of the time. Check the balance of the Left and Right channels. Are they within 1 dB?

Next, look at the LED bar graphs. Is the "IMAGE WIDTH" indicator showing a one-half to three-quarters expansion much of the time? If not, something may be wrong with the stereo separation of the signal driving the unit.

When StereoMaxx is in OPERATE (the BYPASS SWITCH dark), the "AUTOMATIC WIDTH LIMITING" indicator should be hovering between 0% and 30% - around the extreme outside. If it is indicating width reduction by being near the center most of the time, try some other program material that is not as highly separated. Also, reduce the setting of the WIDTH control until the width limiting indicator opens up. If nothing seems to help, the input signals may be out of phase, or one channel may be dead, or totally unrelated material may be on the Left and Right channels.

If you still can not get StereoMaxx to sound like the demo cassette, call MSI on our toll free line - (800) 826-2603. If StereoMaxx sounds dynamite in the production studio, but still doesn't seem to do much on the air, read on.

2. The StereoMaxx sounds great in a studio, but doesn't make it on the air.

The problem may be in the music playback equipment or the audio processing. First of all, how good is the stereo separation as measured in the style of a "Proof of Performance?" If the separation is below 30dB, especially above 5 kHz, something is wrong with your transmission system and no amount of processing will improve the separation.

If the transmission separation is OK, then look carefully at the source of music. It is very easy to lose a lot of stereo separation, especially above 5 kHz, in the process of dubbing from an LP to cartridge in a production studio, and then playing the cartridge back on a machine in the air studio. Cart systems that record matrix (L + R, L-R) seem to be a consistent source of degraded separation. Check this by actually recording an audio sweep on one channel at -10 VU, and measuring the separation on a few playback machines.

Turntables can degrade separation a lot if the pickup cartridge and stylus are not in good condition and correctly adjusted. Check out the turntable with a test record such as those available from the National Association of Broadcasters.

Audio processing can also degrade the stereo image by removing the subjective (psychoacoustic) cues to separation. High frequency roll off in limiters is the most common problem. Even though a limiter may measure perfectly flat, a lot of highs get removed under program conditions. A good test for this is to compare the off-air signal with a good disc or CD of the same cut. If it sounds "dull," not only are highs being lost, but separation is too.

The cure is to readjust the processing for less high frequency roll off try another brand of limiter. If adjusting the processor works, but reduces loudness too much, a Modulation Sciences CP-803 Composite Processor will allow increased loudness without reducing the high end.

3. StereoMaxx works great, but multipath seems to have gotten worse.

Multipath is the great bugaboo of FM broadcasting. Ever present, impossible to measure, poorly understood, it is the catch-all for anything that goes wrong in FM coverage that can not pinned on something definite.

Often any change at a station will produce reports of increased multipath. In fact, nothing the station can do has any actual effect on multipath. What does change with such things as peak L-R subchannel energy is the "susceptiblity" of the signal to multipath. Weather is the only parameter that has an actual short term impact on multipath. It is very difficult to identify what causes notacable changes in multipath when, for example, driving the same route at different times. Is it the weather that has changed the reflectivity of the local terrain and buildings, or has some change at the station increased multipath susceptibility?

It is well understood that increased stereo separation will increase susceptibility to multipath. Because StereoMaxx does not increase the peak level of L-R significantly, it does not make the signal any more susceptible to multipath than it would be while playing a recording of the same stereo width.

Simple matrix devices significantly increase the peak level of the L-R subchannel, but the StereoMaxx does not increase this peak level appreciably. In fact, StereoMaxx does not increase the average L-R anymore than a traditionally recorded selection of the same subjective separation would.

There are several things to do if, after installing the StereoMaxx, multipath seems to increase. First, be certain something really has changed. Make no adjustments of station equipment for several days and each day ask if there has been any change in multipath. Don't tell the multipath experts that you didn't make any changes, just ask if any difference was noted. Don't be surprised if significant changes are reported each day. And don't discredit your observers; they may only be responding to differences in the weather.

Another station parameter that has a significant effect on multipath suspectibility is the amount of synchronous AM produced by the transmitter. Synchronous AM will increase the peak level of the L-R subchannel. Tuning the transmitter for minimum synchronous AM will reduce the effect of naturally occurring multipath. If you need an application note on reducing

synchronous AM, contact Modulation Sciences for a copy. Our toll free number is (800) 826-2603.

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Chapter 7

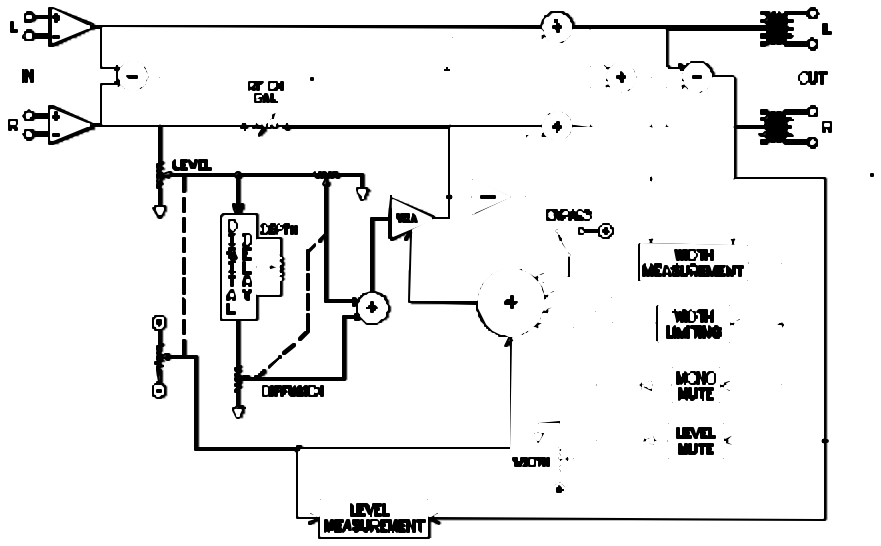
Theory of Operation

As the StereoMaxx processes the signal, the incoming audio channels are subtracted to form a difference signal, L-R. This difference signal is delayed 3 to 15 milliseconds, then split into the Left output channel and the other is mixed into the Right output channel.

Note that the stereo is *never* converted into sum and difference format, processed, then converted back to Left and Right.

7.1 Simplified Block Diagram

Simplified Block Diagram



Let's examine what is happening, by first extracting a difference signal to use in the enhancement process, we guarantee that only stereo information will be acted upon. When a mono signal is fed into StereoMaxx, no difference signal is produced and thus no enhancement will take place. This insures that a DJ's voice will stay put—not wander or be diffused between the speakers.

Next the difference signal is delayed. This delay is the most critical step in StereoMaxx because it creates the subjective effect of "bigness". Electrically, it

offsets the enhanced signal in time so that it no longer adds and subtracts from the stereo signal in a predictable way. This prevents StereoMaxx from increasing the peak modulation of the L-R subchannel much beyond what it would be without enhancement.

More technically, the delay *decorrelates* the enhancement signal from the stereo program.

Another way to look at the process is that by using delay, the enhancement "fills up" the brief periods of silence between the notes in the music. The average energy in the L-R channel increases, but not the *peak* amplitude.

By re-inserting the delayed signal into the Left and Right stereo channels out-of-phase, the effect is made inaudible to monaural listeners. This is important, because with the point source of a mono signal, the delayed signal would sound strange.

