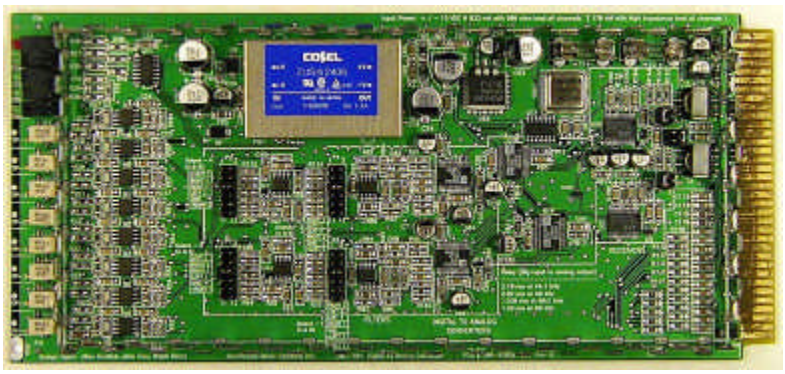
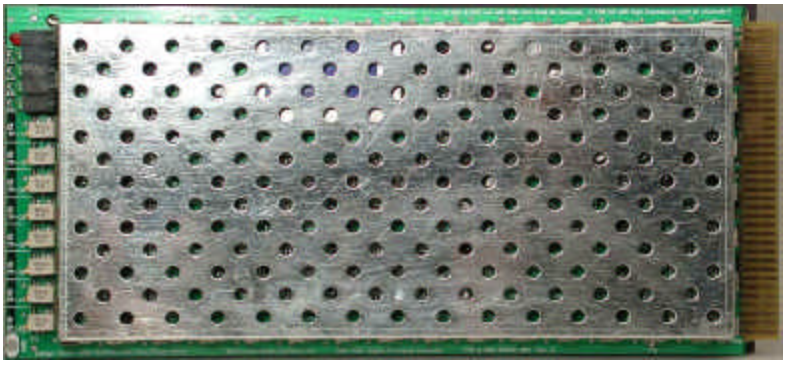
Benchmark Media Systems, Inc.

DAC-104
Instruction Manual

(System 1000™ 4-channel 24-bit 96-kHz Audio DAC)





Revision History:

Revision	Filename	Date	Author
Rev A	DAC-104 – Manual. Doc	07/06/01	John Siau
Rev B	DAC-104 – Manual Rev B. Doc	09/29/01	John Siau
Rev C	DAC-104 – Manual Rev C. Doc	10/19/01	John Siau
Rev D	DAC-104 – Manual Rev D. Doc	11/15/01	Allen Burdick

SYSTEM OVERVIEW:

The DAC-104 is a 4-channel 96-kHz 24-bit audio digital-to-analog converter for Benchmark System1000™ card frames. The card supports input sample rates from 28 kHz to 108 kHz, and any word length up to and including 24-bits.

The DAC-104 card is double-shielded and is designed to operate adjacent to microphone preamplifier cards (or any other analog card) without interference or crosstalk. The card has two digital audio inputs, four analog output channels, and a total of eight balanced outputs (each analog channel drives two balanced analog outputs). The levels of all 8 analog outputs are individually adjustable from the front panel.

The performance of the DAC-104 exceeds that of the highly respected Benchmark DAC2008 converters and virtually all stand-alone studio converters. When compared to other card-frame DACs, the DAC-104 is in a league by itself.

The DAC-104 is 100% jitter immune. The D/A conversion clock is totally isolated from the AES/EBU digital audio clocks in a topology that outperforms two-stage PLL designs. In fact, no jitter-induced artifacts can be detected using an Audio Precision System 2 Cascade test set. Measurement limits include detection of artifacts as low as –140 dBFS, application of jitter amplitudes as high as 12.75 UI, and application of jitter over a frequency range of 2 Hz to 200 kHz. Any AES/EBU signal that can be decoded by the on-board AES/EBU receivers will be reproduced without any added jitter artifacts. In addition, the on-board receiver ICs have been selected for their ability to decode AES/EBU signals in the presence of very high levels of jitter.

The DAC-104 is designed to perform gracefully in the presence of errors or interruptions at the digital audio inputs. A soft mute circuit eliminates pops when a digital signal is applied. Power management circuitry controls the muting and resetting of all digital circuits upon removal and application of power. Audio is present at the outputs only 60 ms after applying a digital input signal, and only 500 ms after hot-plugging the board.

The DAC-104 is designed to avoid all unnecessary mute scenarios. Muting is only enabled upon loss of power, or when a receive error occurs. The DAC-104 does not mute when the input data is all zeros. Consequently, no audio is lost when an audio transient follows full silence. Furthermore, the DAC-104 SNR specifications represent the system performance, not just the performance of an output mute circuit.

The DAC-104 does not require sample rate indication on the digital inputs. Sample rate is determined by measuring the incoming signal. Lack of sample rate status bits, or incorrectly set status bits will not cause loss of audio.

The DAC-104 is phase accurate between channels, between cards, and between frames of cards. A fully populated MF-300 frame will provide 48 phase-accurate analog output channels. An accurate stereo image can be reproduced using any two channels in the system.

Audio channels 1 and 2 are fully independent from channels 3 and 4 and may be operated at different sample rates and/or in different status formats. The digital audio interfaces automatically support either consumer or professional formats.

A fully digital de-emphasis circuit supports 44.1, 48, 88.2, and 96 kHz and is automatically enabled in response to pre-emphasis status bits.

Special features include; polarity inversion, channel swapping, mono summing, L+R/L-R matrix, and a high-performance stereo mode that boosts the dynamic range by 3 dB.

SYSTEM 1000™ COMPATIBILITY:

The DAC-104 can be added to any existing System 1000™ frame. It can coexist with any combination of digital or analog cards.

No special digital power supply rail is required. The DAC-104 is entirely powered from the +/- 15V analog supplies and draws less than 175 mA.

All input and output pins are carefully filtered to eliminate any possibility of interference with analog cards. The DAC-104 has exceptional shielding and will not interfere any of the System 1000™ cards (including microphone pre-amplifiers).

