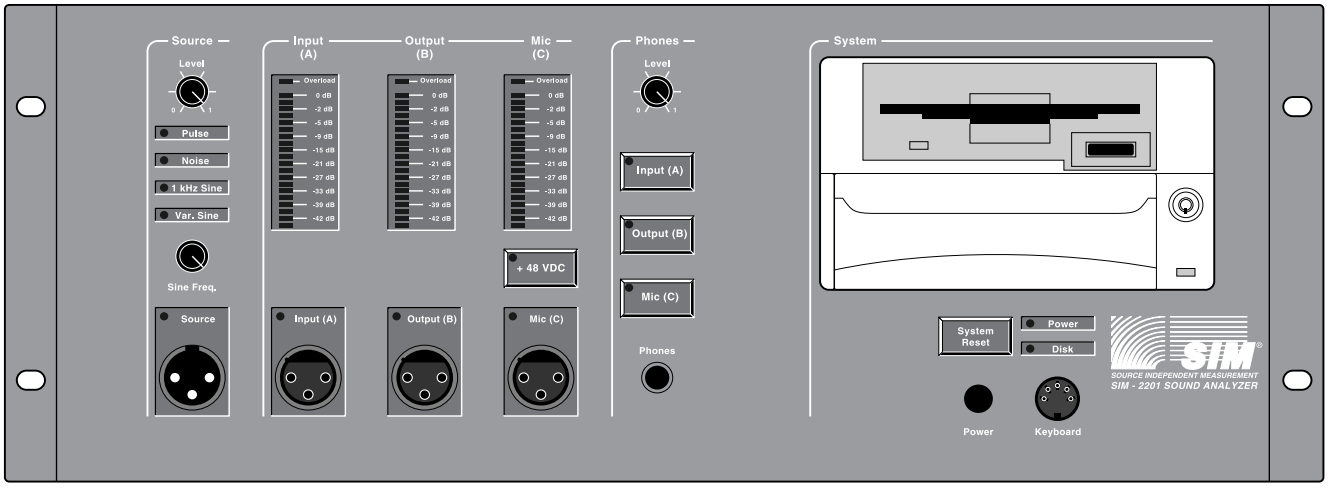
Meyer Sound

SIM System II
Reference Manual Addendum:
Accommodating Digital Equalizers



SIM®
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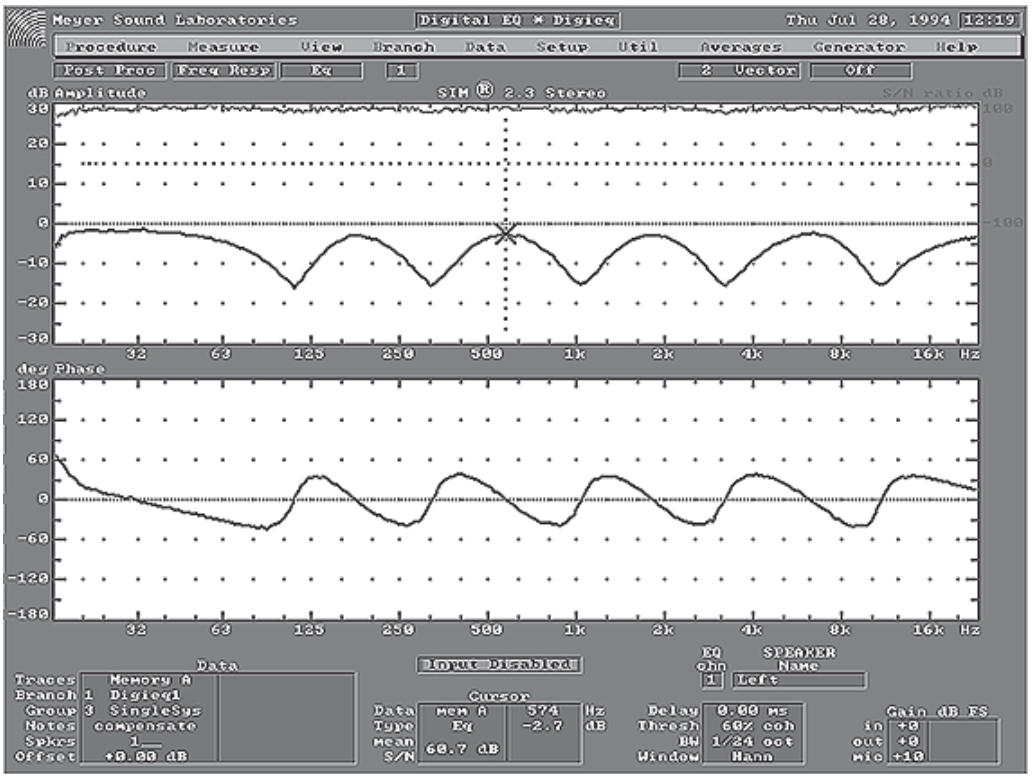

