IFA-7
INSTRUCTION MANUAL

BENCHMARK MEDIA SYSTEMS, INC.
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REVISIONS				
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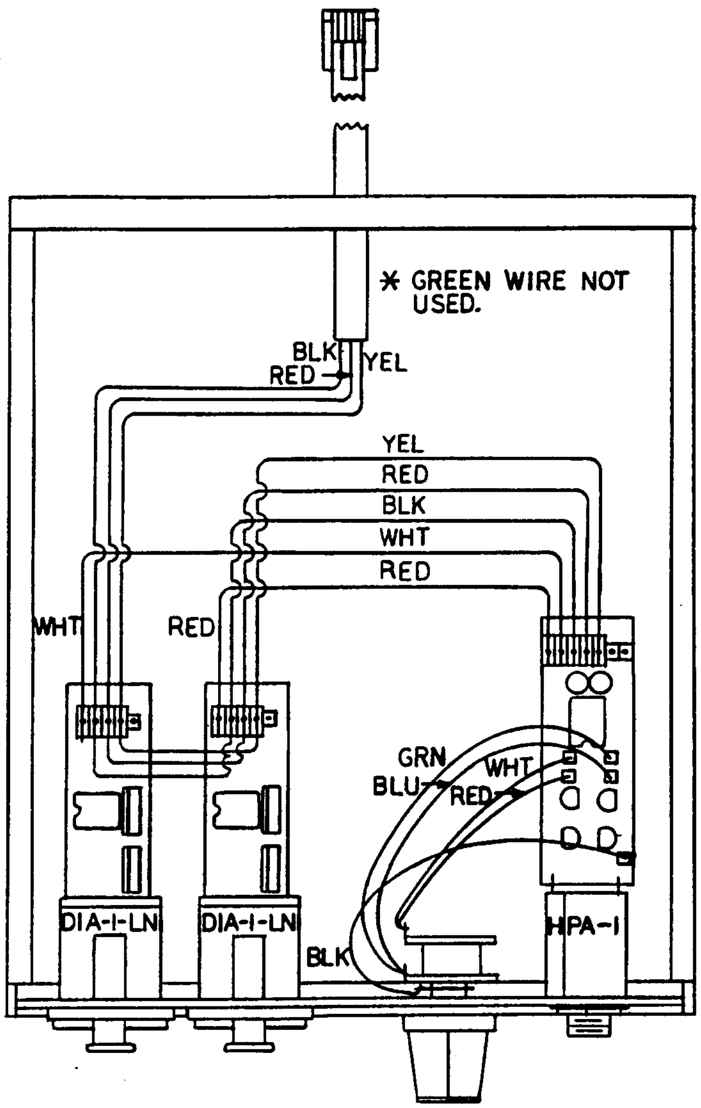

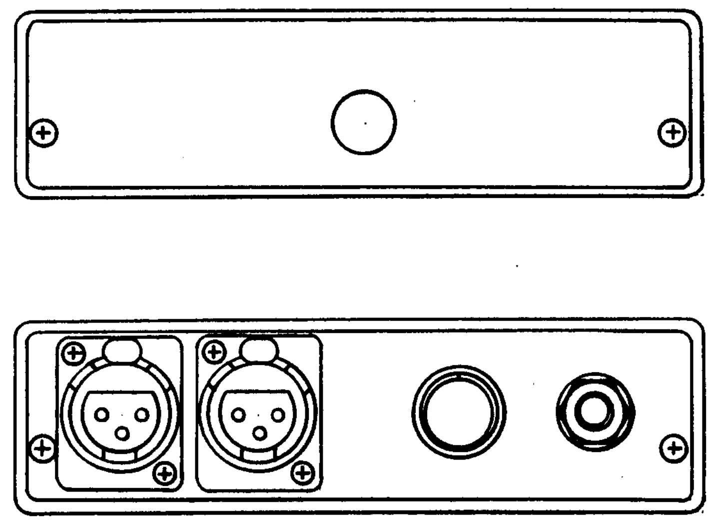

NOTES:
1. POWER CORD MAY PASS THROUGH EITHER END PLATE.

Benchmark Media Systems		
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DATE 7/25/88		
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BENCHMARK MEDIA SYSTEMS, INC.

DIA-1 and 2 Instruction Manual

Table of Contents

1.0 Introduction

The standard DIA-1 & 2 and the Low Noise DIA-1-LN & 2-LN Differential Input Amplifiers are universal input devices designed to provide both a balanced input and the gain reduction necessary to interface consumer and semi-professional audio equipment to the professional environment.

2.0 General Features

The DIA-1&2 balanced input devices have fixed gain that must be selected at the time of order, an input impedance of 100 k Ω with the standard series and 10 kΩ with the low noise series, and an output impedance of 47 Ω, single ended. This circuitry is on a small printed circuit board that may be mounted on either a 1/4" TRS jack or a female XLR type jack, both Switchcraft and Neutrik types, or the device may be used card only. The operational amplifiers used are either a TLO71 or 72 with the standard DIA series and a NE5534 or NE5532 in the low noise series.

The DIAs may be purchased with a choice of two connectors, a female XLR type or a 1/4" Tip Ring Sleeve type. The DIAs may also be purchased with no connector. The gain options that are available are; unity, -6 dB, and -12 dB. Additional gain structures may be purchased on a custom basis with surcharge added.

2.1 Gain Structures

Most of the applications of the DIAs will be in converting Semi-Pro or High Fidelity equipment to operate in the professional environment. Therefore a loss in amplification is most commonly needed. The choice of gain directly effects the input headroom of the device. All DIAs operating at the power voltage limits, will have an <u>output</u> clip point of approximately +22 dBu. (The dBu is a voltage reference of 0.7746 volts without an impedance reference) The input clip point of a unity gain DIA, operating at the power voltage limit, will be equal to its output clip point. A DIA with 6 dB of loss, however, will have an input clip point that is 6 dB higher than its output clip point, +28 dBu, and a DIA with 12 dB of loss will have an input clip point that is 12 dB higher than its output clip point, +34 dBu. Likewise any custom positive gain structures will directly <u>reduce</u> the input clip point (referenced to unity gain) by the amount of that gain.

In the professional environment, most equipment is capable of putting out +27 to +30 dBu. All of this is to say that if you want to maintain the system dynamic range, input clip points of +27 or higher should be considered necessary in your modified equipment. This necessitates that 6 dB loss be taken in the DIA, and this is what we recommend. If a direct drop from +4 dBu to -10 dBV (-8 dBu) is desired then the -12 dB gain structure may be chosen. In our opinion, however, the 6 dB loss is preferable. This is because most IHF type equipment has an input attenuation potentiometer directly after the RCA pin jack, and the additional loss necessary may be taken at this point. This preserves some gain capability, should it be necessary from time to time, without sacrificing the input clip point.

3.0 Unpacking and Installation

As with any delicate electronic equipment , care must be exercised in the handling of this board. Carefully unpack the DIA-1 or 2 and place it on the work table for installation in the intended equipment. Care has been taken during packing to assure the withstanding of normal shipping conditions. Examine the equipment carefully as it is unpacked. If the shipping carton appears to have been damaged during shipment check the equipment and notify the carrier and Benchmark immediately if there are signs of damage.

