Arcline 8/212

User Guide V1.0

Version 1.0

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1 Safety and regulations

1.1 Important safety instructions

The lightning flash with an arrowhead symbol within an equilateral triangle is intended to alert the user to the presence of uninsulated "dangerous voltage" within the product's enclosure that may be of sufficient magnitude to constitute a risk of electric shock to persons.

The exclamation point within an equilateral triangle is intended to alert the user of the presence of important operating and maintenance (servicing) instructions in the literature accompanying the appliance.

Safety instructions - read this first

1. Read these instructions.
2. Keep these instructions.
3. Heed all warnings.
4. Follow all instructions.
5. Do not use this apparatus near water.
6. Clean only with a dry cloth.
7. Do not block any ventilation openings. Install in accordance with the manufacturer's instructions.
8. Do not install near any heat source such as radiators, heat registers, stoves, or other such 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 power cords from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit the apparatus.
11. Only use attachments and accessories specified by Void Acoustics.
12. Only use with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.
13. Unplug the apparatus during lightning storms or when unused for long periods of time.
14. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as when the power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.
15. Since the mains power supply cord attachment plug is used to disconnect the device, the plug should always be easily accessible.
16. Void loudspeakers can produce sound levels capable of causing permanent hearing damage from prolonged exposure. The higher the sound level, the less exposure needed to cause such damage. Avoid prolonged exposure to the high sound levels from the loudspeaker.

1.2 Limitations

This guide is provided to help familiarise the user with the loudspeaker system and its accessories. It is not intended to provide comprehensive electrical, fire, mechanical and noise training and is not a substitute for industry-approved training. Nor does this guide absolve the user of their obligation to comply with all relevant safety legislation and codes of practice.

While every care has been taken in creating this guide, safety is user-dependent and Void Acoustics Research Ltd cannot guarantee complete safety whenever the system is rigged and operated.

1.3 EC declaration of conformity

Manufacturer:
Void Acoustics Research Ltd,
Unit 15 Dawkins Road Ind Est,
Poole, Dorset,
BH15 4JY,
United Kingdom.

We declare that under our sole responsibility the following product models: Arcline 8, Arcline 212

are intended to be used as loudspeakers and are in conformity with the following EC Directives, including all amendments, and with national legislation implementing these directives:

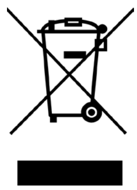
- BS EN 60065:2002
- BS EN 55103-1/-2

March 2016

Alex Skan
Technical Director

1.4 WEEE directive

If the time arises to throw away your product, please recycle all the components possible.



This symbol indicates that when the end-user wishes to discard this product, it must be sent to separate collection facilities for recovery and recycling. By separating this product from other household-type waste, the volume of waste sent to incinerators or land-fills will be reduced and natural resources will thus be conserved.

The Waste Electrical and Electronic Equipment Directive (WEEE Directive) aims to minimise the impact of electrical and electronic goods on the environment. Void Acoustics Research Ltd complies with the Directive 2002/96/EC and 2003/108/EC of the European Parliament on waste electrical finance the cost of treatment and recovery of electronic equipment (WEEE) in order to reduce the amount of WEEE that is being disposed of in land-fill sites. All of our products are marked with the WEEE symbol; this indicates that this product must NOT be disposed of with other waste. Instead it is the user's responsibility to dispose of their waste electrical and electronic equipment by handing it over to an approved reprocessor, or by returning it to Void Acoustics Research Ltd for reprocessing. For more information about where you can send your waste equipment for recycling, please contact Void Acoustics Research Ltd or one of your local distributors.

2 Limited warranty

The warranty

For a period of three (3) years from the date of delivery to the original purchaser (as shown on the original invoice or sales receipt; a copy of this may be required as proof of warranty dates), Void Acoustics Research Ltd (hereinafter 'Void') warrants to the Original Owner (person or company who originally purchased the product brand new from either Void or a Void Authorised Dealer/Distributor) of each new Arcline Series product (provided it was purchased at an Authorised Void Dealer) that it is free of defects in materials and workmanship and that each product will meet or exceed all factory published specifications for each respective model. Void agrees to repair or replace (at its discretion) all defective parts at no charge for labour or materials; subject to following provisions:

Warranty violations

Void shall take no responsibility for repair or replacement as specified under this warranty, if the damaged product has been subject to misuse, accident, neglect or failure to comply with normal maintenance procedures; or if the serial number has been defaced, altered or removed. Nor will Void accept responsibility for, or resulting from, improper alterations or unauthorised parts or repairs. This warranty does not cover any damage to speakers or any other consequential damage resulting from breach of any written or implied warranty.

Void warranty provisions

Void will remedy any defect, regardless of the reason for failure (except as excluded) by repair, or replacement. Void will remedy the defect and ship the product within a reasonable time after receipt of the defective product at a Void Authorised Service Centre.

To obtain warranty service

If a Void product requires service, the Owner must contact Void or an Authorised Void Service Centre to receive an R.A.N. (Return Authorisation Number) and instructions on how to return the product to the Void Authorised Service Centre, or to Void.

Void (or its Authorised Service Centre) will initiate corrective repairs upon receipt of the returned product. Please save the original carton and all the packing materials in case shipping is required. All products being returned to the factory or service centre for repairs must be shipped prepaid.

If the repairs made by Void or the Void Authorised Service Centre are not satisfactory, the Owner is instructed to give written notice to Void. If the defect or malfunction remains after a reasonable number of attempts by Void to remedy the defect or malfunction, the Original Owner shall then have the option to elect either a refund or replacement of said Void product free of charge. The refund shall be an amount equal to but not greater than the actual purchase price, not including any taxes, interest, insurance, closing costs and other finance charges (minus reasonable depreciation on the product).
If a refund is necessary, the Original Owner must make the defective or malfunctioning product available to Void free and clear of all liens or other restrictions.

Equipment modifications

Technical and design specifications are subject to change without notice.

Void reserves the right to modify or change equipment (in whole or part) at any time prior to delivery thereof, in order to include therein electrical or mechanical improvements deemed appropriate by Void, but without incurring any liability to modify or change any equipment previously delivered, or to supply new equipment in accordance with any earlier specifications.

Disclaimer of consequential and incidental damages

You, the Original Owner, are not entitled to recover from Void any incidental damages resulting from any defect in the Void product.

This includes any damage to another product or products resulting from such a defect.

Warranty alterations

No person has the authority to enlarge, amend, or modify this Warranty. This Warranty is not extended by the length of time which the Original Owner is deprived of the use of product. Repairs and replacement parts provided pursuant to the Warranty shall carry only the non-expired portion of the Warranty.

This Statement of Warranty supersedes all others contained in this user guide.

3 Unpacking and checking

All Void Acoustics products are carefully manufactured and thoroughly tested before being dispatched. Your dealer will ensure that your Void products are in pristine condition before being forwarded to you but mistakes and accidents can happen.

Before signing for your delivery:

- Inspect your shipment for any signs of contamination, abuse or transit damage as soon as you receive it
- Check your Void Acoustics delivery fully against your order
- If your shipment is incomplete or any of its contents are found to be damaged; inform the shipping company and inform your dealer.

Arcline loudspeakers are heavy and require a minimum two people to lift.

- Undo the four butterfly catches on the transport case then remove the lid making sure the lid is clear before moving sideways
- If you need to place the Arcline on a flat surface ensure you use a lint free product to protect the finish
- When removing the Arcline take care not to damage the lower tray of the transport case.

Keep the original packaging in case you need to return a product for service later.

See section 2 for warranty conditions and see section 9 if your product needs servicing.

4 About

4.1 Welcome

Many thanks for purchasing this Void Acoustics Arcline Series product. We truly appreciate your support. At Void, we design, manufacture and distribute advanced professional audio systems for the installed and live sound market sectors. Like all Void products, our highly skilled and experienced engineers have successfully combined pioneering technologies with groundbreaking design aesthetics, to bring you superior sound quality and visual innovation. In buying this product, you are now part of the Void family and we hope using it brings you years of satisfaction. This guide will help you both use this product safely and ensure it performs to its full capability.

4.2 Arcline 8

4.2.1 Overview

A host of new technologies dramatically improve the perceived sound quality and definition of the Arcline 8, while an advanced rigging system reduces setup time and the need for more than one person to rig multiple enclosures. Delivering a true 110-degree dispersion results in a highly uniform polar pattern, bringing uniform sound quality across the entire sound field.

The high frequency horn design optimises the waveguide and a new phase shading device allows multiple Arcline 8 enclosures to form a true cylindrical wavefront by splitting two acoustic sources into four, with the acoustic centre positioned optimally for coupling. Rigging angles can also be pre-selected before flying the system.

4.2.2 Key features

- Two-way active, three-way line array module
- 110° horizontal dispersion
- True cylindrical wavefront
- 2 x 8” mid transducers with phase devices
- 2 x 8” horn loaded low frequency transducers
- 2 x 1.4′′ compression drivers
- Rigging angle pre-selected before lifting the enclosures
- Ground stackable

4.2.3 Arcline 8 specifications

Frequency response	110 Hz - 20 kHz single enclosure, 90 Hz - 20 kHz three enclosures ±3 dB
Efficiency[1]	LF: 97 dB (100 dB referenced to 1 W) | MF/HF: 103 dB (106 dB referenced to 1 W)
Crossover points	LF: 110 Hz - 300 Hz, HMF: 300 Hz - passive 1.2 kHz
Nominal impedance	2 x 16 Ω
Power handling[2]	LF: 500 W AES, HF: 500 W AES
Maximum output[3]	128 dB cont, 145 dB peak
Driver configuration	2 x 1.4″ compression drivers 2 x 8″ mid drivers with phase device 2 x 8″ horn loaded low frequency drivers
Dispersion	110°H x 12°V
Protection	Internal electronic control
Connectors	2 x 4-pole speakON™ NL4
Height	285 mm (11.2″)
Width	881 mm (34.7″)
Depth	470 mm (18.5″)
Weight	39 kg (86 lbs)
Enclosure	15 mm multi-laminate plywood
Rigging	Rigging angle pre selected before you lift the enclosures Ground stackable A2 stainless steel
Finish	Textured TourCoat polyurea
Grille	Perforated steel with foam filter

[1] Measured in half space [2] AES2 - 1984 compliant [3] Calculated

4.2.4 Arcline 8 dimensions

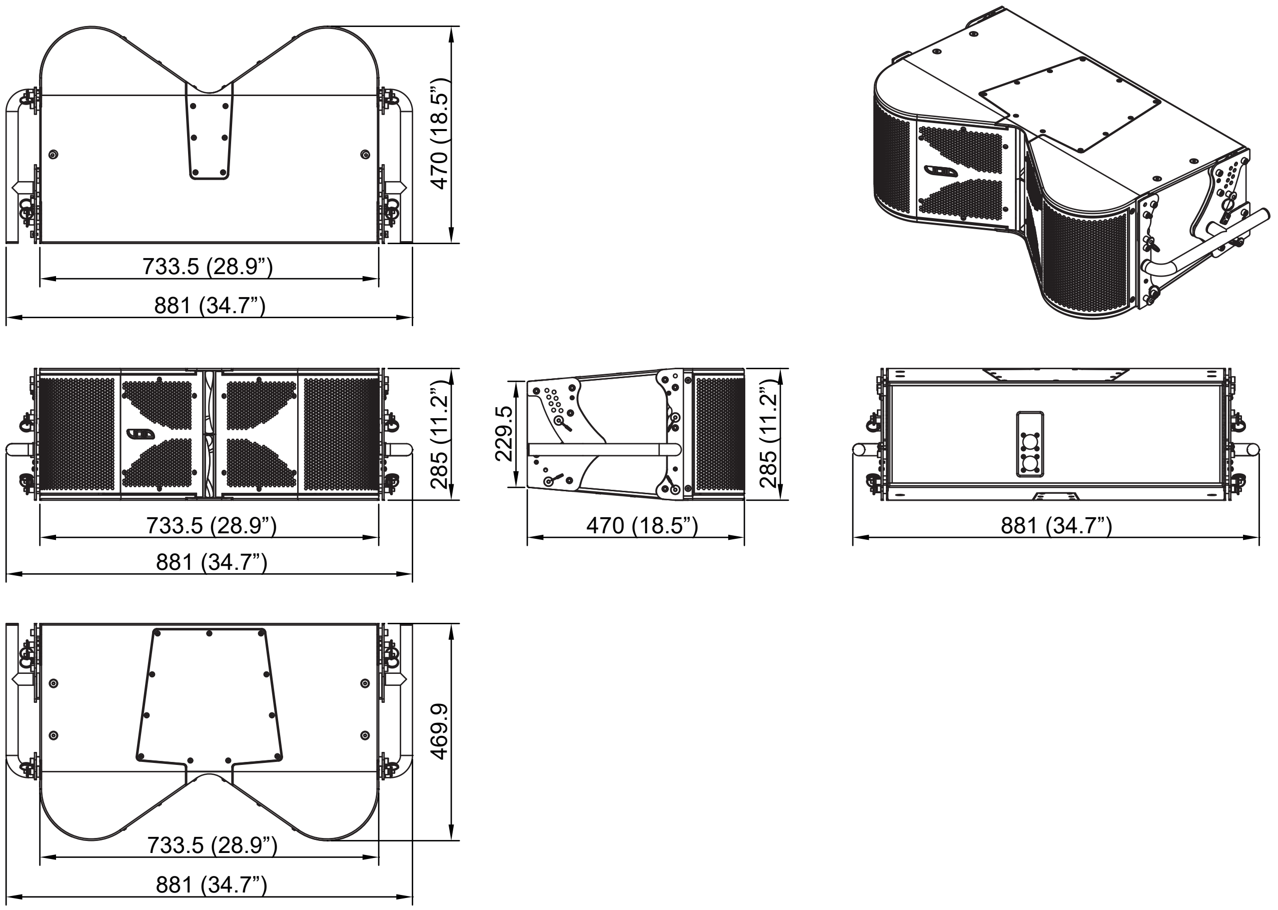


Figure 4.1: Arcline 8 dimensions

4 About

4.3 Arcline 212

4.3.1 Overview

Specially designed to extend the low frequency range of the Arcline line array, the Arcline 212 features two 12" 900 W low frequency drivers. This makes it possible to extend the frequency response range to as low as 50Hz, while also reaching up to 200Hz.

For ease, the Arcline 212 is flyable with the Arcline 8. It can be used in any application where suspended bass is required, including large venues and medium to large scale touring.
Two Neutrik speakON™ NL4 connectors provide input and link through connections. Its lightweight birch plywood enclosure is finished in a textured TourCoat polyurea finish, bringing longevity for life on the road.

4.3.2 Key features

- Extended frequency range from 55 Hz to 120 Hz
- Flyable with Arcline 8
- Cardioid configuration integrated in the rigging
- FEA optimised porting

4.3.3 Arcline 212 specifications

Frequency response	50 Hz to 200 Hz
Efficiency[1]	99 dB
Nominal impedance	2 x 8 Ω
Power handling[2]	2 x 900 W AES
Maximum output[3]	132 dB cont, 138 dB peak
Driver configuration	2 x 12" low frequency drivers
Dispersion	Array dependent
Connectors	2 x 4-pole speakON™ NL4
Height	367 mm (14.4")
Width	877.5 mm (34.5")
Depth	470 mm (18.5")
Weight	42 kg (92.6 lbs)
Enclosure	15 mm multi-laminate plywood
Rigging	A2 stainless steel rigging for use with Arcline 8 when flown or ground stacked
Finish	Textured TourCoat polyurea
Grille	Perforated steel with foam filter

[1] Measured in half space [2] AES2 - 1984 compliant [3] Calculated

4.3.4 Arcline 212 dimensions

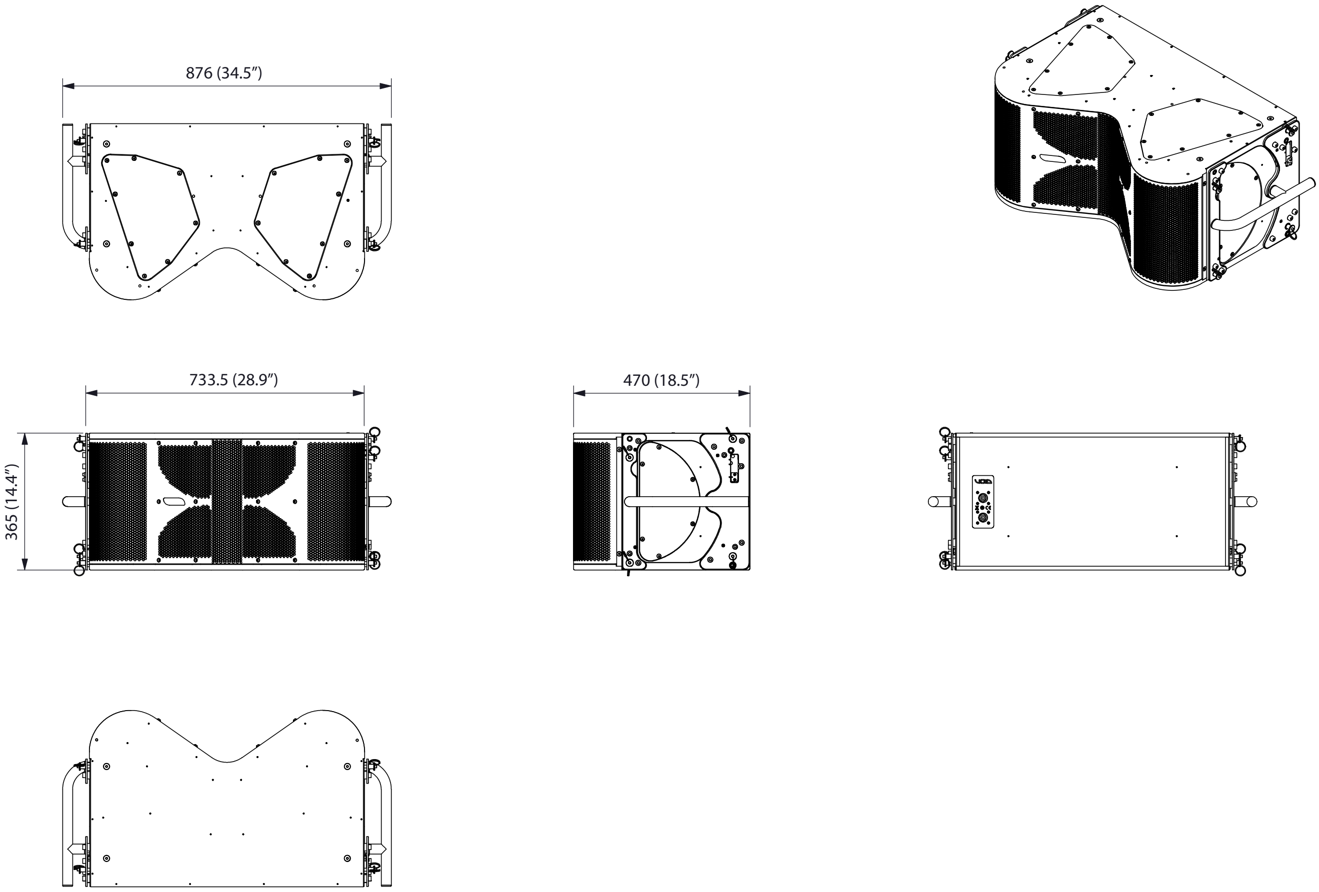


Figure 4.2: Arcline 212 dimensions

4.4 System compliance

Product	Standards applied	Limitations of use
Arcline 8 fly frame	BGV C1	Conforms to BGV C1 for suspending: 15 Arcline 8 line-array elements
	BS7906-1 Category A	Conforms to BS7906-1 Category A for suspending: 19 Arcline 8 line-array elements
	BGV D8 and BS7906-1 Category B	Conforms to BGV D8 and BS7906-1 Category B for suspending: 24 Arcline 8 line-array elements as a static load with secondary suspension
Arcline 8 line-array element suspension system	BGV C1	Conforms to BGV C1 for suspending: 15 Arcline 8 line-array elements
	BS7906-1 Category A	Conforms to BS7906-1 Category A for suspending: 19 Arcline 8 line-array elements as a dynamic load without secondary suspension
	BGV D8 and BS7906-1 Category B	Conforms to BGV D8 and BS7906-1 Category B for suspending: 24 Arcline 8 line-array elements as a static load with secondary suspension
Arcline 212 fly frame	BGV C1	Conforms to BGV C1 for suspending: 14 Arcline 212 line-array elements
	BS7906-1 Category A	Conforms to BS7906-1 Category A for suspending: 17 Arcline 212 line-array elements
	BGV D8 and BS7906-1 Category B	Conforms to BGV D8 and BS7906-1 Category B for suspending: 24 Arcline 212 line-array elements as a static load with secondary suspension
Arcline 212 line-array element suspension system	BGV C1	Conforms to BGV C1 for suspending: 14 Arcline 212 line-array elements
	BS7906-1 Category A	Conforms to BS7906-1 Category A for suspending: 17 Arcline 212 line-array elements as a dynamic load without secondary suspension
	BGV D8 and BS7906-1 Category B	Conforms to BGV D8 and BS7906-1 Category B for suspending: 24 Arcline 212 line-array elements as a static load with secondary suspension

Note: Must be safetied once in position.

5 Cabling and wiring

5.1 Electrical safety

To avoid electrical hazards please note the following:

- Only connect electrical equipment to 50-60 Hz AC power outlets rated at 100-120 VAC or 200-240 VAC
- Do not supply electrical power to equipment without a safety ground connection
- Do not supply electrical power to equipment that has been exposed to moisture (e.g. rain)
- Do not supply electrical power to equipment that has become coated in moisture (e.g. condensation)
- Do not access the inside of any electrical equipment. Refer servicing to Void-approved service agents.

5.2 Cable considerations for fixed installations

We recommend specifying installation-grade Low Smoke Zero Halogen (LSZH) cables for permanent installations. The cables should use Oxygen Free Copper (OFC) of grade C11000 or above. Cables for permanent installations should be compliant with the following standards:

- IEC 60332.1 Fire retardancy of a single cable
- IEC 60332.3C Fire retardancy of bunched cables
- IEC 60754.1 Amount of Halogen Gas Emissions
- IEC 60754.2 Degree of acidity of released gases
- IEC 61034.2 Measurement of smoke density.

We suggest using the following maximum copper cable lengths to keep level losses below 0.6 dB.

