Galileo Callisto® 616 : Array Processor

thinking sound

Meyer Sound®

The Galileo Callisto 616 array processor is an elegant hardware and software solution for driving and aligning Meyer Sound loudspeaker array systems. The 2–space, rack–mount Callisto 616 includes six inputs, 16 outputs, and a fully digital matrix processor. The accompanying Compass® control software provides comprehensive control of all parameters from a Mac® or Windows®–based computer.

Designed as the perfect complement to Meyer Sound's M Series™ and LEO–M arrays, the Callisto 616 features delay integration for aligning loudspeaker arrays, atmospheric correction filters, and simultaneous low– and high–pass filters for subwoofer control.

The Callisto 616 offers an extensive equalization architecture that includes U–Shaping equalization, comprised of five bands with adjustable slopes, widths, and gain, and 10–band complementary phase parametric filtering, both available on out–puts. TruShaping® equalization, comprised of four bands equalization with adjustable widths and gain, is available on inputs.

Equalization parameters are easily edited in the Compass control software, with numeric entry or by graphically dragging frequency bands. Parameters can be adjusted while viewing multiple layers of equalization in a composite graphic plot to achieve the ideal equalization curve. The Compass software's intuitive user interface is the culmination of Meyer Sound's extensive experience optimizing complex loudspeaker systems.

The Callisto 616 features full digital operation with fixed latency across all output channels regardless of any applied processing. It can also be connected directly to the SIM® 3 audio analyzer, providing complete measurement and control for integrated audio systems.

FEATURES & BENEFITS

- Six inputs (analog, AES/EBU, or mixed) and 16 analog outputs with full matrix mixing and routing for driving systems of any size

- Robust +26 dBu outputs easily drive Meyer Sound self–powered loudspeaker systems over long cable runs

- A/D/A conversion with 24–bit resolution at 96 kHz; digital inputs converted to 96 kHz sample rate

- Monolithic 1 GHz vector DSP architecture

- Internal processing performed at 96 kHz, 32–bit floating point resolution with fixed latency across all output channels

- Delay integration for M Series line array loudspeakers

- Atmospheric correction filters

- U–Shaping equalization and 10–band parametric filtering yield corrections with minimal impact on phase response

- Simultaneous low– and high–pass filters

- Up to 2 seconds of delay on inputs and outputs

- Front–panel LED ladder meters on inputs, presence/clip LEDs on outputs, and illuminated mute switches

- Ethernet connection for remote control from Mac and Windows–based computers running the Compass control software

- Direct connection to Meyer Sound's SIM 3 audio analyzer

The Galileo Callisto 616 features six analog inputs with balanced XLR connectors and state-of-the-art A/D converters operating at 24-bit resolution with a 96 kHz sample rate. The inputs can be individually switched to operate as stereo AES/EBU digital inputs, accepting sample rates up to 96 kHz. Because internal processing is performed at 96 kHz with 32-bit vector floating point, source signals with lower sample rates are upsampled using advanced hardware sample rate converters. The six input channels can be configured in pairs to receive a combination of analog and digital sources.

The 16 analog outputs feature balanced XLR connectors with high-resolution 96 kHz, 24-bit D/A converters, and a robust maximum output level of +26 dBu, capable of driving Meyer Sound self-powered loudspeakers to full output, across all frequencies, over long cable runs.

The Callisto 616 processor is built around a monolithic, 1 GHz vector DSP architecture with a direct DMA audio path to maximize processing power and guarantee fixed low-latency performance, no matter how much processing is applied. High-quality algorithms with 32-bit floating-point resolution and 96 kHz sample rates are used to deliver a large assortment of processing.

The rear panel includes two SIM bus ports

*Galileo Callisto 616 Front and Rear Panels*

for direct connection to Meyer Sound's SIM 3 audio analyzer, allowing the Callisto 616 to function as a line switcher for the analyzer so that measurements can be taken from any selection of Callisto inputs and outputs, without patching beyond a single connection to the analyzer.

The front panel displays input levels with 26-segment LED meters and output levels with variable-intensity, bi-color clip LEDs. Illuminated mute switches are also available

on both inputs and outputs. Parameters settings are viewable on a 128 x 64 LCD.

AC power is software-activated so that accidental button-pushes won't power down the Callisto 616. A locking powerCON® AC connector prevents unwanted power disconnections. Front panel locking and password protection are available to guard against errant parameter changes.

