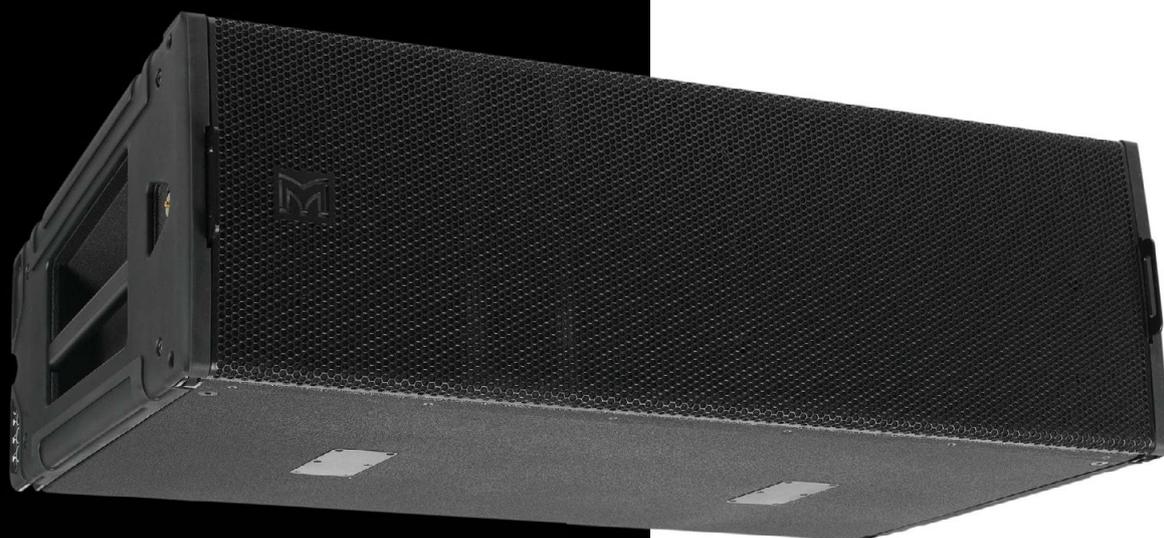


# MLA

Multi-cellular Loudspeaker Array

## User Guide





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## Introduction

MLA and MLA Compact are the first products utilising a revolutionary Multicellular approach to sound distribution in large venues. The MLA system prioritises the coherence and balance of sound where it arrives at the audience areas ignoring the sound emitted from the array. Incorporating Martin Audio’s superb acoustic design the system makes it possible to achieve a phenomenally even distribution of sound to each and every audience member and to ensure minimum sound leakage into areas where it is not wanted, something that no other system can offer.



Zac Brown Tour, Chicago 2010

## About This Manual

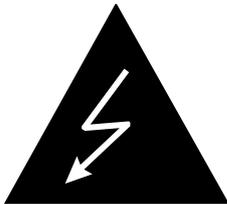
This manual explains in detail the individual components that comprise a complete system which may be MLA, MLA Compact, MLA Mini or even a combination of all three. System wiring and rigging is explained and the two key software packages are covered. It is not however the intention for this manual to be the sole tutorial medium for those wishing to use the system. Each system sale is accompanied by an extensive three day training course which covers using the system including a day spent hands-on setting up and de-rigging a system. There is a growing band of trained technicians who have completed the course. In no circumstances should a system be used without a trained MLA technician present, this manual is intended as a reference for those who have completed the course NOT as a replacement for it.



## Important Safety Instructions

### MLA/MLD MLA Compact

- Read These Instructions
- Keep these instructions for future reference
- Heed all warnings
- Follow all instructions
- No naked flame sources such as lighted candles should be placed on the apparatus.
- Do not block any ventilation openings
- Install in accordance with the Martin Audio instructions
- Do not install near any heat sources such as radiators, heat registers, stoves or other such apparatus that produce heat.
- Do not defeat the safety purpose of the grounding-type plug. A grounding plug has two blades and a third grounding prong. The third prong is provided for your safety. If the provided plug does not fit your outlet consult an electrician for replacement of the obsolete outlet.
- Protect the power cable from being walked on or pinched particularly at plugs, convenience receptacles, and the point where they exit from the apparatus
- This equipment must be earthed.
- Only use attachments / accessories specified by Martin Audio.
- Use only with wheelboard and rigging hardware specified by Martin Audio. When moving the MLA using the supplied wheelboard, caution should be used to avoid injury from the cabinet tipping over.
- Unplug this apparatus during lightning storms or when unused for long periods of time.
- No user serviceable parts inside, refer servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way such as 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.
- Do not remove covers

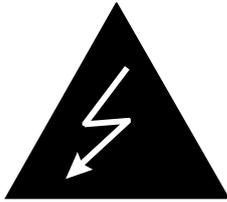


- Do not remove any protective earth or signal cable shield connections.

### Merlin

- ⚡ Read These Instructions
- ⚡ Keep these instructions
- ⚡ Heed all warnings
- ⚡ Follow all instructions
- ⚡ Do not use this apparatus near water
- ⚡ To reduce the risk of fire or electric shock, do not expose this apparatus to rain, moisture or excessive dust.
- ⚡ No naked flame sources such as lighted candles should be placed on the apparatus.
- ⚡ Do not block any ventilation openings. This product is designed to be installed in a professional 19"rack with adequate ventilation. Do not allow anything inside or on top of the 19"rack to block the ventilation of the apparatus or rack.
- ⚡ Do not install near any heat sources such as radiators, heat registers, stoves or other such apparatus (including amplifiers) that produce heat.
- ⚡ Do not defeat the safety purpose of the grounding-type plug. A grounding plug has two blades and a third grounding prong. The third prong is provided for your safety. If the provided plug does not fit your outlet consult an electrician for replacement of the obsolete outlet.
- ⚡ This equipment must be earthed.
- ⚡ Only use accessories specified by Martin Audio.
- ⚡ Unplug this apparatus during lightning storms or when unused for long periods of time.
- ⚡ No user serviceable parts inside, refer servicing to qualified service personnel.

 Do not remove covers



-  Do not expose the equipment to sources of dripping or splashing liquids and objects containing liquids, such as vases, must not be placed on this equipment.
-  Do not remove any protective earth or signal cable shield connections.

## Electrical Compliance



**SAFETY** IEC60065:2002 + A1:2005

**Country of origin** United Kingdom

**EMC EMISSION** EN55103-1:1998

**EMC IMMUNITY** EN55103-2:1996

This is a class A product. In a domestic environment this product may cause radio interferences in which case the user may be required to take adequate measures.

## Unpacking the Units

After unpacking the unit, please check it carefully for any damage. If any is found, immediately notify the carrier concerned - you, the consignee, must instigate any claim. Please retain all packaging in case you need to return the unit.



Please think of our environment.

When the product has reached the end of its useful life, please dispose of it responsibly through a recycling centre.

## MLA



The MLA is a three-way active Multicellular loudspeaker with each cell comprising of a drive unit, a Class D high power, high efficiency amplifier and comprehensive digital signal processing. There are six cells in total, three high frequency, two mid and a low frequency cell comprising of a pair of 12" bass drivers. The combination of built-in amplification and DSP offers a hitherto unheard of level of control in a compact, lightweight loudspeaker. In conjunction with Display 2 system design and VU-Net network control software applications, outstanding levels of consistent, high quality audio can be distributed to every point throughout the audience in a venue.

The MLA has audio inputs that can be either standard balanced analogue or AES/EBU digital. A parallel connection is available to daisy-chain between cabinets. The MLA features network control via a U-Net interface which as well as carrying all control data for the on-board DSP also feeds digital audio to the system. U-Net connections are made via a pair of very high quality, rugged 8-way push-pull latching connectors rated for high speed data applications.

Mains connection is via a 16A Ceeform connector. A comprehensive mains distribution system is supplied as part of the MLA system.

Each of the six channels of DSP comprises extensive processing optimised for the driver(s) under control, this includes delay, parametric EQ, High and low pass filters, IIR all-pass filters, FIR low pass filter and EQ, gain, phase and limiting. In addition there are user accessible parameters including delay, 10 bands of parametric EQ, high pass filtering, gain, phase and muting.

The MLA system has a rigging system based on the existing popular and efficient Martin Audio line array systems but with some innovative improvements. This allows phenomenally quick system rigging and de-rigging particularly in view of the fact that there are no amplifier racks to set up and break down.

The MLA is designed for use outdoors in virtually any weather conditions so is rated to IP24. Electrical systems are protected by a waterproof flexible cowl.

The cabinets are elegantly styled with a wrap over grill and injection moulded rubberised end cheeks that as well as adding to the visual aesthetic make for easy and stable stacking in trucks or warehouses. A large bar handle makes handling and rigging the system an easy job and each cabinet is supplied with a front-mounted wheelboard and protective canvas cover.



### Mechanical Design

MLA is designed mechanically to be an easy to handle, quick to rig, safe, rugged and stable touring loudspeaker. The cabinet is constructed predominantly from high grade 18mm birch plywood with rigging fabricated from powder coated steel and with decorative rubber end panels which also give improved stability when stacking on end. A strong, wide steel bar handle makes handling safe and easy and the cabinet is coated in a plasticised two part completely weatherproof textured black coating. Together with the canvas weather cowl protecting the amplifier module from either excessive sunlight or precipitation the system can be used outdoors without any additional weatherproofing for the arrays.

### Rigging

MLA's rigging has been derived from the highly successful rigging system employed on Martin Audio's line array system. This has proved to be popular, quick and above all safe. Rigging MLA will be instantly familiar to anyone who has rigged Martin Audio systems in the past, we have made a few minor improvements to make it even easier to use and it has proved to be incredibly quick to fly and land.

The MLA system uses a front rigging system which ensures the best possible coupling between cabinets with the required angle adjusted using the rear rigging points which allow angles from 0.5° to 7.5°.



The cabinets are joined using machined quick-release pins. These have spring loaded ball bearings at the end of the pin which protrude beyond the outer diameter of the pin thus locking them in place. To release them, the central button is depressed whilst pulling the pin clear using the wide flange. This is best done with the fore and index fingers pulling the pin whilst your thumb depresses the central button, a very quick and easy operation. When using the pins to link cabinets, the central button must again be depressed so the pin can be pushed into position. It is important to check that the central button does not remain depressed once you have put it in place as this would indicate that the pin has not been pushed all the way into position and the ball bearings at the end of the pin have not been able to pop out and lock the pin in place. If the pin is not locked the array is unsafe. The pin **MUST** be repositioned until it is securely locked in place.



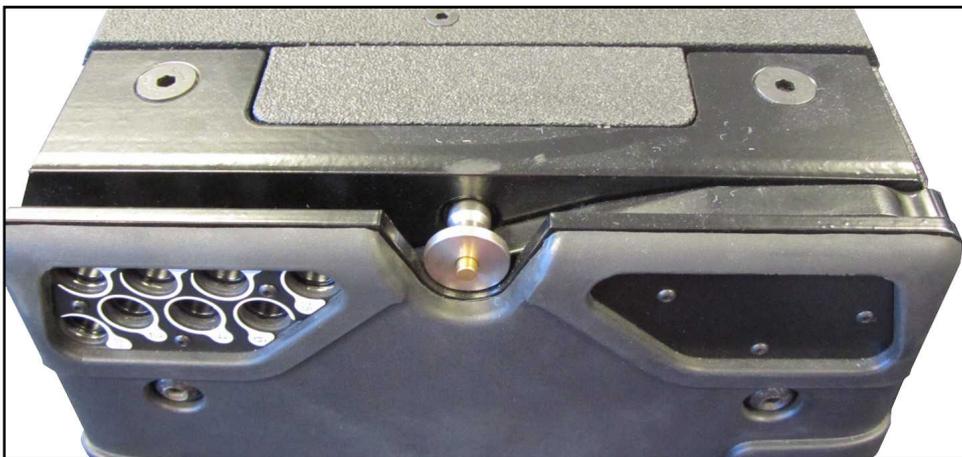
The MLA has an improved front rigging bracket with a bar that runs the full height of the cabinet. This prevents the cabinets collapsing down on each other where there is more weight supported on the rear point; although this may only make a difference

of a few millimetres, where cabinets are projecting over distances of up to 100 metres a few millimetres will have enough of an impact on the cabinet angle to make a difference of several metres to the coverage area of a particular cabinet.



The bar travels in the parked position with the connecting pin in the central hole which ensures that the bar and pin are flush with the cabinet sides thus avoiding damage in transit.

The rear bracket also has a parked position with the pin in a central hole which retains the linking bar when in transit



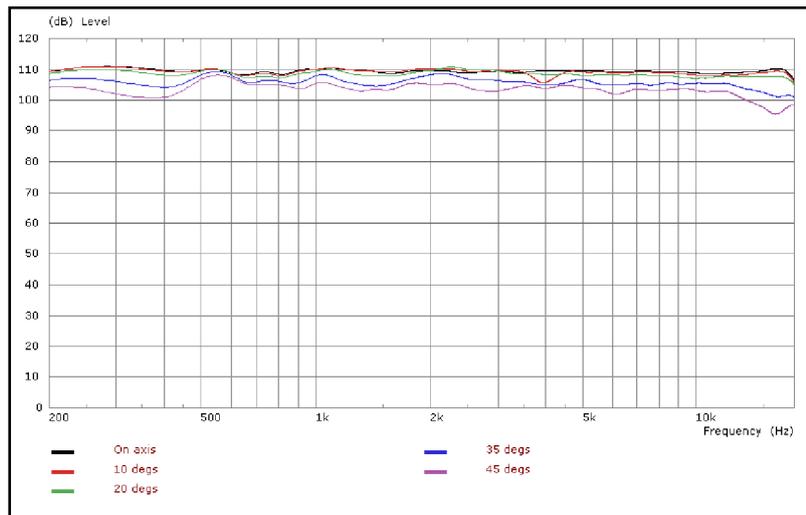
One issue with previous Martin Audio rigging system was the difficulty experienced flicking the rear linking bar out of its parked position. This problem has been solved with the addition of a protruding tongue at the base of the bar where it pivots. This can easily be used to rotate the bar out of its slot once the securing pin has been removed.



**Acoustic Design**

The MLA system uses a highly sophisticated combination of software and DSP to achieve outstanding coverage however the acoustic system still needs to perform to the highest level; DSP cannot cure a poorly designed speaker. Acoustically, MLA raises performance to a new level – with increases of 5dB in low frequency output, 10dB in mid frequency output and 10dB in high frequency output over existing, comparably-sized designs.

In common with many Martin Audio concert sound products, MLA is an all-horn loaded, 3-way design with an exceptionally smooth frequency response - both on and off-axis. In contrast to systems which utilise direct radiators for the lows and mids, MLA’s all-horn design ensures that lows and mids are able to keep up with the very high efficiency HF section. MLA deliberately avoids the use of coaxial, co-entrant or cross-firing midrange/HF driver arrangements which introduce acoustic discontinuities that affect the on and off-axis frequency response of both mid and HF sections. The MLA’s mid and HF horns are completely separate – a key factor in MLA’s ability to produce consistent, true 90° horizontal constant directivity coverage. This gives startlingly consistent frequency response when listening off-axis and “walking the field”.



Sonically, MLA delivers power, clarity and detail to over 150 metres. Its peak output capability of 140dB LF, 139dB midrange and 145dB HF, per box at 1 metre, is huge.

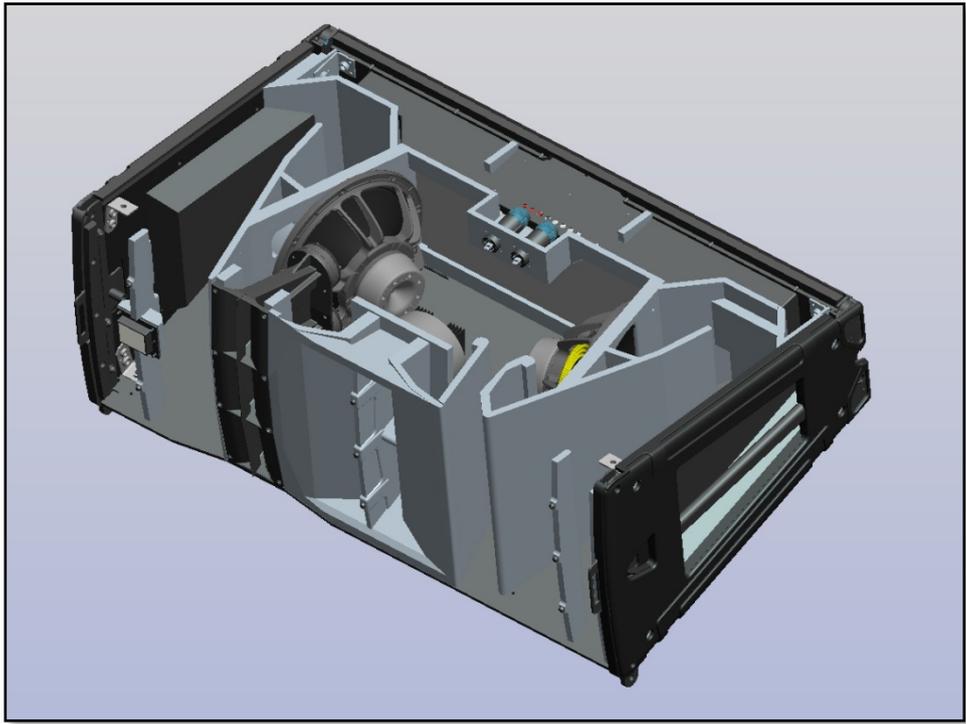
**Low Frequency**



With an efficiency of 104dB @ 1m/2.83V, MLA's Dual Hybrid® LF section has a big advantage. This is 6dB more than 98dB figure typical of a direct radiator design.

MLA's LF section utilises 2 x 12"(305mm)/3"(75mm) voice coil, neodymium drive units in Martin Audio's trademark Hybrid low frequency horn configuration. Each driver is front loaded by a hyperbolic horn with a low flare rate, whilst the rear of the driver is reflex loaded to extend the LF output below the natural cut-off point of the horn. The Hybrid design provides the best of both worlds - packing a punch that direct radiators cannot compete with and convincingly outperforming the LF extension of similarly sized, horn-only designs.

The twin LF drivers have separate horns spaced as far apart as possible within the enclosure. This double-source arrangement significantly improves the directivity control of the LF section down to 150Hz, reducing mid-bass output at the sides and rear of the array. The LF drivers themselves are very high excursion with forced air cooling to reduce power compression.

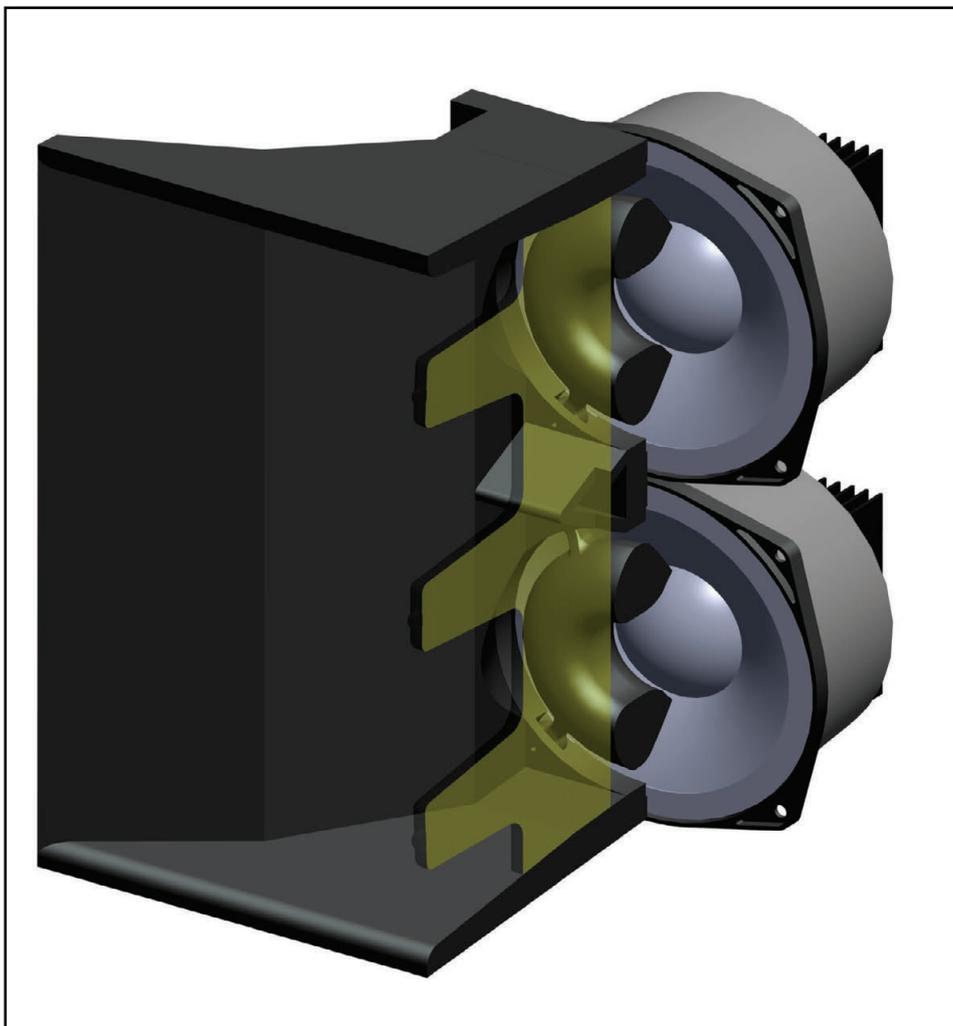
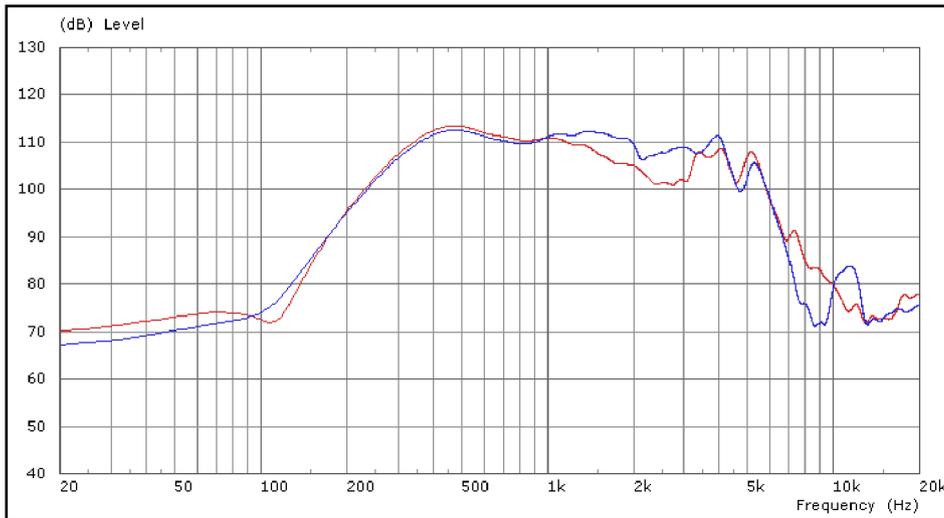


## Mid-Range

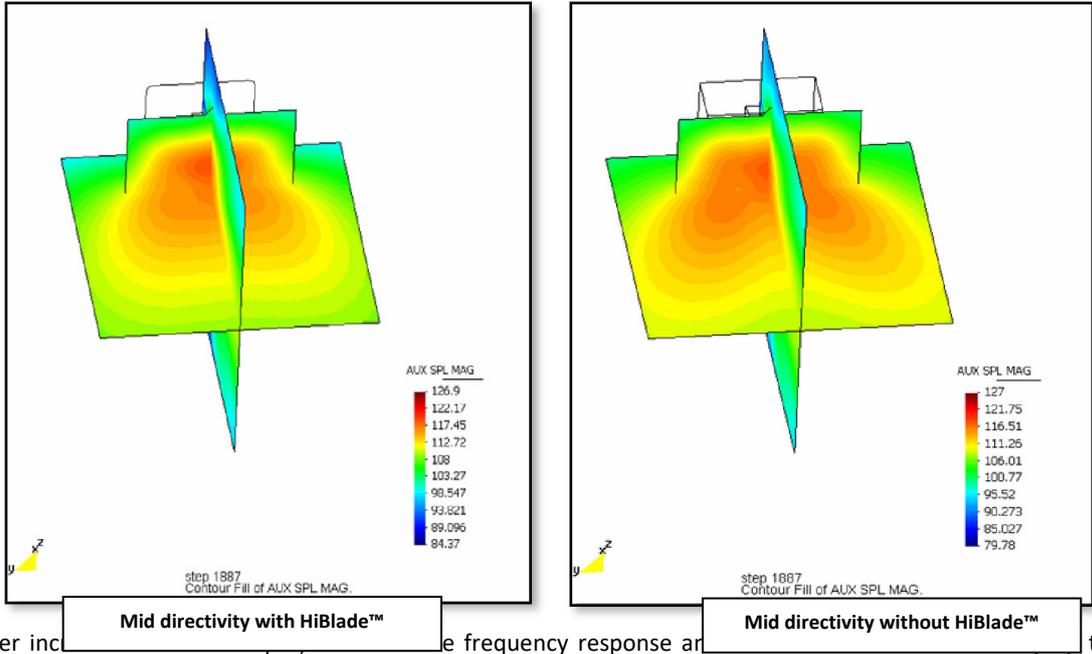
With so much design effort concentrated on the vertical performance of arrays, the horizontal dispersion can sometimes suffer – particularly in designs that use coaxial, co-entrant or cross-firing midrange arrangements. MLA has completely separate mid and HF horns and the horizontal off-axis response tracks the on-axis response exactly. Martin Audio has 30 years' experience developing cone-driven midrange horns, and this experience, together with BEM optimised horn geometry has been put to good use in the design of the MLA midrange section.