Arcline cabinets in parallel		2 x Arcline 8	4 x Arcline 8
		1 x Arcline 212	2 x Arcline 212
Metric mm^2	Imperial AWG	8 Ω load	4 Ω Load
2.5 mm^2	13 AWG	36 m	18 m
4 mm^2	11 AWG	60 m	30 m

5 Cabling and wiring

5.3 Arcline 8 wiring diagram

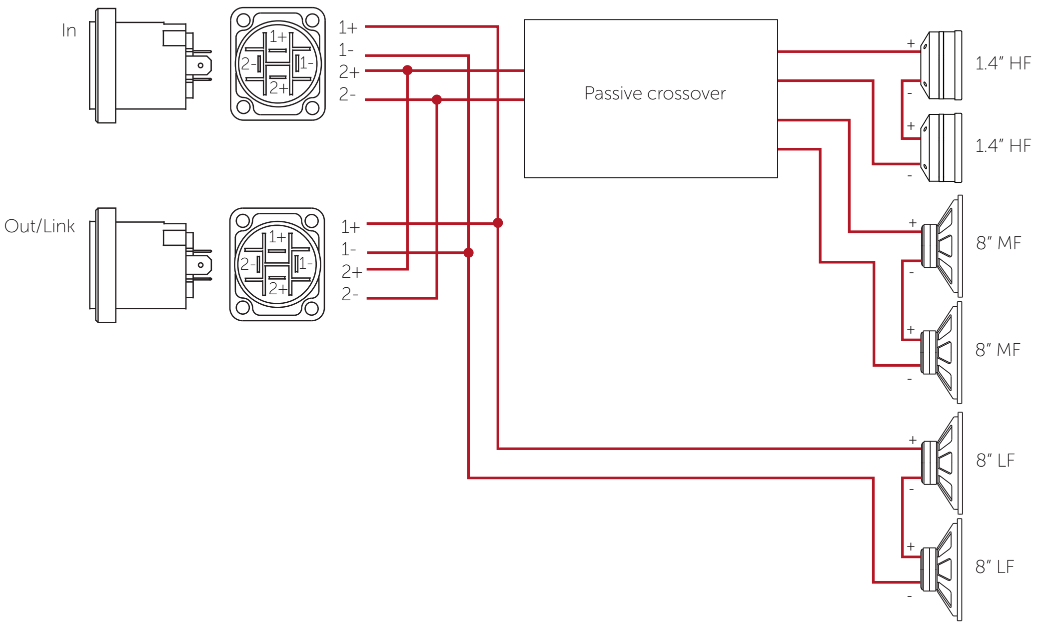


Figure 5.1: Arcline 8 wiring diagram

	speakON™ pins 1+/1-	speakON™ pins 2+/2-
In	LF (2 x 8")	MHF (2 x 8" and 2 x 1.4")
Out	LF link	MHF link

5.4 Arcline 212 wiring diagram

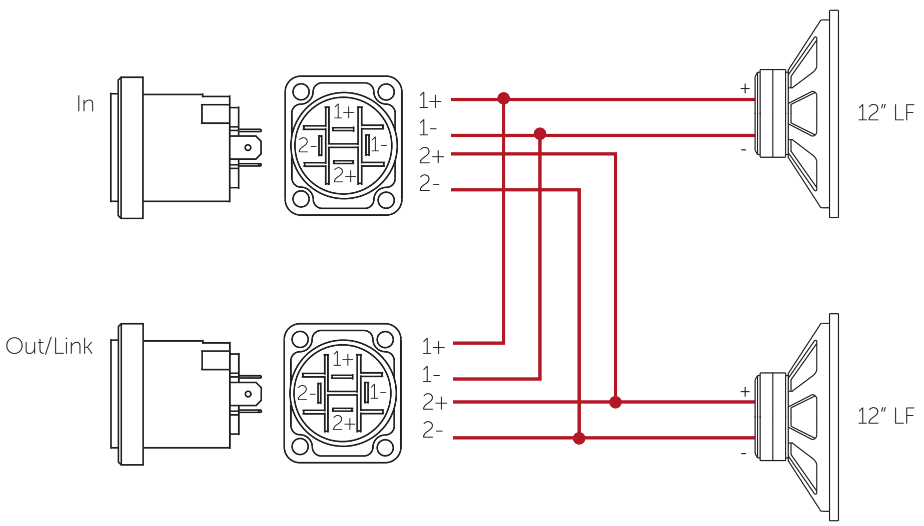


Figure 5.2: Arcline 212 wiring diagram

	speakON™ pins 1+/1-	speakON™ pins 2+/2-
In	LF (12")	LF (12")
Out	LF link	LF link

5.5 Arcline 8 Bias Q5 speakON™ wiring

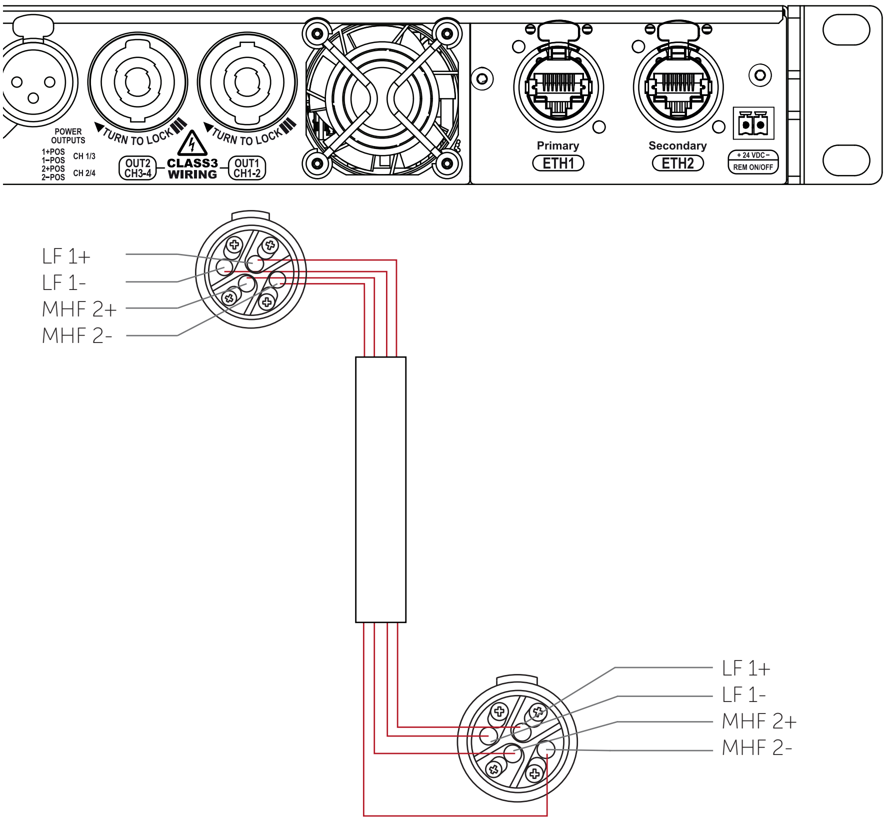


Figure 5.3: Arcline 8 Bias Q5 wiring

Bias Q5	Output 1	Output 2
Output	LF (2 x 8")	MHF (2 x 8" and 2 x 1.4")

Note that Q5 amplifier output channels do not share a common ground for "1-" and "2-"

- Avoid grounding Q5 amplifier outlet pins or loudspeaker connector pins
- Never wire loudspeaker installation panels with common Ch1 and Ch2 loudspeaker return lines

5.6 Arcline 212 Bias Q5 speakON™ wiring

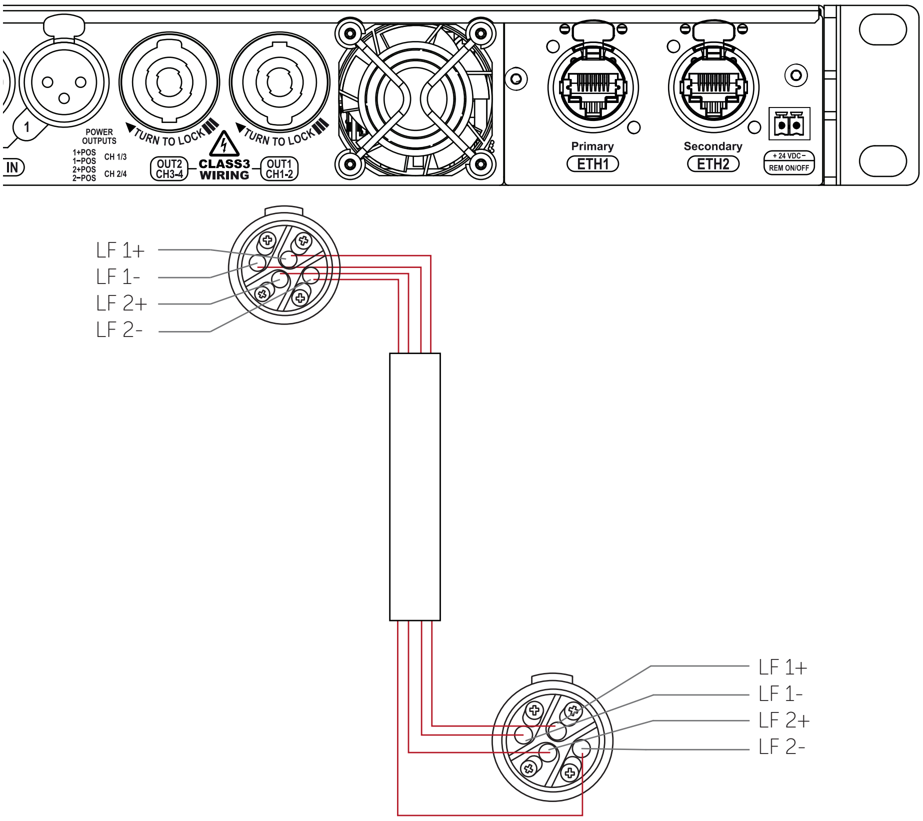


Figure 5.4: Arcline 212 Bias Q5 wiring

Bias Q5	Output 1	Output 2
Output	LF (12")	LF (12")

Note that Q5 amplifier output channels do not share a common ground for "1-" and "2-"

- Avoid grounding Q5 amplifier outlet pins or loudspeaker connector pins
- Never wire loudspeaker installation panels with common Ch1 and Ch2 loudspeaker return lines

6 Amplification and control

6.1 System control using Armonía software

Arcline systems are powered by Bias Q5 DSP power amplifiers that are controlled via Powersoft's Armonía Plus System Manager.

Armonía Plus System Manager software, updates and tutorials are provided via the www.powersoft-audio.com website as follows:

Armonía on-line support go to https://armonia.powersoft.it/ for details

Ensure that all your Bias Q5 amplifiers are loaded with the same firmware version.

1. Different firmware versions on different amplifiers may lead to latency mismatches
2. Keeping your amplifier firmware up-to-date will ensure that your Bias Q5 amplifiers work with the latest version of Armonía Plus.

Figure 6.6: Armonía Plus workspace for a Void Arcline 8/Arcline 212/Arcline 218

Arcline presets and updates

All void prestes are available through the marketplace in Armonia Plus as well as the latest firmware updates.

7 System design

7.1 Hearing safety

To avoid noise hazards, please note the following:

- Public address loudspeakers are designed to project sound to a large audience and are not designed for close listening. Do not place your ear too close when checking individual loudspeakers in case someone inadvertently unmutes an audio channel or increases its level without warning
- Design your system to provide smooth coverage. This will ensure that you project sound to the rear of the audience without overexposing audience members and venue staff at the front
- Venue managers should swap staff around occasionally, to reduce the cumulative effect of noise exposure on individual staff members
- Ensure you comply with the relevant noise exposure/noise at work regulations. There is a very useful web site covering the topic. See www.soundadvice.info
- Unweighted and/or short-term sound pressure levels will usually be higher as A-weighting under-represents the LF and HF content and LEQ measurements are averaged over a specified time interval
- Instantaneous/peak sound pressure levels must never exceed 137dB unweighted*

(*Overexposure to low frequencies used to be disregarded but it is now understood to cause significant hearing damage)

7.2 System design basics

Void Acoustics Arcline systems may be vertically arrayed to form high-power line array systems of exceptional quality.

The following points should be considered when designing any vertically-arrayed sound system:

- Point-source (non-line array) loudspeaker sound pressure level (SPL) reduces at approximately 6 dB per doubling of distance unless something is done to compensate for this natural radial attenuation. A line array behaves more like a point-source at lower frequencies where its line length is short when compared with low frequency wavelengths
- Modern PA line arrays rely on multiple cabinet summation to partially compensate for this single-cabinet radial attenuation. A vertical array of cabinets is formed that is relatively straight at the top (for maximum vector summation), with increasing curvature towards the bottom (to tailor the summation to the coverage requirements). See Appendix A for line array basics
- The line array effect is limited by:
    - The number of cabinets available to provide far audience level compensation
    - The length of the array. Low frequency projection is related to the square of the line length (acoustically-small arrays, with respect to wavelength, revert to point-source radial attenuation)
    - The array curvature. Summation is related to coverage overlap between multiple cabinets and becomes more critical at high frequencies where the vertical directivity of individual cabinets is higher and where multiple arrival phase shifts reduce vector summation.

7 System design

Long-distance sound propagation can be adversely affected by:

- Temperature gradients: The speed of sound increases with temperature so any temperature difference with height can cause the sound propagation to rotate upwards when the air near the surface is warmer than the air higher up (e.g. a warm, sunny day), or to rotate downwards when the air near the surface is cooler than the air higher up (e.g. after summer showers or during ice shows)
- Wind gradients: As sound normally relies on air as a medium, the speed of sound is relative to the air and not to the ground. So the resultant speed of sound may be increased by air movement in the direction of the sound propagation or decreased by air movement in the opposite direction. Wind speed varies with height so its effect on sound also varies with height. A wind blowing from the stage will cause sound propagation to rotate downwards, whereas wind blowing towards the stage will cause sound propagation to rotate upwards. A cross-wind will cause the sound direction to be "blown" sideways often resulting in "phasing" due to multiple arrival time changes with changing wind speeds
- Air absorption: When air resonates under the influence of the sound propagating through it, the air absorbs energy from that sound – particularly at mid and high frequencies. The "tuning" of that resonance varies with temperature and relative humidity in a complex way but tends to be worse around 20% RH and worse at higher frequencies. The significant thing about air absorption is that it attenuates (in dB) over linear distance – not per-doubling as with radial attenuation. Air absorption can be as high as 0.287 dB per metre (10 kHz) at 22°C, 20% RH = 28.7 dB over 100 m.

See Appendix A for more in-depth information and guidance.
As temperature gradients can vary significantly over a period of a few minutes – especially inside a big open-roof stadium after sunset, and wind gradients can vary from second to second, it's difficult to correct for them completely. It's usually more practical to design systems for the worse-case scenario – i.e. slightly over-designing systems for longer coverage and then retaining some network control over level shading to compensate for any long-term effects.

Air absorption tends to vary over far longer periods of time so it can be partially compensated for by designing line array HF sections for maximum efficiency and headroom and then by adding mid-hi/HF shelving EQ into the loudspeaker management presets for the upper sections of large "long-throw" arrays.

⚠ Delay towers should always be considered and budgeted for when designing system to cover more than 100 m in low humidity conditions. Relative humidity often falls below 30% on dry summer days – even in Northern Europe.

Prediction software

Poorly designed sound systems will quickly fail to deliver in adverse weather conditions so design your sound system for the best performance possible to avoid climatic conditions hindering with system performance.

To simplify day-to-day system design, the Void Acoustics Arcline 8 system has been designed to be compatible with industry-standard EASE Focus 3 prediction software.

7.3 EASE Focus 3 prediction software

EASE Focus software and updates are provided via the http://focus.afmg.eu web site.

On-line EASE Focus 3 information

- Go to http://focus.afmg.eu for details
- An on-line introduction will be found at: www.afmg-support.eu/AFMGDownloads/Downloads.aspx?SWP=EASE%20Focus&FILE=EASE_Focus_3_Mail.pdf
- Frequently asked questions are covered here: http://focus.afmg.eu/index.php/fc-faq-en.html
- The latest version is EASE Focus 3.0.18 – available to download free of charge from: www.afmg-support.eu/AFMGDownloads/Downloads.aspx?SWP=EASE%20Focus&FILE=EASE_Focus_v3.0.18.zip
- Windows 7 requires Microsoft .NET Framework 4.0 - available from: https://www.microsoft.com/en-us/download/details.aspx?id=17851

7.4 Array design using EASE Focus 3

7.4.1 How many cabinets?

The following factors should be considered:

- Maximum low frequency SPL will increase by approximately 6 dB for every doubling of cabinet quantities
- Low-mid to high-mid far audience spectral balance will vary with effective* array length for a given distance so it's important to maintain low curvature (low single-figure splay angles) over most of the array by not flying too high and by using front fills – if possible – to cover the front rows. Front fills also improve imaging
- Air absorption may curtail HF propagation over long distances in dry conditions so, again, it's important to maintain headroom by using low-curvature array designs.

* This would only include cabinets whose coverage contributes to the SPL at the listener distance. For instance, the far audience wouldn't benefit from the mid & HF output from the bottom cabinets as the listeners would be out of their coverage.

For flat (e.g. festival) venues, the following multiples of four cabinets are a good starting point, depending on the genre of entertainment expected (for instance, heavy metal, some dance genres and strongly amplified outdoor orchestral material will benefit from the extra low-mid – mid-bass directivity that a longer array will provide, even in a relatively short venue). But always use EASE Focus 3 to help finalise your decisions.

Up to 20 m	4 – 8 Arcline 8
Up to 35 m	8 - 12 Arcline 8
Up to 65 m	12 - 16 Arcline 8
Up to 100 m	16 – 24 Arcline 8
Up to 120 m	24 Arcline 8; but note that long distance HF propagation will be limited by air absorption – see above.

7.4.2 100 m flat field example

Assuming you've familiarised yourself with EASE Focus 3 and know your way around it, here are some example plots of a house left array for a 100 m flat field using 16 x Arcline 8:
(It makes sense to optimise one side before copying and pasting for stereo or multi-channel)

A note about these auto-splay and manually-adjusted examples:

- The following plot examples are for one side only. Full stereo will add 3–5 dB over a wide coverage area
- The first few views simply use the EASE Focus 3 Auto Splay facility ("Conventional" Auto-splay strategy) with no array eq or shading. The EASE Focus 3 Auto Splay function will give useful results if you're in a hurry
- The last few plots are manually splay-adjusted to illustrate the coverage control available.

Note, of course, that EASE Focus 3's SPL predictions will be subject to the usual laws of physics regarding bandwidth; so bandlimited level predictions – to just three octaves in some of the examples below – will be significantly below broadband level predictions. Always use broadband predictions for overall level assessments.

"Conventional" auto-splay examples

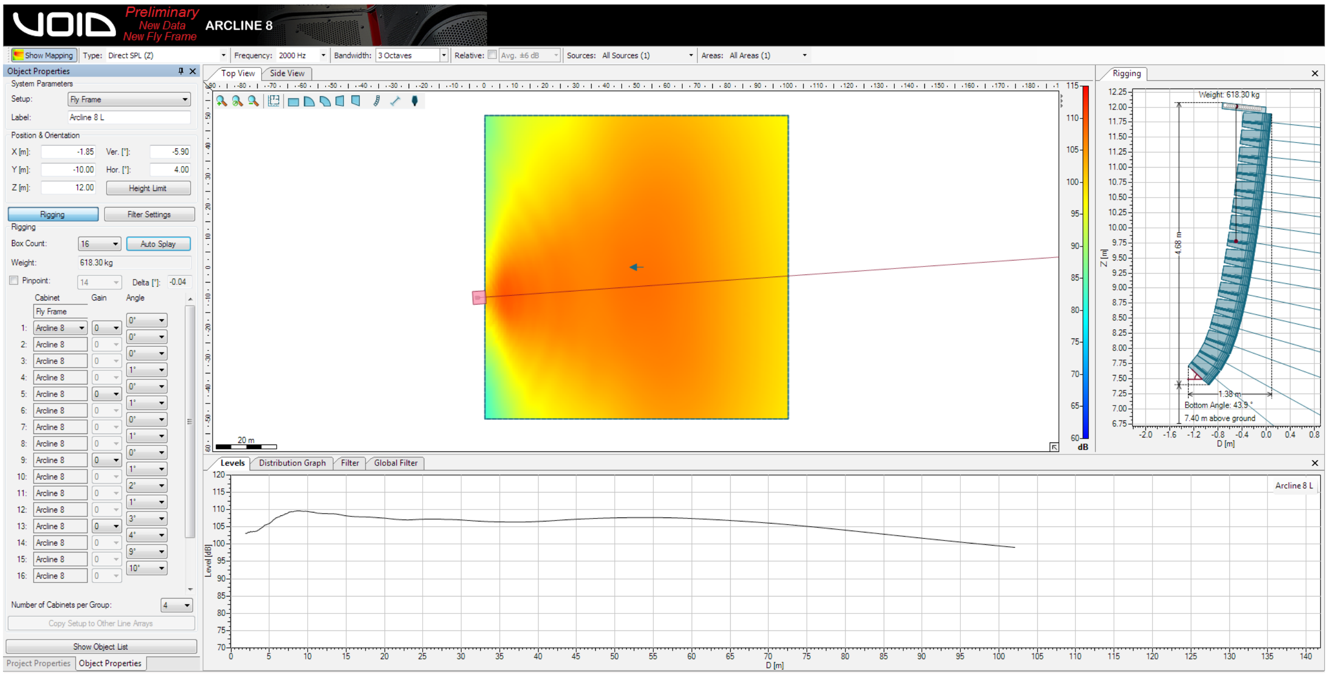


Figure 7.1: Top view showing initial 2 kHz 3-octave coverage
using EASE Focus 3's "Conventional" auto splay

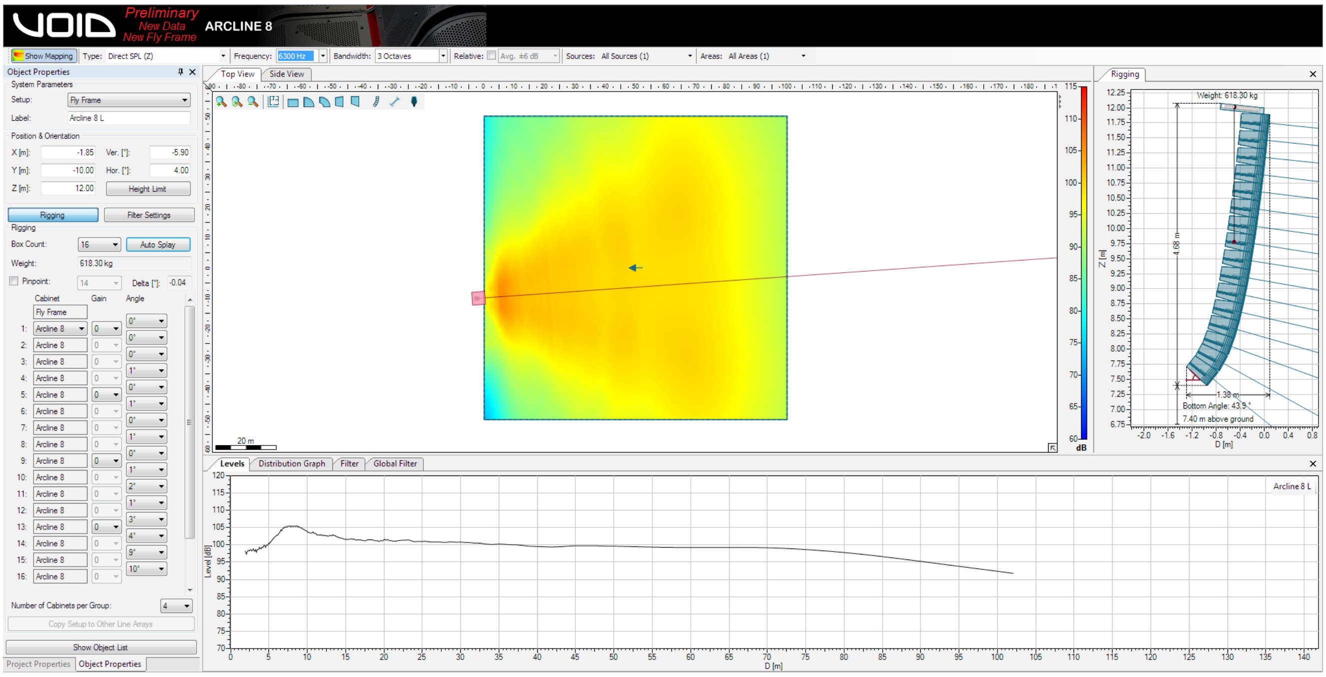


Figure 7.2: Top view showing initial 6.3 kHz 3-octave coverage using EASE Focus 3's
"Conventional" auto splay (Good for checking HF propagation)

7 System design

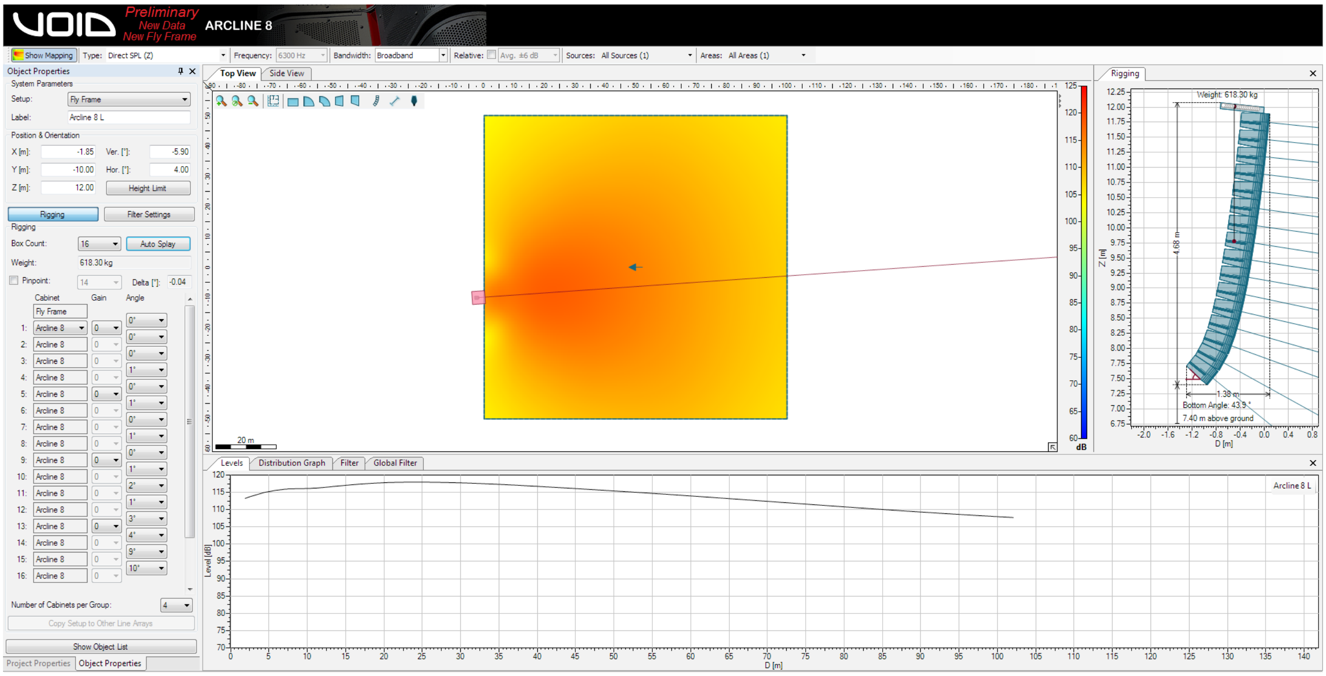


Figure 7.3: Top view showing initial broadband coverage using EASE Focus 3's "Conventional" auto splay (Note scale change) (Good for checking coverage levels)

Broadband coverage will often show an SPL maximum near the front (at about 25 m in the example above). This is due to the arrays' finite size making it act partly like a conventional point source at low frequencies. This is perfectly acceptable if mid and high frequency coverage is smooth and often reduces when larger array presets are employed.

