MILO High-Power Curvilinear Array Loudspeaker

Keep these important operating instructions.
Check www.meyersound.com for updates.

DECLARATION OF CONFORMITY ACCORDING TO ISO/IEC GUIDE 22 AND EN 45014

Manufacturer's Name:
Meyer Sound Laboratories Inc.

Manufacturer's Address:
2832 San Pablo Avenue
Berkeley, CA 94702-2204, USA

declares that the products
Product Name: MILO Loudspeaker

conforms to the following Product Specifications

Safety:	EN60065: 1998
	IEC60065: 1998
EMC:	EN55103-1: 1997 emmission[1]
	EN55103-2: 1997 immunity[2]

This device complies with the requirements of the Low Voltage Directive 73 / 23 / EEC and the EMC Directive 89 / 336 / EEC.

This device also complies with EN 55103-1 & -2. 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.

Supplementary Information

The product herewith complies with the requirements of the Low Voltage Directive 73/23/EEC and the EMC Directive 89/336/EEC.

Office of Quality Manager
Berkeley, California USA
July 22, 2003

European Contact: Your local Meyer Sound dealer or Meyer Sound Germany, GmbH. Carl Zeiss Strasse 13, 56751 Polch, Germany. Telephone: 49.2654.9600.58 Fax: 49.2654.9600.59

Environmental specifications for Meyer Sound Electronics products

Operating temperature	0°C to +45°C
Non-operating temperature	-40°C to +75°C
Humidity	to 95% at 35°C
Operating altitude	to 4600 m (15,000ft)
Non-operating altitude	to 6300 m (25,000ft)
Shock	30 g 11 msec half-sine on each of 6 sides
Vibration	10 Hz to 55 Hz (0.010 peak-to-peak excursion)

Made by Meyer Sound Laboratories
Berkeley, California USA
European Office:
Meyer Sound Lab. GmbH
Carl Zeiss Strasse 13
56751 Polch, Germany
CE

3K59 COMMERCIAL AUDIO SYSTEM
c UL us LISTED

N775

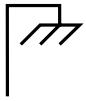
MILO Operating Instructions

Printed in the U.S.A.

Part Number: 05.132.095.01

SYMBOLS USED

These symbols indicate important safety or operating features in this booklet and on the chassis:

			
Dangerous voltages: risk of electric shock	Important operating instructions	Frame or chassis	Protective earth ground
Pour indiquer les risques résultant de tensions dangereuses	Pour indequer important instructions	Masse, châssis	Terre de protection
Zu die gefahren von gefährliche spanning zeigen	Zu wichtige betriebs-anweisung und unter-haltsanweisung zeigen	Rahmen oder chassis	Die schutzerde
Para indicar voltajes peligrosos.	Instrucciones importantes de funcionamiento y/o manteniento	Armadura o chassis	Tierra proteccionista

IMPORTANT SAFETY INSTRUCTIONS

1 Read these instructions.

2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this loudspeaker near water.
6. Clean only with dry cloth.
7. Do not block any ventilation openings. Install in accordance with Meyer Sound's installation instructions.
8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus that produce heat.
9. Do not defeat the safety purpose of the grounding-type plug. A grounding type plug has two blades and a third grounding prong. The third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.
10. Protect the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where they exit from the loudspeaker. The AC mains plug or appliance coupler shall remain readily accessible for operation.
11. Only use attachments/accessories specified by Meyer Sound.
12. Use only with the caster rails or rigging specified by Meyer Sound, or sold with the loudspeaker. Handles are for carrying only.
13. Unplug this loudspeaker during lightning storms or when unused for long periods of time.
14. Refer all servicing to qualified service personnel. Servicing is required when the loudspeaker has been damaged in any way, such as when the power-supply cord or plug has been damaged; liquid has been spilled or objects have fallen into the loudspeaker; rain or moisture has entered the loudspeaker; the loudspeaker has been dropped; or when for undetermined reasons the loudspeaker does not operate normally.

WARNING: To reduce the risk of electric shock, do not expose this loudspeaker to rain or moisture. Do not install the loudspeaker in wet or humid locations without using weather protection equipment from Meyer Sound.

SAFETY SUMMARY

English

- To reduce the risk of electric shock, disconnect the loudspeaker from the AC mains before installing audio cable. Reconnect the power cord only after making all signal connections.
- Connect the loudspeaker to a two-pole, three-wire grounding mains receptacle. The receptacle must be connected to a fuse or circuit breaker. Connection to any other type of receptacle poses a shock hazard and may violate local electrical codes.
- Do not install the loudspeaker in wet or humid locations without using weather protection equipment from Meyer Sound.
- Do not allow water or any foreign object to get inside the loudspeaker. Do not put objects containing liquid on or near the unit.
- To reduce the risk of overheating the loudspeaker, avoid exposing it to direct sunlight. Do not install the unit near heat-emitting appliances, such as a room heater or stove.
- This loudspeaker contains potentially hazardous voltages. Do not attempt to disassemble the unit. The unit contains no user-serviceable parts. Repairs should be performed only by factory-trained service personnel.

Français

- Pour réduire le risque d'électrocution, débrancher la prise principale de l'haut-parleur, avant d'installer le câble d'interface allant à l'audio. Ne rebrancher le bloc d'alimentation qu'après avoir effectué toutes les connections.
- Branchez l'haut-parleur dans une prise de courant à 3 dérivations (deux pôles et la terre). Cette prise doit être munie d'une protection adéquate (fusible ou coupe-circuit). Le branchement dans tout autre genre de prise pourrait entraîner un risque d'électrocution et peut constituer une infraction à la réglementation locale concernant les installations électriques.
- Ne pas installer l'haut-parleur dans un endroit où il y a de l'eau ou une humidité excessive.
- Ne pas laisser de l'eau ou tout objet pénétrer dans l'haut-parleur. Ne pas placer de r´cipients contenant un liquide sur cet appareil, ni à proximité de celui-ci.
- Pour éviter une surchauffe de l'haut-parleur, conserver-la à l'abri du soleil. Ne pas installer à proximité d'appareils dégageant de la chaleur tels que radiateurs ou appareils de chauffage.
- Ce haut-parleur contient des circuits haute tension présentant un danger. Ne jamais essayer de le démonter. Il n'y a aucun composant qui puisse être réparé par l'utilisateur. Toutes les réparations doivent être effectuées par du personnel qualifié et agréé par le constructeur.

Deutsch

- Um die Gefahr eines elektrischen Schlages auf ein Minimum zu reduzieren, den Lautsprecher vom Stromnetz trennen, bevor ggf. ein Audio-Schnittstellensign alkabel angeschlossen wird. Das Netzkabel erst nach Herstellung aller Signalverbindungen wieder einstecken.
- Der Lautsprecher an eine geerdete zweipolige Dreiphasen-Netzsteckdose anschließen. Die Steckdose muß mit einem geeigneten Abzweigschutz (Sicherung oder Leistungsschalter) verbunden sein. Der Anschluß der unterbrechungsfreien Stromversorgung an einen anderen Steckdosentyp kann zu Stromschlägen führen und gegen die örtlichen Vorschriften verstoßen.
- Der Lautsprecher nicht an einem Ort aufstellen, an dem sie mit Wasser oder übermäßig hoher Luftfeuchtigkeit in Berührung kommen könnte.
- Darauf achten, daß weder Wasser noch Fremdkörper in das Innere den Lautsprecher eindringen. Keine Objekte, die Flüssigkeit enthalten, auf oder neben die unterbrechungsfreie Stromversorgung stellen.
- Um ein Überhitzen dem Lautsprecher zu verhindern, das Gerät vor direkter Sonneneinstrahlung fernhalten und nicht in der Nähe von wärmeabstrahlenden Haushaltsgeräten (z.B. Heizgerät oder Herd) aufstellen.
- Im Inneren diesem Lautsprecher herr-schen potentiell gefährliche Spannungen. Nicht versuchen, das Gerät zu öffnen. Es enthält keine vom Benutzer reparierbaren Teile. Reparaturen dürfen nur von ausgebildetem Kundenienstpersonal durchgeführt werden.

Español

- Para reducir el riesgo de descarga eléctrica, desconecte de la red de voltaje el altoparlante antes de instalar el cable de señal de audio. Vuelva a conectar la alimentacion de voltaje una vez efectuadas todas las interconexiones de señalizacion de audio.
- Conecte el altoparlante a un tomacorriente bipolar y trifilar con neutro de puesta a tierra. El tomacorriente debe estar conectado a la protección de derivación apropiada (ya sea un fusible o un disyuntor). La conexión a cualquier otro tipo de tomacorriente puede constituir peligro de descarga eléctrica y violar los códigos eléctricos locales.
- No instale el altoparlante en lugares donde haya agua o humedad excesiva.
- No deje que en el altoparlante entre agua ni ningún objeto extraño. No ponga objetos con líquidos encima de la unidad ni cerca de ella.
- Para reducir el riesgo de sobrecalentamiento, no exponga la unidad a los rayos directos del sol ni la instale cerca de artefactos que emiten calor, como estufas o cocinas.
- Este altoparlante contiene niveles de voltaje peligrosos en potencia. No intente desarmar la unidad, pues no contiene piezas que puedan ser repardas por el usuario. Las reparaciones deben efectuarse únicamente por parte del personal de mantenimiento capacitado en la fábrica.

CONTENTS

INTRODUCTION

HOW TO USE THIS MANUAL

As you read this manual, you'll find figures and diagrams to help you understand and visualize what you're reading. You'll also find numerous icons that serve as cues to flag important information or warn you against improper or potentially harmful activities. These icons include:

A **NOTE** identifies an important or useful piece of information relating to the topic under discussion.

A **TIP** offers a helpful tip relevant to the topic at hand.

A **CAUTION** gives notice that an action can have serious consequences and could cause harm to equipment or personnel, delays, or other problems.

INTRODUCING MILO

The MILO high-power curvilinear array loudspeaker is part of Meyer Sound's M Series. Compact and lightweight for a self-contained, self-powered four-way system, MILO produces a robust peak output of 140 dB SPL with exceptionally flat phase and frequency response. The wide operating frequency range (60 Hz to 18 kHz) is complemented by extended high-frequency headroom, while three dedicated transducers for the very high-frequency band (4.2 kHz to 18 kHz) provide detailed resolution of delicate transient information — even in very long throw applications.

Figure i.1: The MILO high-power curvilinear array loudspeaker

MILO can serve as the keystone component in scalable, building block systems comprising any or all M Series products (Figure i.2) and selected Concert Series models. With compatible acoustical and performance characteristics and dedicated QuickFly® rigging hardware, MILO and the M Series can provide you with everything you need to create systems for optimum performance in venues of any size or shape. For example, MILO could be combined with the M3D line array loudspeaker for very large venue applications, or transitioned to M2D compact curvilinear array loudspeakers for near field coverage where appropriate.

Figure i.2: MILO is easily deployed with other members of the M Series family.

In addition, by integrating M3D-Sub directional subwoofers (Figure i.3) with a MILO system (MILO and M3D/M3D-Sub cabinets are identical in width), you can easily augment bass power with real depth and extend low-frequency bandwidth and headroom. Since the M3D-Sub employs Meyer Sound's proprietary low-frequency directional control, you can configure arrays that steer bass energy away from the area behind the array.

Figure i.3: A combined MILO/M3D-Sub array

NOTE: MILO can also be used in combination with other Meyer Sound subwoofers — for example, the 650-P.

MILO's QuickFly rigging employs rugged, reliable and user-friendly components that remain captive both in use and in transit. Custom front and rear AlignaLinks at the cabinet corners couple the units for either flying or stacking, and allow nine positions from 0° to 5° of cabinet splay (0°, 0.5°, 1°, 1.5°, 2°, 2.5°, 3°, 4° and 5°). Because rigging connections are rigid, the array tilt is easy to adjust – often eliminating the need for a pullback strap in flown configurations. If circumstances dictate an acute array curve, then a PBF-MILO pull back frame can be attached to the lowest cabinet.

NOTE: Rigging accessories for MILO are illustrated in Meyer Sounds MG-3D/M Assembly Guide.