Galileo Callisto 616 Signal Flow
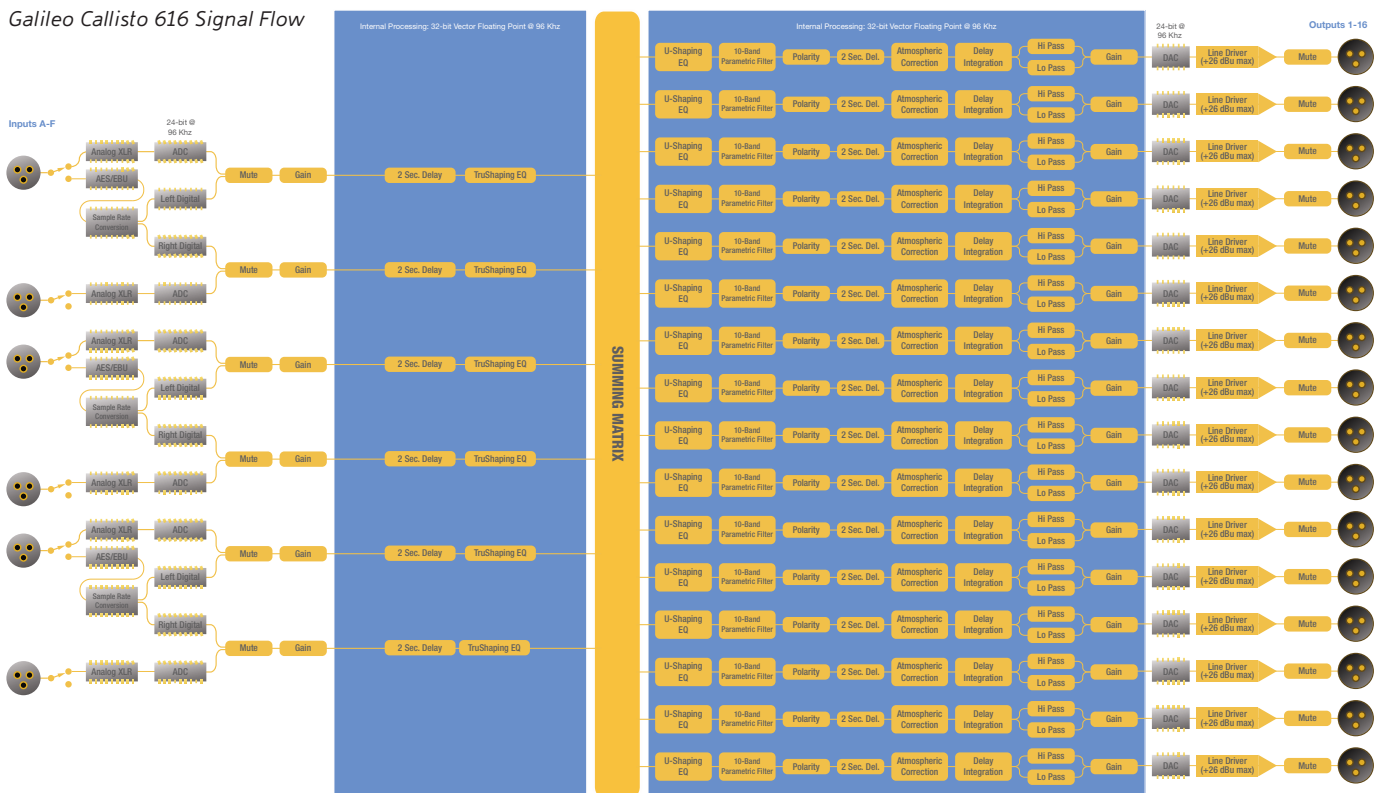
The Galileo Callisto 616 includes a powerful arsenal of DSP for tuning and aligning Meyer Sound loudspeaker arrays. In addition to standard DSP components like delay (up to 2 seconds), gain, and polarity reversal, the Callisto 616 boasts an unprecedented architecture of equalization and filtering capable of addressing phase alignments, as well as a range of acoustic anomalies and subjective tailoring of system responses, without introducing excessive shifts in phase that degrade intelligibility and signal clarity.

U–Shaping equalization is available on outputs and is comprised of five interactive filters configured in a unique cascading topology that allows bands to overlap, yielding extremely smooth response curves with minimal phase shifts. The slope, width, and gain for U–Shaping bands are user adjustable. Because Meyer Sound loudspeaker systems are optimized to produce flat frequency and phase responses out of the box, U–Shaping is a powerful tool for adding warmth, presence, and other subjective sonic qualities.

To address anomalies resulting from loudspeakers interactions with acoustical environments, 10–band complementary phase parametric filtering is also provided on outputs. As a second–order filter, the parametric filter is ideal for treating these types of interaction artifacts.