3.1 Physical Installation

The appropriate holes must be drilled or punched in the intended equipment chassis. For 1/4" jack installation a 3/8" hole should be drilled. From a practical standpoint it is well to start with a small drill size, such as a 1/8", to be used as a pilot hole, with a 1/4" intermediate hole also a genuine help before drilling the 3/8" final size. This will enable more precise location of the jack. If you no not have a deburring tool, a larger drill bit will work for that operation.

!!! Warning !!!

Be careful not to over tighten the nut on the plastic threads of the 1/4" jack. It is very possible to strip the threads on this connector.

Figure 3.1 shows the drill pattern for the Switchcraft D3F female XLR type connector.

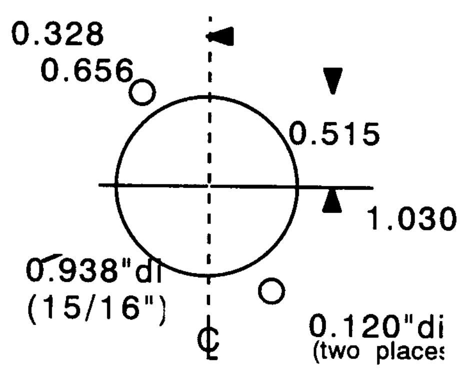

Fig 3.1 Switchcraft D3F Drill Template

You may find it convenient to have removed the inner portion of the D3F connector, with the board attached, while mounting the metal portion of the D3F.

3.2 Electrical Installation

The DIA-1 must be powered from bipolar supplies. The power voltage range is from ±9 to ±18 volts for the standard series, and to ±22 with the low noise series. If the devices need to be installed in equipment that have high voltage supplies only, such as in power amplifiers, on board zener regulation may be added. A group of three wires at the rear of the DIA-1 are used to bring power into the device. The red wire must connect to the positive supply, the blue wire to the negative supply, and the black wire ties to the power supply common point. See figure 3.2 for the correct pin assignments.

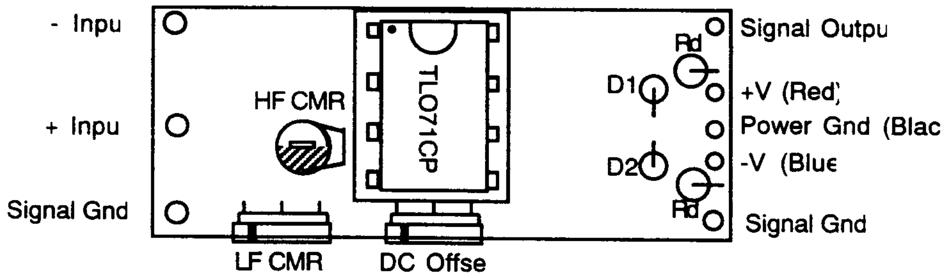

Fig 3.2 DIA-1 Connections and Controls

The DIA-2 must be powered from a single positive supply. The power voltage range is from +18 to +36 volts for the standard series, an to +44 volts for the low noise series. Two wires at the rear of the DIA-2 are used to bring power into the device. The red wire must be connected the supply's positive terminal and the black wire to the supplies negative terminal. See figure 3.3 for the correct pin assignments.

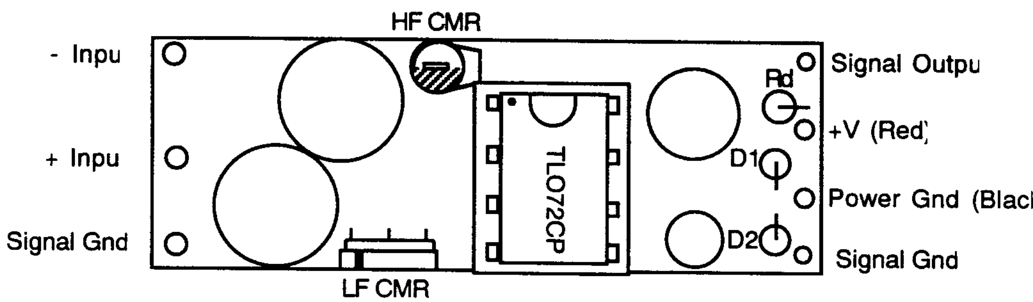

Fig 3.3 DIA-2 Connections and Controls

Output connections are made at the right end of the board. Output wires should be soldered to the two extreme outside holes. The output signal to the top hole and the ground to the bottom hole. The input connections, shown on the left end of the board are solder connections if you ordered "board only". The inputs, as identified on the pictorial, are correct for the board only, the 1/4" TRS jack, and for the XLR type connector.

3.2.1 Power Connections

Use the highest power supply voltage possible within the constraints of the op-amp limits. Often within a piece of equipment you will find both unregulated voltages of ± 15 to ± 18 volts as well as ± 9 to ± 12 volts regulated (+30 and +24 respectively for the DIA-2). It is sometimes possible to power the DIA-1 or 2 using the raw DC voltages, provided the ripple content is very low, but since the NE5532 and NE5534 do not have high power supply rejection ratios, caution must be exercised when doing this. Using the highest voltage available will give the best headroom, but high ripple content will degrade the signal to noise ratio, particularly in the annoying 120 Hz range. So use this option only if you can measure the results of your work.

Once again the maximum supply voltage that the TLO series op amps may use is ±18 volts (+36 on the DIA-2) and ±24 on the DIA-1-LN (+48 on the DIA-2-LN). Powering the amplifiers from higher voltages than these, <u>must</u> be accomplished using the optional on board zener regulation. When installing the DIA-1 or 2 in a power amplifier, it is preferable to power the device from the high voltage power supply by using this zener regulation. The ±10 volt supply that exists in many of the

CROWN power amplifiers will limit the headroom of the DIA-1 by approximately 3.5 dB.

There is no limitation to the maximum power supply voltage that may be used when using zener regulation. The physical space limitations necessary for the dropping resistors limit the maximum supply voltage to ±42 volts in the case of the DIA-1 and +58 volts in the case of the DIA-2. Higher supply voltages than these require the dropping resistors be mounted external to the DIA board. A convenient place to mount the external dropping resistors is directly at the power amplifiers filter capacitors. The chart on the schematic lists the appropriate resistor values for varying supply voltages. A set of dropping resistors is necessary for each DIA board to be installed within a power amplifier. The values for resistors not listed for the DIA-1 may be calculated by

$$R = \frac{V_{ps} - 18}{0.01}\ \Omega \qquad [3.1]$$

and the power rating of the resistor may be calculated by

$$P_r = (V_{ps} - 18) \times 0.02\ \text{Watts}, \qquad [3.2]$$

rounded off to the next higher standard power rating. The formulas for the DIA-2 are

$$R = \frac{V_{ps} - 36}{0.01}\ \Omega \qquad [3.3]$$

and

$$P_r = (V_{ps} - 36) \times 0.02\ \text{Watts}, \qquad [3.4]$$

again rounded to the next higher standard power rating.

