BENCHMARK MEDIA SYSTEMS, INC.

Jr. Audio Director - Instruction Manual

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1.0 Overview

The Jr. Audio Director is a stand-alone product with the mode and level control functions, found in the System 1000.

Featuring balanced inputs and outputs, the Jr. Audio Director provides output source selection between **Left Only**, **Right Only**, **Mono**, **Stereo**, and **Stereo Reverse**. Right Channel **Polarity** is provided to correct polarity inversion in source material that causes sum and difference swapping in stereo broadcasts. The Jr. Audio Director has manual gain adjustment of both Left and Right inputs. This feature provides control over the mix in the Mono mode. It also provides independent gain for each channel when the audio source equipment isn't physically near by.

The rack mountable chassis includes LEDs to indicate the operating mode. The mono mode has built-in gain reduction to correct for the natural summing level increase; front panel adjustable with a range of -6 to -3 dB. Installation is easy, using the plug-in Euro-style barrier strip.

Power for the Jr. Audio Director comes from a PS-1, the Benchmark wall mount ±18 V regulated supply.

2.0 Performance Specifications

File Name : Jr.Aud DirTHD&Ø.eps
Title : Audio Precision Plot 2.02
Creator : file "Jr. Audio Director THD & Phase #2"
CreationDate : Thu Dec 10 16:38:39 199
Pages : 1

Figure 1. Typical Total Harmonic Distortion and Phase

3.0 Features

- 2 MΩ Balanced inputs
- CMR >100 dB to 2 kHz, 75 dB @ 20 kHz
- 60 Ω Balanced outputs
- THD = 0.00088% @ 2 kHz, 0.0011% @ 20 kHz
- Ø @ 20 kHz = -9.9°0..
- Bandwidth = 160 kHz
- Excellent RF immunity
- Mono mode built in gain reduction (reduction is adjustable between -6 dB to -3 dB)
- Eurostyle barrier strip rear connector
- Rack mountable with optional RM-1

4.0 Installation and Operation

4.1 Mechanical Installation

The Jr. Audio Director may be operated on a desk or rack mounted as desired. If the unit is to be operated in a rack mount, the knobs and front plate must be taken off to allow removal of the plastic bezel. The rack mount plate replaces the plastic bezel.

4.2 Electrical Installation

Electrical installation is very simple. Connect the outputs from the stereo signal source to the inputs of the Jr. Audio Director. Now feed the outputs of the Jr. Audio Director to its destination. If you intend to take the output of an unbalanced consumer or semi-professional device, use the forward referencing method described in "A Clean Audio Installation Guide" by Allen Burdick, a Benchmark Media Systems, application note.

Power is supplied by the PS-1 wall mount power supply. Alternately, power can be supplied from a PS-11, which can power up to four such devices. The PS-11 is capable of being rack mounted along side the Jr. Audio Director.

4.3 Setting Levels

The Jr. Audio Director is intended to operate at or near unity gain. This is found at the 1 o'clock position of the gain potentiometer. We recommend that metering be permanently placed at the output of the Jr. Audio Director. This will facilitate the setting of levels on a day to day basis. 15 dB additional gain is available when the potentiometers are in their full clockwise position, approximately 5 o'clock.

If the incoming source is in mono and there is no need to have the source "on the air" at just this time, there is an easy way to precisely match levels. Set one output level to the approximate desired level. Monitor one of the outputs. Place the Jr. Audio Director into the mono mode and invert the right channel input polarity with the polarity control. While listening to the monitor adjust the second input level until there is an exact cancellation. This technique will match the two levels to within 0.1 dB or better.

4.4 Circuit Description

The circuit of the Jr. Audio Director is of the utmost simplicity. It consists of the following major parts. There are two instrumentation input amplifiers, two level potentiometers, two gain make up stages, a mono mix amplifier and inverting follower, a mode select switch bank, and output amplifiers. While reading the following description, it will be well to have the schematic along side.