Figure 1 — Frequency Response of an Analog Equalizer

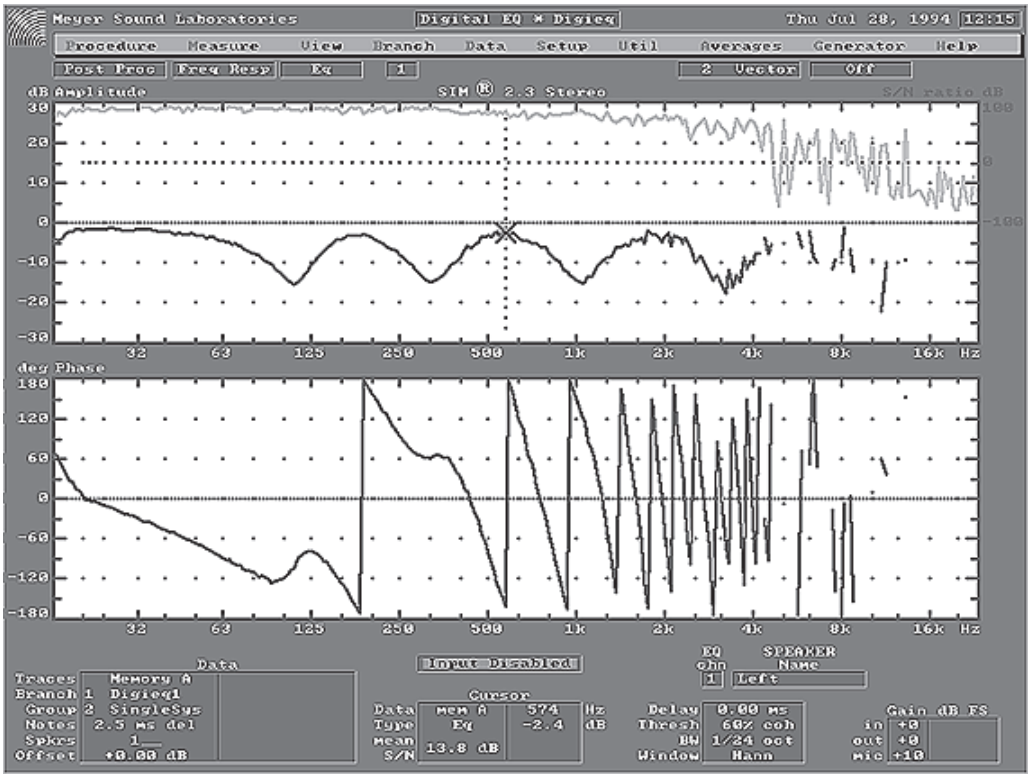

Figure 2 — Frequency Response of an Equalizer with Processing Delay

Introduction

There is an increasing trend in the audio industry toward the use of digital equalizers for speaker system alignment. This addendum to the SIM System II Reference Manual describes the effect of digital equalizers on system measurements, and illustrates optional modifications to SIM System II to accommodate them.

Equalizer Types

Equalizers can be divided into three categories:

- **Analog** — These are devices such as the CP-10 Complementary Phase Parametric Equalizer. The use of such equalizers is described in the SIM System II instruction manuals.
- **Digitally controlled analog** — These devices employ analog filters under digital control. If properly designed for minimum phase and symmetrical characteristics, such equalizers require no special consideration.
- **Digital** — These devices digitize the signal and create equalization filters in the digital domain. Of special concern is the bulk delay that results from the time required to process the signal. This delay time varies widely from model to model and, if left uncompensated, will adversely affect SIM System II measurements.

Effect of Digital Equalizers

SIM System II is designed on the premise that the system equalizer is to be used for equalization only. (Gain setting and delay setting are best done at points ahead of, or behind, the equalizer, and the reasons for this are outlined in the SIM manuals.) In SIM System II, the Eq transfer function is always computed with no time offset, and at unity gain from input to output.

The processing delay of a digital equalizer (or any equalizer with delay) creates a net delay between the Eq Input and Eq Output measurement points. This causes the Eq transfer function to become invalid.

Figure 1 shows a frequency response measurement of an analog equalizer set to produce a series of dips with equal bandwidth. The phase response is consistent, and shows no sign of frequency-independent delay. The signal-to-noise is very high, indicating valid data at all frequencies. Such a measurement would also be expected from a well-designed digitally-controlled analog equalizer.