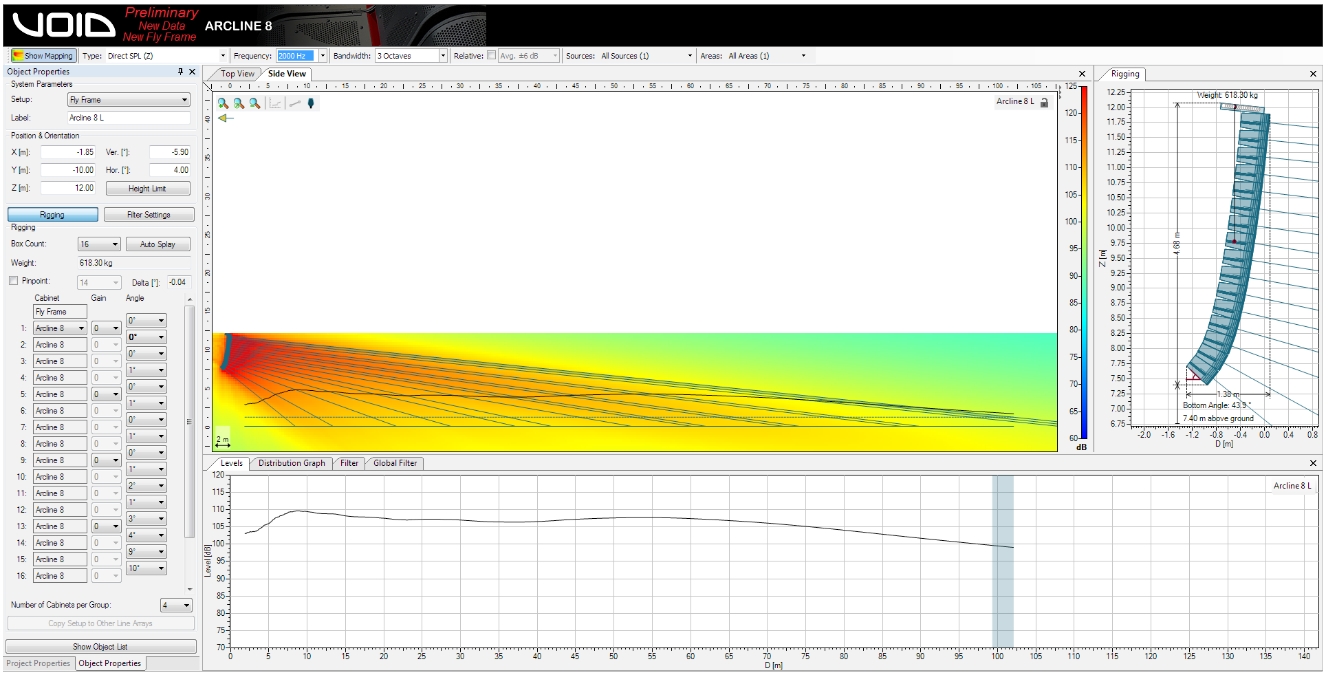


Figure 7.4: Side view showing initial 2 kHz 3-octave coverage using EASE Focus 3's "Conventional" auto splay

Conventional Auto splay tends to aim the upper part of the array towards the far audience listening height. This minimises rear wall reflections but can provide an overly sharp cut-off for outdoor use – where temperature and wind gradients can modify propagation. We usually recommend designing outdoor systems for a few degrees extra vertical coverage – to provide up to 10-15% extra coverage distance – as a hedge against climatic effects.

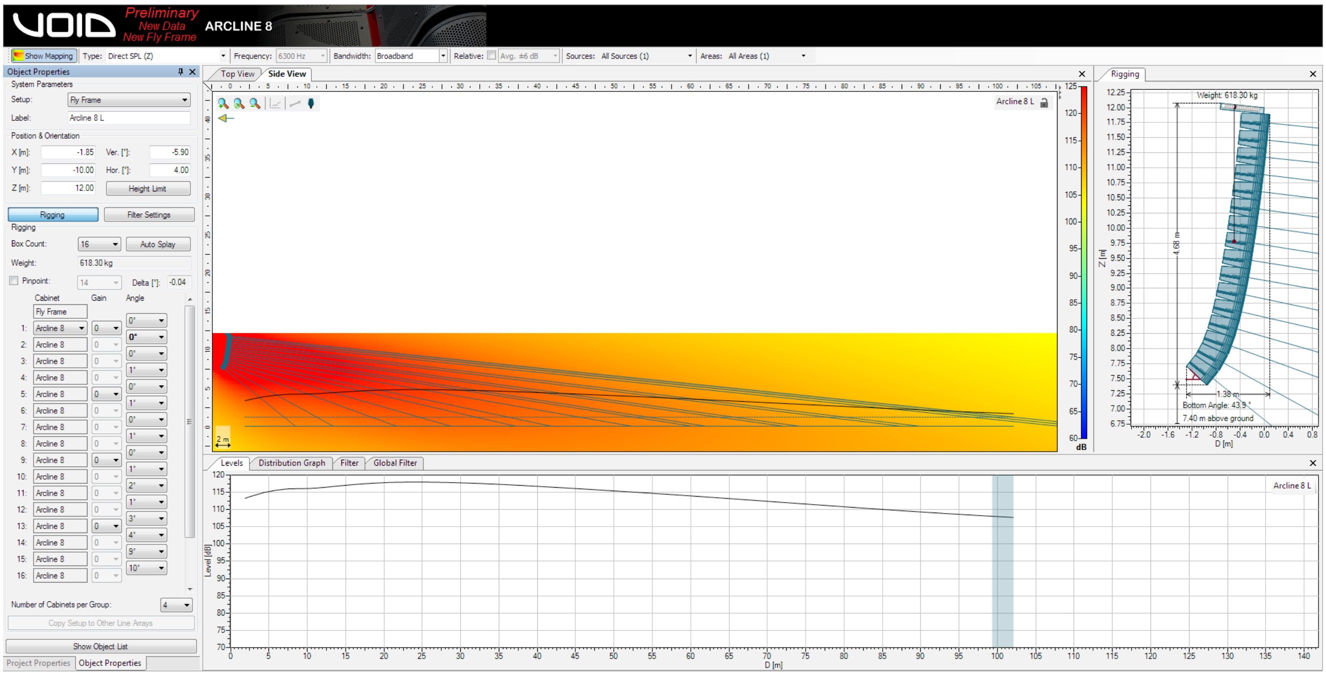


Figure 7.5: Broadband side view using EASE Focus 3's "Conventional" auto splay

7.4.3 Manually adjusting splay and gain

EASE Focus 3's "Conventional" auto splay feature usually provides a good balance between smooth coverage and maximum SPL. Most results will show a mid-high frequency level variation with distance – typically up to +5 dB near the front dropping to -5 dB at the rear, which sounds natural and is perfectly acceptable for most applications.

Although EASE Focus 3's auto splay feature provides an easy way to optimise your array designs, some minor manual adjustments may be felt necessary where much tighter level control requirements override a more natural-sounding lowering of levels with distance.

For instance, festival sound system operators are often required to comply with overly simplistic sound level restrictions. Instead of being asked to ensure that high sound levels are kept within the site boundaries – a fairly easy task with real-time network-controlled line array systems like the Arcline 8, even with varying atmospheric conditions – noise abatement restrictions often assume that the sound system will be as leaky as a wide-vertical point source and calculate maximum front-of-house (FOH) levels accordingly – often restricting FOH levels to around 105 dB(A) Leq over (typically) 10 minute intervals with a very strict limit on instantaneous peaks.

105 dB(A) Leq would be regarded as loud in a domestic environment but, for an excited festival audience singing along to their favourite artist, it can be weak and uninspiring – especially if there are subtle weak spots in the voice range. It only takes 32 audience members singing in unison to compete with 105 dB(A) so it is often more important to ensure even coverage over the three octaves centred on 2 kHz than worry about a "natural" level attenuation with distance in these circumstances.

Here's a reminder of the previously auto-splayed mid-voice coverage for our 100 m venue:

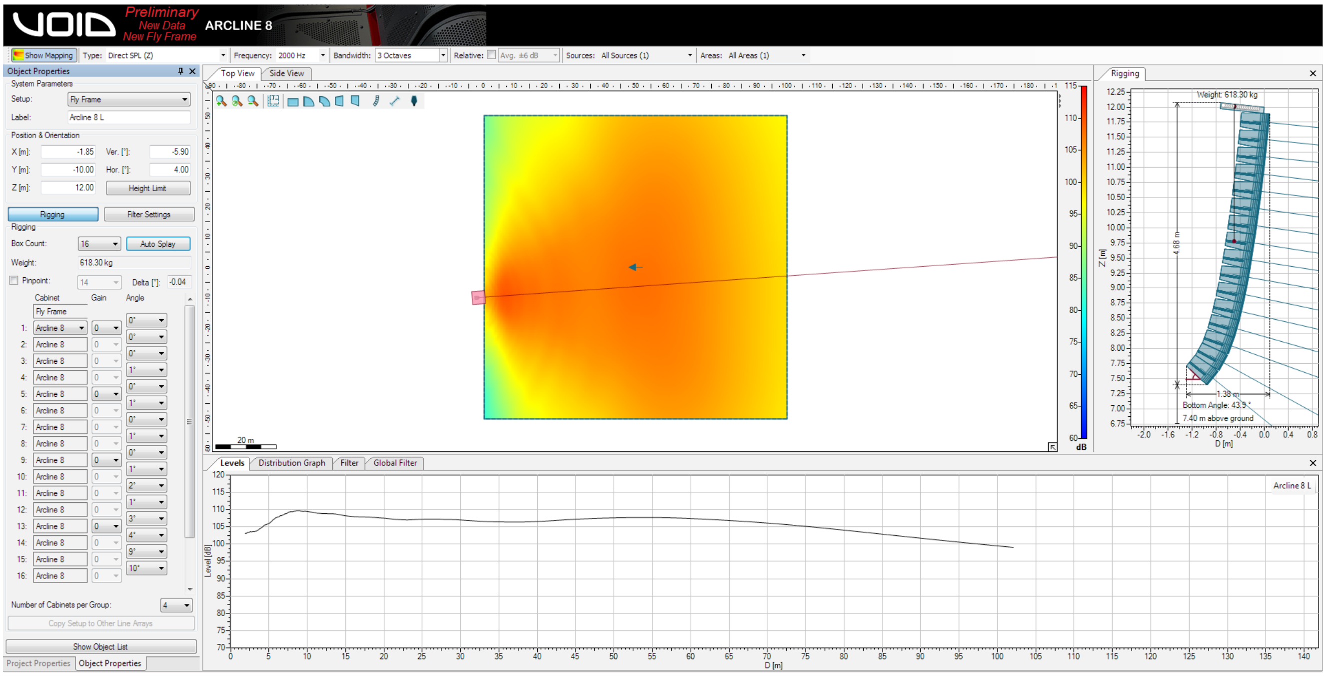


Figure 7.6: Top view showing initial 2 kHz 3-octave coverage
using EASE Focus 3's "Conventional" auto splay

7 System design

The auto-splayed design is probably acceptable as it is; but if the FOH happened to be positioned in the level bump around 55 m, its dB(A) reference level would look higher than the levels around it – at 35 m and beyond 70 m, for example.

And here's an example of what can be done to smooth out the coverage by simply adjusting the array tilt and inter-cabinet (splay) angles (reducing the splay angle to increase summation/level, increasing the splay angle to reduce summation/level). No headroom-robbing broadband gain adjustments have been made –see the 2nd note below.

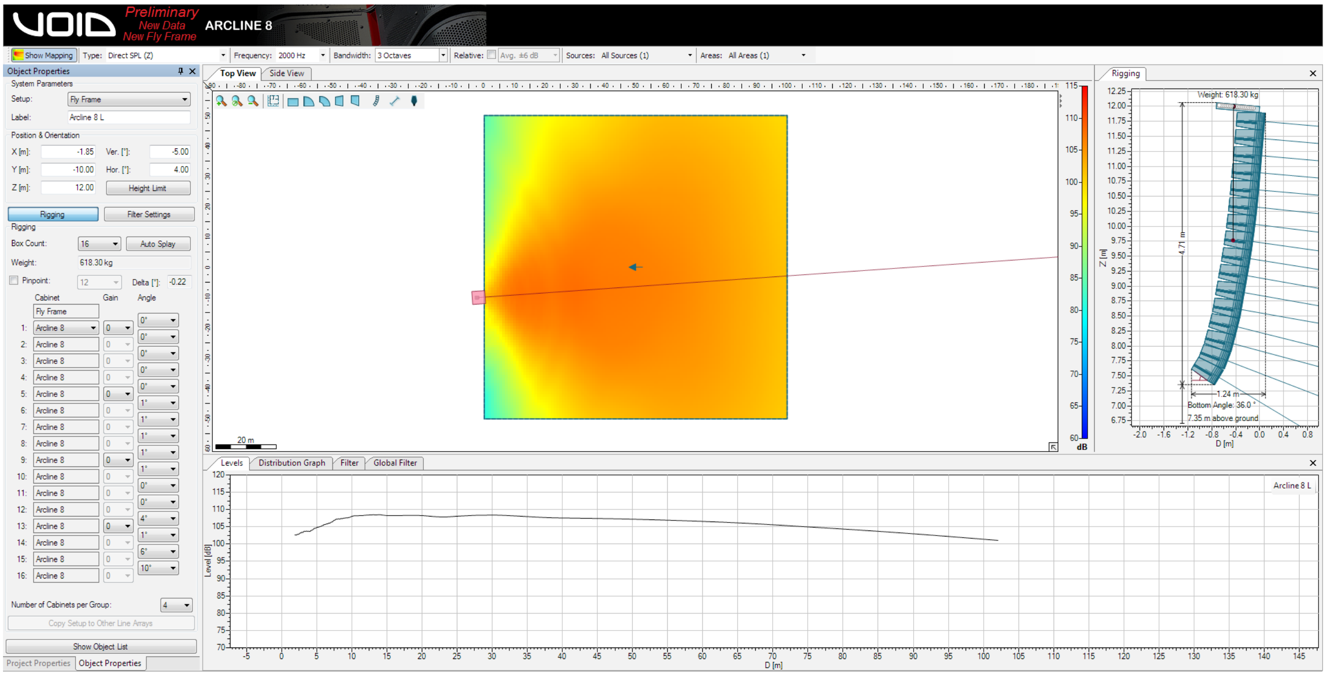


Figure 7.7: Top view showing initial 2 kHz 3-octave
coverage after manual inter-cabinet angle adjustments

When every dB helps, it makes sense to smooth out vocal coverage - and it's always worth ensuring that, if the FOH level is going to be monitored for noise abatement purposes, its vocal levels shouldn't be significantly higher than other audience areas.

Note: A relatively flat coverage profile is usually designed first to ensure robust initial coverage. Fine section-by-section gain adjustments would be made with listening tests to achieve a natural reduction of level vs distance.

At first glance, you might argue that we haven't improved things level-wise, but don't forget that the above two plots are for just three (vocal) octaves so they are well below broadband SPL levels - see earlier.

A Note about EASE Focus 3's broadband gain adjustments

Significant broadband gain boosts to the upper section of an array during manual adjustments (using the Gain adjustments available in EASE Focus 3's Systems properties panel) would cause EASE Focus 3 to display significantly lower maximum SPL levels than the instantaneous peak levels expected in practice. This is due to EASE Focus 3's strict adherence to maximum RMS SPL which doesn't allow one array section (or "group") to be boosted beyond its maximum SPL capability. Instead, a "boost" to one group is translated as no boost at all, but simply as an equal and opposite cut to all other groups in the array.

For instance, a 3 dB gain "boost" to the upper four cabinets of the 16-cabinet array above, would simply attenuate the other twelve cabinets by 3 dB in EASE Focus 3 terms. This situation would only happen in practice if all the array section limiters were ganged – and then only when the highest gain section was driven into limit.

So, it's best to leave any array shaping to the Void Arcline 8 presets – which will be banded rather than broadband.

The array sizes per venue depth shown here will be perfectly sufficient in reality as peak SPLs will be significantly higher than the RMS values shown.

7.4.4 Balconies and bleachers

As you will observe when designing systems for smooth audience coverage using EASE Focus 3, array shapes need to be tailored to the venue profile (the shape of the audience areas observed as a vertical section). The classic array shape (with increasing curvature from top to bottom) often needs to be modified for venues with bleachers or balconies. In fact, the upper (balcony) and lower (stalls) sections each need their own curvature – a kind of double-curvature array.

Balconies example

This double-curvature approach is particularly important if the mix position is tucked away under the balcony.

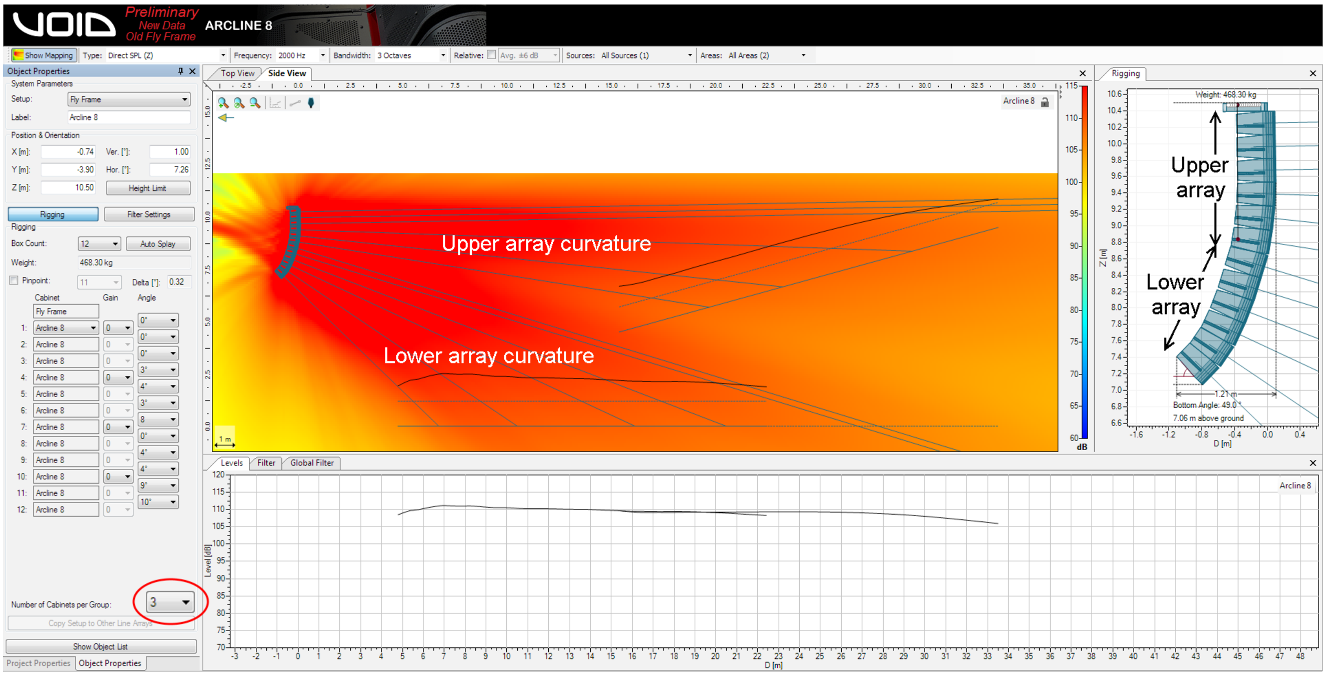


Figure 7.8: Venue side view showing initial stalls & balcony 2 kHz 3-octave coverage after manual inter-cabinet angle adjustments

The Number of Cabinets per Group has been set to 3 (circled red at bottom left of above screenshot) to allow for fine stalls, under-balcony, front balcony and rear balcony level adjustments.

Again, the relatively flat initial level profiles shown in the examples on this page ensure robust initial coverage. Fine sectional gain adjustments would be made with listening tests to achieve a natural reduction of level vs distance.

Bleachers

A double curvature approach can also help with floor and bleacher audience areas. Note the two curvatures; one from the top to the bottom of the bleacher - and another from the rear to the front of the floor.

