BENCHMARK MEDIA SYSTEMS, INC.

MicMan™ Jr. Installation Guide

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1.0 INTRODUCTION

1.1 General

The MicMan™ Jr. is a two channel portable mic-preamp system designed to achieve a very high level of performance with microphones and other low level signal sources. It is also characterized as a dual one-in, one-out mic-preamplifier with front panel variable gain from +26 to +82 dB. The MicMan™ Jr. is ideal for anyone who wants very high performance from analog or digital recorders, live broadcasts, and sound reinforcement, using the superior microphone technologies available today. With an individual MicMan™ Jr at or close to each microphone, additional performance benefits are realized by eliminating long mic cable runs to a console. By immediately raising the microphone signal amplitude to line level, minimum interference is allowed to enter the system from power lines, SCR stage lighting, etc., so that longer lines may be driven.

In addition to the obvious use as a microphone preamplifier, the unit may be used wherever amplification is needed and minimum noise is desired, such as with electric guitars. One application which is finding increased acceptance is to bring up low telco levels without adversely affecting the noise floor. With its overall amplification range of +26 to +82 dB and input clip point equal to the output clip point minus the amplification, the MicMan™ Jr. becomes a low noise gain block with performance that is very excellent compared to standard operational amplifier circuits.

In this manual we reference all voltage amplitudes to 0 dBu, i.e., a voltage reference of 0.7746 volts. See the Benchmark Media Systems application note “A Clean Audio Installation Guide” by Allen Burdick.

1.2 Features

The MicMan™ Jr. is one of a series of very high performance amplifier and processing modules, a product line known as the IFA Interface Amplifier Series. The preamplifier features:

- Front panel variable gain from +26 to +82 dB
- A 1 dB noise figure
- 0.001% THD @ 1 kHz, A = 40 dB (22 kHz measurement filter)
- A 160 kHz bandwidth
- +12 V phantom microphone power capability

The balanced output section utilizes an NE5532, which provides all of the very desirable qualities of a designed-for-audio op-amp. Output impedance is 60 Ω, while the output clip point is +27 dBu when using the external ± 16 volt power supply included. The 160 kHz bandwidth provides excellent transient and square wave response, with low phase shift at 20 kHz (≤ 9°).

A red LED provides indication of power presence, from either the internal minus 9 volt battery or the external -16 volt supply.