INTEGRATED AMPLIFIER AND PROCESSING

As a self-powered loudspeaker, MILO incorporates a very high power, four-channel, class AB/H power amplifier and sophisticated control circuitry — all housed within the cabinet — dramatically simplifying setup and installation. Power distribution is supplied to the array, line-level signal connected, and that's it – you're focusing on design implementation instead of installation.

MILO's on-board amplifier delivers a prodigious 3935 watts total burst power. TruPower™ limiting (see Chapter 2 for more information) extends the life of MILO's drivers under severe non-linear circumstances at very high levels, and keeps long-term power compression to less than 1 dB (versus the typical 3 - 6 dB for conventional systems).

The modular, field-replaceable amplifier/processing package also incorporates Meyer Sound's Intelligent AC power supply, which automatically adjusts for any line voltage worldwide and provides both soft turn-on and transient protection. MILO is fitted standard with Meyer Sound's exclusive RMS™ interface, giving you the capability to monitor and troubleshoot an entire RMS-equipped Meyer Sound system remotely from your PC notebook or desktop system.

NOTE: In order to use RMS, you will need Meyer Sound's optional RMS software and a PC running Windows® 98/NT 4.0/2000/XP or higher. The optional RMS host card is also required, and is available as a full-size (standard) PCI or Type II PCMCIA card, depending on your PC's hardware.

ADVANCED M SERIES TECHNOLOGY

MILO was created specifically as a modular, flexible design solution for high-power systems in medium to large venues. In size and weight, MILO fits into the M Series between the M3D and the M2D; in output power and operating frequency range, it scales more closely to the M3D.

The MILO loudspeaker is a four-way design. The lowest frequency range, from 60 Hz to about 300 Hz, is reproduced by dual 12-inch cone drivers working in tandem, each powered by a dedicated amplifier channel with 1125 watts of peak output. The drivers are a proprietary design employing neodymium magnets for higher efficiency and power handling with reduced weight.

To assure the smoothest response in the critical midrange and crossover region, MILO incorporates a complex active crossover design. In the low-mid frequencies, the crossover feeds only one of the two 12-inch drivers while rolling off the other driver. This technique eliminates interference between the drivers that would otherwise occur at shorter wavelengths, while at the same time maintaining optimal polar and frequency response characteristics at the crossover frequencies.

MILO employs two REM™ ribbon emulation manifolds for the separate mid-high and very-high frequency sections, each coupled to individual constant-directivity horns. REM is a proprietary coupling device that introduces driver output to the horn throat across a very short path (three inches for the mid-high section and 1.5 inches for the very-high section), effectively controlling the output, but with dramatically reduced distortion in comparison to other techniques. MILO's mid-high section (560 Hz to 4.2 kHz) uses a single 1.5–inch exit, 4-inch diaphragm compression driver powered by a dedicated 560-watt amplifier channel. The very high-frequency section utilizes three, 0.75–inch exit, 2-inch diaphragm compression drivers to produce extraordinary power and clarity, and extend operating frequency range up to 18 kHz. Power for the very high-frequency section is supplied by a dedicated 1125-watt amplifier channel with enough headroom to reproduce all the dynamics of the upper frequency range.

NOTE: Complete acoustical and electrical specifications are covered in Appendix B.

The MG-3D/M multipurpose grid accommodates multiple hanging configurations for up to 24 MILO loudspeakers (or the equivalent weight of MILO, M3D, M3D-Sub and M2D or any other relevant combination). The MG-3D/M grid allows multipoint support and bridles. Ground stacks of up to six MILOs (or the equivalent height of MILOs and M3D-Subs) may be achieved.

MILO is truck-smart. Exterior cabinet dimensions are ideal for both European and US truck widths. The optional MCF-MILO caster frame allows smooth transport of stacks of up to four MILO loudspeakers and facilitates the use of forklifts. A range of rugged protective transport covers is also available. See Chapter 4 for additional information.

The Meyer Sound MAPP Online® acoustical prediction software allows you to quickly determine the coverage, frequency response, impulse response and maximum output of arrayed MILO loudspeakers.

Information and specifications are applicable as of the date of this printing. Updates and supplementary information are posted on the Meyer Sound web site at:

http://www.meyersound.com

You may contact Meyer Sound Technical Support at:

Tel: +1 510 486.1166

Fax: +1 510 486.8356

Email: techsupport@meyersound.com

CHAPTER 1: POWER REQUIREMENTS

Self-powered and highly mobile, MILO is advanced loudspeaker technology with equally advanced power capabilities. Understanding MILO's power distribution, voltage and current requirements, as well as electrical safety issues, is critical to the safe and correct operation and deployment of MILO.

AC POWER

When AC power is applied to the MILO loudspeaker, the Intelligent AC power supply automatically selects the correct operating voltage, allowing MILO to be used internationally without manually setting voltage switches. The Intelligent AC power supply performs the following protective functions to compensate for hostile conditions on the AC mains:

- Suppresses high-voltage transients up to several kilovolts
- Filters common mode and differential mode radio frequencies (EMI)
- Sustains operation temporarily during low-voltage periods
- Provides soft-start power-up, eliminating high inrush current

VOLTAGE REQUIREMENTS

The MILO loudspeaker operates safely and without audio discontinuity if the AC voltage stays within either of two operating windows at 50 or 60 Hz:

- 85 to 134 volts
- 165 to 264 volts

MILO can withstand continuous voltages up to 275 volts and allows any combination of voltage to GND (that is neutral-line-ground or line-line-ground).

CAUTION: Continuous voltages higher than 275 volts can damage the unit.

TIP: Since MILO does not require a dedicated Neutral, and it can tolerate elevated voltages from ground, it can be connected between Line-Line terminals in a 120 V 3-phase Wye system. This results in 208 V AC betweens lines (nominal) and will therefore draw less current for the same output power compared to operating MILO from 120 V AC (Line- Neutral). Make sure that the voltage remains within MILO's recommend operating window (180 V AC to 250 V AC). The Ground terminal must always be used for safety and the Line to Ground voltage should never exceed 250 V AC (typically there will be 120 V AC from Line to Ground in the above example).

MILO uses a NEMA L6-20P, an IEC 309 male power connector or a multipin VEAM connector and complies with worldwide product safety standards.

AC POWER DISTRIBUTION

All amplifier modules and directly associated audio equipment (mixing consoles, processors, etc.) must be properly connected to the AC power distribution, preserving AC line polarity and connecting earth ground such that all grounding points are connected to a single node or common point using the same cable gauge as the neutral and line(s) cable(s).

Improper grounding connections between loudspeakers and the rest of the audio system may produce noise, hum and/or serious damage to the input/output stages in the system's electronic equipment.

CAUTION: Before applying AC to any Meyer Sound self-powered loudspeaker, be sure that the voltage potential difference between neutral and earth ground is less than 5 V AC.

Figure 1.1 shows a sample three-phase AC distribution system, with the load between loudspeakers distributed among the three phases and all of the loudspeakers connected to common neutral and earth ground points.

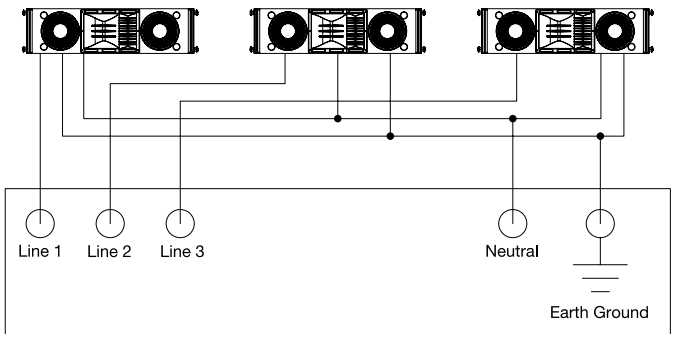


Figure 1.1: A sample AC power distribution block diagram

NOTE: Refer to Appendix B for details on the MILO loudspeaker's AC voltage requirements.

After applying AC power, the proper operating voltage is automatically selected, but the system is muted. During the next three seconds the following events occur:

1. The primary fans turn on.
2. The main power supply slowly ramps on.
3. The green Active LED on the user panel lights up, indicating that the system is enabled and ready to pass audio signals.

CAUTION: If the Active LED does not illuminate or the system does not respond to audio input after ten seconds, remove AC power immediately. Verify that the voltage is within the proper range. If the problem persists, please contact Meyer Sound or an authorized service center.

If voltage drops below the low boundary of either safe operating range (brownout), MILO uses stored energy to continue functioning briefly, and shuts down only if voltage does not rise above the low boundary before MILO's storage circuits are depleted. How long MILO will continue to function during brownout depends on the amount of voltage drop and the audio source level during the drop.

If the voltage increases above the upper boundary of either range, the power supply rapidly turns off, preventing damage to the unit.

NOTE: If voltage fluctuates within either operating range, automatic tap selection stabilizes the internal operating voltage. This tap selection is instantaneous, and there are no audible artifacts.

If MILO shuts down due to either low or high voltage, its power supply automatically turns on again after three seconds if the voltage has returned to either normal operating window. If the MILO loudspeaker does not turn back on after ten seconds, remove AC power immediately (see previous Caution).

NOTE: It is recommended that the supply be operated in the rated voltage windows at least a few volts away from the turn on/off points. This ensures that that AC voltage variations from the service entry – or peak voltage drops due to cable runs – do not cause the amplifier to cycle on and off.

CURRENT REQUIREMENTS

The MILO loudspeaker presents a dynamic load to the AC mains, which causes the amount of current to fluctuate between quiet and loud operating levels. Since different cables and circuit breakers heat up at varying rates, it is essential to understand the types of current ratings and how they correspond to circuit breaker and cable specifications.

The *maximum long-term continuous current* is the maximum rms current during a period of at least ten seconds. It is used to calculate the temperature increase in cables, in order to select a cable size and gauge that conforms to electrical code standards. It is also used to select the rating for slow-reacting thermal breakers.

The *burst current* is the maximum rms current during a period of apprximately one second, used to select the rating of most magnetic breakers and to calculate the peak voltage drop in long AC cables according to the formula:

V pk (drop)= I pk x R (cable total)

The *ultimate short-term peak current* is used to select the rating of fast reacting magnetic breakers.

Use Table 1.1 below as a guide when selecting cable gauge size and circuit breaker ratings for your operating voltage.

Table 1.1: MILO Current Ratings

Current Draw	115 V AC	230 V AC	100 V AC
Idle current	1.1 A rms	0.55 A rms	1.3 A rms
Max. long-term continuous	11.2 A rms	5.6 A rms	12.9 A rms
Burst current	14.4 A rms	7.2 A rms	16.6 A rms
Ultimate short-term peak	32 A pk	16 A pk	37 A pk

NOTE: For best performance, the AC cable voltage drop should not exceed 10 volts, or 10 percent at 115 volts and 5 percent at 230 volts. Make sure that even with the AC voltage drop the AC voltage always stays in the operating windows.

The minimum electrical service amperage required by a MILO system is the sum of each loudspeaker's *maximum long-term continuous current*. An additional 30 percent above the minimum amperage is recommended to prevent peak voltage drops at the service entry.

CAUTION: In the unlikely event that the circuit breakers trip (the white center buttons pop out), disconnect the AC power cable. Do not reset the breakers with the AC connected. Contact Meyer Sound for repair information.

POWER CONNECTOR WIRING CONVENTIONS

The MILO loudspeaker requires a grounded outlet. It is very important that the system be properly grounded in order to operate safely and properly. Figures 1.2, 1.3, and 1.4 illustrate correct wiring for the creation of power cables and distribution systems.

