# MILO 120 High-Power Expanded Coverage 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 120 Loudspeaker

conforms to the following Product Specifications

| | |
|---|---|
| **Safety:** | EN60065: 1998 |
| | IEC60065: 1998 |
| **EMC:** | EN55103-1: 1997 emission[1] |
| | EN55103-2: 1997 immunity[2] |

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
June 22, 2004

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

3K59 COMMERCIAL AUDIO SYSTEM
US LISTED

N775



MILO 120 Expanded Coverage High-Power Curvilinear Array Loudspeaker Operating Instructions

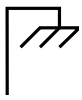


Printed in the U.S.A.

Part Number: 05.142.003.01 A

## 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

These operating instructions provide important information about the form, features, function and specifications of the MILO 120 high-power expanded coverage curvilinear array loudspeaker. In addition to power requirements and audio characteristics, fundamental line array design, useful software tools and rigging options for the MILO 120 loudspeaker are discussed.

**Chapter 1: Introducing MILO 120 Loudspeaker** provides a general description of MILO 120 and its capabilities and functionality.

**Chapter 2: Power Requirements** discusses power distribution, voltage and current requirements, as well as electrical safety issues.

**Chapter 3: Amplification and Audio** will help you understand and harness the power of the MILO 120 amplifier and audio systems. Amplifier specifications, connectivity, limiting and cooling system components are all covered.

**Chapter 4: RMS Remote Monitoring System** introduces you to the RMS communications module in the MILO 120 amplifier, enabling you to make use of Meyer Sound's RMS remote monitoring system.

**Chapter 5: Line Arrays and System Integration** will walk you through the integration of the MILO 120 in mid-high or full-range line array systems.

**Chapter 6: System Design and Integration Tools** covers two comprehensive tools — Meyer Sound MAPP Online® and SIM® — for assisting you with the acoustical and functional requirements of system design and optimization.

**Chapter 7: QuickFly® Rigging** shows you the QuickFly rigging components available for use with MILO 120, including the MILO 120-I insert.

**Appendix A: Amplifier Replacement and Optional Rain Hood** discusses the procedure for replacing the MILO 120 amplifier and rain hood.

**Appendix B:** Specifications lists the audio, power and physical specifications for the MILO 120 loudspeaker and the physical specifications of the MIO 120-I insert.

## 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 icons that flag important information or warn you against improper or potentially harmful activities. These icons include:

A **NOTE** identifies an important 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.

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:

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Fax: +1 510 486.8356

Email: techsupport@meyersound.com

# CHAPTER 1: INTRODUCING THE MILO 120 LOUDSPEAKER

A variation on the popular MILO high-power curvilinear loudspeaker, the MILO 120 high-power expanded coverage curvilinear array loudspeaker excels where wide horizontal and increased vertical coverage are needed.

*Figure 1.1. MILO 120 high-power expanded coverage curvilinear array loudspeaker*

The self-powered MILO 120 is a compact, lightweight four-way system that provides 120 degrees of horizontal and 20 degrees of vertical coverage. The MILO 120 expanded coverage pattern is optimized for medium to near field applications, making it the perfect downfill complement for standard MILO or M3D line array loudspeaker systems. MILO 120 can also be used to form wide coverage arrays or in other fill applications that can be satisfied by one or two cabinets.

As part of the M Series, the MILO 120 loudspeaker comes standard with Meyer Sound's RMS™ remote monitoring system. The MILO 120 shares the same dimensions as the standard MILO cabinet to facilitate seamless integration with MILO and existing MILO QuickFly® rigging accessories, like the MG-3D/M multipurpose grid and MCF-MILO caster frame. The flexibility of MILO 120 also allows it to be configured with other Meyer Sound loudspeakers in complex systems.

MILO 120 produces a peak output of 138 dB SPL with exceptionally flat phase and frequency response. Its wide operating frequency range (60 Hz to 18 kHz) is complemented by extended high-frequency headroom and a dedicated very-high frequency section (4.2 kHz to 18 kHz) that renders delicate transient information with detailed resolution through its wide coverage pattern. The MILO 120 loudspeaker's acoustical characteristics are designed to facilitate seamless integration when used with other MILO curvilinear elements.

MILO 120's greater vertical coverage dictates larger splay angles between cabinets, which is accommodated by dedicated AlignaLinks, allowing the angle to be set in 2-degree increments between 13 and 19 degrees. Due to the larger splay angles, the use of the MILO 120-I insert is recommended between cabinets (Figure 1.2).

*Figure 1.2. MILO 120 and MILO 120-I insert*

The optional MILO 120-I insert can be fitted to enhance the appearance of arrays which include the MILO 120, and also provide acoustical benefits that allow MILO and MILO 120 cabinets in the same array to be fed with identical signals, with no additional equalization.

The weather-protected version of MILO 120 includes comprehensive weather protection to suit frequent use in inclement outdoor applications as well as permanent installations.

MILO 120 can serve as a component in scalable systems including any combination of MILO, M3D, M3D-Sub and select Concert Series models.

*Figure 1.3. MILO 120 is easily deployed with MILO arrays as downfill*

For example, MILO 120 can be used as downfill with the MILO curvilinear array loudspeaker for large venue applications. It can be also used to create curvilinear arrays in situations where wide horizontal and vertical coverage are needed while the longer throw of MILO is not, as well as in small arrays of one or two cabinets for sidefill coverage where needed.

In addition, by integrating Meyer Sound M3D-Sub directional subwoofers (Figure 1.4) with a MILO/MILO-120 system (MILO, MILO 120 and M3D/M3D-Sub cabinets are identical in width), you can easily augment bass power with real depth while extending low-frequency bandwidth and headroom.

*Figure 1.4. The MILO 120 integrates easily with M3D-Sub subwoofers.*

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.

In applications where M3D-Sub features like directional low-frequency control are not needed, a MILO/MILO 120 array can be deployed in combination with Meyer Sound 700-HP ultrahigh-power subwoofers. The 700-HP subwoofer extends the MILO/MILO 120 system frequency response down to 30 Hz.

**NOTE:** MILO 120 can also be used with other Meyer Sound subwoofers, including the 650-P high-power subwoofer.

## RIGGING AND TRANSPORT

MILO 120's QuickFly rigging employs rugged, reliable and user-friendly components that remain captive in transit. Custom front and rear AlignaLinks at the cabinet corners couple the units for flying or stacking, and allow from 13 to 19 degrees of cabinet splay adjustable in two-degree increments.

**NOTE:** Optimal acoustical performance for MILO 120 loudspeakers is achieved by using angles between 13 and 19 degrees between cabinets; avoid using angles outside this range.

Because rigging connections are rigid, 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. The MG-3D/M multipurpose grid accommodates multiple hanging configurations for up to 24 MILO/MILO 120 loudspeakers (or the equivalent weight of MILO, MILO 120, M3D, M3D-Sub or any other relevant combination). The MG-3D/M grid allows multipoint support and bridles and ground stacks of up to five MILO 120 cabinets and corresponding MILO 120-I inserts.

MILO 120 is truck-smart: Its exterior cabinet dimensions are ideal for both European and US truck widths, while its AlignaLinks are fully compatible with the optional MCF-MILO caster frame — allowing you to transport stacks of MILO 120, with or without the MILO 120-I insert, and facilitating the use of forklifts.

**NOTE:** Rigging accessories for MILO 120 are the same as for MILO and are illustrated in Meyer Sounds MG-3D/M Assembly Guide (PN 05.132.036.01).

## INTEGRATED AMPLIFIER AND PROCESSING

As a self-powered loudspeaker, MILO 120 incorporates a very high power, 4-channel, class AB/H power amplifier and sophisticated control circuitry — all housed within the cabinet — dramatically simplifying setup and installation.

MILO 120's on-board amplifier delivers 3560 watts total burst power. TruPower® limiting (see Chapter 3 for more information) extends the life of the 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 to 6 dB for conventional systems).

This 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. The MILO 120 loudspeaker 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 120 was created specifically as a modular, flexible design solution to complement high-power systems in medium to large venues. The MILO 120 loudspeaker is a four-way design. The lowest frequency range, from 60 Hz to about 180 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 120 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 120 employs two REM™ ribbon emulation manifolds for the separate mid-high and very-high frequency sections, each coupled to individual 120-degree horizontal constant-directivity horns. REM is a patented coupling device that introduces driver output to the horn throat across a very short path (3 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 120'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 two highly efficient, 0.75-inch exit, 2-inch diaphragm compression drivers to produce power and clarity, and extend operating frequency range up to 18 kHz. Power for the very high-frequency section is supplied by a dedicated 750-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.

**TIP:** 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/MILO 120 loudspeakers.

# CHAPTER 2: POWER REQUIREMENTS

The self-powered MILO 120 is advanced loudspeaker technology with equally advanced power capabilities. Understanding MILO 120's power distribution, voltage and current requirements, as well as electrical safety issues, is critical to the safe and correct operation and deployment of the MILO 120 loudspeaker.

## AC POWER

When AC power is applied to the MILO 120 loudspeaker, the Intelligent AC power supply automatically selects the correct operating voltage, allowing MILO 120 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 120 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 120 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 120 does not require a dedicated neutral, it can tolerate elevated voltages from ground and can be connected between line-line terminals in a 120 V 3-phase Wye system. This results in 208 V AC between lines (nominal) and will therefore draw less current for the same output power compared to operating MILO 120 from 120 V AC (line-neutral). Make sure that the voltage remains within the 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 120 uses a NEMA L6-20P, an IEC 309 male power connector or a multi-pin 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 2.1 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.