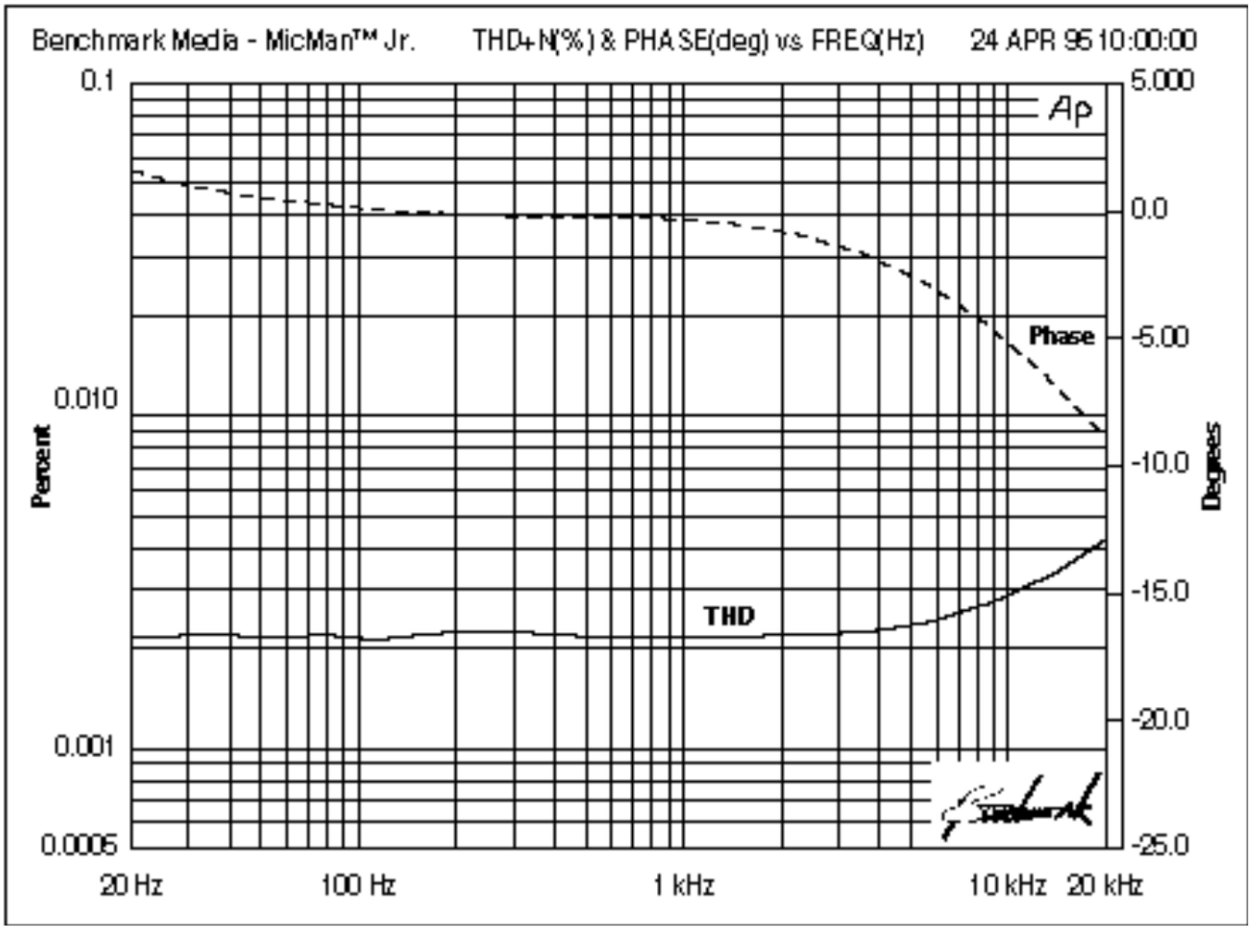

Fig 1.0 THD + Noise Performance

2.0 UNPACKING

Care has been taken in packing the MicMan™ Jr. to assure that it will withstand normal shipping conditions. Examine the equipment carefully as it is unpacked. If the shipping carton appears to have been damaged, check the equipment and immediately notify the carrier and Benchmark.

3.0 INSTALLATION

A correct understanding of the proper installation is necessary to achieve the capabilities built into the MicMan™ Jr. It is important that the Benchmark Media Systems, Inc. application note, “A Clean Audio Installation Guide,” be read, digested, and applied as a part of the installation of MicMan™ Jr.

3.1 Packaging Options

The MicMan™ Jr. is housed in a 1/3rd wide modem style chassis of aluminum construction. The plastic bezel between each panel and the base of the chassis may be replaced with a deep bezel, to further protect the knobs and switches on either end of the chassis when used in remote operations. Call the Benchmark sales department for pricing and delivery. Rack mount kits, consisting of the RM-1 19" panel and RM-1 panel blanks, are also available to mount up to three similar Benchmark product chassis.

3.1.1 Rack Mounting

To rack mount the MicMan™ Jr., remove the knobs and the front plate to allow the removal of the plastic bezel. The rack mount panel replaces the plastic bezel. Place the rack mount frame against the base of the chassis, replace the front plate, and insert the mounting screws to secure the base of the chassis to the rack mount panel.

3.2 Battery Installation

The MicMan™ Jr. uses two standard 9V batteries to power the electronics of the module. The battery housing, accessible from the front of the chassis, is easily removed for battery installation or replacement. Be sure to observe proper polarity with the batteries. Additionally, 2 AA size 1.5 volt cells are located internally to add with the positive 9 volt source, providing the 12 volts necessary for microphone phantom powering. These are accessed easily by removing the *rear* cover of the chassis and then sliding the top cover off the base. The 9 volt batteries will have an operational life of approximately 10 hours, depending upon the microphones' phantom power requirements. The AA batteries have an ampacity of 2.55 amp-hours; hence, the expected life of the AA batteries will be at least 20 times that of the 9 volt batteries, or ≈ 200 hours.