Photo 1 - 48 Channels of D/A Conversion in a 3 RU System 1000™ Card Frame

FEATURE SUMMARY:

- Two AES/EBU digital inputs (total four channels of audio)
- Two analog outputs for each audio channel (total 8 analog outputs)
- Benchmark Phase Accurate – Jitter Immune – UltraLock™ technology
- Two Error LEDs
- Four Sample Rate Indicator LEDs
- Polarity Inversion – jumper selectable
- LR Swap – jumper selectable
- Matrix (L+R to L out, L-R to R out) – jumper selectable
- Mono (L+R Sum to both L and R outputs) – jumper selectable
- High Performance Stereo Mode (Dual DACs per channel) – jumper selectable
- Automatic De-emphasis for 44.1, 48, 88.2, and 96 kHz when Pre-emphasis bit is set
- Adjustable Output Levels – Multi-turn trimmers – 1 trimmer per output – 20 dB Range, 2 dB/turn
- Powered from +/- 15 VDC
- Low Power Consumption (171 mA at +/- 15V, 5.13 Watts)
- Hot-Pluggable
- Reliable and consistent performance under all operating conditions
- Meets FCC and CE emissions requirements

I/O:

Analog Outputs:

- Two outputs per analog channel (8 outputs total).
- EMI filtered.
- Output Impedance is 60 Ohms.
- Output Level adjustable via trimmer (one trimmer per analog channel).
- Minimum Output Level at 0 dBFS:
  +7.5 dBu
- Maximum Output Level at 0 dBFS:
  +27.5 dBu Balanced when driving > 5k Ohms.
  +26 dBu Balanced when driving 600 Ohms.

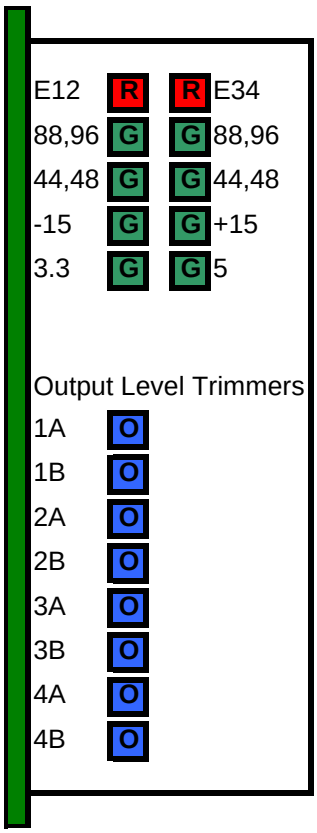
Digital Inputs:

- Two AES Inputs
- Transformer Coupled
- DC blocking capacitors before transformer
- Diode ESD and overload protection
- Series resistor for protection and isolation of non-powered inputs
- Jumper selectable 75 Ohm, 110 Ohm, or High-Z loop through
- Loop Output Connectors
- Two Channel Mode Select Jumper (Feeds Digital 12 In to both receivers)

FRONT PANEL:

LED Display:

- "E12" – Red LED, Receive error on channels 1 and 2
- "E34" – Red LED, Receive error on channels 3 and 4
- "88, 96" – Green LED, Channel pair 1,2 sample rate exceeds 54 kHz
- "88, 96" – Green LED, Channel pair 3,4 sample rate exceeds 54 kHz
- "44, 48" – Green LED, Channel pair 1,2 sample rate is less than 54 kHz
- "44, 48" – Green LED, Channel pair 3,4 sample rate is less than 54 kHz
- "+15V" – Green LED, +15V supply is normal when lit
- "-15V" – Green LED, -15V supply is normal when lit
- "+5V" – Green LED, +5V supply is normal when lit
- "+3.3V" – Green LED, +3.3V supply is normal when lit



Output Level Trimmers:

- One trimmer per Analog Output (8 total) *
- Trim Range: 20 dB, 2 dB/turn, +7.5 to +27.5 dBu at FSD
- Trimmers located on front edge of card

*** Audio channels are identified numerically.** Channels 1 and 2 form the first stereo pair, and channels 3 and 4 form the second stereo pair. **Each audio channel has an "A" and "B" output.** For example, outputs 1A and 1B are driven from the same audio channel, but are individually adjustable. Outputs 1A and 1B may be set to different output levels if desired.

Audio Test Points:

- One unbalanced test point per output (two per channel).
- Test points are post gain control.
- Test points consist of large vias at front edge of PCB.
- Test points are adjacent to trim pots.
- Vias are sized and located to provide convenient clip points for a scope probe.
- One ground tab is provided on front edge of PCB (to attach scope ground clip).
- Audio test points are unbalanced and will measure 6 dB lower than the balanced outputs.

Power Supply Test Points:

- One test point is provided for each of the 4 internal power rails.
- Test points consist of large vias at front edge of PCB.
- Vias are sized and located to provide convenient clip points for a scope probe.
- One ground tab is provided on front edge of PCB (to attach meter ground clip).
- Test points are adjacent to power status LEDs.

SPECIFICATIONS:

Digital Inputs:

Number of Digital Inputs:	2
Number of Audio Channels:	4
Input Sample Frequency Range:	28 to 108 kHz
Maximum Input Word Length	24-bits
Digital Input Impedance (Jumper Selected):	75, 110, or Hi-Z Loop-Thru
Maximum Load on Loop-Thru when Board is not powered:	110 Ohms
Transformer Coupled Digital Inputs:	Yes
DC Blocking Capacitors in series with Transformer Inputs:	Yes
Transient and Over-Voltage Protection on Digital Inputs:	Yes
Minimum Digital Input Level:	300 mV
Jitter Tolerance (With no measurable change in performance):	>12.75 UI sine, 100Hz-10 kHz > 3.5 UI sine at 20 kHz > 1.2 UI sine at 40 kHz > 0.4 UI sine at 80 kHz > 0.29 UI sine at 90 kHz > 0.25 UI sine above 160 kHz
Jitter Attenuation Method:	Benchmark UltraLock™

Analog Outputs:

Number of Analog Outputs:	8 (2 per channel)
Output Type:	Balanced, Direct Drive
Output Impedance:	66 Ohms
Output Level Controls:	8 10-turn pots (1 per output)
Output Level Adjustment Range (at 0 dBFS):	+7.5 dBu to +27.5 dBu
Output Level Adjustability:	2 dB / turn
Output Level Variation with Sample Rate (44.1 kHz vs. 96 kHz):	< 0.006 dB

LED Status Indicators:

LED Location:	Front Edge of Card
Error LEDs (Indicate error on digital input, Mute Enabled)	2 (one per channel pair)
Fs High LEDs (Fs > 54 kHz):	2 (one per channel pair)
Fs Low LEDs (Fs < 54 kHz):	2 (one per channel pair)
Power LEDs (+15, -15, 5, 3.3):	4 (one per voltage rail)

Test Points:

Test Point Location:	Front Edge of Card
Analog Outputs:	8 (one per analog output)
Power:	4 (one per voltage rail)
Ground:	1

Matrix and Invert Functions:

Channel Invert Jumpers:	4 (1 per audio channel)
LR Swap Jumpers:	4 (1 per audio channel)
L+R Sum Jumpers:	4 (1 per audio channel)
L+R, L-R Matrix Jumpers:	4 (1 per audio channel)

Audio Performance:

Fs = 44.1 to 96 kHz, 20 to 20 kHz BW, 1 kHz test tone, 0 dBFS = +24 dBu (unless noted):

SNR – A-Weighted, (0 dBFS = 20 to 27.5 dBu):	110 dB
SNR – Unweighted, (0 dBFS = 20 to 27.5 dBu):	108 dB
SNR at Reduced Gain:	
SNR – A-Weighted (0 dBFS = 10 to 18 dBu):	109 dB
SNR – A-Weighted (0 dBFS = 8 dBu):	108 dB
THD+N, 1 kHz at 0 dBFS:	-99 dBFS, -99 dB, 0.0011%
THD+N, 1 kHz at –1 dBFS:	-101 dBFS, -100 dB, 0.0010%
THD+N, 1 kHz at –3 dBFS:	-105 dBFS, -102 dB, 0.00079%
THD+N, 20 to 20 kHz test tone at –3 dBFS:	-104 dBFS, -101 dB, 0.0009%
Frequency Response at Fs=48,000:	+/- 0.1 dB (20 to 20 kHz) -0.02 dB at 10 Hz -0.20 dB at 20 kHz
Frequency Response at Fs=96,000:	+/- 0.1 dB (20 to 20 kHz) -0.02 dB at 10 Hz -0.20 dB at 20 kHz -0.86 dB at 40 kHz -2.7 dB at 45 kHz
Maximum Amplitude of Jitter Induced Sidebands: (10 kHz 0 dBFS test tone, 12.75 UI sinusoidal jitter at 1 kHz)	< -141 dB
Maximum Amplitude of Spurious Tones with 0 dBFS test signal:	< -130 dB
Maximum Amplitude of Idle Tones:	< -130 dB
Interchannel Differential Phase (Stereo Pair):	+/- 0.5 degrees at 20 kHz
Interchannel Differential Phase (Channel 1 to Channel 3):	+/- 0.5 degrees at 20 kHz
Interchannel Differential Phase (Between Boards):	+/- 0.5 degrees at 20 kHz
Delay (Digital Input to Analog Output):	1.01 mS + (48/Fs) 2.10 ms at 44.1 kHz 2.02 ms at 48 kHz 1.53 ms at 88.2 kHz 1.49 ms at 96 kHz
Maximum Lock Time – after Fs change:	100 mS
Soft Mute Ramp Up/Down Time:	10 mS
Mute on Receive Error:	Yes
Mute on Lock Error:	Yes
Mute on Idle Channel:	No
50/15 uS De-Emphasis Enable:	Automatic
De-Emphasis Method:	Digital IIR
De-Emphasis Supported at:	Fs = 32, 44.1, 48, and 96 kHz

System Group Delay:

Delay from digital input to analog output is a function of sample rate:

2.72 ms at 28 kHz
2.51 ms at 32 kHz
2.10 ms at 44.1 kHz
2.01 ms at 48 kHz
1.55 ms at 88.2 kHz
1.51 ms at 96 kHz
1.45 ms at 108 kHz

The delay can be calculated using the following formula:

Delay = 1.01 mS + (48/Fs)

Where Fs = the sample rate in Hz.

Power Requirements:

+/- 15 volts regulated
Minimum regulated input voltage = +/- 14 volts.
Maximum regulated input voltage = +/- 20 volts.
165 mA – Idle channel, digital inputs active, any sample rate.
171 mA - +24 dBu at all outputs, 0 dBFS, any sample rate.
Ground current < 2 mA (Loads are balanced to better than 1.2%).

Dimensions:

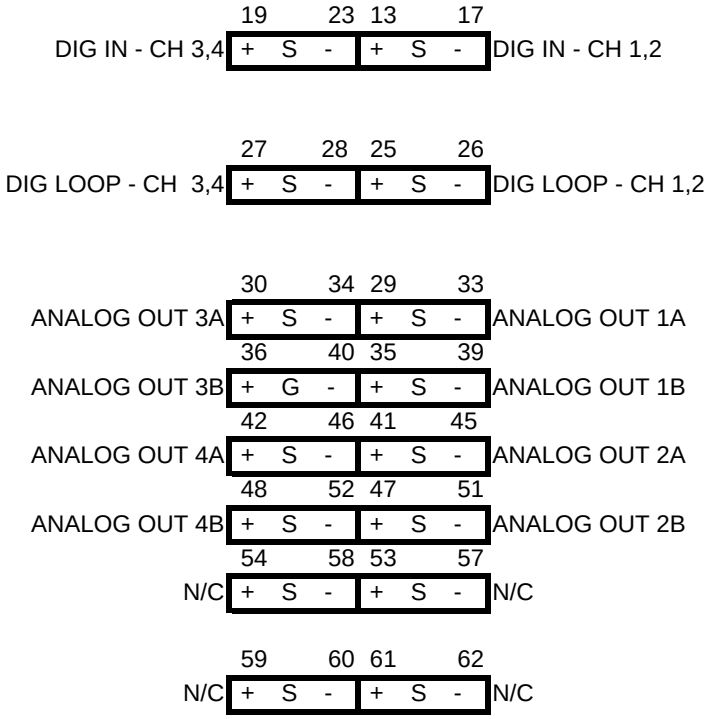
(Standard System 1000™ Card Dimensions)

220 mm x 100mm x 16mm
8.75” x 3.95” x 0.625”
(L x W x H)

DAC-104 PIN ASSIGNMENTS – MLX (MOLEX) CARD FRAME:

(As Seen from Rear of System 1000™ MLX Card Frame)

MOLEX SL CONNECTORS



(S=Cable Shield)