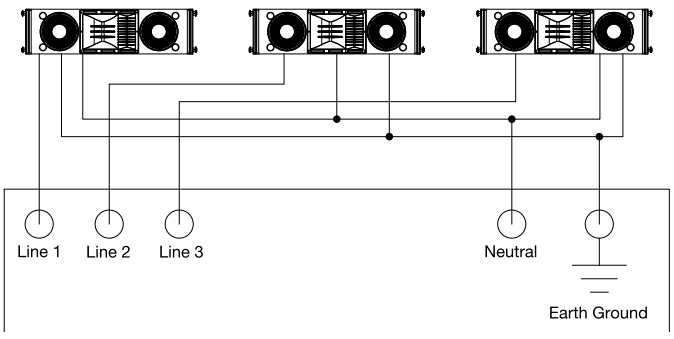



*Figure 2.1. A sample AC power distribution block diagram*

**NOTE:** Refer to Appendix B for details on the MILO 120 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 10 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 120 uses stored energy to continue functioning briefly, and shuts down only if voltage does not rise above the low boundary before MILO 120's storage circuits are depleted. How long MILO 120 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 120 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 120 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 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 120 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 approximately 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 2.1 below as a guide when selecting cable gauge size and circuit breaker ratings for your operating voltage.

**Table 2.1: MILO 120 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/MILO 120 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 on the user panel 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 120 loudspeaker requires a grounded outlet. It is very important that the system be properly grounded in order to operate safely and properly. Figures 2.2, 2.3, and 2.4 illustrate correct wiring for the creation of power cables and distribution systems.

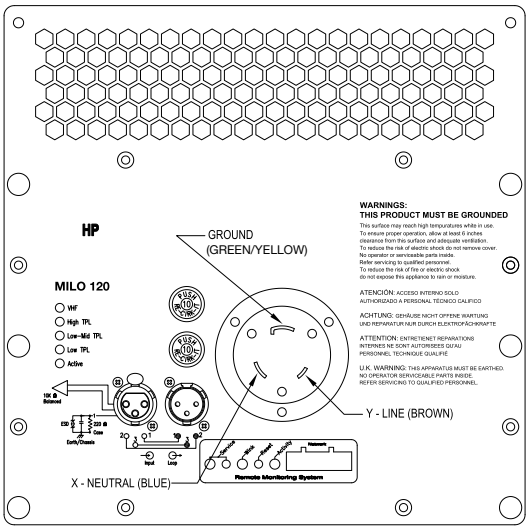



*Figure 2.2. MILO 120 user rear panel with L6-20 power connector*

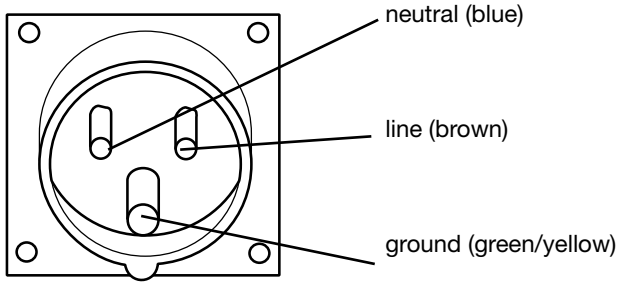



*Figure 2.3. IEC 309 power connector pin-out*

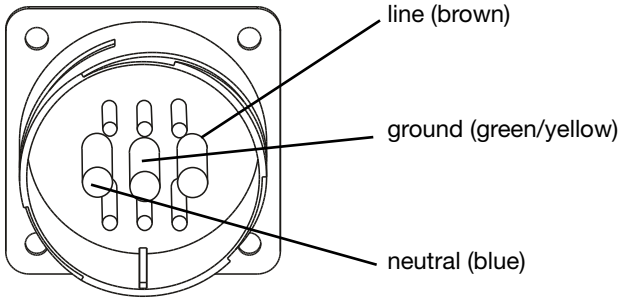



*Figure 2.4. VEAM multi-pin connector power pin-out*

If your MILO 120 loudspeaker is fitted with the VEAM multi-pin 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 120 loudspeakers fitted with VEAM connectors, as shown in Figure 2.5.

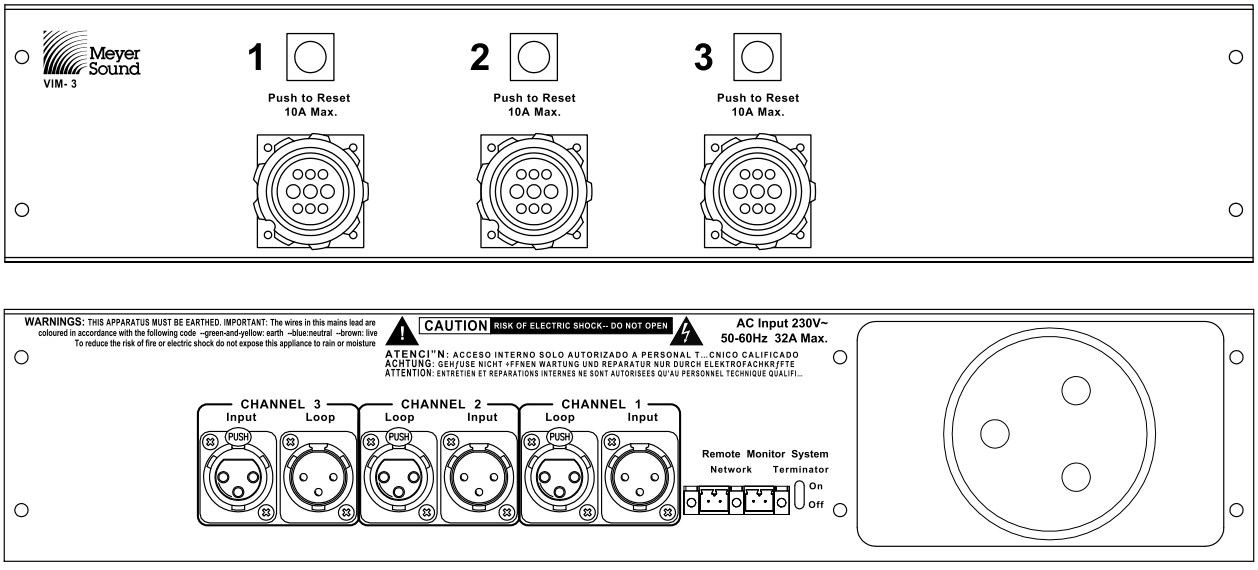
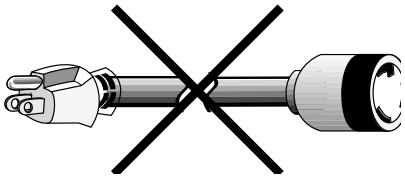



*Figure 2.5. VIM-3 module, front (top) and rear (bottom)*

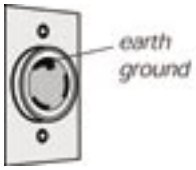
## ELECTRICAL SAFETY ISSUES

Pay close attention to these important electrical and safety issues.

**CAUTION:** Do not use a power cord adapter to drive the MILO 120 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 120 loudspeaker requires a ground connection. Always use a grounded outlet and plug.





**TIP:** Use the ring located on the rear of MILO 120's cabinet (to the right of the amplifier) to provide strain relief for power and signal cables. Do not use this ring for any other purpose.

# CHAPTER 3: AMPLIFICATION AND AUDIO

More than just a self-powered loudspeaker, MILO 120 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 120's amplifier and audio systems.

## AUDIO INPUT

The MILO 120 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/ MILO 120 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/MILO 120 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 hissing and popping are produced by the loudspeaker, disconnect the audio cable from the loudspeaker. If the noise stops, 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 120 loudspeaker (Figure 3.1). A single source can drive multiple MILO/MILO 120 loudspeakers with a paralleled input loop, creating an unbuffered hard-wired loop connection.

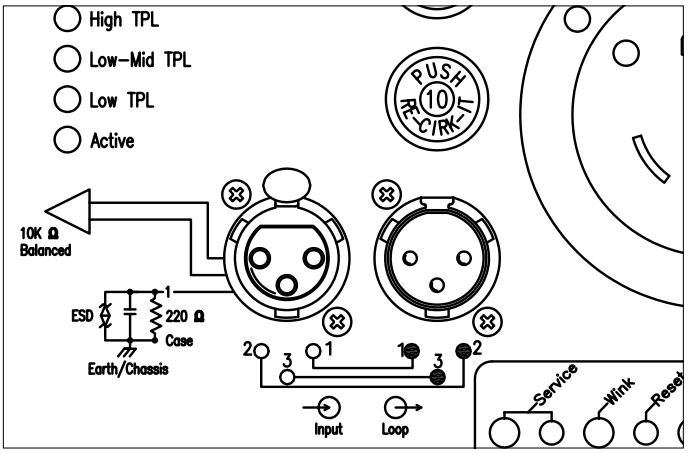



*Figure 3.1. MILO 120's rear panel audio input connectors*

When driving multiple MILO/MILO 120 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/MILO 120 loudspeaker is 10 kOhms: if n represents the number of MILO/MILO 120 loudspeakers in an array, paralleling the inputs of n MILO/MILO 120 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/MILO 120 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/MILO 120 loudspeakers in parallel (loop out) with other self-powered Meyer Sound loudspeakers, for example M3D, M3D-Sub, 700-HP, or 650-P models.

**NOTE:** Meyer Sound 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/MILO 120 array performance.

**NOTE:** For details on audio input characteristics and amplification, see Appendix B.

## AMPLIFICATION AND PROTECTION CIRCUITRY

MILO 120 is powered by the Meyer Sound HP-4/MILO 120 amplifier, a high-power four-channel amplifier (1125 watts/channel with 4-ohm loads, 750 watts with 6-ohm loads and 560 watts with 8-ohm loads) with a total power of 3560 watts. The HP-4/MILO 120 amplifier utilizes complementary MOSFET output stages (class AB/H). All the specific functions for the MILO 120 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 120 INTERCONNECTIONS

Each front 4-ohm, 12-inch, low-frequency cone driver is powered by one 1125-watt channel of the HP-4/MILO 120 amplifier. The single 4-inch diaphragm, 8-ohm high-frequency compression driver is powered by a single 560 watt channel and the two 2-inch diaphragm, 12-ohm very high-frequency compression drivers share the fourth 750-watt channel. Figure 3.2 shows how MILO 120's drivers are connected to the amplifier.

