

***m908 Monitor Controller
System Specifications
Revision F March, 2021
System Firmware Version 1.0.7***

Table of Contents

1 ACU.....	1	3.5 Downmix Formats.....	4
1.1 Input Connector configuration.....	1	3.6 Meter Output Routing.....	4
1.2 Output connector configuration.....	2	3.7 Other.....	4
1.3 Other connectors.....	2	4 PSU.....	5
2 RCU.....	3	4.1 Model A140 redundant power supply.....	5
2.1 I/O Connections.....	3	2 x 40W SMPS modules.....	5
2.2 Sound Pressure Level Meter.....	3	4.2 AC power input: IEC C14.....	5
2.3 User interface.....	3	4.3 DC output to ACU: CPC-8.....	5
3 Signal processing functions.....	3	5 Signal Processing Specifications.....	5
3.1 Volume Control.....	3	6 Electrical Specifications.....	6
3.2 Headphone cross feed.....	3	7 Mechanical Specifications.....	12
3.3 Bass Management.....	3	7.1 Dimensions.....	12
3.4 Supported speaker formats.....	3	7.2 Document Revisions.....	15

The Grace Design m908 Monitor Controller is designed for monitoring in 7.1, 5.1, stereo, and mono as well as higher channel count playback systems such as Dolby Atmos, Auro-3D, and DTS-X. Up to 24 channel speaker systems can be controlled. The system consists of an Audio Control Unit (ACU), Remote Control Unit (RCU), and Power Supply Unit (PSU). The RCU communicates with the ACU via RS-485 serial connection. The PSU contains dual redundant universal input power supplies which provide the ACU/RCU with DC power for analog and digital circuits.

The m908 standard features include a total of 68 digital input channels, 16 analog output channels, and 24 digital output channels. Up to 16 channels of analog inputs are available with the addition of optional 8 channel ADC modules. The Option I/O module slot provides up to 32 additional digital inputs and outputs. Up to 24 input channels can be received simultaneously and routed to the 24 channel processor. The processor has 24 output channels. The m908 supports sample rates of up to 192kHz at 24bits. Following is an outline of the m908 I/O connections.

1 ACU

1.1 Input Connector configuration

1.1.1 Analog

- (2) 8 Channel balanced: DB25 (optional)
- (1) 2 Channel balanced: XLR (optional)
- (1) 2 Channel unbalanced: RCA Phono (optional)

- (1) 2 Channel unbalanced RIAA phonograph preamp: RCA Phono (optional)
- (1) 1 Channel balanced Talkback microphone input w/ 48V mic power: XLR
- (1) 1 Channel balanced Talkback input: DB15 (from RCU)

1.1.2 Digital

- (3) 8 Channel AES3: DB25
- (2) 8 Channel ADAT: Optical
- (2) 2 Channel TOSLINK (Uses ADAT connectors): Optical
- (1) 2 Channel AES3: XLR
- (1) 2 Channel SPDIF: RCA Coaxial
- (1) 24 Channel USB 2.0: USB-B (asynchronous mode)
- (1) 32 Channel IO Option Module

1.2 Output connector configuration

1.2.1 Analog

- (2) 8 Channel CR Speaker balanced: DB25
- (1) 8 Channel CR Speaker/4 x 2ch Cue: DB25
- (1) 2 Channel CR Speaker balanced: XLR
- (1) 1 Channel Talkback balanced: XLR
- (2) 2 Channel Headphone: 1/4"TRS (one on RCU)

1.2.2 Digital

- (3) 8 Channel AES3 x 4: DB25
- (1) 32 Channel IO Option Module Slot

1.3 Other connectors

1.3.1 Option I/O Slot

- Dante Option
 - 32 Ch In/32 Ch Out 44.1-48kHz
 - 16 Ch In/16 Ch Out 88.2-96kHz
 - 8ch In/8 Ch Out 176.4-192kHz
- Ravenna/AES67 (Merging ZMAN)
 - 32 Ch In/32 Ch Out 44.1-192kHz
- Digilink Option
 - 32 Ch In/32 Ch Out 44.1-192kHz

