BENCHMARK MEDIA SYSTEMS, INC.

FSG-01 Instruction Manual

1.0 GENERAL FEATURES

The FSG-01 is a First Stage Gain daughterboard for the MDA-101, a System 1000 microphone preamplifier - line level distribution amplifier. The FSG-01 performs gain change directly at the input stage of the microphone preamp thereby optimizing the noise and distortion performance of the preamp. By placing the actual gain change at the first stage of a microphone preamplifier, the noise figure of that preamp is maintained.

The FSG-01 uses 8 ultra miniature relays to select 9 different gain settings for the first stage of a preamp. The gain range is +25 to +65 dB inclusive in 5 dB gain steps (± 0.7 dB). Control for the daughterboard is performed by way of an input voltage of 0 to 10 volts, either positive or negative going, where 0 volts represents 25 dB of gain and 10 volts represents 65 dB of gain. An additional remote attenuator option on the MDA-101 provides a total gain control range of +5 to +65 dB. The control port input to the daughterboard is a differential amplifier that facilitates noise free control over long distances.

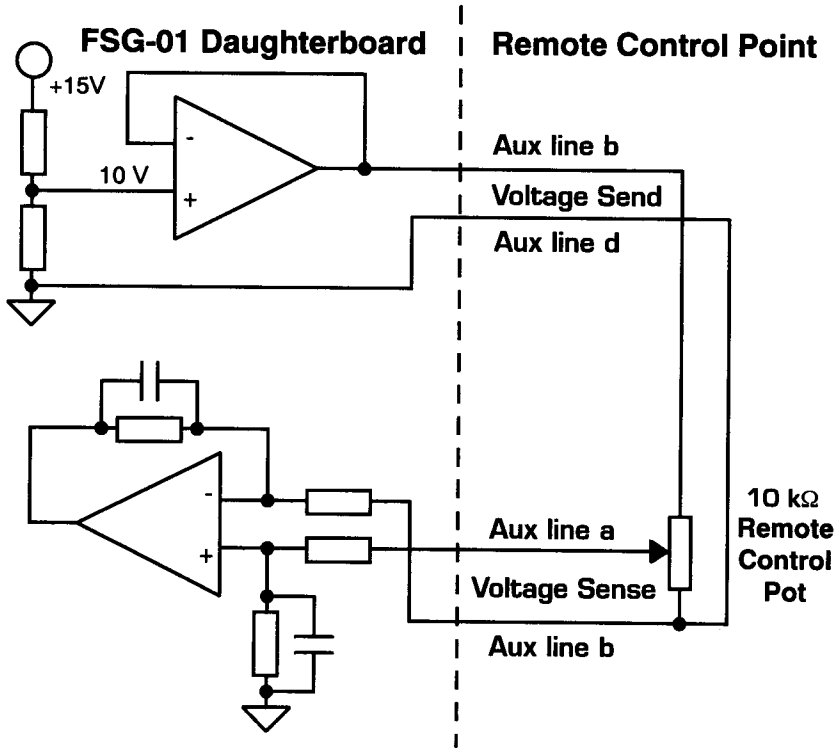

Figure 1.0 FSG-01 Remote Control Block

The FSG-01 remote controller can be as simple as a single 10 kΩ potentiometer placed between ground and a single + 10 volt power supply, or as sophisticated as a full computer control system feeding the output of a simple 8-bit DAC to the control port input.

All logic on the daughterboard is static, that is, there is no clock input signal that would compromise the operating signal to noise ratio.

Since the FSG-01 provides First Stage Gain control for the MDA-101PA, the FSG-01 should be viewed as a remotely controllable replacement for the MDA-101s gain control potentiometer.

2.0 UNPACKING AND PHYSICAL INSTALLATION

Care has been taken in packing the FSG-01 to assure it will withstand normal shipping conditions. Examine the equipment with care, as it is unpacked. If the shipping carton appears to have been damaged and if there are signs of physical damage check the equipment and immediately notify the carrier and Benchmark.

As with any delicate electronic equipment, care must be exercised in its handling. The FSG-01 daughter board uses as a part of its logic circuitry CMOS devices. These devices, while internally diode protected, may be damaged by electrostatic discharge. Appropriate caution must be taken in their handling, particularly in low humidity environments. A full static controlled workstation is highly recommended.

2.1 Installation of the FSG-01

Before installing the FSG-01 on the MDA-101PA, make sure that the both routing switches remain in the on position. There is a two-post header on the MDA-101 near the gain potentiometer. This header enables or disables the front panel gain potentiometer. When using the FSG-01 this jumper must be stored on one pin or removed from the DA entirely. If the MDA-101 is to be used without the FSG-01, the shunt must be reinstalled on the two-pin header to enable the potentiometer.