**NOTE:** For details on replacing the HP-4/MILO 120 amplifier see Appendix A.

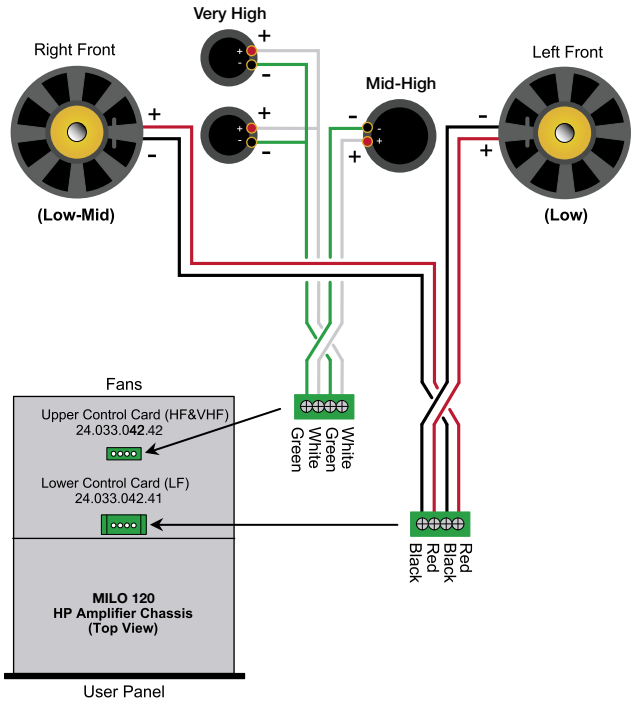



*Figure 3.2. MILO 120 internal wiring harness diagram*

**CAUTION:** Please note that MILO 120 and MILO amplifiers are different. Specific functions for each model, such as crossover points, frequency and phase correction and driver protection are determined by the control cards installed inside the amplifier. Do not exchange amplifiers between MILO and MILO 120 loudspeakers.

## CABLING

MILO 120 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 120 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 120 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 optional rain hood's side flaps if installed), and tie the cables off to the ring/stud fitting, as shown in Figure 3.3.

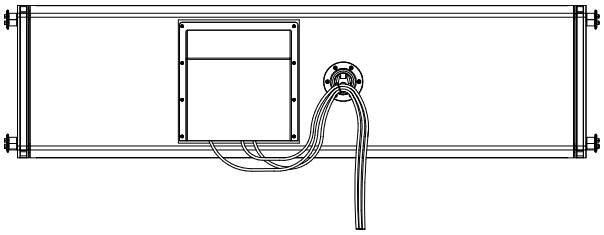


*Figure 3.3. Cables are easily tied off using the rear ring/stud fitting (figure shows optional rain hood installed).*

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

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

In addition, TruPower limiting 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 120's four amplifier channels. When the safe continuous power level is exceeded, the TruPower limiter controlling that amplifier channel engages. TruPower limiting activity is indicated by the LEDs on the user panel (Figure 3.4). The very-high frequency channel is controlled by a sophisticated average and peak voltage limiter.

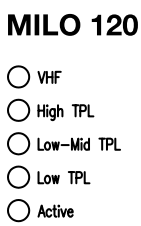



*Figure 3.4. MILO 120 Limit LEDs*

### Low- and Mid-Frequency Limiters

The MILO 120 loudspeaker'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 TruPower 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 TruPower 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 TruPower limiting activity.

## Very-High Frequency Limiters

The two 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.

**NOTE:** 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 not lit.

MILO 120 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/MILO 120 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 120 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 3.5).

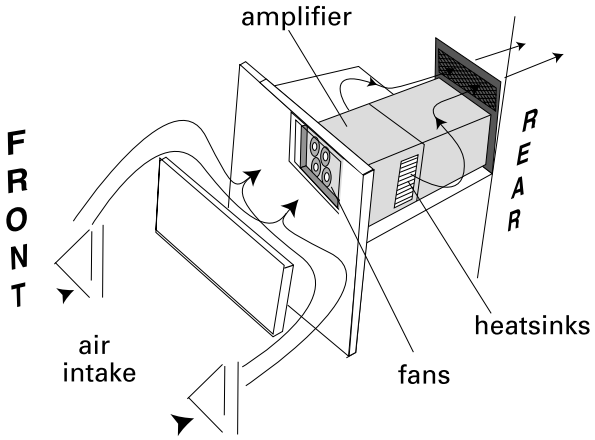



*Figure 3.5. Airflow through MILO 120*

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 120 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 120 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 120 loudspeaker automatically shuts down until AC power is removed and reapplied. If the MILO 120 loudspeaker shuts down again after cooling and reapplying AC power, contact Meyer Sound for repair information.

Despite 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 120 loudspeakers, the foam covering the horns should also be cleaned with compressed air.

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

# CHAPTER 4: RMS REMOTE MONITORING SYSTEM

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. MILO 120 is RMS-ready and fitted standard with an RMS communication board installed in its HP-4/MILO 120 amplifier.

Optional RMS software delivers extensive status and system performance data from every installed loudspeaker, allowing 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 loudspeaker 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 120'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 120 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. 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 4.1.

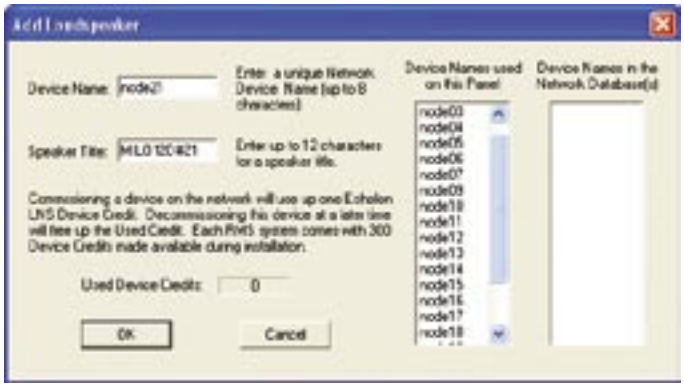



*Figure 4.1: Commissioning a MILO 120 loudspeaker using RMS.*

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 120 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.

MILO 120 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 4.2). This makes verifying Loudspeaker View titles and Loudspeaker Field labels easy, using the Wink or Service Button commands.


*Figure 4.2: MILO 120 RMS icon*

## UNDERSTANDING THE RMS USER PANEL

The RMS section of the user panel has three LEDs and two buttons (Figure 4.3).

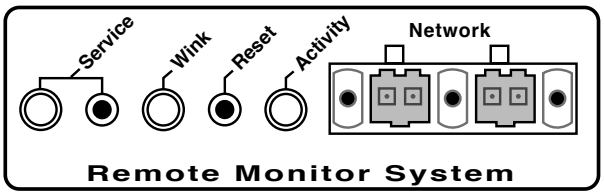



*Figure 4.3: The RMS user panel*

**NOTE:** The LEDs and buttons on the user panel of the RMS communication board shown in Figure 4.3 are used exclusively by RMS, and have no effect on the acoustical and/or electrical activity of the MILO 120 loudspeaker itself – unless MUTE or SOLO is enabled at the board and from the RMS software.

The following section describes 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.

## 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 4.4, 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 4.4: Sample RMS display panel showing MILO, MILO 120 and M3D-Sub loudspeakers.*

**NOTE:** For more information on RMS, please refer to the RMS User Guide included with the software.

# CHAPTER 5: 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 precise 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 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.

## MILO 120 CURVILINEAR ARRAY

The MILO 120 loudspeaker employs a unique combination of drivers to enable you to optimize both coverage and directivity in a MILO 120 line array system. To achieve optimal results, it's important to understand how these components work together.

### High Frequencies

For high frequencies, MILO 120 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 120 degrees for MILO 120; in the vertical, however, Meyer Sound's REM technology provides semi-narrow coverage in order to:

- Minimize destructive interference between adjacent elements
- Promote 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.

Curving a line array can aid in covering a broader vertical area, while narrow angles provide a longer throw and coverage that more closely matches that of the mid-low frequencies.

MILO 120 has been specifically designed to achieve wider vertical angles, therefore the angles between the cabinets should be larger than conventional line arrays, optimally between 13 and 19 degrees. This will give a very broad coverage area. However, due to these larger angles the coupling will be affected and the throw will not be as long as with other line arrays such as MILO or M3D.

**NOTE:** Optimal acoustical performance for the MILO 120 loudspeaker is achieved by using angles of between 13 and 19 degrees between cabinets. Avoid using angles outside this range. If the angles are less than 13 degrees, too much interaction will occur between cabinets, degrading the response of the system at high frequencies.

**NOTE:** Due to the larger splay angles, the use of the MILO 120-I insert is highly recommended between cabinets to allow MILO and MILO 120 cabinets in the same array to be fed with identical signals, with no additional equalization.

## Mid to Low Frequencies

For the mid to low frequencies, line arrays must be coupled to narrow their vertical coverage and project mid and low energy to the far field. The directional control of the array is achieved when the length of the array is similar to or larger than the wavelength of the frequencies being reproduced by the array. As frequencies get lower and wavelengths get longer, the number of cabinets has a critical effect while the splay angle between cabinets has little effect since the total length is not modified substantially. The number of array elements, however, is important: The more MILO 120 loudspeakers used, the more directional the vertical beamwidth becomes at mid to low frequencies.

## Adjusting Line Array Coverage

Regardless of the needs of your system design, fine-tuning coverage for a MILO 120 curvilinear array will be dependent on three factors:

- **Number of Array Elements**. Determining the number of elements to use is critical: The number of elements drastically affects 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 of MILO 120 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 in the horizontal plane 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 guides) built into each MILO 120 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 and in Chapter 6, is the tool of choice to enable you to make accurate and comprehensive predictions for optimal coverage(s) during the design phase.