1.3.2 Clocking

- Connectors
 - (1) Word Clock in: BNC
 - (1) Word Clock through/out: BNC
- The m908 can synchronize to a variety of clock sources listed below.
 - External Word Clock Input
 - Internal Fixed Oscillators
 - AES3 Inputs
 - SPDIF Input
 - ADAT Inputs
 - TOSLINK Inputs
 - Option I/O Module

1.3.3 Control/Computer IO

- Ethernet: RJ45 (reserved for future use)
- RCU: DB15 RS485/GPIO/Headphones
- USB Host: USB-A
- (3) GPIO on Pin 25 of AES3: DB25
- (1) GPIO on Pin 5 of RCU: DB15
- External Talkback switch with tally: 1/4" TRS

2 RCU

2.1 I/O Connections

- Talkback/SPL Microphone, Built in
- USB Type A Host connector. User preset backup/restore via USB Mass Storage Class.
- RS485 communications and headphone signal from ACU on DB15
- Headphone Jack 1/4" TRS

2.2 Sound Pressure Level Meter

- Sound Pressure Level with A weighting, C weighting, or no weighting.
- Peak Hold with Fast or Slow averaging

2.3 User interface

- 480x272 QVGA display, LED dimable back light with adjustable dim levels and dim timer.
- 24 detent encoder with integrated push-button for level control and parameter configuration
- 8 user defined input buttons
- 3 user defined illuminated control room speaker output buttons
- 3 x 3 speaker Solo/Mute dual color push-button array
- 3 user defined multi-function dual color push-buttons
- Illuminated talkback push button
- Illuminated DIM push-button, push-hold for headphone crossfeed on/off
- Illuminated MONO push-button, push-hold for L-R function
- Illuminated MUTE push-button
- Illuminated MON>CUE push-button
- Illuminated Setup push-button

3 Signal processing functions

3.1 Volume Control

3.2 Headphone cross feed

3.3 Bass Management

- Crossovers for up to 22.2 speaker systems
- Bypass available on High Pass filters
- Independent High/Low Pass filter slope settings:
- Adjustable crossover frequency.

3.4 Supported speaker formats

- Custom user defined formats up to 24 channels
- Atmos up to 14.2.6

- Auro-3D up to 13.1
- DTS-X up to 14.2.6
- Standard surround formats (ie: 5.1, 7.1 9.1)
- LCRS
- 2.1
- Stereo 2.0
- Mono

3.5 *Downmix Formats*

- 7.1 > 5.1
- 7.1 > 5.1 (Dolby PLII)
- 7.1 > LCRS
- 7.1 > LCRS2
- 7.1 > Lt/Rt
- 7.1 > Lt/Rt (Dolby PLII)
- 7.1 > Lo/Ro
- 5.1 > LCRS
- 5.1 > LCRS2
- 5.1 > Lt/Rt
- 5.1 > Lt/Rt (Dolby PLII)
- 5.1 > Lo/Ro
- LCRS > L/R
- LCRS2 > L/R

3.6 *Meter Output Routing*

- All inputs can be routed to any available output for metering.
- Meter feed can be pre or post Input Level cal.
- Meter feed can follow monitoring source or be fixed to a single input.