The tendency to de-stabilize the image of some stereo material was cured by bleeding some signal around the delay line. Not much, about 15 dB below program level. However, this small undelayed component in the output seems to hold the image "locked" in place, without any significant affect on monaural compatibility.

Another concern was how StereoMaxx would affect material that was already highly separated. Too much of even a good thing can sound bad. To prevent this, a control circuit was added: AUTOMATIC WIDTH LIMITING. This unique circuit senses how "stereo" the program material is. If it is "big enough", the gain of the L-R enhancement channel is reduced. Below this threshold the L-R gain is constant.

Two LED bar indicators on the front panel indicate the status of these circuits. The lower one, IMAGE WIDTH, displays as an expanding line the ratio of L-R to L+R. Above it is a display of AUTOMATIC WIDTH LIMITING. This indicator moves inward to indicate reduced gain in the L-R enhancement channel.

If either the Left or Right channel goes silent, the enhancement must squelch off. This prevents the enhancement from being heard on a channel without program. It also prevents enhancing impulse noise that might appear on the silent channel.

Another special circuit takes care of signals that are "almost" monaural, but not quite. For example, a console can add enough level unbalance and phase shift between left and right channels to make the DJ mike seem a bit stereo. A stereo threshold detector prevents these marginal signals from being enhanced as though

they were stereo.

Because StereoMaxx operates in the time domain rather than the amplitude domain, it is fully compatible with all processing used in broadcasting

7.2 Multipath

Problems with multipath discourage many stations that try to increase their stereo width. In addition to loss of monaural loudness, using simple linear matrices to increase L-R energy also increase L-R peak levels. As the peak level of the L-R channel increase, the impact of any multipath increases too. This effect devastates the effective coverage of a station. It doesn't matter how many millivolts of signal you've got if the station sounds so distorted by multipath that no one will listen to it.

StereoMaxx avoids these problems by not increasing the peak level of the L-R subchannel significantly over what it would be without StereoMaxx. The result increases stereo image size without degrading the sound quality or coverage of the station.

StereoMaxx will not cause any additional multipath susceptibility than would result from broadcasting a selection of the same separation.

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Chapter 8

Specifications

Size:	H x W x D –Inches (mm) 1-3/4" x 19" x 12-1/4" (44.5 x 483 x 311)
Power:	50/60 Hz AC 100 - 130 V, 1/4 A maximum 200 - 260 V, 1/8 A maximum
Temperature Range:	0 to 50 degrees Celsius

Controls:

Width	The amount of enhanced signal returned to the Left and Right output channels
Depth	The length of time the L-R audio is digitally delayed
Diffusion	The percentage of direct signal that is bled around the delay
R CH BAL	Trims to + 1 dB the level of the Right Channel
LVL ADJ	Sets the operating point for the StereoMaxx

Indicators:

Image Width	LED bar indicator measuring the ratio of L-R to L + R. This width indication is independent of level.
Automatic Width Limiting	LED bar indicator displaying the width reduction voltage. It is analogous to the gain reduction signal in a

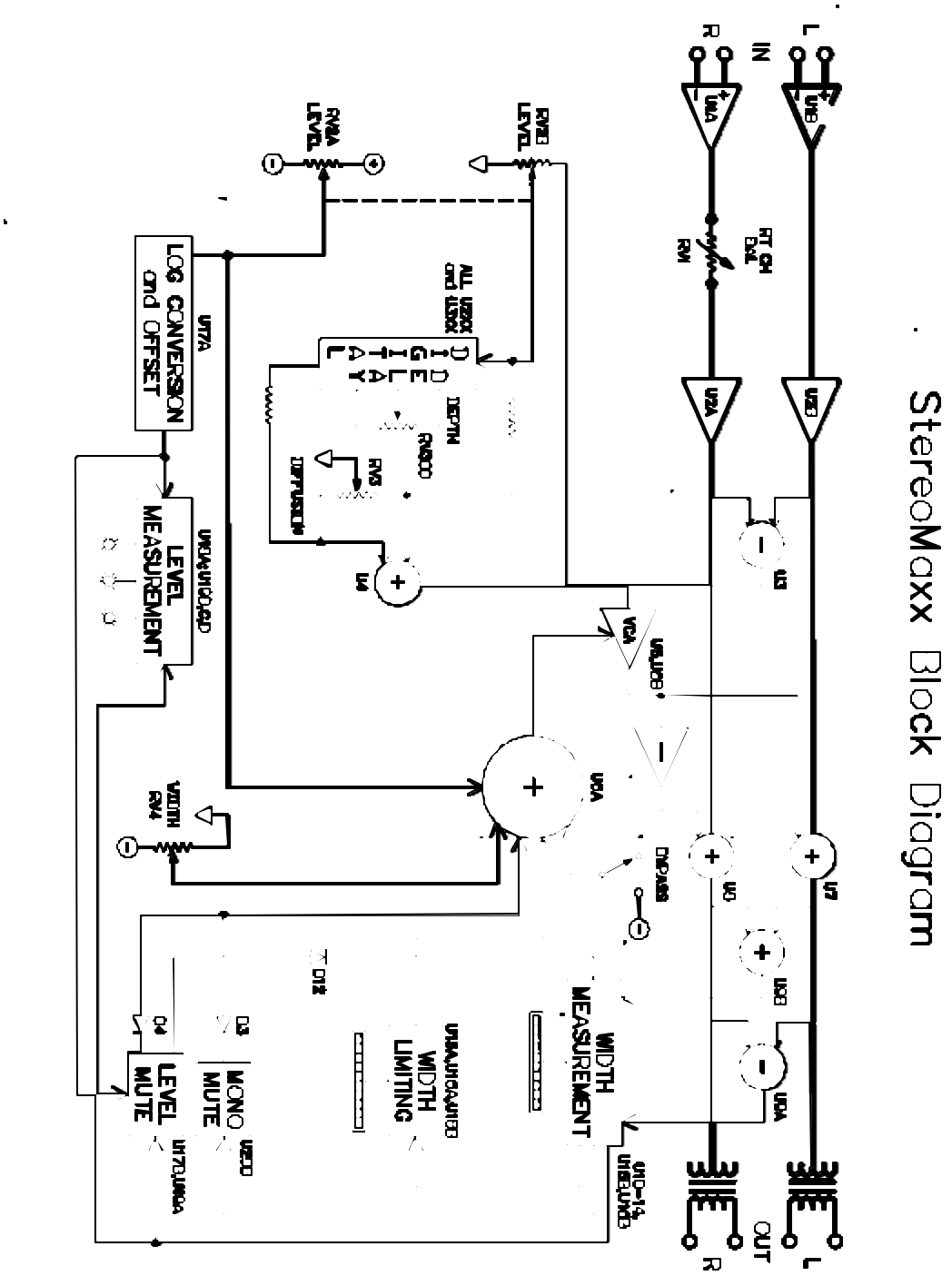
compressor.

Audio Inputs	Switchcraft® A3F connectors Input impedance 600Ω or 20KΩ, internally jumper selectable Level -10 to + 10 VU[1] (20 V P-P maximum)
Audio Outputs:	Switchcraft® A3M connectors Minimum load impedance 600Ω Actual output impedance 100Ω Maximum output level + 10 VU[1] (20 V P-P)
Electronic Output	Conversion Kit available which provides for an active electronic output in addition to the Jensen transformer outputs supplied as standard equipment.
Gain:	(L or R INPUT TO L or R OUTPUT) 0 ± 1dB

[1] Note 1: 0 VU = 0 dBm, 600Ω sine wave

Chapter 9

StereoMaxx Block Diagram



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Chapter 10

Regular Maintenance

The StereoMaxx requires no routine maintenance.