## USING MILO 120 AS DOWNFILL FOR MILO CURVILINEAR ARRAYS

MILO 120 acoustical characteristics and rigging are designed to facilitate seamless integration with MILO when used as downfill in MILO curvilinear arrays. Understanding the differences and similarities between the two loudspeakers is very important for fine-tuning system coverage. For a combined MILO/MILO 120 array, the design will be dependent on three factors:

- **Number of Array Elements**. Determining the number of elements of each type to use is critical: The number of elements drastically affect the uniformity of coverage of both SPL and frequency response. The number of long-throw elements (MILO) and downfill (MILO 120) needs to be carefully selected.
- **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 and longer throw in the top elements (MILO), while wider splay lowers the Q at high frequencies for wider coverage on the lower elements (MILO 120).
- **Horizontal Coverage**. Horizontal coverage needs to be divided in two sections. The top section covered by MILO (90 degrees) and the lower section covered by MILO 120 (120 degrees). These two sections can be considered fairly constant regardless of the number of array elements on each section or the angles between them.

With two different technologies (low-frequency cone radiators and high-frequency wave guide) built into each cabinet and two different cabinet types (MILO and MILO 120), achieving design goals becomes a multi-step process, with different strategies for the lower and higher frequencies for long and short throws.

**NOTE:** MAPP Online 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 deciding the number and type of elements and fine-tuning the splay angles between cabinets. 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 vertical coverage and throw capabilities of the array.

For the far field, a smaller mechanical splay angle between cabinets achieves superior throw through better coupling to compensate for energy lost over distance. The longer the throw needed, the more elements needed with smaller angles at the top of the array.

In the near- to mid-field, larger splay angles increase vertical coverage. It is very important to use the correct number of long throw devices (MILO) and short wider-throw downfill(s) (MILO 120). The angles used between cabinets depends on the application.

**NOTE:** For a smooth transition between MILO and MILO 120 cabinets, you must use between 13 (optimal for most applications) and 15 degrees (maximum) splay. Larger angles can create a hole in the coverage and smaller angles can create too much interaction.

**NOTE:** Due to the larger splay angle needed between a MILO and a MILO 120, the use of the MILO 120-I insert is highly recommended between cabinets. The MILO 120-I insert promotes better acoustic coupling between cabinets in the vertical plane, as well as providing an improved appearance for the array.

## Low-Frequency Design Strategies

While waveguides provide isolated control over various mid- to high-frequency coverage areas, the low-frequency section of a MILO/MILO 120 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. The directional control of the array is achieved when the length of the array is similar or larger than the wavelength of the frequencies being reproduced by the array.

## Electronically Driving the Array

Once the design (number and type of elements, vertical splay angles and horizontal splay angles between arrays) has been designed using MAPP online, 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/MILO 120 line array uses a third zone for short throws, high frequencies in that zone may need to be attenuated to more appropriate near-field levels.

### *Low-Frequency Equalization 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, severe 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 at low frequencies.
2. Low-frequency headroom decreases.
3. The length of the line array column is effectively shortened.

Figure 5.1 on the following page shows a series of MAPP Online predictions based on an example MILO/MILO 120 system design. In this case, small vertical splay angles on the upper part of the array for MILO are used to cover longer distances, while greater angles for MILO 120 are used in the lower elements to increase vertical coverage for shorter distances.

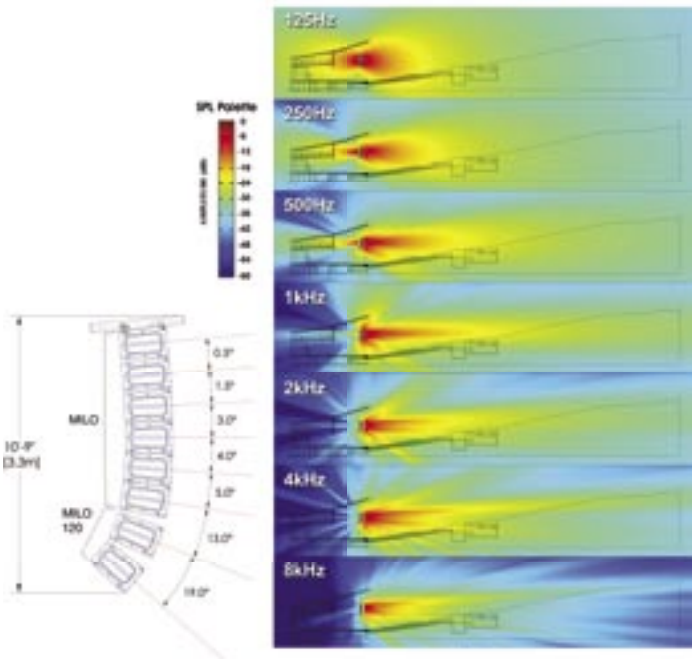



*Figure 5.1. MAPP Online plots on the right illustrate the vertical directivity characteristics of the array on the left, with a section view of the venue superimposed.*

The block diagram (Figure 5.2) shows one method of driving this example array, along with subwoofers (not in the MAPP Online predictions).

Equalizers for each zone, as well as digital delays, provide frequency and time adjustment to compensate for the various sub-systems if they are geometrically out of plane. For example, flown array and ground-stacked subs.

**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.

### *LD-3 Compensating Line Driver*

In addition to its unique atmospheric correction for high frequencies and low-frequency compensation capabilities, Meyer Sound's LD-3 air attenuation compensating line driver (Figure 5.3) can be used effectively to integrate subwoofers in a design with MILO/MILO 120 arrays.

*Figure 5.3. The LD-3 compensating line driver*

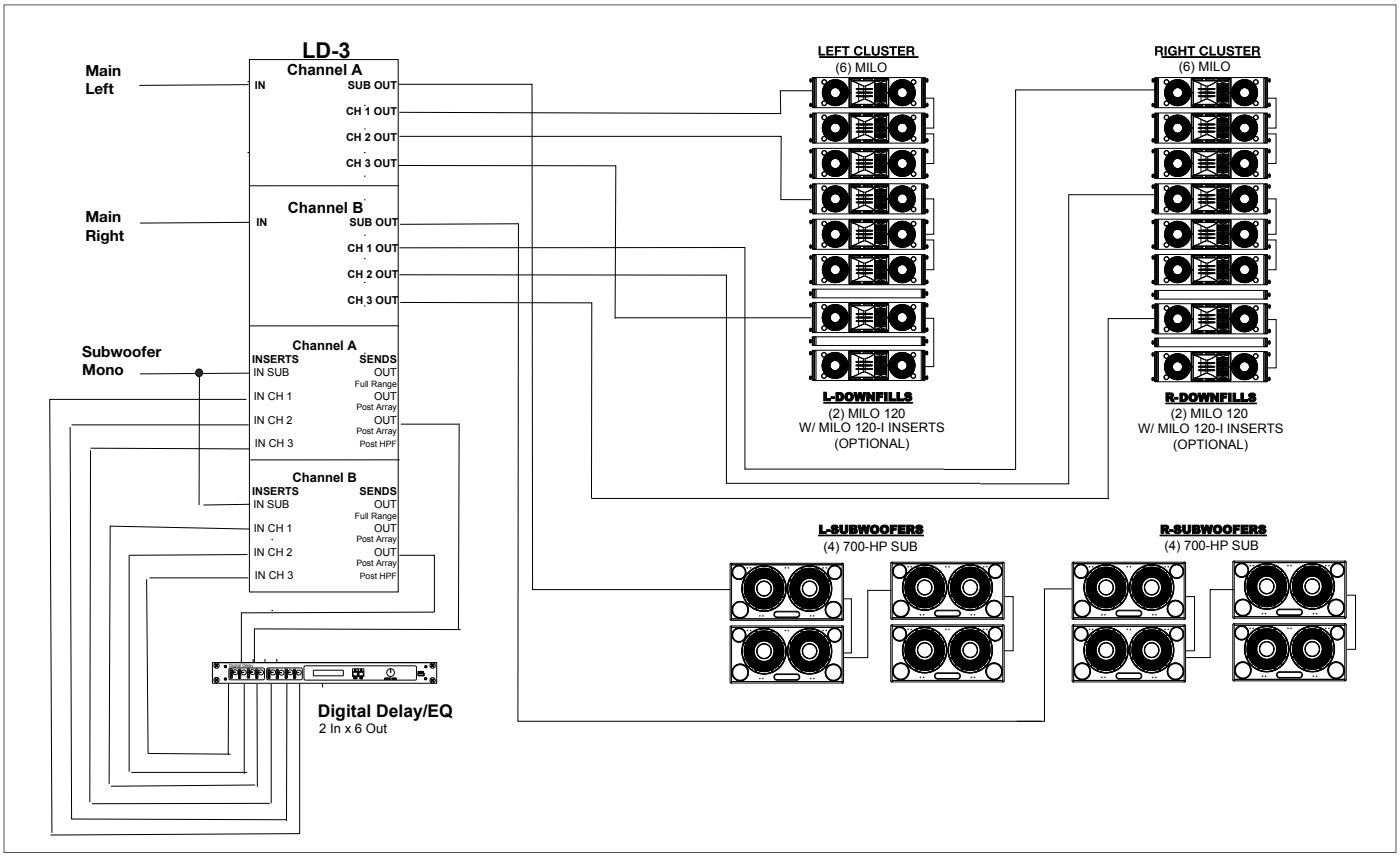



*Figure 5.2. Sample block diagram of MILO, MILO 120, 700-HP system*

**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 was specifically designed to allow you to follow these strategies:

- The array can be divided into a maximum of three zones.
- The LD-3's atmospheric correction capabilities compensates for the air absorption of the air at high frequencies. Each section allows different correction settings according to the distance each section's intended coverage.
- The LD-3 effectively manages low-frequency build-up in the array and corrects all three zones equally.