The mid horn of the MLA utilises 2 x 6.5"(165mm)/2"(50mm) voice coil neodymium drivers to produce 112dB @ 1m/2.83V - a huge gain on the typical efficiency of 102dB for cross-firing direct radiator designs. This is a result of painstaking acoustic and thermal design, utilising forced-air cooling and a thermally-conductive aluminium housing.

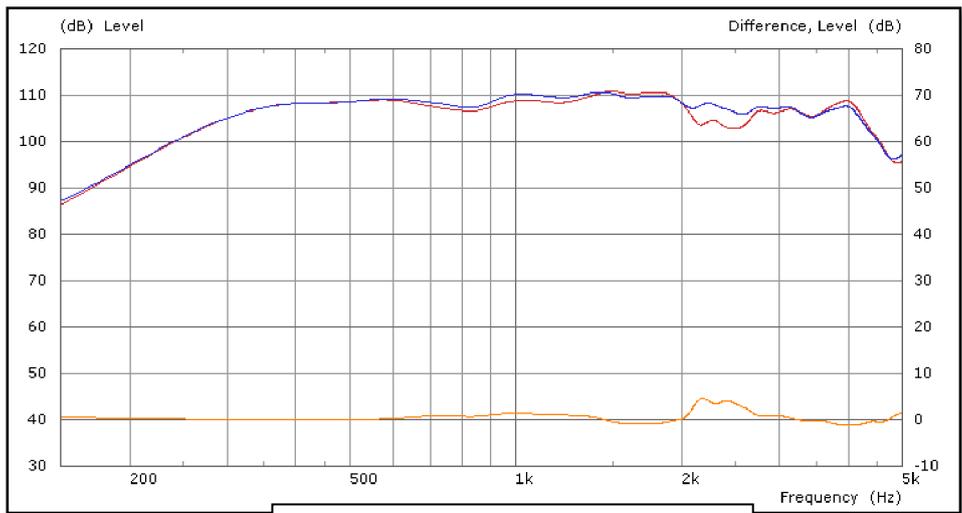
Generally, adding a horn to a cone loudspeaker increases its acoustic output in a non-uniform manner - with the greatest output in the lower part of the horn's operating band and output tailing off toward that of the cone itself at the upper end of the pass-band. In MLA's midrange horn, a patented\*, toroidal phase-bung is placed between the driver cone and the throat of the horn. This counteracts the tendency of the horn's frequency and energy response to tilt downwards as the frequency rises.



Another feature of MLA's midrange horn is the HiBlade™ device, which modifies the wave-propagation in the horn throat.



This further increase in the frequency response and directivity to the 4kHz crossover point. This is high for a midrange horn and is key to enabling the use of 1" compression drivers for reproduction of high frequencies. MLA's 6.5" cone/1" compression driver combination replaces the more traditionally used large format compression driver and has less distortion, as well as having a much more extended HF response.



Mid response with HiBlade (blue) & without

\* US Patent 6950530

### High Frequency

MLA's HF section utilises 3 x 1"(25mm) exit neodymium compression drivers which feed separate, diffraction slot horns for true 90° horizontal constant directivity. In the vertical plane, MLA makes significant advances over previous thinking by adopting new vertical wavefront criteria.



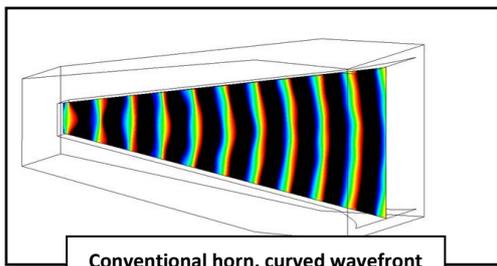
Early proponents of touring line arrays strongly advocated a flat wavefront from each individual HF element. However, our sophisticated in-house BEM (Boundary Element Method) modelling techniques have shown that slightly curved wavefronts deliver much more consistent SPL's to the audience in real-world use where the array is curved.

BEM models of a conventional horn show that the waveform expands as its travels down the horn to produce a convex vertical wavefront which would generally be too curved for an ideal array element. Placing a kite shaped "wedge" part-way down the horn\* introduces a concavity in the waveform which compensates for this.

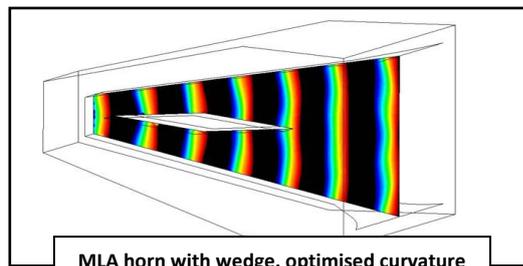


HF array cutaway showing "wedge" waveguide

By suitable choice of the length and shape of this wedge, the overall curvature of the exiting wavefront is accurately and specifically optimised to meet our new wavefront curvature criteria – neither flat nor excessively curved.



Conventional horn, curved wavefront



MLA horn with wedge, optimised curvature

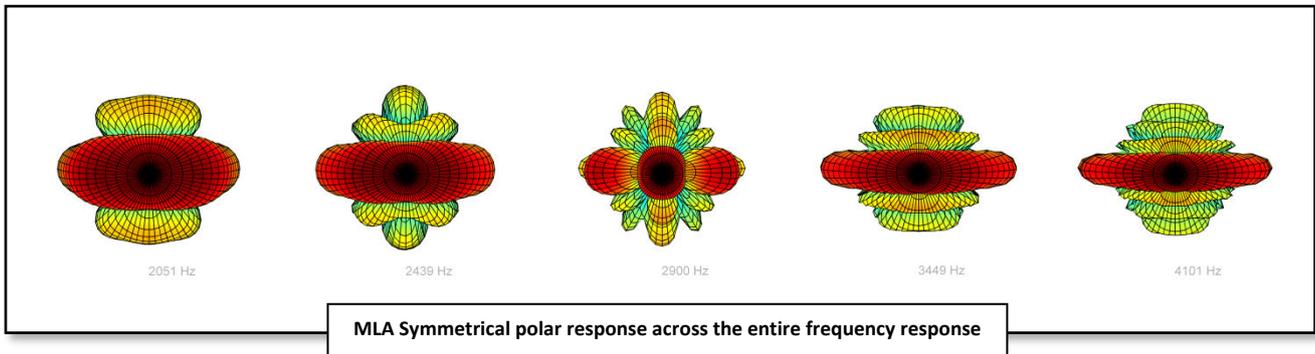
\* Patent Application WO2007054709

### FIR Crossovers

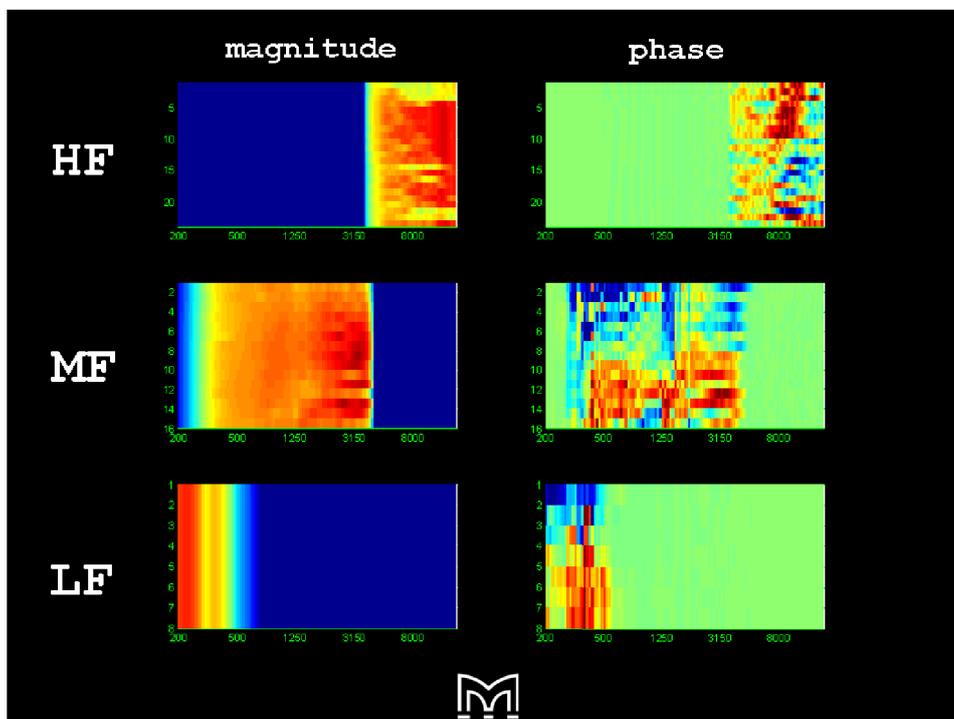
Like all three-way systems, MLA's low, mid and high frequency sections are combined by a crossover. Up to now, Linkwitz-Riley, 4th order filters have been the industry standard. With traditional filters like these, overlap at crossover can result in a non-symmetrical horizontal polar pattern if the devices being crossed-over are side by side.

In the theoretical opposite extreme, a brick-wall filter would completely eliminate overlap, and the polar pattern would be unaffected and symmetrical.

MLA’s practical implementation uses very steep, VanishingPoint™, FIR filters. They are not actually brick-wall, because of the effects of brick-wall filters on transient response. Listening tests confirm that the two devices are impossible to locate separately, but sound like a single acoustic source, located at the point in space at which we have optimised the FIR filter.



MLA’s VanishingPoint FIR filters give us the freedom to physically separate the mid and HF horns, so they do not compromise each other’s dispersion pattern, yet achieve the spatial performance of a single device – giving us the best of both worlds.



### Amplifier Module

The amplification and control module is an entirely self-contained section. This may be removed by unscrewing the rear panel which also holds the weather cowl in place. Once unscrewed the module is quickly disconnected using the pair of Neutrik NL8 connectors which connect the amplifier outputs to the drive units. This means that field replacement of the module is quick and easy in the unlikely event of a module failure.

Each MLA is fitted with a 6-channel amplifier module. Its Class D circuitry delivers a total of 3kW continuous and 6kW peak output, whilst producing significantly less heat than a linear output stage design. All channels share the same circuit topology and are driven from the same power supply. This configuration effectively shares the total power available between the LF, mid and high frequency channels - providing high continuous power for the low frequency channel and high peak power for the mid and HF channels.

The lightweight, switched-mode power supply auto-ranges to global mains voltages from 100 to 240V 50/60Hz. Power Factor Correction smooth's out the mains current draw over the whole of the AC waveform, effectively reducing cable losses caused by high peak currents in the mains distribution system.



The module features advanced monitoring and protection, including over-temperature power limiting, short-circuit and overload protection. Amplifier monitoring via U-NET™ includes input signal, output signal at the drive unit terminals, limiter status, heatsink temperatures and fault conditions.

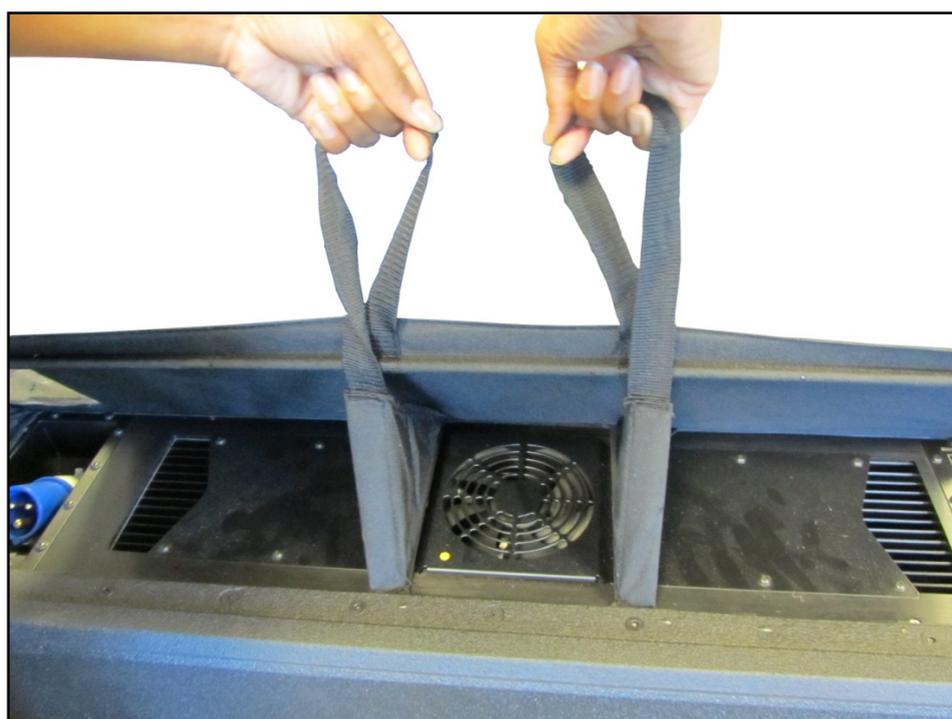
The amplifier section is designed to withstand the various environmental conditions typically found in live sound applications – such as rain and ambient temperatures of up to 45°C. A sophisticated cooling arrangement, where air is forced over the amplifiers' heatsinks through a metal tunnel, employs an IP rated fan with intelligent drive for quiet operation when the system is used at lower powers.

## Connections

The amplifier and network module housed in the rear of the cabinet is protected by a weatherproof canvas cowl. This vital accessory has two functions. In the event of poor weather it will keep all electrical connections dry. In the event of very hot weather it acts as a sun shade to keep direct sunlight off the amplifier cooling system and thus prevents over-heating.



The cowl travels folded flat for ease of transportation. It is held in the operating position by two triangles of canvas mounted towards the middle of the cowl. These have straps attached and by pulling the straps the cowl pops up into position and is held in place with the two supporting triangles which connect to the inside of the cowl using Velcro. To fold the cowl flat, the straps are again used to pull the supporting triangles down left and right.



### Mains

The MLA mains inlet is located on the rear of the cabinet and is a standard 16A Male 230V single phase IP44 rated Ceeform inlet connector. A comprehensive mains distribution system is supplied with the MLA systems which features female outlets rated at IP67.



The MLA has a universal PSU suitable for direct connection to virtually any mains voltage anywhere in the world. If you are not using the Martin Audio MLA distribution system a matching Ceeform 16A female outlet connector must be used. For outdoor use this should be rated at IP67, this is to ensure safe operating when any connectors are disconnected in damp conditions.

### Audio & network

The main connection panel is on the rear of the cabinet to the right and features a male input and female link 3 pin XLR for balanced analogue or AES/EBU digital input signals. Input type is selected via the Vu-Net software. The Neutrik XLR's are fitted with a hinged cover for protection when not in use.

Two 8-pin ODU rugged latching push-pull style data connectors are provided for the U-Net network connection. The two ports are available so that the network connections can be daisy chained between other MLA cabinets or U-Net equipped devices such as Martin Audio amplifiers or Merlin system controllers. Either connector can be used as input or link.

A single green LED indicates power and two bi-colour LED's indicate U-Net network integrity. Green indicates that the network is stable and red indicates an error.





U-Net connections are made using Cat5 cables fitted with 8-way push pull latching connectors compatible with ODU Series K. Robust Cat 5 cable should be used such as Neutrik Etherflex or Belden 1305A, this will ensure reliable network connections of up to 125 metres between network ports. U-Net protocol uses a redundant ring fault tolerance so connections "daisy-chain" between all units in the network going from port 1 on the first unit to port 2 on the next and so on before finally making a return connection back to port 2 on the first unit to complete the loop. The U-Net network will operate perfectly well without a closed loop but it is strongly recommended to use this option so that the network will continue to work in the event of a break in cable or disconnected connector.

Ready-made tour-grade network cables in a variety of lengths from short inter-cabinet patching to long front of house to stage are supplied as part of an MLA system.

Analogue inputs should be connected with a good quality 3-pin Male XLR wired to good quality twin screened cable, this is particularly important if the feed is a long length of cable; from front of house to stage for example. Good quality cable will minimise losses over the cable run. The link outputs should use a similarly high quality Female XLR. Wiring is the industry standard for balanced connections;-

- Pin 1. Ground or shield
- Pin 2 +, Hot, in phase
- Pin 3 -, Cold, out of phase.

The signal source used to feed the MLA array must have line drive capabilities suitable for driving the combined load of the entire array.

AES/EBU output connections are identical to analogue but cable used must be a dedicated 110Ω, low capacitance digital cable such as Belden 1800F or 1696A.

## Block Diagram

The MLA features sophisticated processing which feeds an amplifier for the low frequency and individual amplifiers for each mid and high frequency drivers. The diagram below shows the signal path from the input which may be derived from analogue, AES/EBU digital, or digital from the U-Net network, through to the drivers. All signal routing and monitoring is done via VU-Net

The input signal is first selected between back panel (the 3-pin XLR) or U-Net. If 'Back Panel' is selected there is then a further choice of either analogue, AES Left or AES Right (as AES/EBU is a stereo feed). If U-Net is selected you may then select from any of the four inputs or ten outputs from the Merlin controller which is supporting the network. A VU Meter displays the input level prior to any internal processing, useful as an indicator of inappropriate levels from the signal source feeding the system.

There are then 10 bands of parametric EQ, a high pass filter and a gain control that are accessible for user adjustment of the response. The array can be divided into up to six zones so that different EQ can be applied to different areas of the system.

Each band of parametric may be Peak, 2<sup>nd</sup> order Low Shelf or 2<sup>nd</sup> order High Shelf. Filter bandwidth may be adjusted from a Q of 0.4 up to 126 and gain may be adjusted between +15dB and -30dB.

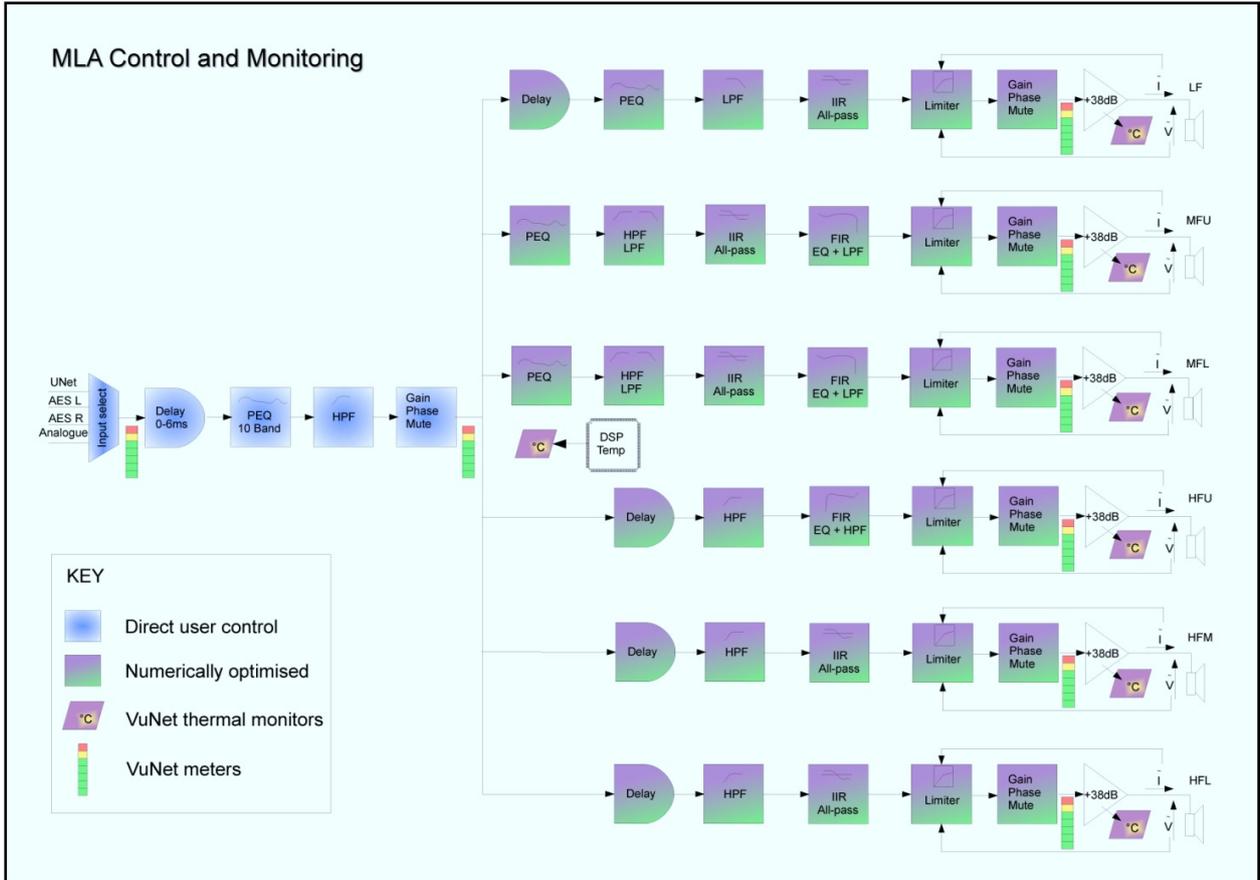
The high pass filter can be either a Butterworth at 6, 12, 18, 24 or 48dB/Octave, Bessel at 12 or 18 dB/Octave or Linkwitz Riley at either 12, 18, 24 or 48dB/Octave. Frequency is adjustable from 10Hz to 300. Finally gain may be adjusted from +15dB to -40dB.

There is a post EQ VU meter for each of the zones to ensure that over-zealous EQ hasn't done anything too drastic to system headroom.

The signal is then fed to each of the six cells where further parametric EQ, an IIR all pass filter, high and low pass filters, FIR filters, delay, gain, phase and limiting. The parameters for this extensive processing are created using Display 2 and uploaded to the system via the U-Net network.

Finally, each cell has an amplifier tailored to the requirements of the driver(s) being driven. This adds 38dB of gain. The output of the amplifier is fed back to the limiter to provide the best possible protection to each drive unit.

There are temperature sensors checking the temperature of the DSP and each individual cell amplifier. Finally each cell output is displayed on a VU Meter.



### Essential Maintenance

Coming Soon

### Tools Required

Coming Soon

### Replacing the amplifier module

There is no need to remove a cabinet from an array to replace a module if you can safely access the rear of the MLA speaker, the module can be replaced in situ. Disconnect all power, audio and network connections from the module. Undo all M5 Countersunk screws holding the rain cowl assembly with the appropriate size hex head driver. Once the rain cowl is removed the module can be eased out of the cabinet, there are no additional screws holding it in place. Once you have removed it sufficiently to access the connections disconnect both Speakon NL8's and remove the module. Fitting the replacement is a reversal of the removal. Offer the module to the cabinet and connect the NL8s making sure they have made a positive latch. Before proceeding and further you may wish to re-connect to the array to make sure that everything is connected and working perfectly, see details later in this guide. Replace the rain cowl assembly and all screws. Reconnect all connections, ensure that the module powers up, the fan will briefly run at full speed and the red power LED will light. Connect U-Net cables to the two ports and ensure that both U-Net LEDs light green. Connect audio input and if required output connections. You will need to upload the correct settings to the array if the system is in use at the time, please see the section in the Vu-Net chapter for detailed instructions on how to do this.