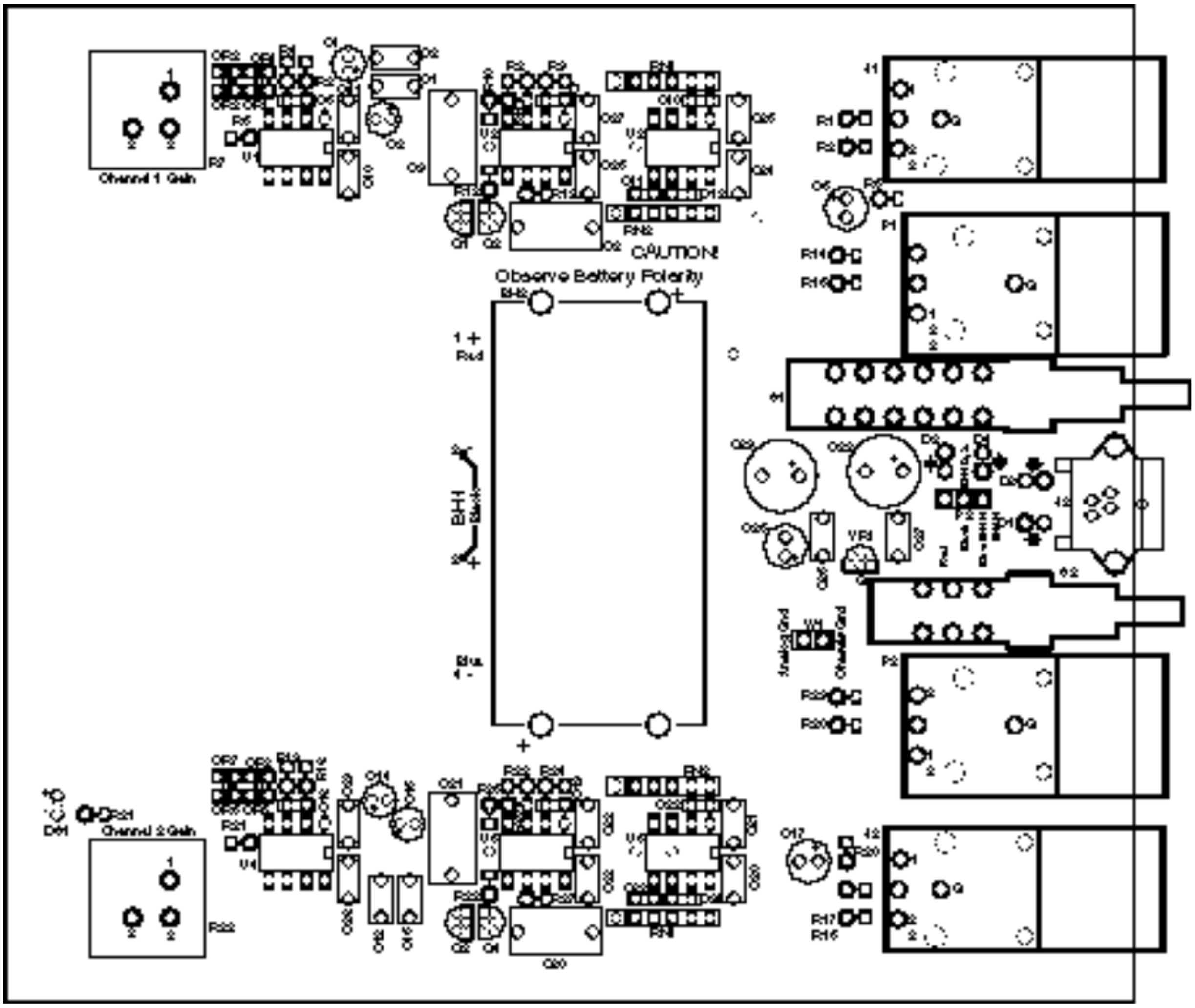

Fig. 3.0 - PCB Layout

3.3 Signal Connections - General

Both input and output connectors on the MicMan™ Jr. use the standard XLR style connectors. Pin 2 is high, or non-inverting, while pin 3 is the inverting pin on both inputs and outputs.

3.4 Input Connections

12 volt phantom power is available on pins 2 and 3, fed from 1.00 kΩ series resistors that are matched to 0.1%. The return of the phantom power is by way of the shield of the cable to pin 1 on the chassis.