## USING MILO/MILO 120 WITH SUBWOOFERS

A MILO/MILO 120 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/MILO 120 loudspeaker array(s).

Meyer Sound subwoofers, such as the M3D-Sub and 700-HP, 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/MILO 120 system with subwoofers increases the headroom of the array in the lowest end of its usable spectrum.

The ideal ratio of MILO/MILO 120 loudspeakers to subwoofers depends on two factors:

- Configuration of the array and if the subwoofers are flown or ground-stacked
- Frequency content of the signal being reproduced by the system

For most applications, two MILO/MILO 120 loudspeakers for each subwoofer yields good results in frequency response and headroom. Using higher ratios (for example, three MILO/MILO120 cabinets for one subwoofer) can have very negative consequences, decreasing the headroom in the low frequencies and exposing the drivers on the subwoofers to excessive level.

**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.

Using the LD-3's filters helps to easily integrate and optimize your MILO/MILO 120 arrays with subwoofers. The use of high-pass filters augment array headroom by removing lower frequencies near the unit's lower operating range, while low-pass filters can remove unwanted mid-low frequencies reproduced by the subwoofers. The use of these filters reduces the area of overlap and minimizes the interaction and possible cancellations between subsystems.

**NOTE:** Full-range signals may be applied to Meyer Sound's self-powered loudspeakers and subwoofers because they have built-in active crossovers. However, the use of external filters – like the ones in the LD-3 – is optional, and should be used very carefully to minimize phase shifts that can cause cancellations.

### MILO/MILO 120 and the M3D-Sub

The M3D-Sub directional subwoofer, shown in Figure 5.4, adds substantial low-frequency headroom to a MILO/MILO 120 array, extending the system frequency response to 30 Hz.

*Figure 5.4. The M3D-Sub directional subwoofer*

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/MILO 120 since they share the same width.

**NOTE:** For most applications, you want to keep low frequencies from being produced behind the array 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 6 to 12 meters behind the cabinet (-20 dB at 8 meters).

Table 5.1 shows how you can integrate MILO/MILO 120 with M3D-Sub using the LD-3's filtering capabilities to fine-tune the system. All data in Table 5.1 is based on designs with a 2:1 ratio and in a close-proximity, coplanar orientation.

**NOTE:** When loudspeakers and subwoofers are separated by more than 4 feet – or delay must be used between them – a measurement system such as the SIM audio analyzer (covered in chapter 6) should be used to determine the correct delay and polarity.

**Table 5.1: MILO/MILO 120 and M3D-Sub**

| HPF | LPF | Ø Reverse Switch | Result |
|---|---|---|---|
| 80 | 80 | Engaged | Flat response |
| 80 | Off | Engaged | Flat response |
| 160 | Off | Engaged | Very flat response |
| Off | Off | Off | Boost in the 80 Hz region |

## MILO/MILO 120 and the 700-HP Subwoofer

In applications where M3D-Sub features like directional low-frequency control are not needed, a MILO/MILO 120 array can be deployed in combination with Meyer Sound 700-HP subwoofers (Figure 5.5). The 700-HP subwoofer extends the MILO/MILO 120 system frequency response down to 30 Hz.

*Figure 5.5. The 700-HP ultrahigh-power subwoofer*

The Table 5.2 show how you can integrate MILO/MILO 120 with a subwoofer like the 700-HP using the LD-3's filtering capabilities to fine-tune the system. All data in Table 5.2 is based on designs with a 2:1 ratio and in a close-proximity, coplanar orientation.

**NOTE:** When loudspeakers and subwoofers are separated by more than 4 feet – or delay must be used between them – a measurement system such as the SIM audio analyzer (covered in chapter 6) should be used to determine the correct delay and polarity.

**Table 5.2: MILO/MILO 120 and 700-HP Subwoofer***

| HPF | LPF | Ø Reverse Switch | Result |
|---|---|---|---|
| Off | Off | Engaged | Boost in the 100 Hz region |
| 160 | Off | Engaged | Very flat response |
| 80 | 80 | Off | Very flat response |
| 160 | 80 | Off | Flat response |

**NOTE: Because the 700-HP and the 650-P subwoofers have identical phase on their operating range, this table also applies when using the 650-P subwoofer. However, due to the higher output and headroom of the 700-HP, when using the 650-P a lower ratio must be used to achieve the same system headroom, e.g., three MILO/MILO 120 with two 650-P.*

## 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 120 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 MILO 120 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/LD-3 characteristics themselves, as shown in Table 5.3.

Table 5.3: LD-1 / LD-2 "Lo-Cut Filter" Parameters

| Type | Order | Pole Frequency | Q |
|---|---|---|---|
| High Pass | 2nd (-12 dB/oct) | 162 Hz | 0.82* |

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

**TIP:** All other filters on the LD-3 are parabolic filters with minimal phase shift; most commercially available DSP devices have no presets to emulate the LD-3's parabolic filters.

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, LD-3, CP-10 parametric equalizer and the VX-1 program equalizer are highly recommended.

# CHAPTER 6: SYSTEM DESIGN AND INTEGRATION TOOLS

Meyer Sound offers two comprehensive tools to assist you with the acoustical and functional requirements of system design and optimization. This chapter introduces you to Meyer Sound MAPP Online — a powerful online acoustical prediction tool — and the SIM audio analyzer, a robust instrumentation package for system measurement, analysis, and more.

## MEYER SOUND MAPP ONLINE

MAPP Online (Figure 6.1) 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.

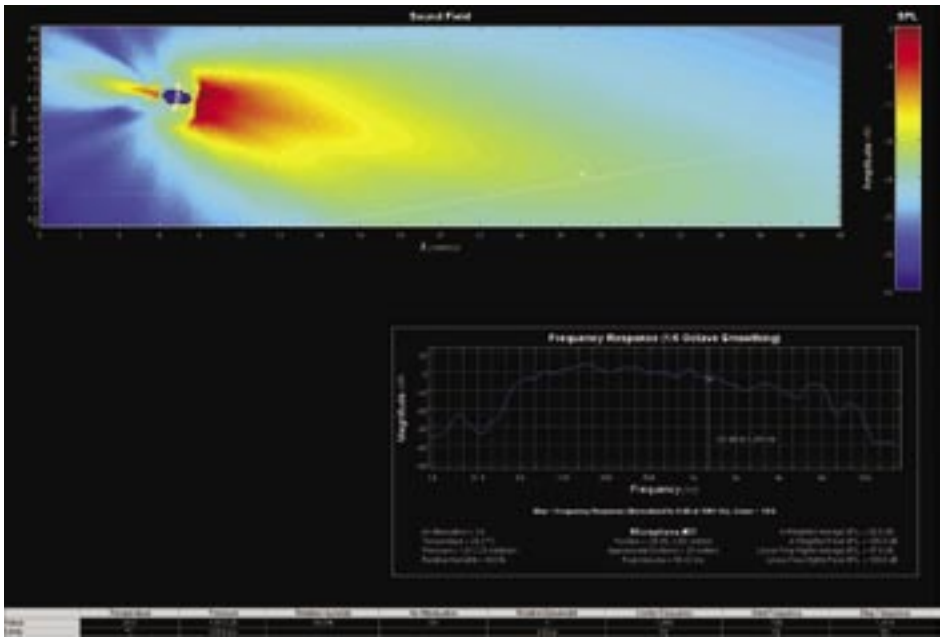


*Figure 6.1. MAPP Online is an intuitive, powerful system design tool.*

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 site listed above. After registration and upon approval, an e-mail will be sent to you with a user name and password along with the address for the Web site 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 on site 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.

## SIM MEASUREMENT SYSTEM

SIM is a measurement and instrumentation system including a selection of hardware and software options, microphones and accessory cables. The SIM audio analyzer is optimized for making audio frequency measurements of an acoustical system with a resolution of up to 1/24 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

The SIM audio analyzer 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

# CHAPTER 7: QUICKFLY RIGGING

MILO 120 features Meyer Sound's QuickFly rigging system with rugged, reliable and simple components. QuickFly facilitates flying or ground stacking MILO 120 loudspeakers in a variety of applications.

**CAUTION:** All Meyer Sound products must be used in accordance with local, state, federal and industry regulations. It is the owner's and/or user's responsibility to evaluate the reliability of any rigging method for their application. Rigging should be carried out only by experienced professionals.

**CAUTION:** Always use properly rated rigging hardware.

**CAUTION:** It is important to inspect rigging hardware regularly and replace worn or damaged components immediately.

## MILO 120 CUSTOM ALIGNALINKS

MILO 120 loudspeakers are designed to be rigged using the same QuickFly accessories as the MILO standard model, including the MG-3D/M multipurpose grid and MCF-MILO caster frame. The MILO 120's custom front and rear AlignaLinks at the cabinet corners couple the units for either flying, stacking or transporting allowing multiple positions.

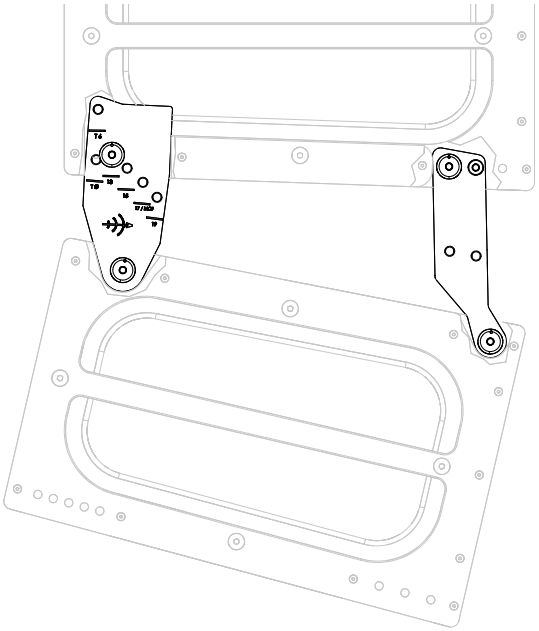


*Figure 7.1. Custom MILO 120 front and rear AlignaLinks*

**NOTE:** The MILO 120 custom AlignaLinks attach to the MILO standard rigging frame. When setting the angles for the MILO 120, use the numbers engraved on the rear AlignaLinks as a guide, and ignore the numbers engraved on the frame.