### Replacing a low frequency driver

Coming Soon

### Replacing a mid driver



Coming Soon

Replacing a compression Driver

Coming Soon

Replacing a Diaphragm

Coming Soon

**Specifications**

**Acoustical**

TYPE Three-way cellular drive, active array element  
 FREQUENCY RESPONSE (1) 52Hz-18 kHz ± 3dB  
 MAXIMUM SPL@ 1m LF: 133dB continuous, 139dB peak (3)  
 MF: 134dB continuous, 140dB peak (4)  
 HF: 139dB continuous, 145dB peak (4)

**Drivers**

LF 2 x 12"(300mm)/3"(75mm) voice coil, ultra-long excursion, neodymium magnet drivers, Hybrid® bass horn loaded  
 MF 2 x 6.5"(165mm)/2"(50mm) coil, neodymium magnet drivers, horn loaded  
 HF 3 x 1"(25mm) exit neodymium magnet compression drivers, horn loaded

**Rated Power (2)**

LF 800W AES, 3200W peak  
 MF 400W AES, 1600W peak  
 HF 150W AES, 600W peak

**Dispersion**

(-6dB) 90° horizontal  
 (-10dB) 120° horizontal  
 7.5° vertical

**Crossover Frequencies**

320Hz 8th-order Linkwitz-Riley  
 4 kHz Vanishing Point™ FIR filters

**Audio input**

CONNECTORS Female XLR input, male XLR link output  
 ANALOGUE INPUT IMPEDANCE 20kΩ balanced to ground  
 MAXIMUM ANALOGUE INPUT LEVEL 6.15Vrms (+18dBu), over voltage protected  
 NOMINAL SYSTEM GAIN 28.5dB  
 AES/EBU IMPEDANCE 110Ohms balanced, Receive and transmit termination

**Network**

CONNECTORS 2x IP68 rated 8-way, quick-release type  
 PROTOCOL Unet

**Amplifier Module**

TYPE Six channel switch mode, fixed frequency  
 PEAK OUTPUT POWER 4000W  
 AVERAGE EFFICIENCY 75%  
 COOLING 4 x temperature controlled internal fans



- 1 x low-speed internal blower
- 1 x temperature controlled external fan

MAXIMUM AMBIENT TEMPERATURE 45°C (113°F) for full output

**Power Supply**

TYPE	Switch mode, fixed frequency with PFC
AC INPUT OPERATING RANGE	100 – 240V ~ AC, 50 - 60Hz
AC OVERVOLTAGE TOLERANCE	400V AC
POWER FACTOR	> 0.95
NOMINAL POWER CONSUMPTION	900W
MAINS CONNECTOR	16A IEC309 (Ceeform) – IP44 rated

**General**

ENCLOSURE	Vertical trapezoid with 3.75° wall angle, multi-laminate birch and poplar ply construction
FINISH	Textured black PU coating
PROTECTIVE GRILLE	Black HEX perforated steel
FITTINGS	Proprietary rigging system Bar handles on each side Protective Rubber side-cheeks incorporating skids Wheel-board Transit cover Weather Protection Cowl
IP RATING	IP 24
DIMENSIONS (inc. wheelboard)	(W) 1136mm x (H) 372mm (376mm) x (D) 675mm (825mm)
WEIGHT (ex. wheelboard)	(W) 44.7in x (H) 14.6in (14.8in) x (D) 26.5in (32.4in) 87.5kg (193lbs)

**Accessories**

- Flying frame (including clinometer)
- Ground stacking bar
- Flying Pin
- Mains distribution system
- Tour-grade network interconnects
- Merlin Controller/Unet Hub

**Notes**

- (1) Measured on-axis in open (4<sup>th</sup>) space at 4 metres, then referred to 1 metre.
- (2) AES Standard ANSI S4.26-1984.
- (3) Measured in half-space at 1 metre with a tone burst signal, then referred back to open (4<sup>th</sup>) space.
- (4) Calculated from 4m 2.83v sensitivity, referred to 1m.

## MLD



The MLD is the accompanying downfill enclosure to complement the MLA. It is designed primarily to be used at the bottom of an array using either a single MLD or a pair. Display 2.1 does not support any more than two MLD in an array. As a downfill box the dispersion is optimised for a wider coverage so the MLD has a horizontal coverage of 120° compared to MLA's 90°, and a vertical coverage of 20° compared to MLA's 7.5.

### Mechanical Design

The MLD uses the same mechanical principals as the MLA and obviously has exactly the same width so it can be rigged with MLA. The cabinet is slightly taller at 454mm (17.9") to allow for the greater vertical coverage. The same rugged 18mm ply construction with PU weather-proof finish and black powder coated steel rigging is employed as MLA

### Rigging

The rigging on the MLD is designed to complement the MLA. The front rigging brackets operate in exactly the same way with the rigging bar running the full height of the cabinet and dropping down when the flying pin is removed from the central sowing position. The rear bracket is slightly shorter than the MLA as the cabinet is not as tall at the back; it has a more exaggerated trapezoidal shape as a result of the greater vertical coverage angle.



The rear bracket swings up as the MLA to join to an array but links to one position to give an angle of 13.75°. There is only a single hole in the bottom of the bracket to accommodate a second MLD in the array which will give a fixed angle between the two of 20°.



## Acoustic Design

The acoustic design of the MLD matches that of the MLA with the dispersion characteristics the only difference. The same drivers are used throughout. It is also an all horn loaded three way enclosure.

## Low Frequency

The low frequency section is virtually identical to MLA featuring the same 12" neodymium drivers in a twin Hybrid® horn loaded configuration. In spite of the different enclosure size and shape the same low frequency output has been achieved delivering 133dB continuous and 139dB peak (Measured in half-space at 1metre with a tone burst signal, then referred back to open (4π) space) to match the MLA providing excellent low frequency coherence. The drivers are front loaded onto a hyperbolic horn with the rear chamber also reflex loaded to achieve extended low frequency response below the cut off of the horn. The low frequency response of the MLD matches the MLA reaching down to 52Hz, often making subs unnecessary for certain applications.

## Mid-Range

The horn loaded mid-range uses the same 6.5" neodymium magnet drivers as the MLA. It also uses the same patented toroidal phase bung to smooth the mid horns frequency response. Wave propagation in the horn throat is smoothed by the Martin Audio HiBlade™ device. The mid horn however has a 120° horizontal and 20° vertical dispersion pattern.

## High Frequency

The High frequency section utilises the same configuration of three 1" neodymium magnet compression drivers as the MLA but fitted to a 120° horizontal and 20° vertical dispersion horn.

## Connections

The amplifier and network module housed in the rear of the cabinet is protected by a weatherproof canvas cowl. This vital accessory has two functions. In the event of poor weather it will keep all electrical connections dry. In the event of very hot weather it acts as a sun shade to keep direct sunlight off the amplifier cooling system and thus prevents over-heating.



The cowl travels folded flat for ease of transportation. It is held in the operating position by two triangles of canvas mounted towards the middle of the cowl. These have straps attached and by pulling the straps the cowl pops up into position and is held in place with the two supporting triangles which connect to the inside of the cowl using Velcro. To fold the cowl flat, the straps are again used to pull the supporting triangles down left and right.



## Mains

The mains inlet to the MLD in common with all larger format MLA series enclosures is a 16A male 230V Ceeform inlet connector. As the MLD is always going to be at the bottom of an array and will always be at 13.75° to the MLA cabinet above it in an array which may already have a steep curve, the mains inlet may be angled upwards making ingress of water a possibility where systems are deployed outdoors. This could easily occur due to rain running down the mains cable and then to the mains connection. Whilst the Ceeform connectors have an IP67 rating the MLD features an additional weatherproofing measure in the form of a canvas bag in which the mains inlet is housed. Once the in-coming mains connector is mated with the inlet, the draw-string around the opening of the bag is pulled tight around the cable to seal it from water ingress. The string has a button-press release catch to hold it closed.



**Audio & network**

The main connection panel is on the rear of the cabinet to the right and is identical to all MLA enclosures featuring a male input and female link 3 pin XLR for balanced analogue or AES/EBU digital input signals. Input type is selected via the Vu-Net software. The Neutrik XLR's are fitted with a hinged cover for protection when not in use.

Two 8-pin ODU rugged latching push-pull style data connectors are provided for the U-Net network connection. The two ports are available so that the network connections can be daisy chained between other MLA cabinets or U-Net equipped devices. Either connector can be used as input or link.

A single green LED indicates power and two bi-colour LED's indicate U-Net network integrity. Green indicates that the network is stable and red indicates an error.



U-Net connections are made using Cat5 cables fitted with 8-way push pull latching connectors compatible with ODU Series K. Robust Cat 5 cable should be used such as Neutrik Etherflex or Belden 1305A, this will ensure reliable network connections of up



to 125 metres between network ports. U-Net protocol uses a redundant ring fault tolerance so connections “daisy-chain” between all units in the network going from port 1 on the first unit to port 2 on the next and so on before finally making a return connection back to port 2 on the first unit to complete the loop. Ready-made tour-grade network cables in a variety of lengths from short inter-cabinet patching to long front of house to stage are supplied as part of an MLA system.

Audio wiring is the industry standard for balanced connections;-

- Pin 1. Ground or shield
- Pin 2 +, Hot, in phase
- Pin 3 -, Cold, out of phase.

The signal source used to feed the MLA array must have line drive capabilities suitable for driving the combined load of the entire array.

AES/EBU output connections are identical to analogue but cable used must be a dedicated 110Ω, low capacitance digital cable such as Belden 1800F or 1696A.

## Essential Maintenance

Coming Soon

### Tools Required

Coming Soon

### Replacing the amplifier module

Coming Soon

### Replacing a mid driver

Coming Soon

### Replacing a compression Driver

Coming Soon

### Replacing a Diaphragm

Coming Soon



**Specifications**

**Acoustical**

TYPE	Three-way cellular drive, active array element
FREQUENCY RESPONSE (1)	52Hz-18 kHz ± 3dB
MAXIMUM SPL@ 1m	LF: 133dB continuous, 139dB peak (3) MF: 133dB continuous, 139dB peak (4) HF: 134dB continuous, 140dB peak (4)

**Drivers**

LF	2 x12"(300mm)/3"(75mm) voice coil, ultra-long excursion, neodymium magnet drivers, Hybrid® bass horn loaded
MF	2 x 6.5"(165mm)/2"(50mm) coil, neodymium magnet drivers, horn loaded
HF	3 x 1"(25mm) exit neodymium magnet compression drivers, horn loaded

**Rated Power (2)**

LF	800W AES, 3200W peak
MF	400W AES, 1600W peak
HF	150W AES, 600W peak

**Dispersion**

(-6dB)	120°horizontal
(-10dB)	140° horizontal 20° vertical

**Crossover Frequencies**

320Hz	8th-order Linkwitz-Riley
4 kHz	Vanishing Point™ FIR filters

**Audio input**

CONNECTORS	Female XLR input, male XLR link output
ANALOGUE INPUT IMPEDANCE	20kΩ balanced to ground
MAXIMUM ANALOGUE INPUT LEVEL	6.15Vrms (+18dBu), over voltage protected
NOMINAL SYSTEM GAIN	28.5dB
AES/EBU IMPEDANCE	110Ohms balanced, Receive and transmit termination

**Network**

CONNECTORS	2x IP68 rated 8-way, quick-release type
PROTOCOL	U-Net

**Amplifier Module**

TYPE	Six channel switch mode, fixed frequency
PEAK OUTPUT POWER	4000W
AVERAGE EFFICIENCY	75%
COOLING	4 x temperature controlled internal fans 1 x low-speed internal blower 1 x temperature controlled external fan
MAXIMUM AMBIENT TEMPERATURE	45°C (113°F) for full output

**Power Supply**

TYPE	Switch mode, fixed frequency with PFC
AC INPUT OPERATING RANGE	100 – 240V ~ AC, 50 - 60Hz
AC OVERVOLTAGE TOLERANCE	400V AC



POWER FACTOR	> 0.95
NOMINAL POWER CONSUMPTION	900W
MAINS CONNECTOR	16A IEC309 (Ceeform) – IP44 rated

**General**

ENCLOSURE	Vertical trapezoid with 10° wall angle, multi-laminate birch and poplar ply construction
FINISH	Textured black PU coating
PROTECTIVE GRILLE	Black HEX perforated steel
FITTINGS	Proprietary rigging system Bar handles on each side Protective Rubber side-cheeks incorporating skids Wheel-board Transit cover Weather Protection Cowl
IP RATING	IP 24
DIMENSIONS (inc. wheelboard)	(W) 1136mm x (H) 454mm (458mm) x (D) 680mm (840mm) (W) 44.7in x (H) 17.9in (18in) x (D) 26.8in (33.1in)
WEIGHT (ex. wheelboard)	91.5kg (201lbs)

**Accessories**

- Flying frame (including clinometer)
- Ground stacking bar
- Flying Pin
- Mains distribution system
- Tour-grade network interconnects
- Merlin Controller/Unet Hub

**Notes**

- (1) Measured on-axis in open (4<sup>th</sup>) space at 4 metres, then referred to 1 metre.
- (2) AES Standard ANSI S4.26-1984.
- (3) Measured in half-space at 1 metre with a tone burst signal, then referred back to open (4<sup>th</sup>) space.
- (4) Calculated from 4m 2.83v sensitivity, referred to 1m.

## MLX



MLX is the accompanying sub bass enclosure for an MLA system. Given the advanced principals used with the MLA system the challenge was to produce a sub that was equally ground-breaking. The MLX meets that challenge. This has been achieved by marrying Martin Audio's Hybrid combined horn and reflex loaded acoustic design with IPAL driver and amplifier technology. The enclosure is a twin 18" design and is the same width as an MLA or MLD cabinet so can be flown using the same flying grid either as an independent array or a combined array using two grids. The rigging is symmetrical front to back to allow flown cardioid arrays with subs facing backwards in the array. MLX is completely weatherproof with a rugged PU coating and electronics protected by a hinged cover. It is rated to IP24.

The cabinet is styled to match the MLA system with a wrap over grill on both front and back and rubber side panels protecting the rigging brackets. Each MLX is supplied with a front or rear fitted wheelboard and a canvas cover with an integral timber support to protect the front or rear grill even when heavy items are placed on top of the sub in the truck pack.

### Mechanical Design

The MLX cabinet is constructed from 18 and 24mm birch plywood and is finished with a black textured PU coating. All rigging and other metalwork is powder coated steel with all exposed fixings high grade black stainless steel. Rubber covers are utilised over the rigging brackets to complement the MLA end cheeks and to add additional protection. Black nylon skids on the base locate easily into routed slots on the top of the cabinet to give a positive lock aiding stability of ground stacked systems.

Whilst there is no escaping the considerable weight of the MLX, every possible measure has been taken to make the sub as manageable as possible. It is supplied with a wheelboard and as the rigging brackets at symmetrical this can be fitted to the front or the rear of the enclosure depending on whether you prefer to transport the cabinet face up or down. Each side of the MLX has a strong bar handle running almost the full depth of the cabinet making it easy for four crew to lift the cabinet with two at each side. A rugged canvas cover is supplied which has an integral timber board which locates on the wheelboard fittings on the uppermost surface of the sub when it is on its wheelboard. This protects the grill making it completely safe to transport the MLX either way up even with other equipment stacked on top of the MLX in the truck or back in the shop.

The MSX is designed to complement the MLA system and has been dimensioned accordingly. It is the same width as an MLA or MLD and is flown using the same flying grid. Combination arrays of MLX and MLA can be created using a pair of flying grids, one to fly the MLX at the top of the array and the second to link between the bottom MLX and first MLA. The cabinet is symmetrical front to back with identical rigging brackets so cardioid arrays can easily be flown with a third of the MLX facing backwards. The rear of the cabinet features a wrap over grill to match the front so the neatness of the array is maintained even with the back of



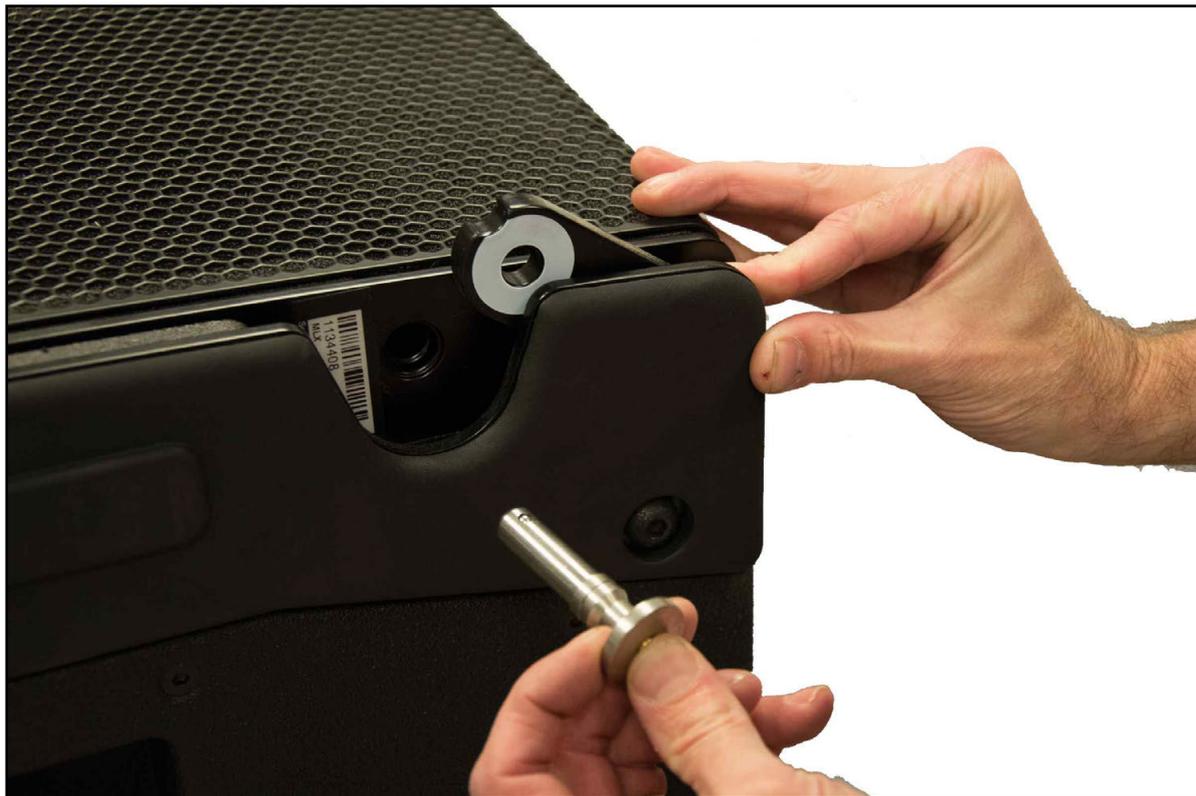
the enclosure facing forward. The top of the cabinet features a channel down which all connecting cables are laid and there is a cable entry position at the back so connections can be made and hidden by the hinged cover. There is also a hinged ventilation cover above the connection panel which must be opened during operation; at a distance this is the only obvious sign that you are viewing the rear of the enclosure.

In common with MLA and MLD, the MLX features a Martin Audio logo which can be illuminated via Vu-Net software to identify its location on the U-Net network, to ensure complete compatibility when an MLX is used rear-facing, there is also an illuminated logo on the rear of the enclosure, the choice of which badge lights is made in Vu-Net.

## Rigging

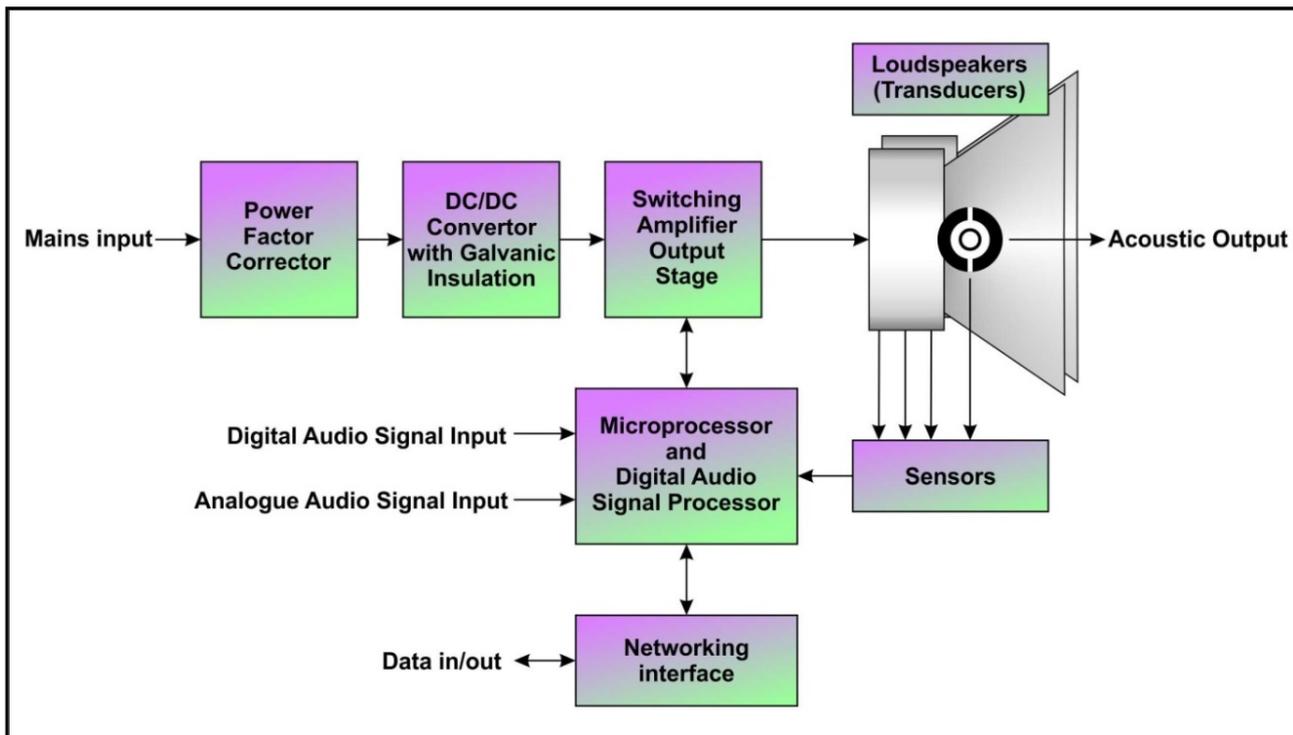
MLX rigging is a derivative of the MLA rigging system. As there is no requirement for multiple angles each rigging bar on all four corners at the bottom of the cabinet are relatively short with a single hole to locate into either the MLX below it or into the MLA flying grid for combination flown arrays. The rigging bar hinges up and is secured in its stored position with a flying pin. Each MLX has a slot and single hole on all four corners at the top of the cabinet to accept either the rigging bar from another MLX above it or the drop-down bars on the MLA flying grid.





The acoustic design of the MLX is based on the successful Hybrid<sup>®</sup> system with the drivers horn-loaded on their front with a reflex port on the rear chamber to obtain the efficiency of a horn loaded design with the extra low frequency extension possible from a reflex enclosure. The cabinet uses twin 18" drivers into a large format folded horn exiting at the front of the enclosure with four reflex ports, two from each driver located on the front of the box in the four corners.

The MLX uses a revolutionary iPal (Integrated Powered Adaptive Loudspeaker) system which involves a unique integration between a Class D high power amplifier module, a differential pressure sensing device, a very low latency DSP system and a dedicated high efficiency transducer. The amplifier is PFC (Power Factor Corrected) equipped making it immune from fluctuations in mains voltage and is capable of delivering up to 8,500W. This drives the dedicated iPal 18" neodymium magnet 3,400W rated woofers. The output from the drivers is monitored by the differential pressure sensor both in front and behind the baffle. The sensor feeds back pressure information to the DSP module which in turn feeds the amplifier module. Thus the system is a closed loop with continuous monitoring of the exact position of the driver cone at any moment in time. This is compared to the input signal and corrections are made to the drive signal resulting in an incredibly linear system capable of phenomenal output without fear of damage as the close monitoring of the precise driver output allows the DSP to restrict levels to the safe operating limits;-



MSX IPal Block Diagram

The closed loop system is a patented technology dubbed DPC® (Differential Pressure Control) that is the core of the IPAL system. Without an accurate method of linking acoustic output back to the electrical domain the system would be impossible. The pressure sensor was developed to provide this vital link in the chain.

