BENCHMARK MEDIA SYSTEMS, INC.

Stereo/Mono Switch - Instruction Manual

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1.0 Overview

Featuring balanced inputs and outputs, the Stereo/Mono Switch provides remote selection between Mono and Stereo modes. The Stereo/Mono Switch operates at unity gain through both Left and Right channels. In the Mono mix mode, automatic gain reduction reduces the mono gain buildup. This gain reduction is adjustable between -3 and -6 dB. Additionally, a left channel output gain trim allows the two channels to have precisely the same output level, useful in setting up stereo channel gains using a portable L-R test set.

The rack mountable chassis includes LEDs to indicate power presence, mono operating mode and signal presence/onset of overload. Installation is easy, using standard XLR connectors. Power for the Stereo/Mono Switch comes from a PS-1, the Benchmark wall mount ±16 V regulated supply. An optional UL Listed wall mount power supply is available when required by local codes.

2.0 Performance Specifications

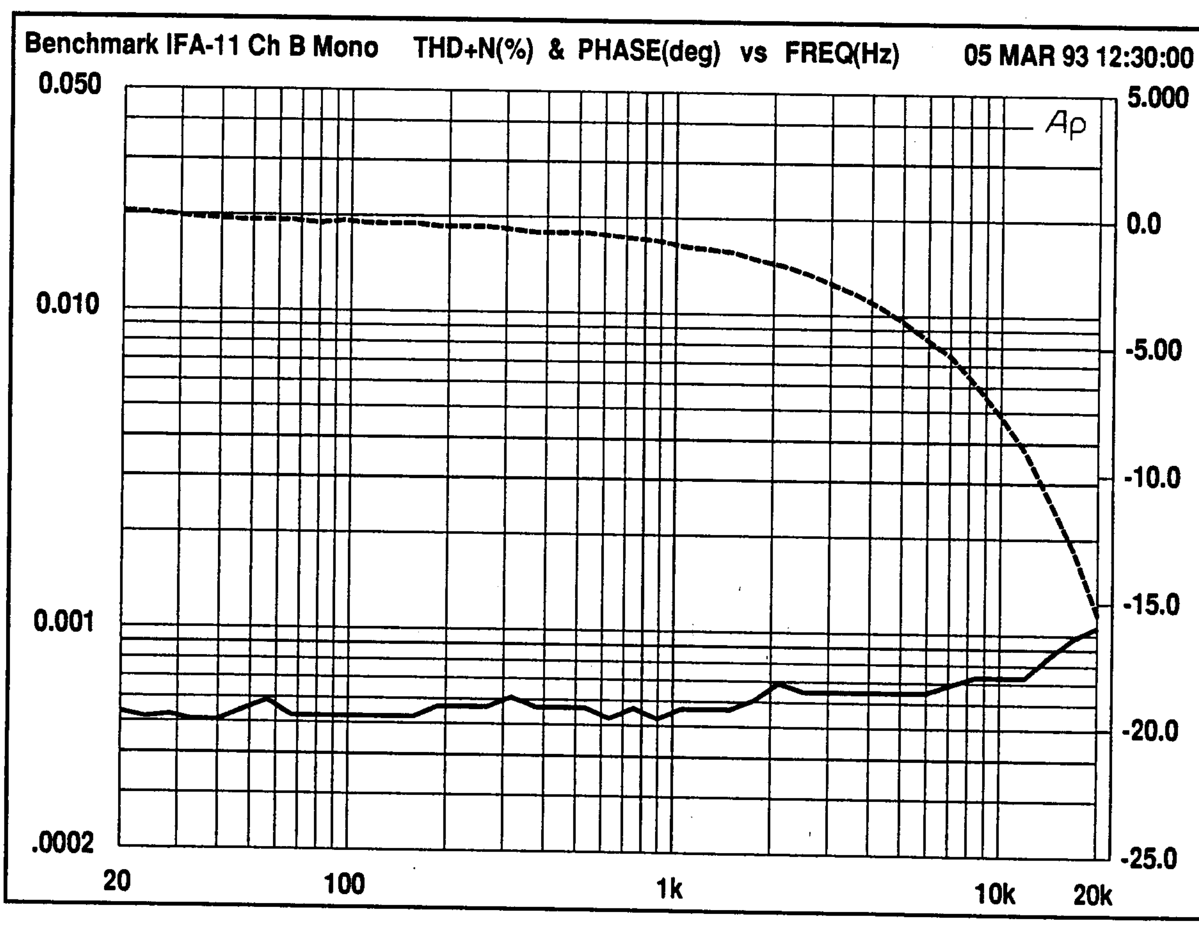

Figure 1. Typical Total Harmonic Distortion and Phase (Mono or Stereo)