For flying or stacking, the rear AlignaLinks allow four positions for optimum acoustical performance — from 13 to 19 degrees of cabinet splay (13°, 15°, 17°, 19°) — as shown in Figure 7.2. In addition to the four angle settings, the rear AlignaLinks include two dedicated transport positions and one shared position (17 / MCF) that is used for setting an angle or for transport.

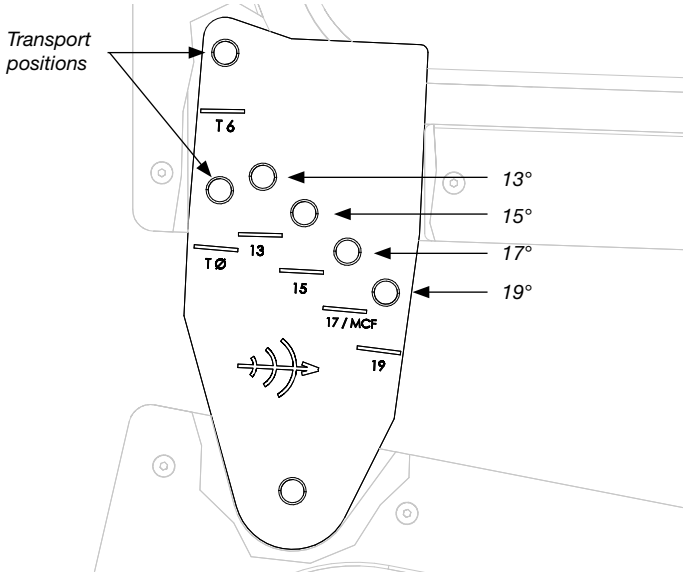



*Figure 7.2. Splay angle and transport settings on the MILO 120 rear AlignaLinks*

**NOTE:** Optimal acoustical performance for MILO 120 is achieved by using angles between 13 and 19 degrees in a MILO 120 array; avoid using angles outside of this range.

The front AlignaLinks include two sets of holes: The top set is used for rigging while the bottom set is for securing the optional MILO 120-I insert (Figures 7.3 and 7.4). This position can also be used when transporting cabinets with the MCF-MILO caster frame, as shown in Figure 7.5.

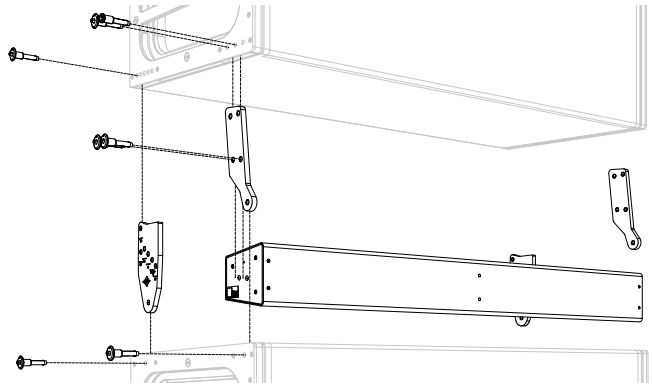


*Figure 7.3. MILO 120-I insert*

**NOTE:** Due to the larger splay angles and distance between the front of the enclosures, the use of the MILO 120-I insert is recommended between cabinets. The MILO 120-I insert promotes better acoustic coupling between cabinets in the vertical plane, as well as providing an improved aesthetic appearance.

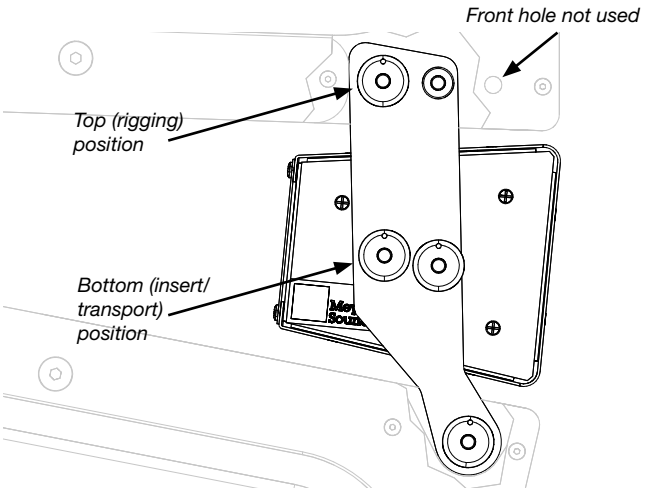



*Figure 7.4. Front AlignaLinks in rigging position, with MILO 120-I*

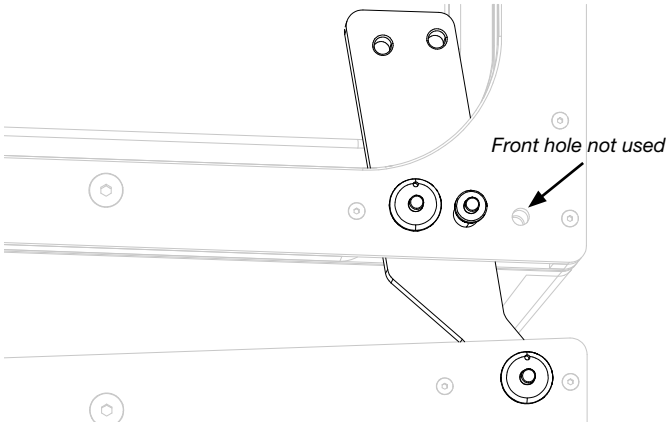



*Figure 7.5. Front AlignaLinks in transport position*

**NOTE:** The front rigging hole in the rigging frame is not used when the MILO 120 front Alignalink is employed.

## MILO 120 As Downfill in MILO/MILO 120 Curvilinear Arrays

The MILO 120 loudspeaker's acoustical characteristics and rigging are designed to facilitate seamless integration when used as downfill in MILO/MILO 120 curvilinear arrays.

To ensure a smooth transition, there must be between 13 (optimal for most applications) and 15 degrees of splay between the last MILO standard and the top-most MILO 120 cabinet in the array. Use the MILO 120 custom AlignaLinks between the two cabinets to achieve these angles.

**NOTE:** Splay angles greater than 15 degrees between MILO standard and MILO 120 create a hole in the coverage, and angles of less than 13 degrees can create too much interaction.

**TIP:** No additional AlignaLinks are required when attaching MILO 120 cabinets underneath a MILO standard array. Simply swap the AlignaLinks of the last MILO standard cabinet for the AlignaLinks of the last MILO 120 cabinet in the array. The standard links (from the last MILO standard on the array) can be used to secure the last MILO 120 cabinet to the MCF-MILO caster frame for transport.

## MG-3D/M MULTIPURPOSE GRID

The MG-3D/M multipurpose grid supports flying and ground stacking multiple MILO/MILO 120 loudspeakers and/or M3D line array loudspeakers (or M3D-Subs) in numerous configurations (Figure 7.6).

**NOTE:** The MLK-MILO link kit is required when using the grid with MILO or MILO 120 loudspeakers, and the MLK-3D is required for M3D and M3D-Sub loudspeakers.

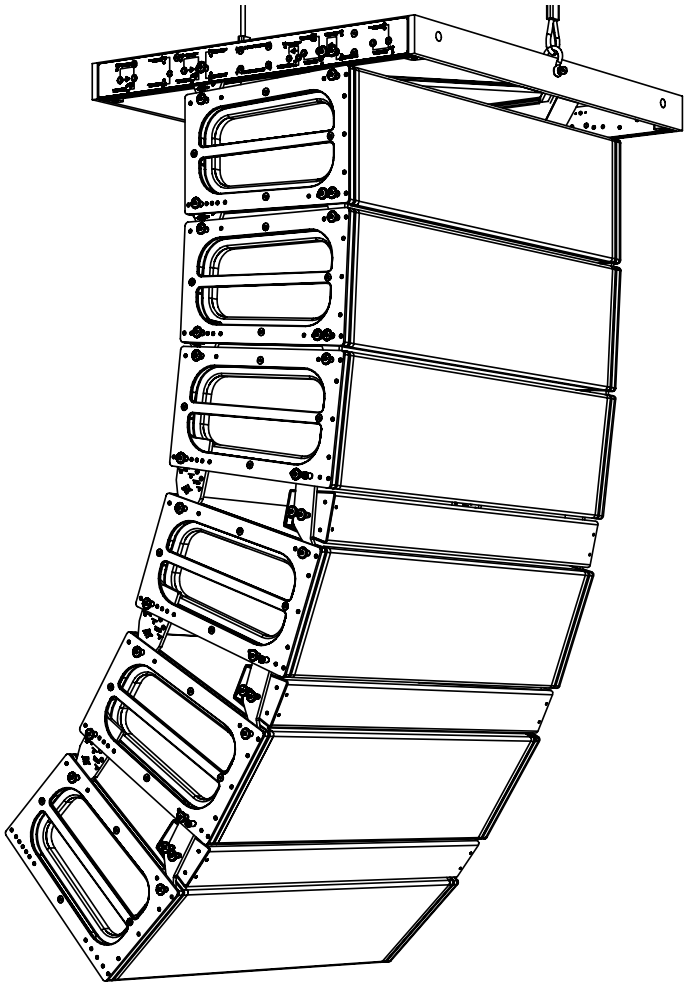


*Figure 7.6. MG-3D/M multipurpose grid supporting a MILO (top three cabinets)/MILO 120 (bottom three) curvilinear array*

**NOTE:** For information on load ratings and how to set up the MG-3D/M, please use the MG-3D/M Multipurpose Grid and Accessories Assembly Guide available at www.meyersound.com.