For even more flexibility, TruShaping equalization, comprised of four first–order interactive filters with user–adjustable widths and gain, is available on inputs.

The delay integration filter automatically aligns M Series loudspeakers with LEO–M loudspeakers. Simply specify the M Series loudspeaker model employed in the array and the Callisto 616 will use its stored table of compensation parameters to adjust for the array's output.

The atmospheric correction filter compensates for high frequencies absorbed when sound travels through the air over long distances. By entering just a few atmospheric settings — temperature, relative humidity, distance, and altitude — the system automatically calculates and applies the appropriate filtering to correct for the environmental conditions. The user–defined Atmospheric Gain Factor ensures that sufficient headroom is available for reinforcement systems that require maximum output.

Also included are simultaneous low– and high–pass filters for subwoofer control.

Unique settings for multiple loudspeaker configurations can be stored as presets and recalled from the front panel or from the host computer.

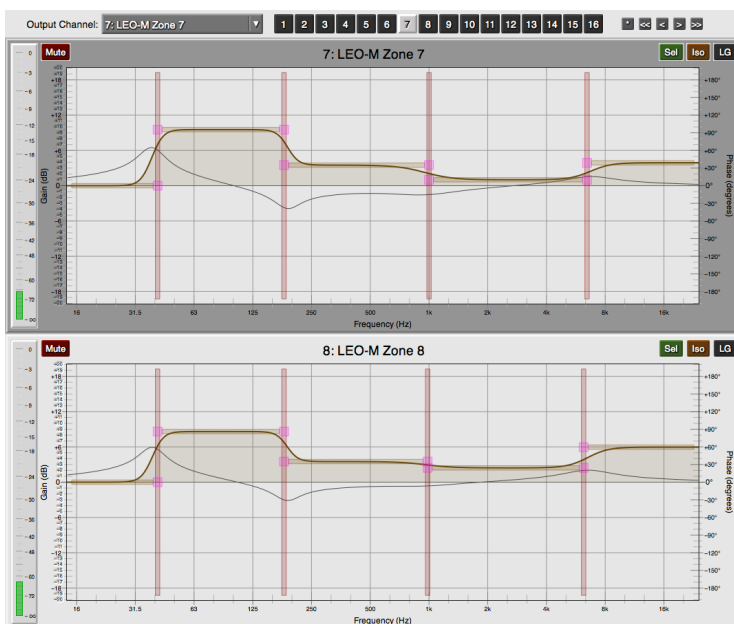$$f_{rO} = \frac{p_a}{p_r} \left(24 + \frac{(4.04 * 10^4\, h)(0.02 + h)}{0.391 + h} \right) \tag{1}$$

$$f_{rN} = \frac{p_a}{p_r} \left(\frac{T}{T_f r} \right)^{-\frac{1}{2}} * \left(9 + 280\, h\, \exp\left[-4.170 \left(\left(\frac{T}{T_r} \right)^{-\frac{1}{3}} - 1 \right) \right] \right) \tag{2}$$

$$\mathrm{Oxygen} = \left(0.01275 \left[\exp\left(\frac{-2239.1}{T} \right) \right] \left[\frac{f_{rO}}{f_{rO}^2 + f^2} \right] \right) \tag{3}$$

$$\mathrm{Nitrogen} = \left(0.1068 \left[\exp\left(\frac{-3352.0}{T} \right) \right] \left[\frac{f_{rN}}{f_{rN}^2 + f^2} \right] \right) \tag{4}$$

$$\alpha(f) = 8.686\, f^2 \left(\left[1.84 * 10^{-11} \left(\frac{p_a}{p_r} \right)^{-1} \left(\frac{T}{T_r} \right)^{\frac{1}{2}} \right] + \left(\frac{T}{T_r} \right)^{-\frac{5}{2}} [\mathrm{Oxygen} + \mathrm{Nitrogen}] \right) \tag{5}$$

Air Absorption Calculation (ANSI S1.26 – 1995)

Compass Control Software, EQ Plots

Compass Control Software

The Compass control software provides comprehensive control of the Galileo Callisto 616 from an intuitive graphical user interface. The software enables easy access to all features and even provides control of multiple units. Compass runs on a Mac or Windows–based computer.

The Callisto Map tab displays a summary overview of all Callisto channels complete with signal flow. Inputs and outputs can be labeled and conveniently grouped for gang edits.

The Input Processing and Output Processing tabs provide access to all DSP settings. Equalization parameters can be easily edited with numeric entry or by graphically dragging frequency bands. Multiple layers of equalization can be viewed for a composite graphic plot of equalization curves.