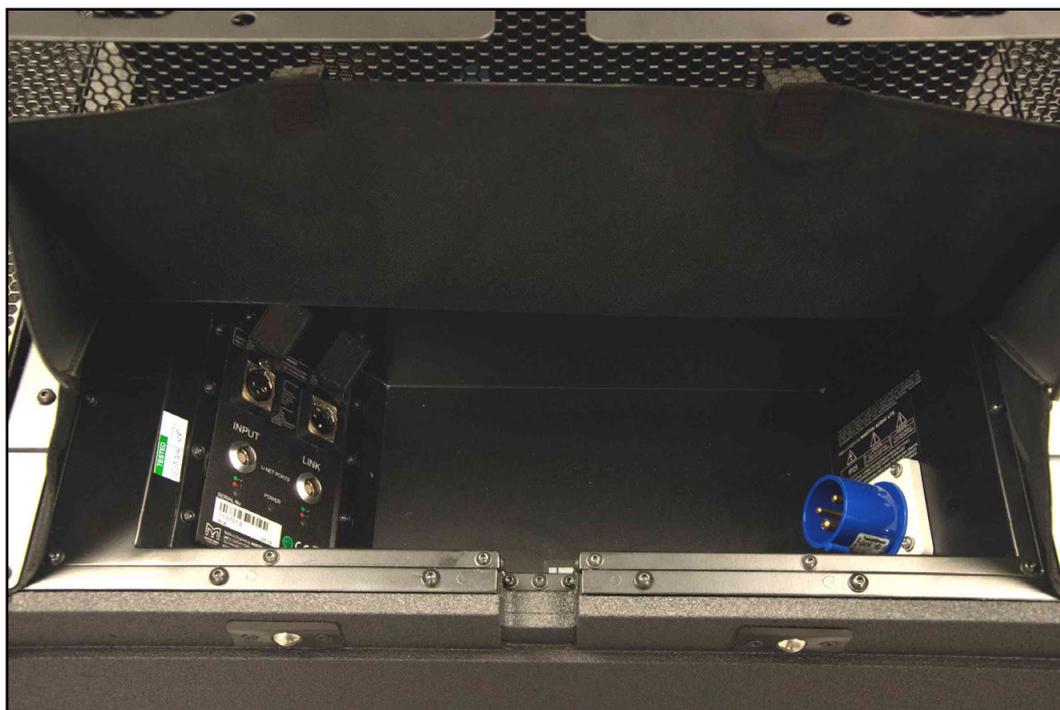
IPAL used “zero” latency DSP to control the signal applied to the amplifier with input from the DPC system. Low latency is vital since corrections to the output signal have to be made in real time not several milliseconds after an event. The DSP in the IPAL system was developed with an innovative architecture that achieves an astonishing 10µs making it fast enough to easily handle any sudden transient deviations in the sub band.

### Amplifier Module

The MLX features a completely self-contained amplifier module housing the iPal amp module and U-Net interface.



The module is held in place behind the ventilation panel and connector lid, removal is a simple case of unscrewing the fixing screws and disconnecting the two Neutrik NL4's which connect the drivers and LED's to the module, the Neutrik p-pin XLR which connects the iPal pressure sensor and the Cat 5 cable that links to the iPal data port. Field replacement therefore is very quick and easy in the unlikely event of a module failure.



## Connections

All connections to the MLX are on the amplifier module and are accessed behind the connection cover which hinges upwards to facilitate connecting all cables. There is an exit space in the middle of the cabinet at the bottom to allow the cables to be neatly run into the cabinet with the cover closed.



## Mains

The MLX mains inlet is located on the right of the amplifier module a standard 16A Male 230V single phase IP44 rated Ceeform inlet connector. A comprehensive mains distribution system is supplied with the MLA systems which features female outlets rated at IP67.



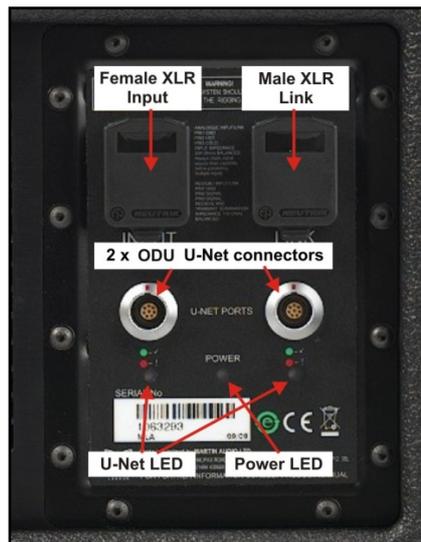
The MLX has a universal PSU suitable for direct connection to virtually any mains voltage anywhere in the world. It is supplied fitted with a 16A Ceeform single phase mains inlet. If you are not using the Martin Audio MLA distribution system a matching Ceeform 16A female outlet connector must be used. For outdoor use this should be rated at IP67, this is to ensure safe operating when any connectors are disconnected in damp conditions.

### Audio & network

The main audio and network connection panel is identical to that on the MLA and is located on the rear of the amplifier module to the right. It features a male input and female link 3 pin XLR for balanced analogue or AES/EBU digital input signals. Input type is selected via the Vu-Net software. The Neutrik XLR's are fitted with a hinged cover for protection when not in use.

Two 8-pin ODU rugged latching push-pull style data connectors are provided for the U-Net network connection. The two ports are available so that the network connections can be daisy chained between other MLA cabinets or U-Net equipped devices such as Martin Audio amplifiers or Merlin system controllers. Either connector can be used as input or link.

A single green LED indicates power and two bi-colour LED's indicate U-Net network integrity. Green indicates that the network is stable and red indicates an error. For a full description of U-Net LED activity please see the Vu-Net chapter.



U-Net connections are made using Cat5 cables fitted with 8-way push pull latching connectors compatible with ODU Series K. Robust Cat 5 cable should be used such as Neutrik Etherflex or Belden 1305A, this will ensure reliable network connections of up to 125 metres between network ports. U-Net protocol uses a redundant ring fault tolerance so connections “daisy-chain” between all units in the network going from port 1 on the first unit to port 2 on the next and so on before finally making a return connection back to port 2 on the first unit to complete the loop. The U-Net network will operate perfectly well without a closed loop but it is strongly recommended to use this option so that the network will continue to work in the event of a break in cable or disconnected connector.

Ready-made tour-grade network cables in a variety of lengths from short inter-cabinet patching to long front of house to stage are supplied as part of an MLA system.

Analogue inputs should be connected with a good quality 3-pin Male XLR wired to good quality twin screened cable, this is particularly important if the feed is a long length of cable; from front of house to stage for example. Good quality cable will minimise losses over the cable run. The link outputs should use a similarly high quality Female XLR. Wiring is the industry standard for balanced connections:-

- Pin 1. Ground or shield
- Pin 2 +, Hot, in phase
- Pin 3 -, Cold, out of phase.

The signal source used to feed the MLA array must have line drive capabilities suitable for driving the combined load of the entire array.

AES/EBU output connections are identical to analogue but cable used must be a dedicated 110Ω, low capacitance digital cable such as Belden 1800F or 1696A.



### iPal Firmware upgrade

As with all products in the MLA series, the iPal module is subject to continuous development and improvement and so there may be occasions when an iPal firmware upgrade is necessary.

### IPAL vs MLX firmware

It is important to differentiate between the two systems found within the MLX. What is referred to as "MLX firmware" refers to the U-Net network interface and DSP which is controlled via Vu-Net. This DSP controls all EQ, phase, delay, muting and level adjustments available to the user. MSX operating firmware is updated via Vu-Net. Please see the Vu-Net chapter in this User Guide for details on how to check and update MSX Firmware. iPal firmware is the system controlling the internal iPal module. This is completely self-contained, there is no adjustment whatsoever available to the user. Firmware updates are done via a connection directly to the module via a dedicated RS485 port on an RJ45 connector beneath the upper grill on the rear of the MLX.

### Parts Required

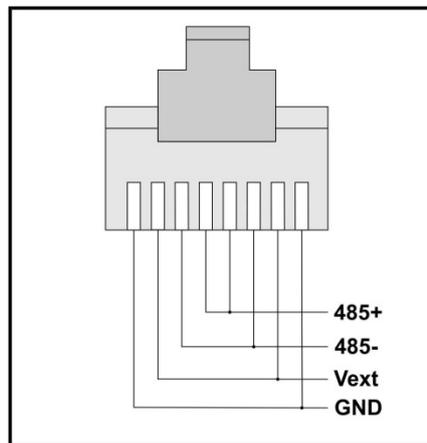
All necessary software is supplied in a zip file which is e-mailed to all MLA users whenever an upgrade is released. Some hardware is also required to connect a PC to the module.

As mentioned, the iPal port is RS485 so you will need an RS485 adaptor to connect between your PC and the module. There are a large number of these available from computer spares stockist however Martin Audio recommend the EasySync ES-U-3001-M available on line directly from EasySync;-

<http://www.easysync-ltd.com/product/542/es-u-3001-m.html>

This versatile USB adaptor can be configured to connect to RS232, RS422 as well as RS485, it is housed in a rugged metal case so will withstand the rigours of the touring industry, and it has its output available on both a 9-pin 'D'-type connector and a six way terminal block which makes it very easy to connect custom cables which is necessary to connect to the iPal module.

You will need to make a suitable adaptor cable to connect to the module. The RJ45 connection is unique to the iPal module, the pin out is as follows;-



This is easily achieved by using a standard CAT5 patch cable, cutting off one end, stripping back the connectors and wiring into the terminal block on the EasySync adaptor is used. This is very much quicker and easier than having to make up a custom RJ45 to 9-pin D-type cable. The cable connections for RS485 on the EasySync are as follows;-

- Pin 1**    **485- (A)**
- Pin 2**    **485+(B)**
- Pin 5**    **+5V**
- Pin 6**    **GND**

If the Cat 5 cable is standard wiring configuration the connection to the EasySync will be as follows;-

- Pin 1**    **485-    Green + Green/White**

Pin 2	485+	Blue + Blue/White
Pin 3		No connection
Pin 4		No connection
Pin 5	+5V	Orange + Brown/White
Pin 6	GND	Brown + Orange/White

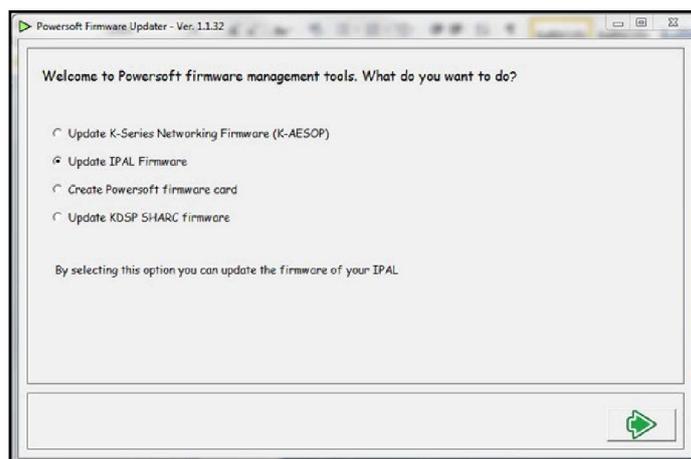
With the USB to RS485 adaptor and modified CAT5 cable connected to your PC, connect the unmolested RJ45 connector to the weatherproof RJ45 socket located underneath the upper grill on the rear of the cabinet;-



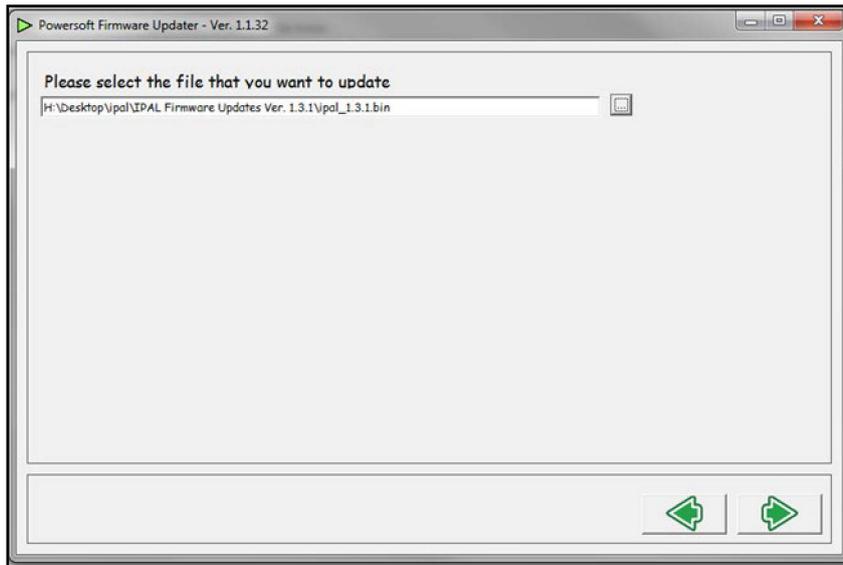
Note that early MLX did not have the cabinet mounted RJ45 port. All MLX should have been modified to fit the socket but if this hasn't happened it will be necessary to remove the amplifier module to access the RJ45 port on the module itself.

On your PC Unzip the file **"FirmwareUpdater\_1.1.37\_Setup.zip"**. From the unzipped folder, run **"FirmwareUpdater\_1.1.37\_Setup.exe"** to load the iPal update software onto your PC.

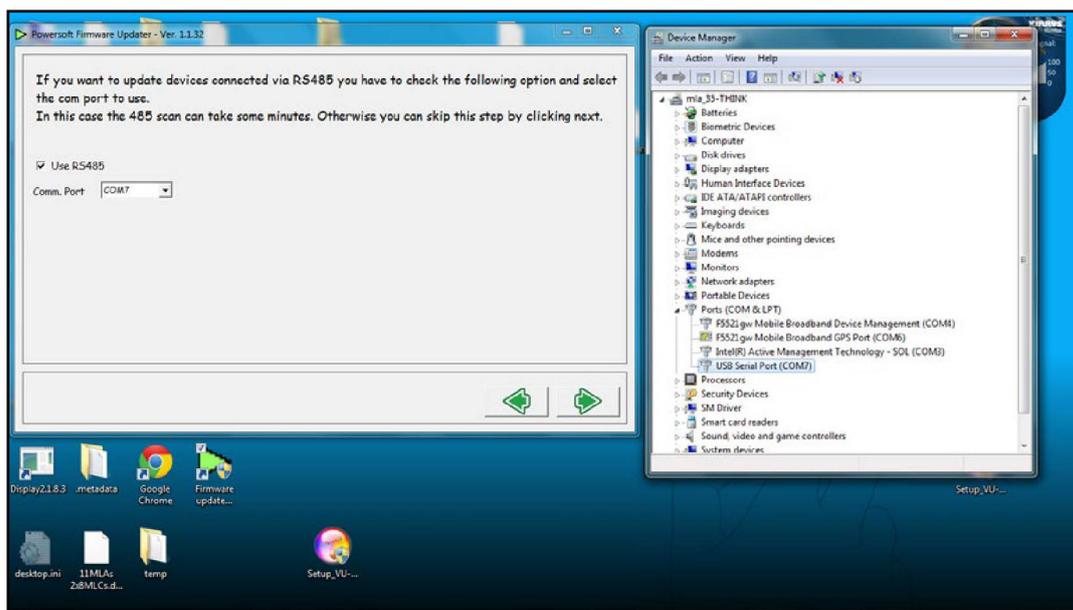
Make certain that the USB to RS485 adaptor is connected and working correctly and run the **"Firmware updater 1.1.17"** application. You will see the following window. Select **"IPAL Firmware"**;-



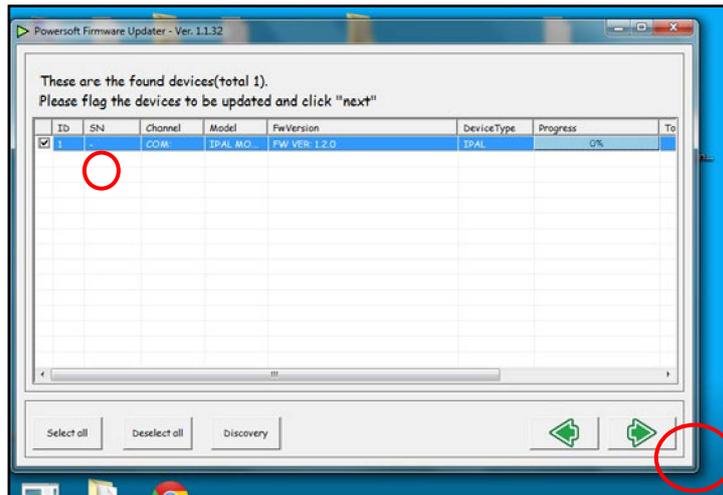
Navigate to select **"IPAL Firmware Updates Ver. 1.3.9\ipal\_1.3.9.bin"**;-



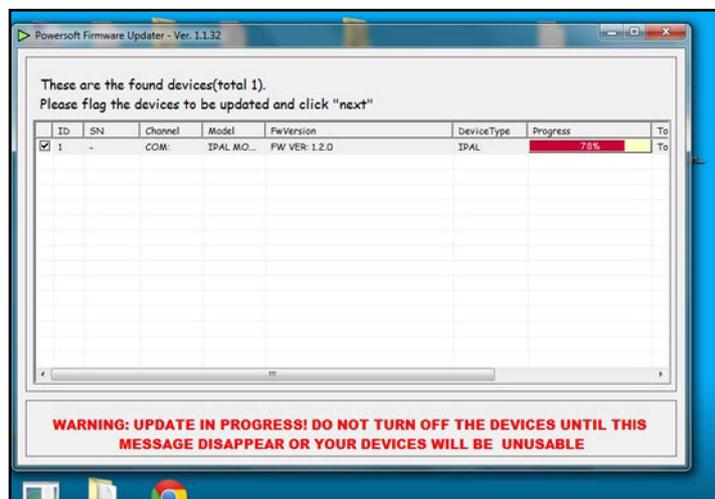
Select the COM port that your computer has used for the USB to RS485 convertor. This can be checked via Windows → Control Panel → Hardware and Sound → Device Manager;-



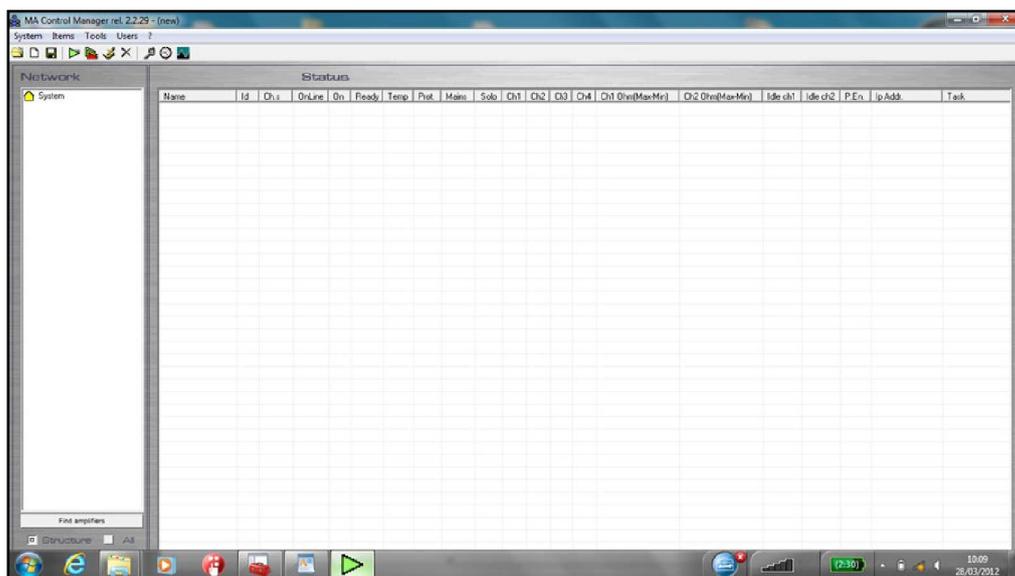
Select the MLX Module that is connected using the check box and use the next arrow to update the firmware;-



You will see the Progress bar showing the update taking place;-



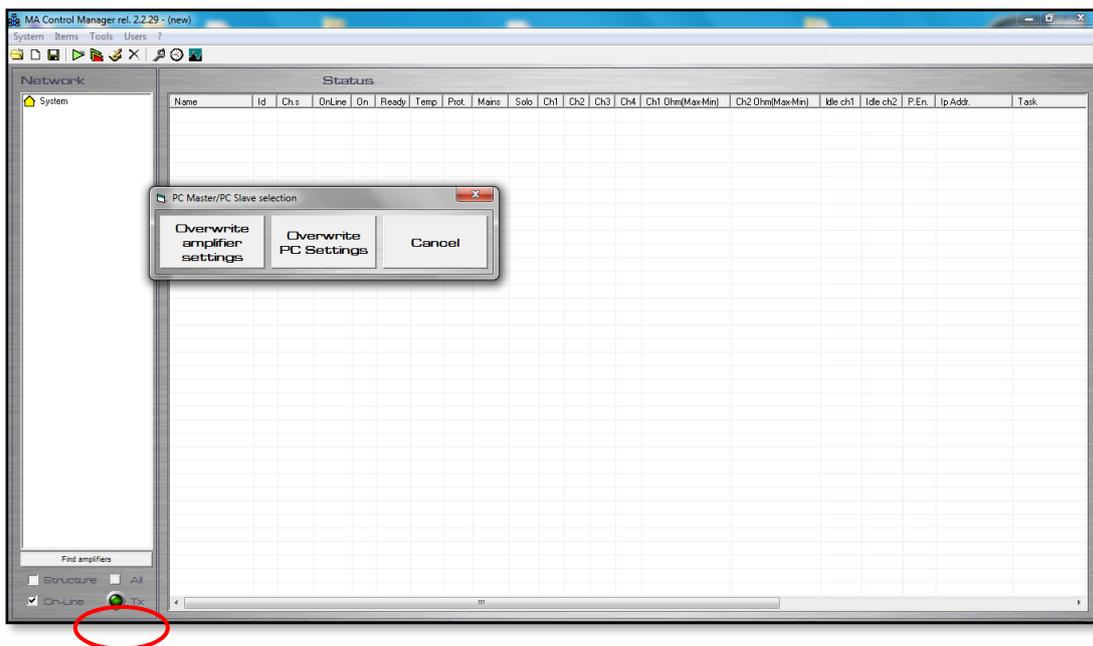
Next install Power Control Manager;- "PowerControlManager\_2.3.1\_Setup.exe"and run the program;-



Go to 'System' → 'Preferences' and choose the 'HubConn' tab. Select the COM port that your USB to RS485 is using previously found to run the Firmware update application;-



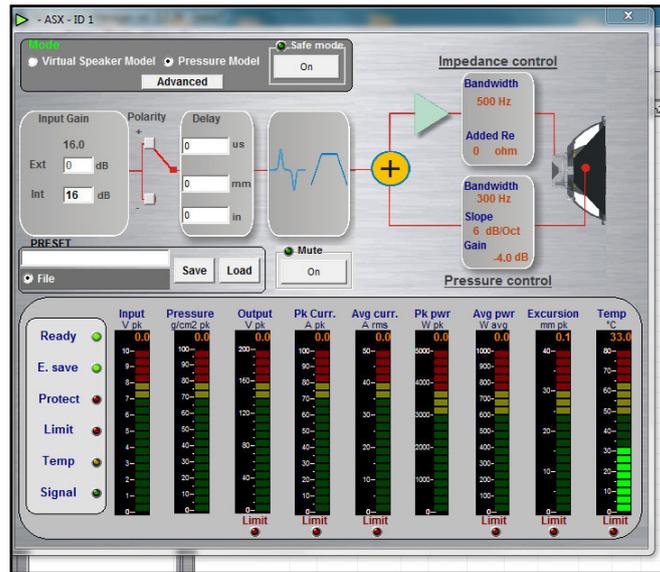
To find the connected MLX click the 'On-line' box at the bottom of the window and select 'Overwrite PC settings';-



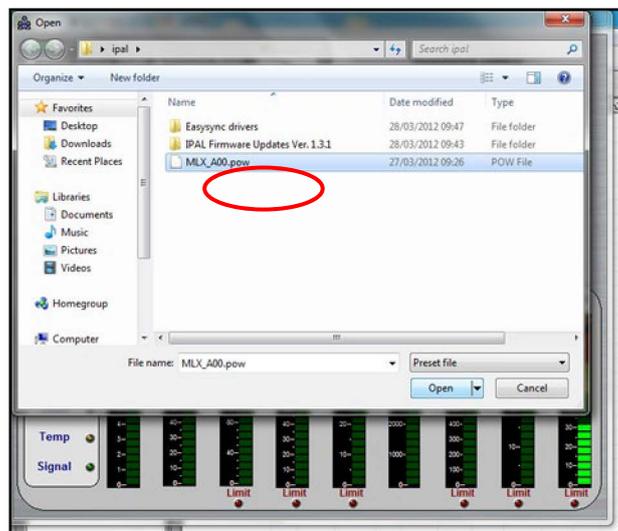
Click 'Find amplifiers';-



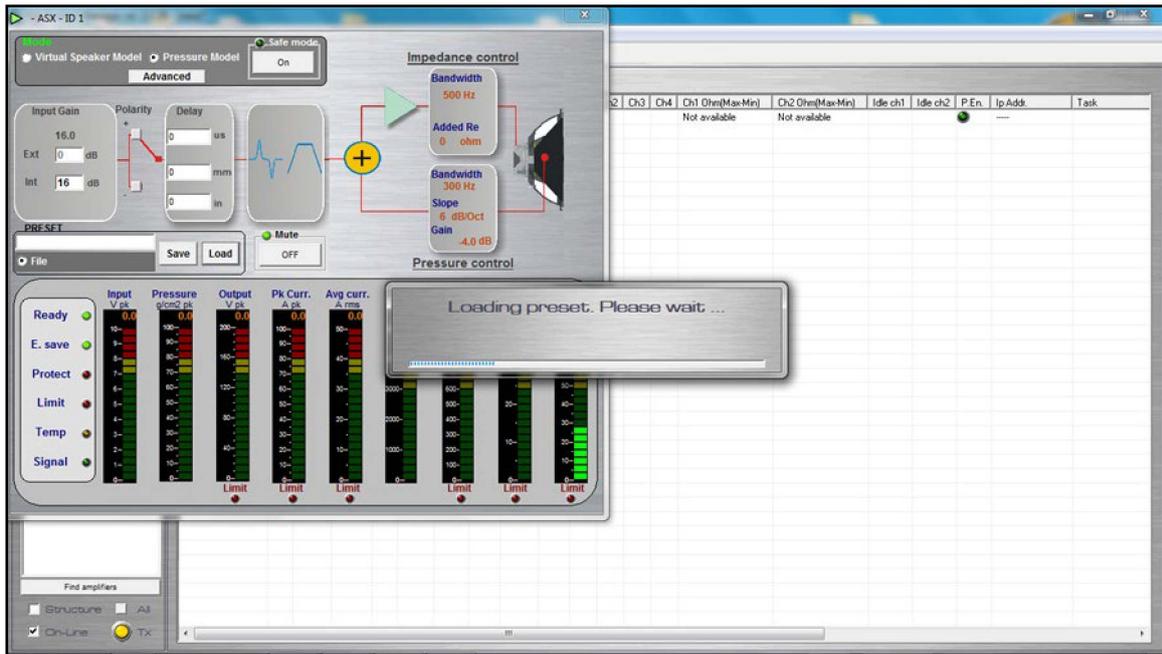
The MLX will be loaded into the application and will be visible in the Network panel on the left of the window. Double click on the amplifier symbol to open the MLX DSP;-



Click on the 'Load' button and navigate to the file "MLX\_A02.pow" in the unzipped upgrade folder;-



The preset will load into the DSP;-



Once the update has loaded Power Control manager can be closed and the MLX disconnected.