2.2 Physical Installation

Remove from operation the MDA-101 module intended to receive the FSG-01.

The FSG-01 has two sets of female header strips that extend from the bottom of the board. One of these sets has ten positions and the other has eight. Install the daughter board on the MDA-101 module, making sure that the corresponding number of pins is being inserted into these headers, as it *is* possible to invert the card

Due to the high parts density on both of these boards make sure that a polycarbonate insulating sheet is in place between the module and the daughter board.

!!! WARNING !!!

It is absolutely imperative that the solder joints on the bottom of the daughter board do not short against the tops of aluminum electrolytic capacitors that are present on the MDA-101. To do so will, at a minimum, cause improper operation and at worst may cause catastrophic failure of the daughter board.

The MDA-101 and daughter board may be inserted into the MF-300 main frame with power on. When plugging the combination into a powered MF-300, insert the card firmly and quickly to eliminate, as much as possible, any time difference in contact mating. Never plug the daughterboard onto an MDA-101 that is powered.

3.0 ELECTRICAL INSTALLATION

In this and other Benchmark documents we use the term dBu. 0 dBu is 0.7746 volts, irrespective of source and load impedance. For more information on dBu, see "A Clean Audio Installation Guide," by Allen H. Burdick, a Benchmark Media Systems application note. This and other application notes are available on the Internet.

3.1 Gain Control

Four wires and a 10 K Ω potentiometer are used to fully control the FSG-01. We recommend that the current limited D.C. power available on Aux-line b output from the daughterboard be used for the power source at the remote control location. Use the diagram shown in figure 1.

3.1.2 Physical Installation of Control Wiring

Molex™ SL series pins and housings should be used, and are available from Benchmark Media Systems, Inc. Follow the directions that came with the crimp tool you purchased for the specifics of the operation with the connector pins used.

4.0 THEORY OF OPERATION

The FSG-01 uses eight ultra-miniature relays to switch nine different resistors into the gain location of the first stage of the MDA-101. The various resistor values range from 1.25 kΩ used at +25 dB of gain down to 7.3 Ω resistor used at + 65 dB of gain. The proper relay for the gain desired and its associated gain resistor is selected by feeding a voltage into the daughterboard between a range of ground and +10 volts. This voltage range will select gains over the range of +25 to +65 dB. The FSG-01 accomplishes this by feeding the receiving the DC input voltage by way of a differential amplifier and then feeding the input voltage into an A-to-D converter. Then the output of the converter feeds a BCD to 1-of-10 decoder.

The FSG-01 utilizes a rather unconventional discrete A-to-D converter. The converter does not use any clock signal and as such does not emit continuous electromagnetic fields. This minimizes the interference that could affect the microphone preamplifier.

The converter is created by using a ladder resistor network that sets reference voltages on the inputs of eight analog voltage comparators. The comparators have a few millivolts of hysteresis built into their threshold range by way of the 1 MΩ feedback and 1 KΩ input resistors. The hysteresis prevents oscillation from in the comparator. The output of the comparators feed the inputs of a priority encoder that creates the digital code that represents the input voltage. The first three bits from the priority encoder feed the corresponding inputs of the BCD 1-of-10 decoder. This arrangement, however, does not allow the first relay to turn off. To solve this problem the enable output of the encoder is taken to the 4^{th} bit input on the decoder, which attempts to turn on non-existent relay #9 and in doing so turns of relay #1. The ultra-miniature relays are actuated by the BCD to 1-of-10 decoder through the 10 KΩ dip resistor package, which feeds the pull down transistors. The gain indicating LEDs are in series with the relays to reduce the amount of current that is drawn from the +12 V power supply.

The reference voltage for the resistive ladder and for the output feed to the 10 KΩ gain control potentiometer is created by the LM317LZ. The output of the second half of the single NE5532 is used to send a current limited (40 mA) to the potentiometer.

5.0 TROUBLESHOOTING TECHNIQUES

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

1. It is best to trouble shoot a module at a workbench using current limited lab power supplies. Set the current limiting of the power supplies to 150 mA for the analog supplies and 100 mA for the logic supply. This will protect the module and still allow the location of failures to be made.

2. Since most failures are catastrophic in nature rather than a gradual degradation of performance, make a close visual inspection of the module for any discoloration of components and possible shorts on the PC board itself. Discoloration would indicate excessive heat, most likely from a component failure. Remove any component that has obviously failed, i.e. carbonized resistors or IC packages that are cracked.

3. 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 any further failures, and the current limiting of the power supplies will show the presence of a short. Allow the device to operate in this condition.

4. Look for any components that are operating to hot to the physical touch. This will show where the shorts are when there are no physical symptoms. Typically one can just keep their hand on a surface at 130° F.

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

5.1 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, 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.

5.2 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 FSG-01 instruction manual. Ed Sept 21, 1998

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