Galileo Callisto 616 Specifications

Inputs

Inputs Section	Six inputs, analog or digital (AES/EBU, selectable in pairs)
Connectors	Goldplated XLR female
Maximum Input Level	+26 dBu (maximum range selected, 0 dB input gain)
Metering	26-segment LED ladder meters on each input

Outputs

Outputs Section	16 analog outputs
Connectors	Goldplated XLR male
Maximum Output Level	+26 dBu into 600 Ω or greater (maximum range selected)
Metering	Variable-intensity, bi-color signal presence/clip LEDs on each output

Summing

	Full 6 x 16 summing matrix; any input summed with any input and routed to any output

Processing

Digital Conversion	24-bit resolution, 96 kHz sample rate
Internal Processing	32-bit vector floating point, 96 kHz
Processor	Monolithic, 1 GHz vector DSP
Input Processing	Gain, delay, TruShaping equalization
Output Processing	Gain, delay, polarity reversal, U-Shaping equalization, 10-band parametric filtering, delay integration, atmospheric correction, simultaneous low- and high-pass filters

Network/Control

Front Panel	128 x 64 LCD, navigation buttons, high-resolution encoder knobs, and illuminated mute switches
Network	RJ-45 port for network connection and control from a Mac or Windows-based computer
Software	Full bidirectional communication with Meyer Sound's Compass control software within a client-server architecture
SIM	Two SIM bus ports for linking to the SIM 3 audio analyzer for measuring Callisto outputs (either post delay or post gain)

AC Power

Connector	powerCON 20
Operating Voltage Range	100–240 V AC, 50/60 Hz
Current Draw	0.55 A rms (115 V AC); 0.27 A rms (230 V AC); 0.56 A rms (100 V AC)

Physical

Dimensions	2-space rack 19.00" w x 3.48" h x 15.30" d (483 mm x 88 mm x 388 mm)
Weight	19.2 lbs (8.71 kg)

16.90 [429 mm]

15.30 [388 mm]

19.00 [483 mm]

3.48 [88 mm]

0.43 [11 mm]

15.93 [405 mm]
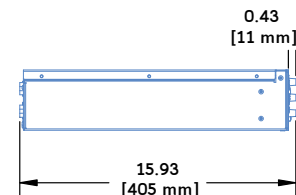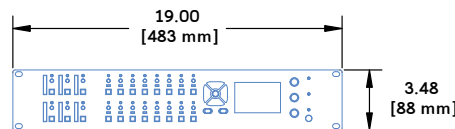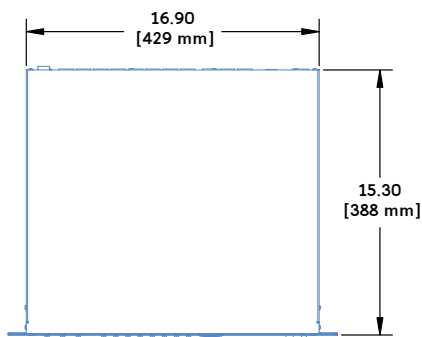
Architect Specifications

The array processor shall include 96 kHz, 32-bit floating point processing for up to six input channels (analog or AES/EBU) and 16 analog output channels. Input channels shall include dedicated processing for mute, gain, delay, and TruShaping equalization; output channels shall include mute, gain, delay, polarity reversal, U-Shaping equalization, 10-band parametric equalization, delay integration for line arrays and curvilinear arrays, as well as filters for atmospheric correction, and subwoofer integration.

Input and output connectors shall be balanced, goldplated XLR connectors with high-current line drivers capable of output voltages up to +26 dBu, without clipping, into loads of 600 Ohms or higher. The system's complex digital matrix processor shall allow routing from any input, or combination of mixed inputs, to any combination of outputs with a fixed latency of 1.52 milliseconds, regardless of the processing applied to the signals.

The front panel shall include a 128 x 64 LCD, navigation buttons, high-resolution encoder knobs, and illuminated mute switches and signal/clip indicators for output channels. Password protection shall be available to avoid unwanted parameter changes.

The unit shall be controlled remotely from a Mac or Windows-based computer via Ethernet; the client server control software shall have bidirectional communication to ensure that parameters are in sync.

The loudspeaker management system shall include direct connectivity to Meyer Sound's SIM 3 audio analyzer so that measurements can be taken directly from the unit.

The unit shall be housed in a 2-space, 19-inch rack-mount cabinet, measuring 15.3 inches (388 mm) in depth, and weighing just 19.2 lbs (8.71 kg). Its AC inlet shall be a powerCON 20 A locking connector to prevent unwanted power disconnections.

The array processor shall be the Meyer Sound Galileo Callisto 616 and its software shall be the Compass control software.