If the MLX had not had the RJ45 upgrade and you had to remove the amplifier module it should now be replaced making sure that the XLR and two NL4's are reconnected.

Using a known audio reference source (please no MP3 or fruit based products) pass audio through the MLX to confirm operation. It is recommended that a reference MLX cabinet is also present to compare acoustic output using the Mk1 Human Ear (not supplied by Martin Audio).

Check LED lights on upgraded MLX cabinets with power connected. If either LED lights, connect the MLX cabinet to VU-Net software and reload the current (build48) firmware.



**Essential Maintenance**

Coming Soon

**Tools Required**

Coming Soon

**Replacing the amplifier module**

Coming Soon

**Replacing a driver**

Coming Soon



**Specification**

**Acoustical**

TYPE Hybrid® horn/reflex subwoofer  
 FREQUENCY RESPONSE (1) 35Hz-150Hz ± 3dB  
 MAXIMUM SPL@ 1m LF: 140dB continuous, 150dB peak (3)

**Drivers**

LF 2 x 18"115mm / 4.5"voice coil, ultra-long excursion, high efficiency neodymium magnet

**Rated Power (2)**

LF 3,000W AES, 12,000W peak

**Dispersion**

Digitally controlled in an array

**Audio input**

CONNECTORS Female XLR input, male XLR link output  
 ANALOGUE INPUT IMPEDANCE 20kΩ balanced to ground  
 MAXIMUM ANALOGUE INPUT LEVEL 6.15Vrms (+18dBu), over voltage protected  
 NOMINAL SYSTEM GAIN 28.5dB  
 AES/EBU IMPEDANCE 110Ohms balanced, Receive and transmit termination

**Network**

CONNECTORS 2x IP68 rated 8-way, quick-release type  
 PROTOCOL U-Net

**Amplifier Module**

TYPE Single channel switch mode, fixed frequency  
 PEAK OUTPUT POWER 8,5000W  
 AVERAGE EFFICIENCY 85%  
 COOLING 2 x temperature controlled internal fans  
 1 x low-speed internal blower  
 1 x temperature controlled external fan  
 MAXIMUM AMBIENT TEMPERATURE 45°C (113°F) for full output

**Power Supply**

TYPE Switch mode, fixed frequency with PFC  
 AC INPUT OPERATING RANGE 100 – 240V ~ AC, 50 - 60Hz  
 AC OVERVOLTAGE TOLERANCE 400V AC  
 POWER FACTOR > 0.95  
 NOMINAL POWER CONSUMPTION 600W  
 MAINS CONNECTOR 16A IEC309 (Ceeform)

**General**

ENCLOSURE Extensively braced multi-laminate birch and poplar ply construction  
 FINISH Textured black PU coating  
 PROTECTIVE GRILLE Black HEX perforated steel  
 FITTINGS Proprietary rigging system  
 Bar handles on each side  
 Protective Rubber side-cheeks incorporating skirts  
 Wheel-board  
 Transit cover  
 Weather Protection Cowl



IP RATING	IP 24
DIMENSIONS (inc. wheelboard)	(W) 1126mm x (H) 607mm (607mm) x (D) 1027mm (1200mm) (W) 44.4in x (H) 23.9in (18in) x (D) 47.2in
WEIGHT (ex. wheelboard)	160kg (352lbs)

## Accessories

Flying frame (including clinometer)  
Flying Pin  
Mains distribution system  
Tour-grade network interconnects  
Merlin Controller/Unet Hub

## Notes

- (1) Measured on-axis in open (4<sup>th</sup>) space at 4 metres, then referred to 1 metre.
- (2) AES Standard ANSI S4.26-1984.
- (3) Measured in half-space at 1 metre with a tone burst signal, then referred back to open (4<sup>th</sup>) space.
- (4) Calculated from 4m 2.83v sensitivity, referred to 1m.

## MLA Compact



MLA Compact was launched as the second product in the multicellular range to bring the proven benefits of the large format MLA system to a wider range of applications not requiring the full power and throw that MLA provides or where size and weight restrictions call for a smaller lighter system. MLA Compact shares the sonic attributes of the flagship MLA and is designed for medium-scale touring and fixed installations. Its compact size belies its output capabilities — a 12-box array can easily deliver full rock SPL's in a 5000 seat venue, whilst a 24-box array will approach the output of many "full-size" systems which have less efficient acoustic elements.

Scalable and versatile, MLA Compact is the ideal system for ballroom, theatre and HoW applications and is the natural choice as a side-hang or front-fill for the full-size MLA.

The MLA Compact is a three-way active Multicellular loudspeaker with each cell comprising of a drive unit or units, a Class D high power, high efficiency amplifier and comprehensive digital signal processing. There are five cells in total, two high frequency comprising of a pair of 0.7" exit compression drivers, two mid, and a low frequency cell comprising of a pair of 10" bass drivers. The combination of built-in amplification and DSP offers a hitherto unheard of level of control in a compact, lightweight loudspeaker. In conjunction with Display 2.1 system design and VU-Net network control software applications, outstanding levels of consistent, high quality audio can be distributed to every point throughout the audience in a venue.

The MLA Compact has audio inputs that can be either standard balanced analogue or AES/EBU digital. A parallel connection is available to daisy-chain between cabinets. The MLA Compact features network control via a U-Net interface which as well as carrying all control data for the on-board DSP also feeds digital audio to the system. U-Net connections are made via a pair of very high quality, rugged 8-way push-pull latching connectors rated for high speed data applications.

Mains connection is via a 16A Ceeform connector. A comprehensive mains distribution system is supplied as part of the MLA system.

Each of the five channels of DSP comprises extensive processing optimised for the driver(s) under control, this includes delay, parametric EQ, High and low pass filters, IIR all-pass filters, FIR low pass filter and EQ, gain, phase and limiting. In addition there are user accessible parameters including delay, 10 bands of parametric EQ, high pass filtering, gain, phase and muting.

The MLA Compact system has a rigging system based on the existing popular and efficient Martin Audio line array systems but with some innovative improvements. This allows phenomenally quick system rigging and de-rigging particularly in view of the fact that there are no amplifier racks to set up and break down.

The MLA Compact is designed for use outdoors in virtually any weather conditions so is rated to IP24. Electrical systems are protected by a waterproof flexible cowl.

The cabinets are elegantly styled with a wrap over grill and injection moulded rubberised end cheeks that as well as adding to the visual aesthetic make for easy and stable stacking in trucks or warehouses. A large bar handle makes handling and rigging the system an easy job and each cabinet is supplied with a front-mounted wheelboard and protective canvas cover.

## Mechanical Design

MLA Compact is extremely easy to handle and deploy and it's astonishingly small size provides a very discreet and attractive enclosure. It is constructed from 18mm multi-laminate birch ply with a very durable PU weather-proof coating. All rigging metalwork and the wrap-over grill are powder coated steel and as with the MLA series the cabinets are finished with decorative protective rubber end cheeks.

## Rigging

MLA Compact Rigging is a simplified version of the array style rigging employed on Martin Audio line arrays and the MLA system. As with these systems the rigging is a fixed front system with angles between cabinets adjustable from  $0.5^{\circ}$  to  $10^{\circ}$  by using the rear rigging brackets and selecting the correct hole in the bottom half of the rear bracket;-



The rear bracket travels in a "parked" position when not in use and the cabinet is in transit;-

One issue with previous Martin Audio rigging system was the difficulty experienced flicking the rear linking bar out of its parked position. This problem has been solved with the addition of a protruding tongue at the base of the bar where it pivots. This can easily be used to rotate the bar out of its slot once the securing pin has been removed.



The front bracket is a little different to other systems in that it is a rigid bracket protruding at both top and bottom of the front of the cabinet at each side;



The cabinets are joined using machined quick-release pins. There are an identical design to the MLA pins but a smaller size. These have spring loaded ball bearings at the end of the pin which protrude beyond the outer diameter of the pin thus locking them in place. To release them, the central button is depressed whilst pulling the pin clear using the wide flange. This is best done with



the fore and index fingers pulling the pin whilst your thumb depresses the central button, a very quick and easy operation. When using the pins to link cabinets, the central button must again be depressed so the pin can be pushed into position. It is important to check that the central button does not remain depressed once you have put it in place as this would indicate that the pin has not been pushed all the way into position and the ball bearings at the end of the pin have not been able to pop out and lock the pin in place. If the pin is not locked the array is unsafe. The pin **MUST** be repositioned until it is securely locked in place.

## Acoustic Design

The MLA Compact acoustic design took the MLA cabinet as a starting point and scaled the design down to fit the smaller enclosure. Many of the key attributes in the MLA have been repeated including the all horn loaded design and Hybrid® low frequency section. This approach – something of a Martin Audio trademark – allows maximum efficiency from the system, the output from the Compact is astonishing for such a small box. MLA Compact deliberately avoids the use of coaxial, co-entrant or cross-firing midrange/HF driver arrangements which introduce acoustic discontinuities that affect the on and off-axis frequency response of both mid and HF sections. The MLA Compact's mid and HF horns are completely separate – a key factor in its ability to produce consistent horizontal constant directivity coverage. This gives startlingly consistent frequency response when listening off-axis and “walking the field”.

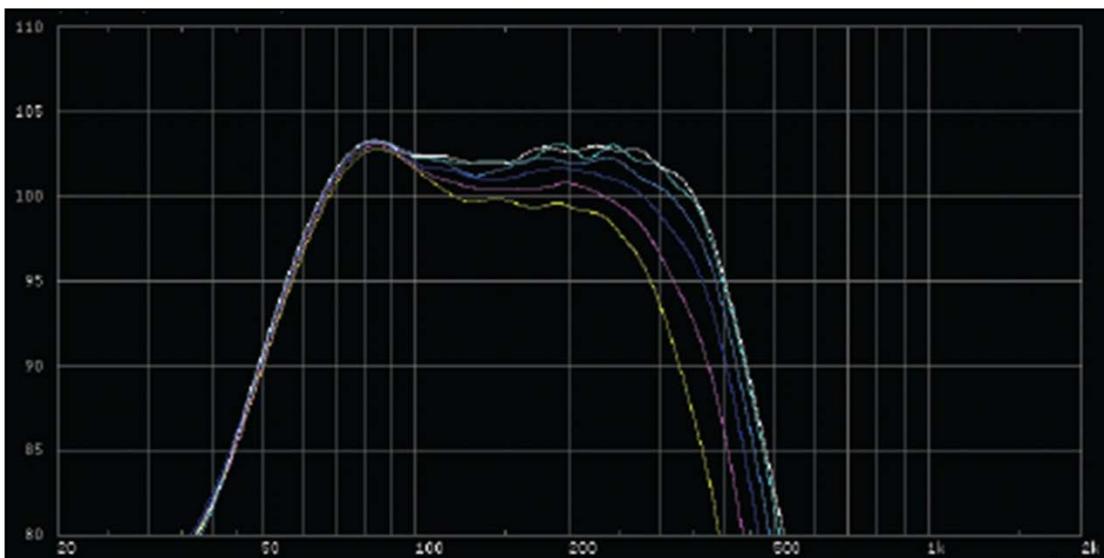
The cabinet has a wider dispersion than MLA as befitting its intended market and covers 100° horizontal and 10° vertical. Note that as the vertical coverage is significantly greater than the MLA the MLA Compact system does not require a dedicated down-fill enclosure.

## Low Frequency

MLA Compact's LF section utilises 2 × 10"(250mm)/2.5"(63mm) voice coil, neodymium drive units in a unique Hybrid® configuration. Each driver is slot-loaded into a truncated horn with a low flare rate, to give a high sensitivity of 103dB @ 1m/2.83V – whilst the rear of the driver is reflex loaded to extend the LF output. MLA Compact's Hybrid LF arrangement provides the best of both worlds – raising the acoustic efficiency and packing a punch that direct radiators cannot compete with, as well as maintaining the LF extension.

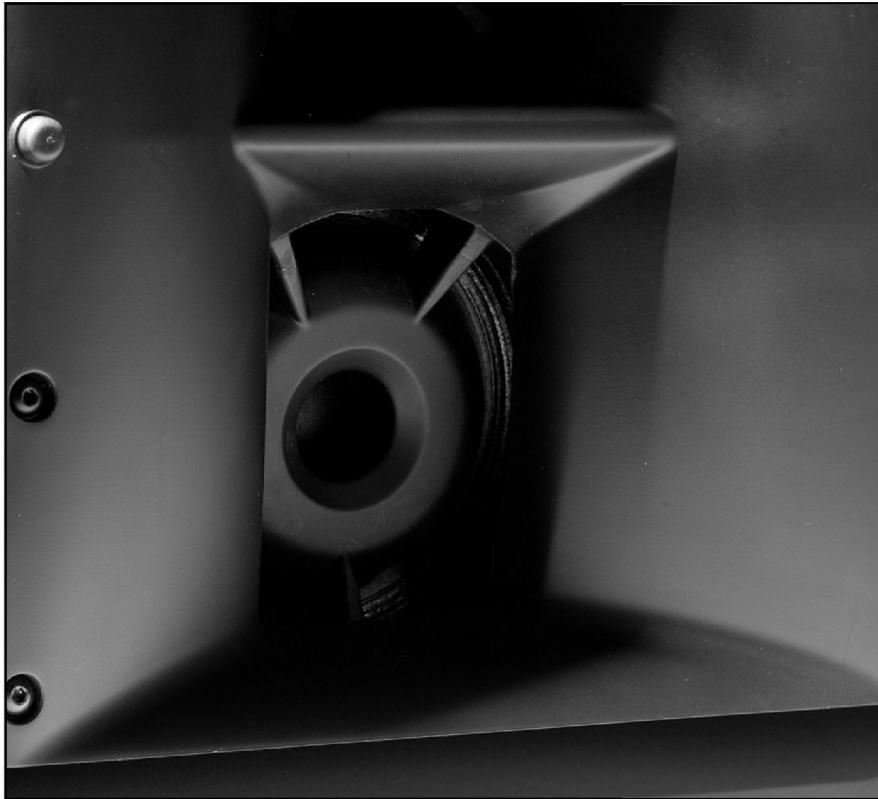


The slot-loading allows the twin LF drivers to be optimally spaced within the enclosure. The double-source arrangement significantly improves the directivity control of the LF section maintaining the 100 degree system beamwidth down to 250Hz and reducing mid-bass output at the sides and rear of the array. The LF drivers themselves are very high excursion with vented poles to reduce power compression and virtually eliminate turbulent air noise.



## Mid-Range

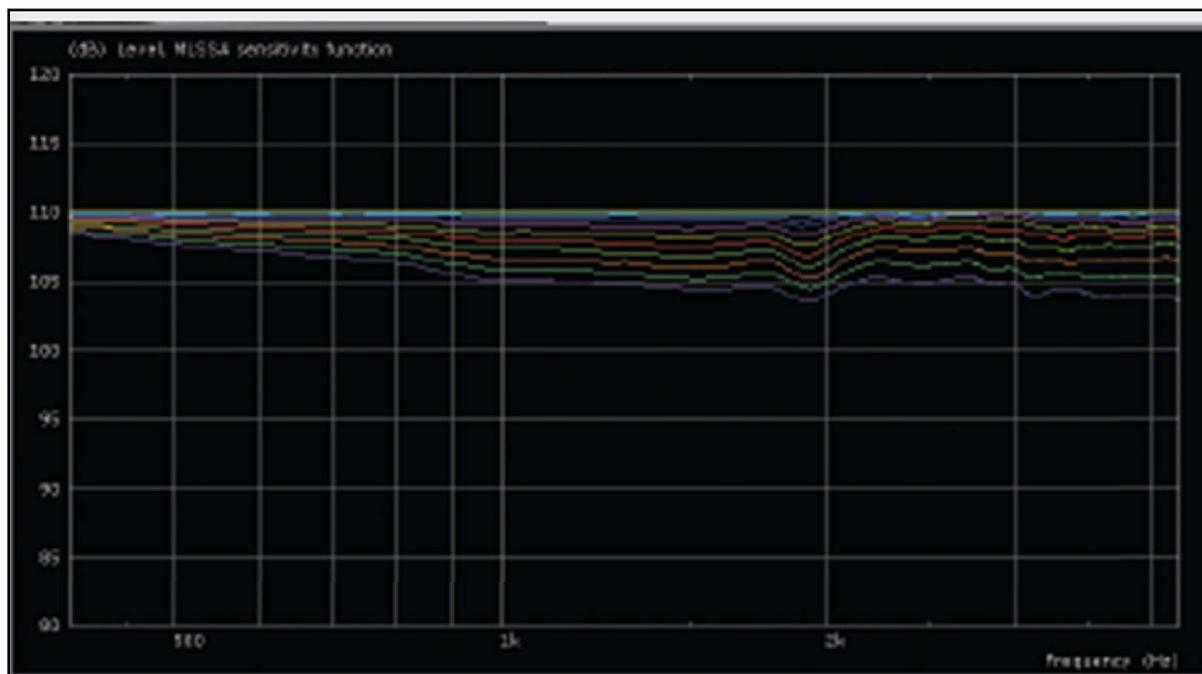
The mid-range section is partnered with the high frequency on a custom designed one piece mid-high cast composite horn flare;-



With so much design effort concentrated on the vertical performance of arrays, the horizontal dispersion can sometimes be less than ideal, with dispersion varying at different frequencies — particularly in designs that use coaxial, co-entrant or cross-firing midrange arrangements for the mid/HF. MLA Compact has completely separate, mid and HF horns with horizontal constant directivity characteristics — so the horizontal off-axis response tracks the on-axis response exactly. Martin Audio has over 30 years' experience developing cone-driven midrange horns, and this experience, together with BEM optimised horn geometry has been put to good use in the design of MLA Compact's mid and HF sections.

The mid horn utilises  $2 \times 5''(125\text{mm})/1.5''(38\text{mm})$  voice coil neodymium drivers to produce  $109\text{dB @ }1\text{m}/2.83\text{V}$  — a big gain on the typical efficiency of  $102\text{dB}$  for cross-firing direct radiator designs in comparably sized systems. This is a result of painstaking acoustic and thermal design, utilising forced-air cooling and a thermally conductive aluminium housing

The  $5''\text{cone}/0.7''\text{compression}$  driver combination replaces the more traditionally used large format compression driver and has less distortion, as well as having a much more extended HF response.



Mid frequency Horizontal Directivity at 10 degree intervals

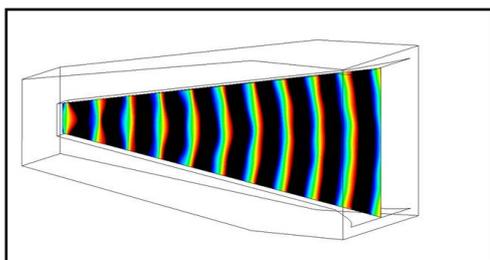
High Frequency



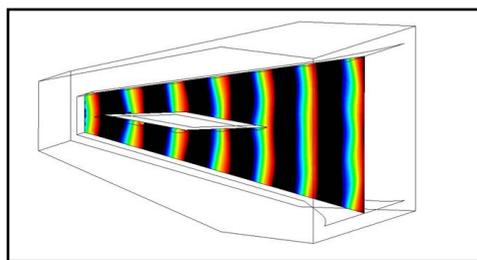
MLA Compact’s HF section utilises 4 × 0.7" (19mm) exit neodymium compression drivers which feed separate horns for true 100° horizontal constant directivity. In the vertical plane, MLA Compact makes significant advances over previous thinking by adopting new criteria for vertical wavefront curvature.

Instead of adopting flat wavefronts as advocated by early proponents of touring line arrays, our sophisticated in-house BEM (Boundary Element Method) modelling techniques have shown that slightly curved wavefronts deliver much more consistent SPL's to the audience where the array is curved — as in most practical, real-world applications.

Placing a kite shaped “wedge” part-way down the horn\* enables a specific, desired curvature to be achieved — depending on the shape of this wedge. In the case of MLA Compact, the HF wavefront is curved to provide a balance between optimal summation over distance and summation at the maximum inter-cabinet splay angle of 10°;-



Conventional horn, curved wavefront



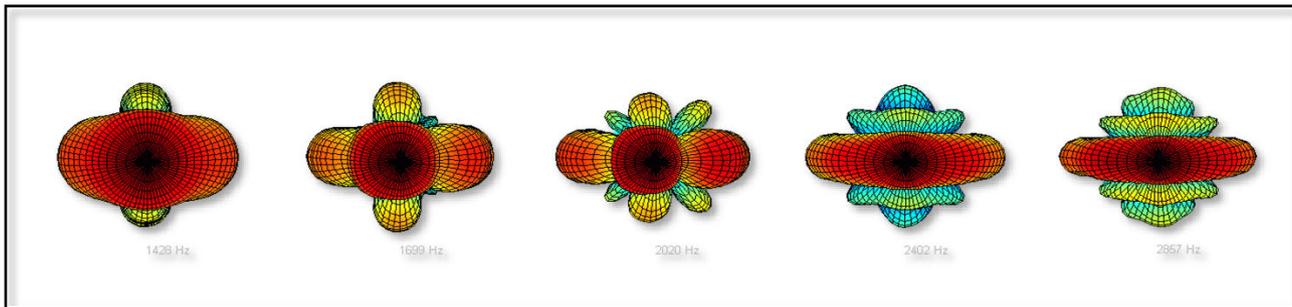
With wedge: curvature is ideally optimised

## FIR Crossovers

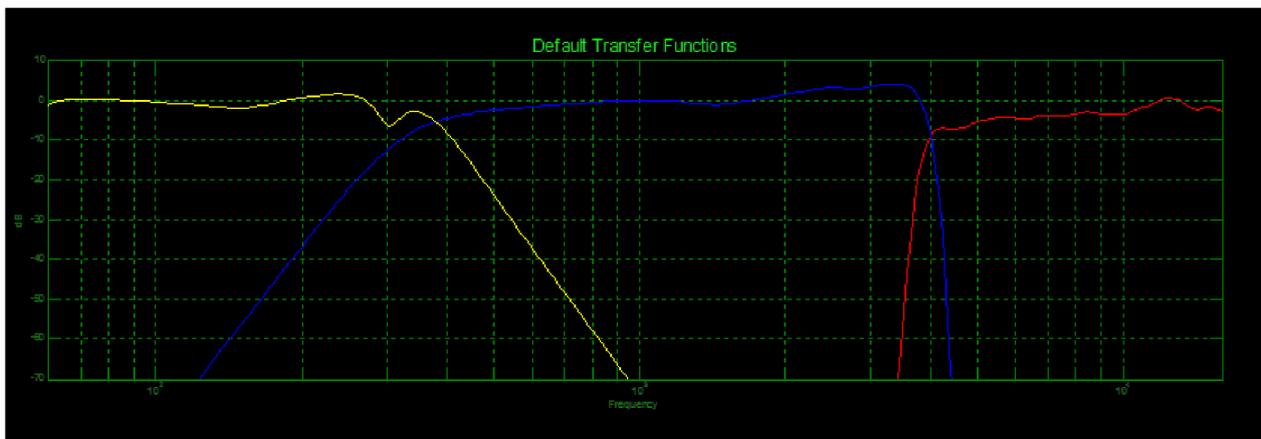
Like all three-way systems, MLA Compact's low, mid and high frequency sections are combined by a crossover. Up to now, Linkwitz-Riley, 4th order filters have been the industry standard. With traditional filters like these, overlap at crossover can result in a non-symmetrical horizontal polar pattern if the devices being crossed-over are side by side.