4.4.1 Instrumentation Input Amplifiers

The instrumentation input amplifiers consist of two unity gain non inverting buffer amplifiers that in turn feed a highly trimmed differential amplifier whose gain is -6 dB. The input to the instrumentation amplifier consists of paralleled input capacitors. The 100 μF aluminum electrolytic provides low frequency response, while the paralleled 0.1 μF film capacitor overrides the ESR and inductive effects of the electrolytic at high frequencies. The input resistor attenuator network provides isolation to the output stage that drives the Jr. Audio Director in the event of a power loss to the Jr. Audio Director. The attenuator also provides very high over voltage protection for the input amplifiers, with the inputs able to take 125 V AC, differentially, without harm.

4.4.2 Level Potentiometer and Gain makeup Stage

The output of the differential amplifier feeds the log taper level potentiometer. The output of the pot feeds the non inverting input of the gain makeup stage. The amplification factor of the stage is +15 dB. The gain makeup amplifier sets the noise floor of the entire Jr. Audio Director.

4.4.3 Mono Mixer and Inverting Amp

The mono mix amp takes its two inputs from the outputs of the gain makeup amplifier. The gain of the mix amplifier is variable with a gain range of ≈ -3 to -6 dB. This is necessary due to the signal level addition that takes place when summing two signals. When summing two non-coherent signals such as noise sources the addition causes a 3 dB increase in level. When summing two fully coherent sources, the level increase is 6 dB. The gain has been set at the factory to –3 dB. If further gain reduction is necessary, this is easily available at the front panel and can be adjusted with the aid of a green Xcelite® screwdriver, or “greenie” as they are often called.

Since the mix amplifier is an inverting amplifier, absolute polarity would be compromised without additional inversion, hence the unity gain inverter.

4.4.4 Mode Control Switch Bank

The rear bank of the six position Schadow switch bank, controls the signal routing as well as having the right channel polarity inversion. The front bank actuates the indicator LEDs. A single 10 kΩ resistor provides the current for the LED that is on for the mode selection and a second resistor provides the current for the polarity LED.

4.4.5 The Output Stages

The output of the switch bank feeds two paralleled capacitors, the same as on the inputs. The outputs of the capacitors feed the inputs to the balanced outputs. The purpose of the capacitors is to isolate any DC offset coming from the previous stages.

The output stages consist of two amplifiers, an inverting amplifier, and a non-inverting differential amplifier. Both the inverting amp and the differential amp have the same 20 kHz phase shift. As a result, there is no differential phase shift between the two outputs.

The output impedance of the output stages is set to 60 Ω balanced by the two 30.1 Ω output resistors.

5.0 Troubleshooting and Repair

5.1 Servicing Techniques

Service and calibration can be easily performed at the test bench. Be sure to use current limited power supplies set for a current limit at ≈ ±100 mA.

The first thing to do is to look for integrated circuits that are hot to the touch. Since most passive components are extremely reliable, most circuit failures occur with the active semiconductors. Replace any extremely hot chips. Keep in mind that the NE5532 runs *very* warm to the touch. In fact, many people cannot keep a finger on a working NE5532 (approximately 135° F).

If you strongly suspect a passive component failure, replace it. Remember, however, printed circuit boards are *very* easy to damage with excessive heat. Unless you have developed the specialized skills necessary to remove and replace components, we strongly suggest that you leave the task to someone skilled in these techniques.

5.1.1 Circuit Board De-Soldering

When servicing printed circuit boards we strongly recommend the use of a vacuum de-soldering station, such as the Hako 470 or various Pace models. 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. 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 *lightly* against the board, and *without* applying pressure to the pad, you are able to remove solder from the plated-through hole. When this procedure is performed correctly the component will often drop out of the board of its own weight. If the solder is not thoroughly removed from the plated-through hole do not pull the component. Attempting to force the component will bring with it plating from inside the hole. This, in turn, will require the repair of the hole with an eyelet. Also, if your attempt to completely remove the solder from the hole has failed, do not re-heat the area with the de-soldering tool. Doing so will overheat the pad, and will not heat 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.