3.7 *Other*

3.7.1 *Inputs*

- Source summing
 - Up to 3 inputs can be summed together
- Sync Delay
- Level offset
- De-emphasis control
- System Clock source override

3.7.2 *Speakers:*

- Volume control
- MUTE/DIM
- MONO and Left minus Right
- User assignable MUTE/SOLO control
- Global level offset
- Channel level offset
- Channel Delay
- Bass management

3.7.3 Room Correction EQ

- 6 band parametric EQ per channel for Sub channels
- 3 band parametric EQ per channel for Speaker channels
-

3.7.4 CUE Outputs

- Up to 8 stereo cue paths
- Independent stereo level control on each cue
- Assignable talkback routing
- Source can be configured for CUE input, Control Room L/R, or downmix

3.7.5 Talkback System

- Talkback mic amp gain control for RCU and ACU talkback mics
- Talkback trigger sources:
 - RCU Talkback switch
 - ACU External Talkback switch
 - A, B, or C User definable buttons on RCU
 - GPIO 1-4 on ACU
- Each talkback trigger source can be assigned to enable a specific talkback mic (ACU and/or RCU) and route it to any or all CUE sends.
- Adjustable Talkback DIM for control room monitors
- Adjustable Talkback DIM for CUE sends

4 PSU

4.1 Model A140 redundant power supply

- 2 x 40W SMPS modules.

4.2 AC power input: IEC C14

4.3 DC output to ACU: CPC-8.

5 Signal Processing Specifications

SIGNAL PROCESSING	
Signal Processing – Delay	
Input sync delay	0-1000 ms, 5ms steps
Speaker channel delay	0-250ms, 0.1ms steps
Signal Processing – Bass Management	
Crossover Frequency	50-150Hz, 1Hz steps
HPF Response	6, 12,18, 24dB/octave
6dB/octave	
12dB/octave	Linkwitz Riley
18dB/Octave	Butterworth
24dB/Octave	Linkwitz Riley
LPF Response	6, 12,18, 24dB/octave

SIGNAL PROCESSING	
6dB/octave	
12dB/octave	Linkwitz Riley - Inverted LPF Output
18dB/Octave	Butterworth
24dB/Octave	Linkwitz Riley
Signal Processing – Room Correction EQ	
Number of bands per Channel	Up to 12
Total number of bands:	85
Filter frequency range, 246 steps ~1/24 octave spacing	10-20,000Hz
Filter Q	0.02-50
Filter Shapes	Low Shelf, Low Pass, Peak, High Pass, High Shelf
Monitor Control	
Attenuation Range	-inf, -99.5dB to 0dB, 0.5dB steps
DIM Attenuation	-30.0dB to 0.0dB, 0.5dB steps
MONO Sum Law	-9.0dB to 0dB, 0.5dB steps
Speaker System Latency AD in to DA out	
Fs=44.1kHz	5.1ms
Fs=48kHz	4.7ms
Fs=88.2kHz	2.6ms
Fs=96kHz	2.4ms
Fs=176.4kHz	1.3ms
Fs=192kHz	1.2ms
Cue System Latency AD in to DA out	
Fs=44.1kHz	0.70ms
Fs=48kHz	0.64ms
Fs=88.2kHz	0.35ms
Fs=96kHz	0.32ms
Fs=176.4kHz	0.15ms
Fs=192kHz	0.14ms

6 Electrical Specifications

DA CONVERTER CONTROL ROOM OUTPUTS Fs=48kHz unless otherwise noted.		
THD+N		
0dBFS In, +18dBu Out, 22Hz-22kHz BW		<-115dB
Intermodulation Distortion		
SMTPE/DIN 4:1 50Hz, 7kHz, 1.0V Out		<107dB
Frequency response	+/-0.2dB	-3dB
44.1kHz Fs	DC-20.5kHz	DC-20.6kHz
48kHz Fs	DC-22.2kHz	DC-23.5kHz

DA CONVERTER CONTROL ROOM OUTPUTS $F_s=48\text{kHz}$ unless otherwise noted.		
88.2kHz F_s	DC-27kHz	DC-43.2kHz
96kHz F_s	DC-27kHz	DC-47kHz
176.4kHz F_s	DC-27kHz	DC-85.5kHz
192kHz F_s	DC-27kHz	DC-92.7kHz
Dynamic Range		
20-22kHz bandwidth		123dB
20-22kHz bandwidth and A weighting filter		125dB
Output Level		
0dBFS		+18dBu
Output Noise		
20-22kHz		-105dBu
2022kHz, A weighting filter		-107dBu
Crosstalk		
Interchannel crosstalk, 1kHz		-123dB
Interchannel crosstalk, 10kHz		-103dB
Attenuation Range	0 to -99dB, 0.5dB steps	
Channel Tracking Accuracy		+/-0.05dB
Maximum Output Level		+18dBu
Output Impedance (balanced)		300 Ω