For example, the DIA-1 will power from the following;

Bipolar Supplies	R_d	P_r
±60 Volt Supplies	4500 Ω	1 Watt
±70 Volt Supplies	5500 Ω	1 Watt
±80 Volt Supplies	6500 Ω	2 Watt
±90 Volt Supplies	7500 Ω	2 Watt

3.2.2 Input and Output Connections

If the DIA-1 or 2 was purchased with a connector attached, then of course no input connections need to be made to the board. If you purchased a board only, then the intended input wires must be soldered to the P.C. board according to figures 3.2. and 3.3 The unbalanced output connection must also be made. Use the Figure 3.2 and 3.3 to identify the correct hole locations.

!!! Warning !!!

> The DIA 1&2 are constructed on single sided printed circuit boards that may be easily damaged by excessive heat while soldering. It is very easy to "lift" a run from the board hence extreme caution must be exercised during the soldering process. We strongly recommend the use of a temperature controlled soldering station, set for a temperature of 600°. See the section on soldering in the Troubleshooting and Repair section 4.0

The DIA-1 is a DC coupled device, therefore you must be sure that no DC voltage is present at the output of the original equipment. If this is not done the DIA-1 will amplify this DC voltage. If DC is present, 100 μF aluminum electrolytic capacitors should be installed between the signal source and the input of the DIA-1. This large a capacitor is necessary to preserve the common mode rejection ratio of the DIA-1. Even larger capacitors are needed for the DOA-1-LN, and 330 μF, or larger, capacitors are recommended. The DIA-2 has no need for further isolation, as it already is an AC coupled device. Connect the existing input lead (original input in equipment) to the signal output of the DIA board.

When connecting the power and signal wires of the DIA-1 to their respective points, you should be aware of the jumper strap that ties the power ground and the signal ground together. This jumper offers an option for the installer. While there is normally no problem, it is possible to separate the power and signal grounds as a means of achieving hum free audio. It is our experience that this option is rarely needed since there is very little current flowing in the ground lead, unless the zener option is installed on the card, and then only to the amount allowed by the combined tolerance limits of those components.

The "ground" lead is the signal reference, therefore it is important where this lead is connected. We have found that some bipolar power supply common points are not necessarily a clean audio reference, whereas, the signal ground originally used with the equipment is almost always a good reference point. Care at this point is necessary in order to achieve the noise floor as a system, to which the DIA is capable. Perform close noise measurements and/or careful listening tests under high gain, to determine the result of your work.

3.2.2.1 Equipment Interconnection

Connect the output of the equipment that is feeding the newly modified piece (in which the DIAs were installed) in the following fashion. Balanced outputs are connected using both the black wire as the inverting and red wire as the non-inverting signal path in normal foil shielded audio cable. Connect the non-inverting output to non-inverting input and inverting output to inverting input. The shield of the interconnecting cable should be connected at only one end, either the output end or the input end. Additionally a separate insulated wire should tie the pieces of equipment together. See the Benchmark Media application note, "A Clean Audio Installation Guide" by Allen H. Burdick for the particulars as to how this external wire should be connected.

Unbalanced feeds should be connected to the input of the DIA in a similar fashion with the exception of the black wire (inverting input), which should connect to the signal reference (usually chassis ground) of the sending equipment. This is known as forward referencing. It allows the DIA to reject voltage differences between the two pieces of equipment. Again see the "Clean Audio Installation Guide".

!!! Notice !!!

It is not uncommon for the manufacturers of high fidelity and semi-professional equipment to place a series resistor between the output of the internal amplifier and the RCA connector, whose value may be as high as 10 kΩ. The purpose of this resistor is to protect against those who would "mix" two outputs via a "Y" connector. This resistor will destroy the exceptional common mode rejection expected from the DIA and hence it should be removed.

3.2.3 Output Impedance

The output impedance of the DIAs is 47 Ω resistive. The purpose of this resistor is to isolate cable capacitance from the operational amplifiers output and thus preserve its phase margin. These devices are designed to work into input impedances not lower than 2 kΩ. If you intend to drive a long line, from 10' to 300' with your input unit, you will need to use a DOA line driver. If you have to drive a line longer than 300' then a CBO-1, with its high current output capability is the appropriate line driving device. This is due to the current requirements that are necessary to feed the cables capacitance at high frequencies. Further information on this may be found in "A Clean Audio Installation Guide".

3.2.4 Trim Adjustments

All of the variable controls on the DIAs are for factory presets, and are not user adjustments.

!!! Warning !!!

The factory sealed adjustments must not be adjusted by the installer or user without precise measuring equipment and a knowledge of the circuit parameters affected. These are not gain controls.

The DIA-1 has three controls that are sealed. Two of these are the common mode rejection adjustments and the third is a DC offset null. The DIA-2 has only the two common mode rejection adjustments.

If you have strong reason to believe that any of the factory presets have been changed or are not correct then the following procedure may be used to correct these settings.

3.2.4.1 DC Offset Adjustment

The DC offset control, shown in figure 3.2, allows the "no signal" DC voltage at the output of the DIA-1 to be adjusted to near zero volts. To perform this adjustment a 4&1/2 digit DVM, with 0.05% accuracy or better, is necessary. We recommend the Fluke 8050A voltmeter.

1. With no signal present, connect the voltmeter to the output of the DIA-1

2. Measure the output voltage and adjust it as close to zero as possible. This should be at least lower than 1.0 millivolt and in many cases may be adjusted to less than 10 microvolts. The resolution of the 8050A is 10 μV. The DIA should not be expected to maintain this low an offset voltage under varying temperature conditions. Op-amp thermal instabilities will prevent the tight maintenance of this setting over temperature. Therefore, if it is possible, adjust the offset voltage at or near the temperature the device will see in actual use.

3.2.4.2 Common Mode Rejection Adjustment.

Common mode rejection adjustment must be performed using an oscillator with a "single ended" output (ground referenced), a function generator will work very well and a sensitive, wideband analog, AC type voltmeter. The voltmeters found in distortion analyzers with sensitivities down to -100 dBu or better are good. A digital voltmeter is not a proper choice for this measurement. Most preferable, however, is a logarithmic type voltmeter, such as those formerly made by **dbx** and Valley People. Unfortunately these are no longer available, except perhaps on the used market. Additionally an oscilloscope is very advantageous in this test setup. The oscilloscope should receive its signal from the output of the voltmeter, where the voltmeter is acting as a preamplifier for the scope. The scope should be triggered from the output of the function generator.

Connect the test equipment to the Differential Input Amplifier as shown in figure 3.4

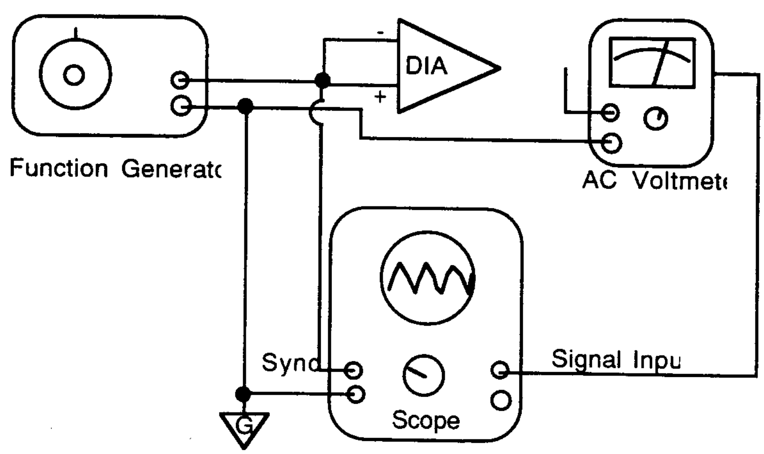

Fig 3.4 CMR Test Setup

The common mode rejection adjustment is actually a series of iterative adjustments between the resistive portion of the bridge and the capacitive portion. This adjustment should be performed at a frequency of 2 kHz.