3.5 Output Connections

Feeding balanced inputs from the MicMan™ Jr. is done normally. However, when feeding an unbalanced input from the MicMan™ Jr., only *one* output leg and ground must be used. *Do not* use the second output pin. Care must be taken not to short one of the amplifier's outputs to ground. This will not cause catastrophic destruction of the output, since current limiting is provided within the stage, but it will produce severe distortion at the chosen output.

!!! Warning !!!

> Do not ground one side of a balanced output when feeding an unbalanced input. This active output does not have a transformer, nor is it of the quasi-transformer type active outputs. Grounding an output will cause severe distortion and overload of the amplifier module.

3.6 Setting Levels

It is very important that you carefully set up the levels in your system. Set them so that all of the gains allow each of the various pieces of equipment and, indeed, every stage within every piece of equipment, to reach their clip points at the same time. This is done by taking almost all the gain needed from the amplifier stage that has the lowest noise figure, the MicMan™ Jr., thus maximizing the system's dynamic range. As simple as it sounds, this is the key to an outstanding system setup, assuming that the rest of the installation is correct and the equipment is of high quality.

4.0 OPERATION

Once the system has been installed and all levels properly set, microphone gain should only be adjusted at the MicMan™ Jr. An exception may be where you would like to "fade to off" between various recording segments, since the MicMan™ Jr. will not go to a "full off" condition. In such a case, the gain control of the recorder can be used to "fade to off" and then returned to its *original* preset position at the beginning of the next recording. Actual level adjustments must be made, however, at the mic-preamp to ensure optimum dynamic range.

4.1 Controls

The controls provided on the MicMan™ Jr. are the battery on/off, external power switch, the mic power switch, and the gain controls.

4.1.1 +12 Volt Phantom

Microphone power should be turned on 1/2 hour ahead-of-time, to allow the formation of the dielectric in the coupling capacitors.

5.0 SPECIFICATIONS

Input Section:

Type -	Active instrumentation type input with ultra low noise input
Input Clip Point -	Equal to the output clip point, minus the gain
Microphone Pwr -	+12 V Phantom (Optional) switch selectable
Input Impedance -	1.818 kΩ (balanced)
C M Rejection -	80 dB @ 1 kHz typ, 70 dB min. 70 dB @ 20 kHz typ., 60 dB min., 20 Hz - 20 kHz.

Output Section:

Type -	Active balanced, ground referenced output
Output Clip Point -	+27 dBu with external supply, +21 dBu when battery powered
Output Impedance -	60 Ω (150 or 600 Ω on special order)
Output Current -	40 mA peak per output leg
Differential Phase -	0.5° @ 20 kHz max., 0.35° typ.

Overall:

Gain Range -	+26 to +82 dB
THD @ A=40 dB -	0.001% typical 2 kHz (Measurement filters = 22 Hz and 22 kHz)
20 kHz Ø shift -	- 8° typical
Bandwidth -	160 kHz min.
Min Gain Noise -	-83 dBu typical
Noise @ A = 50 dB -	-77 dBu typical
Supply Current -	48 mA quiescent (typical)
Slew Rate:	≈ 8 V/μ Sec

5.1 Noise Performance Evaluation

5.1.1 Source Impedance

Specific procedures are necessary for the proper evaluation of noise performance from a microphone preamplifier. To obtain the correct noise level measurements, two specific criteria must be met:

[1] A 150 Ω source impedance

[2] A 20 kHz measurement bandwidth.

The preamplifier must have the proper source impedance at its input. If the input of the preamplifier does not "see" the normal microphone source impedance, it will amplify the noise of the parallel combination of the internal bias resistors and the 1.00 kΩ phantom power resistors. An input termination can be made up with an XLR type connector and the appropriate resistor. When making an input termination, be sure to use a carbon film or a metal film resistor, not a carbon composition resistor. Carbon composition resistors have a phenomenon known as "excess noise," and this will yield a noise figure that is misleading.

5.1.2 Noise Bandwidth

The second criterion that must be met for correct noise evaluation is the limitation of the measurement instrument's bandwidth to 20 kHz. All the Benchmark noise specifications are 20 kHz bandwidth measurements. If the test instrument that you are using does not have an internal filter for this purpose, you will need to construct a device that will give the same results as a 20 kHz "brick wall" filter. We have available an article by the late Deane Jensen, entitled "A 20 kHz Low Pass Filter for Audio Noise Measurements." If you should need to construct such a filter, this would be a good circuit to follow. If you need a copy, please call the sales department and request it.