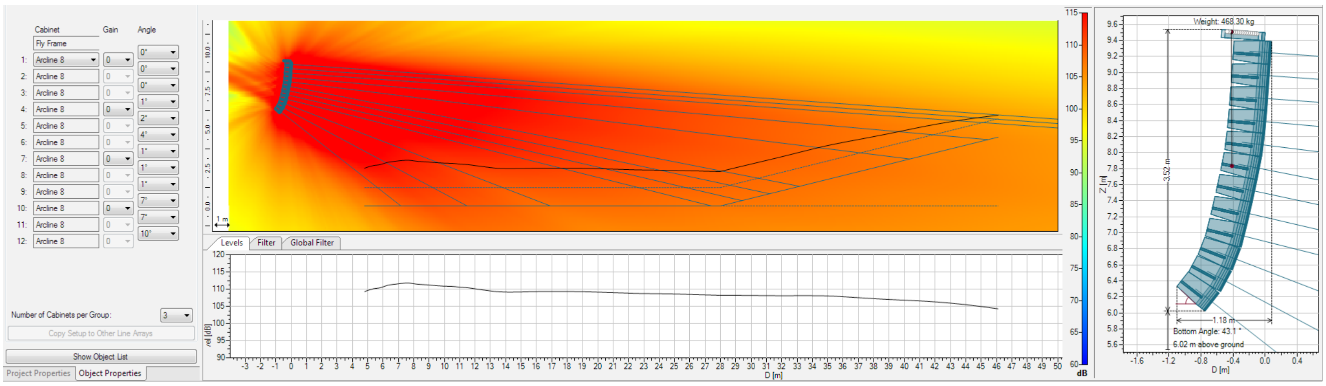


Figure 7.9: Venue side view showing initial floor & bleacher 2 kHz 3-octave coverage after manual inter-cabinet angle adjustments

8 Flying and stacking

8.1 Arcline rigging components and key features

8.1.1 Arcline fly frame

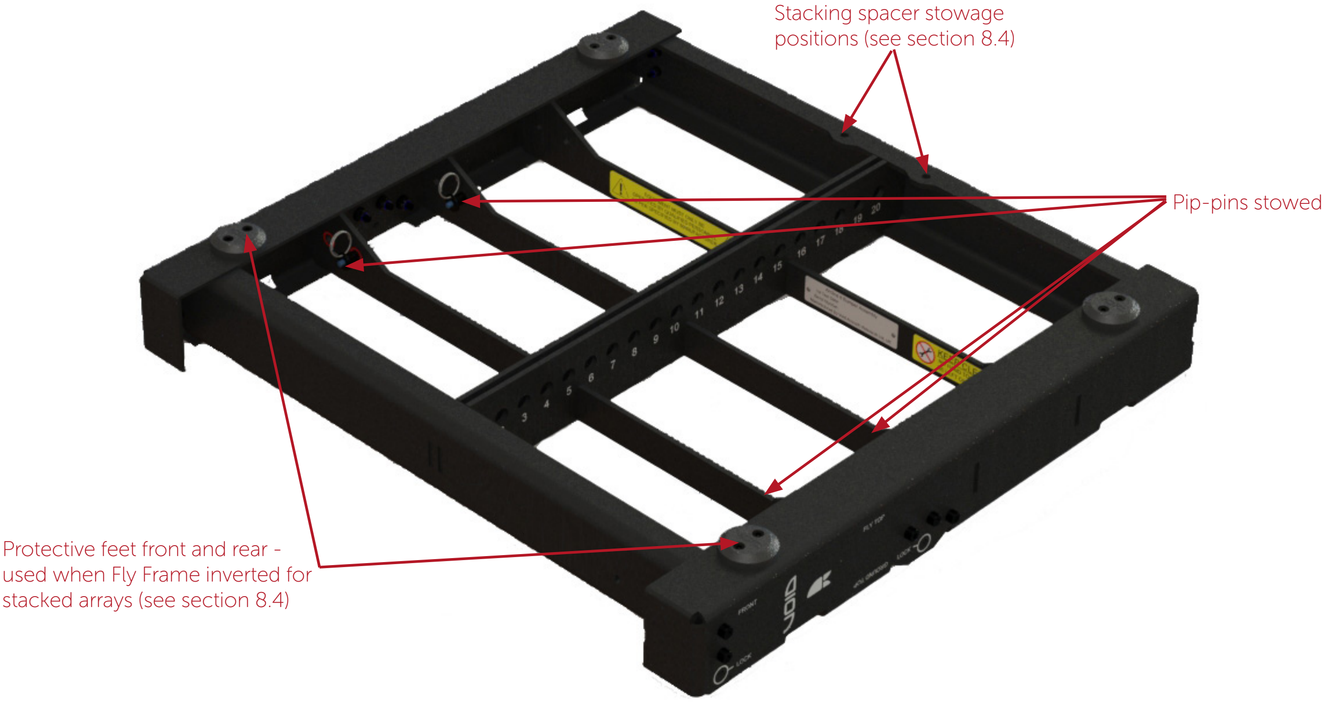


Figure 8.1: Void Arcline 8 Fly Frame looking from front right - shackles and pip-pins stowed for trucking
(Top four protective feet used when Fly Frame inverted for stacking)

⚠ Note! The stowage positions should never be used as flying or safety points!

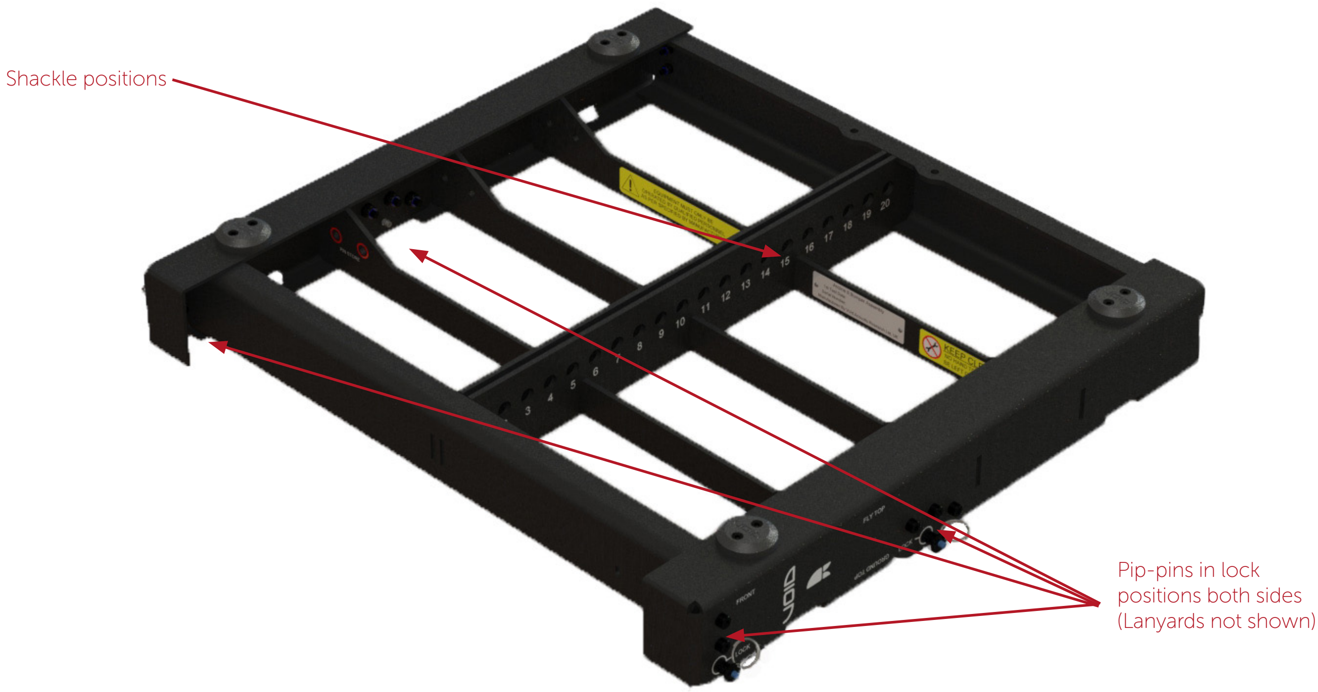


Figure 8.2: Void Arcline 8 Fly Frame looking from font left - shackles and pip-pins deployed

8.1.2 Laser/inclinometer

Your Void Arcline flying system can be fitted with a Sigma Electronics Prosight2 Laser/ inclinometer system for Fly Frame tilt angle verification and aiming. A typical Arcline 8 system is supplied with two sender units (one on each Arcline 8 Fly Frame) and a meter unit.

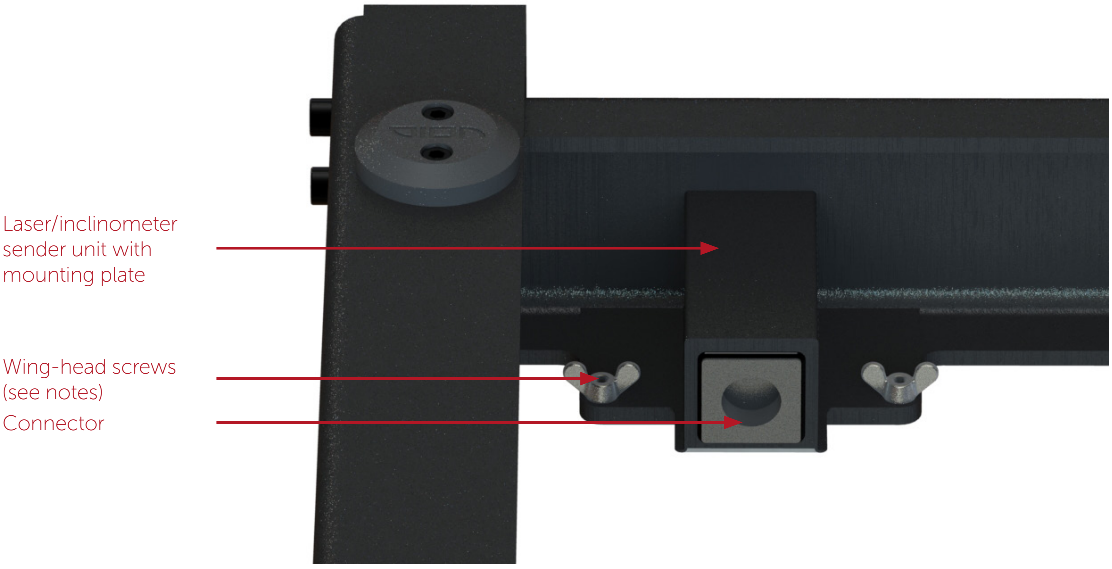


Figure 8.3: Void Arcline 8 Fly Frame laser/inclinometer sender unit mounting

Important notes:

⚠ The sender unit must be fitted with a safety lanyard Thread-locking fluid must be used on the wing-head screw threads to prevent loosening.

⚠ Always observe laser safety precautions.
Click here to download the Prolight2 User Guide

Cabling

Data is transferred from the sender unit to the meter via a fully-populated (all pins connected) Cat5e cable with EtherCON connectors. The sender unit gets its power via this fully-populated Power over Ethernet (PoE) cable.

The laser/inclinometer's PoE cabling must NEVER be patched into your amplifier control network.

For further details, see - www.prosight2.co.uk

8 Flying and stacking

8.1.3 Arcline 8

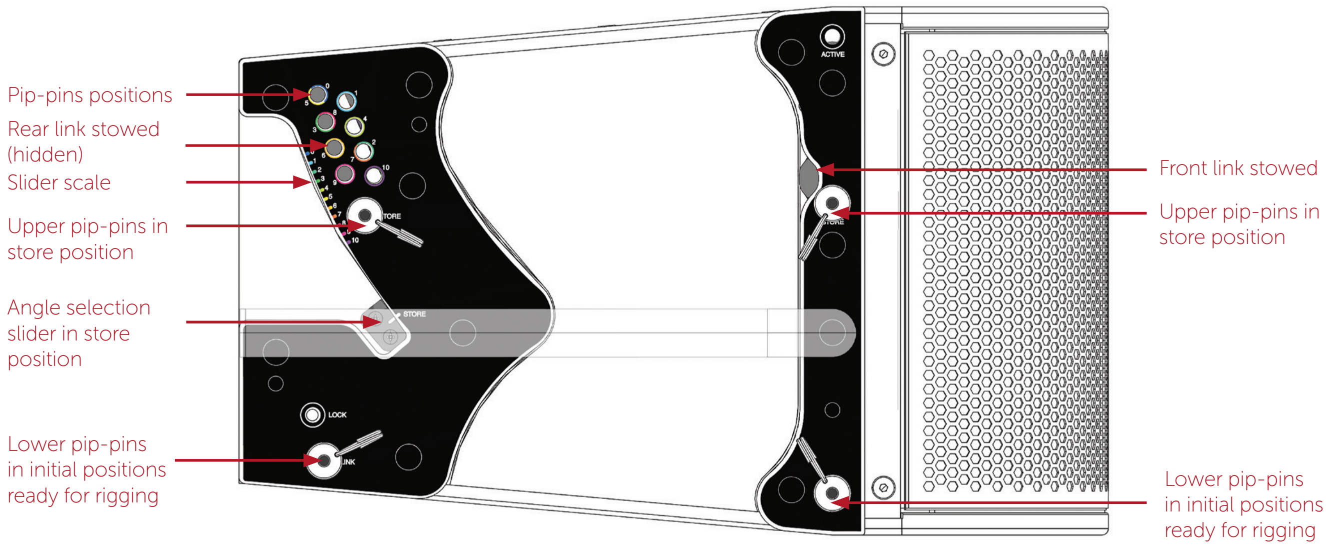


Figure 8.4: Void Arcline 8 left side view–links stowed

Note that Arcline 8 cabinets are usually trucked in groups of four, either cased straight (all set to 0°) to take up the minimum truck space or preset to the required inter-cabinet angle and cased tight-packed.

See information on rear link positions later.

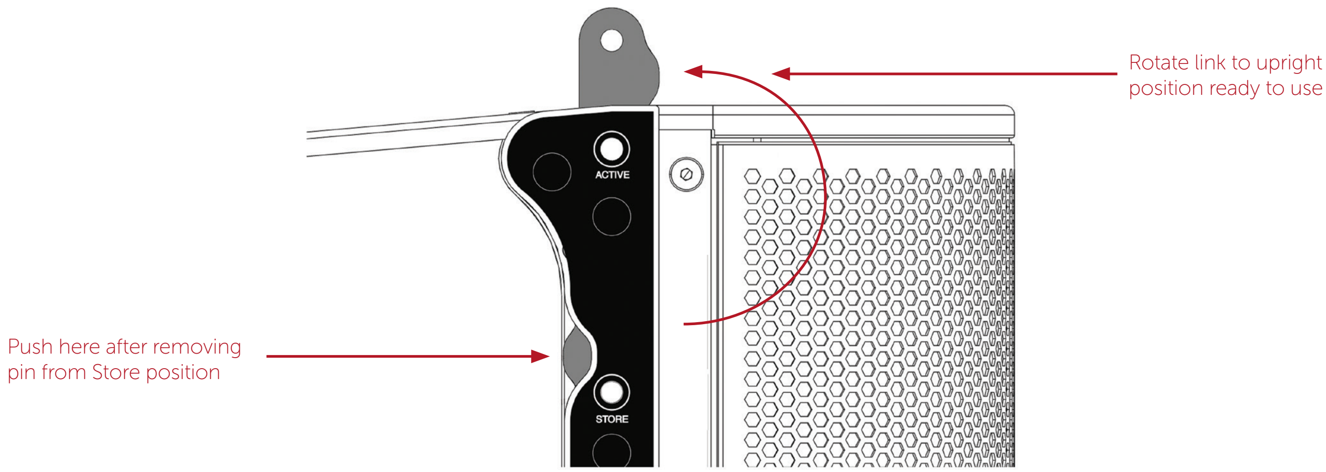


Figure 8.5: Void Arcline 8 front link deployment

Once the pip-pin is removed from the Store position, the link can easily be pushed forward to emerge from the front of the rigging mechanism. It may then be rotated to a vertical position ready for use.

8 Flying and stacking

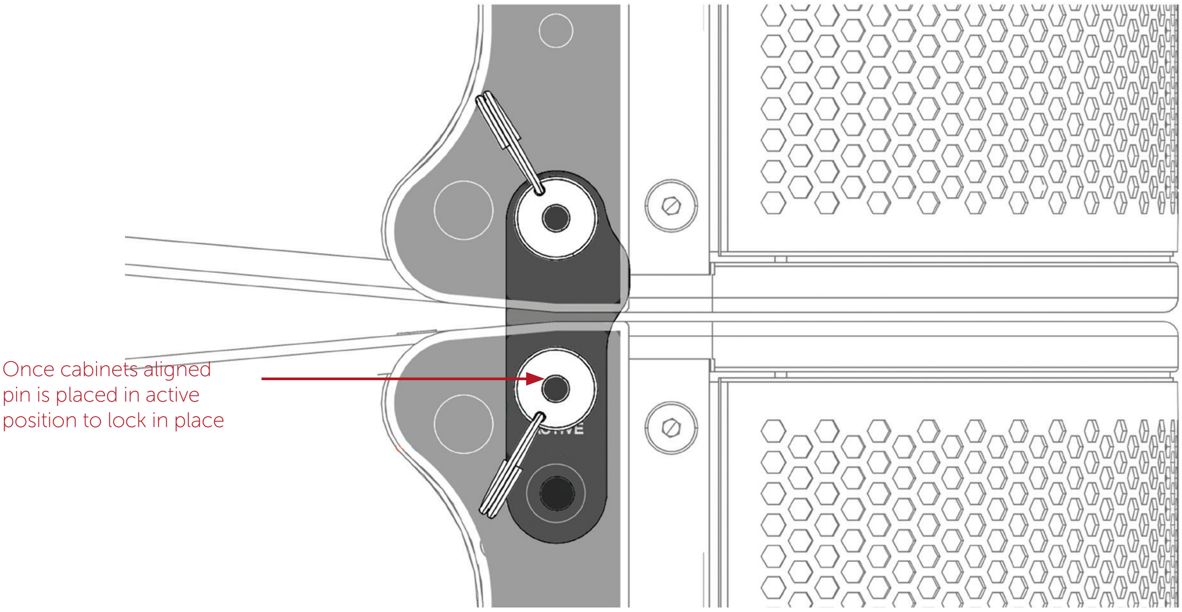


Figure 8.6: Front link pinned in Active position

Once upper and lower cabinets have been physically aligned and successfully linked, a pin is inserted into the Active position to maintain close coupling.

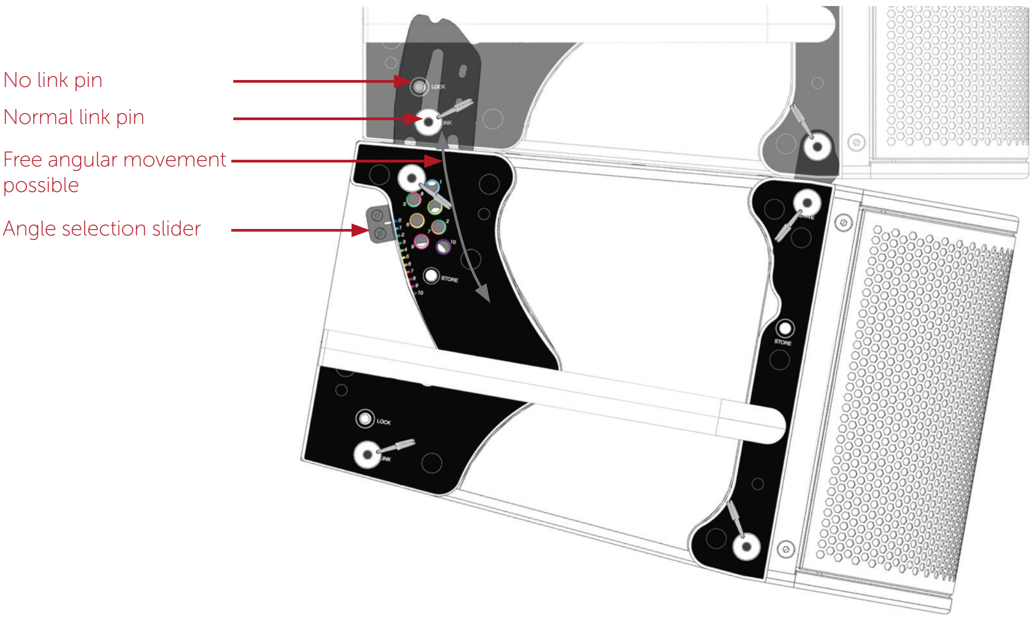


Figure 8.7: Rear link unlocked – cabinets tight-packed

When cabinets are linked together with only the rear Link pins, full angular movement is available due to the slotted rear link mechanism. Arcline 8 cabinets may be tight-packed – typically in groups of four – allowing all the inter-cabinet angles to be preset with the Angle Selection Slider and pre-pinned. This example shows two cabinets preset for a 0° splay angle. Groups of cabinets are usually raised at the rear (to tight-pack) and then lowered in a controlled way using a small chain hoist or lever hoist. See later.

8 Flying and stacking

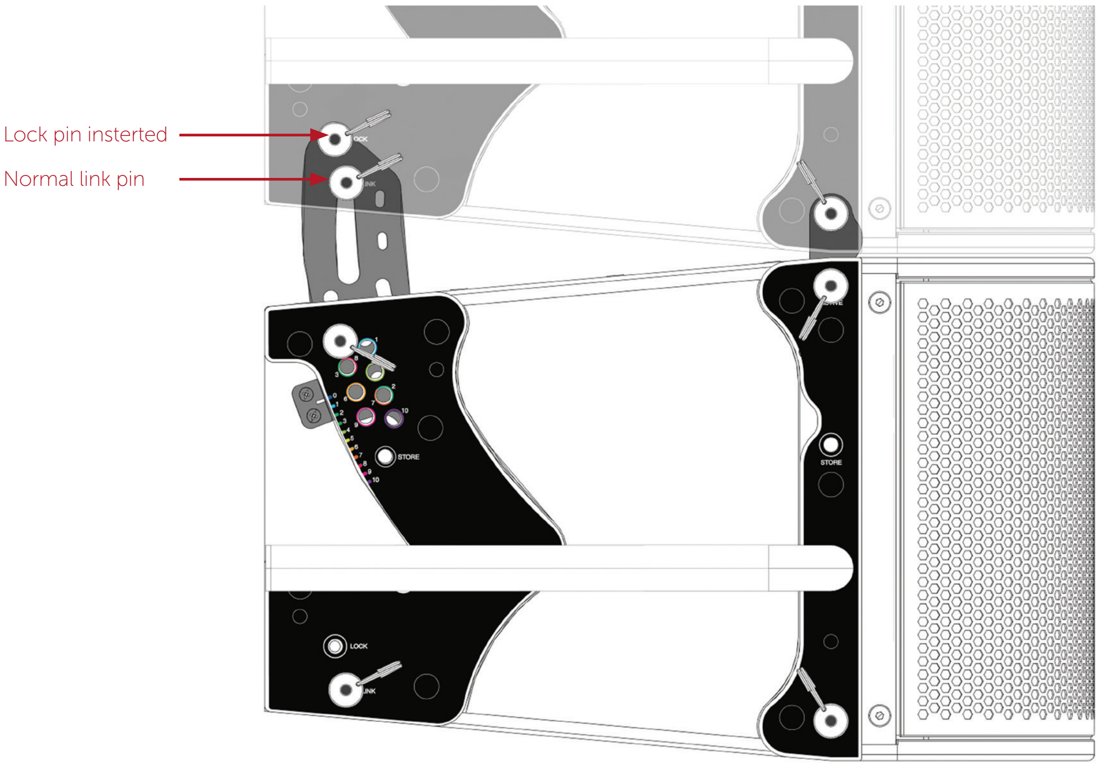
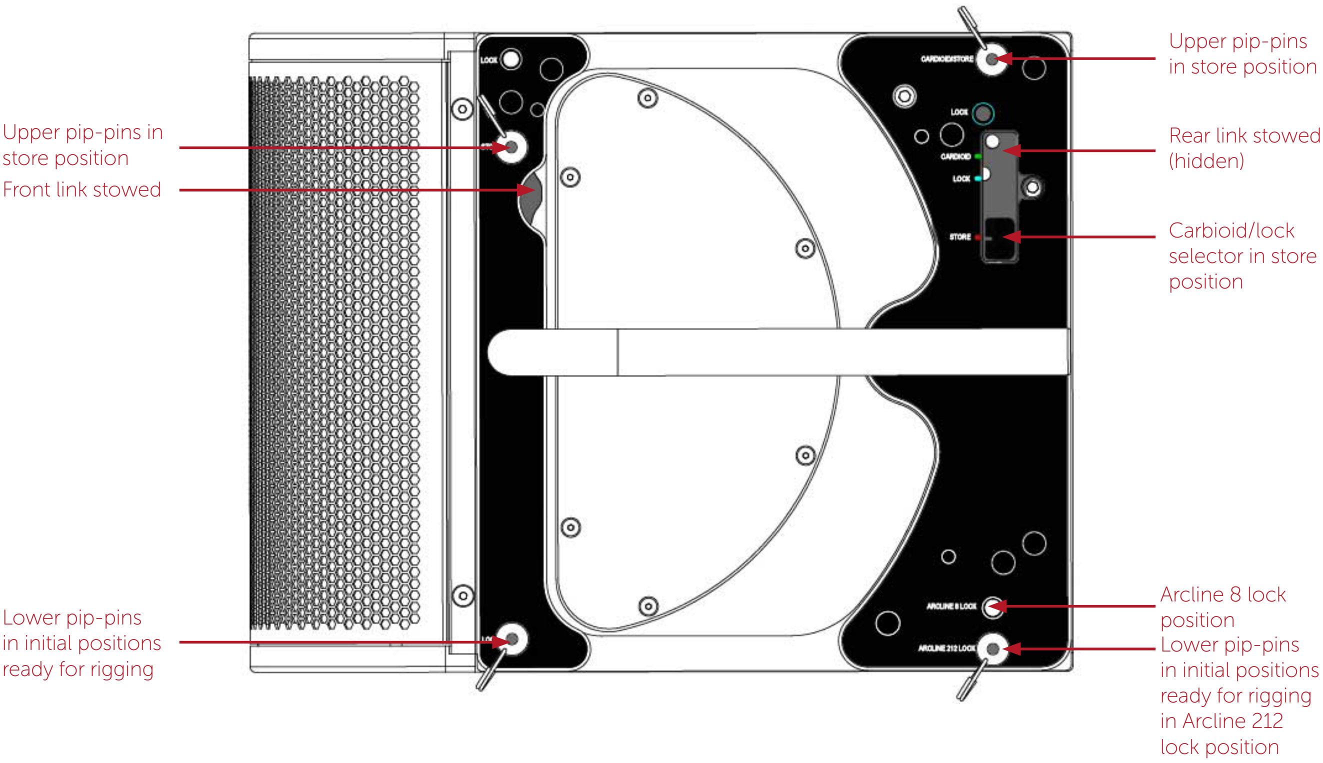


Figure 8.8: Rear of cabinet lowered and lock pin inserted

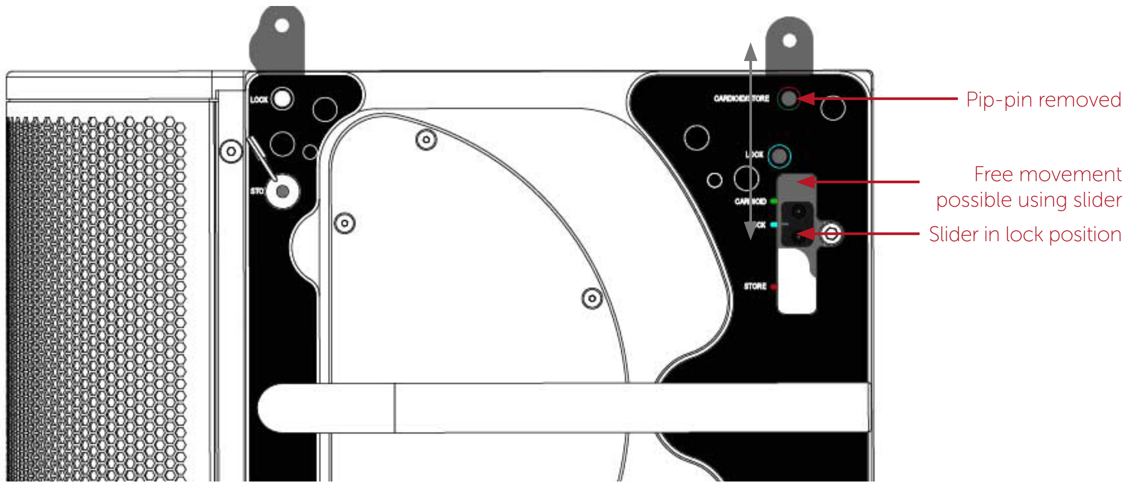
The preset angle is obtained once the bottom boxes are lowered and the normal link pin reaches the top of the rear link slot. An extra pin is now inserted into the lock position to prevent accidental array compression – when an array is up-tilted, for example.