CARD EDGE CONNECTOR

GND	2	1	GND
GND	4	3	GND
+15 Volts (Analog +V)	6	5	+15 Volts (Analog +V)
+15 Volts (Analog +V)	8	7	+15 Volts (Analog +V)
-15 Volts (Analog -V)	10	9	-15 Volts (Analog -V)
-15 Volts (Analog -V)	12	11	-15 Volts (Analog -V)
	14	13	DIG IN 12 +
	16	15	GND
	18	17	DIG IN 12 -
	20	19	DIG IN 34 +
	22	21	GND
	24	23	DIG IN 34 -
DIG LOOP 1,2 -	26	25	DIG LOOP 1,2 +
DIG LOOP 3,4 -	28	27	DIG LOOP 3,4 +
ANALOG 3A OUT +	30	29	ANALOG 1A OUT +
GND	32	31	GND
ANALOG 3A OUT -	34	33	ANALOG 1A OUT -
ANALOG 3B OUT +	36	35	ANALOG 1B OUT +
GND	38	37	GND
ANALOG 3B OUT -	40	39	ANALOG 1B OUT -
ANALOG 4A OUT +	42	41	ANALOG 2A OUT +
GND	44	43	GND
ANALOG 4A OUT -	46	45	ANALOG 2A OUT -
ANALOG 4B OUT +	48	47	ANALOG 2B OUT +
GND	50	49	GND
ANALOG 4B OUT -	52	51	ANALOG 2B OUT -
NC	54	53	NC
GND	56	55	GND
NC	58	57	NC
NC	60	59	NC
NC	62	61	NC
NC	64	63	NC
NC	66	65	NC
NC	68	67	NC
NC	70	69	NC

Notes:

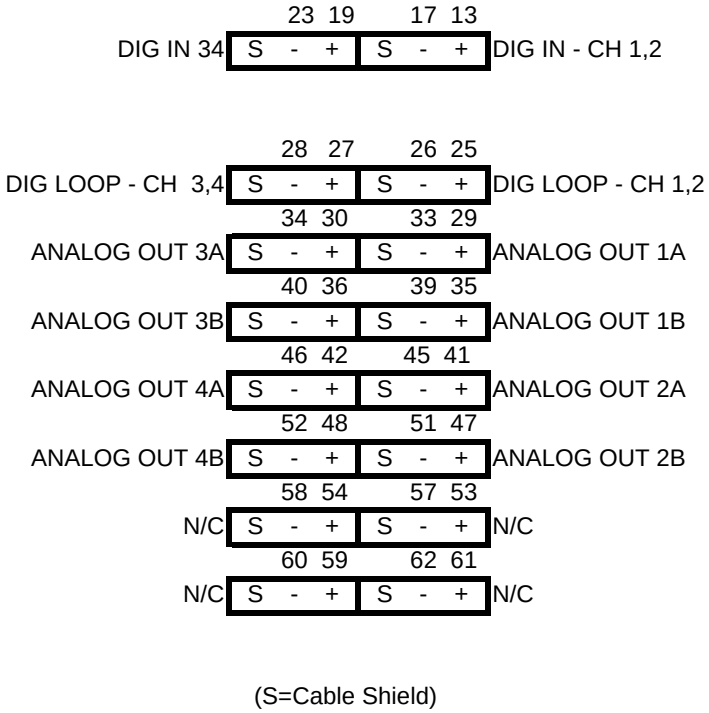
Audio channels are identified numerically. Channels 1 and 2 form the first stereo pair, and channels 3 and 4 form the second stereo pair.

Each audio channel has an "A" and "B" output. For example, outputs 1A and 1B are driven from the same audio channel, but are individually adjustable. Outputs 1A and 1B may be set to different output levels if desired.

DAC-104 PIN ASSIGNMENTS – WEC (WECO HSL) CARD FRAME:

(As Seen from Rear of System 1000™ WEC Card Frame)

WECO HSL CONNECTORS



(S=Cable Shield)

CARD EDGE CONNECTOR

GND	2	1	GND
GND	4	3	GND
+15 Volts (Analog +V)	6	5	+15 Volts (Analog +V)
+15 Volts (Analog +V)	8	7	+15 Volts (Analog +V)
-15 Volts (Analog -V)	10	9	-15 Volts (Analog -V)
-15 Volts (Analog -V)	12	11	-15 Volts (Analog -V)
	14	13	DIG IN 12 +
	16	15	GND
	18	17	DIG IN 12 -
	20	19	DIG IN 34 +
	22	21	GND
	24	23	DIG IN 34 -
DIG LOOP 12 -	26	25	DIG LOOP 12 +
DIG LOOP 34 -	28	27	DIG LOOP 34 +
ANALOG 3A OUT +	30	29	ANALOG 1A OUT +
GND	32	31	GND
ANALOG 3A OUT -	34	33	ANALOG 1A OUT -
ANALOG 3B OUT +	36	35	ANALOG 1B OUT +
GND	38	37	GND
ANALOG 3B OUT -	40	39	ANALOG 1B OUT -
ANALOG 4A OUT +	42	41	ANALOG 2A OUT +
GND	44	43	GND
ANALOG 4A OUT -	46	45	ANALOG 2A OUT -
ANALOG 4B OUT +	48	47	ANALOG 2B OUT +
GND	50	49	GND
ANALOG 4B OUT -	52	51	ANALOG 2B OUT -
N/C	54	53	N/C
N/C	56	55	N/C
N/C	58	57	N/C
N/C	60	59	N/C
N/C	62	61	N/C
N/C	64	63	N/C
N/C	66	65	N/C
N/C	68	67	N/C
N/C	70	69	N/C

Notes:

Audio channels are identified numerically. Channels 1 and 2 form the first stereo pair, and channels 3 and 4 form the second stereo pair.

Each audio channel has an "A" and "B" output. For example, outputs 1A and 1B are driven from the same audio channel, but are individually adjustable. Outputs 1A and 1B may be set to different output levels if desired.

WIRING EXAMPLES (Photos):