10.1 TROUBLE SHOOTING

Simple troubleshooting of StereoMaxx can be performed using only audio signals and the indicators on StereoMaxx, but you cannot do most of this while it is on the air. You will need to be able to vary its input level, and to drive only one channel at a time. An ideal test setup would be in a production room where you can feed its inputs with your program signal and monitor its output signal.

If you have equipment to measure frequency response, distortion, and noise, the input and output amps can be checked with StereoMaxx set to BYPASS. The results should be similar to the measurements of an excellent audio amplifier.

10.1.1 Audio Problems

Set the R CH BAL control to the center of its rotation. With StereoMaxx in BYPASS, its output level should be the same as its input level. Its output impedance is about 100 Ohms, so its output level does not vary significantly from a bridging load to a 600Ω load. (NOTE: this is not true if you have the active balanced output option. In this case, the output impedance is 600Ω. See the instructions supplied with the option.) If you are measuring level DIRECTLY at the input and output connectors, the levels should be within 1 dB. If they aren't, StereoMaxx is sick. Note, however, that StereoMaxx is supplied from the factory set for 600Ω input impedance. This may load the preceding piece of equipment, so the level may drop when StereoMaxx is connected. If you are not using a 600Ω system, you should set StereoMaxx for bridging input impedance by following the instructions in the section on INTERNAL JUMPERS.

10.1.2 Enhancement Problems

These steps should be performed in order, since the results of later steps may depend on control settings made in earlier steps.

1. Set StereoMaxx to BYPASS (flashing red), and apply a sine wave to the left input only. Signal level should be between 0 and + 10 VU (0 VU = 0 dBm, 600Ω).

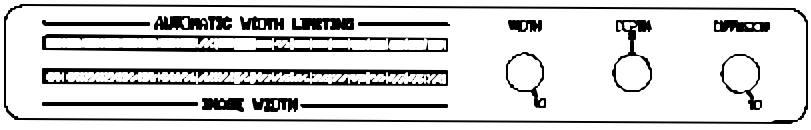
2. Set LVL ADJ so the LEVEL indicator shows green or yellow. The IMAGE WIDTH indicator should be at full scale (widest expansion),and the AUTOMATIC WIDTH LIMITING indicator should show no indication (widest expansion)

3. Reduce the input level until the yellow LEVEL indicator just goes off (the entire display dark). Then reduce the input level an additional 10 dB. The IMAGE WIDTH indicator should read 0.

4. Restore the input level to its original setting. Set the WIDTH control to 10, the DELAY control to 5, and the DIFFUSION control to 10. Release the BYPASS button (dark, not flashing). With left channel only audio, the IMAGE WIDTH indicator should be at full scale, and the AUTOMATIC WIDTH LIMITING indicator should read 80% to 100%.

Front Panel Readings

Front Panel Readings



5. Turn the DIFFUSION control to 0. The AUTOMATIC WIDTH CONTROL indicator reading may reduce somewhat, but should still read at least 40% inward deflection.

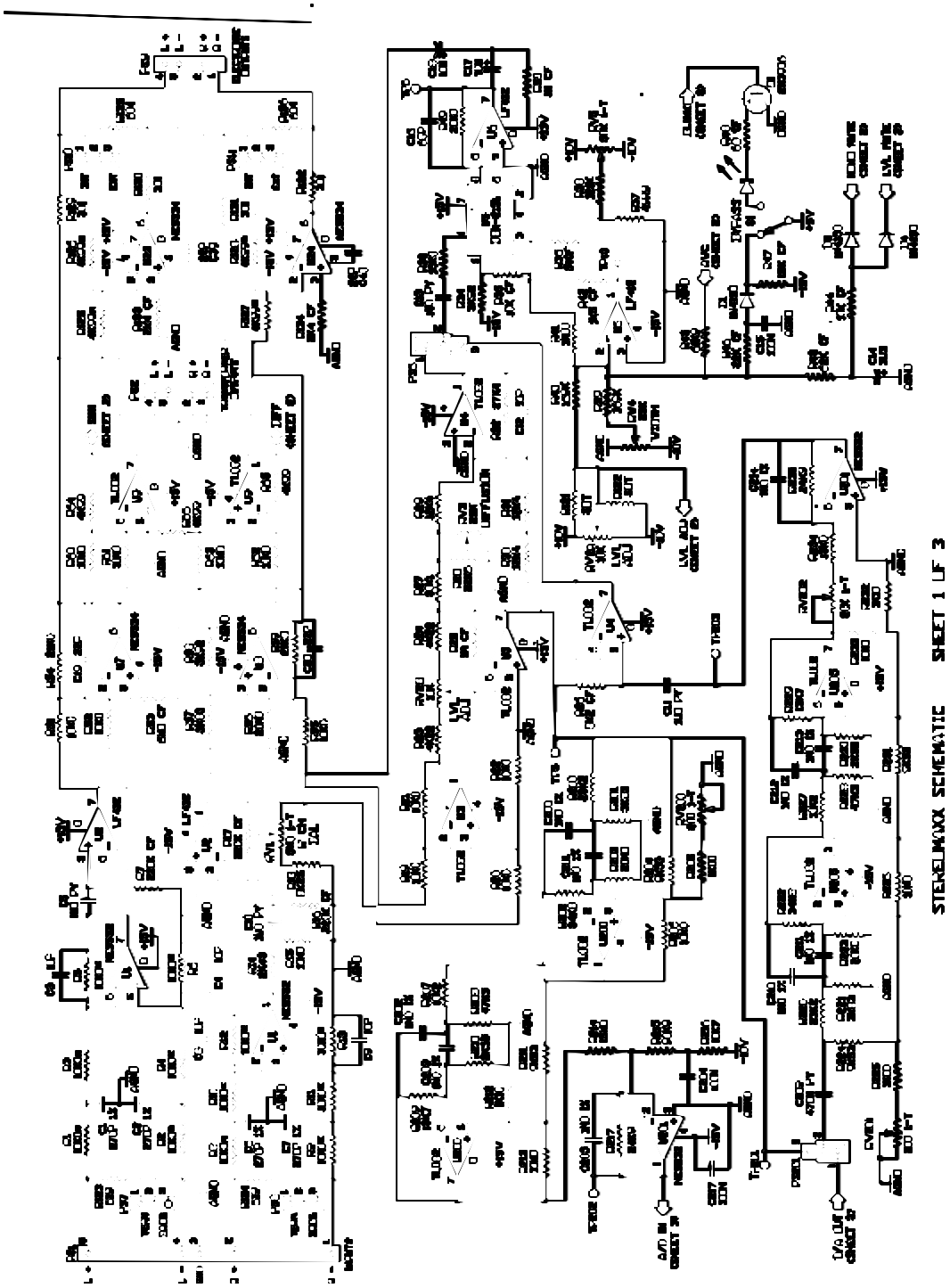
   All of the above tests should produce identical results with right-channel-only audio instead of left-channel-only audio.