8 Flying and stacking

8.1.4 Arcline 212

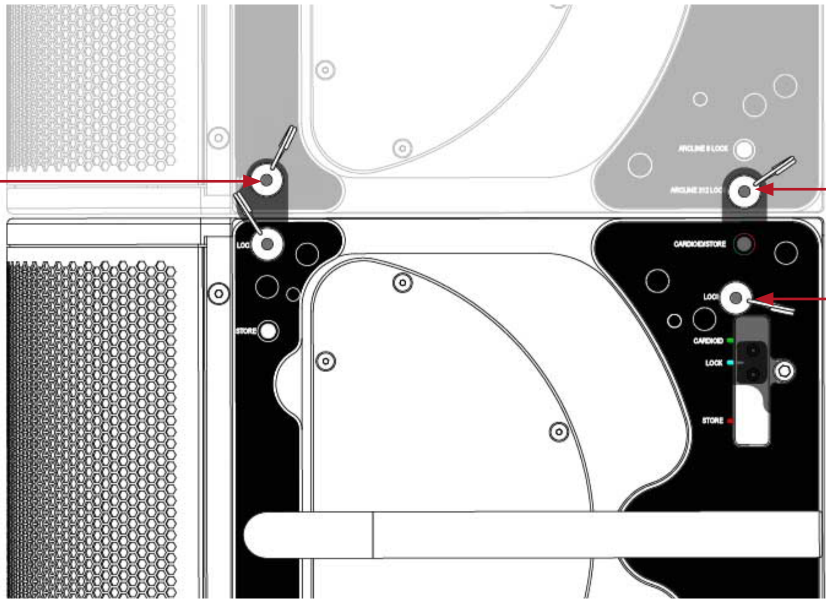


Arcline 8 and Arcline 212 front link follows the same procedure. See section 8.1.3 above for instructions on fitting the front link and pip-pin.

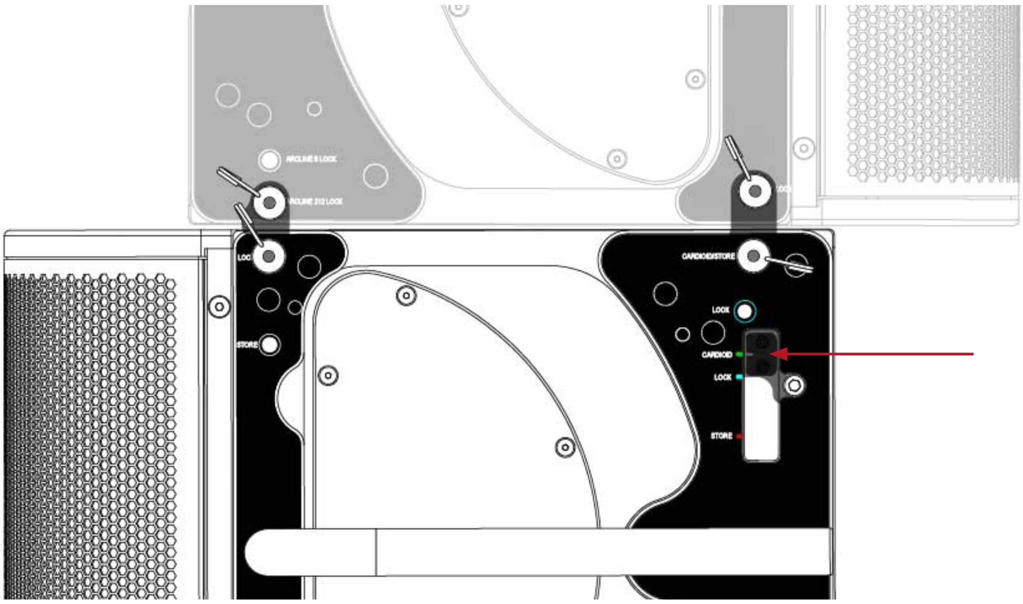


Removing the rear pip-pin allows the rear link to move freely. Use the slider to move the link into the desired position and insert the pip-pin into the relevant slot.

8 Flying and stacking



Once the cabinet is in position insert the lower pip-pins from the upper cabinet into the lock position. Note that for Arcline 8 use the upper lock position as shown above.



When deploying the Arcline 212 in cardioid configuration follow the same procedure but move the slider to the cardioid position and insert the pip-pin.

8 Flying and stacking

8.2 Rigging safety

⚠ To avoid mechanical hazards, please note the following:

- Safety regulations vary in different regions. Full compliance with those regulations must be your priority
- Keep clear of rigging operations if you are tired, distracted, unwell or suffering from the effects or after-effects of medication, alcohol or drugs
- Rigging and stacking must only be undertaken by fully qualified and experienced riggers in full compliance with local, national and international regulations
- Remember that all personnel have a duty of care to themselves, to their assistants, to the venue staff and to the public
- Before lifting any part of the system above head height, check the whole rig for loose tools or other items that may fall and cause injury
- Ensure that you watch the rig and its motors during motor operations. Do not allow yourself to be distracted by inclinometer readings etc. The inclinometer meter may be checked each time the rig is stopped
- Do not use a telephone (even if hands-free) whilst rigging. Always concentrate fully on the rigging operation
- Do not rig equipment that is worn, damaged, corroded, mishandled or over-stressed in any way
- Do not fly more than 24 Arcline 8 cabinets
- Do not stack more than 6 Arcline 8 cabinets
- Use only Void-approved accessories.

8.3 Typical flying procedure

The Arcline Fly Frame allows arrays to be flown from single or dual lifting motors:

- A single motor pick-up complies with the single 1-tonne points found in many small to medium sized venues. Refer to the EASE Focus 3 system design software for the recommended Fly Frame pick-up hole number. (Section 7.1)
- Dual motor pick-up provides additional up/down tilt control. This makes rigging easier and provides horizontal aiming stability indoors. (Breezy outdoor conditions may still require stabilising guys)

8 Flying and stacking

Typical flying sequence, once the Fly Frame has been flown and lowered

Once you have familiarised yourself with the key features of the Arcline 8 Fly Frame and cabinet rigging facilities (section 8.1), flying the system should be easy. Follow this sequence:

Assuming your Arcline 8 cabinets have been pre-linked and trucked in groups of four:

1. Attach the first four cabinets to the Fly Frame. (The top cabinet is set to 5° to be parallel to the Fly Frame)
2. Remove the rear Lock position pins
3. Double-pin the Arcline 8 bridle assembly (illustrated below) to the bottom cabinet's lower rear Lock & Link positions and attach a bridle to the bottom cabinet's lower rear pip-pin position
4. Then attach a temporary chain hoist or lever hoist between the bottom cabinet's rear bridle and the Void-supplied oval ring. (Note: the bridble is not a lifting device and is not intended to be used as a sole point of lifting)
5. Now temporarily tight-pack the array
6. Preset the inter-cabinet angles with the angle selection slider and pin the appropriately coloured angle hole.

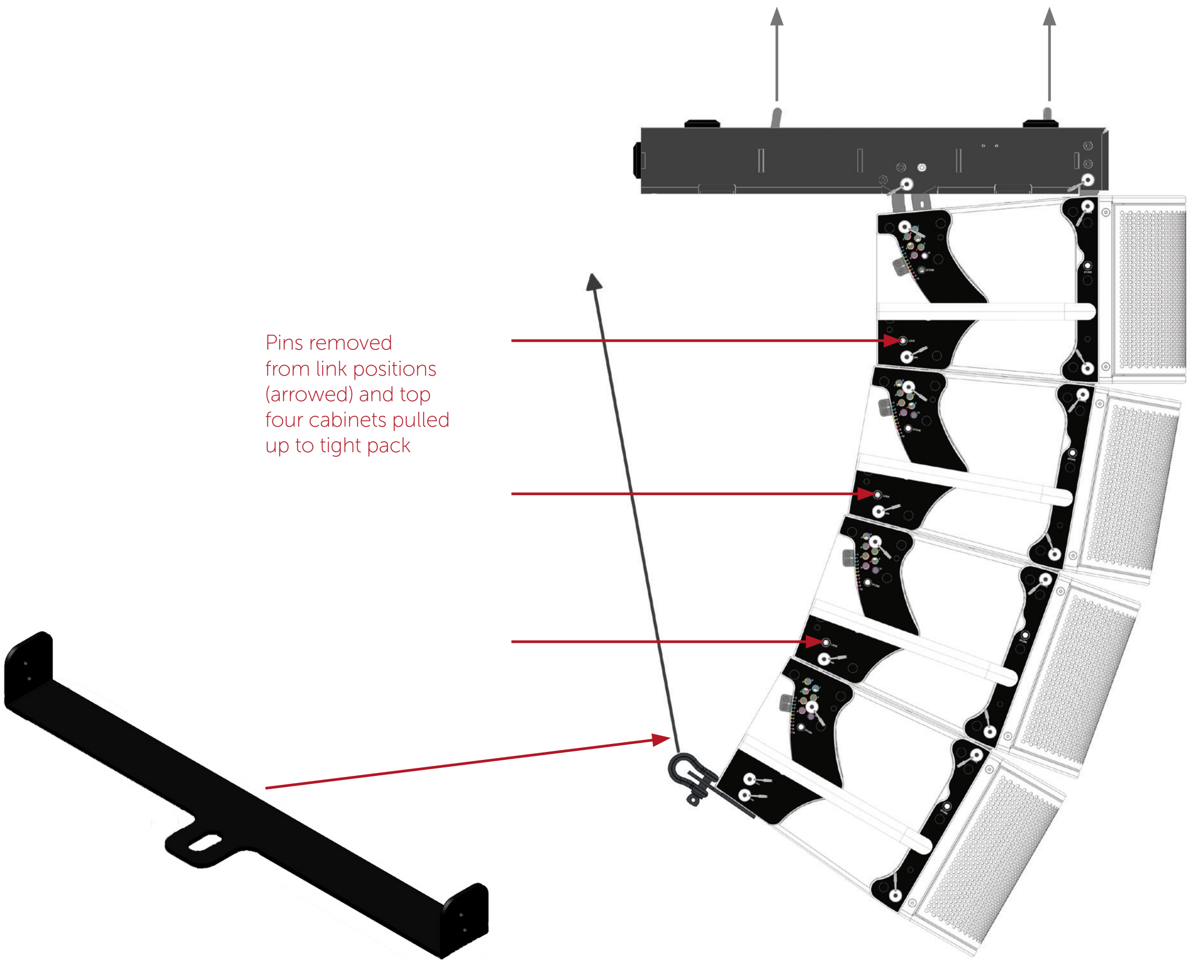


Figure 8.9: First four cabinets after steps 1 – 6 have been completed
Rear bridle assembly - attach to rear of bottom cabinet

7. Gently release the hoist to allow the cabinets to take up their preset inter-cabinet angle positions
8. Replace the rear Lock position pins (arrowed in figure 8.10)
9. Remove the temporary chain hoist
10. Remove the rear bridle

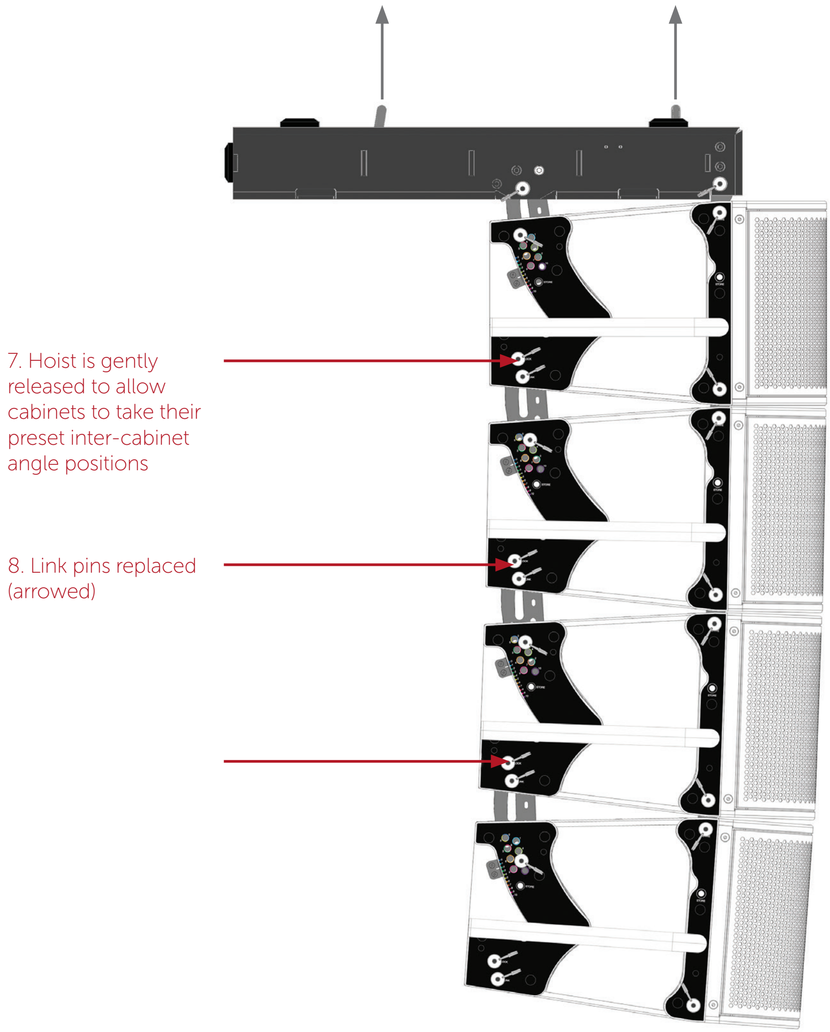


Figure 8.10 : Steps 7 – 10 have been completed and the chain hoist and rear bridle have been removed

8 Flying and stacking

Further cabinets

The sequence may be repeated to increase the length of the array up to a maximum of 24 Arcline 8 cabinets.

Again, assuming your Arcline 8 cabinets have been pre-linked and trucked in groups of four, additional cabinets are added as follows:

1. Attach the next four cabinets to the ones above
2. Remove these next four cabinets' rear Lock position pins
3. Double-pin the Arcline 8 bridle assembly to the bottom cabinet's lower rear lock & link positions and attach a bridle (see previous page) to the bottom cabinet's lower rear pip-pin position
4. Again, attach a temporary chain hoist or lever hoist between the bottom cabinet's rear bridle and the Void-supplied oval ring. (Not visible in the illustration below but usually attached to a rear Fly Frame)
5. Now temporarily tight-pack the new four cabinets
6. Preset the inter-cabinet angles with the angle selection slider and pin the appropriately coloured angle hole

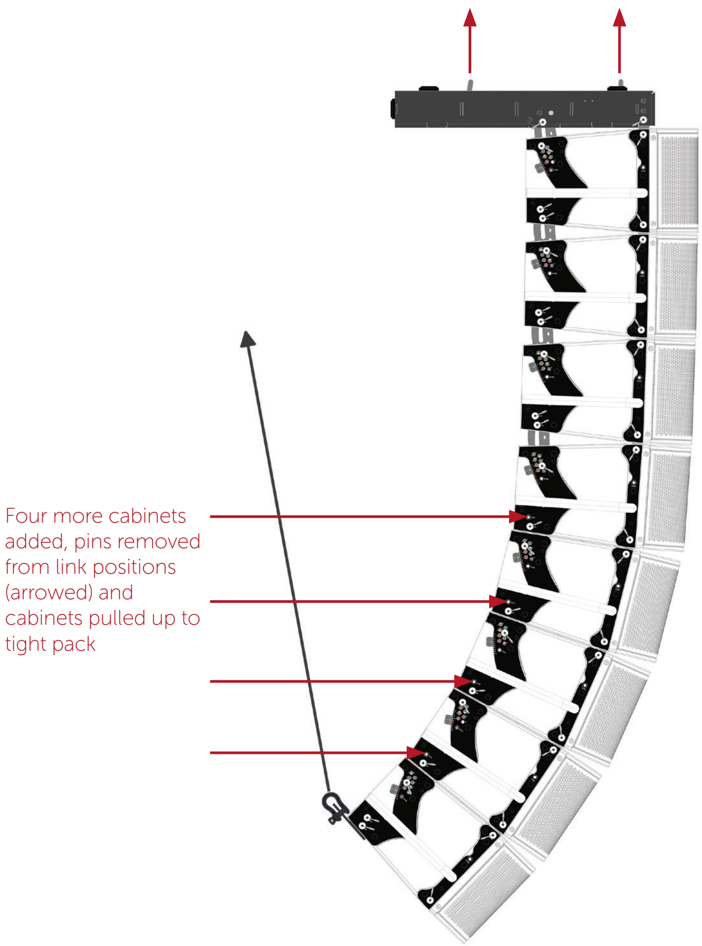


Figure 8.11: Steps 1 – 6 are repeated and another four cabinets are linked underneath, their Lock position pins removed and the extra four cabinets temporarily pulled back to a tight-pack configuration to allow angles to be preset

8 Flying and stacking

7. Gently release the hoist to allow the cabinets to take up their preset inter-cabinet angle positions
8. Replace the rear lock position pins
9. Remove the temporary chain hoist
10. Remove the rear bridle.

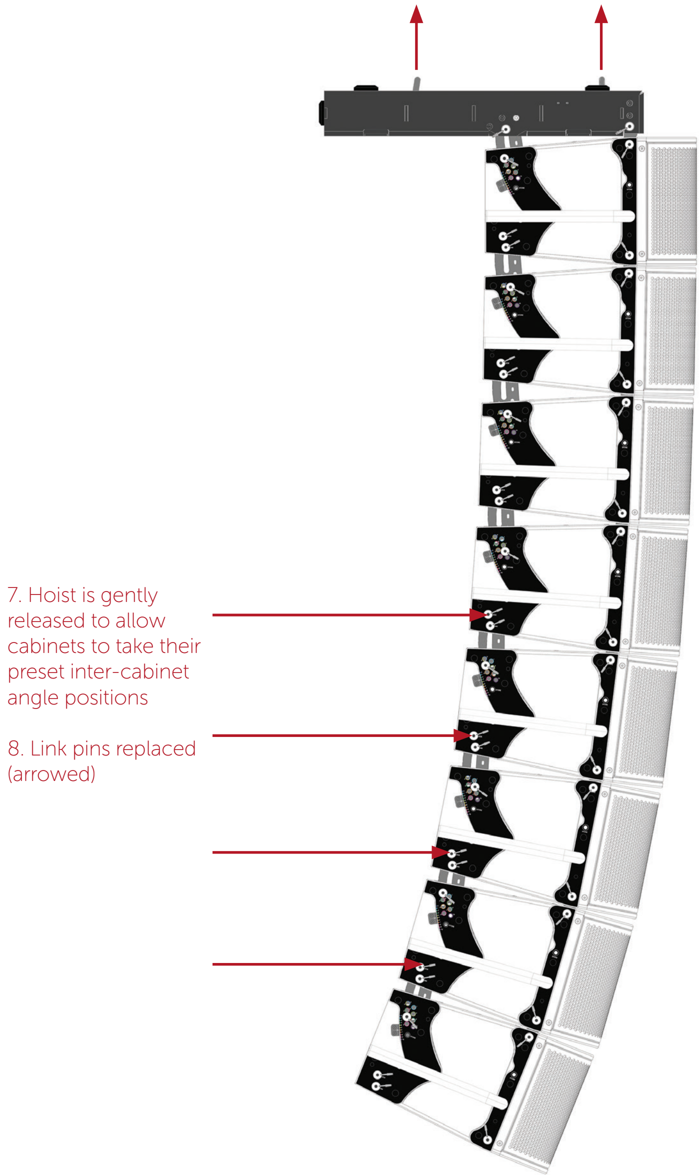


Figure 8.12: Steps 7 – 10 have been completed and the chain hoist and bridle have been removed

8.4 Stacking

Important stacking safety notes
You are advised to employ a qualified rigger for system stacking

- Do not stack Arcline 8 systems more than six cabinets high
- Always stack on a solid mounting base
- Your Arcline 8 stack must be safety-tethered to a solid and well-anchored structure with the strength to prevent the array from toppling over if tilted well beyond its tipping point
- Safety tethering should provide a 5:1 load-bearing safety margin
- Do not tether to scaffolding unless it has been specifically designed and ballasted for the purpose
- When designing stacked Arcline 8 arrays, always use EASE Focus 3 with the latest approved Arcline 8 System definition (GLL) file installed – and ensure you make things safe if presented with warnings
- Ensure that EASE Focus 3 confirms that your Arcline 8 stack's centre-of-gravity (CoG) at least 150 mm behind the front of the inverted Fly Frame
- Ensure that safety barriers are installed between the stack and the venue staff, audience and crew. The space between safety barrier and array must be at least the array height +20%.