In the theoretical opposite extreme, a brick-wall filter would completely eliminate overlap, and the polar pattern would be unaffected and symmetrical.

MLA's practical implementation uses very steep, VanishingPoint™, FIR filters. They are not actually brick-wall, because of the effects of brick-wall filters on transient response. Listening tests confirm that the two devices are impossible to locate separately, but sound like a single acoustic source, located at the point in space at which we have optimised the FIR filter.



MLA Compact’s VanishingPoint FIR filters give us the freedom to physically separate the mid and HF horns, so they do not compromise each other’s dispersion pattern, yet achieve the spatial performance of a single device – giving us the best of both worlds.



### Amplifier module

The amplification and control module is an entirely self-contained section. This may be removed by unscrewing the rear panel which also holds the weather cowl in place. Once unscrewed the module is quickly disconnected using the pair of Neutrik NL8 connectors which connect the amplifier outputs to the drive units. This means that field replacement of the module is quick and easy in the unlikely event of a module failure.

Each MLA Compact is fitted with a 5-channel amplifier module. Its Class D circuitry delivers a total of 2.1kW continuous and 4.2kW peak output, whilst producing significantly less heat than a linear output stage design. All channels share the same circuit topology and are driven from the same power supply. This configuration effectively shares the total power available between the LF, mid and high frequency channels - providing high continuous power for the low frequency channel and high peak power for the mid and HF channels.

The lightweight, switched-mode power supply auto-ranges to global mains voltages from 100 to 240V 50/60Hz. Power Factor Correction smooth’s out the mains current draw over the whole of the AC waveform, effectively reducing cable losses caused by high peak currents in the mains distribution system.



The module features advanced monitoring and protection, including over-temperature power limiting, short-circuit and overload protection. Amplifier monitoring via U-NET™ includes input signal, output signal at the drive unit terminals, limiter status, heatsink temperatures and fault conditions.

The amplifier section is designed to withstand the various environmental conditions typically found in live sound applications – such as rain and ambient temperatures of up to 45°C. A sophisticated cooling arrangement, where air is forced over the amplifiers’ heatsinks through a metal tunnel, employs an IP rated fan with intelligent drive for quiet operation when the system is used at lower powers.

### Connections

The amplifier and network module housed in the rear of the cabinet is protected by a weatherproof canvas cowl. This vital accessory has two functions. In the event of poor weather it will keep all electrical connections dry. In the event of very hot weather it acts as a sun shade to keep direct sunlight off the amplifier cooling system and thus prevents over-heating.



The cowl travels folded flat for ease of transportation. It is held in the operating position by two triangles of canvas mounted towards the middle of the cowl. These have straps attached and by pulling the straps the cowl pops up into position and is held in place with the two supporting triangles which connect to the inside of the cowl using Velcro. To fold the cowl flat, the straps are again used to pull the supporting triangles down left and right.



### Mains

The MLA mains inlet is located on the left of the amplifier module at the rear of the cabinet and is a standard 16A Male 230V single phase IP44 rated Ceeform inlet connector. A comprehensive mains distribution system is supplied with MLA Compact systems which features female outlets rated at IP67. As the MLA Compact has a vertical dispersion of 10°, it is quite possible for the lower cabinets in a steeply curved array to have their mains inlet connectors pointing above the horizontal and therefore in extreme weather conditions at outdoor events there is the possibility of water ingress even with an IP64/67 rated connector combination. To compact this there is an additional measure in form of a canvas bag with a drawstring neck in which the amplifier mains inlet is housed. Once the connection has been made with the incoming Ceeform from the mains distribution system, the drawstring is pulled around the mains cable and is held tightly secure with a spring-loaded button press release catch.



The MLA Compact has a universal PSU suitable for direct connection to virtually any mains voltage anywhere in the world. If you are not using the Martin Audio MLA distribution system a matching Ceeform 16A female outlet connector must be used. For outdoor use this should be rated at IP67, this is to ensure safe operating when any connectors are disconnected in damp conditions.

### Audio & network

The main connection panel is on the rear of the cabinet to the right and features a male input and female link 3 pin XLR for balanced analogue or AES/EBU digital input signals. Input type is selected via the Vu-Net software. The Neutrik XLR's are fitted with a hinged cover for protection when not in use.



Two 8-pin ODU rugged latching push-pull style data connectors are provided for the U-Net network connection. The two ports are available so that the network connections can be daisy chained between other MLA cabinets or U-Net equipped devices such as Martin Audio amplifiers or Merlin system controllers. Either connector can be used as input or link.

A single green LED indicates power and two bi-colour LED's indicate U-Net network integrity. Green indicates that the network is stable and red indicates an error. For a full description of U-Net LED behaviour please see the Vu-Net chapter.



U-Net connections are made using Cat5 cables fitted with 8-way push pull latching connectors compatible with ODU Series K. Robust Cat 5 cable should be used such as Neutrik Etherflex or Belden 1305A, this will ensure reliable network connections of up to 125 metres between network ports. U-Net protocol uses a redundant ring fault tolerance so connections "daisy-chain" between all units in the network going from port 1 on the first unit to port 2 on the next and so on before finally making a return connection back to port 2 on the first unit to complete the loop. The U-Net network will operate perfectly well without a closed loop but it is strongly recommended to use this option so that the network will continue to work in the event of a break in cable or disconnected connector.

Ready-made tour-grade network cables in a variety of lengths from short inter-cabinet patching to long front of house to stage are supplied as part of an MLA system.

Analogue inputs should be connected with a good quality 3-pin Male XLR wired to good quality twin screened cable, this is particularly important if the feed is a long length of cable; from front of house to stage for example. Good quality cable will minimise losses over the cable run. The link outputs should use a similarly high quality Female XLR. Wiring is the industry standard for balanced connections;-

- Pin 1. Ground or shield
- Pin 2 +, Hot, in phase
- Pin 3 -, Cold, out of phase.

The signal source used to feed the MLA array must have line drive capabilities suitable for driving the combined load of the entire array.

AES/EBU output connections are identical to analogue but cable used must be a dedicated 110Ω, low capacitance digital cable such as Belden 1800F or 1696A.

**Block Diagram**

MLA Compact features sophisticated processing which feeds the amplifiers driving the low frequency, mid and high frequency drivers. The diagram below shows the signal path from the input which may be derived from analogue, AES/EBU digital, or digital from the U-Net network, through to the drivers. All signal routing and monitoring is done via VU-Net

The input signal is first selected between back panel (the 3-pin XLR) or U-Net. If 'Back Panel' is selected there is then a further choice of either analogue, AES Left or AES Right (as AES/EBU is a stereo feed). If U-Net is selected you may then select from any

of the four inputs or ten outputs from the Merlin controller which is supporting the network. A VU Meter displays the input level prior to any internal processing, useful as an indicator of inappropriate levels from the signal source feeding the system.

There are then 10 bands of parametric EQ, a high pass filter and a gain control that are accessible for user adjustment of the response. The array can be divided into up to six zones so that different EQ can be applied to different areas of the system.

Each band of parametric may be Peak, 2<sup>nd</sup> order Low Shelf or 2<sup>nd</sup> order High Shelf. Filter bandwidth may be adjusted from a Q of 0.4 up to 126 and gain may be adjusted between +15dB and -30dB.

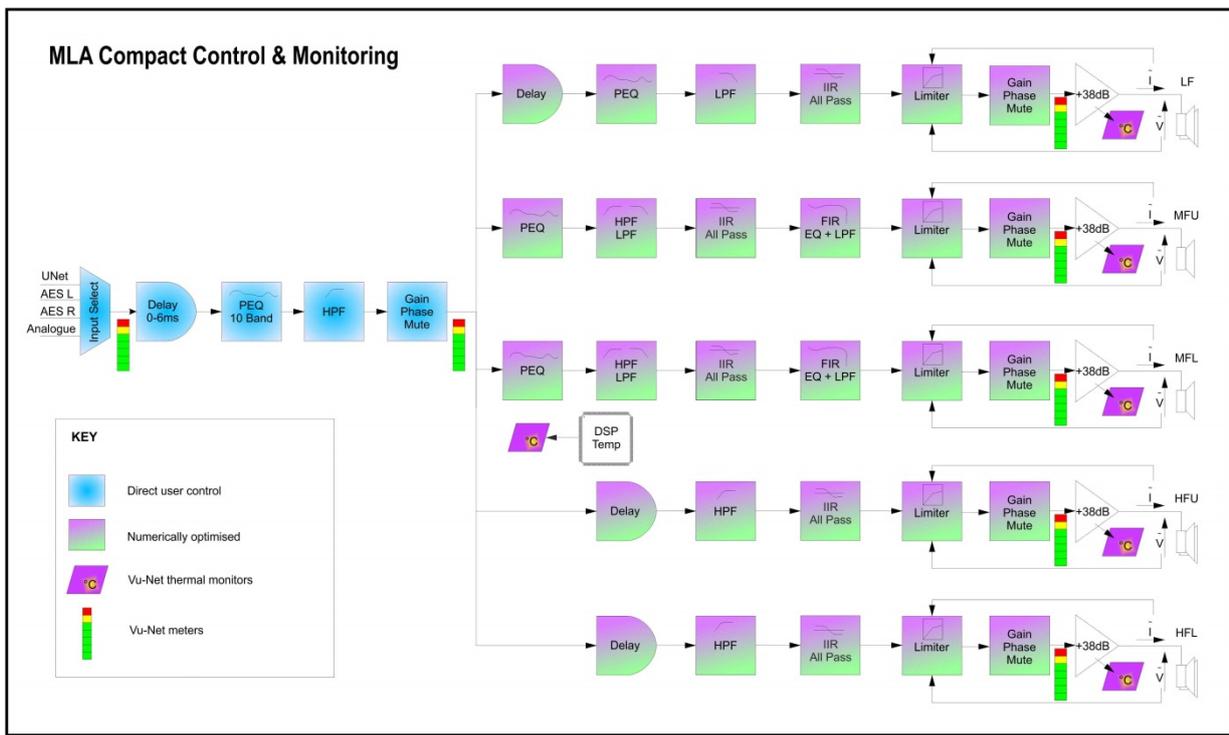
The high pass filter can be either a Butterworth at 6, 12, 18, 24 or 48dB/Octave, Bessel at 12 or 18 dB/Octave or Linkwitz Riley at either 12, 18, 24 or 48dB/Octave. Frequency is adjustable from 10Hz to 300. Finally gain may be adjusted from +15dB to -40dB.

There is a post EQ VU meter for each of the zones to ensure that over-zealous EQ hasn't done anything too drastic to system headroom.

The signal is then fed to each of the five cells where further parametric EQ, an IIR all pass filter, high and low pass filters, FIR filters, delay, gain, phase and limiting. The parameters for this extensive processing are created using Display 2.1 and uploaded to the system via the U-Net network using Vu-Net software.

Finally, each cell has an amplifier tailored to the requirements of the driver(s) being driven. This adds 38dB of gain. The output of the amplifier is fed back to the limiter to provide the best possible protection to each drive unit.

There are temperature sensors checking the temperature of the DSP and each individual cell amplifier. Finally each cell output is displayed on a VU Meter.



## Essential Maintenance

Coming Soon

### Replacing the amplifier module

There is no need to remove a cabinet from an array to replace a module if you can safely access the rear of the MLA Compact speaker, the module can be replaced in situ. Disconnect all power, audio and network connections from the module. Undo all M5 Countersunk screws holding the rain cowl assembly with the appropriate size hex head driver. Once the rain cowl is removed the module can be eased out of the cabinet, there are no additional screws holding it in place. Once you have removed it sufficiently to access the connections disconnect both Speakon NL8's and remove the module. Fitting the replacement is a



reversal of the removal. Offer the module to the cabinet and connect the NL8s making sure they have made a positive latch. Before proceeding and further you may wish to re-connect to the array to make sure that everything is connected and working perfectly, see details later in this guide. Replace the rain cowl assembly and all screws. Reconnect all connections, ensure that the module powers up, the fan will briefly run at full speed and the red power LED will light. Connect U-Net cables to the two ports and ensure that both U-Net LEDs light green. Connect audio input and if required output connections. You will need to upload the correct settings to the array if the system is in use at the time, please see the section in the Vu-Net chapter for detailed instructions on how to do this.

## Tools Required

Coming Soon

## Replacing a low frequency driver

Coming Soon

## Replacing a mid driver

Coming Soon

## Replacing a compression Driver

Coming Soon

## Replacing a Diaphragm

Coming Soon



**Specifications**

**Acoustical**

TYPE	Three-way cellular drive, active array element
FREQUENCY RESPONSE (1)	65Hz-18 kHz ± 3dB
MAXIMUM SPL@ 1m	LF: 129dB continuous, 135dB peak (3) MF: 129dB continuous, 135dB peak (4) HF: 129dB continuous, 135dB peak (4)

**Drivers**

LF	2 x10"(250mm)/2.5"(63mm) voice coil, long excursion, vented pole magnet drivers neodymium, Hybrid® slot-horn loaded
MF	2 x 5"(125mm)/1.5"(38mm) coil, neodymium magnet drivers, horn loaded
HF	4 x 0.7"(19mm) exit neodymium magnet compression drivers, horn loaded

**Rated Power (2)**

LF	500W AES, 2000W peak
MF	180W AES, 720W peak
HF	40W AES, 160W peak

**Dispersion**

(-6dB)	100° horizontal
(-10dB)	130° horizontal 10° vertical

**Crossover Frequencies**

400Hz	8th-order Linkwitz-Riley
4.25 kHz	Vanishing Point™ FIR filters

**Audio input**

CONNECTORS	Female XLR input, male XLR link output
ANALOGUE INPUT IMPEDANCE	20kΩ balanced to ground
MAXIMUM ANALOGUE INPUT LEVEL	6.15Vrms (+18dBu), over voltage protected
NOMINAL SYSTEM GAIN	22dB
AES/EBU IMPEDANCE	110 Ohms balanced, Receive and transmit termination

**Network**

CONNECTORS	2x IP68 rated 8-way, quick-release type
PROTOCOL	U-Net

**Amplifier Module**

TYPE	Five channel Class D, fixed frequency
PEAK OUTPUT POWER	4200W
AVERAGE EFFICIENCY	78%
COOLING	2 x temperature controlled internal fans 1 x temperature controlled external fan
MAXIMUM AMBIENT TEMPERATURE	45°C (113°F) for full output

**Power Supply**

TYPE	Switch mode, fixed frequency with PFC
AC INPUT OPERATING RANGE	100 – 240V ~ AC, 50 - 60Hz
AC OVERVOLTAGE TOLERANCE	400V AC
POWER FACTOR	> 0.95



NOMINAL POWER CONSUMPTION 600W  
 MAINS CONNECTOR 16A IEC309 (Ceeform) – IP44 rated

## General

ENCLOSURE Vertical trapezoid with 5° wall angle, multi-laminate birch and poplar-ply construction  
 FINISH Textured black PU coating  
 PROTECTIVE GRILLE Black HEX perforated steel  
 FITTINGS Proprietary rigging system  
 Bar handles on each side  
 Protective Rubber side-cheeks incorporating skids  
 Weather Protection Cowl  
 IP RATING IP 25  
 DIMENSIONS (W) 788mm x (H) 280mm x (D) 500mm  
 (W) 31in x (H) 11in x (D) 19.7in  
 WEIGHT (ex. wheelboard) 49.5kg (109lbs)

## Accessories

Flightcase for two enclosures  
 Flying frame (including clinometer)  
 Ground stacking bar  
 Flying Pin  
 Mains distribution system  
 Tour-grade network interconnects  
 Merlin Controller/U-Net Hub

## Notes

- (1) Measured on-axis in open (4<sup>th</sup>) space at 4 metres, then referred to 1 metre.
- (2) AES Standard ANSI S4.26-1984.
- (3) Measured in half-space at 1 metre with a tone burst signal, then referred back to open (4<sup>th</sup>) space.
- (4) Calculated from 4m 2.83v sensitivity, referred to 1m.

## DSX / DSX-F



MLA Compact deserves a subwoofer that can match its performance. With an extremely high output level, compact size and advanced DSP-based realisation of directional arrays, the DSX more than meets this challenge.

Capable of 146dB peak output at 1m (half space, measured), the DSX powered and networked subwoofer is an incredible performer. Its high output level is achieved by combining state-of-the-art LF driver technology with an on-board Class D amplifier module which can deliver 6kW peak power.

The DSX features 2 × 18"(450mm)/4"(100m) voice coil, ferrite drivers in a reflex-loaded enclosure with four flared ports, carefully designed to improve linear airflow. Each driver is housed in its own separate chamber to move any cabinet resonances out of band. Sonically, the DSX is a perfect balance of low frequency extension and punch.

### Mechanical Design

The MLX cabinet is constructed from 18 and 24mm birch plywood and is finished with a black textured PU coating. All metalwork is powder coated steel with all exposed fixings high grade black stainless steel. Black nylon skids on the base locate easily into routed slots on the top of the cabinet to give a positive lock aiding stability of ground stacked systems. Rubber locating skids on the sides protect the cabinet and offer positive locating when stacking DSX up on end in trucks or back in the shop.

Every possible measure has been taken to make the sub as manageable as possible. It is supplied with heavy duty castors fitted to the rear of the cabinet for transportation. Each side of the MLX has a strong bar handle running almost the full depth of the cabinet making it easy for four crew to lift the cabinet with two at each side. A rugged canvas cover is supplied which has an integral timber board which locates on the uppermost surface of the sub when it is on its castors. This protects the grill making it completely safe to transport the MLX even with other equipment stacked on top of the MLX in the truck or back in the shop.

The DSX is designed to complement the MLA system and has been dimensioned accordingly. It is the same width and height as an MLX but is not as deep. It is therefore the same width as an MLA and is flown using the same flying grid which has additional drop-down bars to accommodate the shallower cabinet. Combination arrays of DSX-F and MLA Compact can be created using the MLA flying grids at the top for the DSX-F and the Combination grid to link between the bottom DSX-F and first MLA Compact.

The cabinet is designed with cardioid arrays in mind and can easily be stacked or flown (DSX-F only) with a third of the DSX facing backwards. The top of the cabinet features a channel down which all connecting cables are laid and there is a cable entry position at the back so connections can be made and hidden by the hinged cover. There is also a hinged ventilation cover above the connection panel which must be opened during operation.

In common with MLA Compact, the MLX features a bright LED on the front grill which can be illuminated via Vu-Net software to identify its location on the U-Net network, to ensure complete compatibility when an DSX is used rear-facing, there is also an LED on the rear of the enclosure, the choice of whether front or rear LED lights is made in Vu-Net.

## Flying Upgrade



An upgrade kit is available to convert a DSX to a DSX-F. The principal addition is a pair of end cheeks with the flying brackets attached; these are quickly and easily fitted with eight M10 bolts. A wheelboard is also supplied but without castors. The castors on the rear of the DSX are unbolted and attached to the wheelboard which may then be used on with the front or the rear of the cabinet so it may travel face down or face up, entirely your choice. Finally, a new canvas cover is supplied which is slightly larger than the DSX cover so it will fit the greater width resulting from the end cheeks. This cover is fitted with a strong timber insert to protect the upper surface of the cabinet (front or back) when it is in transit on its wheelboard.

## Rigging

DSX-F rigging is identical to the MLX rigging system. The rigging is entirely symmetrical front to back to make it easy to fly cabinets facing backwards when creating flown cardioid arrays. As there is no requirement for multiple angles each rigging bar on all four corners at the bottom of the cabinet are relatively short with a single hole to locate into either the DSX below it or into the MLA flying grid for combination flown arrays;-



The rigging bar hinges up and is secured in its stored position with a flying pin.



### Acoustic Design

The acoustic design of the DSX owes much to the extremely successful WS218X Wavefront twin 18" sub. The straightforward twin chamber reflex enclosure is remarkably efficient and delivers excellent low frequency extension. The design features two 18" (450mm)/4" (100m) voice coil, ferrite drivers in a reflex-loaded enclosure with four flared ports, carefully designed to improve linear airflow. Each driver is housed in its own separate chamber to move any cabinet resonances out of band. Sonically, the DSX is a perfect balance of low frequency extension and punch.

### Amplifier module

The DSX uses a self-contained amplifier module which contains the network and audio interface as well as the amplifier that drives the sub. The module is retained in the rear of the enclosure behind a protective hinged panel and may quickly and easily be removed for replacement in the unlikely event of a failure.



### Connections

All connections to the DSX are on the amplifier module and are accessed behind the connection cover which hinges upwards to facilitate connecting all cables. There is an exit space in the middle of the cabinet at the bottom to allow the cables to be neatly run up into the connection run into the cabinet with the cover closed.



### Mains

The DSX mains inlet is located on the right of the amplifier module a standard 16A Male 230V single phase IP44 rated Ceeform inlet connector. A comprehensive mains distribution system is supplied with the MLA systems which features female outlets rated at IP67.



The DSX has a universal PSU suitable for direct connection to virtually any mains voltage anywhere in the world. It is supplied fitted with a 16A Ceeform single phase mains inlet. If you are not using the Martin Audio MLA distribution system a matching



Ceeform 16A female outlet connector must be used. For outdoor use this should be rated at IP67, this is to ensure safe operating when any connectors are disconnected in damp conditions.

**Audio & network**

The main audio and network connection panel is identical to that on all other MLA family products and is located on the rear of the amplifier module to the right. It features a male input and female link 3 pin XLR for balanced analogue or AES/EBU digital input signals. Input type is selected via the Vu-Net software. The Neutrik XLR’s are fitted with a hinged cover for protection when not in use.

Two 8-pin ODU rugged latching push-pull style data connectors are provided for the U-Net network connection. The two ports are available so that the network connections can be daisy chained between other MLA cabinets or U-Net equipped devices such as the Merlin system controllers or Martin Audio amplifiers fitted with a U-Net interface card. Either connector can be used as input or link.

A single green LED indicates power and two bi-colour LED’s indicate U-Net network integrity. Green indicates that the network is stable and red indicates an error. For a full description of U-Net LED activity please see the Vu-Net chapter.



U-Net connections are made using Cat5 cables fitted with 8-way push pull latching connectors compatible with ODU Series K. Robust Cat 5 cable should be used such as Neutrik Etherflex or Belden 1305A, this will ensure reliable network connections of up to 125 metres between network ports. U-Net protocol uses a redundant ring fault tolerance so connections “daisy-chain” between all units in the network going from port 1 on the first unit to port 2 on the next and so on before finally making a return connection back to port 2 on the first unit to complete the loop. The U-Net network will operate perfectly well without a closed loop but it is strongly recommended to use this option so that the network will continue to work in the event of a break in cable or disconnected connector.

Ready-made tour-grade network cables in a variety of lengths from short inter-cabinet patching to long front of house to stage are supplied as part of an MLA system.

Analogue inputs should be connected with a good quality 3-pin Male XLR wired to good quality twin screened cable, this is particularly important if the feed is a long length of cable; from front of house to stage for example. Good quality cable will minimise losses over the cable run. The link outputs should use a similarly high quality Female XLR. Wiring is the industry standard for balanced connections:-

- Pin 1. Ground or shield
- Pin 2 +, Hot, in phase
- Pin 3 -, Cold, out of phase.

The signal source used to feed the MLA array must have line drive capabilities suitable for driving the combined load of the entire array.



AES/EBU output connections are identical to analogue but cable used must be a dedicated 110Ω, low capacitance digital cable such as Belden 1800F or 1696A.