Remember, when measuring noise, the output noise (for gains of ≈55 dB and higher) of the preamplifier will be the 20 kHz bandwidth Johnson noise of the source impedance (-130.8 dBu for a 150Ω source over 20 kHz), plus the amplification of the preamplifier, plus the noise figure of the preamplifier.

5.1.3 Additional Points to Note

Since the output impedance of the unit is 60 ohms, the length of line that may be driven is three to four times longer than can be driven with a 150 to 200 ohm microphone drive impedance for the same small signal high frequency cutoff point. For example, almost 2800' of foil shielded cable may be driven with a *small signal* high frequency cutoff of 30 kHz. Lines with the relatively high capacitance of 32 pF/ft may be driven up to 300', and may be driven to full amplitude at up to 30 kHz with the 40 mA output capability of the device. For longer lines low capacitance cable such as the Mogami 2574 should be used. Mogami 2574 has an interconductor capacitance of 6 to 7 pF/ft, versus the 30 to 32 pF/ft to be found in most foil shielded cables, and thus will preserve the high frequency slew capability of the system. Mogami cable is normally available from stock at Benchmark Media Systems, Inc. See "A Clean Audio Installation Guide" for more information on slew rate limiting due to cable capacitance.

5.1.4 Noise Performance Summary

The amplification required for most microphones will typically be 35 dB or greater, and the preamp section will most often be the limiting factor in the output noise of the electronics, prior to any recording or transmission medium. Therefore, the majority of amplification needed, consistent with desired headroom, should be taken from the MicMan™ Jr., since it has the lowest noise figure of any of the amplifying stages.

6.0 CIRCUIT DESCRIPTION

6.1 General

The excellent performance of the MicMan™ Jr. is a result of careful attention to detail in the circuit design. The following description explains the operation of each of the three stages in the unit and the available powering options.

6.2 Input Stage

Following the signal flow through the preamplifier, the input signal first encounters the phantom power circuit, which consists of a pair of 1.00 kΩ resistors that feed power to the microphone line. This power is turned on or off by the small pushbutton switch in the rear of the chassis, which has a black button. Next in line are the input coupling capacitors. These capacitors are aluminum electrolytics, rather than tantalum, for their superior dielectric absorption characteristic. Dielectric absorption is the distortion producing mechanism in capacitors. Additionally, all aluminum electrolytics are bypassed with film capacitors for superior high frequency performance.

Next are the 10 kΩ input bias resistors. These resistors provide the bias current necessary for the input transistors within the SSM2017. These are followed by the zener protection diodes, which protect the emitter-base junctions of the input transistors to the SSM2017. It is important to prevent these transistors from ever going into their emitter-base reverse biased zener mode. If this should happen, the low noise capability of the transistors is destroyed, and the devices are then more prone to failure. The zeners absorb the phantom power surge that occurs with the plugging and unplugging of a microphone. The last element of the input circuit, prior to the amplifier itself, is the 220 pF input capacitor, which provides high frequency roll off and frequency stabilization.

The SSM2017 is a high performance amplifier chip that was designed specifically to be a low noise microphone preamplifier. The combination of the 2.7 Ω resistor and the 2.5 kΩ potentiometer provide a gain range of 20 to 70 dB at the output of the chip.

6.3 2nd Stage Amplifier

The second stage of the microphone preamplifier is a combination gain of two amplifier and DC servo amplifier. The DC servo amplifier is necessary because of the rather large, as high as 100 mV, but of unpredictable polarity, DC output voltage of the SSM2017 amplifier chip. The servo senses this DC voltage with respect to the analog signal reference (0 volt reference). The only DC voltage residual that will remain after the servo is the DC offset voltage of the servo amplifiers themselves and the offset voltage of the output amplifiers.

6.4 Output Stage

The output amplifier stage consists of an NE5532 dual operational amplifier, one side configured as a non-inverting amplifier, and the other side as an inverting amplifier. Each half of the output stage drives a 30.1 Ω buildout resistor. The circuit topology was designed so that both halves of the output stage would have the same noise gain. This eliminates a differential output phase shift that might otherwise exist between the two halves of the output amp.

The D.C. offset voltage from the output amplifiers of the MicMan™ Jr. is typically less than 2 millivolts.