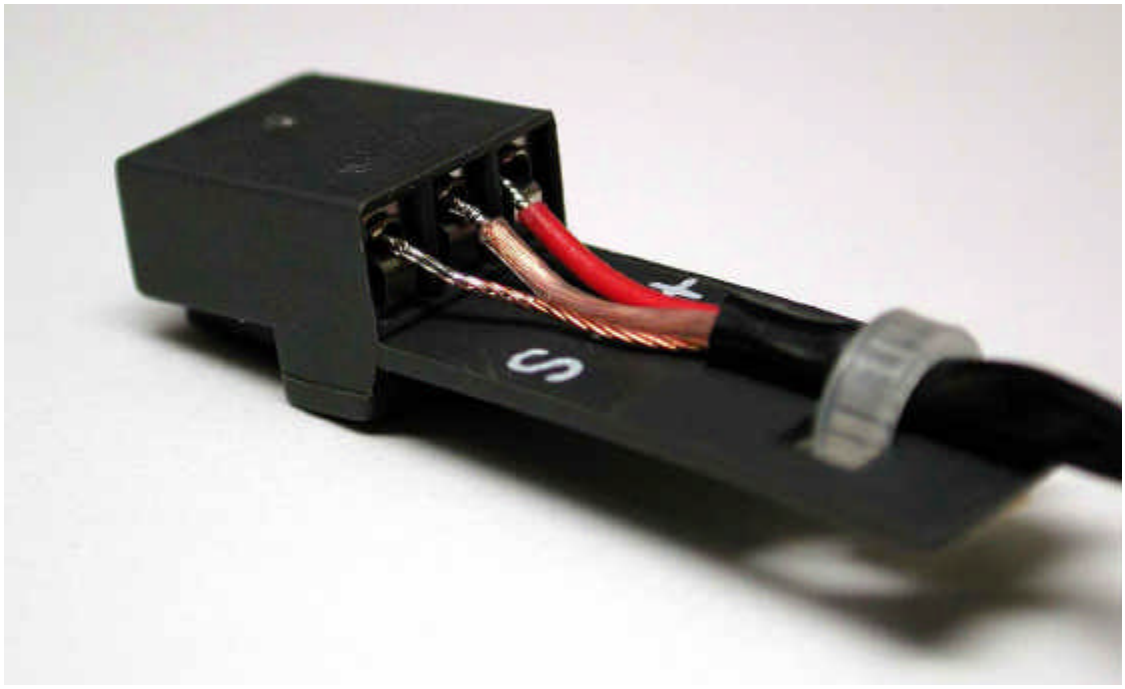


Photo 2 - Balanced (Analog or Digital) I/O using WECO HSL Connectors

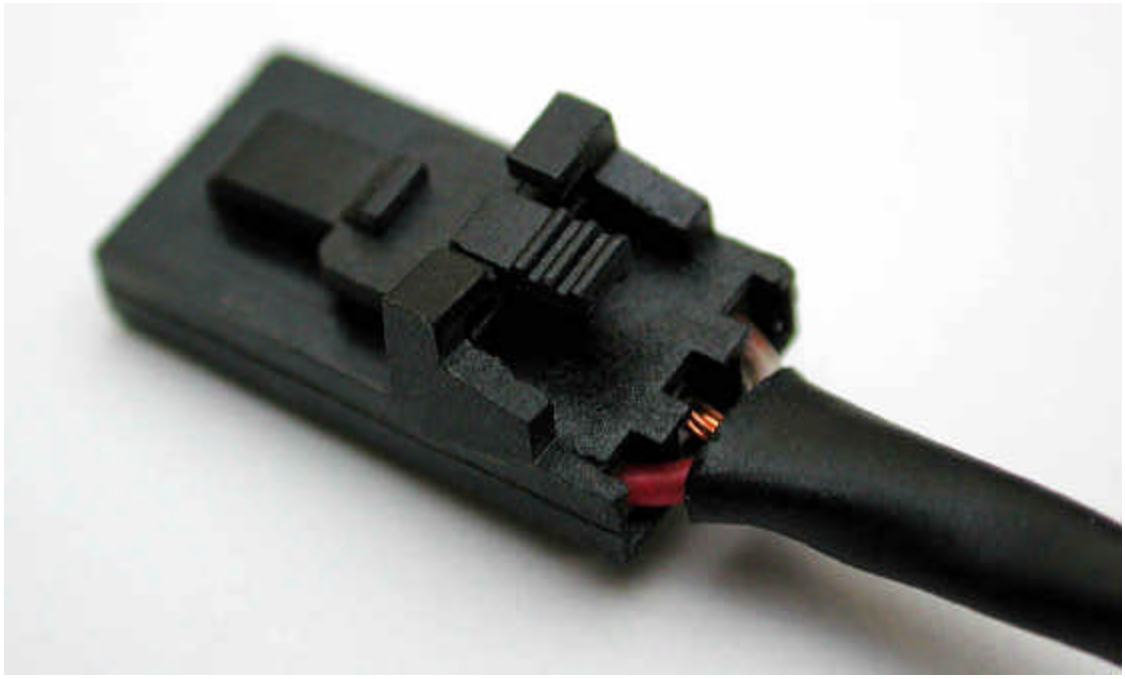


Photo 3 - Balanced (Analog or Digital) I/O using Molex SL Connectors

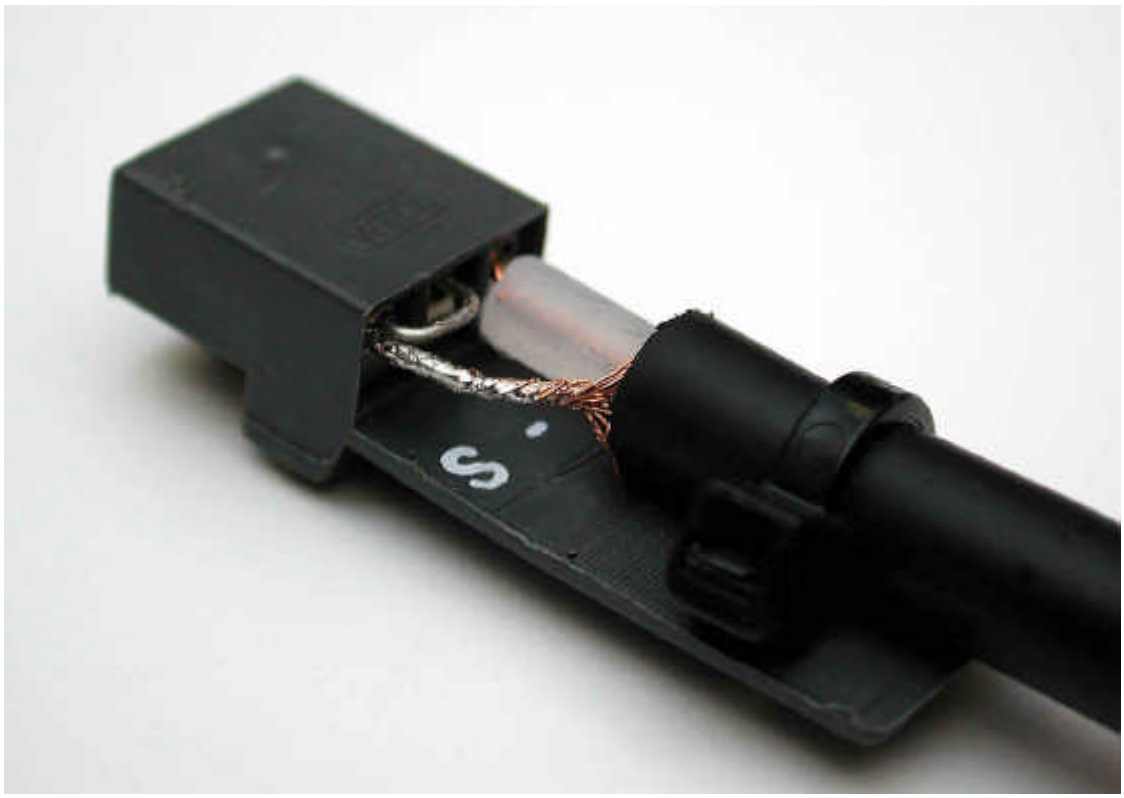


Photo 4 - 75 Ohm Unbalanced Digital I/O using WECO HSLConnectors

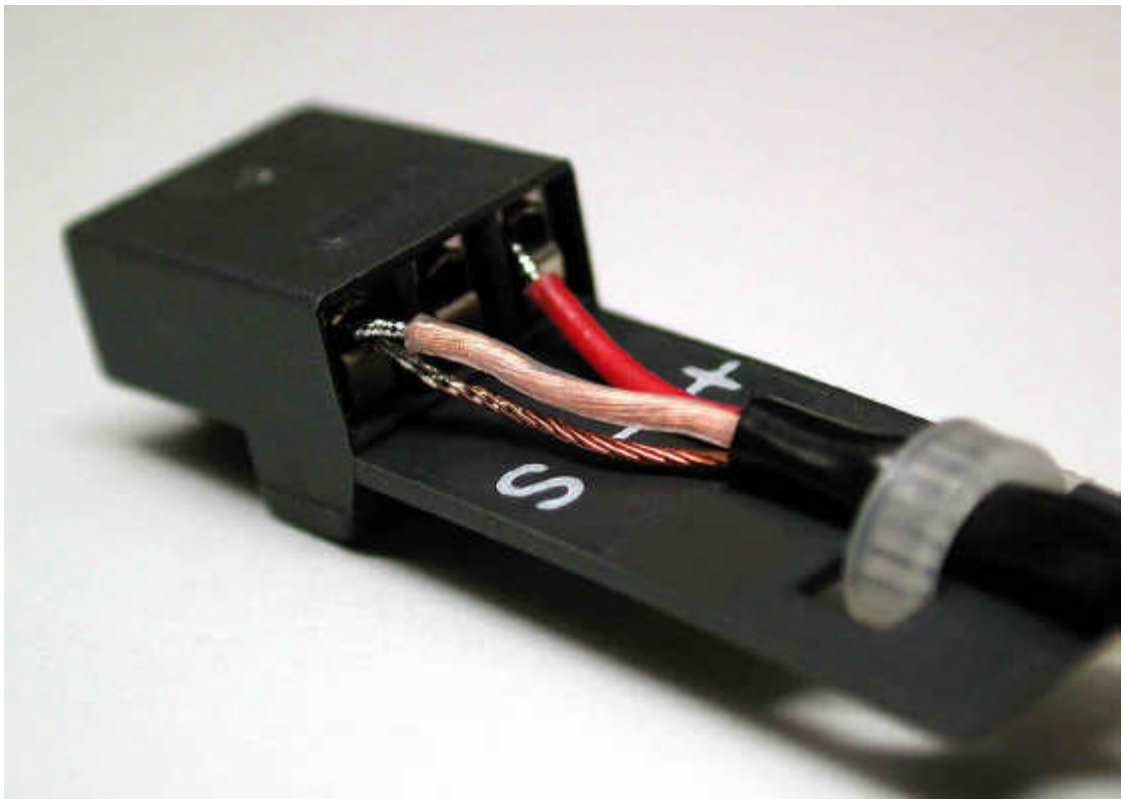


Photo 5 - Special Wiring - Balanced Analog Outputs Driving Unbalanced Devices

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WIRING INSTRUCTIONS – WECO HSL or Molex SL Connectors:

System 1000™ Analog Audio Outputs to Balanced Inputs:

See Photo 2 for WECO HSL connectors.
See Photo 3 for Molex SL connectors.

S = Shield * (connect to pin 1 on XLR connectors – do not connect to XLR shell)
+ = Positive Audio Out (connect to pin 2 on XLR connectors)
- = Negative Audio Out (connect to pin 3 on XLR connectors)

*** Never lift the shield at an audio output.**

System 1000™ Analog Audio Outputs to Unbalanced Inputs:

See Photo 5 for WECO HSL connectors.
S = Shield* (connect to Sleeve on phone plug, or shield on RCA plug)
+ = Positive Audio Out (connect to Tip on phone plug, or center pin on RCA plug)
- = No Connection! **

** **Never tie the "-" analog output pin to ground.