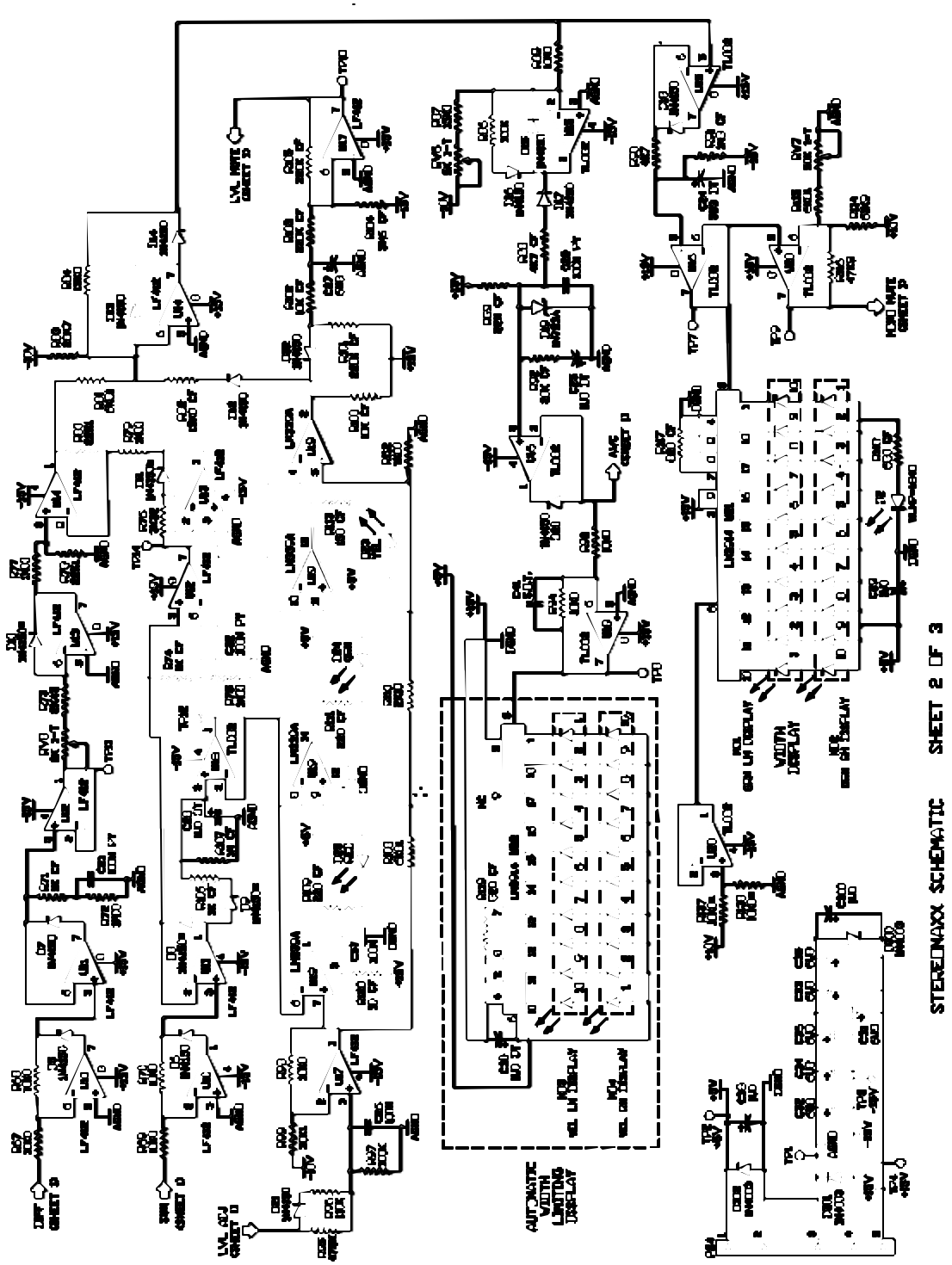
6. Set the DIFFUSION control to 10. Apply mono audio (same signal to

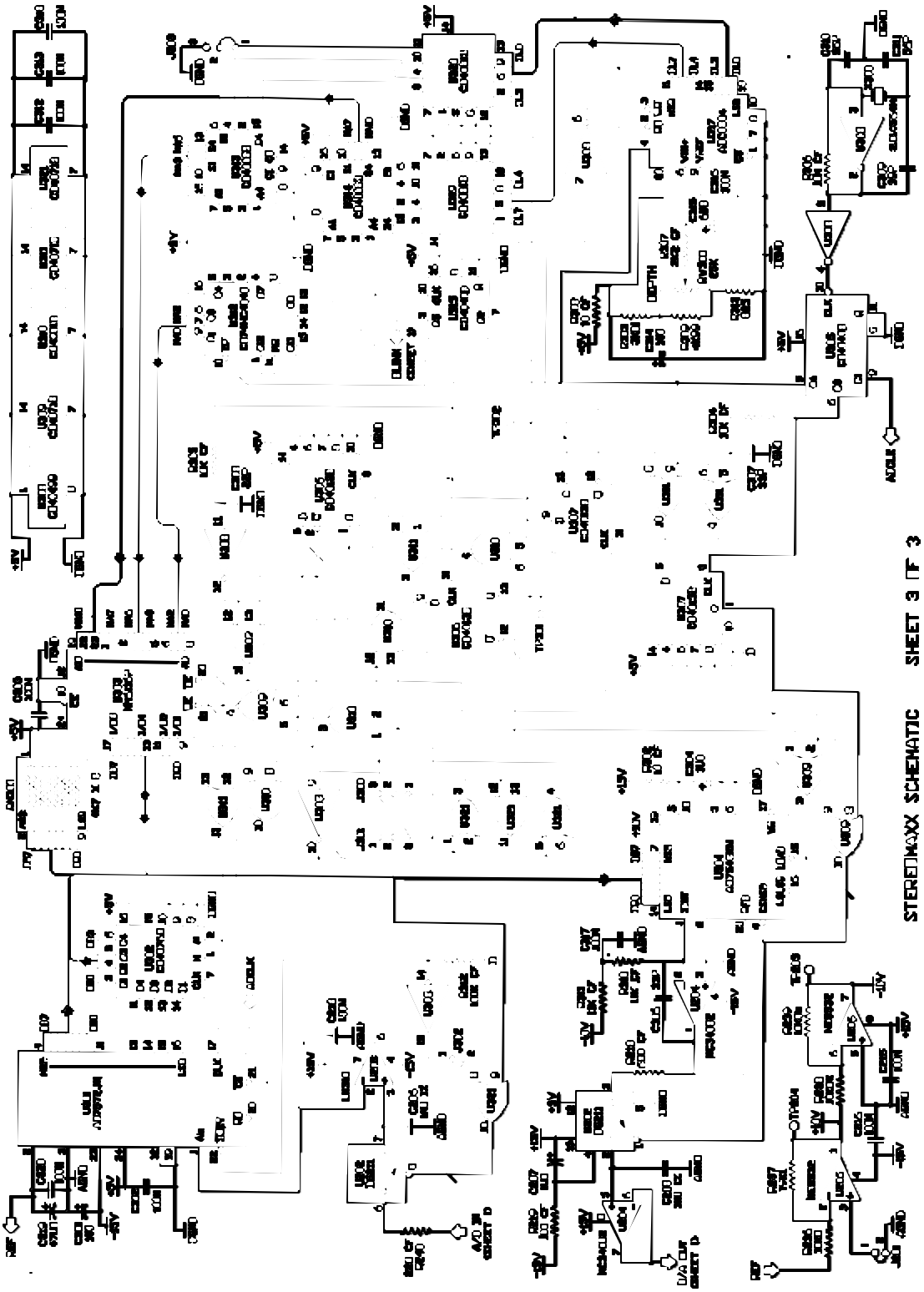
both left and right inputs). If the LEVEL indicator does not show green or yellow, reset LVL ADJ so that it does. The IMAGE WIDTH indicator should read 0 (only one LED in center on). If it does not, adjust the R CH BAL control to get this indication.