6.5 The DC Power System

Two power systems are provided with the MicMan™ Jr. They are the internal battery supply and the fully regulated external wall mount power supply. The switches, battery holders, and diodes provide isolation between the two systems.

6.5.1 The External Power Supply

The external supply may be either the PS-1 (included) or a PS-11 external supply for powering up to four mic-pre systems at once. The PS-11 will also rack mount along side the MicMan™ Jr., eliminating the need for numerous AC power ports to accommodate the PS-1s.

Isolation diodes, D1 and D2, are placed within the MicMan™ Jr. to protect the unit from reversed power supply voltages when other external power supply systems are used. When the MicMan™ Jr. is operated from an external supply, an additional power regulator is functional to provide the +12 volts necessary for phantom powering of the microphones. This regulator uses the +15 volt (or higher) source for the creation of the +12 volt power. The power on/off (source) select switch provides the selection between the 12 volt battery combination and the 12 volt regulator.

6.5.2 The Battery Supply

The battery supply consists of two 9 volt and two 1.5 volt batteries. The 9 volt batteries provide power for the amplifier circuitry. They have polarity protection with the use of two low on voltage Schottky barrier diodes. The two 1.5 volt batteries are series wired with the + 9 volt battery to provide the 12 volt phantom power for the microphone. As mentioned above, ten battery changes, if not more, may be expected for the 9 volt batteries before one change is necessary for the 1.5 volt cells. Please observe battery polarity when changing the 1.5 volt cells, since there is no polarity protection provided for these cells.

The power indicating LED gets its power from the minus power supply. Doing this will tend to equalize the life of the two 9 volt batteries since the positive battery is used with the microphone power.

This completes the MicMan™ Jr. circuit description.

7.0 TROUBLESHOOTING TECHNIQUES

Armed with the knowledge of the circuit descriptions given above, standard trouble-shooting techniques should be used to first determine the general area of a malfunction, and then the actual offending components. A review of the most basic of these techniques follows.

1. It is best to troubleshoot a module at a work bench using current-limited lab power supplies. Set the current limit of the power supplies to 125 mA. This will protect the module and still allow the location of failures to be made. A special connector pigtail interconnect system will have to be constructed, to provide power as well as signal inputs and outputs. Edge card connectors are available from Benchmark.

2. The highest percentage of failures within systems, without a doubt, are due to component failures with semiconductors. Another source of failure is with electrolytic capacitors whose dielectric may dry out. Improvements in capacitor manufacturing techniques, however, have reduced this problem.

3. Since most failures are catastrophic rather than a gradual degradation of performance, make a close visual inspection of the module. Look for discoloration of components and possible shorts between vertical leads of resistors, diodes, etc., and shorts on the PC board itself. Discoloration indicates excessive heat, and is most likely associated with component failure. Remove any component that has obviously failed, i.e., carbonized resistors or IC packages that are cracked, etc. A stereo optical magnifier such as the "OptiVISOR" #7, manufactured by Donegan Optical Co., will allow close inspection of the module and rapid identification of physical problems.

4. If fuses are blown, replace them and power up the module. If there are short circuits on the module, the current limiting of the power supplies will prevent further failures. The presence of a short will be shown by the current limiting of the power supplies. If this occurs, allow the supplies to run at their preset current limit. Look for any components that are operating hot to the touch. This will often show up shorts when there are no visual symptoms. Next, trace the current flow using a DC millivolt meter to view small voltage drops across PC board traces that are carrying relatively high currents. This technique will provide the precise location of shorts. Even sub-hairline shorts in bare boards can be easily located with this method. A pair of very sharp needle pointed probes, such as Huntron Microprobes™, are ideal for piercing the solder mask on the PCB. Meaningful voltage drop can be measured over as little as 1" of PCB trace.

Typically, one can just maintain hand contact on a surface at 130°-135° F (≈ 40° C). When in the modular frame, no component should run with a temperature beyond that.

5. Remove any components, i.e., transistors or integrated circuits, that are overheating. Most often at this point, the power supplies will come out of current limiting, and the module will function, at least in part. If further problems exist after the power supplies come out of current limiting, and the removed components have been replaced, they can most often be found by performing the normal voltage checks throughout the circuitry.