** The analog outputs on the DAC104 (and all System 1000™ boards) are actively balanced and, are driven with very low source impedances (typically 30 ohms per side). Unlike some transformer coupled outputs, the "-" pin should not be tied to ground when driving a device with an unbalanced input. If the "-" analog output pin is tied to ground, power consumption will increase dramatically. If many outputs are miss-wired in this fashion, power supply overloading may occur.

System 1000™Digital Outputs to 110 Ohm Balanced Digital Inputs:

See Photo 2 for WECO HSL connectors.
See Photo 3 for Molex SL connectors.

Set output impedance jumper to 110 Ohms (located on DAC104 card)
Use 110-Ohm digital audio cable.
S = Shield *** (connect to pin 1 on XLR connectors, and connect to XLR shell)
+ = Positive Digital Out (connect to pin 2 on XLR connectors)
- = Negative Digital Out (connect to pin 3 on XLR connectors)

***** Never lift ground on a digital input or output.** Digital shields should not be lifted at either end of a digital audio interconnect. Lifting a ground on a digital interconnect may produce EMI that exceeds allowable limits.

System 1000™ Digital Outputs to 75 Ohm Unbalanced Digital Inputs:

See Photo 4 for WECO HSL connectors.

Set output impedance jumper to 75 Ohms (located on DAC104 card)
Use 75-Ohm coax.
S = Coax shield
+ = Coax center conductor
- = Coax shield ****

****** Note that both the "S" and the "-" pins must be connected to the shield of the coax.** A short piece of bus wire can be used to tie the "-" pin to the "S" pin (see Photo 4). The DAC104 digital outputs are transformer coupled. If the "-" pin is left floating little or no signal will be transmitted.