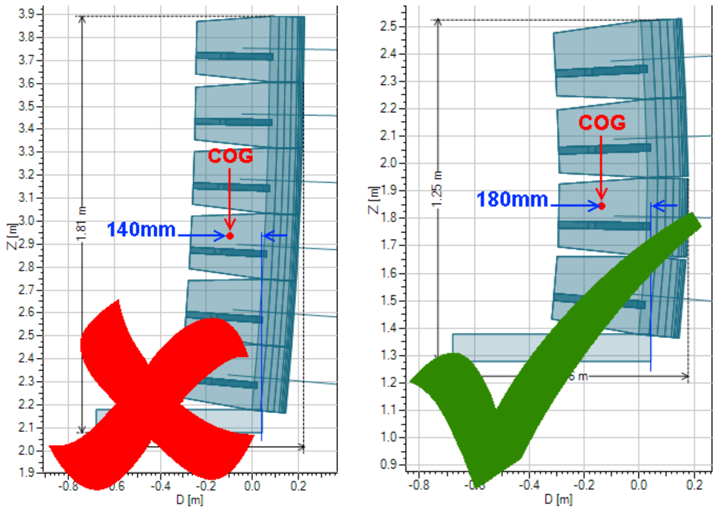


Figure 8.13: Arcline 8 stack centre-of-gravity

8 Flying and stacking

Stacking your Arcline 8 system

The Arcline 8 Fly Frame and Arcline 8 cabinets are inverted for stacking. Think of an Arcline 8 stack as a completely inverted array (below).

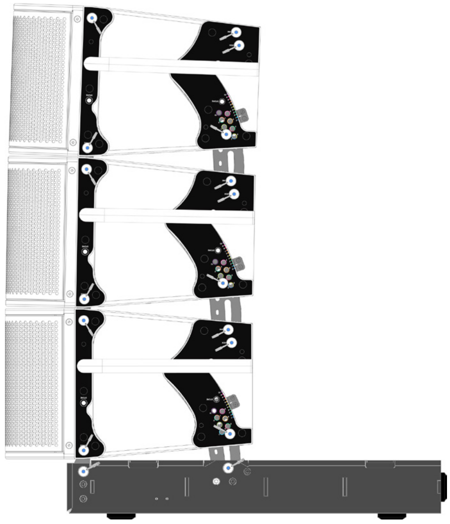


Figure 8.14: Arcline 8 stack showing inverted Fly Frame and cabinets

Stacking spacer

Steeper tilts may be required if the system is stacked on a high stage wing or a tall stack of subwoofers.

Mirror-image stacking spacers are available to provide an extra 10° of tilt when required.

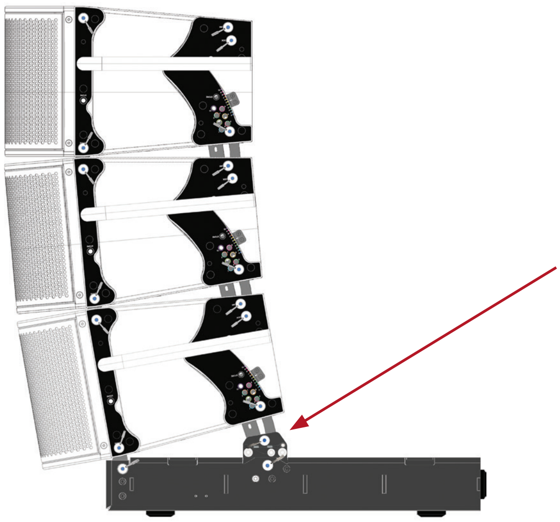


Figure 8.15: Arcline 8 stack showing stacking spacers

The stacking spacers fit between the lower Arcline 8's rear arms and the Fly Frame (arrowed above).

8 Flying and stacking

The spacers slot into rear cabinet arm sockets on the inverted Fly Frame

Figure 8.16: Stacking spacers shown deployed and ready for use

The stacking spacers may be stowed at the rear centre of the Fly Frame for transportation.

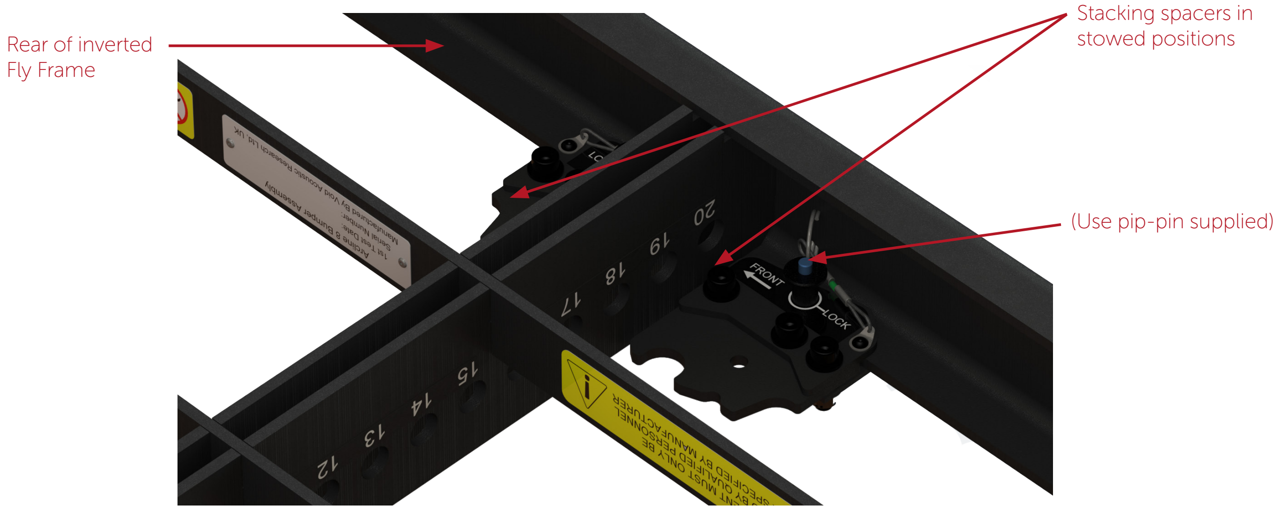


Figure 8.17: Stacking spacers in stowed position for transportation

9 Typical configurations

9.1 Stacking

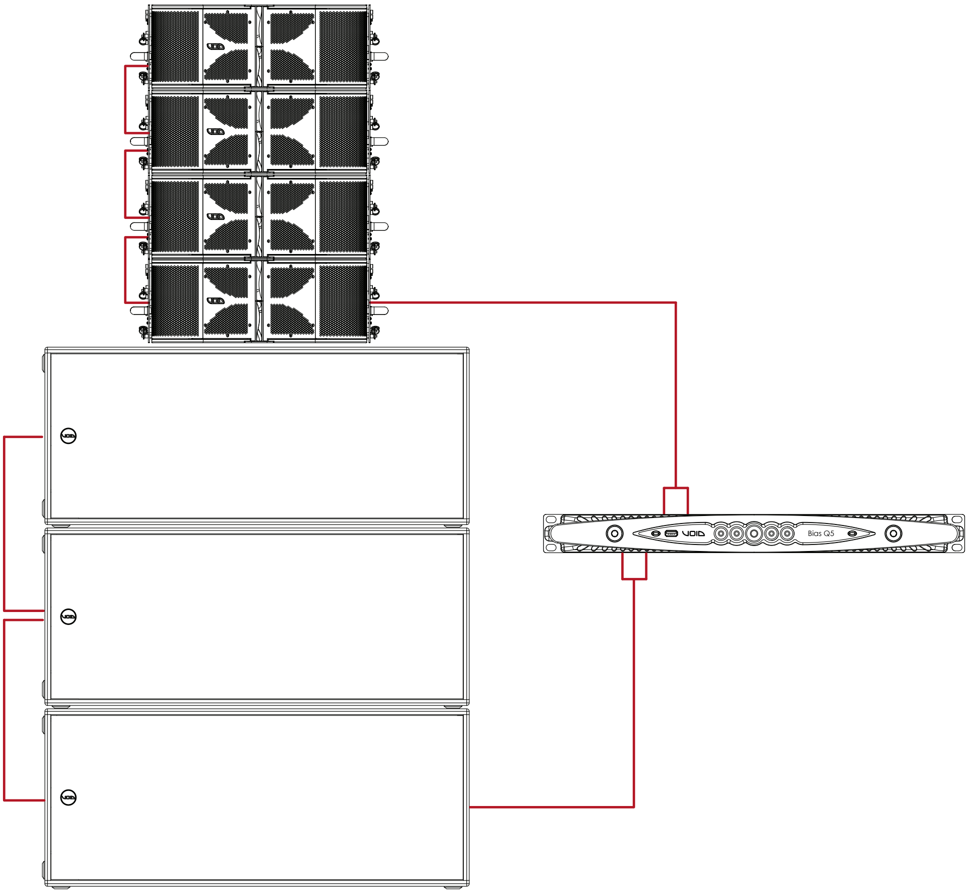


Figure 9.1: 3 x Arcline 218 and 4 x Arcline 8

A standard configuration for ground stacking is three Arcline 218 with four Arcline 8. This gives a loading of 2.66 Ω on channel 1 and 2 for the Arcline 218 and 4 Ω on channel 3 and 4 for the Arcline 8. Loading the amplifiers asymmetrically like this makes use of the amplifiers power sharing capabilities.

9 Typical configurations

9.2 Flying Arcline 8

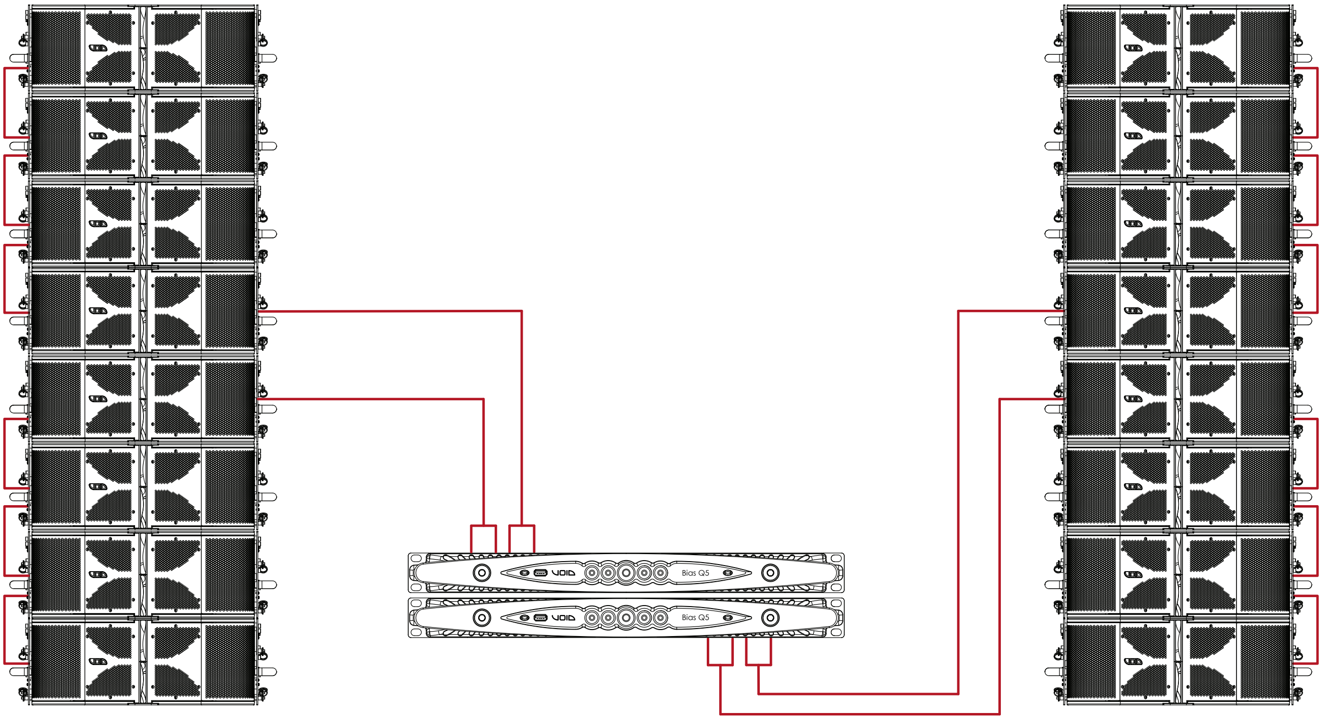


Figure 9.2: 16 Arcline 8

Flying eight Arcline 8 per side for stereo sound with four cabinets per every two amplifier channels keeping the impedance at 4 Ω. Use one amplifer per side.

9 Typical configurations

9.3 Flying Arcline 8 with Arcline 212

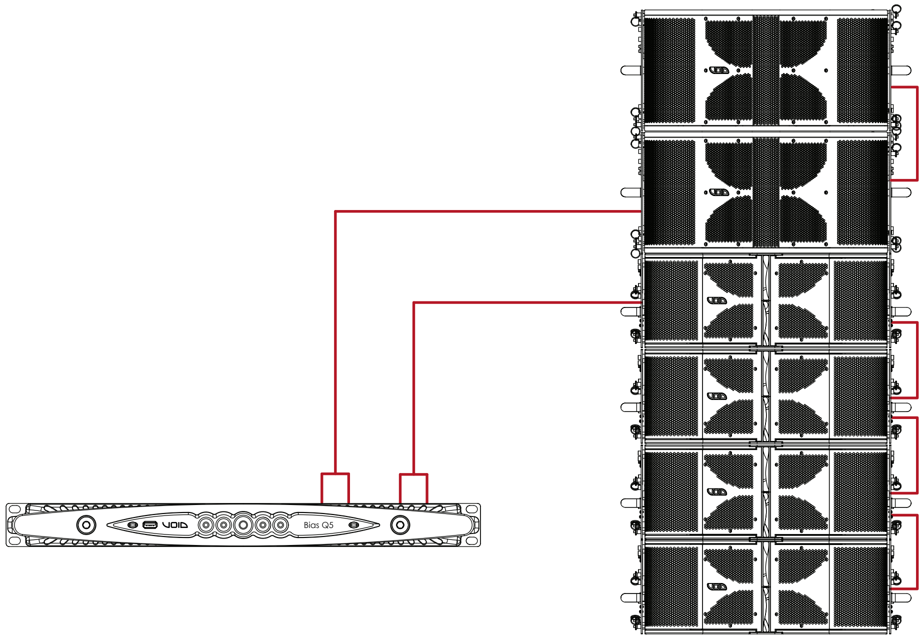


Figure 9.3: Arcline 8 with Arcline 212

Arcline 8 and Arcline 212 should be configured in a 2:1 ratio. Two Arcline 212 and four Arcline 8 keeps the impedance to 4 Ω.

10 Service

Void Arcline loudspeakers should only be serviced by a fully-trained technician.

No user serviceable parts inside. Refer servicing to your dealer.

10.1 Return authorisation

Before returning your faulty product for repair, please remember to get an R.A.N. (Return Authorisation Number) from the Void dealer who supplied the system to you. Your dealer will handle the necessary paperwork and repair. Failure to go through this return authorisation procedure could delay the repair of your product.

Note that your dealer will need to see a copy of your sales receipt as proof of purchase so please have this to hand when applying for return authorisation.

10.2 Shipping and packing considerations

- When sending a Void Arcline loudspeaker to an authorised service centre, please write a detailed description of the fault and list any other equipment used in conjunction with the faulty product.
- Accessories will not be required. Do not send the instruction manual, cables or any other hardware unless your dealer asks you to.
- Pack your unit in the original factory packaging if possible. Include a note of the fault description with the product. Do not send it separately.
- Ensure safe transportation of your unit to the authorised service centre.

11 Appendix A - Line array basics

A.1 Level compensation vs distance

Point sources

Non-line array loudspeakers - and line arrays at low frequencies - tend to have near-spherical radial radiation characteristics.

Sound radiating from an acoustically small omnidirectional source would radiate in all directions from a common point source. However, we'll deal with directional sound sources (e.g. HF horns) here as these are more typical for PA use.

A directional sound source's radiation will be restricted to just part of a sphere.

We've used a conical horn in this example

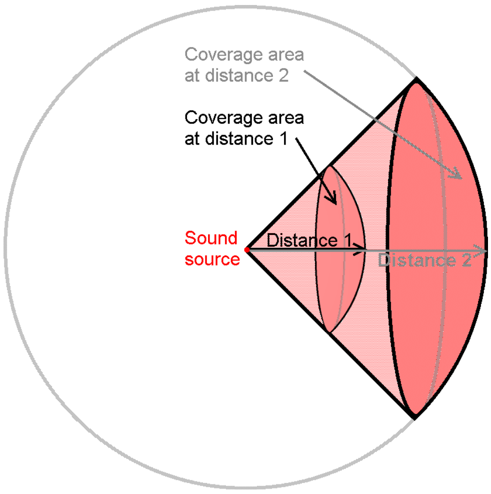


Figure A.1: Conical point source

The coverage area will increase by the square of the distance so sound intensity (measured in power per coverage area - e.g. watts per square metre) will decrease with distance squared. This is the often-quoted inverse square law.

However, as sound pressure is proportional to the square root of sound power, sound pressure (measured in force per coverage area – e.g. newtons per square metre or Pascals) decreases in proportion to the distance (not the square of the distance). In terms of sound pressure (the parameter most commonly used to measure sound levels in the PA world), we have an inverse-proportional law not an inverse square law.

So sound pressure from a spherically radiating sound source halves every time you double the listening distance.

In terms of relative sound pressure, sound pressure decreases by a factor of 20 x $Log_{10}2$ every time you double the distance - a 6 dB level reduction per doubling of distance.

11 Appendix A - Line array basics

Line sources

If we use an imaginary sound source, e.g. an “ideal” line source that produces a theoretical cylindrical wavefront, we could restrict the radial expansion to width only.

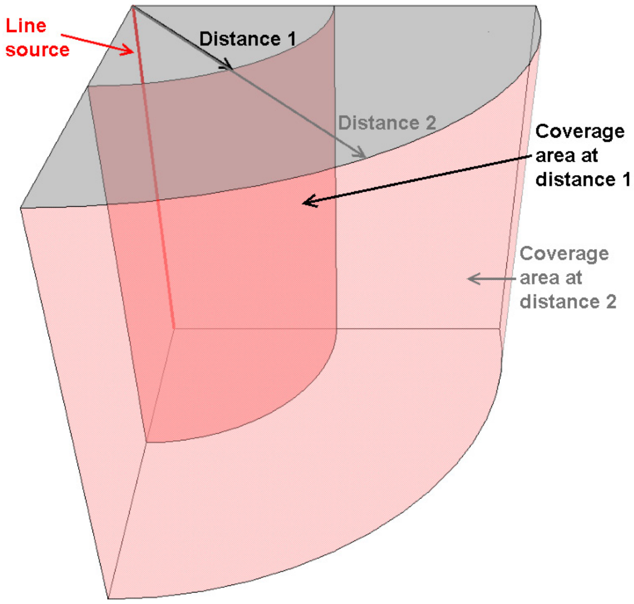


Figure A.2: Theoretical “ideal” line source

The height of our theoretical wavefront would remain constant with distance – see illustration above.

Reducing the radial expansion from two dimensions to one would reduce the sound pressure attenuation from 20 x $Log_{10}2$ = 6 dB per doubling of distance to 10 x $Log_{10}2$ = 3 dB per doubling of distance. The technique effectively extends the system’s nearfield.

The only snag with this imaginary “cylindrical” radiation pattern is that it rarely exists in practice unless you believe some manufacturers’ sales hype or install an infinitely long array (or a floor-to-ceiling array where the floor and ceiling are perfectly hard boundaries).

Polar response vs array length and signal wavelength

A real-world (i.e. finite-length) vertical array’s vertical directivity will increase with frequency and array length and the wavefront certainly won’t be cylindrical over a wide frequency range.

A straight vertical array will exhibit the directivity function for a uniform line source (assuming it’s driven with constant amplitude and phase over its length).

Its directivity function will vary with the array length ÷ wavelength (L/λ):

$$R_U(\alpha) = \frac{\sin(\frac{\pi L}{\lambda}\sin\alpha)}{\frac{\pi L}{\lambda}\sin\alpha}$$

11 Appendix A - Line array basics

This gives the following characteristics for a six-metre long uniform line source:

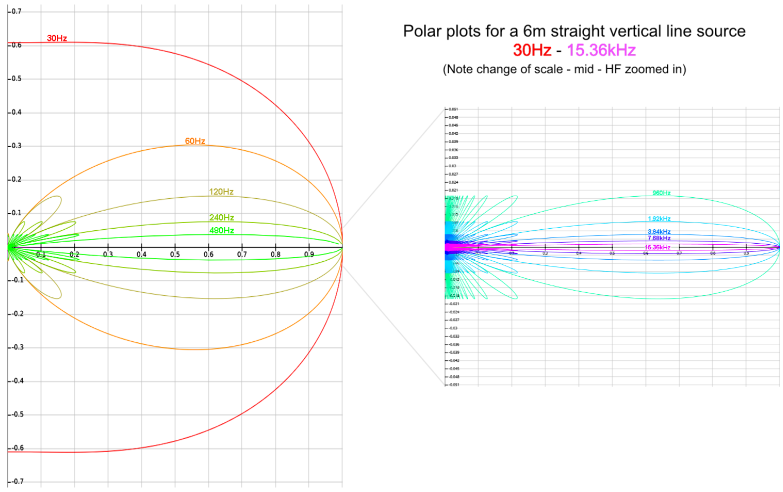


Figure A.3: Polar plots for a 6 m straight vertical line source

At low frequencies, the array will exhibit one main lobe that begins to narrow as L/λ = 1 (where the array length equals the wavelength). One lobe will appear either side of the main lobe at L/λ = 2, two lobes either side of the main lobe at L/λ = 3 etc.

In the above example, L/λ = 1 just below 60 Hz so 60 Hz shows just one central lobe, 120 Hz shows one lobe either side of a central lobe, 240 Hz shows three lobes either side of a central lobe, etc.

The number of lobes on one side + 1 indicates is proportional to L/λ. As L/λ increases, the number of lobes increases but their amplitudes decrease.

Line source emulation and real-world array shapes

In practice, we can achieve near-line source characteristics by vertically arraying multiple sound radiating elements. These elements are usually close-coupled (i.e. placed within ½ wavelength of each other centre-to-centre, or horn mouth-to-horn mouth at high frequencies where wavelengths are short and tolerances proportionally tighter).

We can achieve more practical polar responses by curving our arrays to tailor the vertical coverage to the venue profile. This curvature also gives us control over element-to-element summation* at the listening position.

Near-zero inter-cabinet splay angles emulate a line source for radial attenuation characteristics that approach the theoretical 3 dB per doubling of distance - with useful summation at far-listener positions - whilst larger inter-cabinet splay angles emulate a point source for a 6 dB per doubling radial attenuation characteristic with reduced summation at the listener position. Medium inter-cabinet splay angles can be tailored for anything in between.

(*Sound waves don’t, in fact, sum together; they pass through each other like ripples on a pond. Their effects only sum when they act in unison on the listener’s ear. But we usually refer to sound summation, as that’s what we experience as listeners)

11 Appendix A - Line array basics

Vector summation

Each Arcline 8 has 12° vertical HF coverage (i.e. -6 dB points 6° above and below axis). Adjacent Arcline 8 outputs "sum" together with an efficiency that depends on the axis-to-axis splay angle.

The process is often called vector summation as any phase difference between elements also affects the summation.

The Arcline 8's subtle HF wavefront curvature provides flexible vector summation. It provides good, gap-free coverage at high splay angles whilst retaining excellent wavefront summation for near-zero splay angles.