A/D CONVERTER OPTION $F_s=48\text{kHz}$ unless otherwise noted.		
THD+N		
1kHz, -1dBFS, 20Hz-22kHz	< 0.0004%	
Intermodulation Distortion		
IMD SMPTE 4:1 60Hz, 7kHz, -3dBFS	<0.002%	
Frequency response	+/-0.2dB	-3dB
44.1kHz F_s	14Hz-20.6kHz	4.5Hz-21.1kHz
48kHz F_s	15Hz-22.4kHz	4.5Hz-23.0kHz
88.2kHz F_s	14.9Hz-41.1kHz	4.5Hz-42.3kHz
96kHz F_s	15Hz-44.7kHz	4.5Hz-46.1kHz
176.4kHz F_s	15.5Hz-79.6kHz	4.5Hz-88.09kHz
192kHz F_s	15Hz-86.7kHz	4.5Hz-95.97kHz
Dynamic range		
22Hz-24kHz, 48kHz	>117dB	
"A" weighted, 48kHz	>120dB	
Full scale input level 0dBFS		
Jumper Selectable	+20dBu OR +24dBu	
Crosstalk		
Interchannel crosstalk, 1kHz	-140dB	

A/D CONVERTER OPTION Fs=48kHz unless otherwise noted.	
Interchannel crosstalk, 10kHz	-127dB
Input Impedance	
Balanced Input (DB25 or XLR)	20k Ω
Unbalanced Input	10k Ω

TALKBACK MIC IN > TALKBACK MIC OUT (ANALOG)	
Gain Range	+11, +19-74dB in 1dB steps
Frequency Response	
@ 40dB gain \pm 0.2dB (50 Ω source)	15Hz-300kHz
@ 40dB gain \pm 3dB (50 Ω source)	4.5Hz-1.0MHz
THD+N	
@ 20dB gain +20dBu out, 1kHz	<.0003%
@ 40dB gain +20dBu out, 1kHz	<.0010%
@ 60dB gain +20dBu out, 1kHz	<.0080%
Intermodulation Distortion	
@ 40dB gain +20dBu out	
SMPTE/DIN 1:1 (50Hz, 7kHz)	<.001%
SMPTE/DIN 4:1 (50Hz, 7kHz)	<.0020%
Noise - Referred to Input	
@ 60dB gain, 50 Ω source	-129dB
@ 60dB gain, 150 Ω source	-127dB
@ 60dB gain, 600 Ω source	-123dB
Phase Deviation	
40-20KHz @ 40dB gain	<5 $^{\circ}$
Crosstalk	
Any Channel @ 40dB gain 1kHz	-127dB
Any Channel @ 40dB gain 10kHz	-113dB
CMRR	
@ 60dB gain, +20dBu CM, 1kHz	>75dB
@ 60dB gain, +20dBu CM, 10kHz	>85dB
@ 60dB gain, +20dBu CM, 60Hz	>55dB
Maximum Output Level	
Balanced, 1kHz, 100k Ω Load	+27dBu
Balanced, 1kHz, 600 Ω Load	+26.2dBu
Impedance	
Input	8k Ω
Output	300 Ω