REMOVING TOP COVER:

The DAC104 has a removable shield cover. This cover prevents crosstalk between System 1000™ and provides supplementary EMI shielding, and greatly reduces the chances of damaging the ESD sensitive components.

It is necessary to remove the cover for access to the configuration jumpers. See Photo 5

1. Starting at one of the corners, pry the cover up about 1/16".
2. Proceed to an adjacent corner and pry it up about 1/16".
3. Proceed to the other two corners.
4. Repeat the process if necessary.

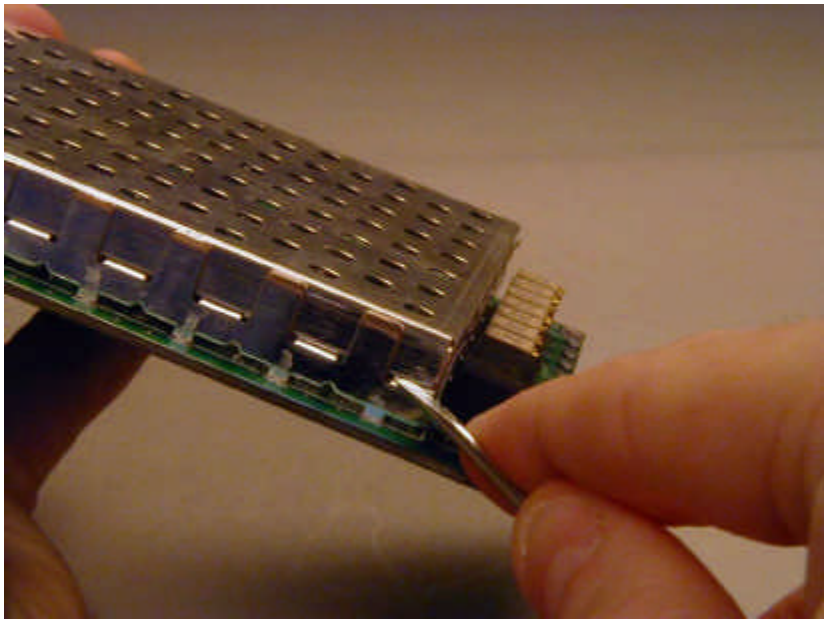


Photo 6 - Removing the Cover

JUMPERS:

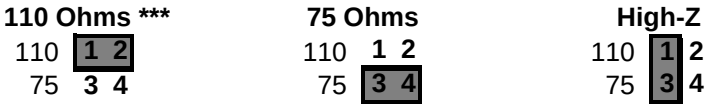
See Figure 1 for jumper locations.

Input Impedance Jumpers (JP9, JP10):

One 4-pin header per digital input, allows selection of:

- 110 Ohm Input Impedance ***
- 75 Ohm Input Impedance
- High-Z

JP9 sets the input impedance of "**DIG IN 12**" (digital input for channels 1 and 2).
JP10 set the input impedance of "**DIG IN 34**" (digital input for channels 3 and 4).



***** = Factory Default is 100 Ohms.**

Input Mode Jumper (JP11):

One 4-pin header, allows selection of:

- 4-channel (normal) mode ***
- 2-channel (high-performance mode)

***** = Factory Default is 4-Channel Mode.**

Output Mode Jumpers (Headers P1, P2, P3, and P4):

One 12-pin jumper header per analog channel, allows selection of:

- Normal ***
- Invert
- Mono Sum
- Difference
- LR Swap
- 2-Channel Mode
- 4-Channel Sum
- Any other combination of 4-channels

***** = Factory Default is Normal Mode.**

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Left-1 Output Mode Jumper Settings (Outputs 1A and 1B, Header P3):

Normal *** (L1)			**Invert** (-L1)			**Mono Sum** (L1+R1)			**LR Swap** (R1)			**2-Ch. Mode** (L1+L2)			**4-Ch. Sum** (L1+L2+R1+R2)		
R2	**1**	**2**	R2	**1**	**2**	R2	**1**	**2**	R2	**1**	**2**	R2	**1**	**2**	R2	**1**	**2**
L2	**3**	**4**	L2	**3**	**4**	L2	**3**	**4**	L2	**3**	**4**	L2	**3**	**4**	L2	**3**	**4**
L1	**5**	**6**	L1	**5**	**6**	L1	**5**	**6**	L1	**5**	**6**	L1	**5**	**6**	L1	**5**	**6**
R1	**7**	**8**	R1	**7**	**8**	R1	**7**	**8**	R1	**7**	**8**	R1	**7**	**8**	R1	**7**	**8**
G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**
-L1	**11**	**12**	-L1	**11**	**12**	-L1	**11**	**12**	-L1	**11**	**12**	-L1	**11**	**12**	-L1	**11**	**12**

Right-1 Output Mode Jumper Settings (Outputs 2A and 2B, Header P1):

Normal *** (R1)			**Invert** (-R1)			**Mono Sum** (L1+R1)			**LR Swap** (L1)			**2-Ch. Mode** (R1+R2)			**4-Ch. Sum** (L1+L2+R1+R2)		
L2	**1**	**2**	L2	**1**	**2**	L2	**1**	**2**	L2	**1**	**2**	L2	**1**	**2**	L2	**1**	**2**
R2	**3**	**4**	R2	**3**	**4**	R2	**3**	**4**	R2	**3**	**4**	R2	**3**	**4**	R2	**3**	**4**
R1	**5**	**6**	R1	**5**	**6**	R1	**5**	**6**	R1	**5**	**6**	R1	**5**	**6**	R1	**5**	**6**
L1	**7**	**8**	L1	**7**	**8**	L1	**7**	**8**	L1	**7**	**8**	L1	**7**	**8**	L1	**7**	**8**
G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**
-R1	**11**	**12**	-R1	**11**	**12**	-R1	**11**	**12**	-R1	**11**	**12**	-R1	**11**	**12**	-R1	**11**	**12**

Left-2 Output Mode Jumper Settings (Outputs 3A and 3B, Header P4):