Assuming all the Arcline 8s HF sections are being driven with identical signals:

- Adjacent Arcline 8 HF outputs sum to a full 6 dB at 0° axis-to-axis inter-cabinet (splay) angles
- A flat array (all Arcline 8s at 0° splay angle) would sum to an extra 6 dB per doubling of cabinets
- Adjacent Arcline 8 HF outputs sum to approximately 0 dB (unity gain) at 12° inter-cabinet angle – but with increased vertical coverage
- A wide variety of summation/coverage options are available for all the angles in between

Here's an example of a real-world (i.e. finite-length, curved) Arcline 8 array:

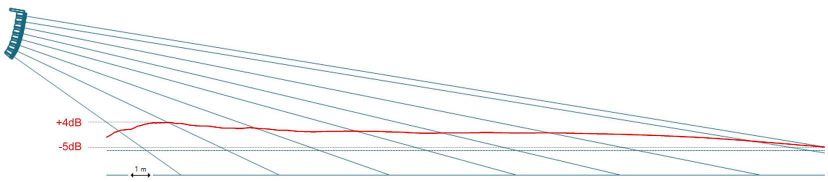


Figure A.4: Array of 8 x Arcline 8 adjusted for very smooth
5 kHz octave coverage of a 35 m flat-floor venue

The inter-cabinet angles were adjusted in the above example for a very flat HF level coverage (shown red above) to show what is possible by simply adjusting splay angles for the required coverage. All Arcline 8s were driven in unison. Here's a detailed illustration of what is going on:

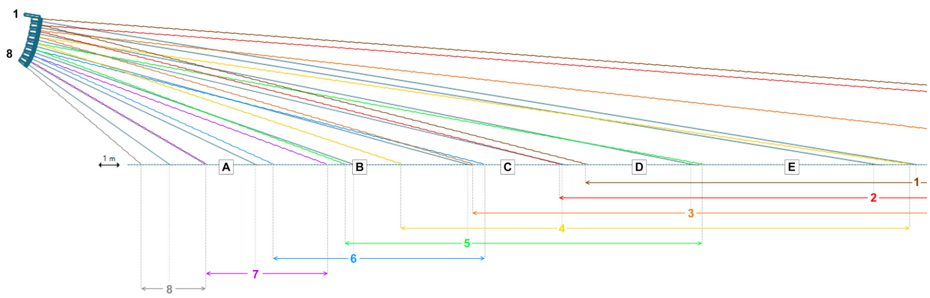


Figure A.5: Arcline 8 vector summation
(The cabinets are numbered from top to bottom – as per EASE
Focus 3 - with -6 dB lines HF coverage lines added for each cabinet)

Level changes are minimised by summing more and more cabinets to compensate for the usual radial attenuation with distance. Front audience area A is served by just one Arcline 8 at a time (7 or 8), area B with two (5 & 6), area C with three (3, 4 & 5), area D with five (1, 2, 3, 4 & 5) and area E with four (1, 2, 3 & 4) – two of which are splayed at 0° to provide maximum on-axis summation for the rear of the audience.

A.2 Transition region and spectral balance

As you can see from the previous illustration, summing an increasing number of Arcline 8 outputs to compensate for increasing listener distance works very well – assuming you've allocated an adequate number of Arcline 8s to cater for the venue depth.

As we usually have a finite number of cabinets, there is a limit to the level compensation available:

1. For a straight vertical array with all cabinets driven in unison, a low attenuation region will extend into the audience to a point where the listener is within the vertical coverage angle of all the cabinets. Beyond that point, often referred to the transition distance (or the nearfield-farfield transition), there are no more cabinets available to provide compensation so we move into a high attenuation region – in fact, a point source type attenuation rate - a 6 dB level reduction per doubling of distance (ignoring air absorption).
2. A curved array will exhibit similar level compensation-vs-distance characteristics, but with fewer cabinets contributing to the rear audience summation at mid and high frequencies – depending on the curvature. In our example, for instance (repeated below), the rear of the audience will be out of the main coverage of cabinets 5 – 8

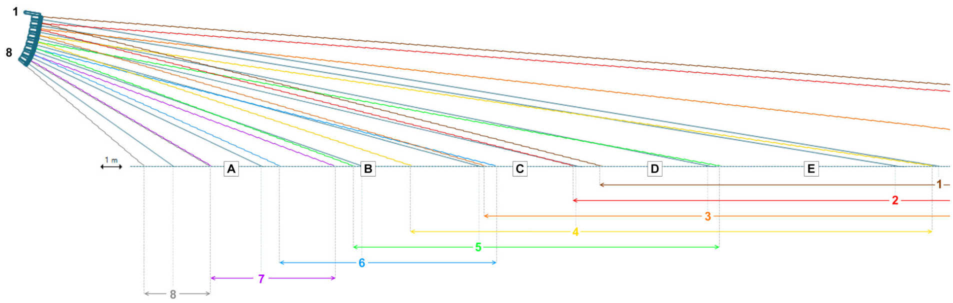


Figure A.6: Arcline 8 vector summation
(The cabinets are numbered from top to bottom – as per EASE
Focus 3 - with -6 dB lines HF coverage lines added for each cabinet)

3. If we assume our venue is outdoors and we zoom out to see the bigger picture, we'll see what happens beyond the rear of the audience where we run out of level compensation vs distance.

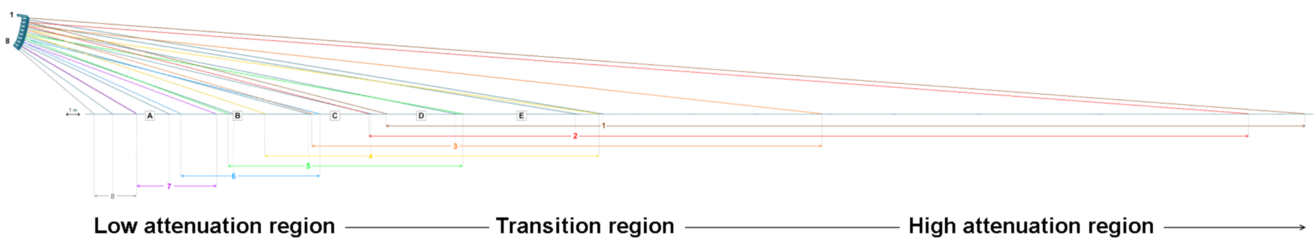


Figure A.7: Attenuation and transition region

Our contributing cabinets dwindle away to the off-axis coverage of cabinets 1, 2 & 3 through 1 & 2 to just 1. The vector summation is decreasing rather than increasing so we enter a high attenuation region at high-mid & HF.

Spectral balance

At low frequencies where individual cabinets are less directional (see earlier), the full vector summation occurs nearer the stage. You enter their combined influence earlier because they are not as directional at LF.

The downside of this is that you run out of cabinets to compensate for radial attenuation earlier too, so the "line array effect" ceases to apply. Smaller array coverage is also difficult to adjust using inter-cabinet angles as opening an angle to reduce vector summation too near the front of the audience would simply create a hole in the mid/HF coverage. And any attempt to equalise, say, the lower cabinets, simply attenuates the whole LF "point source".

This equation is often quoted for a straight array of acoustically small sources:

$$\text{Transition Distance} = \frac{\text{line length}^2 \times \text{frequency}}{2 \times \text{speed of sound}}$$

Source: Mark S. Ureda - Analysis of Loudspeaker Line Arrays

Note that doubling the line length quadruples the transition distance, and vice versa, so don't be tempted to reduce the number of cabinets because "it's only a folk act". The line array advantage disappears with reduced array length.

The transition distance equation above assumes omnidirectional array elements. It is only applicable where individual cabinets' vertical baffle or horn mouth dimensions are acoustically small compared with the wavelengths to be projected.

Most modern line arrays (e.g. the Arcline 8) are modular with each element having acoustically small vertical dimensions below a few hundred hertz (500 Hz and lower for the Arcline 8). Modular arrays rely very heavily on designers specifying a vertical array that's long enough for spectrally balanced coverage to be provided.

Frequency	(C = 343 m/s)	125 Hz	250 Hz	500 Hz
Number of Arcline 8	Straight vertical array length	Approx straight-line transition distance		
4	1.14 m	0.24 m	0.47 m	0.95 m
8	2.28 m	0.95 m	1.89 m	3.79 m
12	3.42 m	2.13 m	4.26 m	8.53 m
16	4.56 m	3.79 m	7.58 m	15.16 m
20	5.70 m	5.92 m	11.84 m	23.68 m
24	6.84 m	8.53 m	17.05 m	34.10 m

Nearfield – farfield transition distances at low/low-mid frequencies

As you can see, the transition distance is almost non-existent for small arrays at low frequencies. In SPL terms, you end up with a low/low-mid coverage peak nearer the stage whereas the same length of array provides much smoother coverage at higher frequencies.

Undersized arrays

The illustration at the top of the following page shows a small, typically-curved array being deployed to cover 100 m.

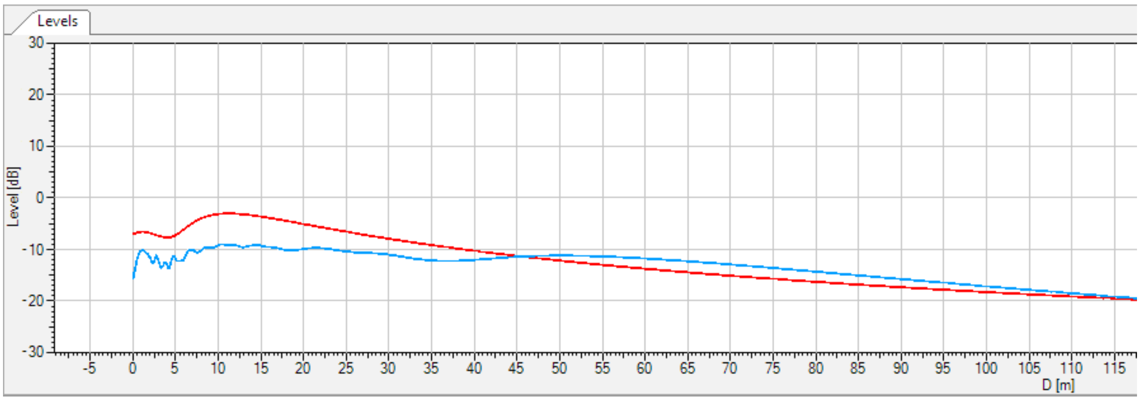


Figure A.8: Flown and curved 6-cabinet (1.71 m) Arcline 8 array – too short for 100 m - showing coverage level vs distance (red = 315 Hz oct, blue = 3.15 kHz oct)

Flying and curving the array can move the coverage peak out a few more metres but the array still acts like a point source.

Any attempt to apply low-mid equalisation to the cabinets covering the front 30 m would be futile as such equalisation simply makes the array act even more like an LF point source

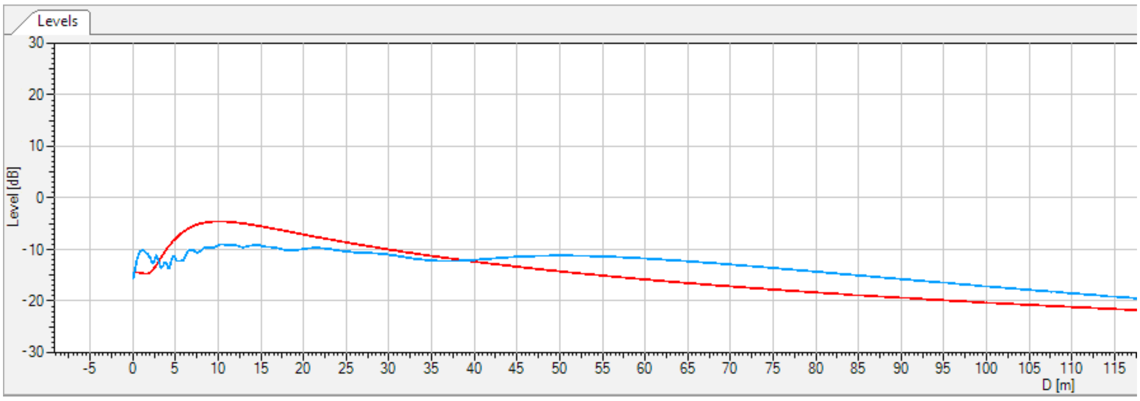


Figure A.9: 6-cabinet (1.71m) Arcline 8 array with futile attempt at bottom cabinet low-mid equalisation (red = 315 Hz oct, blue = 3.15 kHz oct)

Equalising the high-mid/HF to match the low-mid would defeat the object of using a line array, of course.

Adequately-sized arrays

Figure A.10 shows a 24-cabinet array that is more suitable for 100 m coverage:

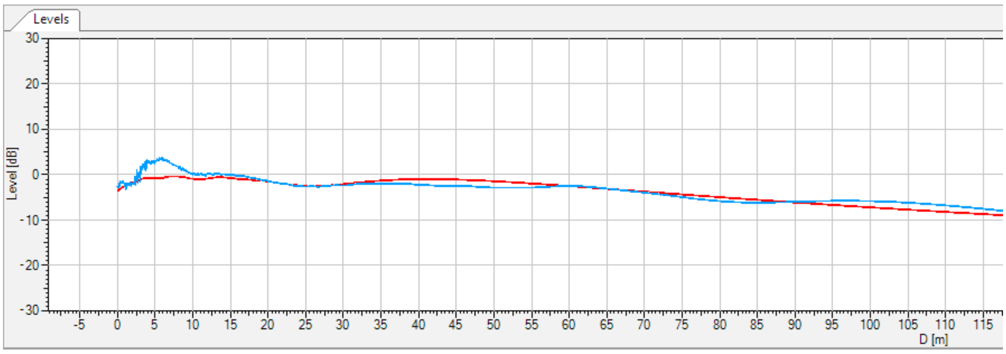


Figure A.10: Flown and curved 24-cabinet (6.84 m) Arcline 8 array showing good low-mid – high-mid spectral balance vs distance (red = 315 Hz oct, blue = 3.15 kHz oct)

The 24-cabinet array is long enough for the low mid directivity to match the required mid/HF coverage of the array.

As a rule of thumb, arrays that are 4.5% (minimum) to 7% the length of the flat-field distance to be covered tend to provide good spectral balance over the vocal range. Section 7.2 for Arcline 8 array length suggestions.

Note: the above examples include some high-mid frequency air absorption, hence the slight drop in the 3.15 kHz (blue) traces at higher distances from the array. See later for information about air absorption.

Broadband coverage level

The length of an array also affects the overall system level. A contiguous, straight vertical array – one that acts as a uniform line source - will provide an additional 6 dB of sound pressure towards the furthest coverage distance every time you double its length.

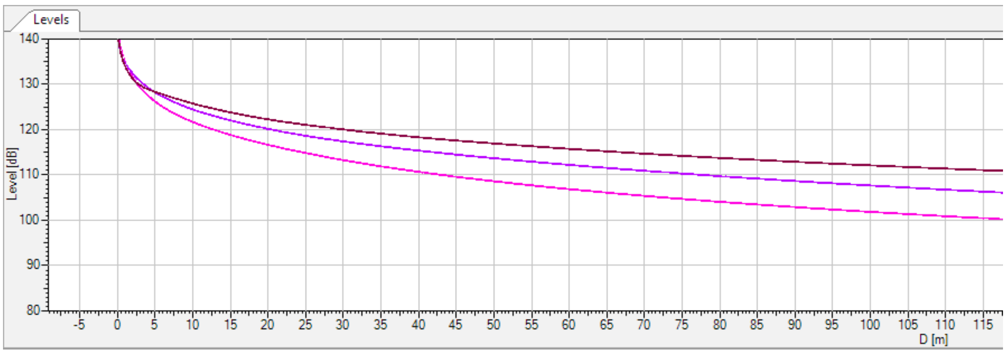


Figure A.11: 6 (1.71 m), 12 (3.42 m) & 24 (6.84 m)-cabinet straight Arcline 8 arrays showing achievable broadband levels vs distance

There is less than 6 dB sound pressure level increase per doubling of cabinets nearer to the array because the audience's ear heights will be below the upper cabinets' mid to high frequency coverage patterns at the front.

(Greater summation is available for audience members further back as they'll be within the coverage pattern of more cabinets.)

A.3 Climatic considerations

Atmospheric (air) absorption

When things sympathetically vibrate in a sound field they absorb sound energy, converting some of that energy to heat and re-releasing an attenuated and phase-shifted version of the sound. Although we tend to think about solid objects when we think of vibration and sound absorption, the elements that make up air also exhibit sound absorbing properties – through viscous losses due to the molecular collisions of all the atmospheric gases plus the vibrational and rotational energy absorption processes of the two main gases, nitrogen and oxygen. Air's absorbent properties are mainly affected by temperature and relative humidity in typical concert venues or festival sites.

These processes are per cycle (per wavelength). This is a problem for long-distance sound propagation as it means that the resultant absorption is per metre, not the radial-type per doubling of distance. And the absorption increases with frequency.

Relative humidity	Temperature °C			
	10°C	20°C	30°C	40°C
10%	0.0696	0.176	0.262	0.220
20%	0.154	0.217	0.167	0.116
30%	0.188	0.168	0.114	0.0838
40%	0.179	0.130	0.0883	0.0707
50%	0.157	0.105	0.0741	0.0646
60%	0.136	0.0889	0.0654	0.0619
70%	0.118	0.0776	0.0599	0.0610
80%	0.105	0.0695	0.0563	0.0611
90%	0.0936	0.0634	0.0539	0.0619

Absorption coefficient (usually shown as α) in dB/metre* at 8 kHz
(8 kHz = minimum bandwidth for good "out of the box" vocal presence)

*Multiply the dB/metre figure by the distance (in metres) required (e.g. 20% RH, 20°C gives a 21.7 dB 8 kHz loss at 100 m).

Red= 8 kHz greater than 20 dB loss at 100 m, Orange= greater than -15 dB at 100 m, Brown = greater than -10 dB at 100 m.

More about air absorption coefficient

Here's a graphical representation of the sound absorption mechanisms mentioned on the previous page:

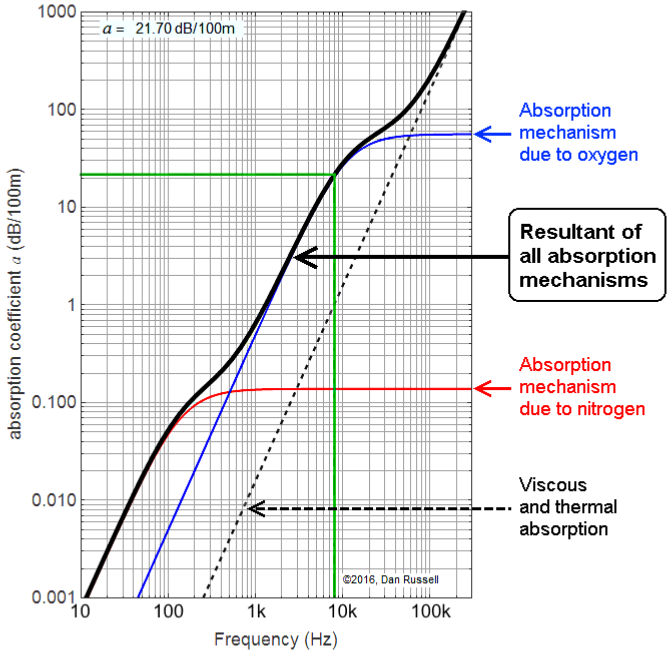


Figure A.12: Graphical representation of atmospheric sound absorption at 20% RH, 20ºC and 1.0 atm
(The Green lines & text box show the 21.7 dB/100 m (vertical axis) loss predicted for 8 kHz (horizontal axis) at 20% RH and 20°C)

Note that this is only a snapshot. The resultant slope varies -mainly with relative humidity and temperature for typical concert or festival conditions - and only slightly with atmospheric pressure unless you're working well above sea level or under extreme weather conditions!

Air absorption calculators

The author uses a Wolfram Computable Document Format (CDF) player running a CDF object designed by Prof. Dan Russell of The Pennsylvania State University to calculate air absorption. The illustration above is a marked-up screen shot from the programme.

See www.acs.psu.edu/drussell/Demos/Absorption/Absorption.html for free laptop software and CDF file.

⚠ Note that Void Acoustics cannot be responsible for non-Void applications. Use at your own discretion!

There are many more on-line calculators and some phone apps that include an air absorption calculator. One of the most popular general-purpose audio, lighting and electrical calculator "toolkits" is Doctor ProAudio's PAcalculator. It's available on-line at www.doctorproaudio.net along with other useful stuff.

A phone app is also available. See www.doctorproaudio.com/doctor/calculadores_en.htm.

11 Appendix A - Line array basics

The speed of sound

The speed of sound (v_{sound} in meters per second) in an ideal gas varies with temperature:

$v_{sound}=\sqrt{(\gamma RT/M)}$ metres/second

Where:
γ = the specific heat ratio of the gas (1.402 for air)
R = the universal gas constant (8.314 joule/mol.K)
T = the absolute temperature K
M = the molecular weight of the gas (0.02895 kg/mole for air)

Ignoring minor effects (e.g. relative humidity – typically $\pm$0.5% worse-case), the speed of sound in air simplifies to:

$v_{sound} = 20.055\sqrt{(273.15+°C)}$ metres/second

The above simplified formula gives the following figures for the speed of sound (in metres/second) are:

337.47 m/s at 10°C
343.37 m/s at 20°C
349.18 m/s at 30°C
354.89 m/s at 40°C

Temperature gradients

Air heats up or cools down most effectively by conduction rather than by radiation, so in open spaces (e.g. festival sites), heating or cooling is usually via contact with the ground.

The air near the ground is usually warmer than the air above during the daytime and cooler than the air above at night or after a heavy rain shower. These temperature variations vs height are known as temperature gradients.

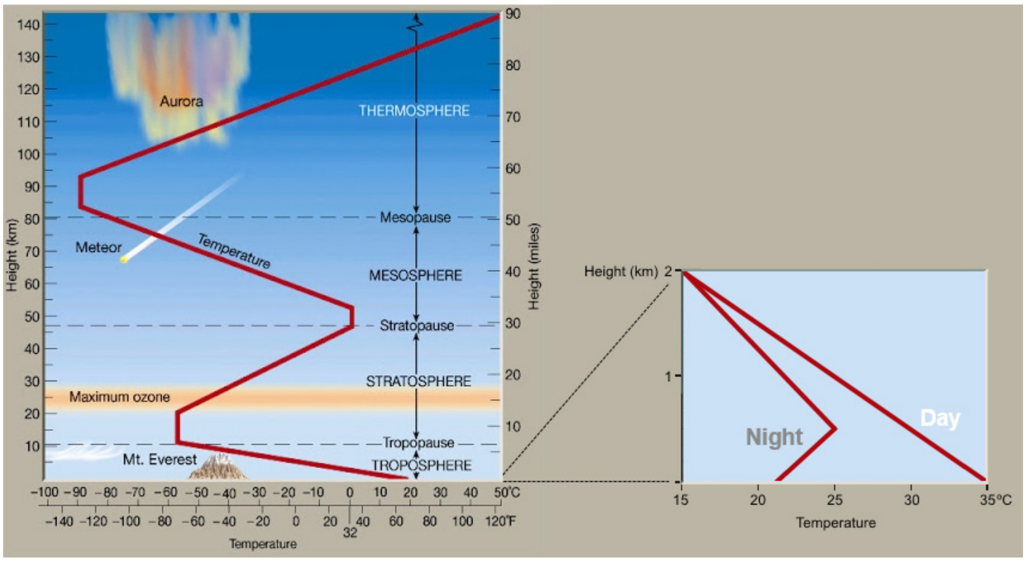


Figure A.13: Air temperature vs height showing the bigger picture (left) and a typical situation near the ground (right)
Adapted from illustrations courtesy https://planetaryvision.blogspot.co.uk

The bent curve labelled Night in the above illustration is often referred to as a temperature inversion. As you'll see from the bigger picture (left), temperature inversions – zones of rising temperature with height - also occur at higher altitudes, where they tend to limit cloud height, but that's outside the scope of this appendix.

Although turbulent conditions will cause some mixing, there is normally a persistent temperature gradient, typically averaging around 0.006 = 0.01°C/m through the bottom few hundred metres of the atmosphere. Any temperature gradient (positive or negative) will cause sound to deviate from its expected path (due to the vertical speed-of-sound differential).

The above °C/m figures may seem very low at first sight, but their effects are cumulative. Remember that we're not simply concerned with sound propagation in terms of audience coverage, which normally works out fine throughout the normal range of temperature gradients if we add 20 m or so contingency to our festival site coverage. But we must also consider noise leakage to neighbours several kilometres away. And, because those neighbours are beyond the previously mentioned transition distance, our "steerable" line array technology will revert to spherical wavefront behaviour and be difficult to control.

If the outdoor site and the surrounding residential area is flat, sound will travel slightly faster through the warm air near the ground, and slightly slower in the cooler air above. This will cause the sound propagation to rise slightly with distance. This upward-going propagation shouldn't be a problem if the system has been designed to cover slightly beyond the rear of the audience as a contingency against temperature and wind gradients - see later.

Sound leakage may be significantly attenuated off-site as a "shadow" region will be created. Care should still be taken though, as leakage is often masked by local background noise in the daytime. And other atmospheric effects may bring the sound back to earth again several kilometres away where ambient noise levels could be lower. Organisers should seek noise abatement history from the local authority to highlight hotspots and troublesome neighbours.