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, 0.0012% @ 20 kHz
- Ø @ 20 kHz = -15°
- Bandwidth ≈ 160 kHz
- Excellent RF immunity
- Mono mode built in gain reduction (reduction is adjustable between -6 dB to -3 dB)
- XLR connector interface
- 3 pin Mini DIN remote control (contact closure) connector
- Rack mountable with optional RM-1

4.0 Installation and Operation

4.1 Mechanical Installation

The Stereo/Mono Switch may be operated on a desk or rack mounted as desired. If the unit is to be operated in a rack mount, 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 Stereo/Mono Switch. Now feed the outputs of the Stereo/Mono Switch 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 Stereo/Mono Switch.

4.3 Setting Levels

All Signal Presence and Onset of Overload LED calibrations are preset. The signal presence threshold is set to -2 dBu, and the onset of overload threshold has been set to +20 dBu. Signal presence is indicated by a steady green indication, and onset of overload is indicated by a flashing red/green indication.

The mono output gain match, even though it is accessible from the front panel, has been set at the factory and should never need adjusting.

The mono gain trim, however, is user adjustable and is set according to the degree of correlation in the program material. The gain reduction range of this potentiometer is -6, fully counterclockwise, to -3 dB, fully clockwise. The factory setting is -4 dBu. It should be kept in mind that fully correlated program material will add by 6 dB and thus a 6 dB gain reduction should be taken. Fully un-correlated program material will have a 3 dB gain increase, and therefore a 3 dB gain reduction should be taken. The normal adjustment range is - 4 to -5 dB.

4.4 Circuit Description

The circuit of the Stereo/Mono Switch is very simple, consisting of two instrumentation input amplifiers, a mono mix amplifier, electronic switches, output amplifiers and LED drivers. While reading the following description refer to the schematic.

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 having a gain of -6 dB. The instrumentation amplifier uses a 100 µF aluminum electrolytic to provide excellent low frequency response, paralleled with a 0.1 µF film capacitor, which overrides the inductive effects of the electrolytic at high frequencies.

The input to the unity-gain buffers has, as its second electrical element, a resistive divider network made up of a 4.99 kΩ and a 1.00 MΩ resistor. The input resistor attenuator network provides isolation to the output stage that drives the Stereo/Mono Switch in the event of a power loss to the unit. The divider networks create an insertion loss of approximately 0.043 dB per network, or 0.086 dB for the balanced input. The attenuator also provides very high over voltage protection for the input amplifiers, with the inputs able to handle 125 V AC, differentially, without harm.

4.4.2 The Input Buffers

The first active elements in each chain are two unity gain buffer amplifiers, with the 1 MΩ resistors of the attenuator serving as input bias current sources for the buffers.

4.4.3 The Differential Amplifier

The buffers drive a precision differential amplifier. The differential amplifier is configured to take a 6 dB loss to maximize the headroom that is available with the relatively low voltage power supplies.

The differential stage has trims that allow for a very high degree of common mode rejection. These trims are adjusted with an input signal level of +10 dBu. The resistive trim and the capacitive trim are both adjusted at an input frequency of 2 kHz. The typical null is a -100 dB out to 2 kHz rising to 75 dB at 20 kHz. This null can be expected to deteriorate by as much as 15 dB under temperature variations.

4.4.4 Mono Mixer and Inverting Amp

The mono mix amp takes its two inputs from the outputs of the instrumentation amplifiers. The gain of the mix amplifier is variable with a gain range of ≈ -3 to -6 dB. Since the mix amplifier is an inverting amplifier, it is followed by a unity gain inverter stage to maintain absolute polarity.

4.4.5 Electronic Switch Bank

The electronic switches control the signal routing. With no + V into the switch control port, the stereo signals feed their respective outputs. In the presence of +V at the control port, the mono signal feeds both outputs. The control port input drives the mono switch control inputs directly, while an inverted control signal drives the mono LED and the stereo switch control inputs.

The switches are used to switch audio currents at the summing node of the first output amplifier. Switching currents offers advantages over switching voltages. In the series/shunt configuration, the current is either passed to the summing node of the operational amplifier, or it is shunted to ground. By shunting the input current to ground, very little voltage swing is at the series FET switch. This greatly improves the high frequency crosstalk performance since the drain to source capacitance of the FET is not insignificant. An additional advantage is that, high voltage FETs are not required for the switch.

4.4.6 The Control Port

Switching occurs with the application of the +V power source to pin two of the mini DIN connector. +V is found on pin 1. Pin 3, ground, has been clipped off to prevent the inadvertent application of +V to ground. See the diagram below for the location of the respective pins.