If the StereoMaxx fails any of these tests, it is probably ill. Call us to arrange repair. If the StereoMaxx passes all of these tests, but still does not seem to operate properly, call us for advice.

10.2 StereoMaxx Schematic




STEREOMAXX SCHEMATIC SHEET 2 OF 3

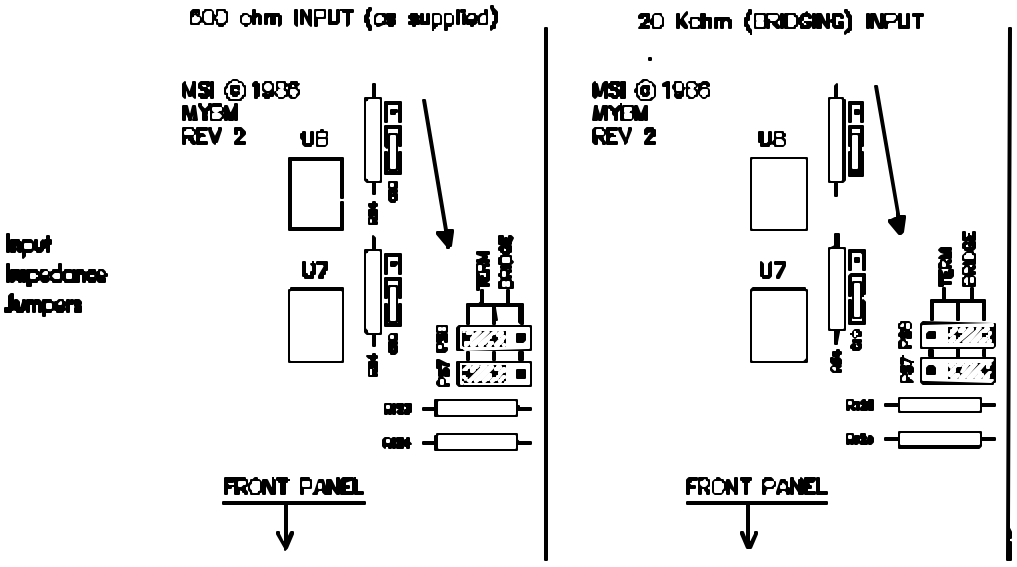

STEREOMAXX SCHEMATIC
SHEET 3 OF 3

Internal Jumpers

Input Impedance

StereoMaxx is supplied from the factory with 600Ω input impedance. To select bridging (20 KΩ) input impedance, move jumpers PS7 and PS8 to the BRIDGE position.

To restore 600Ω input impedance, move the jumpers to the TERM position.



Electronic Output

Please call us at (800) 826-2603 to order the Electronic Output Conversion Option kit. Instructions for installing electronic output are included as part of the package.

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Warranty and Disclaimer

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 the delivery when properly installed. Our sole obligation under this warranty shall be limited to repair or replacement at our option of 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. 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 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, FITNESS FOR A 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 other 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, subjected to negligence, misuse, unauthorized alteration or abuse, or damaged in transit.

OUR LIABILITY HEREUNDER SHALL NOT INCLUDE LOSSES OF ANTICIPATED PROFITS OR SPECIAL INCIDENTAL OR CONSEQUENTIAL DAMAGES.

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Abbreviations and Symbols Used in Parts Lists

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 and should not be replaced without consulting the factory. Abbreviations of Manufacturer's Names

ALLENBRADL	Allen-Bradley Co.
AMP	Amp Special Industries
BOURNS	Bourns, Inc. Electronic Components
CENTRALAB	Centralab, Inc.
DBX	DBX Inc.
HEWLETTPAC	Hewlett-Packard
ITTSCHADOW	ITT Schadow, Inc.
KEYSTONE	Keystone Electronics Corp.
MALLORY	Mallory Capacitor Co.
MSI	Modulation Sciences, Inc.
NATIONALSE	National Semiconductor Cor
PANDUIT	Panduit Corp.
SAMTEC	Samtec
SFETECHNOL	San Fernando Electronic Technology
SPRAGUELEC	Sprague Electric Company
SWITCHCRAF	Switchcraft, Inc.
TEXASINSTR	Texas Instruments
WIMA	WIMA Div., Inter-Technical Group, Inc.

Abbreviations Used in Parts Descriptions

AE	Aluminum Electrolytic Capacitor
CC	Carbon Composition Resistor
CF	Carbon Film Resistor
DT	Dip Tantalum
MC	Monolithic Ceramic Capacitor
MF	Metal Film Resistor
MY	Mylar Capacitor
NF	Nanofarads
PC	Printed Circuit
PF	Picofarads
PS	Polystyrene Capacitor
PY	Polyester/Mylar Capacitor
SM	Silver Mica Capacitor
UF	Microfarads

Parts List

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUFACTURER P/ NUMBER
V01-MYBM					
A02-S203FT001	2	200 OHM 1-T FLAT TP	RV200-RV201	BOURNS	3386P1-201
A02-S204FT001	1	2K 1-T FLAT TRIMPOT	RV8	BOURNS	3386P1-202
A02-S205FT001	1	TRIMPOT, 01T 20K0 FS TOP	RV202	BOURNS	3386P1-203
A02-S504FT001	2	5 K 1-T FLAT TRIMPOT	RV6,RV9	BOURNS	3386P1-502
A02-S504US001	1	5K UPRIGHT TRIMPOT	RV1	BOURNS	3386W1-502
A02-S505FT001	2	50K 1-T FLAT TRIMPOT	RV5,RV7	BOURNS	3386P1-503
A03-1RUA25502	3	POTENTIOMETER, 25K0 LINEAR	RV3-RV4,RV300	CLAROSTAT	308NPC-25K
A03-2RUA10501	1	POTENTIOMETER, 10K0 LINEAR	RV2	ALLENBRADL	70P4G024S103U
A04-1002JMEG1	5	CAP 10PF MC 10%	C3-C4,C8-C9,C12	CENTRALAB	CN15A100K
A04-1006HMCH1	16	.1 UF 50 V 20% MC	C15,C26,C37,C204,C215-C218,C302-C303,C312-C313,C316-C318,C32	CENTRALAB	CZ20C104M
A04-1006JPNF1	4	.1 UF 5% 100V PY	C11,C21-C23	WIMA	MKS4RM7 0.1/100/5 (7.5MM)
A04-1007GTNH1	10	1 UF 35 V DT	C25,C28-C30,C38,C207,C300-C301,C304,C314	SPRAGUE	199D105X0035BB1
A04-1007HPNF1	3	1 UF 5% 63V PY LS 10MM	C5,C10,C13 Wima# MKS4RM10 1uf/5/63 (10mm)		
A04-1008FTNH1	2	10 UF 25 V DT	C17-C18	SPRAGUE	199D106X0025CB1
A04-2202JMAG1	5	22 PF 100 V 10% MC	C19-C20,C39-C40,C308	CENTRALAB	CN15A220K
A04-2703RSND1	4	270 PF 1% SM	C1-C2,C6-C7		DM15FD271F03
A04-3302JMAG1	2	33 PF 100 V 10% MC	C306-C307	CENTRALAB	CN15A330K
A04-3307FTNH1	2	3.3 UF 25 V DT	C14,C24	SPRAGUE	199D335X0025BB1