Figure 2 shows a frequency response measurement of a similarly-tuned equalizer having an internal processing delay, such as would be expected with a digital equalizer employing finite impulse response (FIR) filters. Note that in the high frequencies, where the time records of the SIM analyzer are shortest, the delay causes an unstable amplitude and phase response and low signal-to-noise ratio. Some blanking is also evident, and the delay is clearly visible in the phase response.

The processing delay of this equalizer will also cause an offset in Room + Speaker frequency response measurements, since that transfer function is referenced to the Eq Output and therefore will not include the equalizer's delay in its measurement loop.

Compensating for Equalizer Delays

To enable accurate measurements of digital equalizers with SIM System II, a compensating delay line must be inserted in series with the Eq Input measurement bus. The setting of the external delay line is adjusted to equal the processing delay of the digital equalizer, thus synchronizing the measurement channels.

> **Note:** Both the digital equalizer and the compensating delay line must be of very high quality, so as not to degrade the S/N ratio of the measurements. The units should have at least 96 dB dynamic range and meet the specifications on page 24 of the SIM Sound Reinforcement Applications Guide.

Connections

v. 2.3 Stereo

Figure 3 illustrates connections for the compensating delay in v. 2.3 Stereo systems. The delay is inserted in series with the Console connection to the SIM-2201 Sound Analyzer by way of a “Y” cord, and the Eq In cable of the snake is not used. The procedure for adjusting the compensating delay is given in the next section.