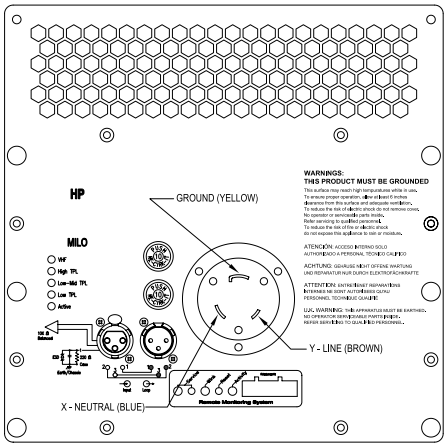


Figure 1.2: MILO user rear panel with L6-20 power connector

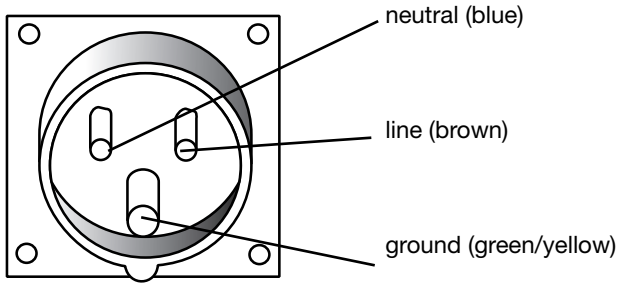


Figure 1.3: IEC 309 power connector pin-out

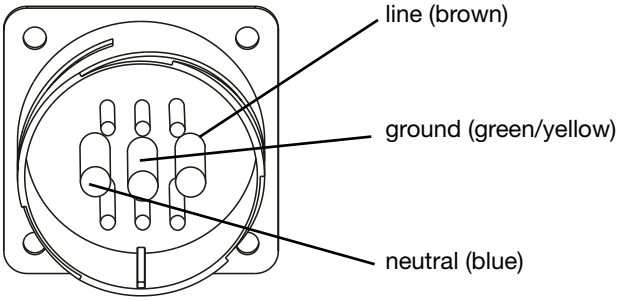


Figure 1.4: VEAM multipin connector power pin-out

If your MILO loudspeaker is fitted with the VEAM multipin connector, see the Meyer Sound document VEAM Cable Wiring Reference (part number 06.033.113) for the wiring conventions and pin-outs for AC, audio, and RMS connections.

Meyer Sound offers the VIM-3 (VEAM interface module) to distribute power, audio, and RMS to MILO loudspeakers fitted with VEAM connectors, as shown in Figure 1.5.

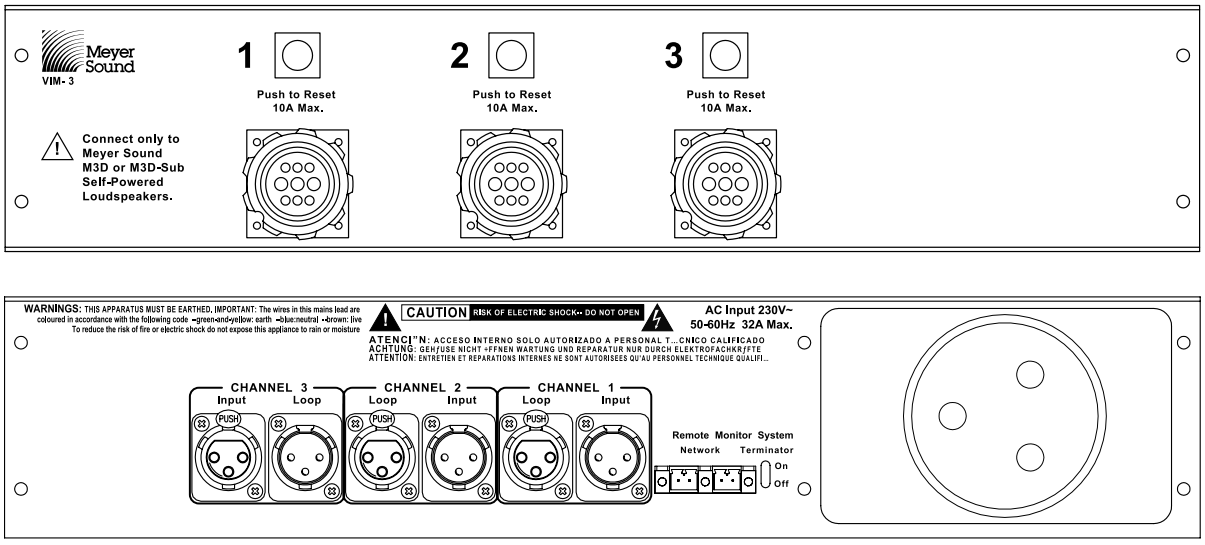
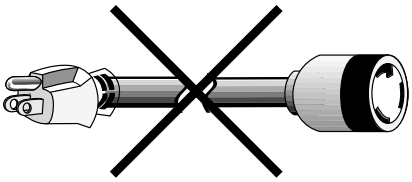


Figure 1.5: VIM-3 module, front (top) and rear (bottom)

ELECTRICAL SAFETY ISSUES

Pay close attention to these important electrical and safety issues.

CAUTION: Do not use a power cord adapter to drive the MILO loudspeaker from a standard three-prong Edison outlet since that connector is rated for only 15 amps (NEMA 5-15R; 125 V AC max.).



CAUTION: The MILO loudspeaker requires a ground connection. Always use a grounded outlet and plug.

TIP: Use the ring located in the rear to the side of the amplifier on the MILO loudspeaker to provide strain relief for power and signal cables. Do not use this ring for any other purpose.

CHAPTER 2: AMPLIFICATION AND AUDIO

More than just a self-powered loudspeaker, MILO uses sophisticated amplification and protection circuitry and an advanced limiting system to produce consistent and predictable results in any system design. This chapter will help you understand and harness the power of MILO's amplifier and audio systems.

AUDIO INPUT

The MILO loudspeaker presents a 10 kOhm balanced input impedance to a three-pin XLR connector with the following connectors:

- Pin 1 — 220 kOhm to chassis and earth ground (ESD and RF clamped)
- Pin 2 — Signal (+)
- Pin 3 — Signal (-)
- Case — Earth (AC) ground and chassis

CAUTION: Shorting an input connector pin to the case can form a ground loop and cause hum.

Pins 2 and 3 carry the input as a differential signal; pin 2 is hot relative to pin 3, resulting in a positive pressure wave when a positive signal is applied to pin 2. Pin 1 is connected to earth through a 220 kOhm, 1000 pF, 15 V clamp network. This ingenious circuit provides virtual ground lift at audio frequencies, while allowing unwanted signals to bleed to ground. Use standard audio cables with XLR connectors for balanced signal sources. Make sure that pin 1 (shield) is always connected on both ends of the cable. Telescoping grounding schemes are not recommended.

CAUTION: Ensure that all cabling carrying signal to MILO loudspeakers in an array is wired correctly: Pin 1 to Pin 1, Pin 2 to Pin 2, and so forth, to prevent the polarity from being reversed. Any number of MILO loudspeakers – even one – in the array with reversed polarity will result in severe degradation in frequency response and coverage.

TIP: If abnormal noises such as hiss and popping are produced by the loudspeaker, disconnect the audio cable from the loudspeaker. If the noise stops, then most likely the problem is not with the loudspeaker. Check the audio cable, source, and AC power to pinpoint the problem.

Audio signals can be daisy-chained using the loop output connector on the user panel of the MILO loudspeaker (Figure 2.1). A single source can drive multiple MILO loudspeakers with a paralleled input loop, creating an unbuffered hard-wired loop connection.

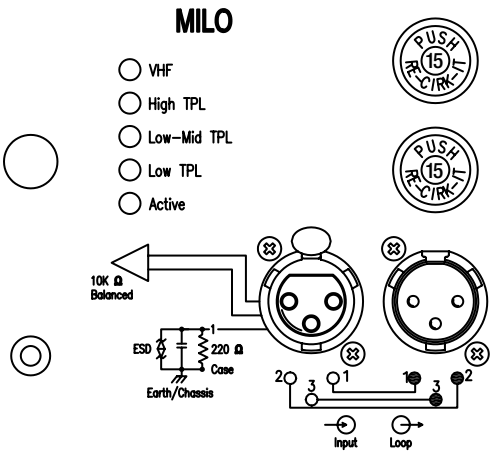


Figure 2.1: MILO's rear panel audio input connectors

When driving multiple MILO loudspeakers in an array, make certain that the source device can drive the total load impedance presented by the paralleled input circuit of the array. The source device must be capable of producing a minimum of 20 dB volts (10 volts rms into 600 ohms) in order to produce the maximum peak SPL over the operating bandwidth of the loudspeaker.

To avoid distortion, make sure the source device provides an adequate drive circuit design for the total paralleled load impedance presented by the array. The input impedance for a single MILO loudspeaker is 10 kOhms: if *n* represents the number of MILO loudspeakers in an array, paralleling the inputs of *n* MILO loudspeakers will produce a balanced input load of 10 kOhms divided by *n*.

NOTE: Most source devices are safe for driving loads no smaller than 10 times the source's output impedance.

For example, cascading an array of 10 units consisting of MILO loudspeakers produces an input impedance of 1000 ohms (10 kOhms divided by 10). The source device should have an output impedance of 100 ohms or less. This is also true when connecting MILO loudspeakers in parallel (loop out) with other self-powered Meyer Sound loudspeakers, for example M3D's, M3D-Subs, M2Ds, or 650-Ps.

Meyer Sound LD-1A, LD-2, or LD-3 line drivers are highly recommended when driving systems using multiple loudspeakers. These line drivers, in addition to maintaining signal integrity for long cable paths, offer independent outputs and filters to help you integrate sub-systems and optimize MILO array performance.

NOTE: For details on MILO's audio input characteristics and amplification, see Appendix B.

AMPLIFICATION AND PROTECTION CIRCUITRY

MILO is powered by the Meyer Sound HP-4/MILO amplifier, a high-power four-channel amplifier (1125 watts/channel with 4-ohm loads, and 560 watts with 8-ohm loads) with a total power of 3935 watts. The HP-4/MILO amplifier utilizes complementary-power MOSFET output stages (class AB/H). All the specific functions for the MILO loudspeaker such as crossover points, frequency and phase response, and driver protection are determined by the control card installed inside the HP-4 amplifier.

All Meyer Sound loudspeakers are tested and shipped with the drivers in correct alignment. However, if a driver needs to be replaced, make sure the replacement is reinstalled with the correct polarity.

CAUTION: Failure to connect a replacement driver using the proper polarity will result in severe degradation in frequency and phase response and can harm the drivers and amplifier.

MILO INTERCONNECTIONS

Each front 4-ohm, 12-inch, low-frequency cone driver is powered by one 1125-watt channel of the HP-4/MILO amplifier. The single 4-inch diaphragm, 8-ohm high-frequency compression driver is powered by a single 560 watt channel and the three 2-inch diaphragm, 12-ohm very high-frequency compression drivers share the fourth 1125-watt channel. Figure 2.2 shows how MILO's drivers are connected to the amplifier.

NOTE: For details on replacing the HP-4/MILO amplifier see Appendix A.

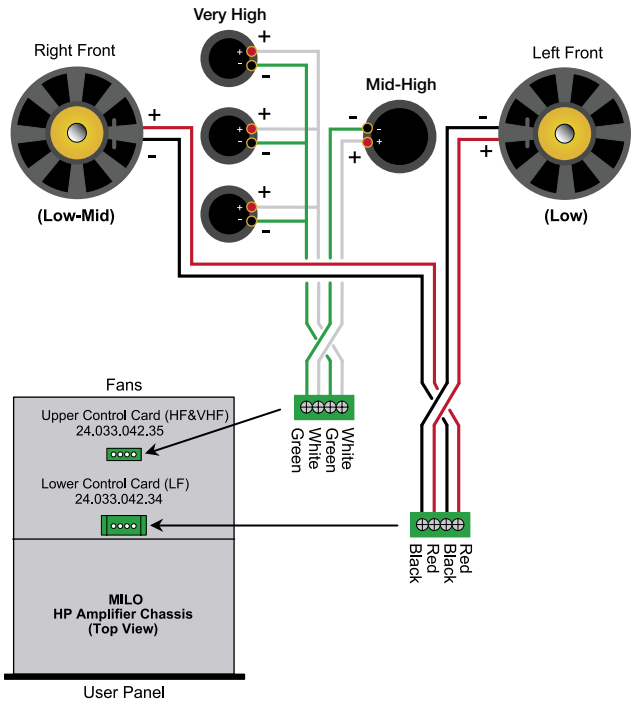


Figure 2.2: MILO internal wiring harness diagram

CABLING

MILO is available with two different cabling/connection options. One is the Meyer Sound/VEAM cable system, which combines AC power, audio signal, and RMS network data into one heavy-duty cable with a single matching connector per MILO cabinet.