A04-3902RCAF1	1	39 PF CER DISC, NPO, 0.25 LS	C309	MALLORY	CMC390J
A04-4706HPNF2	1	0.47 UF 5% 63V PY	C209	WIMA	MKS4RM7 0.47/63/5 (7.5MM)
A04-4708BTNH1	1	47 UF 6 V DT	C319	ITTCAP	TAP47M6.3
A04-5602HCAF1	2	56 PF 5 % COG DISC	C310-C311	MALLORY	CEC560J
A04-6802JMAG1	1	68 PF 100 V 10% MC	C16	CENTRALAB	CN15A680K
A04-6803HMBG1	1	680 PF 50 V 10% MC	C42	CENTRALAB	CW15C681K
A04-6807FTNH1	8	6.8 UF 25 V DT	C27,C31-C36,C315	SPRAGUE	199D685X0025CB1
A10-020971521	1	CRYSTAL 2.097152 MHZ,HC33/U	X300	JANCRYSTAL	MP HC 33/U
AT4-1004HMAD1	12	1 NF MC (BINNED BY 0.1%)	C200-C203,C205-C206,C208,C210-C214	(FOR MSI USE ONLY)	parts do not go to ve
B01-4003	3	RECTIFIER DIODE	D300-D302	VARIOUS	1N4003
B01-4148	17	GLASS DIODE	D1,D3-D7,D12-D18,D20-D22,D26	VARIOUS	1N4150
B02-753A	1	6.2 V ZENER DIODE	D19	VARIOUS	1N753A
B04-P3906	1	LOW POWER PNP TRANSISTOR	Q1	VARIOUS	2N3906
BT1-4148	4	1N4148 DIODE (BINNED VOLTAGE)	D8-D11parts must be installed by MSI)	MSI PARTS	B01-4148 (TESTED
C01-1B0000003	4	NE5534P TI OP AMP, PLASTIC	U7-U8,U23-U24	SIGNETICS	NE5534N
C01-1F0000005	1	LM310N VOLTAGE FOLLOWER	U203	NATIONALSE	LM310N
C01-2B0000001	3	NE5532P DUAL OP AMP, PLASTIC	U1,U201,U206	TEXASINSTR	NE5532P (TI ONLY)
C01-2F0000002	8	LF412CN Dual OP AMP Nsc#	U2,U6,U10-U14,U17	NATIONALSE	LF412CN
C01-2F0000007	9	TL082CP RAYTHEON DUAL OP AMP	U3-U4,U9,U15-U16,U18,U20,U200,U205	MOTOROLA	TL082CP
C01-2F0000008	1	DUAL JFET OP AMP	U204	MOTOROLA	MC34082P (OR AP
C04-400000001	1	QUAD COMPARATOR	U19	NATIONALSE	LM339AN
C07-100000001	1	VCA That Corp.# 2151	U5	DBX	2151
C13-000000001	2	LM3914N	U21-U22	NATIONALSE	LM3914N
D01-4008X0001	2	4 BIT BINARY ADDER	U313-U314	MOTOROLA	MC14008
D01-401300001	2	DUAL D FLIP-FLOP	U306-U307	MOTOROLA	MC14013
D01-4040X0001	2	12 BIT RIPPLE COUNT	U305,U315	MOTOROLA	MC14040

D01-4049X0001	1	HEX INVERTING BUFFER	U308	TOSHIBA	SCL4049BE
D01-4071X0001	3	QUAD OR GATE	U309,U311,U321	MOTOROLA	MC14071BCP
D01-4076X0001	1	QUAD D REG, 3-STATE	U302	NATIONALSE	CD4076BCN
D01-4081X0001	3	CMOS IC QUAD 2-INPUT & GATE	U310,U319-U320	RCA	CD4081BE
D02-000000002	1	12 STAGE BINARY COUNTER	U312	MOTOROLA	MC74HC4040N
D03-000000016	1	2048 X 8 HS CMOS RAM	U303	SONY	CXK5816PS-12
D05-AD0800002	1	8 BIT A/D CONV	U317	NATIONALSE	ADC0804LCN
D05-AD1200003	1	12 BIT A/D CONVERTER	U301		AD7572JN12
D05-DA1200002	1	12 BIT D/A CONVERTER	U304	ANALOGDEVI	AD7548KN
D06-040100101	1	ANALOG SWTCH (SILICONIX ONLY)	U202	SILICONIX	DG211CJ
E01-I20000003	1	RED HI-BRIGHT LED	S1	SOLICO / MEC	XSOLR-312
E01-S20000002	1	RED LED W/LONG CATHODE	D25	LUMEX	SSL-LX4673ID
E01-S40000002	1	YELLOW LED W/LONG Cathode	D23	LUMEX	SSL-LX4673YD
E01-S50000002	1	GREEN LED	D2	HEWLETTPAC	HLMP-1840
E01-S50000003	1	GREEN LED W/LONG CAT	D24	LUMEX	SSL-LX4673GD
E03-LED000003	2	10 SEGMENT GREEN DISPLAY	MD1-MD2	LUMEX	SSA-LXB103GD
E03-LED000004	2	10 SEGMENT YELLOW DISPLAY	MD3-MD4	LUMEX	SSA-LXB103YD
H05-008000001	26	8 PIN EDGE GRIP SS	US1-US4,US6-US18,US20,US23-US24,US200-US201,US203-US206	AMP	2-640463-2
H05-014000002	9	14 PIN FACE GRIP SS	US19,US306-US307,US309-US311,US319-US321	AMP	2-641261-20
H05-016000002	8	16 PIN FACE GRIP SS	US202,US302,US305,US308,US312-US315	AMP	2-641262-20
H05-018000002	2	18 PIN FACE GRIP SS	US21-US22	AMP	2-641263-20
H05-020000002	2	20 PIN FACE GRIP SS	US304,US317	AMP	2-641264-20
H05-024000002	1	24 PIN FACE GRIP SS	US303	AMP	2-641266-20
H05-024000003	1	24 PIN NARROW FG SS	US301	ROBINSON NUGENT	ICE-243-S-TG
H08-001PMS001	16	TEST POINTS	TP1,TP5-TP14,TP201-	OXLEY	040/30P/KP2/L