Adjust the trim resistor for the best null possible at the output of the DIA while observing the voltmeter. If you have an oscilloscope as a part of your test setup, observe the phase shift of the remnant signal as you pass through a voltage minimum. The phase change is a more easily observable parameter when near the voltage minimum than is the voltage itself. Set the potentiometer for the center of the phase shift, and then proceed to the capacitive adjustment and adjust for a further reduction in output voltage. You will most likely need to switch the voltmeter to progressively lower ranges during this process. You will find the adjustments progressively more sensitive. Observing the oscilloscope will allow a significantly faster achievement of the desired null.

The common mode adjustment involves passive components that form a bridge around the active operational amplifier and this adjustment is independent of the operational amplifier. If an amplifier integrated circuit ever needs replacing, the common mode rejection adjustments will not need to be performed. The only possible exception to this would be the equivalent of a lightning strike that would take out or change the values of these passive components, in which case those parts would also need to be changed.

4.0 Troubleshooting and Repair

The DIA-1&2 are carefully constructed of very high quality components and therefore will probably never need servicing. Should a problem occur with your device, the following will aid in locating the problem.

The first step in troubleshooting, is to check for solder shorts and other mechanical problems that may have occurred during the installation. Many of the problems with electronic circuits may be solved by close visual inspection. We heartily recommend the use of an "OptiVISOR", manufactured by Donegan Optical Co., or an equivalent stereo optical magnifier.

If after inspection you have determined that no solder bridges were created during installation, the DC operating voltages should be checked. First determine that the proper power voltages exist at the pins of the operational amplifier, pins 4 and 7 on the DIA-1 and pins 4 and 8 on the DIA-2. With the DIA-1 a positive voltage, referenced to ground, at pin 7 (the full power supply voltage) should be present. Likewise a negative voltage at pin 4 should be present. In the case of the DIA-2, pin 4 is ground and pin 8 should have the full power voltage present. The output pins of the amplifier should be checked next, that is, pin 6 on the DIA-1 and pin and 7 on the DIA-2. The DIA-1 should have less than 5 mV at its output, and in reality 100 µV or less, should be typical. These measurements should be made with no audio signal present. The DIA-2, on the other hand, should have a voltage that is nearly one half that of the power voltage present at its outputs. If the output voltages are not correct, under no signal conditions, the replacement of the operational amplifier will in most cases fix the device.

On extremely rare occasions a faulty passive component may exist. If you are unable to locate the problem, a reasonable amount of troubleshooting assistance is available, via telephone, from the customer service department at Benchmark Media Systems.

4.1 Soldering Technique

Once the faulty component is isolated extreme caution must be exercised when removing the component and soldering in a replacement. Benchmark strongly recommends the use of a vacuum de-soldering station such as the Pace MBT-100.

The proper technique is to apply the de-soldering iron tip to the area to be de-soldered and wait for the solder to liquefy. As the solder becomes liquid the vacuum is applied while moving the tip of the iron and rotating the lead of the component coming through the circuit board. Rotate the lead without applying pressure to the pad. If this procedure is correctly applied the component will often drop from the circuit board.

The following is a soldering technique that was developed by NASA to ensure highly reliable solder joints.

> The component lead is heated first since it usually has the larger mass and has little chance of being damaged by excess heat. This is done by applying a small amount of solder to the tip of the soldering iron while simultaneously applying the iron to the component lead. This allows some flux to make it to the component lead. The iron should be slightly above the circuit board. When the lead reaches temperature it liquefies the solder adjacent to 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 longer than as couple of seconds.

The component to be mounted on the circuit board may have leads that are oxidized. Clean them with a "Scotch Bright" abrasive pad, a fine bristle fiberglass brush or equivalent method.

This completes the DIA-1&2 instruction manual. 030392

REVISIONS

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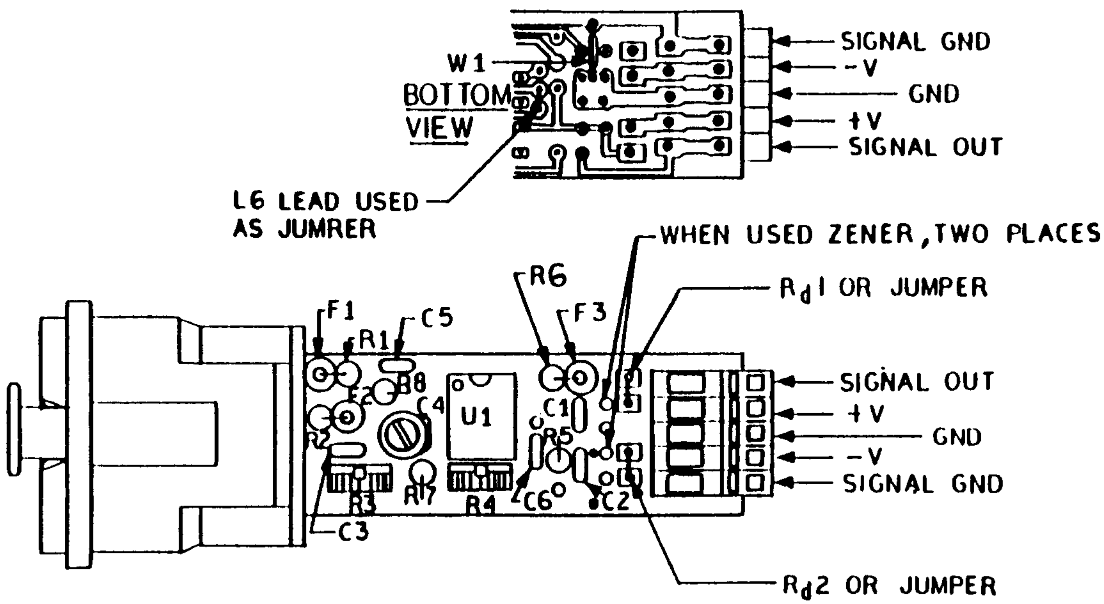


Benchmark Media Systems		
DIA-1-LN		
SCALE ——— DATE 9/30/87	CHECKED BY A.H. Burdick	DRAWN BY J.R.P.
SIZE B	COMP ASS'Y	DRAWING NO. 250021

BENCHMARK MEDIA SYSTEMS, INC.

HPA-1 Headphone Amplifier Instruction Manual

HPA-1 Installation
The HPA-1 is intended for installation in existing audio electronic equipment, blank rack panels or any application requiring a very high quality, general purpose headphone monitor.

Physical Installation
Installation of the HPA-1 requires two (2) mounting holes; one 3/8" diameter hole for the stereo volume /control and one 7/16" diameter hole for the headphone jack.