The other (standard) system uses three separate cables and connectors per cabinet for the AC line current, signal, and RMS data. However, the three can be consolidated to create a "multi-cable" by looming them together for quick connection to each cabinet. This ensures no patching errors and a minimum of discrete cables behind the array.

A ring/stud fitting is provided on the rear of the MILO loudspeaker to act as a strain relief for cabling. Using this fitting will minimize the chance of cables being damaged during installation.

To utilize the strain relief fitting, insert the signal, data, and AC connections into each loudspeaker as the array is being rigged (swag all cables under the rain hood's side flaps if installed), and tie the cables off to the ring/stud fitting, as shown in Figure 2.3.

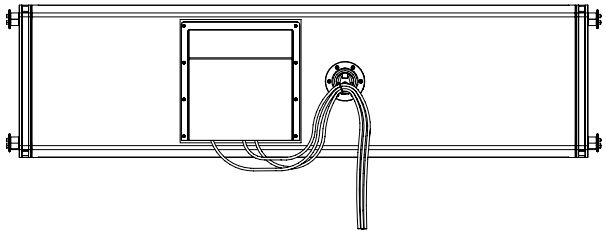


Figure 2.3: Cables are easily tied off using the rear ring/stud fitting.

CAUTION: The strain relief stud fitting must be used only to secure system cabling. This fitting is not intended to be used with system rigging or a pull-back motor (pulling the bottom of the array backward to increase downward tilt). The point is mounted to the side of the amplifier area so as not to interfere with the rain hood (if fitted) and the amplifier fan exhaust area.

THE TRUPOWER™ LIMITING SYSTEM

Conventional limiters assume a constant loudspeaker impedance and therefore set the limiting threshold by measuring voltage only. However, this method is inaccurate because the loudspeaker's impedance varies throughout its frequency range, changing in response to the frequency content of the audio source. In addition, the impedence also changes due to temperature variations in the voice coil and magnet. Consequently, conventional limiters begin limiting prematurely, which under-utilizes system headroom and lessens the loudspeaker's dynamic range.

In contrast, TruPower Limiting (TPL) accounts for varying loudspeaker impedance by measuring current as well as voltage to compute the actual power dissipation in the voice coil. TPL improves performance before and during limiting by allowing each driver to produce maximum SPL across its entire frequency range.

NOTE: TPL only reduces the signal level to keep the voice coil below 180 degrees Celsius, hence the peaks are unaffected.

In addition, TPL eliminates power compression when the system is operated at high levels for extended periods, and also extends the driver life cycle by controlling voice coil temperatures.

The actual power is monitored for three of MILO's four amplifier channels. When the safe continuous power level is exceeded, the TPL limiter controlling that amplifier channel engages. TPL activity is indicated by the LEDs on the user panel (Figure 2.4). The very-high frequency channel is controlled by a sophisticated average and peak voltage limiter.

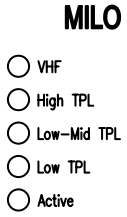


Figure 2.4: MILO Limit LEDs

Low- and Mid-Frequency Limiters

MILO's left and right 12-inch cone drivers are powered by separate amplifier channels, each with a power detector but routed to one limiter; the limiter tracks both channels and uses the higher of the two values to engage. By limiting both amplifier channels equally, any anomalies in the frequency range shared by the drivers is eliminated during limiting. The LO TPL and MID TPL LEDs on the user panel indicate TPL activity for these two drivers.

High-Frequency Limiter

The single 4-inch diaphragm high-frequency compression driver is powered by one amplifier channel; this channel has both TPL and peak limiters. When engaged, the peak limiter prevents signal peaks from causing excessive excursion in the driver as well as distortion in the amplifier channel, preserving headroom and maintaining smooth frequency response at high levels.

The High TPL LED is used to indicate any limiting activity for this driver. When the LED turns on and off in rapid succession, it indicates peak limiting; when it turns on and off slowly, it indicates TPL activity.

Very-High Frequency Limiters

The three 2-inch diaphragm very-high frequency compression drivers are powered by the fourth amplifier channel. The VHF limiter prevents excessive continuous voltages and signal peaks from causing excessive heat and excursion in the drivers as well as distortion in the amplifier channel. The limiter also helps preserve headroom and maintain smooth frequency response at high levels. The VHF LED indicates average and peak voltage limiting activity for these drivers.

All limiters cease operation when the power level and voltage for the channel returns to normal – below the limiter's threshold. The limiting circuitry utilizes optical limiters that add no noise and have no effect on the signal when the limiter is not engaged and the LED is inactive.

MILO is performing within its acoustical specifications and operating at a normal temperature if the limit LEDs are lit for no longer than two seconds, and then go off for at least one second. If an LED remains on for longer than three seconds, that channel enters hard limiting, with the following negative consequences:

- Increasing input level will not increase volume.
- Distortion increases due to clipping and nonlinear driver operation.
- The lifespan of the driver is reduced because it is subjected to excessive heat and/or excursion.

NOTE: The limit LEDs indicate when the safe power level is exceeded. If any channel on an entire system of MILO loudspeakers begins to limit before reaching the required sound pressure level (SPL), consider adding more loudspeakers to satisfy the SPL requirements without exposing the drivers on that channel to excessive heat and/or excursion.

FANS AND COOLING SYSTEM

MILO uses a forced-air cooling system with four fans to prevent the amplifier modules from overheating. The fans draw air in through ducts on the front of the cabinet, over the heatsinks, and out the rear of the cabinet. Because dust does not accumulate in the amplifier circuitry, its lifespan is increased significantly. The front grille surface acts as an air filter for the cooling system and should always be in place during operation (Figure 2.5).

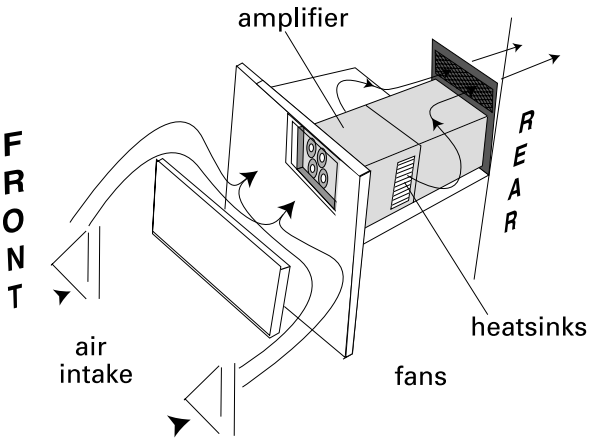


Figure 2.5: Airflow through MILO

Because the grille acts as a filter, it should be inspected and cleaned routinely – once every six months, or once every three months in a dusty environment – to assure proper airflow and cooling. The grille can be vacuumed to remove dust.

TIP: If your MILO loudspeaker is weather-protected, the grille must be removed in order to the clean the additional foam underneath the grille, which covers the air inlets.

CAUTION: When operating a weather-protected MILO loudspeaker be sure the rain hood is fully open. Leaving the hood closed or partially open will limit the airflow through the amplifier, which could cause it to overheat and shut down.

Two variable-speed primary fans run continuously and inaudibly at their slowest speed. The primary fans increase speed when either of the two heatsinks reaches 42˚ C. The fans reach full speed at 62˚ C and are still barely audible even near the cabinet, and without an audio signal. In the unusual event that the heatsink temperature reaches 74˚ C, the secondary fans turn on and are clearly audible without an audio signal. The secondary fans turn on in response to:

- Primary fan failure (check status immediately)
- High source levels for a prolonged period
- Accumulation of dust along the cooling path

The secondary fans turn off when the temperature decreases to 68˚ C.

NOTE: In the highly unlikely event that the secondary fans do not keep the temperature below 85˚ C, the MILO loudspeaker automatically shuts down until AC power is removed and reapplied. If the MILO loudspeaker shuts down again after cooling and reapplying AC power, contact Meyer Sound for repair information.

Despite MILO's filtering, extensive use or a dusty operating environment can allow dust to accumulate along the path of the airflow, preventing normal cooling. To avoid this, you should periodically remove the grille frame and amplifier module and use compressed air to clear dust from the grille, fans and heatsinks. Make sure that the air ducts are clear.

TIP: For weather-protected MILO loudspeakers, the foam covering the horns should also be cleaned with compresed air.

CAUTION: Be sure to unplug power to the unit before cleaning the amplifier.

CHAPTER 3: RMS REMOTE MONITORING SYSTEM

MILO is RMS-ready and fitted standard with an RMS communication board installed in its HP-4/MILO amplifier. RMS is a real-time monitoring system that connects Meyer Sound self-powered loudspeakers with a Windows-based PC at the sound mix position or other location. Optional RMS software delivers extensive status and system performance data from every installed loudspeaker.

RMS allows the monitoring of amplifier voltages, limiting activity, power output, temperature, fan and driver status, warning alerts, and other key data for up to 62 loudspeakers without a network repeater. Data is updated two to five times per second.

NOTE: Optional loudpeaker Mute and Solo functions, helpful for acoustic setup or troubleshooting, are also available. A jumper must be installed in the RMS communication board inside MILO's HP-4 amplifier in order to enable Mute and/or Solo functionality; the software also needs to be enabled for these functions.

NOTE: MILO is shipped with these functions disabled. Once enabled, the jumper(s) can still be removed to eliminate any chance of an operator error (a muting error, for example) during a performance, and both functions can be controlled by software commands in any case. Also note that RMS does not control loudspeaker volume or AC power.

Loudspeakers are identified on the network by Node Names assigned during a one-time "commission" into the RMS database that resides on your computer (as a part of the software) as shown in Figure 3.1. This information is permanently retained on each RMS communication board and in the computer RMS database unless you modify it. Loudspeaker View labels can be modified at any time, allowing you to customize how you view the data. In addition, any MILO can be physically identified from RMS software by activating the Wink function – a Wink LED will turn on the RMS communication board that corresponds to its Node Name.

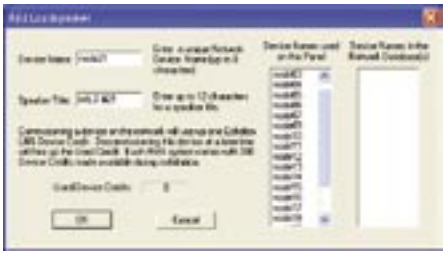


Figure 3.1: Commissioning a MILO loudspeaker using RMS.

MILO loudspeakers are identified using the RMS software by activating the "service" function; an icon will show up on the RMS screen corresponding to its Node Name (Figure 3.2). This makes verifying Loudspeaker View titles and Loudspeaker Field labels easy, using the Wink or Service Button commands.

Figure 3.2: MILO RMS icon

UNDERSTANDING THE USER PANEL

MILO's HP-4/MILO amplifier contains an RMS user panel, as shown in Figure 3.3.

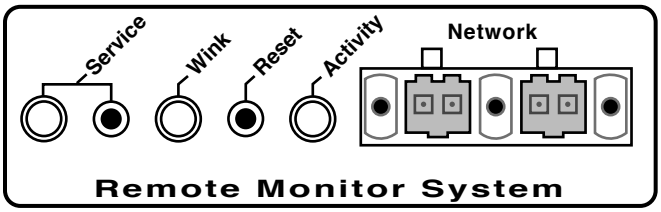


Figure 3.3: The RMS user panel

The RMS user panel has three LEDs and two buttons. The following sections describe their functions.

Service LED (Red)

The Service LED blinks every two seconds to indicate that the network hardware is operational, but the loudspeaker is not installed (commissioned) on the network. When a loudspeaker has been installed on the network the, Service LED will be unlit and the Activity LED will flash continuously.