H08-003PMW001	7	3 PIN WW STRIP	TP203,TP301-TP302 PS6-PS8,PS10-PS11,PS201,PS12	SAMTEC	TSW-103-09-GS
H08-004PMS002	2	MASCON HEAD,4-PIN W/GOLD	PS2,PS9	PANDUIT	MLSS100-4-DA
H08-005PMS001	2	MASCON 5-PIN HEAD. W/ GOLD	PS1,PS4	PANDUIT	MLSS100-5-DA
H08-006PMW001	1	3x2 RT ANG PINSTRIP	PS5	SAMTEC	BST-103-09TD-230
H14-S00800001	1	8 MACH PIN SIL	US5	SAMTEC	SS-108-G-2
H19-002000001	7	0.1` WW PIN JUMPER		BERG	65474-001
I02-010200202	1	ALT ACT LIGHT PB Switch Hi-	S1	ITTSCHADOW	MPXX012UEEN22(W/LED
J01-260000001	4	BUS WIRE, TINNED, 26AWG	J201,J300-302, (QTY IN INCH)		
J03-P242X0001	2	RED 24 AWG stranded hook-up wire	PS3-2 TO MYBWPS1-2		
J03-P243X0001	2	Orange 24 AWG stranded hook-up wire	PS3-3 TO MYBWPS1-3		
J03-P244X0001	2	Yellow 24 AWG stranded hook-up wire	PS3-4 TO MYBWPS1-4		
J03-P248X0001	2	Grey 24AWG stranded hook-up wire	PS3-1 TO MYBWPS1-1		
K02-3122	2	#6 NYLON FLAT WASHER		KEYSTONE	3122
K04-1450B	2	4/40 X 3/8` HEX SPAC		KEYSTONE	1450B
K04-1450C	1	4/40 X 1/2` HEX SPACER		KEYSTONE	1450C
K04-1547A	1	1/4` X 4/40 RND SPCR		KEYSTONE	1547A
L03-PWBSERLAB	1	SERIAL LABEL (KAPTON)		CRITCHELY	CR3-KG10F
O03-4/40E2501	12	4/40 x 1/4 Sems, philips pan		VARIOUS	NONE
O03-4/40M2501	1	4/40 X 1/4` ROUND HD,SLOTTED		VARIOUS	NONE
Z01-102	3	10 OHM 1/4W 5% CF	R120,R302,R308	VARIOUS	1/4 W 5 % CF
Z01-103	1	100 OHM 1/4W 5% CF	R219	VARIOUS	1/4 W 5 % CF
Z01-104	3	1K 1/4W 5% CF	R71,R74,R106	VARIOUS	1/4 W 5 % CF
Z01-105	6	10K 1/4W 5% CF	R35,R44,R100,R102,R304-R305	VARIOUS	1/4 W 5 % CF
Z01-106	1	100K 1/4W 5% CF	R312	VARIOUS	1/4 W 5 % CF
Z01-107	3	1 M 1/4W 5% CF	R25,R50,R107	VARIOUS	1/4 W 5 % CF
Z01-108	1	10 M 1/4W 5% CF	R306	VARIOUS	1/4 W 5 % CF
Z01-115	2	11 K 1/4W 5% CF	R310-R311	VARIOUS	1/4 W 5 % CF
Z01-128	1	12 M 1/4W 5% CF	R139	VARIOUS	1/4 W 5 % CF
Z01-153	1	150 OHM 1/4W 5% CF	R113	VARIOUS	1/4 W 5 % CF

Z01-154	1	1.5 K 1/4W 5% CF	R42	VARIOUS	1/4 W 5 % CF
Z01-155	2	15K 1/4W 5% CF	R47,R82	VARIOUS	1/4 W 5 % CF
Z01-187	1	1.8 M 1/4W 5% CF	R91	VARIOUS	1/4 W 5 % CF
Z01-205	1	20 K 1/4W 5% CF	R92	VARIOUS	1/4 W 5 % CF
Z01-223	3	220 OHM 1/4W 5% CF	R109,R111,R240	VARIOUS	1/4 W 5 % CF
Z01-224	1	2.2K 1/4W 5% CF	R307	VARIOUS	1/4 W 5 % CF
Z01-225	1	22K 1/4W 5% CF	R46	VARIOUS	1/4 W 5 % CF
Z01-226	6	220K 1/4W 5% CF	R7,R16-R17,R101,R103,R105	VARIOUS	1/4 W 5 % CF
Z01-228	1	22M 1/4W 5% CF	R89	VARIOUS	1/4 W 5 % CF
Z01-244	2	2.4 K 1/4W 5% CF	R133-R134	VARIOUS	1/4 W 5 % CF
Z01-394	1	3.9 K 1/4W 5% CF	R26	VARIOUS	1/4 W 5 % CF
Z01-474	2	4.7K 1/4W 5% CF	R88,R90	VARIOUS	1/4 W 5 % CF
Z01-512	1	51 OHM 1/4W 5% CF	R36	VARIOUS	1/4 W 5 % CF
Z01-567	1	5.6 M 1/4W 5% CF	R104	VARIOUS	1/4 W 5 % CF
Z01-625	1	62 K 1/4W 5% CF	R43	VARIOUS	1/4 W 5 % CF
Z01-682	1	68 OHM 1/4W 5% CF	R48	VARIOUS	1/4 W 5 % CF
Z01-683	2	680 OHM 1/4W 5% CF	R118,R218	VARIOUS	1/4 W 5 % CF
Z01-684	1	6.8 K 1/4W 5% CF	R53	VARIOUS	1/4 W 5 % CF
Z01-823	2	820 OHM 1/4W 5% CF	R117,R119	VARIOUS	1/4 W 5 % CF
Z02-1004	6	1.0 K 1/4W 1% MF	R41,R77,R79,R112,R205,R225	VARIOUS	1/4 W 1 % MF
Z02-1005	25	10.0 K 1/4W 1% MF	R15,R19-R22,R51-R52,R55,R60-R63,R67-R70,R85	R93-R94,R98,R206,R213,R226,R233,R236	1/4 W 1 % MF
Z02-1006	2	100 K 1/4W 1% MF	R86,R97	VARIOUS	1/4 W 1 % MF
Z02-1007	2	1.00 M 1/4W 1% MF	R72,R75	VARIOUS	1/4 W 1 % MF
Z02-1025	2	10.2 K 1/4W 1% MF	R207,R227	VARIOUS	1/4 W 1 % MF
Z02-1075	1	10.7 K 1/4W 1% MF	R216	VARIOUS	1/4 W 1 % MF
Z02-1104	2	1.10 K 1/4W 1% MF	R212,R232	VARIOUS	1/4 W 1 % MF
Z02-1105	1	11.0 K 1/4W 1% MF	R87	VARIOUS	1/4 W 1 % MF
Z02-1106	1	110 K 1/4W 1% MF	R96	VARIOUS	1/4 W 1 % MF
Z02-1216	1	121 K 1/4W 1% MF	R38	VARIOUS	1/4 W 1 % MF