### **Essential Maintenance**

Coming Soon

### **Tools Required**

Coming Soon

### **Replacing the amplifier module**

Coming Soon

### **Replacing a driver**

Coming Soon



**Specifications**

**Acoustical**

TYPE Dual 18" reflex loaded subwoofer  
 FREQUENCY RESPONSE (1) 35Hz-150Hz ± 3dB  
 MAXIMUM SPL@ 1m LF: 130dB continuous, 146dB peak (3)  
**Drivers**

LF 2 x 18"100mm / 4"voice coil, ultra-long excursion, high efficiency ferrite magnet  
**Rated Power (2)**

LF 2400W AES, 9600W peak  
**Dispersion**

Digitally controlled in an array

**Audio input**

CONNECTORS Female XLR input, male XLR link output  
 ANALOGUE INPUT IMPEDANCE 20kΩ balanced to ground  
 MAXIMUM ANALOGUE INPUT LEVEL 6.15Vrms (+18dBu), over voltage protected  
 AES/EBU IMPEDANCE 110Ohms balanced, Receive and transmit termination

**Internal Processing**

Single channel DSP, programmable via network  
 10 PEQ / Shelving filters  
 Up to 48dB/Oct HPF and LPF  
 Up to 1 second delay

**Network**

CONNECTORS 2x IP68 rated 8-way, quick-release type  
 PROTOCOL U-Net

**Amplifier Module**

TYPE Single channel switch mode, fixed frequency  
 PEAK OUTPUT POWER 6000W  
 AVERAGE EFFICIENCY 85%  
 COOLING 2 x temperature controlled internal fans  
 1 x low-speed internal blower  
 1 x temperature controlled external fan

MAXIMUM AMBIENT TEMPERATURE 45°C (113°F) for full output

**Power Supply**

TYPE Switch mode, fixed frequency with PFC  
 AC INPUT OPERATING RANGE 100 – 240V ~ AC, 50 - 60Hz  
 AC OVERVOLTAGE TOLERANCE 400V AC  
 POWER FACTOR > 0.95  
 NOMINAL POWER CONSUMPTION 900W  
 MAINS CONNECTOR 16A IEC309 (Ceeform) - IP44 rated

**General**

ENCLOSURE Extensively braced multi-laminate birch ply construction  
 FINISH Textured black PU coating  
 PROTECTIVE GRILLE Black HEX perforated steel  
 FITTINGS Two Skids on base with mating channels on top  
 Four interlocking skids on each side



		Large bar handles on each side Four rear-mounted 100mm (4") rugged tour-grade castors DSX Transit cover with integral plywood lid Weather Protection Cowl Rear castors replaced by front-mounted wheelboard Four proprietary flying brackets and quick-release pins Side-mounted skids replaced by four interlocking rubber side cheeks DSX-F transit cover with integral plywood lid
DSX-F FITTINGS		IP 24
IP RATING		
DIMENSIONS	<b>DSX</b>	(W) 1060mm x (H) 595mm x (D) 834mm (1027mm with vent flap open) (W) 41.7in x (H) 23.4in x (D) 32.8in (40.4in)
	<b>DSX-F</b>	(W) 1125mm x (H) 595mm x (D) 847mm (1027mm with vent flap open) (W) 44.3in x (H) 23.4in x (D) 33.5in (40.4in)
WEIGHT	<b>DSX</b>	122.2kg (269lbs)
	<b>DSX-F</b>	147.6Kg (325lbs) excluding wheelboard

Accessories

- Flying frame including clinometer (DSX-F)
- Flying Pin (DSX-F)
- Mains distribution system
- Tour-grade network interconnects
- Merlin Controller/U-Net Hub

Notes

- (1) Measured on-axis in open (4<sup>th</sup>) space at 4 metres, then referred to 1 metre.
- (2) AES Standard ANSI S4.26-1984.
- (3) Measured in half-space at 1 metre with a tone burst signal, then referred back to open (4<sup>th</sup>) space.
- (4) Calculated from 4m 2.83v sensitivity, referred to 1m.

## Merlin



### Introduction

Merlin has the essential function for MLA, MLA Compact and MLA Mini systems of acting as the interface to connect a U-Net network to enabled products and to monitor and control them from a PC connected via Ethernet to the Merlin.

The Merlin is also powerful DSP based audio processor; it is highly versatile and is suitable for a wide variety of applications from installations to concert touring, where it combines the functions of a multitude of conventional products in a compact 1U unit. To achieve this, the units have inputs and outputs which can be freely configured, not just internally but across a number of Merlin's on the U-NET network.

Each input has a gain control, variable delay up to 1 second and a further eight bands of fully parametric equalisation. The parametric filter bands have a large selection of different filter types available, including shelving.

Each output has a gain control, variable delay; high and low pass crossover filters, eight bands of fully parametric equalisation, polarity switching and additionally, a fully featured limiter, and a final clip limiter. The crossover filters offer slopes of up to 48dB/Octave, with a comprehensive selection of responses available.

The Merlin has four inputs and ten outputs each of which may be configured as analogue or AES/EBU

### Features

Superb audio quality Analogue Devices SHARC™ based DSP platform, effective 64 bit precision arithmetic signal processing coupled with 24 bit ultra-low noise AD/DA conversion ensure a dynamic range in excess of 116dB. The high sampling rate of 96kHz means minimal filtering providing exceptional sonic purity with a bandwidth in excess of 32kHz.

Mixed Point™ processing using a mixture of floating and fixed point architecture at optimised parts of the signal path.

Fixed analogue in to analogue out latency of only 2.6ms.

A flexible input/output multi-mode format caters for any configuration, regardless of scale. Both routing of inputs to outputs, and ganging (for editing) are completely flexible.

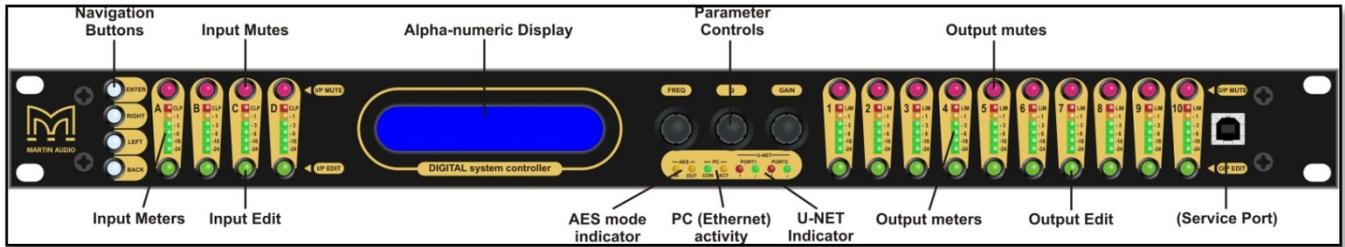
Maximum output level capability of +22dBu.

Delay of up to 1 second may be independently set for each output, with an extraordinarily fine minimum increment of 2.6µs.

Full U-NET interface allowing digital audio and control over CAT 5 cable. Redundant ring fault tolerant protocol. Up to 64 channels of digital audio at 48kHz/24 bit resolution or 32 channels at 96kHz/24 bit resolution.

VU-NET PC network control software.

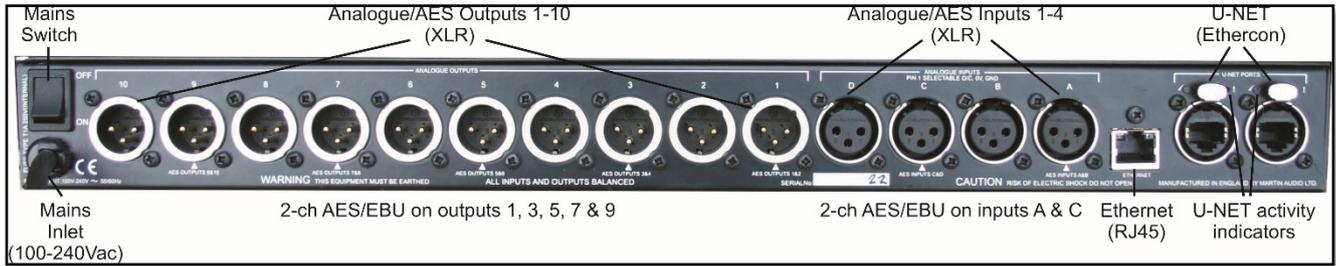
### Front Panel Functions



- ENTER** Switches to a selected menu or sub menu with subsequent presses depending on the screen presently selected
- RIGHT** Navigates to the next menu screen to the right
- LEFT** Navigates to the next menu screen to the left.
- BACK** Returns to the previous screen displayed.
- Input Mutes** Will mute the relevant input; the switch will turn red when muted.
- Input Edit** Selects the relevant input for editing bringing up the input parameters on the screen; the switch will turn green when selected.
- Input meters** Gives a visual indication of the level of signal applied to the input. The meters have six segments displaying -24, -18, -6, -3, -1dB before clipping and the sixth indicates clipping.
- Display** The display is a 2 row, 24 alphanumeric character LCD black display (white characters on a dark blue background for optimum visibility).
- FREQ** Where a selected parameter has a frequency component such as a parametric equaliser, the frequency is adjusted with the FREQ velocity sensitive encoder.
- Q** Where a selected parameter has a bandwidth component such as a parametric equaliser, the Q is adjusted with the Q velocity sensitive encoder.
- GAIN** Where a selected parameter has a gain component such as a parametric equaliser, the level is adjusted with the GAIN velocity sensitive encoder.
- AES Mode** The in and out AES indicators illuminate when with the inputs or outputs have been switched to accept AES/EBU inputs instead of analogue
- PC** Two indicators show the activity of the Ethernet port on the rear panel which is the primary PC connection. The CON LED will illuminate when an Ethernet connection is established either directly to a PC or to an Ethernet Hub or switch. The ACT LED will flash whenever there is data transfer via the Ethernet port.
- U-NET** The U-NET LEDs for the rear panel U-NET ports 1 & 2 indicate U-NET connections, data transfer and errors. Precise operation to be determined.
- Output Mutes** Will mute the output; the switch will turn red when the relevant output is muted.
- Output Edit** Selects the relevant output for editing bringing up the output parameters on the screen; the switch will turn green when selected.
- Output meters** Gives a visual indication of the level of signal present at the output. The meters have six segments displaying -24, -18, -6, -3, -1dB before limiting and the sixth indicates limiter operation.
- USB** The USB connection is used as a service post for Firmware upgrades and diagnostics of the Merlin



Rear Panel Functions



- Mains Switch** Turns the unit’s mains supply off and on.
- Mains Inlet** Connection to the Merlin is via a captive Mains cable supplied fitted with a UK 13A mains plug.
- Ethernet** The primary PC connection is via a standard RJ45 Ethernet port. This can be directly to a PC for one to one communication or via a wired or wireless Ethernet Hub where multiple Merlin’s are used in a system.
- U-NET** A pair of U-Net ports are fitted, each using the Neutrik Ethercon robust RJ45 connector to ensure reliable and rugged network connection
- U-Net Activity Indicators** A pair of LEDs indicate data activity on the two U-Net ports
- Outputs 1-10** Output connections are available on ten electronically balanced male XLR’s. When AES/EBU outputs are selected via the one screen menu, output connectors are on 1, 3, 5, 7 and 9. 2, 4, 6, 8 and 10 are no longer used as AES is two channel.
- Inputs 1-4** Input connections are available on four electronically balanced female XLR’s. When AES/EBU inputs are selected via the on screen menu, inputs are on 1 and 3. 2 and 4 are no longer used.

Connections

Mains

The Merlin has a universal PSU suitable for direct connection to any mains voltage anywhere in the world. It is supplied fitted with a standard UK 13A mains plug. For other territories a suitable approved mains adaptor must be used to suit the local mains connector. Alternatively the UK plug may be removed and a suitable mains connector wired in its place. Wiring connections are as follows:-

- Brown** Live
- Blue** Neutral
- Green / Yellow** Earth

The Merlin **MUST** be disconnected from mains before the mains plug is replaced. Replacing the plug should only be undertaken by a suitably qualified electrical engineer.

Ethernet

The Ethernet connection is a standard 100BASE-T protocol computer network. Standard readily available CAT5 patch cables fitted with RJ45 connections should be used to connect between the Merlin Ethernet port and either directly to a PC or to an Ethernet Hub

U-Net



U-Net connections are also made using Cat5 cables. If longer cable runs are required to U-Net enabled powered loudspeakers, a robust Cat 5 cable should be used such as Neutrik Etherflex or Belden 1304A. Connectors should be Neutrik Ethercon RJ45 connectors. This will ensure reliable network connections of up to 120 metres. U-Net protocol uses a redundant ring fault tolerance so connections "daisy-chain" between all units in the network going from port 1 on the first unit to port 2 on the next and so on before finally making a return connection back to port 2 on the first unit to complete the loop. The U-Net network will operate perfectly well without a closed loop but it is strongly recommended to use this option so that the network will continue to work in the event of a break in cable or disconnected connector.

**Audio Inputs**

Analogue inputs should be connected with a good quality 3-pin Male XLR wired to similarly good quality twin screened cable. Wiring is the industry standard for balanced connections;-

- Pin 1** Ground or shield
- Pin 2** +, Hot, in phase
- Pin 3** -, Cold, out of phase.

Unbalanced connection can be made if necessary by either wiring ground to pin 3 and signal to pin 2 or ground to pin 1 and 3 and signal to pin 2

AES/EBU input connections are identical to analogue but cable used must be a dedicated 110Ω, low capacitance digital cable such as Belden 1800F or 1696A

**Audio Outputs**

Analogue outputs should be connected with a good quality 3-pin Female XLR wired to similarly good quality twin screened cable, this is particularly important if the Merlin is driving a long length of cable; from front of house to stage for example. Good quality cable will minimise losses over the cable run. Wiring is the industry standard for balanced connections;-

- Pin 1. Ground or shield
- Pin 2 +, Hot, In phase
- Pin 3 -, Cold, out of phase.

Unbalanced connection can be made if necessary by omitting connection to pin 3. Do not short the unused pin 3 to ground.

AES/EBU output connections are identical to analogue but cable used must be a dedicated 110Ω, low capacitance digital cable such as Belden 1800F or 1696A.

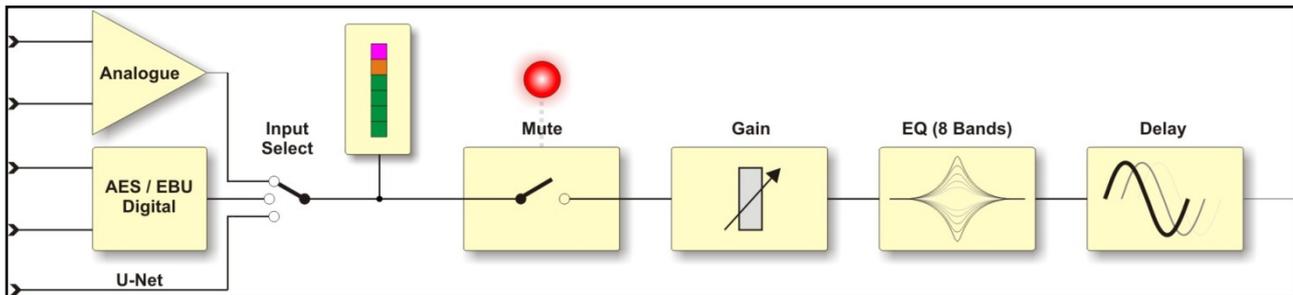
**USB**

The front panel mounted USB connection is for direct connection to a PC for Firmware upgrades and other diagnostics. Connection is standard USB 2.0 and a standard USB type 1 to USB type 2 cable is required

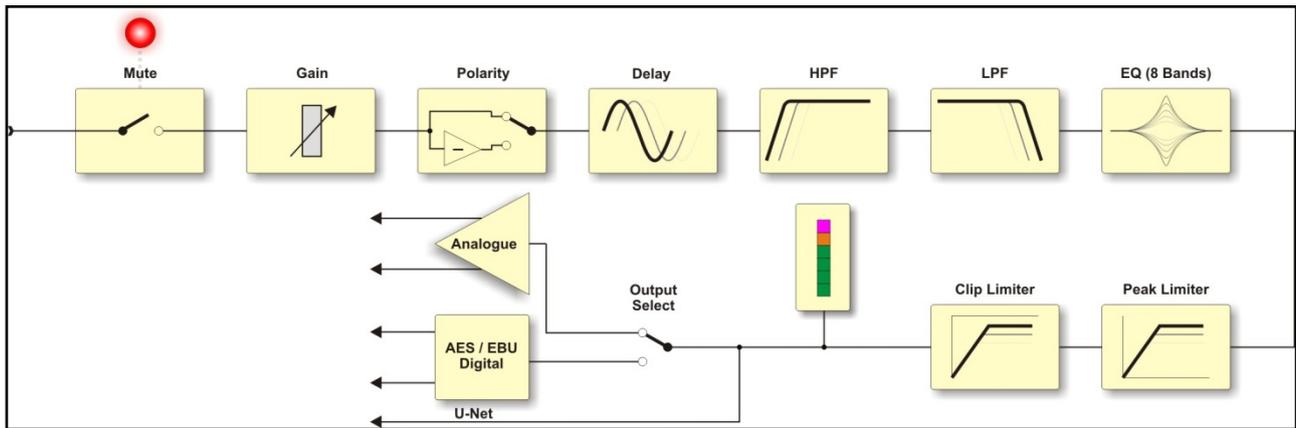
**Processing Functions**

The Merlin has a freely assignable 4 x 10 routing matrix allowing any input to be routed to any or all of the 10 outputs.

The diagram below shows the processing path on each of the 4 inputs.



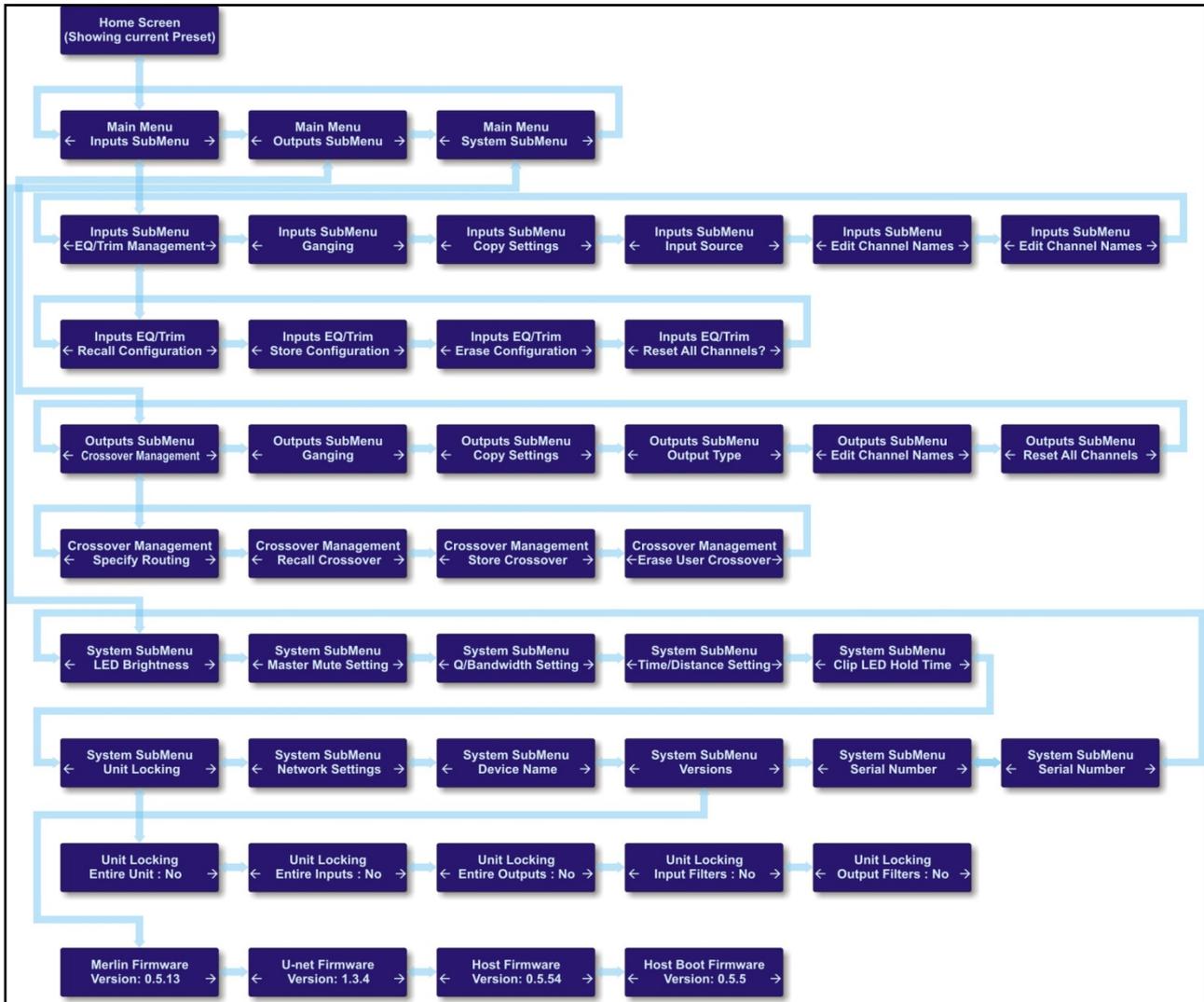
The diagram below shows the processing path for each of the ten outputs which follow the routing matrix



### Menu Tree

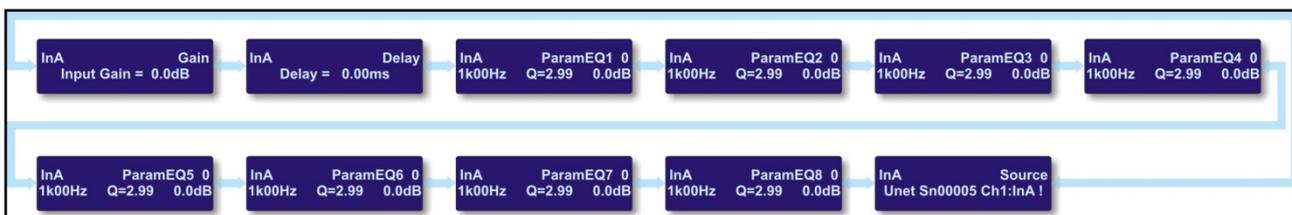
#### Main

Below is a diagram showing the main system menu accessed via the front panel navigation buttons;-



#### Inputs

This diagram shows the input menu accessed by pressing the Input menu button buttons below the bargraph meters for each of the four input channels



#### Outputs

This diagram shows the output menu also accessed by pressing the Output menu button buttons below the bargraph meters for each of the ten output channels



**System Setup**

The System Menu offers a number of options for configuration of the Merlin to tailor its operation to each user's requirements.

To access the System Sub-menu, press the 'Right' Navigation button twice or the 'Left' Navigation button once.

**Network Settings**

As all Merlin functions may be controlled via Vu-Net it is rare to have to access functions via the front panel and LCD display. The one exception to this is the Network settings for connectivity between Master and Slave Racks. By default the Merlin is set for Dynamic IP meaning that the IP address is set once the Merlin is introduced to the network. This means that racks are essentially "plug-and-play", any number of Merlins can be connected either using the Ethernet switch in the Master rack or any other standard Ethernet hub that supports DHCP. The other method of operation is Static IP where the IP address for all items on the network is set by the user within a given range. This has a couple of advantages, first the switch or hub does not rely on DHCP support to assign IP addresses so can be a little more reliable, and secondly, the Ethernet network can be shared with other devices as long as each group of products are assigned IP addresses in different ranges. The disadvantage is that all devices have to have their IP set manually and all must be different although in the same range.

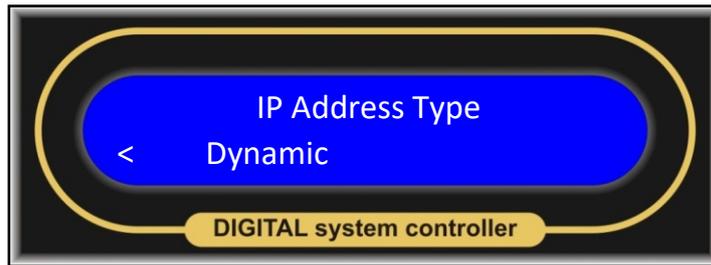
To change between Dynamic and Static IP first enter the System Sub Menu as described above. Next from the LED Brightness menu either click the 'Left' button four times or the right button to arrive at Network Settings;-



Press the 'Enter' Button and you will see the current setting for the IP Type;-



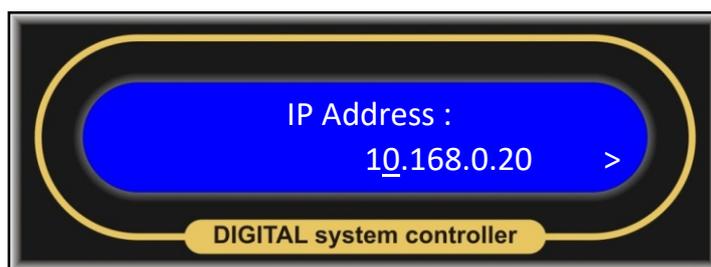
To change to Static press enter, the display will show the following;-



The left arrow indicates that there is an alternative option available accessed by the left button (this would be the right button if you were changing from Static to Dynamic). Press the 'Left' button brings up:-



Press Enter and you have the option to set the Ip address that you wish to use:-



You will notice that the least significant digit of the first range is underlined. Use any of the three control knobs, 'Freq', 'Q' or 'Gain' to adjust the number, then using the 'Right' button shift to the next range and adjust. Continue until the IP is in the same range as your PC but not exactly the same for example 10.10.10.33. Press 'Enter' to return to the Network Settings submenu. Press 'Enter' again to check that the settings are correct;-



Three presses of the 'Back' button will return you to the main menu. Power cycle the Merlin and return to the Network Settings submenu to double check that the settings are correct.