NOTE: When continuously lit, the Service LED indicates that the loudspeaker has had a local RMS hardware failure. In this case, the RMS communication board may be damaged and you should contact Meyer Sound Technical support.

Service Button

Pressing the Service Button will display an icon on the corresponding loudspeaker display on the RMS screen. When used in combination with the Reset Button, the card will be decommissioned from the network and the red Service LED will blink.

Wink LED (green)

When lit, the Wink LED indicates that an ID signal has been sent from the host station computer to the loudspeaker. This is accomplished using the Wink button on the loudspeaker Icon, Meter or Text views in the RMS monitoring program.

Reset Button

Pressing the Reset Button will cause the firmware code within the RMS card to reboot. However, the commissioning state of the card will not change (this is stored in flash memory). When used in combination with the Service Button, the card will be decommissioned from the network and the red Service LED will blink.

Activity LED (Green)

When the loudspeaker has been commissioned the Activity LED will flash continuously. When the Activity LED is unlit the loudspeaker has not been installed on the network.

NOTE: The LEDs and buttons on the user panel of the RMS communication board shown in Figure 3.3 are used exclusively by RMS, and have no effect on the acoustical and/or electrical activity of the MILO loudspeaker itself – unless MUTE or SOLO is enabled at the board and from the RMS software.

USER INTERFACE

The RMS software features an intuitive, graphical Windows user interface. As mentioned earlier, each loudspeaker appears on the computer's color monitor as a View in the form of a status icon, bar graph meter, or text meter (numerical values), depending on your preferences.

Each View contains loudspeaker identification information and data from the amplifier, controller, drivers and power supply of that particular unit. System status conditions cause changes in icon and bar graph indicators, alerting the operator to faults or excessive levels. The views are moveable and are typically arranged on the screen to reflect the physical layout of the loudspeakers. You can design a screen "panel" of icons or meters, as shown in Figure 3.4, and save it on the computer's hard disk, with the panel conveniently named for a unique arrangement or performer.

If the loudspeaker installation pattern changes completely, a new screen panel can be built. If a different subset of already installed loudspeakers will be used for a subsequent show, only selected loudspeakers need to appear on the monitoring screen for that performance.

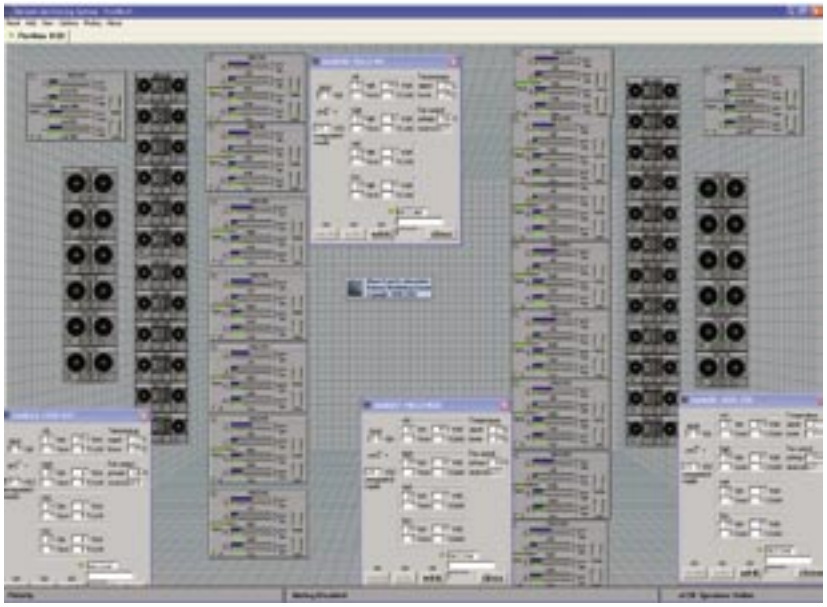


Figure 3.4: Sample RMS display panel showing MILOs and M3D-Subs

CHAPTER 4: LINE ARRAYS AND SYSTEM INTEGRATION

A line array, in the most basic sense, is a group of closely spaced loudspeakers arrayed in a straight line, operating with equal amplitude and in phase. Although line arrays have been used since the 1950s, line array systems that provide full bandwidth directivity are relatively new to the sound reinforcement industry.

HOW LINE ARRAYS WORK

Line arrays achieve directivity through constructive and destructive interference. For example, consider one loudspeaker with a single 12-inch cone radiator in an enclosure. We know from experience that this loudspeaker's directivity varies with frequency: at low frequencies it is omnidirectional; as the frequency increases (wavelength grows shorter), directivity narrows. Above about 2 kHz, it becomes too beamy for most applications, which is why practical system designs employ crossovers and multiple elements to achieve directivity across the audio band.

Stacking two of these loudspeakers one atop the other and driving both with the same signal results in a different radiation pattern. At common points on-axis, there is constructive interference, and sound pressure increases by 6 dB relative to a single unit. At other points off-axis, path length differences produce cancellation, resulting in a lower sound pressure level. In fact, if you drive both units with a sine wave, there will be points where the cancellation is complete, which can be shown in an anechoic chamber. This is destructive interference, sometimes referred to as combing.

A typical line array comprises a line of loudspeakers carefully spaced so that constructive interference occurs on-axis of the array, and destructive interference (combing) is aimed to the sides. While combing has traditionally been considered undesirable, line arrays use combing to positive effect: without combing, there would be no directivity.

THE MILO CURVILINEAR ARRAY

The MILO loudspeaker employs a unique combination of drivers to enable you to optimize both coverage and directivity in a MILO line array system. To achieve optimal results, it's critical to understand how these components work together.

High Frequencies

For high frequencies, MILO uses very precise Constant Q horns, developed using Meyer Sound's own anechoic chamber, which provide a consistent beamwidth of coverage in both the vertical and horizontal planes.

In the horizontal pattern of the array, these horns work just as any wave guide does to produce wide coverage; in the vertical, however, MILO's REM technology provides very narrow coverage in order to:

- Minimize destructive interference between adjacent elements
- Maximize coupling to throw longer distances

As more and more elements are arrayed in a vertical column, they project mid and high-frequency energy more effectively through coupling. The amount of energy can then be controlled using the relative splay between the elements. Gently curving a line array (no more than five degrees of splay between cabinets) can aid in covering a broader vertical area, while narrow angles provide a longer throw and coverage which more closely matches that of the low frequencies.

NOTE: Radically curving a line array introduces problems. While a drastic angle can spread high frequencies over a larger area, low frequencies remain directional (the curvature is trivial at long wavelengths), resulting in uneven coverage. In addition, a vertically narrow high-frequency pattern combined with large angles can produce hot spots and areas of poor high-frequency coverage.

Mid to Low Frequencies

For the mid to low frequencies, line arrays must be coupled together to narrow their vertical coverage and project mid and low energy to the far field. As frequencies get lower and wavelengths get longer, the splay angle between cabinets has little effect. The number of array elements, however, is important: the more MILO loudspeakers used, the narrower the vertical beamwidth becomes, as illustrated by Figure 4.1.

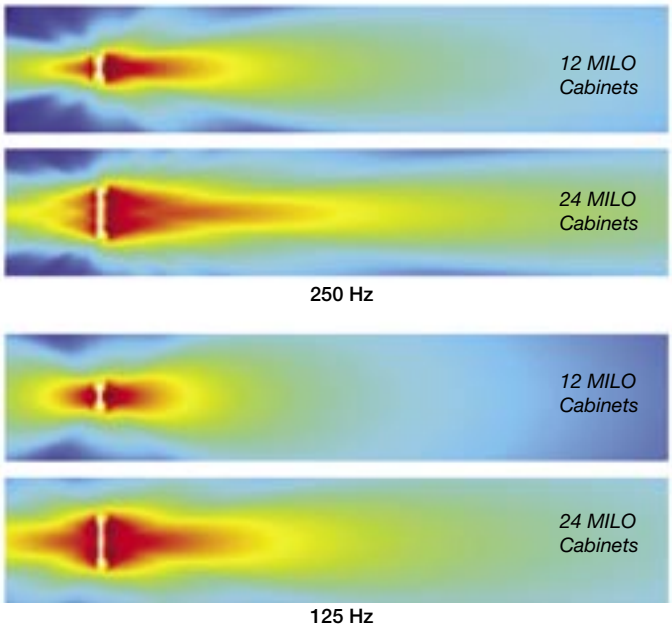


Figure 4.1: 12 and 24 cabinet MILO line arrays

Adjusting Line Array Coverage

Regardless of the needs of your system design, fine-tuning coverage for a single MILO array will be dependent on three factors:

- **Number of Array Elements**. Determining the number of elements to use is critical: Too few elements can drastically affect the uniformity of coverage of both SPL and frequency response.
- **Vertical Splay Angles**. Changing the splay angles between cabinets has a significant impact on vertical coverage, with the result that narrower vertical splay angles produce a higher Q vertical beamwidth, while wider splay lowers the Q at high frequencies.
- **Horizontal Coverage**. Horizontal coverage for a single array can be considered constant regardless of the number of array elements or the angles between them.

TIP: The angle between two or more line arrays can also be changed to meet additional design requirements (for example, wall reflections).

Given these factors, designing and deploying a line array system will typically have the following objectives:

- Even horizontal and vertical coverage
- Uniform SPL
- Uniform frequency response
- Sufficient SPL for the application

With two different technologies (low-frequency cone radiators and high-frequency wave guide) built into each MILO cabinet, achieving these goals becomes a multi-step process, with different strategies for the lower and higher frequencies for long throws and short throws.

NOTE: MAPP Online, covered in greater detail later in this chapter, is the tool of choice to enable you to make accurate and comprehensive predictions for optimal coverage(s) during the design phase.

High-Frequency Design Strategies

Planning for high-frequency coverage is a matter of fine-tuning the splay angles between cabinets while keeping a eye on the number of far-throwing elements in the array. The number of elements does not necessarily have a significant impact on SPL at high frequencies (it will at low frequencies), but can profoundly affect coverage.

For the far field, a smaller mechanical splay angle achieves superior throw through better coupling to compensate for energy lost over distance. In the near- to mid-field, larger splay angles increase vertical coverage.

Low-Frequency Design Strategies

While wave guides provide isolated control over various mid- to high-frequency coverage areas, the low-frequency section of a MILO line array still requires mutual coupling — with equal amplitude and phase — to achieve better directionality.

Low-frequency directionality is less dependant on the array's relative splay angles and more dependent on the number of elements of the array. At low frequencies, the more elements in the array, the more directional the array becomes, providing more SPL in this range.

Electronically Driving the Array

Once the design (number of elements, vertical splay angles and horizontal splay angles between arrays) has been mapped out, you can effectively optimize the array by driving it with multiple equalization channels, or zones. Typically arrays are divided in two or three zones depending the design and size of the array; to optimize EQ, different strategies are used for the low and high frequencies for long throws and short throws.

High-Frequency Equalization Strategies

For the far field, air absorption plays a critical role. The longer the distance, the greater the attenuation at high frequencies. In this zone, high frequencies generally need

a correction to compensate for energy lost over distance; the correction needed is usually proportional to the distance and high frequency air absorption.

In the near- to mid-field, the air absorption is not nearly as critical; in this zone, high frequencies need little or no additional correction.

TIP: If your MILO line array uses a third zone for short throws, high frequencies there may need to be attenuated to more appropriate near-field levels.

Low-Frequency Strategies

Although the array can (and usually should) be zoned for implementing different equalization curves for high frequencies, similar or identical equalization should be maintained in all the low-frequency filters. Different low-frequency equalization settings in the same array will degrade the desired coupling effect.

For the same reason, gain tapering is not recommended for line arrays, since adjusting various zones with an overall amplitude control for each results in the following:

1. Directionality decreases.
2. Low-frequency headroom decreases.
3. The length of the line array column is effectively shortened.

Figures 4.2 shows a series of MAPP Online predictions based on an example MILO system design. In this case, small vertical splay angles on the upper part of the array are used to cover longer distances, while greater angles are used in the lower elements to increase vertical coverage for shorter distances.