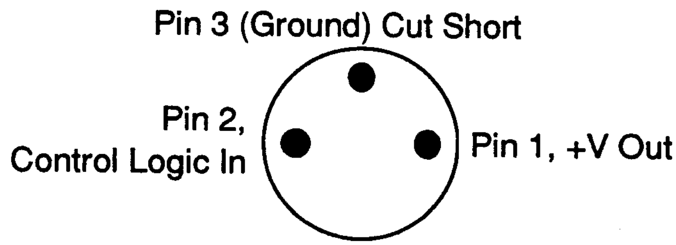

Figure 2. Control Port Connector Pinout - Rear View

4.4.7 The Output Stages

The output of the switches feed the summing node of the output stages through 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, the inverting summing amplifier, and a second inverting follower. 1% gain determining resistors ensure a very close match in the output levels of the two amplifiers. The output impedance of the output stages is set to 60 Ω balanced by the two 30.1 Ω output resistors.

4.4.8 The Signal Indicating LED

The Signal indicating LED is a bi-colored LED with red and green sections and respective drivers. It is the most complex circuit on the module and deserves the greatest explanation.

The green section is used to indicate signal presence, and the red section is used to indicate the approach a of signal clip condition. Both halves of the FET input TLO72 are used as voltage comparators with hysteresis.

The signal presence indicator uses one half of the TLO72 and associated components. The input audio is rectified and the DC voltage is compared with that of a preset (threshold) trimming resistor. This circuit yields a steady green indication when the desired signal threshold has been reached or exceeded.

The operation of the green signal presence LED is as follows. The 1N4148 small signal diodes operate as half wave rectifiers. The turn-on threshold of the diode is precisely at the lowest DC voltage represented by the lowest signal level detection limit. This is serendipitous in that it permits implementation of a half wave rectification without the high parts count required by active circuits. DC from the diode is stored on the 0.1 μF film capacitor.

Charge is held on the 0.1 μF capacitor to prevent a flashing condition with the quick absence of audio such as between words in dialog. The discharge time to an off condition will vary with the peak level of audio, and thus the peak voltage on the capacitor. Typically, however you will see a variation from 1 to 4 seconds to an off state. The 10 MΩ resistor provides a discharge path for the 0.1 μF capacitor as well as providing bias current source for the FET input operational amplifier.

The peak indicator is an oscillating half wave detecting comparator. When the audio input exceeds a predetermined level, the comparator trips and begins to oscillate. The factory calibration point is +20 dBu unless otherwise requested. The output of the comparator, in addition to driving the red portion of the LED, also drives a transistor that shunts the current from the green LED, causing an alternating red/green flash when the signal exceeds the trip point.

The peak comparator is an oscillating comparator by virtue of the fact that AC coupled hysteresis is applied around the device. Initially the output voltage of the comparator is near the + supply voltage, in the off state. The trip point is determined by the input resistor string and clamp diode. When the inverting input signal rises above ground potential the comparator trips. R2112 is the calibration trim for the peak indicator. It has a range of ≈ +16 to +26 dBu. The comparator is held in the off state by the bias that is applied to the inverting input until an input peak overcomes the preset bias. When the comparator trips the output voltage swings to the opposite supply rail. The 0.1 μF capacitor, in turn, pulls the noninverting input negative holding the comparator in the on state. The capacitor recharges with opposite polarity through the two 220 kΩ resistors and when the new threshold is passed the device turns off and is now held off, again by the charge on the capacitor, until the capacitor recharges to its original state. This action is that of a pulse stretcher which allows the operator to "see" very short peaks as they occur.

All of the circuitry of the signal indicators is high impedance and has no measurable effect on the audio signal quality.

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 desoldering 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 Stereo/Mono Switch set to unity. See Figure 3.0

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.

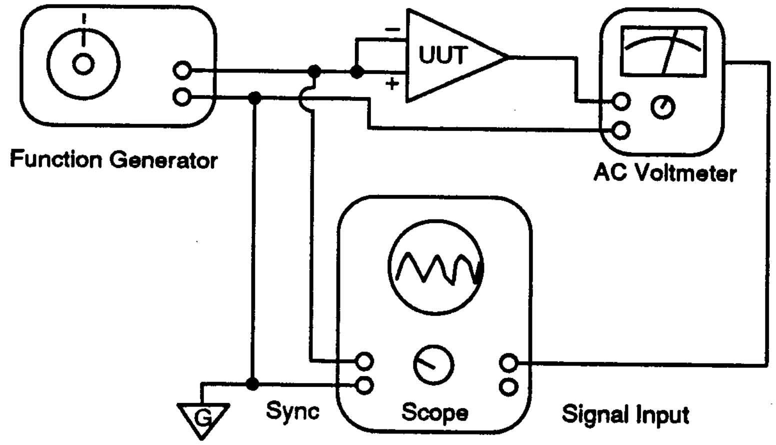

Fig. 3 - Common Mode Rejection Adjustment

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 Stereo/Mono Switch. 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 Stereo/Mono Switch Instruction Manual