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.

## MCF-MILO CASTER FRAME

The MCF-MILO caster frame (Figure 7.7) allows you to transport stacks of up to four MILO/MILO 120 cabinets, using the MILO 120 AlignaLinks to secure the cabinets to the caster frame.

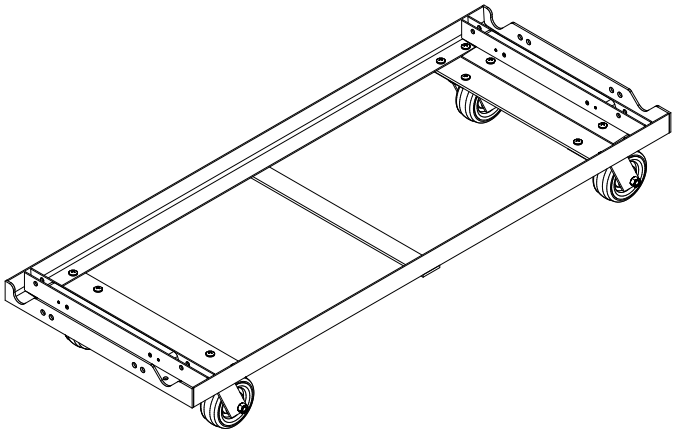


*Figure 7.7. MCF-MILO caster frame*

Whether you're deploying or striking a MILO/MILO 120 array, the MCF-MILO caster frame can support the entire weight of the array — making it easy to assemble or dissemble. The rigid frame also facilitates the use of forklifts.

**CAUTION:** Do not exceed four cabinets high on a block to avoid tipping over the stack.

**CAUTION:** When lifting a block with a forklift, always keep the forks wide – close to the MCF-MILO caster frame's wheels. Doing otherwise (for example, moving the forks together in the center) may bend the frame.

The versatility of the MILO 120 AlignaLinks allows for several configurations when transporting stacks of MILO/MILO 120 cabinets. Tables 7.1 and 7.2 show the most common.

**Table 7.1: MILO/MILO 120 connection to another cabinet**

| Front Link Position | Rear Link Position | Angle Between Cabinets | MILO 120-I Insert |
|---|---|---|---|
| Bottom *(transport)* | T 0 | 0 Degrees | No |
| Top *(rigging)* | T 6 | 6 Degrees | Optional |

**Table 7.2: MILO/MILO 120 connection to MCF-MILO caster frame**

| Front Link Position | Rear Link Position | Angle Between Cabinet and Frame | MILO 120-I Insert |
|---|---|---|---|
| Bottom *(transport)* | 17 / MCF | 0 Degrees | No |
| Top *(rigging)* | T 6 | 4 Degrees | Optional |

Figures 7.8, 7.9 and 7.10 show example transport configurations using the MILO 120 AlignaLinks.

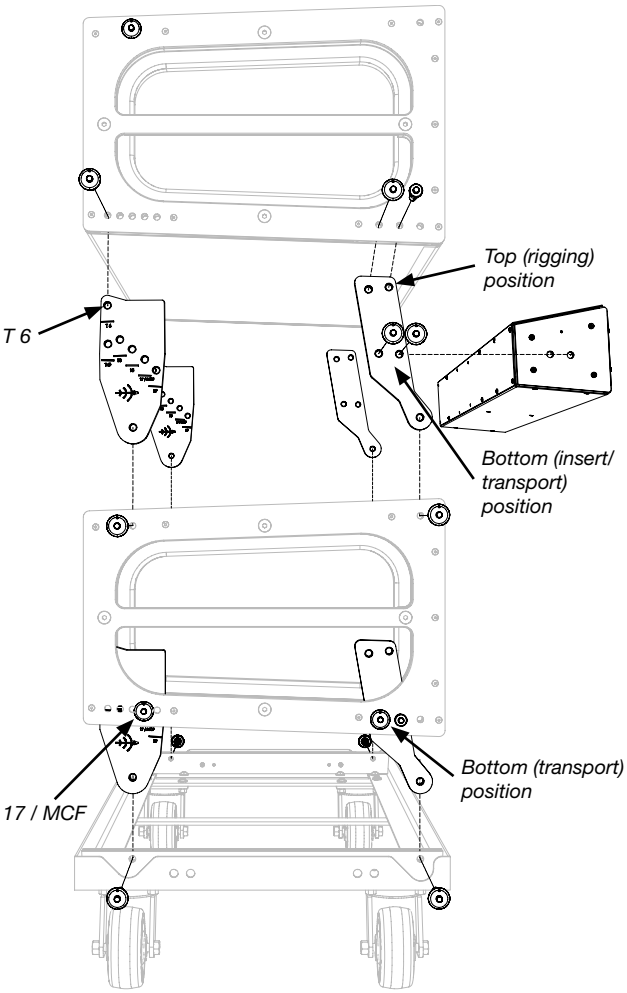



*Figure 7.8. Configuration for transporting cabinets on the MCF-MILO caster frame leaving the MILO 120-I in between cabinets; in this case, there are 6 degrees between cabinets and a splay of 0 degrees between the last cabinet and the caster frame.*

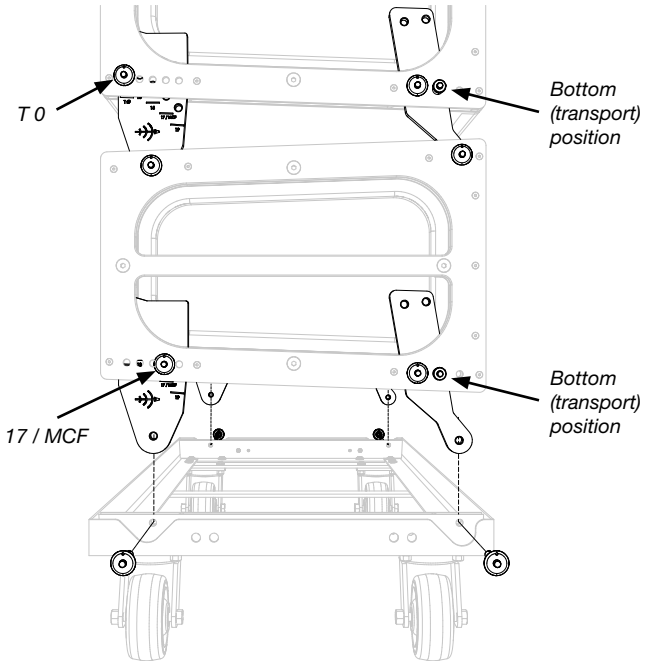



*Figure 7.9. Configuration for transporting cabinets on the MCF-MILO caster frame using the MILO 120 AlignaLinks to achieve a splay of 0 degrees between cabinets and between the last cabinet and the caster frame.*

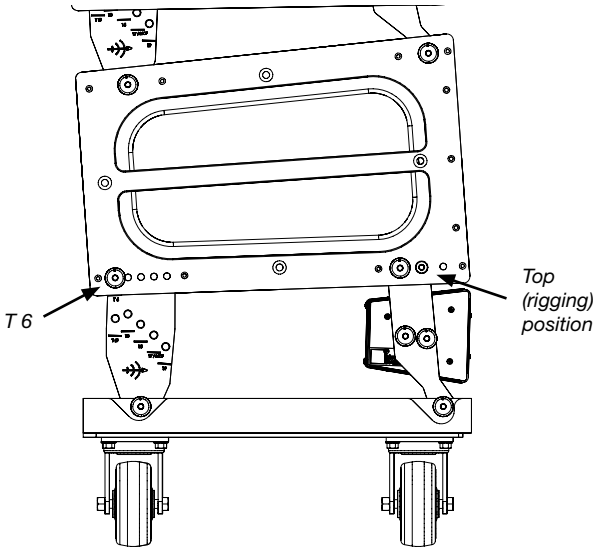



*Figure 7.10. Configuration for transporting cabinets on the MCF-MILO caster frame leaving the MILO 120-I; in this case, there is a splay of 4 degrees between the last cabinet and the caster frame.*

**TIP:** You can also transport the MG-3D/M attached to the top MILO/MILO 120 on a stack.

A range of rugged protective transport covers is also available.

# APPENDIX A: AMPLIFIER REPLACEMENT AND OPTIONAL RAIN HOOD

## USING THE RAIN HOOD (WEATHER-PROTECTED LOUDSPEAKERS)

If your MILO 120 loudspeaker was ordered with optional weather protection, a rain hood is installed on the MILO 120 loudspeaker. It is provided to protect the loudspeaker's electronics from direct exposure to rainfall. Before using the MILO 120 loudspeaker, open the rain hood as described in the following procedure.

1. Pull the exterior Velcro straps off the hood to allow 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 120 loudspeaker's electronics.

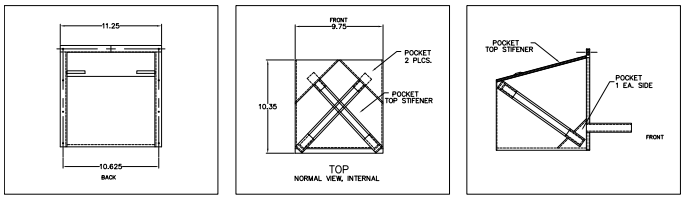



*Figure A.1: Rain hood stiffener pockets*

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

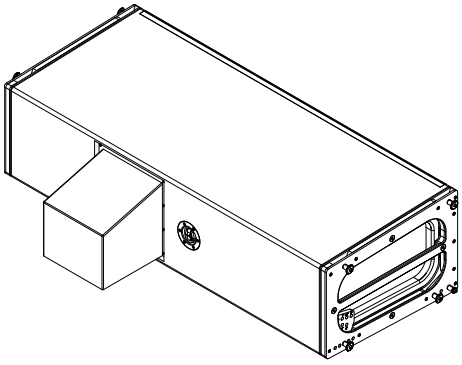


*Figure A.2: A fully opened rain hood installed on a MILO 120*

**CAUTION:** When operating a weather-protected MILO 120 loudspeaker be sure the rain hood is fully open. Leaving the hood closed or partially open will limit the air.ow through the amplifier, which could cause it to overheat and shut down.