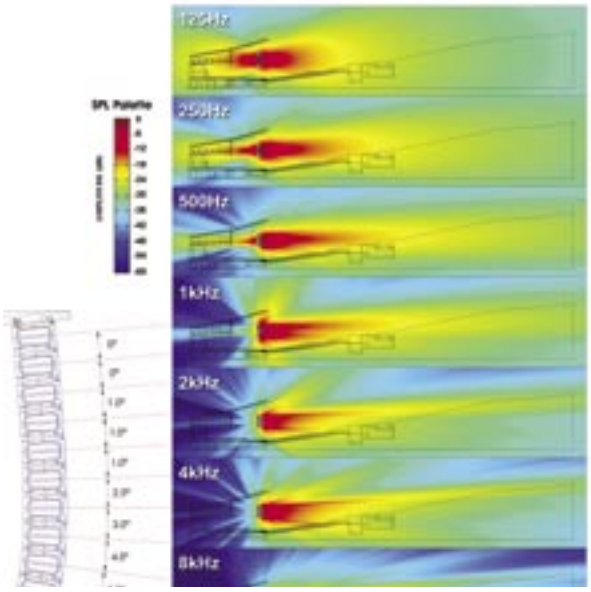


Figure 4.2: The MAPP Online plots on the right illustrate the vertical directivity characteristics of the array on the left, with a section view of the venue superimposed

The block diagram (Figure 4.3) shows one method of driving this example array, along with additional fill loudspeakers

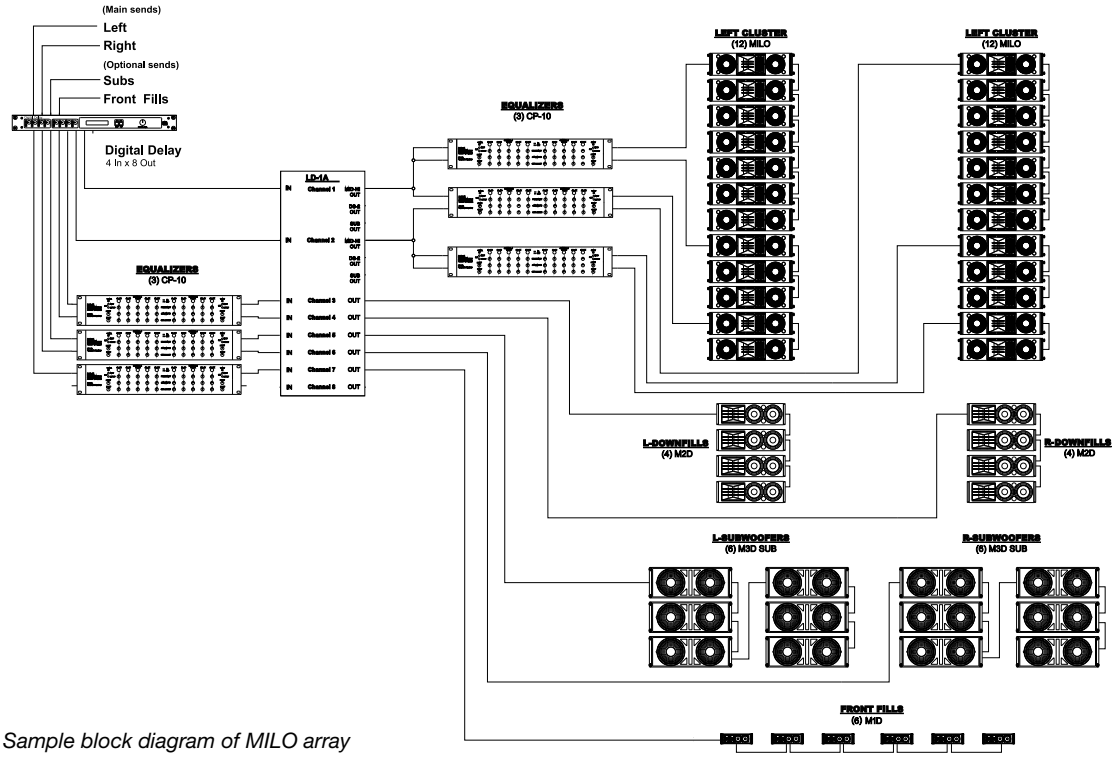


Figure 4.3: Sample block diagram of MILO array

and subwoofers (not in the MAPP Online predictions). Equalizers for each zone, as well as digital delays, provide a time adjustment to compensate for the various sub-systems if they are geometrically out of plane.

CAUTION: This example is not meant to be used as a template for your own system designs. Acoustical characteristics, physical constraints, audio content, audience, and other relevant factors should always be uniquely weighed into your own applications on a per-project basis.

USING MILO WITH SUBWOOFERS

A MILO system will provide full bandwidth frequency response down to 60 Hz. The height of the array (number of cabinets) will determine the total SPL available and how much low frequency energy can be provided, proportional to the upper-frequency spectrum.

If higher SPL is necessary, or the program content requires additional low-frequency energy (e.g. the reinforcement of popular music), then subwoofers should be used to augment your MILO loudspeaker array(s).

Meyer Sound subwoofers, such as the M3D-Sub or 650-P, can achieve frequency response down in the 30 Hz range, extending the system response appreciably and increasing the acoustic power of the system in the lowest frequencies. In addition, the use of high-pass filters to drive a MILO system with subwoofers increases the headroom of the MILO array in the lowest end of its usable spectrum.

The ideal ratio of MILO loudspeakers to subwoofers depends on the configuration of the array and the frequency content of the signal being reproduced by the system. For most applications, two MILO loudspeakers for each subwoofer yields good results in frequency response and headroom.

NOTE: The limit LEDs indicate when the safe power level is exceeded. If the subwoofers used in the system begin to limit before reaching the required SPL at low frequencies, consider adding more subwoofers to satisfy the SPL requirements without exposing the drivers to excessive heat and/or excursion.

MILO and the M3D-Sub

The M3D-Sub directional subwoofer, shown in Figure 5.5, adds substantial low-frequency headroom to a MILO array, extending the system frequency response to 30 Hz.

Figure 4.4: The M3D-Sub loudspeaker

The M3D-Sub has advantages over other subwoofers due to its unique low-frequency directional control and its ability to be vertically arrayed with MILO since they share the same width.

NOTE: For most applications, you want to keep low frequencies from being produced behind the array, in order to reduce or eliminate the low frequency reverberant noise traditionally associated with large-scale, full range loudspeaker arrays. The M3D-Sub's award-winning and patent-pending cardioid directional pattern provides maximum cancellation from six to twelve meters behind the cabinet (-20 dB at 8 meters).

All Meyer Sound products have been optimized with internal crossover networks. When most Meyer Sound loudspeakers are used together, these networks provide maximum power addition through their respective overlapping frequency ranges when used in close proximity and co-planar to one another. The MILO and M3D-Sub can accommodate several basic connection options, discussed in the following sections.

Daisy-Chained

When MILO loudspeakers and M3D-Subs are daisy-chained using the loop feature on the user panel, the result is a smooth frequency response through the "overlap range" of 60 Hz to 100 Hz when M3D-Subs and MILO are co-planar at a ratio of two MILO loudspeakers to each M3D-Sub.

M3D-Sub and MILO loudspeakers should be placed as close as possible to each other so that the relative distances between them are the same at all listening positions. Due to the relative phase responses through the overlap range, M3D-Subs should not be placed farther back than MILO loudspeakers. However, an M3D-Sub array can be placed up to 4 feet in front of MILO loudspeaker array and remain in phase.

If MILO loudspeakers and M3D-Subs are flown side-by-side, there should not be more than 3 feet between them. In addition, the M3D-Subs are better suited to the inside

towards the stage to keep them in phase at both the mix position and throughout the total array coverage.

Similarly, when M3D-Subs are stacked on the floor below your MILO array, they may be several feet closer than the MILO array through most of the coverage, keeping them in phase (provided the distance is 4 feet or less with the M3D-Subs being closer).

NOTE: There is no polarity switch on either the MILO or the M3D-Sub; both are wired pin 2 "hot" (positive acoustic pressure when a positive pulse is applied to pin 2), making their integration when co-planar - and in close-proximity – easier when flown or stacked in the same array.

NOTE: When both a MILO loudspeaker and an M3D-Sub are used in their full-range configuration (e.g. looped audio or the same audio feed), their polarities should be kept the same if they are co-planar or near each other. If they are separated by a greater distance – or delay must be used between them – a measurement system such as SIM should be used to determine the correct delay and polarity.

CAUTION: When daisy-chaining, make sure that the source devices can drive the total load of the paralleled array. (See Audio Input section, page 9)

Adding a LD-1A/LD-2 Line Driver

Driving MILO loudspeakers and M3D-Subs with the same signal from different outputs using a line driver allows adjustments to the gain of each sub-system, and could be used effectively to compensate for the ratio of loudspeakers or acoustical conditions. If the gains are adjusted to the same level, the combined response is identical to a daisy-chain configuration.

Using the LD-1A or LD-2's Lo-Cut filter optimizes MILO's headroom and reduces the area of overlap; the MILO loudspeakers in the array receive their signal following a high-pass filter, while the M3D-Subs apply their normal internal crossover frequencies to a full range signal. This configuration results in a smooth frequency response through crossover and reduces the overlap frequency range between the loudspeakers.

To drive MILO loudspeakers from the Mid-High output of an LD-1A line driver (Figure 4.5) or LD-2 line driver (Figure 4.6), engage the Lo-Cut filter with no polarity reversal on the M3D-Sub's output when co-planar and in close-proximity. Since an M3D-Sub rolls off rapidly after 80 Hz, there is no need to engage the polarity reversal on the sub's output.

Figure 4.5: The LD-1A line driver

Figure 4.6: The LD-2 line driver

M3D-Subs should be kept as close as possible to your MILO loudspeakers to avoid phase errors and cancellation in some seating locations. If M3D-Subs and MILO loudspeakers are flown side-by-side, they should not be separated by more than 3 feet.

NOTE: Placing the M3D-Subs more than 4 feet away from your MILO array may require setting M3D-Subs/MILO loudspeakers to opposite polarities.

With a 2:1 ratio, an M3D-Sub produces roughly 3-6 dB rise below 100 Hz, which is often desirable. The LD-1A or LD-2 Lo-Cut Filter keeps the build-up of energy from 100-200 Hz to a minimum, resulting in the smoothest frequency response you can achieve for an M3D-Sub/MILO combined configuration.

NOTE: When driving MILO loudspeakers from the Mid-Hi output of the LD-1A or LD-2 line driver, with the Lo-Cut filter engaged and the M3D-Subs in their full-range configuration, their polarities should be kept the same if they are co-planar or near each other. If they are separated by a greater distance – or delay must be used between them – a measurement system such as SIM should be used to determine the correct delay and polarity.

MILO and the 650-P Subwoofer

In applications where M3D-Sub features like directional low-frequency control and additional peak SPL are not needed, a MILO array can be deployed in combination with Meyer Sound 650-P subwoofers. The 650-P subwoofer extends the MILO system frequency response down to 30 Hz; MILO and the 650-P can accommodate three basic connection options.

Daisy-Chained

When MILO loudspeakers and 650-P subwoofers are daisy-chained using the loop feature on the user panel, the result is a fairly flat frequency response (and a rise in the 80 to 150 Hz range where the loudspeakers' response overlaps) at a ratio of two MILO loudspeakers to each 650-P. While there is no polarity switch on a MILO loudspeaker, the 650-P does indeed have a polarity switch, and you will need to ensure that the 650-P is set to pin 3 + (reversed with respect to a MILO loudspeaker's pin 2 +) when co-planar and in close-proximity to your MILO array.

CAUTION: Make sure that the source device can drive the total load of the paralleled array. (See Audio Input section, page 9)

NOTE: When both a MILO loudspeaker and a 650-P are used in their full-range configuration (e.g. looped audio or the same audio feed), their polarities should be kept reversed (set the switch on the rear of the 650-P to Pin 3 +) if they are co-planar or near each other. If they are separated by a greater distance – or delay must be used between them – a measurement system such as SIM should be used to determine the correct delay and polarity.