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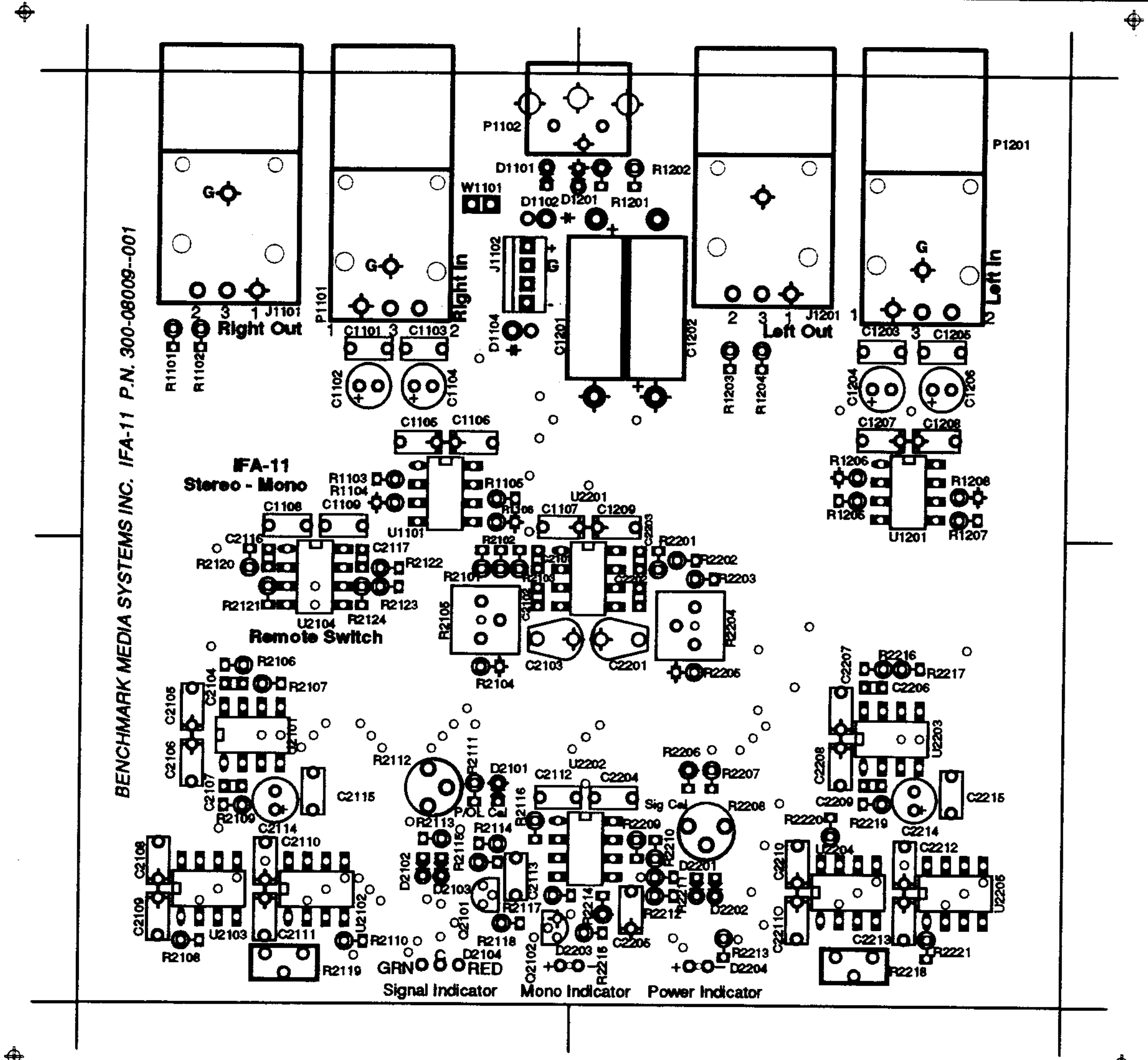

Silk Screen

BENCHMARK MEDIA SYSTEMS, INC.			
IFA-11			
SCALE 1X	PCB# 300-08009-001	DRAWN BY R. FREEMAN	
DATE 10/29/92		ASSEMBLY #	
SIZE A	COMP. ASS'Y	DRAWING #	