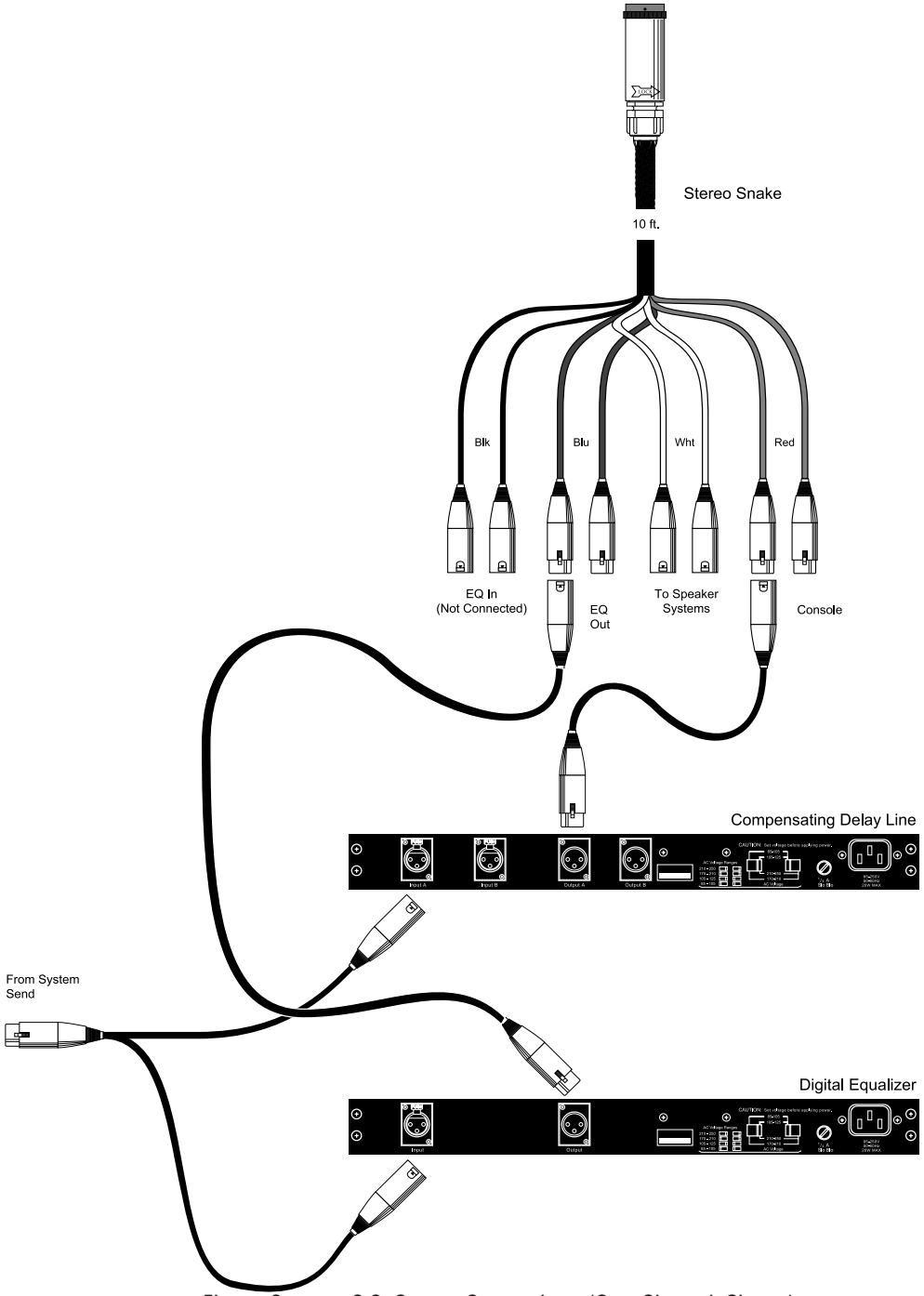

Figure 3 — v. 2.3 Stereo Connections (One Channel Shown)

V. 2.3 Multi-Channel

The present Bus Output cable sends the Eq In, Eq Out and Mic signals from the SIM-2403 Interface Network (Switcher) to the SIM-2201 Sound Analyzer. To access the Eq In bus and insert a delay line, the cable must be modified as shown in Figure 4.

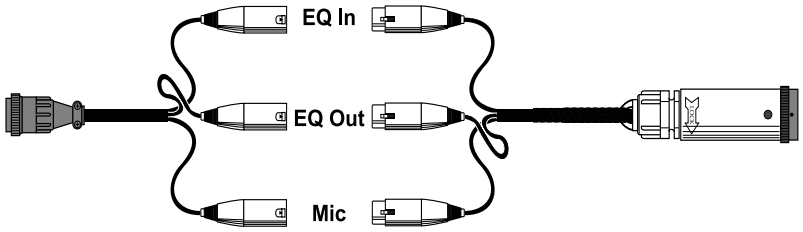

Figure 4 — Modified Bus Output Cable

A completed cable assembly can be purchased directly from Meyer Sound. (To purchase a SIM Bus Output Cable for Digital EQ order MSPN 28.102.163.02.) Alternatively, a standard Bus Output cable can be modified. The modification procedure is given at the end of this Addendum.

When using digital equalizers, the compensating delay line is inserted into the Eq In bus as shown in Figure 5.

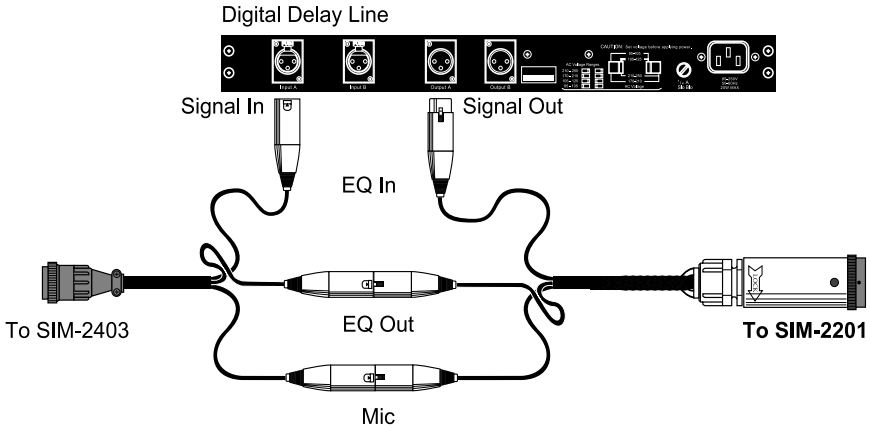

Figure 5 — v. 2.3 Multi-Channel Connections

Compensation Procedure

The delay time setting for the compensating delay is found by the following procedure.

Set the compensating delay time to 0.00 msec. Measure: Delay finder: ±70 ms. View: Eq.

The Delay finder peak will be off center by the amount of delay in the digital equalizer, and the delay time will appear in the cursor box (see Figure 6).