HEADPHONE AMPLIFIER		
THD+N		
+10dBu Out, 22Hz-22kHz BW		<0.0009%
+10dBu Out, 22Hz-22kHz BW, 20Ω load(300mW)		<0.030%
Intermodulation Distortion		
SMTPE/DIN 4:1 50Hz, 7kHz, 10dBu out, no load		<0.0015%
SMTPE/DIN 4:1 50Hz, 7kHz, 10dBu out, 20Ω load (300mW)		<0.060%
Frequency response		
Fs=192kHz , ±3dB		0.2Hz-92kHz
Fs=192kHz , ±0.2dB		1Hz-27kHz
Dynamic Range		
20-22kHz bandwidth		>114dB
20-22kHz bandwidth and A weighting filter		>118dB
Output Noise		
20-22kHz		< -93dBu
20-22kHz, A weighting filter		< -97dBu
Crosstalk		
Interchannel crosstalk, 1kHz		< -107dB
Interchannel crosstalk, 1kHz		< -98dB
Channel Matching Accuracy		
		+/-0.05dB
Maximum Output Level, Both Channels Driven	Level	Power
100K Ω load	+21.0dBu	NA
20 Ω load	+16.4dBu	1.3W
32 Ω load	+19.2dBu	1.57W
600 Ω load	+21.4dBu	280mW
Headphone Output Impedance		1.3Ω

RIAA PHONO AMPLIFIER OPTION		
GAIN		
	LOW GAIN	HIGH GAIN
Gain @1kHz	40dB	60dB
Noise		
22Hz-22kHz	-90dBu	-71dBu
22-22kHz, A weighting filter	-96dBu	-76dBu
THD+N		
1kHz, 5mV IN	<0.0080%	
1kHz, 1mV IN		<0.040%
SMPTE/DIN Intermodulation Distortion		
SMPTE/DIN 4:1 100/2kHz, 5mV IN	<0.004%	
SMPTE/DIN 4:1 100/2kHz, 1mV IN		<0.03%
Max Input Level		
0.1% THD+N	110mV	10mV
Sub Sonic Filter		
-3dB	12Hz	12Hz
RIAA EQ		
accuracy	±0.10dB	±0.10dB

GPIO		
GPIO Inputs	+5V	+3.3V
Input High Voltage level	>3.3V	>2.0V
Input Low Voltage level	<1.5V	<0.8V
Max Input Voltage level	5.5V	3.8V
GPIO Outputs	+5V	+3.3V
Output High Voltage	5.0V	3.3V
Max Output Current	15mA	10mA
Note: GPIO outputs have 330Ω series output resistors.		
External ACU Talkback switch input		
Switch input pull-up voltage	3.3V	
Switch input pull-up resistance	10KΩ	
Tally output voltage	5.0V	
Tally output resistance	330Ω	

CLOCKING	
Supported Sample Rates kHz	44.1, 48, 88.2, 96, 176.4, 192
External Clock	
Lock Range	FS +/- 1%
Word Clock Input Voltage (BNC)	200mV-5.0V peak to peak
Word Clock Output voltage	5V peak to peak
Word Clock Input Impedance	48kΩ or 75Ω
Word Clock polarity	Left data: High, Right data: Low
Intrinsic Jitter, 10Hz-20kHz BW	
Internal Clock	<40ps RMS
External Clock	<40ps RMS
Jitter Rejection Corner Frequency	0.5Hz

GENERAL		
	Weight	Dimensions
Audio Control Unit	6.8lbs (3.2kg)	19"W x 3.5" H x 10.9" L
Remote Control Unit	2.2lbs (1.0kg)	10.5" W x 2.5" H x 5.1" L
Power Supply Unit	2.6lbs (1.2kg)	8.5" W x 1.7" H x 8.2" L
Power Consumption		
90-250V~ 50-60Hz		50W Max

7 Mechanical Specifications

7.1 Dimensions

7.1.1 [\[ACU dimensions drawing\]](#)