Center to center distance between the holes should not exceed 3". Clearance behind the panel mounting location should be 3-3/8" minimum. Caution should be used when tightening the two mounting nuts so as not to twist the interconnecting wires or strip the plastic threads on the headphone jack.

Electrical Installation In General
As a precaution, do not connect power to the HPA with a set of headphones connected. Additionally the HPA-1 was designed to be used with headphones whose impedance is 60 Ω or greater.

All input and power connections are made via a 7 position connector strip at the rear of the HPA-1 amplifier PC board. The seven pins are 0.025" square posts on 0.1" centers which may be terminated using wire wrap tooling or by using the 7 pin female mating connector. The use of the 7 pin mating connector is generally preferable because of the inherent flexibility.

Terminating Wires to the Mating Connector

1. Strip the wire leads 3/32"
2. Lightly tin the lead and connector tab.
3. Solder the lead to the side of the tab, being careful not to create a solder bridge between adjacent connections. Once the solder connections are made cover the connections with heat shrink tubing.

Additionally, connections may be made using either AMPMODU® or Molex SL® connectors if you prefer.

Power Supply
Determine the power supply availability from the host equipment. The HPA-1 is capable of a peak current drain of over 600 mA. We recommend that a supply with a current capacity of 600 mA be used to allow the HPA-1 to run without the possibility of being current starved. If your internal supply does not have enough power available, you will need to design your own outboard power supply. Alternately a BENCHMARK PS-1 supply may be used to power the HPA-1 if high impedance (600 Ω) headphones will be used.

Once your source of power has been selected, locate or install three supply wires, +V, -V and G (ground). We recommend the following color code; +V = red, -V = blue, G = black. Connect the three power supply wires to the three center tabs of the seven pin connector as shown in figure 1.0. We strongly recommend that 0.25 Amp normal blow fuses be added in series with the power supply lines to each HPA-1 to help prevent catastrophic failure of output drivers should there be a loss of one of the power supply voltages. Remember that the HPA-1 is a relatively high current DC coupled device. While there is internal current limiting, incorrect power conditions can and *will* destroy the device! Benchmark Media Systems, Inc. will not be responsible for incorrectly installed or powered HPA-1s.

!!! Warning !!!

Inadvertent power supply polarity reversal at installation will cause the failure of the HPA -1. Loss of a single supply will cause the failure of the output line buffers, and any connected headphones. Power down the system before making any additions of adjustments to the wiring.

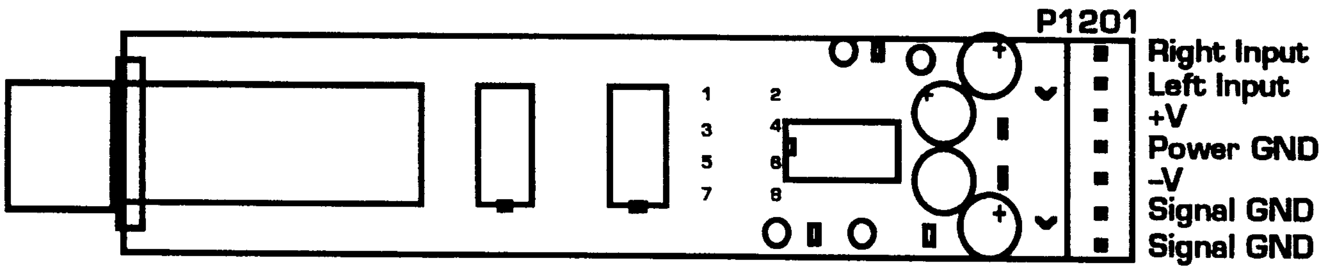


Fig 1.0 Connections to the HPA-1.

Input Connections

Locate and install two wires for each input from your unbalanced audio source. Referring to component assembly drawing for connector pinout designations, install the audio inputs using the techniques described under electrical installation.

Volume Control Knob

The HPA-1 is designed to use standard 1/4" knobs provided by the user. While the shaft length is ≈1", it can be shortened to accommodate shallow collet knobs. Once the desired shaft length has been marked, secure the pot in a bench vise by clamping to the shaft portion to be removed. Then carefully cut the pot shaft using a hack saw. This technique eliminates stress on the pot itself.

Please note that this shaft modification should take place before installation in chassis or panel.

Headphone Application

Any STEREO headphone whose actual impedance is 60 ohms or greater can be used with the HPA-1. We find the performance of the 60 Ω Sony MDR-V6 exceptionally fine. High impedance headphones, such as the 600 Ω AKG 240 series, have the advantage of lower current drain.

HPA-1 Specifications

INPUT:	Two (2) 10K ohm unbalanced
INPUT CLIP:	= Output clip minus Amplification factor.
OUTPUT:	Stereo, for use with Tip/Ring/Sleeve plugs ***only***.
OUTPUT Z:	30 Ω.
LOAD Z:	60 Ω or greater.
OUTPUT LEVEL:	up to +20 dBu into 60 ohms or greater, dependent upon power supply and load.
OUTPUT CONTROL:	Dual 100K ohm linear taper pot (log taper action).
GAIN RANGE:	off to +20 dB
BANDWIDTH:	20 Hz to 50 kHz min.
THD:	Determined by output level and load Z.
NOISE FLOOR:	Better than -75 dBu at maximum gain
POWER:	(Bipolar) ± 9 to ± 18 volts.
PHYSICAL:	Amp length behind panel = 3.65", width = 0.8" volume control; length behind panel = 0.8", width = .525", shaft length = .625", dia = 1/4".