Normal *** (L2)			**Invert** (-L2)			**Mono Sum** (L2+R2)			**LR Swap** (R2)			**2-Ch. Mode** (L1+L2)			**4-Ch. Sum** (L1+L2+R1+R2)		
R1	**1**	**2**	R1	**1**	**2**	R1	**1**	**2**	R1	**1**	**2**	R1	**1**	**2**	R1	**1**	**2**
L1	**3**	**4**	L1	**3**	**4**	L1	**3**	**4**	L1	**3**	**4**	L1	**3**	**4**	L1	**3**	**4**
L2	**5**	**6**	L2	**5**	**6**	L2	**5**	**6**	L2	**5**	**6**	L2	**5**	**6**	L2	**5**	**6**
R2	**7**	**8**	R2	**7**	**8**	R2	**7**	**8**	R2	**7**	**8**	R2	**7**	**8**	R2	**7**	**8**
G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**
-L2	**11**	**12**	-L2	**11**	**12**	-L2	**11**	**12**	-L2	**11**	**12**	-L2	**11**	**12**	-L2	**11**	**12**

Right-2 Output Mode Jumper Settings (Outputs 4A and 4B, Header P2)

Normal *** (R2)			**Invert** (-R2)			**Mono Sum** (L2+R2)			**LR Swap** (L2)			**2-Ch. Mode** (R1+R2)			**4-Ch. Sum** (L1+L2+R1+R2)		
L1	**1**	**2**	L1	**1**	**2**	L1	**1**	**2**	L1	**1**	**2**	L1	**1**	**2**	L1	**1**	**2**
R1	**3**	**4**	R1	**3**	**4**	R1	**3**	**4**	R1	**3**	**4**	R1	**3**	**4**	R1	**3**	**4**
R2	**5**	**6**	R2	**5**	**6**	R2	**5**	**6**	R2	**5**	**6**	R2	**5**	**6**	R2	**5**	**6**
L2	**7**	**8**	L2	**7**	**8**	L2	**7**	**8**	L2	**7**	**8**	L2	**7**	**8**	L2	**7**	**8**
G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**	G	**9**	**10**
-R2	**11**	**12**	-R2	**11**	**12**	-R2	**11**	**12**	-R2	**11**	**12**	-R2	**11**	**12**	-R2	**11**	**12**

***** = Factory Default is Normal Mode on all outputs.**

JUMPER LOCATIONS:

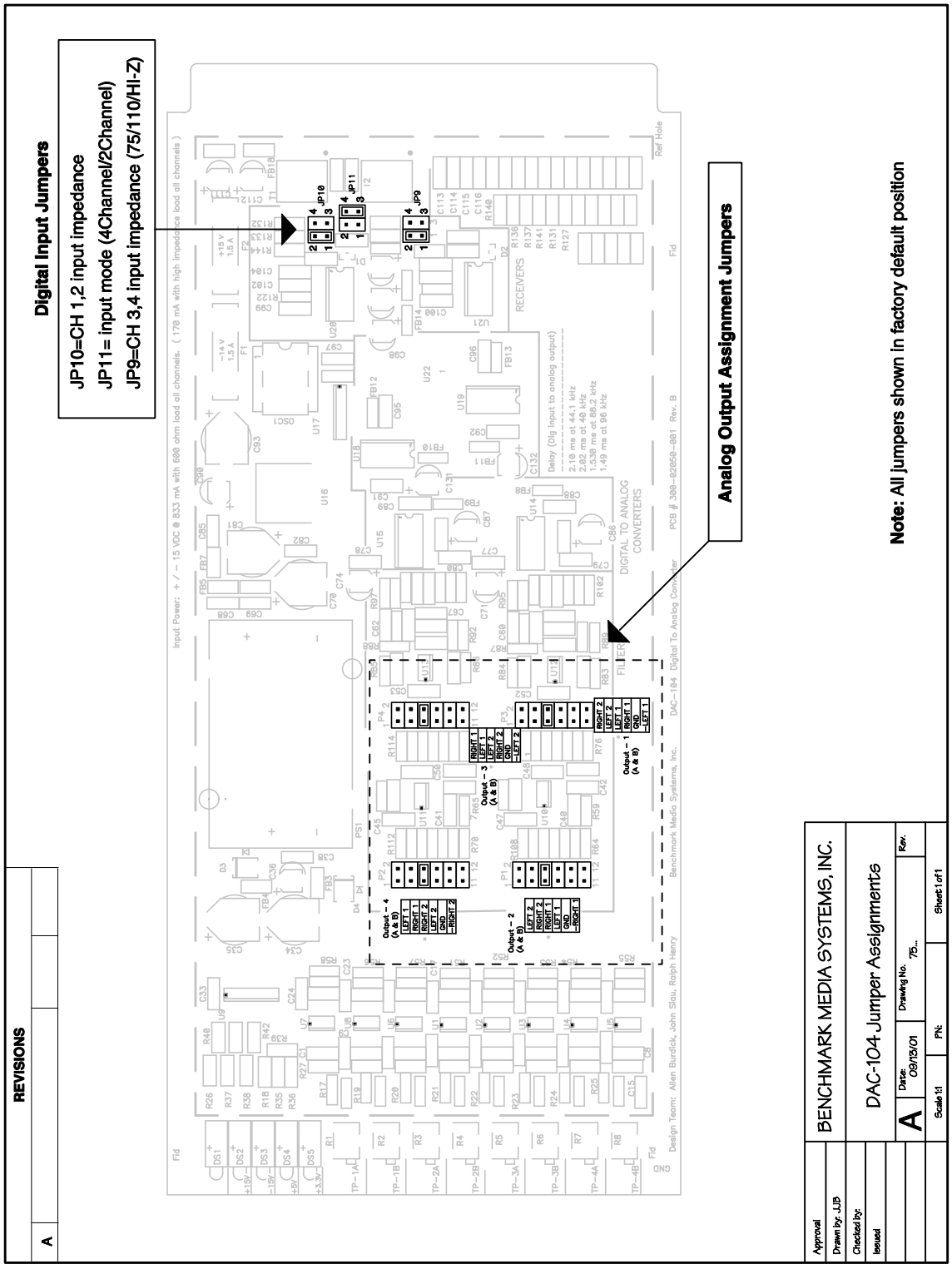

Figure 1 - Jumper Locations

Benchmark Media Systems, Inc.

COMPLIANCE and SAFETY INFORMATION:

FCC Class B Compliance:

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference, and
(2) This device must accept any interference received, including interference that may cause undesired operation.

Safety Information:

Do NOT service or repair this product unless properly qualified. Only a qualified technician or authorized Benchmark Media Systems, Inc. distributor should perform servicing.

For continued fire hazard protection, fuses should be replaced ONLY with the exact value and type as indicated on the rear panel and on this page below.

Do NOT substitute parts or make any modifications without the written approval of Benchmark Media Systems, Inc. Doing so may create safety hazards.