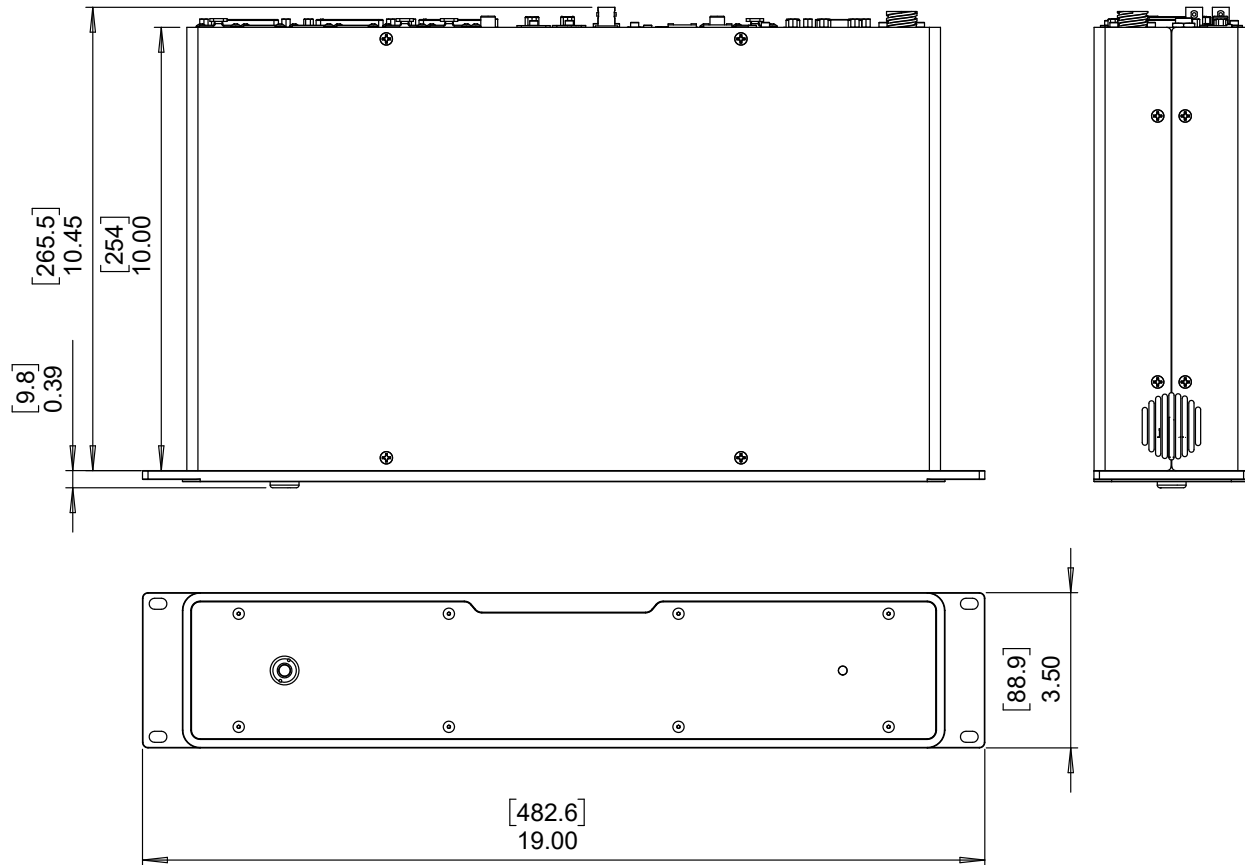


Illustration 1: ACU Dimensions

7.1.2 [RCU dimensions drawing]