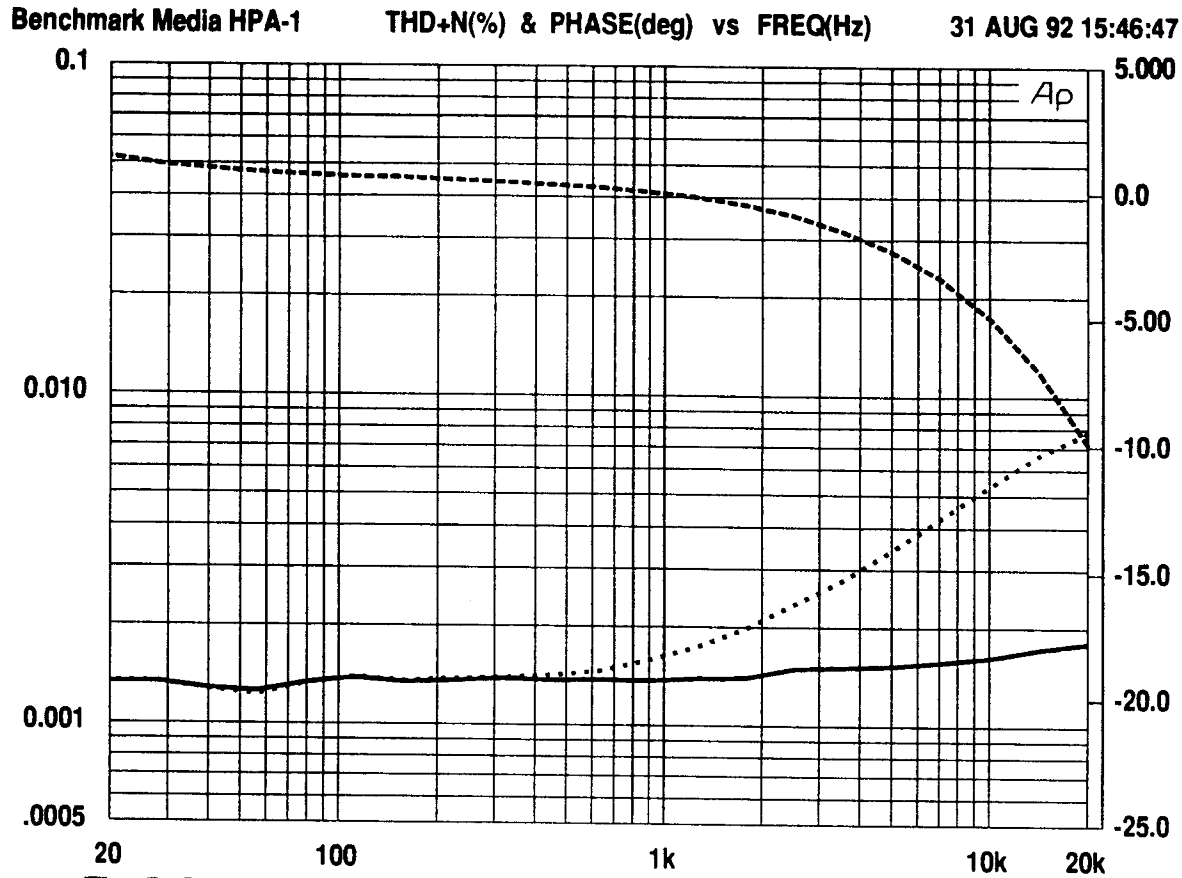


Fig 2.0 - HPA-1 60 Ω (Dotted) and 200 Ω (Solid) THD & Phase

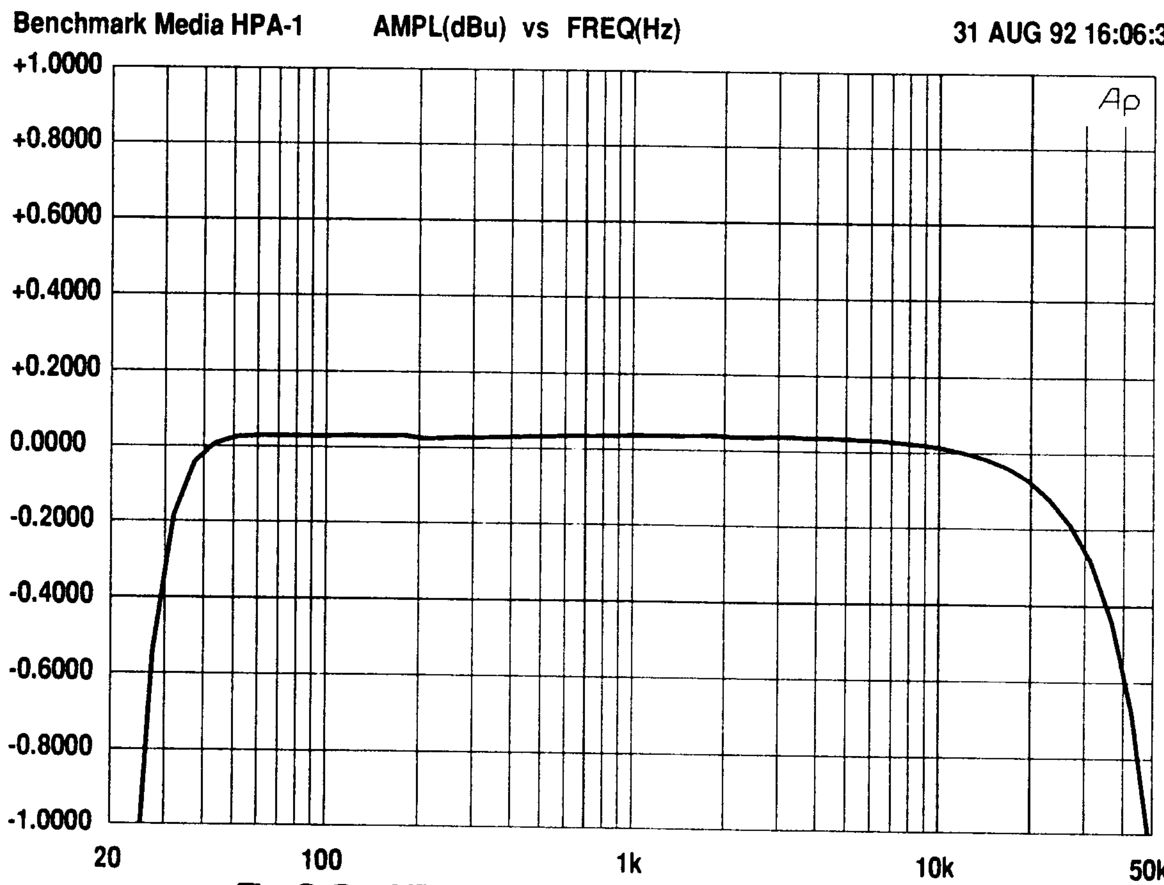


Fig 3.0 - HPA Minus 1 dB Bandwidth Points

Applications
The applications of the HPA-1 are numerous. The following suggestions are a few of the more common applications, and one or two not so common.

Unbalanced Line Driver
Occasionally it is necessary to feed one or a group of unbalanced inputs, such as VCRs. The HPA-1 makes an ideal unbalanced stereo line driver with its variable output, and high current drive capability. A pair of DIA-1 input amplifiers are necessary to make the transition from balanced to unbalanced. Single 100 kΩ potentiometers may be ordered to allow gain control over the individual amplifiers.

Talk-Show Round Table
In a group setting where headphones are used, it is very desirable to give each participant individual control over their own headphone volume. Any number of HPA-1s may be used in parallel when sufficient current is available from the power supply.

When building a talk-show round table system, we recommend the use of a linear open frame power supply such as those made by Power One. When using low impedance headphones (not recommended) the size of the power supply may be decreased from the normal requirement of "# of stations times the Peak current drain of each". This is done by adding a pair of large electrolytic capacitors at the output of the power supply. These capacitors will store current to be available for peak load requirements. The capacitor size may be chosen by

$$C = \frac{I_L \times 6 \times 10^{-3}}{\Delta V} \qquad [1.0]$$

Where C is in Farads. Let delta V be 0.5 volt or less, and IL is the total peak load current from all the HPA-1s. Using this method you can size the supply that you use at 40% of the original current requirement since the average "peak to average ratio" of most audio is 8 dB.

A pair of DIA-1 balanced input amplifiers will most likely need to be used ahead of the group of HPA-1s. The HPA-1 has an unbalanced input, and a pair of the balancing devices is necessary to make the transition. We recommend using a gain of -6 dB at the DIA-1s to maximize the headroom of the system.

The impedance that the DIAs must drive is the input Z of the HPA-1 (5K ohms) divided by the number of paralleled units. If more than five HPA-1s are to be driven from a standard DIA-1, or more than fifteen HPA-1s from a low noise DIA-1, then an additional HPA-1 should be used as an unbalanced line driver to handle the low impedance load.