## REMOVING THE HP-4/MILO 120 AMPLIFIER

**CAUTION:** Please note that MILO 120 and MILO amplifiers are different. Specific functions for each model, such as crossover points, frequency and phase correction and driver protection are determined by the control cards installed inside the amplifier. Do not exchange amplifiers between MILO and MILO 120 loudspeakers.

If you need to remove the HP-4/MILO 120 amplifier from a 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 120 electronics module from the cabinet (Figure A.3).

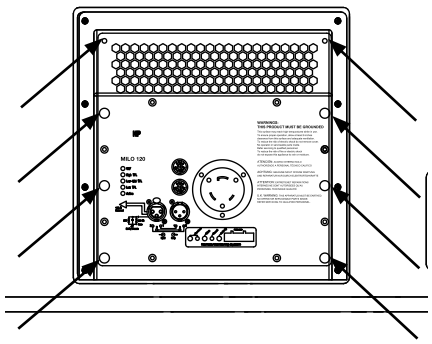


*Figure A.3: Location of the eight screws securing the HP-4/MILO 120 amplifier module*

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).

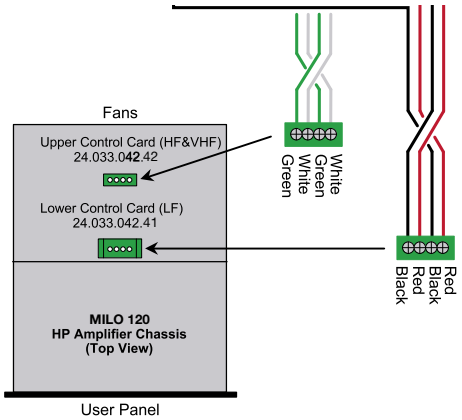



*Figure A.4: MILO 120's two 4-pin connectors*

## Replacing the HP-4/MILO 120 Amplifier

To replace MILO 120's HP-4 amplifier, do the following:

1. Gently slide the amplifier partially back into MILO 120 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 120 loudspeaker.

---

## REMOVING THE HP-4/MILO 120 AMPLIFIER (WITH RAIN HOOD)

If you need to remove and replace the HP-4/MILO 120 amplifier from a weather-protected MILO 120 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 120 Amplifier and Rain Hood

Perform the following steps to replace MILO 120's HP-4/MILO 120 amplifier and rain hood:

1. Gently slide the amplifier partially back into MILO 120 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.

---

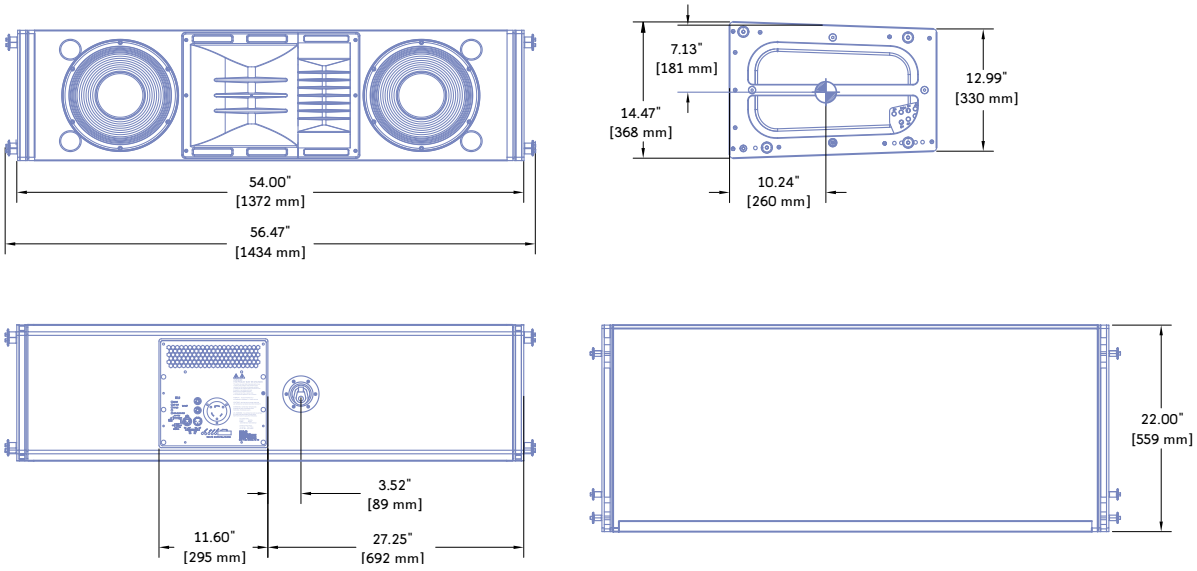
4. Carefully install the fabric rain hood, using the stainless steel screws and washers.
5. Align all eight screws and make sure that the washers are over the fabric.
6. Start all eight screws into the holes before tightening them.
7. Use the screws to sandwich the fabric and its gasket reinforcement 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 120 SPECIFICATIONS

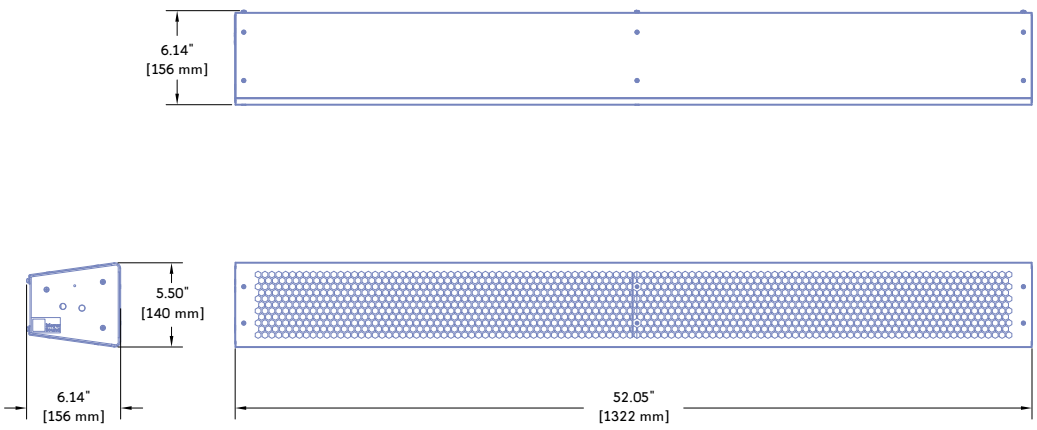
| | |
|---|---|
| **ACOUSTICAL** | |
| **Note:** The low-frequency power response of the system will increase according to the length of the array. | |
| Operating frequency range | 60 Hz - 18 kHz |
| | **Note:** Recommended maximum operating frequency range. Response depends upon loading conditions 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 | 138 dB |
| | **Note:** Measured with music at 1 meter. |
| Dynamic range | >110 dB |
| Horizontal coverage | 120° |
| Vertical coverage | Varies, depending on array length and configuration; for single loudspeaker, 20° |
| 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<br>Nominal impedance: 4 Ω<br>Voice coil size: 4"<br>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 – 180 Hz). At mid frequencies (180 Hz – 560 Hz) only one cone driver is fed from the crossover to maintain optimal polar and frequency response characteristics. | |
| Mid-high frequency | One 4" compression driver<br>Nominal impedance: 8 Ω<br>Voice coil size: 4"<br>Diaphragm size: 4"<br>Exit size: 1.5"<br>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 | Two 2" compression drivers<br>Nominal impedance: 12 Ω<br>Voice coil size: 2"<br>Diaphragm size: 2"<br>Exit size: 0.75"<br>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 two 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<br>Pin 2: Signal +<br>Pin 3: Signal -<br>Case: Earth ground and chassis |
| DC Blocking | None on input, DC blocked through signal processing |
| CMRR | >50 dB, typically 80 dB (50 Hz – 500 Hz) |
| RF filter | Common mode: 425 kHz<br>Differential mode: 142 kHz |
| TIM filter | <80 kHz, integral to signal processing |
| Nominal input sensitivity | 0 dB V (1 V rms, 1.4 V 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 | 3560 W (four channels; 2 x 1125 W, 1 x 560 W, 1 x 750 W) |
| | **Note:** Amplifier wattage rating is based on the maximum unclipped burst sine-wave rms voltage the amplifier will produce in to the nominal load impedance low, mid and very high channels 67 V rms (95 V pk) into 4, 6 and 8 ohms. |
| THD, IM TIM | < .02% |
| Load capacity | 4 Ω low and mid; 8 Ω high channel; 6 Ω very 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<br>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: MILO 120 Loudspeaker | |
|---|---|
| Enclosure | Multi-ply hardwood |
| Finish | Black textured |
| Protective grille | Powder-coated hex stamped steel |
| Rigging | QuickFly MRF-MILO rigging frame, MILO 120 AlignaLink connectors and 3/8” x 1.125” 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) |




| PHYSICAL: MILO 120-I Insert | |
|---|---|
| Enclosure | Cold rolled steel filled with acoustical-dampening fire treated foam (rating UL94-HF2) |
| Finish | Black low-gloss non-textured powder-coated |
| Protective grille | Powder-coated hex stamped steel |
| Rigging | 3/8” x 1.125” quick release pins |
| Dimensions | 52.05” w x 5.50” h x 6.14” d (1322 mm x 140 mm x 156 mm) |
| Weight | 20.50 lbs (9.30 kg) |



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