5.1.2 Circuit Board Re-Soldering

Here is an effective technique that ensures highly reliable solder joints. First, if the component that is to be installed has leads that are highly oxidized, it will be necessary to clean them. This may be done with a Scotch Bright® abrasive pad or fine bristle fiberglass brush, among other methods. After inserting the component, apply a small amount of liquid flux directly at the component leads and PCB with a needle bottle applicator or small brush. We prefer to use water soluble flux for ease of cleaning. The added flux is an immeasurable aid in achieving a good solder joint. Next, heat 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. 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, slide the soldering iron down the lead and heat the printed circuit board pad while applying a controlled amount of solder to the joint. The solder should flow into the joint with extreme ease and create an excellent fillet on the top of the PCB as well as on the bottom. The entire soldering portion of the procedure should take no more than a couple of seconds.

5.2 Common Mode Rejection Null

The common mode rejection trims on the input stages should never need to be readjusted, once they have been set at the factory. This is a passive bridge, and the characteristics of the operational amplifier used do not affect the accuracy of the balance on this bridge, that is, unless there is a malfunction with the op-amp. When replacing the operational amplifier, measure the common mode rejection *before* touching the trims.

The process of nulling the common mode rejection should be performed with the overall gain of the Jr. Audio Director set to unity. See Figure 2.0

Feed an unbalanced signal with a level of +20 dBu, referenced to ground, into both inputs of the module being adjusted. This signal must be *exactly* the same on both inputs. This is best achieved by using an oscillator with a single ended output, tying the ± inputs together and, in turn, to the single ended output of the generator. The ground side of the generator, of course, also ties to ground.

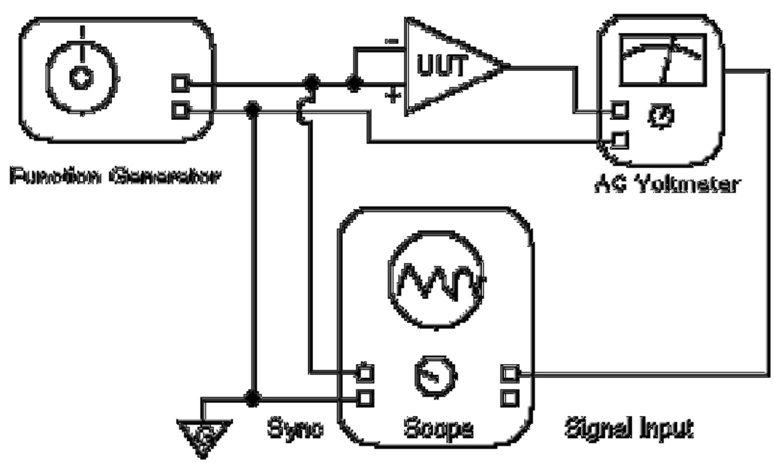

Fig. 2 - Common Mode Rejection Adjustment

Send a 2 kHz signal to the input and adjust the resistive portion of the differential amplifier bridge for a minimum audio output from the Jr. Audio Director. Use either a logarithmic level meter with a sensitivity to below -100 dBu, such as the Audio Precision System One, or a very sensitive linear meter, such as the Amber 3501 distortion and noise meter. It is very helpful to watch the audio signal from the meter output on an oscilloscope, which in turn should be synchronized to the signal source. This will allow you to quickly see the phase/amplitude nulls as they take place. Once a minimum resistive trim has been achieved, null the capacitive trim.

Two or three iterations between these controls should be sufficient to achieve the best broadband null possible. A null of better than 90 dB at 200 Hz, and better than 70 dB at 20 kHz, is achievable. Unfortunately, it is almost impossible to maintain this good a null over the operating temperature range. A degradation of up to 10 dB may be expected when the unit is returned to its working environment.

This completes the Jr. Audio Director Instruction Manual 121192

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