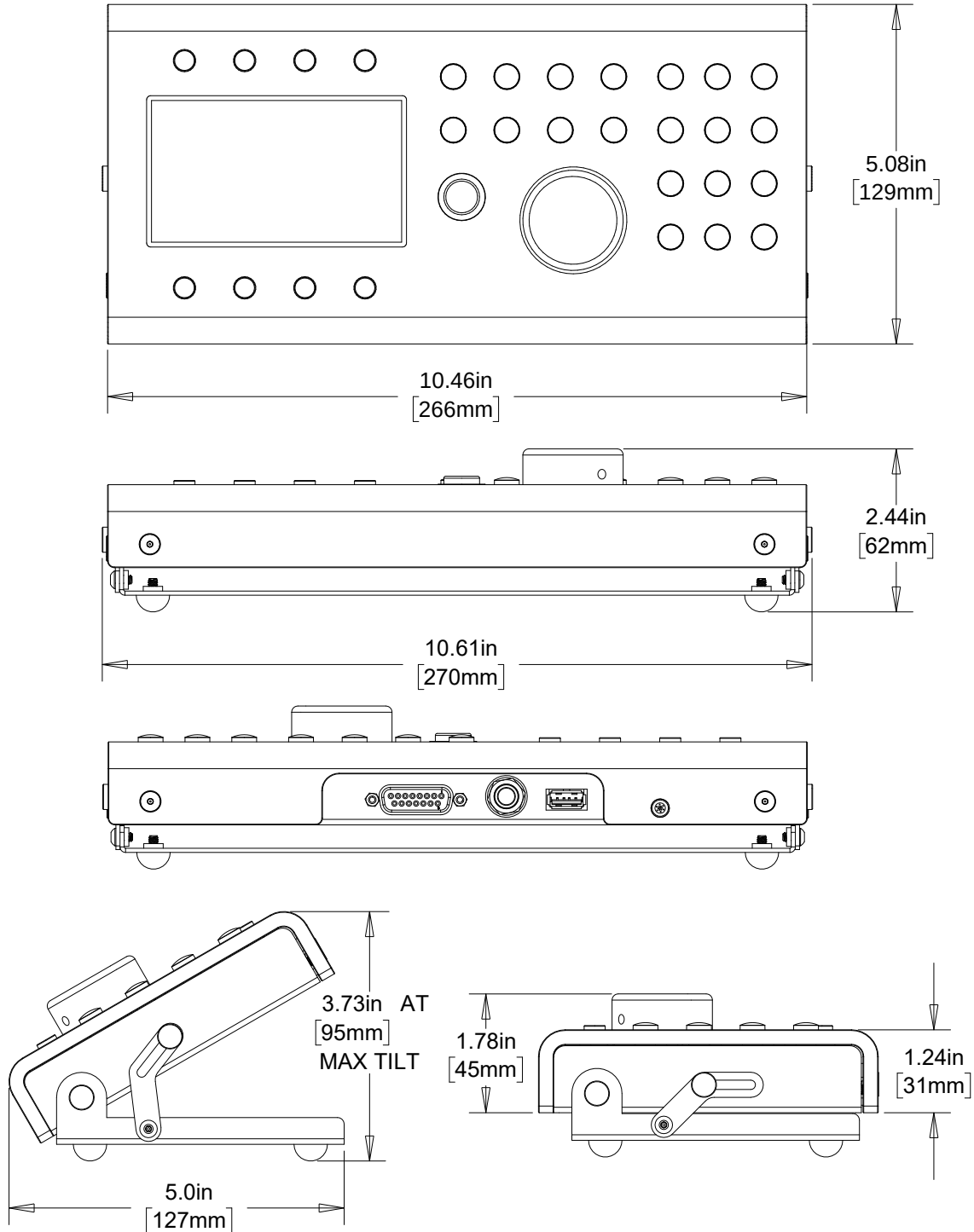


Illustration 2: RCU Dimensions

7.1.3 [PSU dimensions drawing]