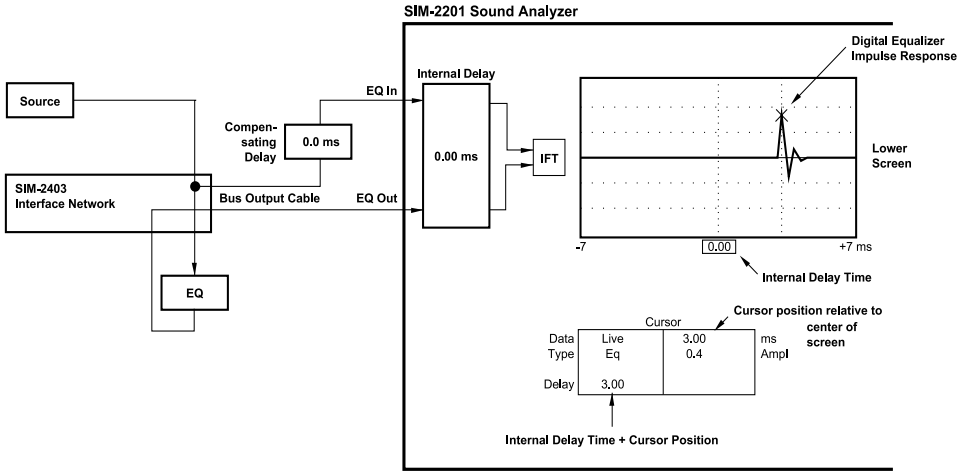

Figure 5 — Measuring the Equalizer Delay

Enter this number into the compensating delay line, then restart the averager (R) to verify the compensation. If the compensation is correct, the Delay finder peak will have moved to the center, as shown in Figure 7.

> **Note:** When multiple equalizers are used they should have the same bulk delay. If they do not, it will be necessary to recalibrate the compensation delay for each change of Branch.

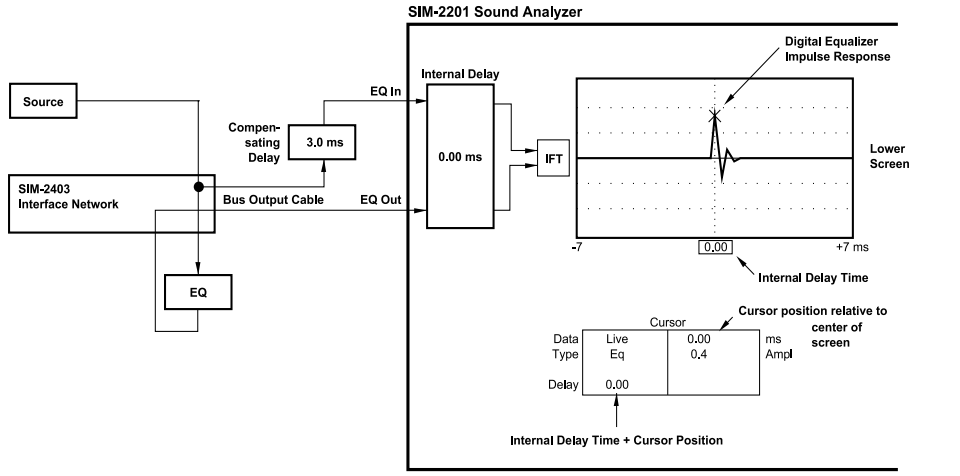

Figure 6 — Compensated Equalizer Delay

Combined Digital Delay/Equalizers

Some units combine the functions of equalization and programmable system delay. The combination of these functions in the measurement loop of the equalizer can cause significant confusion and potential for error, and the use of such units is not recommended. Where they must be handled, the delay function can be set using the Procedure: External Delay: Post Eq (see the SIM System II Reference Manual, page 57). The compensating delay must be set for the full delay of the unit (including processing delay) in order to obtain accurate measurements of the equalizer frequency response. When multiple equalizers/delay lines are used, it is unlikely that each will have the same total delay, so it will be necessary to recalibrate the compensating delay for each change of Branch.

Bus Output Cable Modification Procedure

Tools required

Wire Cutter
Heatshrink gun
Small screwdriver
Soldering Iron

Materials required

3 ea. XLR Inline female connectors
3 ea. XLR Inline male connectors
6 ft. of 1/8 inch heatshrink tubing
6 in. of 1/2 inch heatshrink tubing

1.) Cut the cable in half with wire cutters

2.) Strip back outer sleeving approximately 1 foot on each end.

3.) Locate pairs 1,2 & 3 per the chart below:

	Pin#1	Pin#2	Pin#3	Label
Pair# 1	Shield	Red	Black	Eq Input
Pair# 2	Shield	White	Black	Eq Output
Pair# 3	Shield	Green	Black	Mic

Table 1 - Cable Pinout

4.) Clip off and remove the remaining three pairs.

5.) Apply small heatshrink to pairs 1-3 on each end of cable.

6.) Apply large heatshrink for strain relief at end of fanout.

7.) Solder female XLR connectors onto the cable with the 39 pin connector and label per Table 1.

8.) Solder male XLR connectors onto the cable with the 9 pin CPC connector and label per Table 1.

Meyer Sound
2832 San Pablo Avenue
Berkeley, CA 94702
Phone (510) 486-1166
Fax (510) 486-8356