Patch Bay Monitoring
By using the HPA-1 and two DIA-1 differential input amplifiers you have the ability to listen to the signals at a patch bay. The DIA-1s have an input impedance of 10K ohms and will generally not load the lines being monitored.

Portable Test Box
One of the handiest items in any tool kit is a portable test box. The test box should consist of at least a pair of balanced inputs, two unbalanced outputs to feed an oscilloscope or unbalanced AC voltmeter, and a stereo headphone amplifier. Again, this can be implemented using two DIA-1s from Benchmark, as well as the HPA-1 stereo headphone amplifier. Four 9 volt "transistor" batteries wired to give +/- 18 volts will work fine. We recommend using high impedance headphones (600 Ω) to reduce the current drain on the batteries. BNC output (after the DIA-1 input) connectors are desirable to feed either a scope or meter. Use a power switch to avoid changing batteries often. Enhancements to the box could be VU meters with the Benchmark RPM-1 PPM/VU card (the combination available from Benchmark) a phase meter and, perhaps, even a built-in frequency counter.

Theory of Operation
The HPA-1 consists of a dual operational amplifier with current boosted outputs. The circuit topology is that of an inverting amplifier with the current boost stages included in the feedback loop. The output current boost stages are integrated circuit buffers that have unique characteristics which ideally suit it

to this application. They have an output current limit of 300 mA, a very low crossover distortion, a 50 MHz bandwidth, and a slew rate of 500 v/µS. These characteristics allow it to be included in the feedback loop of the TLO72 and maintain stability.

The gain of the amplifiers is controlled by a dual 100K ohm linear taper potentiometer that is in the feedback loop of the composite amplifier. The advantage of this is that the noise floor is always optimum for any given amplification factor since the amplitude control is a true gain control. In this configuration the gain range is from full Off to +20 dB, usually more than adequate for most applications.

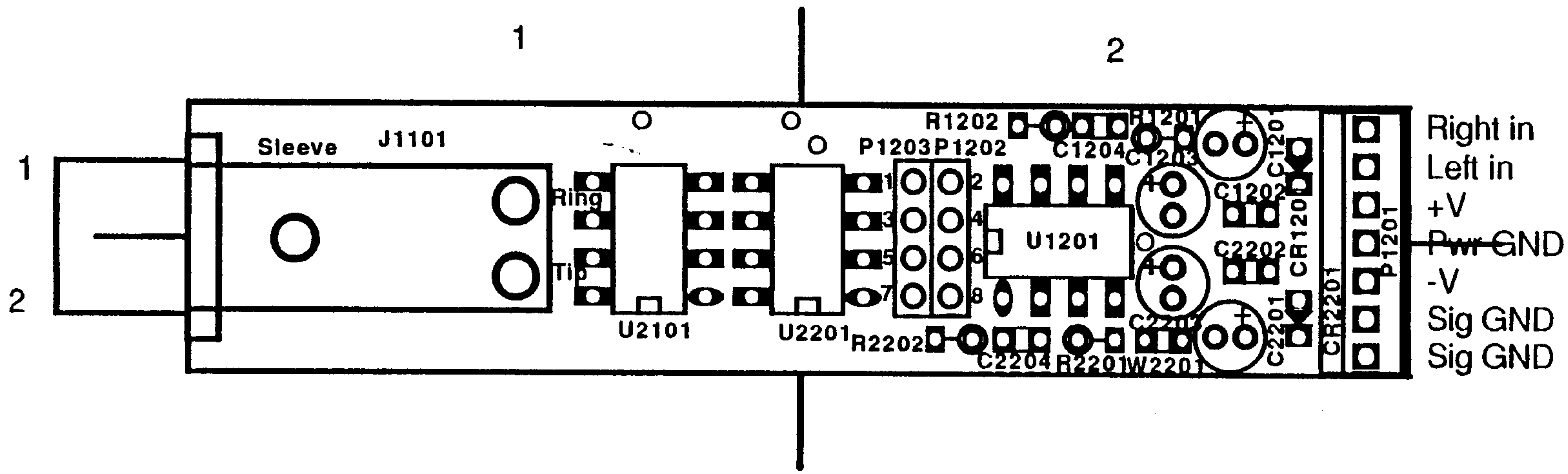
Troubleshooting
Since the unit uses plug in devices trouble shooting should begin with replacement of the ICs beginning with the TLO72 until the offending device is found. Very rarely will a passive component become defective.

Soldering Technique
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, such as the Pace MBT-100. The proper technique with these stations is to apply the tip to the area to be de-soldered and wait for the solder to thoroughly melt. You can be sure of a thorough melt by observing the top side of the board. 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 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. 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.

Circuit Board Re-Soldering
NASA has developed an effective technique that ensures highly reliable solder joints. It involves first heating the component lead, since it usually has the higher mass, by applying a small amount of solder to the tip of the soldering iron at almost the same time as you apply the iron to the component lead. This will allow some flux to make it to the component lead. The iron should be approximately 1/8" above the board. When the lead has come up to temperature so that it melts the 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 a couple of seconds. If the component that is to be installed has leads that are oxidized, it will be necessary to clean them. This may be done with either a Scotch Bright® abrasive pad or fine bristle fiberglass brush, among other methods.
This completes the service procedure. 111892

BENCHMARK MEDIA SYSTEMS, INC.
5925 Court Street Road Syracuse, NY 13206-1707
(315) 437-6300 FAX (315) 437-8119