7.1 Circuit Board De-Soldering

Printed circuit boards are *very* easy to damage by excessive heat. Unless you have developed the specialized skills necessary to remove and replace components, we suggest that you leave the task to someone skilled in these techniques.

When servicing printed circuit boards, we strongly recommend the use of a vacuum de-soldering station. The proper technique with these stations is to apply the de-soldering tip to the area to be unsoldered and wait for the solder to thoroughly melt. You can be sure of a thorough melt by observing the top side of the board or by observing when the component lead moves about freely. *Only* when the solder there has become liquid, apply the vacuum while moving the hollow tip with the component lead in a circular motion. By rotating the lead, with the tip against the board, but *without* applying pressure to the pad, you are able to most thoroughly remove solder in the plated-through hole. In turn, the component will often drop out of the board when you are finished. If you push the tip against the board, it will often destroy the bond between the pad and the board, then requiring an eyelet to be inserted in the board before it can be used.

!!! WARNING !!!

If the solder is not thoroughly removed from the plated-through hole, attempting to remove the component will bring with it plating from inside the hole. This may destroy the usefulness of the board, depending on the size of the hole and the ability to replace the plating with an eyelet. If you find that your attempt to completely remove the solder from the hole and pads has failed, do not attempt to re-heat the area with the de-soldering tool, as this will *overheat* the pad, and not the area that is in need. As a result, the board is usually damaged. Rather, re-solder the joint, and then go back and apply the proper technique, by allowing the solder in the joint to thoroughly melt *before* applying vacuum. This technique uses new solder as an efficient heat conductor to the total area, eliminating hot spots.

7.2 Circuit Board Re-Soldering

Here is an effective technique that ensures highly reliable hand solder joints. It involves heating the component lead first, since it usually has the higher mass and is often in less danger of being damaged from excessive heat.

First, brush a small amount of liquid flux on the board and component area. This greatly aids in the solder flow through the hole, providing nice fillets on both sides of the board. We much prefer water soluble flux, both in the solder core and liquid, because of its easy clean up, and freedom from the need for (and soon to be banned) chlorofluorocarbon solvents.

Next, apply a small amount of solder to the tip of the soldering iron at the same time as you apply the iron to the component lead. This provides a good solder joint between the lead and the iron. This good junction between the iron and the component lead is necessary for efficient heat transfer.

The iron should be approximately 1/8" above the board. When the lead has come up to temperature so that it melts solder when placed against it and has good wetting, slide the soldering iron down the lead and heat the printed circuit board pad while applying a controlled amount of solder to the joint. All of this should take no more than two to four seconds.

If the component that is to be installed has leads that are oxidized, it will be necessary to pre-clean them. This may be done with either a Scotch-Bright® abrasive pad, a fine bristle fiberglass brush, or even woven flexible wire strap, among other methods.

8.0 WARRANTY

> Benchmark Media Systems, Inc. warrants its products to be free from defects in material and workmanship under normal use and service for the period of five years from the date of delivery. This warranty extends only to the original purchaser. This warranty does not apply to fuses, lamps, batteries, or any products or parts which have been subjected to misuse, neglect, accident, or abnormal operating conditions.
>
> In the event of failure of a product under this warranty, Benchmark Media Systems, Inc. will repair, at no charge, the product returned to its factory. Benchmark Media Systems, Inc. may, at its option, replace the product in lieu of repair. If the failure has been caused by misuse, neglect, accident or abnormal operating conditions, repairs will be billed at the normal shop rate. In such cases, an estimate will be submitted before work is started, if requested by the customer.
>
> The foregoing warranty is in lieu of all other warranties, expressed or implied, including but not limited to any implied warranty of merchantability, fitness or adequacy for any particular purpose or use. Benchmark Media Systems, Inc. shall not be liable for any special, incidental, or consequential damages.
>
> A return authorization is required when sending products for repair. They must be shipped to Benchmark Media Systems, Inc. prepaid and preferably, in their original shipping carton. A letter should be included, addressed to the customer service department, giving full details of the difficulty.

This completes the MicMan™ Jr. service instructions.

References

1) "A Clean Audio Installation Guide," Allen H. Burdick, 1988, Benchmark Media Systems, Inc., AN-01

2) Low Noise Electronic Design, C.D. Mothchenbacher & Fitcher, 1973, John Wiley & Sons, Inc., ISBN 0-471-61950-7

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