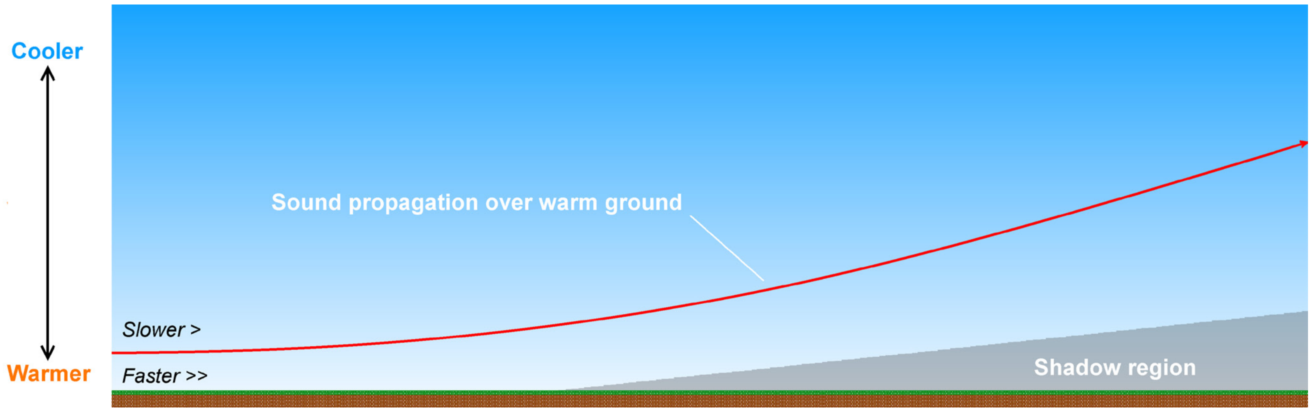


Figure A.14: Sunny-day temperature gradient causing typical curved array sound to veer upwards slightly beyond the site

Sound propagation may change after sunset as air near the ground cools whilst the air above it cools more slowly.

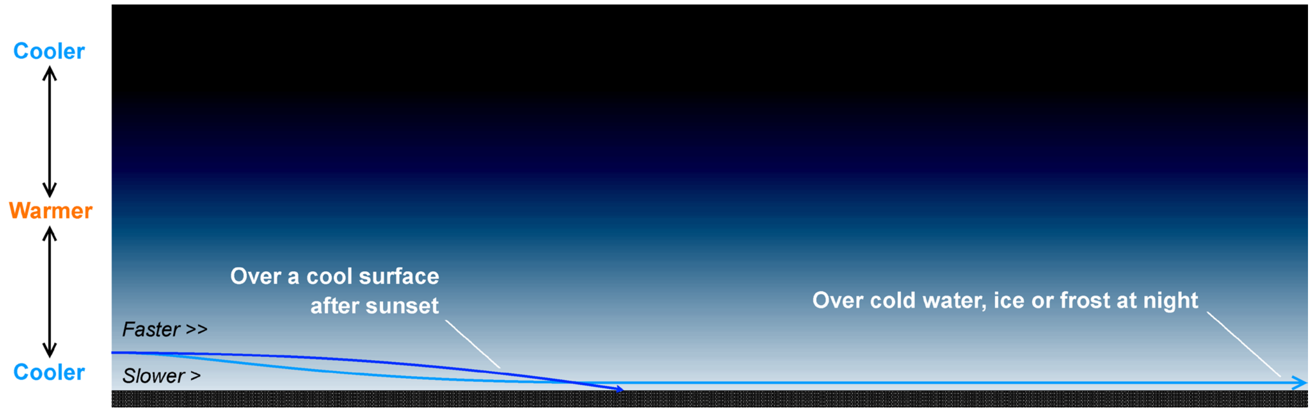


Figure A.15 Temperature gradient on a still night causing sound to veer downwards or travel along the ground beyond the site

Cooler air near the ground after sunset will cause the sound propagation to head towards the surface causing one of two scenarios. Sound will either be scattered and dispersed at surface level or, if the surface happens to be cold water, ice, frost or just a significantly colder surface layer, long-range propagation can occur. Sound gets “trapped” at ground level deprived of normal dispersion. Sound can often be clearly audible several kilometres away under these conditions - unless natural or man made barriers afford some attenuation.

Concrete stadiums and the twilight zone

The change from day to night temperature gradients after sunset in open-roof stadiums can have very audible effects. The air in the stadium will cool much more slowly than the outside air due to the thermal capacity of the concrete whilst the ground-level temperature outside drops more than 10°C.

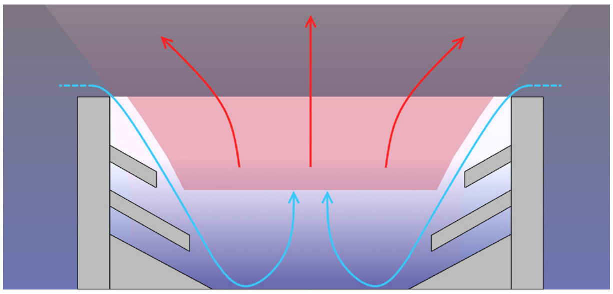


Figure A.16: Temperature gradients

The air above the ground outside gradually cools and when that cool air reaches the top of the stadium, it pours into the bowl creating a dramatic temperature gradient approximately twenty times stronger that a normal outdoor temperature inversion.

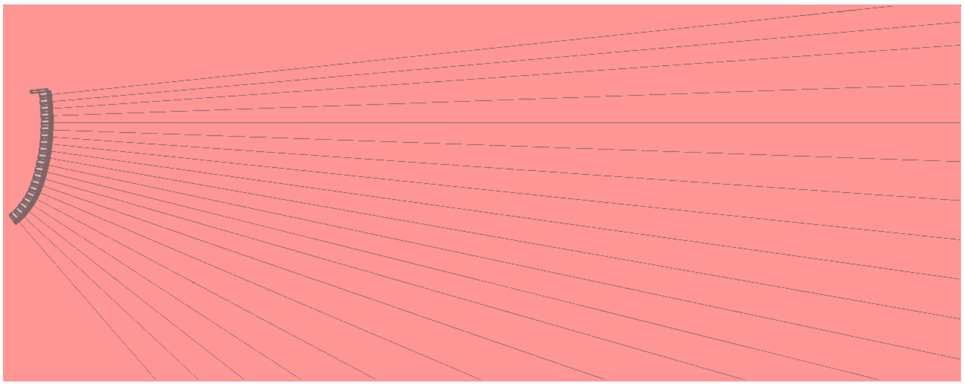


Figure A.17: Normal array propagation through stable air in the stadium

This temperature inversion line rises from the field, up past the loudspeaker system (see illustration below) and then disperses in a matter of minutes. This creates consternation amongst the sound crew as the abrupt temperature change causes the array wavefront to split. The upper propagation keeps calm and carries on for a while whilst the lower propagation bends downwards leaving a gap in coverage as if part of the system has failed or the loudspeaker management has switched presets. After about three minutes of sound crew head-scratching, the air displacement is complete and the system settles down again.

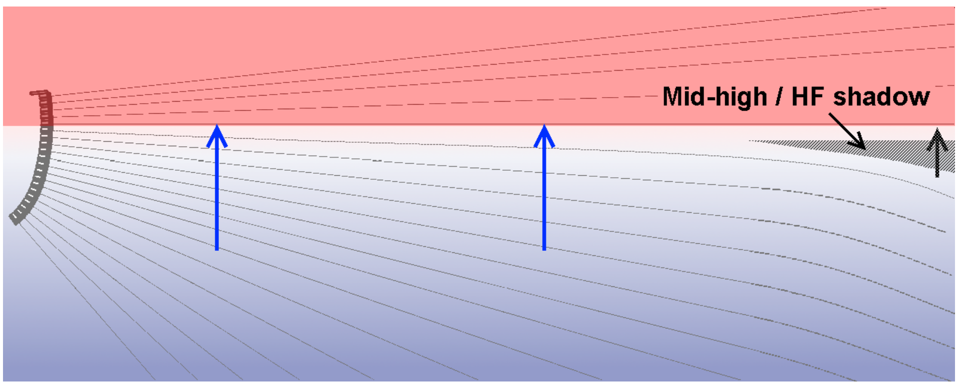


Figure A.18: Moving coverage shadow created by rapid air displacement in open-roof stadium

Wind gradients

When we talk about the speed of sound in air, that speed of sound is with respect to the air and not necessarily with respect to the source, the listener or the ground.

- The speed of sound propagating directly into a head wind, with respect to the ground, is the regular speed of sound in air (depending on the temperature, of course) minus the speed of the head wind
- The speed of sound propagating under the influence of a tail wind, with respect to the ground, is the regular speed of sound in air plus the speed of the tail wind
- The direction of sound propagating under the influence of a cross wind (wind from the side) will vary by the ratio of the wind speed to the regular speed of sound - see later.

We normally refer to this speed of sound $\pm$ the wind speed and direction (or wind vector, if you like) as the resultant speed of sound. Because wind speed tends to be lower near the ground and higher at altitude - due to decreasing density with height, friction with the surface, objects getting in the way on the ground etc. – wind effects cause sound propagation to veer from a straight path. This variation of wind speed with height is usually called a wind gradient, although it is more accurately described as a wind speed gradient.

Wind speed gradients are usually positive with height unless there's a local funnelling effect caused by buildings, trees etc. It's mainly the wind direction that determines the propagation path:

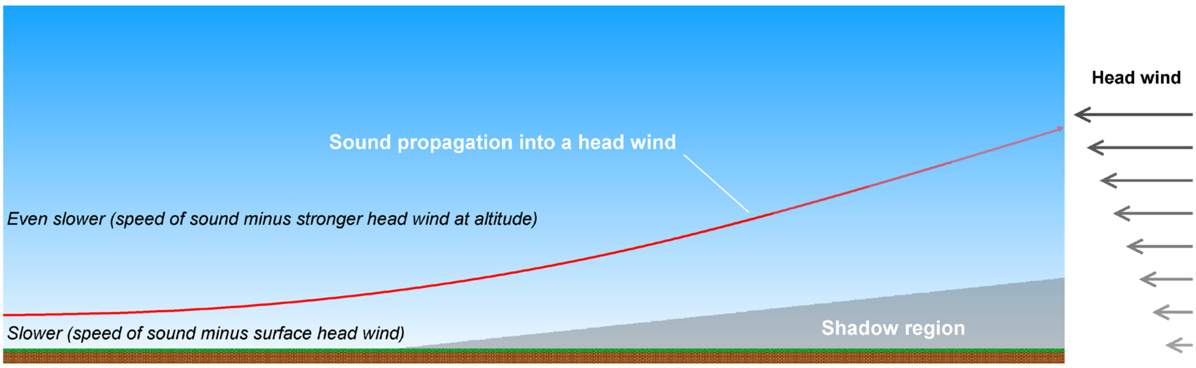


Figure A.19: Acoustic shadow due to head wind

Head winds cause sound to take a curved path upwards due to the slower resultant speed of sound at altitude (see above). This can create a shadow region where high-mid and HF levels will be significantly attenuated.

11 Appendix A - Line array basics

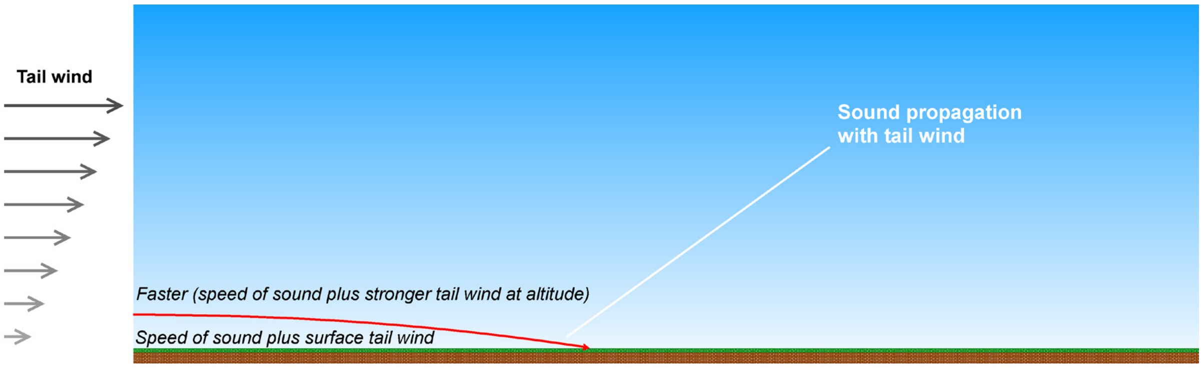


Figure A.20: Reduced acoustic propagation due to tail wind

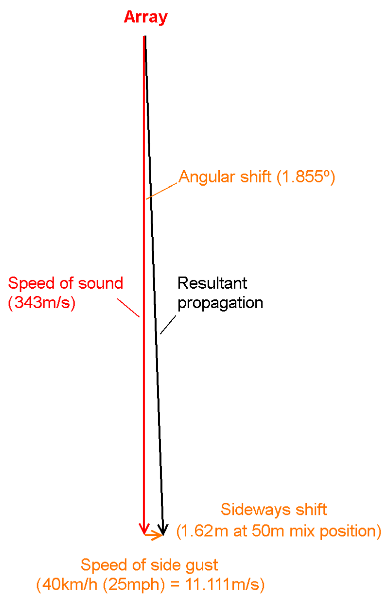
Tail winds cause sound to take a curved path downwards due to the faster resultant speed of sound at altitude (see above).

Note: all propagation illustrations in this user guide assume that the sound source is a typical curved line array or cluster with very little propagation upwards or backwards. Omnidirectional noise sources may act quite differently. For example, the above tail wind could cause upwards propagation to diffract “up and over” in a large arc, increasing off-site leakage instead of decreasing it.

11 Appendix A - Line array basics

Side winds

Gusts of wind change the horizontal aim of arrays.



The vector illustration above shows what can happen to our horizontal aiming in just a few milliseconds when our sound system is subjected to a gust of wind from the side:

- The long red arrow's length represents the speed of sound and the intended direction of propagation
- The small orange arrow's length represents the speed of the side gust from its offending direction
- The long black arrow represents the resultant speed of sound and its direction under the influence of the side gust.

For simplicity, we've drawn the side gust coming in at right angles to the intended propagation.

This simplifies the calculation of the change in sound direction to:

Change of direction (degrees) = $\tan^{-1}$(speed of side gust/speed of sound)

($\tan^{-1}$ = the angle whose tangent is)

The illustration (above) shows the effect of a 40 km/h side gust (11.111 m/s) with an evening air temperature of about 19°C.

If we take the speed of sound at 19°C as 343 m/s then:

Change of direction (degrees) = $\tan^{-1}(0.03239) = 1.855°$

A mix position at 50 m will experience sound shifting 50 m x (speed of side gust/speed of sound) = approximately 1.62 m to the right.

An intermittent side wind up to this strength can easily cause phasing between left and right arrays due to variable comb filter effects above 107 Hz. However, as both left and right arrays may be similarly affected (unless there is excessive local turbulence) most of the phasing will be audible at high frequencies.

If phasing is particularly audible, a 6 dB/octave lowpass filter set to about 8 kHz sometimes helps reduce the audible effects until the gusty weather has passed.

Wind and temperature gradients significantly affect off-site coverage but their individual effects can be quite subtle on-site. However, the combined effects of wind and temperature gradients may cause significant on-site coverage degradation if it isn’t taken into consideration at the system design stage.

Make sure you design large-scale sound systems to provide 10-15% extra depth and width coverage as a contingency.

12 Appendix B - Accessories

Arcline 8 fly frame / ground stack frame (product number IT1837)

- Frame to fly Arcline 8 - or to stack on flat surface when inverted

Arcline 8 flight case (product number IT1198)

- Flight case for Arcline 8
- Clamshell design
- Holds four Arcline 8

Arcline 8 fly frame flight case (product number IT1197)

- Flight case for Arcline 8 Fly Frame
- Holds two Fly Frames
- Central compartment for hardware storage

Arcline 212 flight case (product number IT2922)

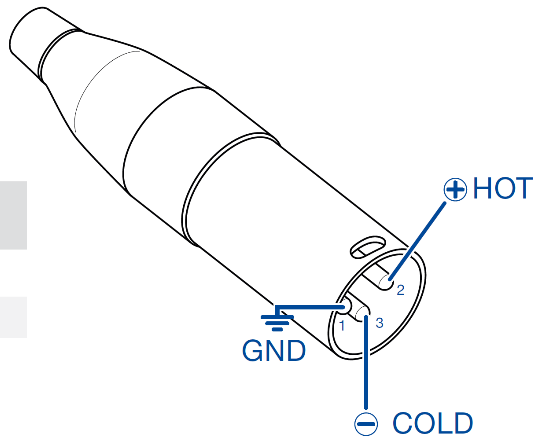
- Flight case for Arcline 212
- Holds two Arcline 212

Arcline RAL extention (product number IT1832)

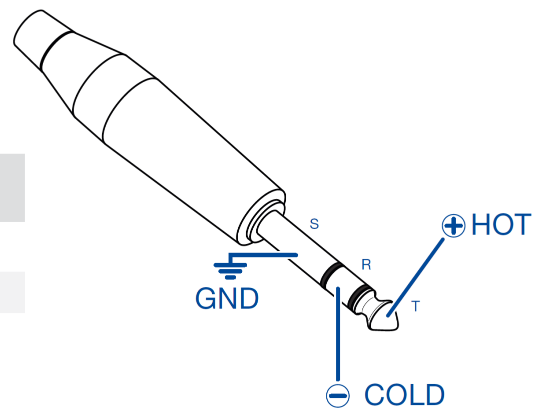
- Stacking spacer for ground stack of Arcline 8
- Adds 10° tilt

Bias V9 DSP amplifier input cable connectors

Analog input XLR-M pinout	
Pin 1	GND
Pin 2	HOT ⊕
Pin 3	COLD ⊖

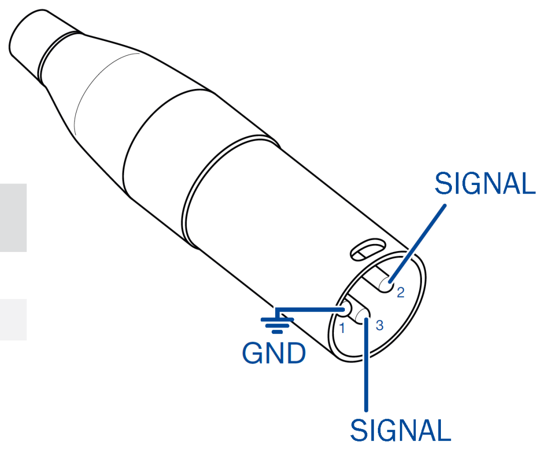


Analog input TRS Jack pinout	
Tip	HOT ⊕
Ring	COLD ⊖
Sleeve	GND



XLR or TRS jack analogue input cable connectors

AES 3 input XLR-M pinout	
Pin 1	GND
Pin 2	SIGNAL
Pin 3	SIGNAL



XLR AES 32-channel digital audio cable connector
(Use V9 IN2 socket)

⚠ Note

For AES3 2-channel digital audio signals via a 110 Ω twisted pair cable, XLR pins 2 & 3 polarity is unimportant.

13 Appendix C - Connectors and cabling

Bias Q5 DSP amplifier 1000BASE-T S/UTP Ethernet cable connectors

Color code (TIA/EIA-568-B)	Pin
ORANGE / WHITE	1
ORANGE	2
GREEN / WHITE	3
BLUE	4
BLUE / WHITE	5
GREEN	6
BROWN / WHITE	7
BROWN	8

1000BASE-T (4-pair) S/UTP* ethernet cable pinouts suitable for data + AES3 (AESOP) applications. (*Note S/UTP – not U/UTP)

Braided-shield 1000BASE-T (4-pair) S/UTP Cat-5e ethernet cables(overall braided-Shield protecting Unshielded Twisted Pairs to ISO/IEC 11801:200) can normally be used to convey AESOP (AES3 &Ethernet Simple Open Protocol) digital audio plus control data for distances up to 100 m.

Lower cost U/UTP Cat-5e cables (Unshielded Twisted Pair with no overall shield – as defined by ISO/IEC 11801:200) may be used in low-interference environments – but you must avoid running cables near mains, lighting or video screen drive cables.

Adherence to the colour-coding (TIA/EIA-568-B standard illustrated) is very important as the cable comprises four carefully-designated twisted pairs (1 & 2 - orange, 3 & 6 - green, 4 & 5 - blue, 7 & 8 - brown). Ignoring this pairing will defeat the cable's common mode rejection and will degrade performance.

14 Appendix D - Architectural specifications

Arcline 8 architectural specifications

The loudspeaker shall be a two way active, three-way line array module system consisting of two high power 8” (203.2 mm) direct radiating reflex loaded low frequency (LF) transducer, two high power 8” (203.2 mm) direct radiating reflex loaded mid frequency (MF) transducer and two 1.4” (35.6 mm) exit high frequency (HF) compression transducers on a proprietary planar wave tube mounted in a birch plywood enclosure.

The low and mid frequency transducers shall be constructed on a cast aluminium frame, with a treated paper cone, 50.8 mm (2”) voice coil, wound with copper wires on a high quality Kapton voice coil former, for high power handling and long-term reliability. The high frequency transducer shall project its sound through an elliptic horn with a 150 mm (6”) baffle diameter to achieve pattern control and low distortion.

Performance specifications for a typical production unit shall be as follows: the usable on-axis bandwidth shall be 110 Hz to 20 kHz (±3 dB) for a single enclosure and 90 Hz – 20 kHz for three enclosures; shall average 110° directivity pattern on the horizontal axis and 12° on the vertical one (-6 dB down from on-axis level) from 1 kHz to 12 kHz; maximum SPL of 145 dB peak measured at 1 m using IEC268-5 pink noise bursts. Power handling shall be 500 W AES at a rated impedance of 2 x 16 Ω; crossover point at 1.2 kHz using a 2nd order filter (24 dB per octave). The wiring connection shall be via two Neutrik speakON™. One for input and one for loop-out to another speaker, to allow for pre-wiring of the connector before installation.

The enclosure shall be constructed from 15 mm multi-laminate birch plywood finished in a textured polyurea and shall contain fixture points for a pressed weather-resistant steel powder coated grille with foam filter. The integral rigging system shall allow for inter cabinet angles of 1,2,3,4,5,6,7,8,9 and 10 degrees with stowage positions for transport. The cabinet shall have two handles (one per side) for efficient manual handling. External dimensions of (H) 285 mm x (W) 881 mm x (D) 470 mm (11.2” x 34.7” x 18.5”). Weight shall be 39 kg (86 lbs).

The loudspeaker system shall be a Void Acoustics Arcline 8.

14 Appendix D - Architectural specifications

Arcline 212 architectural specifications

The loudspeaker shall be a compact sub bass system consisting of two high power 12” (304.8 mm) direct radiating reflex loaded low frequency (LF) transducers mounted in a rectangular enclosure.

The low frequency transducers shall be constructed on a cast aluminium frame, with a treated paper cone, dual 50.8 mm (2”) voice coil, wound with copper wires on a high-quality voice coil former for high power handling and long-term reliability.

Performance specifications for a typical production unit shall be as follows: the usable bandwidth shall be 50 Hz to 200 Hz (±3 dB) and have a maximum on axis SPL of 138 dB peak (132 dB continuous) measured at 1 m using IEC265-5 pink noise. Power handling shall be 2 x 900 W AES at a rated impedance of 2 x 8 Ω and a pressure sensitivity of 99 dB measured at 1W/1m. The system shall be powered by its own dedicated power amplification module with DSP management, with the wiring connection via two Neutrik speakON™; one for input and one for loop-out to another speaker.

The enclosure shall be constructed from a 15 mm multi-laminate birch plywood, finished in a textured polyurethane and shall contain fixture points for a pressed weather-resistant, powder coated steel grille to protect the low frequency transducer. The integral rigging system shall be stainless steel with two handles (one per side) for efficient manual handling. External dimensions of (H) 367 mm x (W) 877.5 mm x (D) 470 mm (14.4” x 34.5” x 18.5”). Weight shall be 42 kg (92.6 lbs).

The loudspeaker system shall be a Void Acoustics Arcline 212.

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