BOARD OUTLINE DIMENSIONS .70 X 3.25

BENCHMARK MEDIA SYSTEMS, INC.		
HPA-1B		
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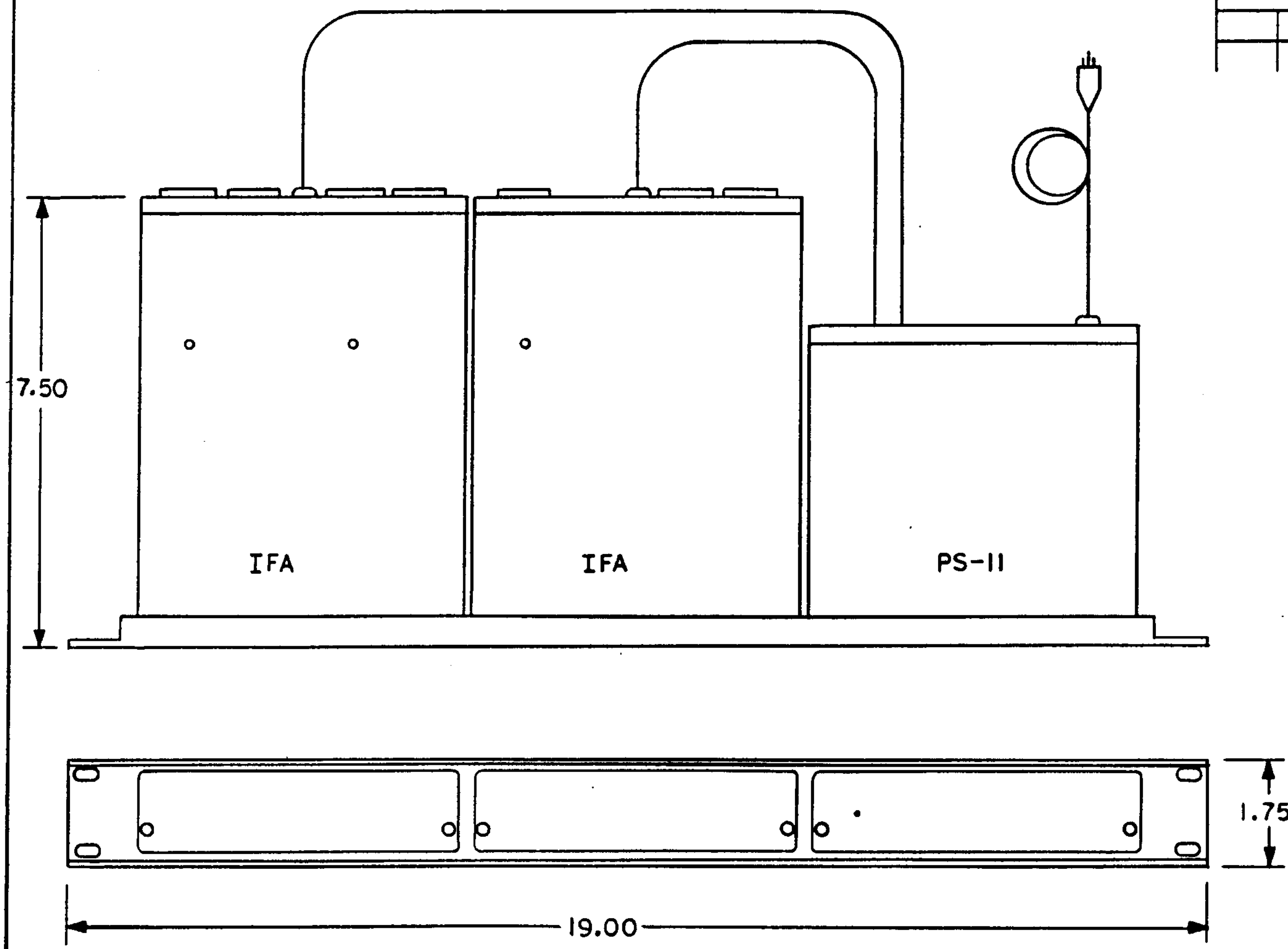
DATE 9 / 25 / 91		ASSEMBLY #
SIZE A	COMP. ASS'Y	DRAWING # 250097



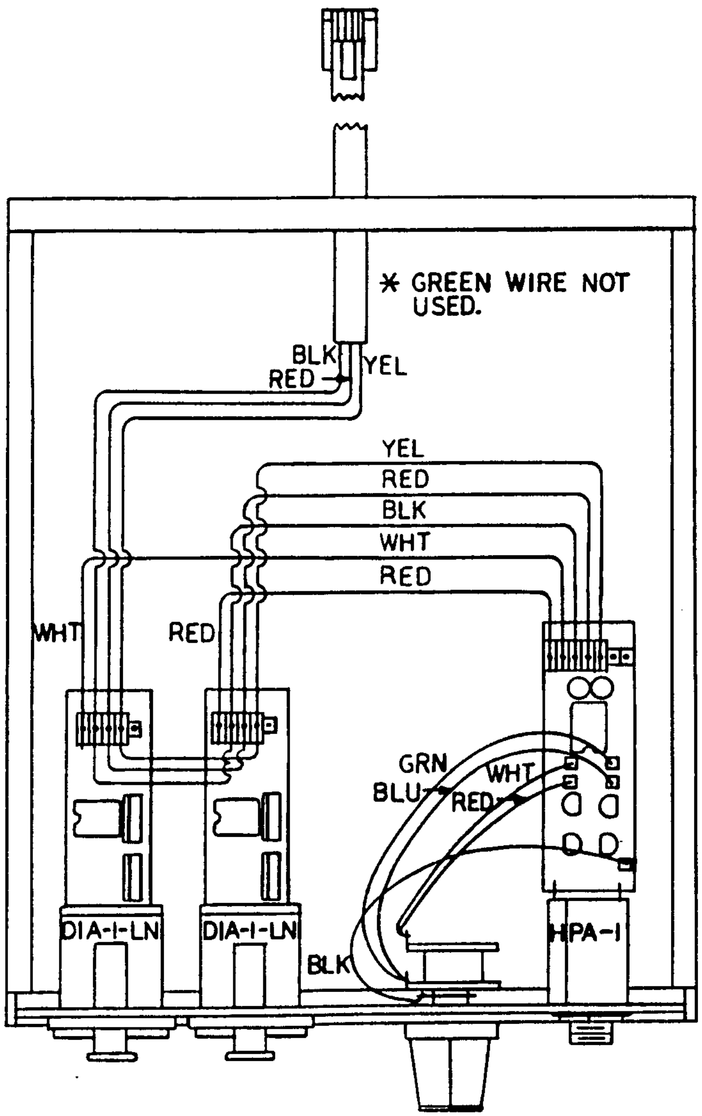
REVISIONS

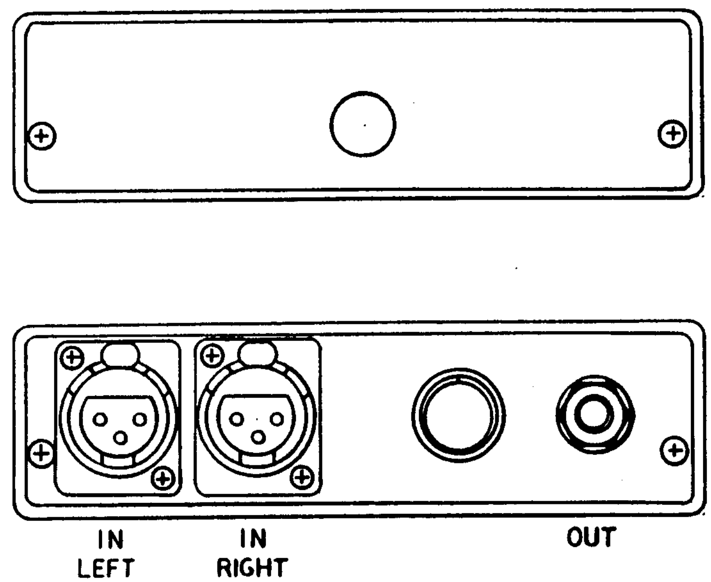
Benchmark Media Systems

RM-1/IFA RACK MOUNT UNIT

SCALE	CHECKED BY [signature]	DRAWN BY J.PENFIELD
DATE 5/2/88		
SIZE B	COMP. ASS'Y.	DRAWING NO. 250043

REVISIONS			
A	SEE DCN NO. 59	5/18/89	[signature]
B	SEE DCN NO. 179	9/6/90	[signature]





NOTES:
1. POWER CORD MAY PASS THROUGH EITHER END PLATE.

Benchmark Media Systems		
IFA -7		
SCALE	CHECKED BY [signature]	DRAWN BY L.PENFIELD
DATE 7/25/88		
SIZE B	WIRING DIAGRAM	DRAWING NO. 350021