Z02-1245	3	12.4 K 1/4W 1% MF	R29-R31	VARIOUS	1/4 W 1 % MF
Z02-1305	1	13.0 K 1/4W 1% MF	R234	VARIOUS	1/4 W 1 % MF
Z02-1375	2	13.7 K 1/4W 1% MF	R209,R229	VARIOUS	1/4 W 1 % MF
Z02-1505	3	15.0 K 1/4W 1% MF	R33,R84,R214	VARIOUS	1/4 W 1 % MF
Z02-1696	2	169 K 1/4W 1% MF	R39-R40	VARIOUS	1/4 W 1 % MF
Z02-1915	1	19.1 K 1/4W 1% MF	R237	VARIOUS	1/4 W 1 % MF
Z02-2005	4	20.0 K 1/4W 1% MF	R49,R56,R203,R223	VARIOUS	1/4 W 1 % MF
Z02-2104	1	2.10 K 1/4W 1% MF	R110	VARIOUS	1/4 W 1 % MF
Z02-2105	2	21.0 K 1/4W 1% MF	R54,R59	VARIOUS	1/4 W 1 % MF
Z02-2215	2	22.1K 1/4W 1% MF	R78,R80	VARIOUS	1/4 W 1 % MF
Z02-2265	1	22.6 K 1/4W 1% MF	R28	VARIOUS	1/4 W 1 % MF
Z02-2325	2	23.2 K 1/4W 1% MF	R200,R220	VARIOUS	1/4 W 1 % MF
Z02-2434	2	2.43 K 1/4W 1% MF	R14,R73	VARIOUS	1/4 W 1 % MF
Z02-2495	2	24.9 K 1/4W 1% MF	R217,R235	VARIOUS	1/4 W 1 % MF
Z02-2554	2	2.55 K 1/4W 1% MF	R210,R230	VARIOUS	1/4 W 1 % MF
Z02-2745	1	27.4 K 1/4W 1% MF	R32	VARIOUS	1/4 W 1 % MF
Z02-2875	1	28.7 K 1/4W 1% MF	R83	VARIOUS	1/4 W 1 % MF
Z02-3013	4	301 OHM 1/4W 1% MF	R129-R132	VARIOUS	1/4 W 1 % MF
Z02-3014	1	3.01 K 1/4W 1% MF	R303	VARIOUS	1/4 W 1 % MF
Z02-3015	2	30.1 K 1/4W 1% MF	R27,R99	VARIOUS	1/4 W 1 % MF
Z02-3324	1	3.32 K 1/4W 1% MF	R76	VARIOUS	1/4 W 1 % MF
Z02-3485	2	34.8 K 1/4W 1% MF	R202,R222	VARIOUS	1/4 W 1 % MF
Z02-3834	3	3.83 K 1/4W 1% MF	R57,R201,R221	VARIOUS	1/4 W 1 % MF
Z02-3924	2	3.92 K 1/4W 1% MF	R34,R58	VARIOUS	1/4 W 1 % MF
Z02-4224	2	4.22 K 1/4W 1% MF	R23-R24	VARIOUS	1/4 W 1 % MF
Z02-4755	3	47.5 K 1/4W 1% MF	R116,R208,R228	VARIOUS	1/4 W 1 % MF
Z02-4756	1	475 K 1/4W 1% MF	R95	VARIOUS	1/4 W 1 % MF
Z02-4992	1	49.9 OHM 1/4W 1% MF	R37	VARIOUS	1/4 W 1 % MF
Z02-4994	4	4.99 K 1/4W 1% MF	R64-R66,R309	VARIOUS	1/4 W 1 % MF
Z02-6043	2	604 OHM 1/4W 1% MF	R135-R136	VARIOUS	1/4 W 1 % MF
Z02-6193	2	619 OHM 1/4W 1% MF	R123-R124	VARIOUS	1/4 W 1 % MF

Z02-6195	2	61.9 K 1/4W 1% MF	R45,R114	VARIOUS	1/4 W 1 % MF
Z02-6814	3	6.81 K 1/4W 1% MF	R81,R108,R115	VARIOUS	1/4 W 1 % MF
Z02-8253	1	825 OHM 1/4W 1% MF	R313	VARIOUS	1/4 W 1 % MF
Z02-8254	1	8.25 K 1/4W 1% MF	R18	VARIOUS	1/4 W 1 % MF
Z02-9095	1	90.9 K 1/4W 1% MF	R215	VARIOUS	1/4 W 1 % MF
Z02-9534	4	9.53 K 1/4W 1% MF	R204,R211,R224,R231	VARIOUS	1/4 W 1 % MF
Z02-XXXX	2	RESISTOR 1% SELSCT AT TEST	R121-R122	VARIOUS	1/4 W 1 % MF
Z14-1005	16	10.0K RN55.1% 1/4W 50 PPM	R1-R6,R8-R13,R137-R138,R238-R239	MILITARY	RN55 1/4W 0.10%
Z14-4994	4	4.99K RN55 .1% 25OR 50 PPM	R125-R128	MILITARY	RN55 1/4 W 0.10%
Z20-470409S01	1	4.7K X 9 SIP resistor network	RN300	SPRAGUE	256CK472X2PD

MSI PART NUMBER	QTY	DESCRIPTION	REFERENCE DESIGNATOR	MANUFACTURER	MANUFACTURER NUMBER
VO3-MYBP					
A04-1006HMCH1	3	.1 UF 50 V 20% MC	C4-C5,C9	CENTRALAB	CZ20C104M
A04-1007GTNH1	3	1 UF 35 V DT	C6-C8	SPRAGUE	199D105X0035BE
A04-220AGANI1	2	2200 UF 50 V 20% AE	C1-C2	PANA	ECE-B1VFS222
A04-470ADANH1	1	4700 uF 16V AE	C3	SIEMENS	82009-4700/16
A08-D12234201	1	34 VAC CT PC MT XFRM	T1	MAGNETCOIL	4-05-3-034
A08-D60113201	1	TRANSFORMER Mci# 4-05-2-012	T2	MAGNETCOIL	4-05-2-012
B01-4003	6	RECTIFIER DIODE	D1-D6	VARIOUS	1N4003
C02-1N152M001	1	-15 VOLT REGULATOR	U2	VARIOUS	UA79M15
C02-1P152M001	1	+15 VOLT REGULATOR	U1	VARIOUS	UA78M15
C02-1P501M002	1	5 VOLT LOW DROP REG.	U3	SGSATES	L4805CV
H08-005CFW001	1	5 PIN END CONNECTOR,GOLD PLAT	J4	PANDUIT	CE100F24-5-DA
H11-CRN160401	1	Crimp lug, screw size 6		ZIERICKMAN	A3651W/.144"HO
H20-MP0000001	4	PC MT MALE QUICKCONNECTOR	P1-P4	KEYSTONE	1267
J03-P240X0001	38	Black 24 AWG stranded hook-up wire			1550
J03-P242X0001	16	RED 24AWG stranded hookup wire			UL1007

J03-P243X0001	16	Orange 24AWG stranded hookup wire			
J03-P247X0001	16	Violet/Purple 24 awg, stranded			
K02-000000003	2	ELECT. ISOLATING THE	U1-U2	1ST TWO VOLTAGE REGUALTORS!	
K02-3051	3	NO 2 SHOULDER BUSH	U1-U3	KEYSTONE	3051
K06-4INCH	1	4 INCH CABLE TIES	FASTEN HARNESS TO BOARD	HEYMANMANU	3510NT90
K06-D08477	2	11` LADDER CABLE TIE		DENNISON	8477
K08-MYBPMB	1	MOUNTING BRACKET	MB1	MSI	MYBP-MB
L03-PWBSERLAB	1	SERIAL LABEL (KAPTON)		CRITCHELY	CR3-KG10F
L03-VMRHINSUL	1	4.5 X 5.75 X 7MIL MY	C1,C2	We make here w/ Lexan Material	
L03-VMRHINSUL	1	4.5 X 5.75 X 7MIL MY	C3	We make here w/ Lexan Material	
O03-2/56M3801	4	2/56 X 3/8 Round head, philips		VARIOUS	NONE
O03-2/56P0001	4	2/56 PC MT. PEM NUT		PENNENGINE	KF2-256
U05-MYBP	1	ASSEMBLY LABOR, V03-MYBP			