Adding an LD-1A/LD-2 Line Driver

Driving MILO loudspeakers and 650-P subwoofers with the same signal from different outputs using a line driver allows adjustments to the gain and polarity of each sub-system, and could be used effectively to compensate for the ratio of loudspeakers or acoustical conditions. If the gains are adjusted to the same level, the combined response is identical to a daisy-chain configuration.

When driving MILO loudspeakers from the Mid-Hi output of the LD-1A or LD-2 line driver, with 650-P subwoofers in their full-range configuration, their polarities should be kept reversed if they are co-planar or near each other. The best way to achieve this is to set the switch on the rear of the 650-P to Pin 2 + and control the 650-P polarity using the LD-1a or LD-2 by inverting sub-out polarity. If your MILO loudspeakers and 650-P subwoofers are separated by a greater distance – or delay must be used between them – a measurement system such as SIM should be used to determine the correct delay and polarity.

Using the LD-1A or LD-2's Lo-Cut filter can keep the MILO loudspeaker and 650-P subwoofer (when co-planar) in phase with a minimal area of overlap; the MILO loudspeakers in the array receive their signal following a high-pass filter, while the 650-P subwoofers apply their normal internal crossover frequencies to a full range signal. Frequency response using this configuration remains flat, though there is a slight rise from 80–100 Hz due to the natural response shape of the 650-P.

TIP: How flat the response will be is, in any case, dependent on proximity to boundary surfaces.

To drive MILO loudspeakers from the Mid-Hi output of the LD-1A line driver (Figure 4.5) or the LD-2 line driver (Figure 5.6), the Lo-Cut filter is engaged with no polarity reversal on the 650-P Sub's output set to pin 2 +. Simply change the 650-P subwoofer's user panel to pin 2 + and the line driver's sub output to "normal".

While the change of polarity with respect to a daisy-chained configuration is needed due to the phase shift caused by the high-pass filter at overlapping frequencies, placing the subwoofers more than 4 feet apart may require reversing the polarities once again to compensate for the delay propagation.

NOTE: When driving MILO loudspeakers from the Mid-Hi output of the LD-1A or LD-2 line driver – *with the Lo-Cut filter engaged* - and 650-P subwoofers in their full-range configuration, their polarities should be kept the same if they are co-planar or near each other.

If your MILO loudspeakers and 650-P subwoofers are separated by a greater distance – or delay must be used between them – a measurement system such as SIM should be used to determine the correct delay and polarity.

Adding an LD-3 Line Driver

In addition to its unique atmospheric correction capabilities, Meyer Sound's LD-3 air attenuation compensating line driver (Figure 4.7) can be used effectively to manage low-frequency build-up and integrate subwoofers in a design with MILO arrays.

Figure 4.7. The LD-3 air attenuation compensating line driver

NOTE: The LD-3 utilizes multiple-variable atmospheric loss equations and pre-calculated MAPP Online stored values to provide frequency response correction quickly and efficiently (up to 16 kHz at a resolution down to 1 dB). Its high-quality, digitally-controlled analog filters provide the best of both worlds: the low latency and wide dynamic range of analog and the nimble, precise, repeatable results of digital.

The LD-3 features high-quality high-pass and low-pass filters to help integrate MILO and other M Series curvilinear line arrays with Meyer Sound subwoofers. These filters, along with the LD-3's dedicated sub section, will optimize your MILO loudspeakers' headroom and reduce the area of overlap with subwoofers, minimizing cancellations.

NOTE: For more information on recommended settings for the integration of MILO arrays with Meyer Sound subwoofers, as well as the LD-3's atmospheric and array correction features, please refer to the LD-3 Operating Instructions or visit www.meyersound.com.

Digital Signal Processors

Full-range signals may be applied to Meyer Sound's self-powered loudspeakers because they have built-in active crossover circuits; external crossovers and digital signal processors (DSP) are optional and should be used very carefully due to phase shifts that can cause cancellations.

If DSP is used, both MILO loudspeakers and subwoofers should be fed from the same DSP in order to keep their delay time the same. Otherwise you may experience phase shift differences between the MILO loudspeakers and the subwoofers. In addition, you should verify the delay time between channels: some DSPs may develop channel-to-channel delay errors when the DSP is near maximum throughput, which becomes more likely as the number of filters the DSP is using increases.

In no case should a filter higher than 2nd-order be used. The additional phase shift introduced deteriorates the impulse response and higher roll-off does not improve crossover interaction. In fact, it is highly recommended that the crossover/filter are set to emulate the low-cut LD-1A/LD-2 characteristics themselves, as shown in Table 4.1.

Table 4.1 LD-1 / LD-2 "Lo-Cut Filter" Parameters

Type	Order	Pole Frequency	Q
High Pass	2nd (-12 dB/oct)	162 Hz	1.82*

* If the DSP does not have variable Q for high-pass filters, the filter should be set to "Butterworth" (Q ≈ .7).

If the loudspeakers are going to be driven directly from the DSP, verify that the outputs of the processor have the driving capabilities to drive the total load presented by the loudspeakers connected to it. Please refer to the Audio Input section on page 9 in this manual.

NOTE: When precise array design, subwoofer integration, DSP and delay systems, and compensation for acoustical conditions all come into play, measurement and correction tools are a must. Meyer's SIM measurement system, the CP-10 parametric equalizer and the VX-1 program equalizer are highly recommended.

MEYER SOUND MAPP ONLINE®

MAPP Online (Figure 4.8) is a powerful, cross-platform, Java-based application for accurately predicting the coverage pattern, frequency response, impulse response, and maximum SPL output of single or arrayed Meyer Sound loudspeakers.

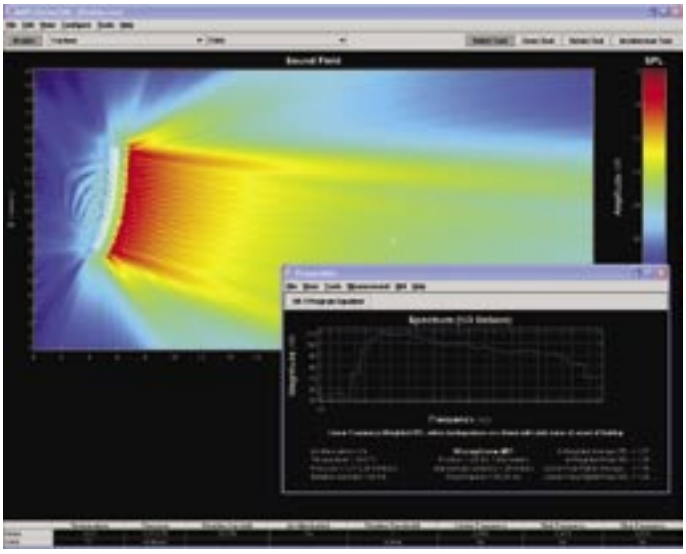


Figure 4.8: MAPP Online is an intuitive, powerful system design tool.

Residing on your computer, MAPP Online facilitates configuring arrays of a wide variety of Meyer Sound products and, optionally, defines the environment in which they will operate, including air temperature, pressure, and humidity, as well as the location and composition of walls.

You can find MAPP Online at:

www.meyersound.com/products/software/mapponline

NOTE: In order to use MAPP Online, you will need to register by clicking “Apply for MAPP Online” on the Web page listed above. After registration and upon approval, an e-mail will be sent to you with a username and password along with the address for the Web page where you can download MAPP Online. Online instructions will guide you through the download and setup process.

As its name indicates, MAPP Online is an online application: when a prediction is requested, data is sent over the Internet to a high-powered server at Meyer Sound that runs a sophisticated acoustical prediction algorithm using high-resolution, complex (magnitude and phase) polar data. Predicted responses are returned over the Internet and displayed on your computer in color.

With MAPP Online, you can:

- Plan an entire portable or fixed loudspeaker system and determine delay settings for fill loudspeakers.
- Clearly see interactions among loudspeakers and minimize destructive interference.
- Place microphones anywhere in the sound field and predict the frequency response, impulse response, and sound pressure level at the microphone position using MAPP Online’s Virtual SIM feature.
- Refine your system design to provide the best coverage of the intended audience area.
- Use a virtual VX-1 program equalizer to predetermine the correct control settings for best system response.
- Gain valuable load information about the array to determine rigging capacities.

MAPP Online enables you to come to an installation prepared with a wealth of information that ensures the system will satisfy your requirements “out of the box” – including basic system delay and equalization settings. Its accurate, high-resolution predictions eliminate unexpected onsite adjustments and coverage problems. With MAPP Online, every sound system installation has a maximum chance of success.

MAPP Online is compatible with Windows, Linux, Unix, and Apple Macintosh computers running Mac OS X version 10.1.2 or higher. The MAPP Online Web page above lists additional system requirements and recommendations.

CHAPTER 5: SIM® SYSTEM

SIM MEASUREMENT SYSTEM

SIM is a measurement and instrumentation system including a selection of hardware and software options, microphones and accessory cables. SIM is optimized for making audio frequency measurements of an acoustical system with a resolution of up to 1/24th of an octave; the high resolution enables you to apply precise electronic corrections to adjust system response using frequency and phase (time) domain information.

Source Independent Measurement Technique

SIM implements the Meyer Sound source independent measurement technique, a dual-channel method that accommodates statistically unpredictable excitation signals. Any excitation signal that encompasses the frequency range of interest (even intermittently) may be used to obtain highly accurate measurements of acoustical or electronic systems. For example, concert halls and loudspeaker systems may be characterized during a musical performance using the program as the test signal, allowing you to:

- View measurement data as amplitude versus time (impulse response) or amplitude and phase versus frequency (frequency response)
- Utilize a single-channel spectrum mode
- View frequency domain data with a logarithmic frequency axis
- Determine and internally compensate for propagation delays using SIM Delay Finder function

Applications

The main application of SIM is loudspeaker system testing and alignment. This includes:

- Measuring propagation delay between the subsystems to set correct polarities and set very precise delay times
- Measuring variations in frequency response caused by the acoustical environment and the placement and interaction of the loudspeakers to set corrective equalization
- Optimizing subwoofer integration
- Optimizing loudspeaker arrays

SIM can also be used in the following applications:

- Microphone calibration and equalization
- Architectural acoustics
- Transducer evaluation and correction
- Echo detection and analysis
- Vibration analysis
- Underwater acoustics

APPENDIX A: AMPLIFIER REPLACEMENT AND WEATHER PROTECTION

USING THE RAIN HOOD (WEATHER-PROTECTED LOUDSPEAKERS)

If your MILO loudspeaker was ordered with optional weather protection, a rain hood is installed on the MILO loudspeaker. It is provided to protect the loudspeaker's electronics from direct exposure to rainfall. Before using the MILO loudspeaker, open the rain hood as described in the following procedure.

1. Pull the exterior Velcro straps off the hood, allowing it to open.
2. Lift the flap fully outward, and unfold the fabric of the rain hood.
3. With your other hand, reach into the hood and free the two PVC supports from their corner pockets in the outer flap.
4. Fold both supports out and re-insert them into the two pockets, shown in Figure A.1, in the lower corners of the soft side flaps. This will hold the rain hood fully open for use, which is necessary for proper cooling of the MILO loudspeaker's electronics.

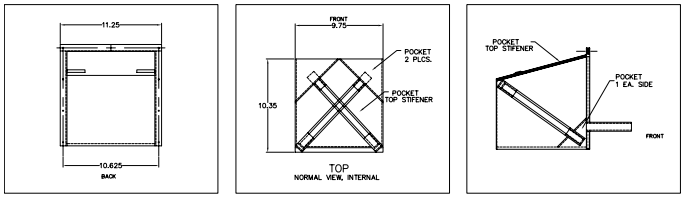


Figure A.1: Rain hood stiffener pockets

Figure A.2 shows an example of an installed rain hood.