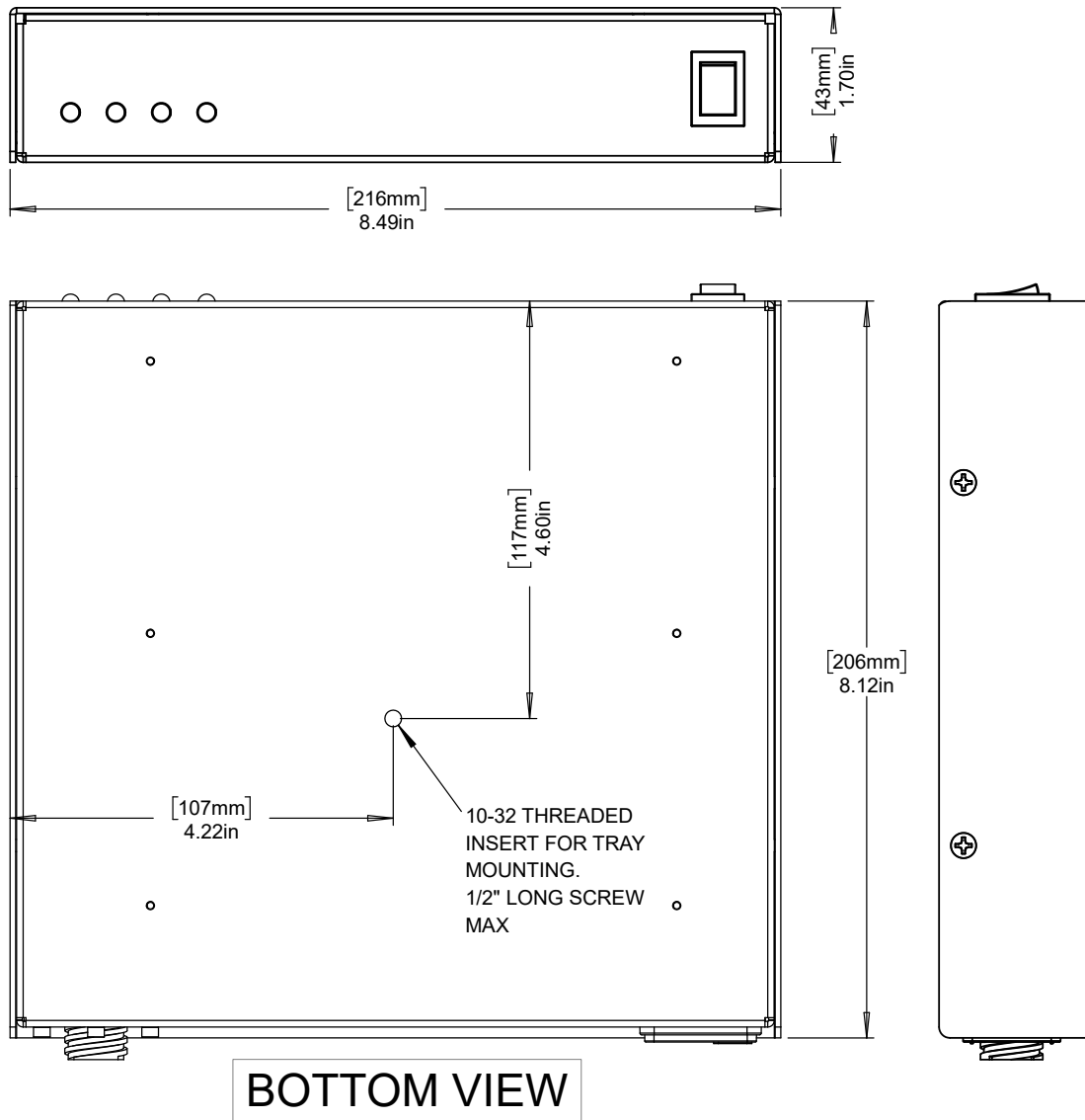


Illustration 3: PSU Dimensions

7.2 Document Revisions

Rev.	Description	Date	Initials
A	Initial preliminary release	05/20/19	MBG
B	Correct Ext. Talkback mic gain range Correct firmware version	10/21/19	MBG
C	Correct ADC Input sensitivity	10/24/19	MBG
D	Update Room EQ Q range Update System and Cue Latency specifications	10/28/19	MBG
E	Update power consumption specification	11/13/19	MBG
F	Add Wordclock Polarity specification Updated specifications for 1.0.7 Firmware Removed Ross Bach Liberty option	03/25/21	MBG