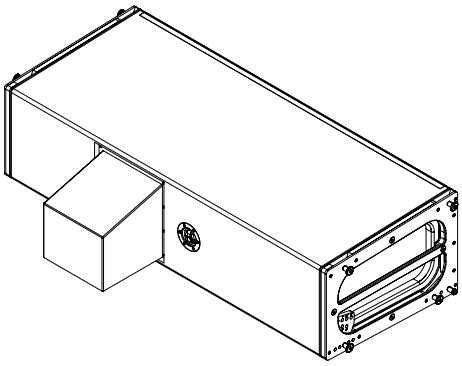


Figure A.2: A fully opened rain hood installed on a MILO

REMOVING AND REPLACING THE HP-4/MILO AMPLIFIER

If you need to remove the HP-4/MILO amplifier from a MILO loudspeaker, perform the following steps:

1. Using a #2 Phillips screwdriver, remove all eight screws from the amplifier module. This will free the HP-4/MILO electronics module from the MILO cabinet (Figure A.3).

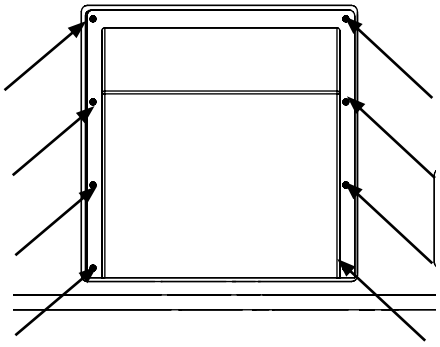


Figure A.3: Location of the eight screws securing the HP-4/MILO amplifier module

2. Carefully slide the amplifier module out of the cabinet using care not to stress the cables.
3. Disconnect the two 4-pin loudspeaker connectors. Note that the harness with red and black wires goes to the connector closest to the user panel, while the harness with green and white cables goes to the connector closest to the fans (Figure A.4).

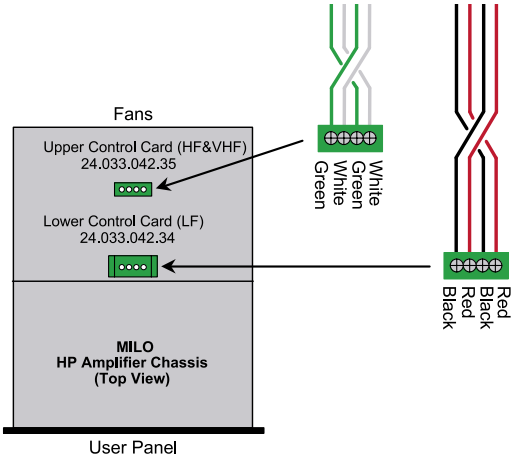


Figure A.4: MILO's two 4-pin connectors

Replacing the HP-4/MILO Amplifier

To replace the MILO's HP-4 amplifier, do the following:

1. Gently slide the amplifier partially back into the MILO and connect the two loudspeaker connectors. Make sure they are connected properly. The harness with red and black wires goes to the connector closest to the user panel, while the harness with green and white cables goes to the connector closest to the fans.
2. Start all eight screws into the holes before tightening them.
3. Once all eight screws are started, tighten them using a #2 Phillips screwdriver.
4. Tighten the inner four screws first, then tighten the remaining four corners.

CAUTION: Never use power tools in high torque settings to remove or replace the stainless steel amplifier and/or rain hood screws on the MILO loudspeaker.

REMOVING AND REPLACING THE HP-4/MILO AMPLIFIER (WEATHER- PROTECTED VERSION)

If you need to remove and replace the HP-4/MILO amplifier from a weather-protected MILO loudspeaker, first remove the rain hood, then remove the amplifier following the steps described in the previous section. Note that the rain hood is attached to the amplifier using the same screws that attach the amplifier to the cabinet.

Replacing the HP-4/MILO Amplifier and Rain Hood

Perform the following steps to replace MILO's HP-4/MILO amplifier and rain hood:

1. Gently slide the amplifier partially back into the MILO and connect the two loudspeaker connectors. Make sure they are connected properly: the harness with red and black wires goes to the connector closest to the user panel, while the harness with green and white cables goes to the connector closest to the fans.
2. With the wires properly connected, slide the amplifier all the way into its cabinet.

TIP: Avoid pinching wires behind the fans; if necessary, reach in and guide the wire(s) toward you as you slide the amplifier into place.

3. Check to be sure that all three steel bars are correctly inserted in the three fabric pockets of the hood.

NOTE: The bars must be inside the fabric pockets to achieve proper water protection.

4. Carefully install the fabric rain hood, using the stainless steel screws and washers.
5. Align all eight screws and make sure that the washers are over the fabric.
6. Start all eight screws into the holes before tightening them.
7. Use the screws to sandwich the fabric and its gasket reinforcement bar over the external gasket.
8. Once all eight screws are started, tighten them using a #2 Phillips screwdriver.
9. Tighten the inner four screws first, then tighten the remaining four corners.

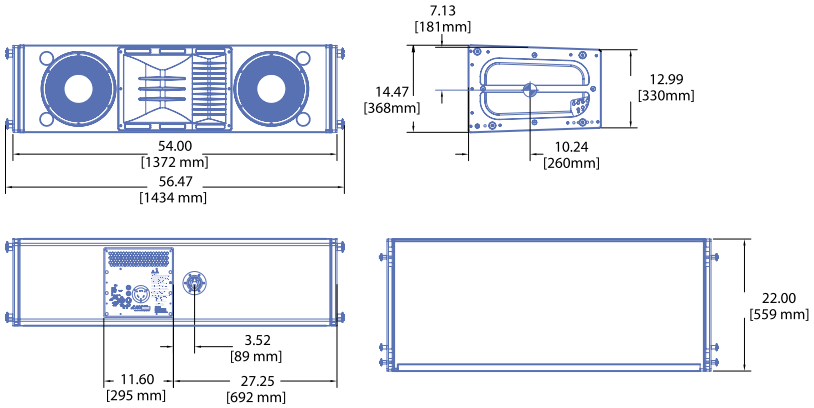
APPENDIX B

MILO SPECIFICATIONS

ACOUSTICAL	
Note: The low-frequency power response of the system will increase according to the length of the array.	
Operating frequency range	60 Hz - 18 kHz
	Note: Recommended maximum operating frequency range. Response depends upon loading conditions and room acoustics.
Free field frequency response	65 Hz - 17.5 kHz ±4 dB
	Note: Measured with 1/3 octave frequency resolution at 4 meters.
Phase response	750 Hz - 16 kHz ±30°
Maximum peak SPL	140 dB @ 1 m
	Note: Measured with music at 1 meter.
Dynamic range	>110 dB
Horizontal coverage	90°
Vertical coverage	Varies, depending on array length and configuration.
Acoustical crossover	560 Hz, 4.2 kHz
	Note: At these frequencies, the transducers produce equal sound pressure levels: 560 Hz for the low-mid and mid-high and 4.2 kHz for the mid-high and very-high frequency drivers.
TRANSDUCERS	
Low/low-mid frequency	Two 12" cone drivers with neodymium magnets Nominal impedance: 4 Ω Voice coil size: 4" Power-handling capability: 1200 W (AES)
	Note: Power handling is measured under AES standard conditions: transducer driven continuously for two hours with band limited noise signal having a 6 dB peak-average ratio.
Note: To eliminate interference at short wavelengths, the two 12-inch drivers work in combination at low frequencies (60 Hz – 300 Hz). At mid frequencies (300 Hz – 560 Hz) only one cone driver is fed from the crossover to maintain optimal polar and frequency response characteristics. Attenuation on the other driver: -6 dB at 300 Hz, -12 dB at 400 Hz, -18 db at 500 Hz.	
Mid-high frequency	One 4" compression driver Nominal impedance: 8 Ω Voice coil size: 4" Diaphragm size: 4" Exit size: 1.5" Power handling capability: 250 W (AES) on REM
	Note: Power handling is measured under AES standard conditions: transducer driven continuously for two hours with band limited noise signal having a 6 dB peak-average ratio.
Note: The driver is coupled to a constant-directivity horn through a proprietary acoustical combining manifold (REM).	
Very-high frequency	Three 2" compression drivers Nominal impedance: 12 Ω Voice coil size: 2" Diaphragm size: 2" Exit size: 0.75" Power handling capability: 100 W (AES) on REM
	Note: Power handling is measured under AES standard conditions: transducer driven continuously for two hours with band limited noise signal having a 6 dB peak-average ratio.
Note: The three drivers are coupled to a constant-directivity horn through a proprietary acoustical combining manifold (REM).	

AUDIO INPUT	
Type	Differential, electronically balanced
Max. common mode range	±15 V DC, clamped to earth for voltage transient protection
Connectors	Female XLR input with male XLR loop output or VEAM
Input impedance	10 kΩ differential between pins 2 and 3
Wiring	Pin 1: Chassis/earth through 220 kΩ, 1000 pF, 15 V clamp network to provide virtual ground lift at audio frequencies Pin 2: Signal + Pin 3: Signal - Case: Earth ground and chassis
DC Blocking	None on output, DC blocked through signal processing
CMRR	> 50 dB, typically 80 dB (50 Hz – 500 Hz)
RF filter	Common mode: 425 kHz Differential mode: 142 kHz
TIM filter	<80 kHz, integral to signal processing
Nominal input sensitivity	0 dB V (1 V rms, 1.4 pk) continuous is typically the onset of TPL limiting for noise and music.
Input level	Audio source must be capable of producing a minimum of +20 dBV (10 V rms, 14 V pk) into 600 Ω in order to produce maximum peak SPL over the operating bandwidth of the loudspeaker
AMPLIFIERS	
Amplifier type	Complementary power MOSFET output stages (class AB/H)
Output power	3935 W (four channels; 3 x 1125 W, 1 x 560 W)
	Note: Wattage rating is based on the maximum unclipped burst sine-wave RMS voltage that the amplifier will produce into the nominal load impedance: low/low-mid and very-high channels 67 V rms (95 pk) into 4 ohms; mid-high channel 67 V rms (95 V pk) into 8 ohms.
THD, IM TIM	< .02%
Load capacity	4 Ω low, mid and very high channels; 8 Ω high channel
Cooling	Forced air cooling, 4 fans total (2 ultrahigh-speed reserve fans)
AC POWER	
AC power connector	250 V AC NEMA L6-20 (twistlock) inlet, IEC 309 male inlet, or VEAM all-in-one connector (integrates AC, audio and network)
Voltage selection	Automatic, two ranges, each with high-low voltage tap (uninterrupted)
Safety agency rated operating voltage	95 V AC – 125 V AC, 208 V AC - 235 V AC, 50/60 Hz
Turn on/turn off points	85 V AC – 134 V AC; 165 V AC - 264 V AC
Current Draw	
Idle current	1.1 A rms (115 V AC), 0.55 A rms (230 V AC), 1.3 A rms (100 V AC)
Max. long-term continuous current (>10 sec)	11.2 A rms (115 V AC), 5.6 A rms (230 V AC), 12.9 A rms (100 V AC)
Burst Current (<1 sec)	14.4 A rms (115 V AC), 7.2 A rms (230 V AC), 16.6 A rms (100 V AC)
Note: AC power cabling must be of sufficient gauge so that under burst current RMS conditions, cable transmission losses do not drop voltage below specified operating range at the speaker.	
Ultimate Short-Term Peak Current Draw	32 A rms (115 V AC), 16 A rms (230 V AC), 37 A rms (100 V AC)
Inrush Current	7 A rms (115 and 110 V AC), 10 A rms (230 V AC)
RMS NETWORK	
	Equipped for two conductor twisted-pair network, reporting all operating parameters of amplifiers to system operator's host computer.

PHYSICAL	
Enclosure	Multi-ply hardwood
Finish	Black textured
Protective grille	Powder-coated hex stamped steel
Rigging	QuickFly MRF-MILO rigging frame, custom AlignaLink connectors and quick release pins
Dimensions	54.00” W x 14.47” H x 22.00” D (1372 mm x 368 mm x 559 mm)
Weight	235 lbs (106.60 kg)



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