## Specifications

<b>Mains</b>	100 to 240V AC 50-60Hz
<b>Inputs</b>	4 x Balanced analogue or AES/EBU. CMRR >67dB
<b>Outputs</b>	10 x Balanced analogue or AES/EBU Output impedance 47 ohms Maximum output +22dBu
<b>Performance</b>	20Hz – 20KHz +/- 0.2dBu Dynamic range >116dB Fixed latency analogue in to analogue out 2.8ms 96KHz sampling frequency 24 Bit ultra-low noise ADC/DAC
<b>Crossover</b>	High and Low pass on all outputs Butterworth, Bessel and Linkwitz-Riley types 3, 12, 18, 24, 48dB/Octave slopes
<b>Equalisation</b>	8 parametric filters on every input & output Gain: -40dB to +15dB Bandwidth: Q 0.4 to 128 Frequency: 20 – 32KHz Hi/Lo shelving Q 0.4 to 1.0, 20Hz – 32KHz 256 tap FIR filter on up to six outputs.
<b>Limiter</b>	Look ahead clip and peak limiter on each output Threshold: -10dBu to +22dBu Attack: 0.3 – 90ms Release: attack x 1, 2, 4, 8, 16 & 32
<b>Display</b>	2 x 24 Character black LCD display
<b>Meters</b>	6 segment LED bargraph input and output metres
<b>Dimensions</b>	(H) 1U 44mm      (W) 482mm      (D) 310mm (H) 1U 1 ¾"      (W) 19"      (D) 12"
<b>Weight</b>	4.6Kg (10.1lbs)

## U-Hub



### Introduction

The Martin Audio U-Hub is an Ethernet to U-NET bridge equipped with analogue and AES3 digital audio transport. It facilitates PC connection and VU-NET™ software control of MLA Series arrays and subwoofers via their inbuilt proprietary U-NET network.

### Key Features

- Ethernet to U-Net™ bridge
- IP addressable (static and dynamic)
- Analogue and digital audio transport
- Designed to work with DX4.0 loudspeaker processor for Dante™ digital audio distribution

Converting TCP/IP to U-NET protocol, U-Hub allows MLA Series enclosures to self-address and identify their position within an array, as well as supporting a simple-to-use redundant loop. With U-Hub, an MLA Series system with onboard U-NET can be seamlessly integrated into a TCP/IP network and controlled via VU-NET software.

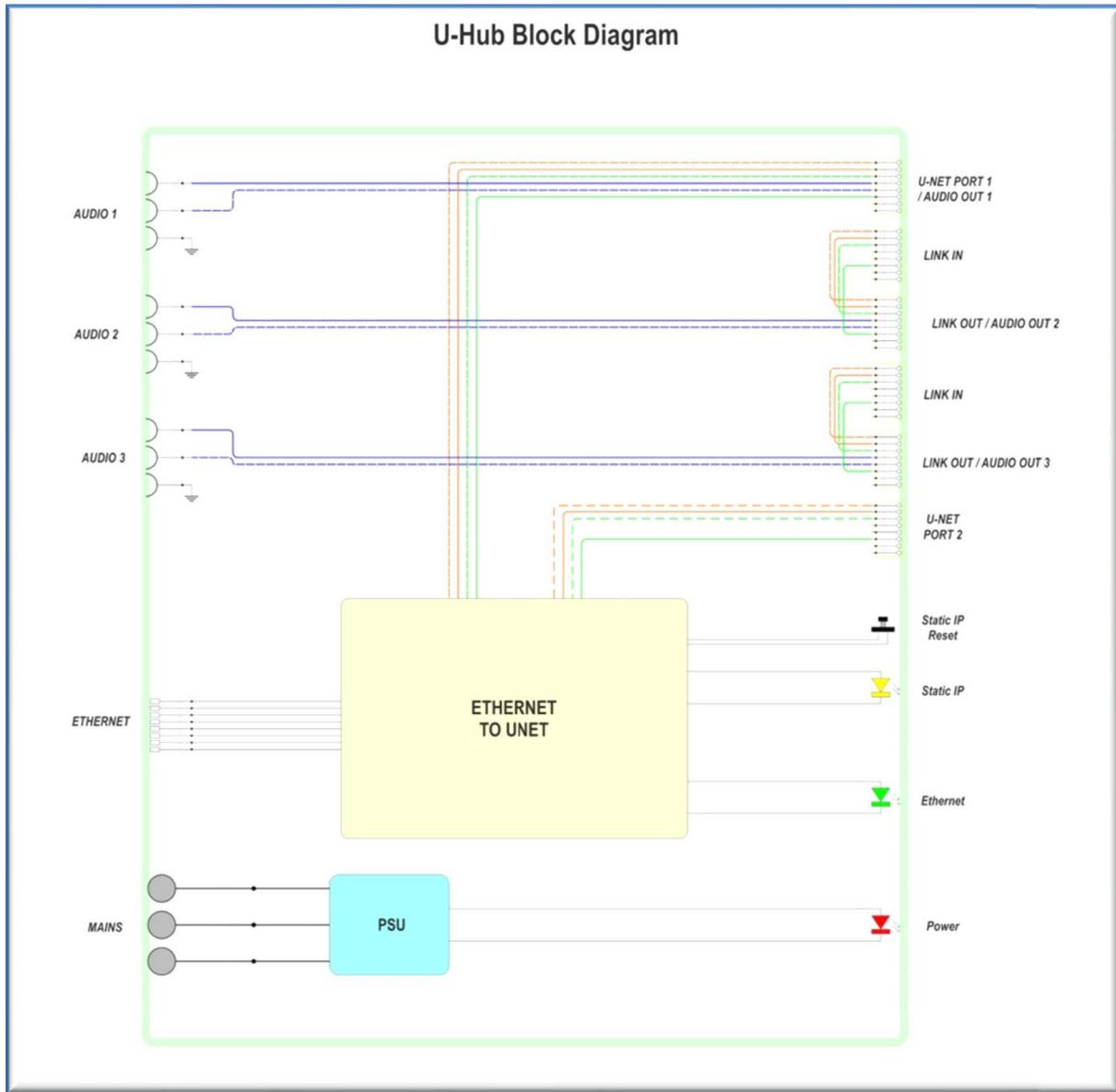
When used in conjunction with the Martin Audio DX4.0 networked system controller, U-Hub can connect audio and network to an MLA Series system with a single cable via a Dante™ digital audio network.

### U-Net Connections

The U-Hub features two U-Net ports and two pairs of parallel links to enable neatly loomed network cables to be used going to and from several arrays. The U-Net connections are available on 8-pin ODU connectors. In common with standard Ethernet data, U-Net only uses four of the available 8 pins allowing balanced analogue or AES audio to be fed down two or the 'spare' cores thus greatly simplifying system wiring as an independent audio cable is no longer required.

### Block Diagram

This diagram shows the essential features of the U-Hub, highlighting how the audio feed from the rear panel inputs is combined onto three of the U-Net connections.

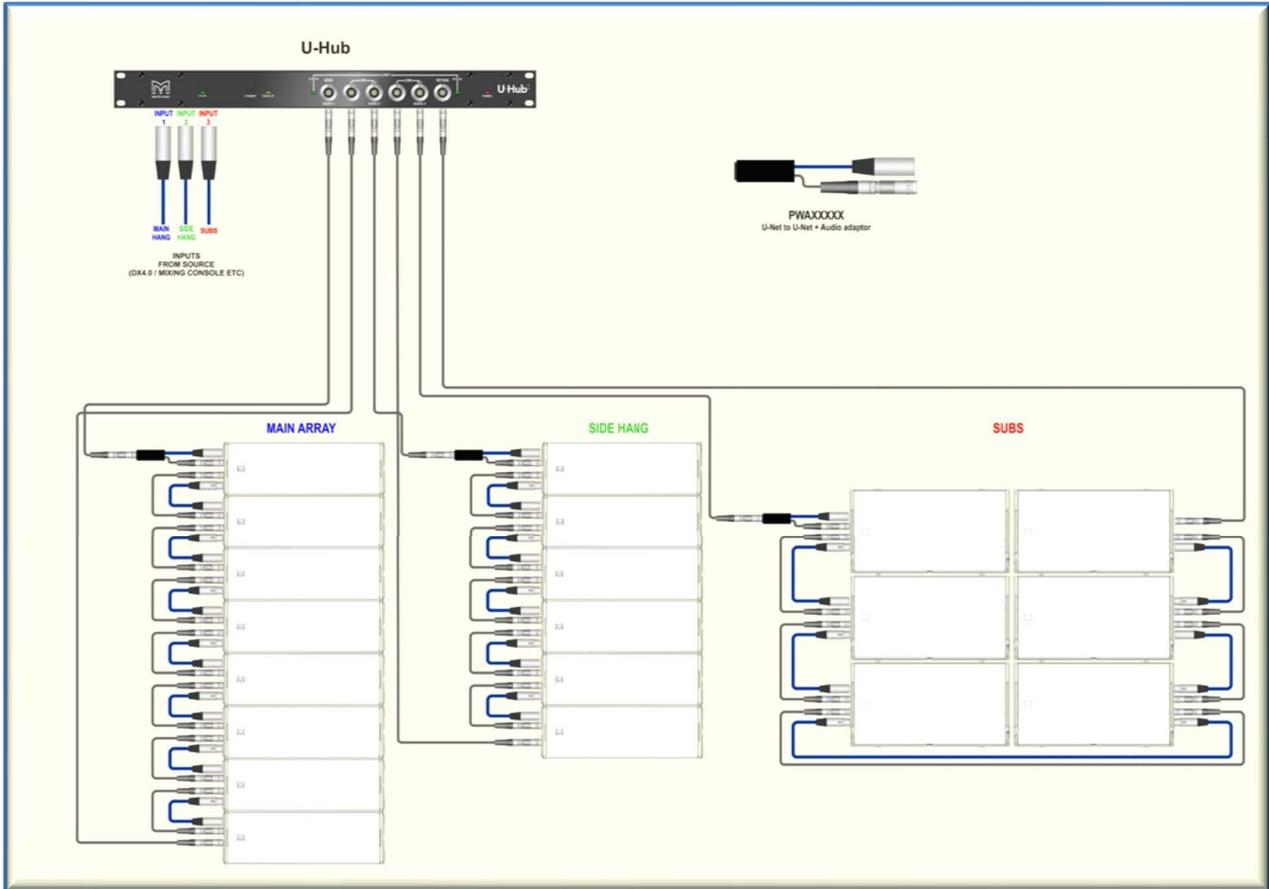


U-Net is run as a redundant loop, all U-Net enabled products have two ports. Port 1 on the U-Hub would be connected to port 1 on the first device, port 2 on this device would link out to the next device and so on with a final link back to port 2 on the U-Hub to complete the loop. This allows the system to continue working seamlessly in the event of a cable being damaged or inadvertently disconnected. Data will simply flow in the opposite direction to allow continuous communication.

Audio connections are combined with the network feeds. Audio input 1 is connected to a pair of spare connections in the U-Net port 1 ODU. This would usually be used as the “send” to the first array. A return from the array would be connected to the first link in connection. Audio 2 is combined with the second ODU in the linked pair allowing audio to be fed to a second array, a side hang for example. The network return from this array comes back to the second link in. Audio 3 is connected to the link out of this pair and can be used to route out to a third array such as the sub-woofer stack. Finally, the U-Net return from the subs is connected to U-Net port 2 on the U-Hub to complete the loop.

### System Example

This diagram illustrates the wiring to the array for a system as described above (note that mains connections have been omitted for clarity); -



Audio input can be direct from a console or from a DX4.0 processor used as a matrix. Three audio feeds – each either balanced analogue or AES EBU digital- are connected to the three audio inputs on the rear of the U-Hub.

The first of these is combined onto the U-Net Port 1 which is connected to the first cabinet of the main array via a PWAXXXX U-Net to U-Net + Audio adaptor which splits the feed from the U-Net cable to a U-Net only cable and an AES spec audio cable terminated in a standard 3-pin XLR. The XLR is connected to the audio input. The audio is daisy chained between cabinets using standard audio link cables.

When the final network cable is routed back to the U-Hub it is terminated using the first of the link pairs. The link pairs link the network connections (first two twisted pairs) but NOT the audio meaning that the link out can be used to route a completely independent audio feed connected to the Audio 2 input up to the side hang in the same way.

The return from the side hang goes to the second link pair input with the output also carrying audio input 3 to feed the sub array.

Finally, the last network connection goes from the final sub back to port 2 on the U-Hub to close the U-Net loop.

## Audio Connections

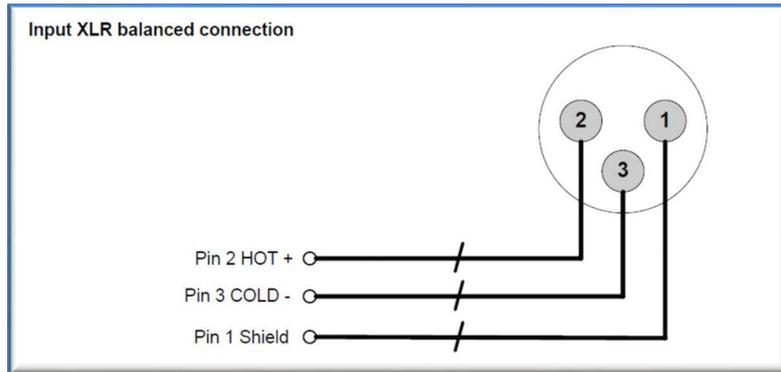
### Input Connections

For each audio input there is a female XLR connector for analogue or AES signals.

The HOT, + or 'in phase' connection should be made to pin 2 of the XLR connector.

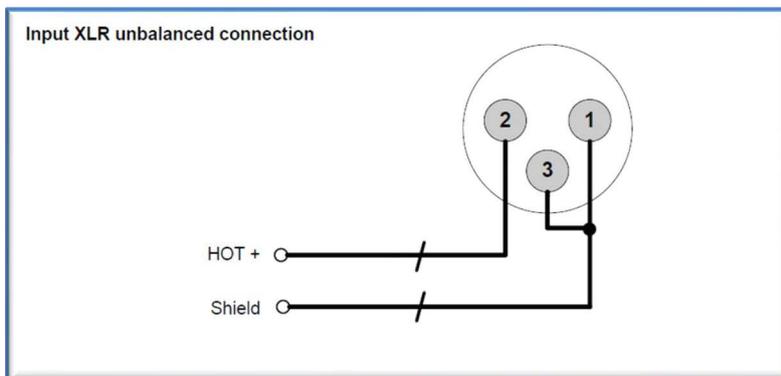
The COLD, - or 'out of phase' connection should be made to pin 3 of the XLR connector.

Pin 1 of the XLR connectors is internally connected to the chassis. The shield of the input cable should always be connected Pin 1 of the XLR to ensure that EMC performance and regulations are met.



### Using unbalanced connections

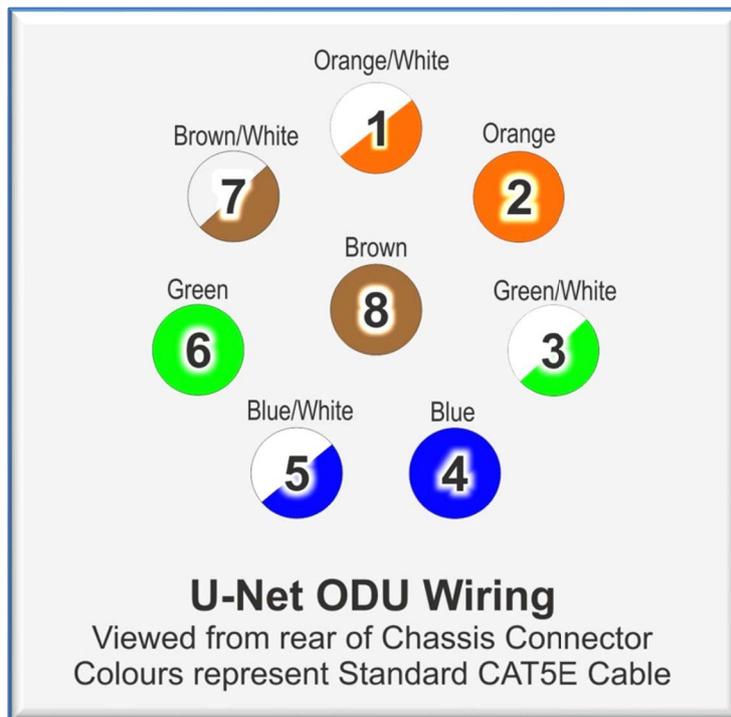
Please note that the use of unbalanced connections is not recommended, however when connecting the U-Hub to an unbalanced audio source, the signal conductor should be connected to XLR pin 2. The 'Cold' conductor or cable screen should be connected to XLR pin 1 with a short connection made between pin 1 and pin 3.



### U-Hub Network Connections

U-Hub features a standard RJ45 Ethernet port on the rear panel using a Neutrik Ethercon connector. This is wired using the standard Ethernet wiring protocol so any off the shelf CAT5E or better network cable can be used to connect the U-Hub to your Ethernet network.

There are two front panel mounted U-Net ports for connection to the U-Net enabled devices in your system. These use ODU connectors to the LEMO high speed data series pattern. Wiring configuration is as follows; -



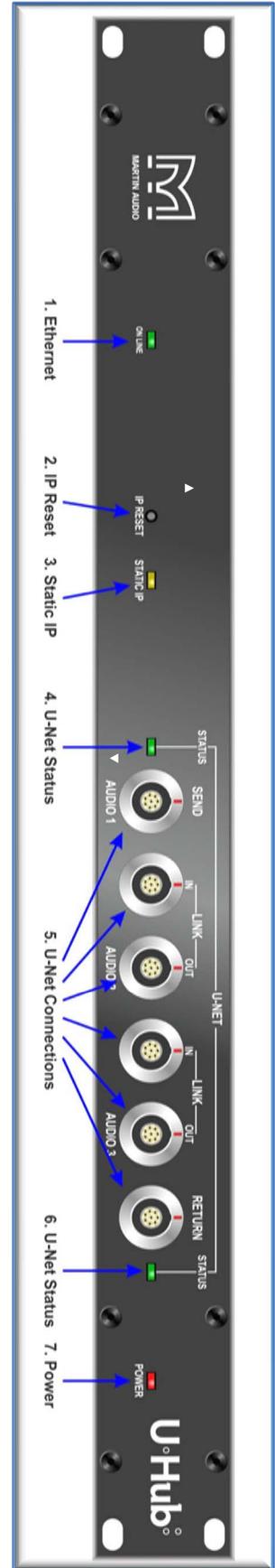
The two pairs of linked ODU connectors are wired as shown in the block diagram. Pins 1, 2, 3 & 6 are linked together, pins 4 and 5 on the link out connectors have the audio signal from the corresponding audio input.

The same cable wiring configuration should be used for all network connections.



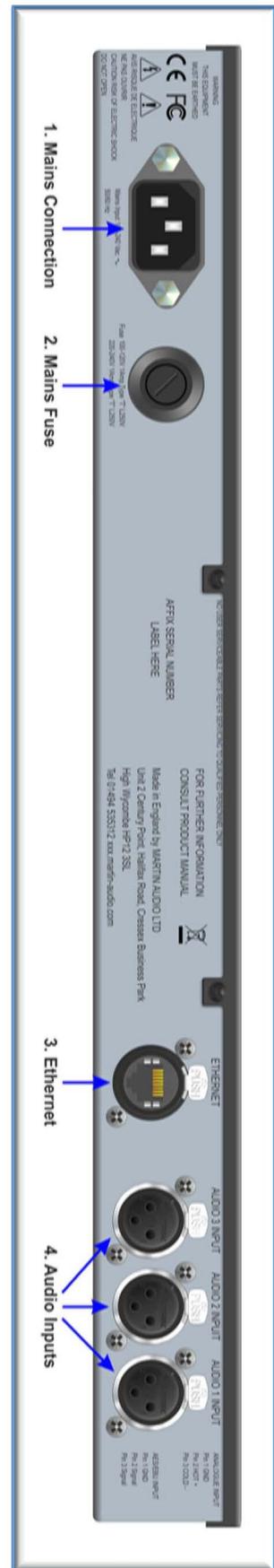
## Panel Layouts

1. **On Line Indicator**- Illuminates to show that the U-Hub is connected to an Ethernet network
2. **IP Reset**- Resets a U-Hub that has been configured for static IP back to dynamic
3. **Static IP**- Indicates that the U-Hub has been configured for static IP
4. **U-Net Status**- The U-Net LED will illuminate green when a good connection is made to a U-Net enabled device connected to port 1
5. **U-Net Connections**- Six ODU connectors provide U-Net connectivity consisting of Port 1, port 2 and two linked pairs. Port 1 and the 'Out' connection of each linked pair also carry audio routed from the input connectors on the rear panel.
6. **U-Net Status**- The U-Net LED will illuminate green when a good connection is made to a U-Net enabled device connected to port 2
7. **Power Indicator**- This red indicator is lit when power is applied



## Rear Panel

1. Power Inlet- The unit should be connected to a suitable mains electricity supply using a standard IEC power lead. The device has a switch mode power supply that is capable of operating with a nominal mains voltage of 100V to 230V, 50/60Hz without re-configuration. The IEC connector should be compatible with the retention clip so it can be secured with the clip to ensure the connector cannot accidentally disconnect.
2. Main Fuse- This should be fitted with an anti-surge (T)fuse rated at 1 amp.
3. Ethernet- Neutrik Ethercon allowing an ethernet connection using wither a standard CAT5E connector or an Ethercon cable.
4. Analogue / AES EBU Audio Inputs- Carries audio feed to the three ODU audio outputs combined with the U-Net network.





## Introduction

### Connect Power to the U-Hub

Connect a power source to the U-Hub using an IEC cable and secure using the retaining clip.

### Connect all input and Network cables.

Input cables should be balanced XLR using 3-core cable with a shield. Most signal processing and mixing products also use XLR connections, so the cable can be a male to female XLR or “microphone” cable.

Network Connections should be made using ODU U-Net cables or adaptors available as accessories from Martin Audio.

### IP Selection

The U-Hub can communicate over the ethernet network which has been configured for static or dynamic IP. The default is dynamic IP where the network has a DHCP server to assign individual IP addresses to all nodes detected on the network. This is extremely straightforward for a plug and play system which is why Domestic routers are configured to act as a DHCP server by default. Static IP removes the requirement for a DHCP server on the network so is frequently the choice for more advanced systems.

The U-Hub can be configured for Static IP, there are two methods to enable this. You will need to know the range for all other products on the network and assign an IP address within the same range but with an address unique to the U-Hub.

You can select the default Static IP address by using the IP Reset switch on the front panel. Press and hold the switch for approximately 3 seconds and the U-Hub will be set to Static IP with an address of 169.254.19.71. The default address gives you the flexibility to connect to the U-Hub without having to adjust your PC LAN settings, if the PC is in dynamic mode it will self-assign a link local address in the 169.254.xxx.xxx domain. If your network is configured for static mode, the U-Hub will be immediately discoverable as long as your network is in the 169.254.xxx.xxx range and as long as there isn't another device with the same IP. The principal intention of this mode is to give you immediate connection to the U-Hub, so you can change the IP to a number of your choice

You can also change the IP mode via Vu-Net (See the Vu-Net chapter) using the right-click menu. Note that if you are in the default dynamic mode and you change to a static IP address outside the 169.254.xxx.xxx range you will lose connection with the U-Hub until you reconfigure your PC to static mode in the same range.

When the U-Hub has been set to static IP, either manually or using the default static IP mode, the Static IP front panel LED will illuminate yellow.

### IP Reset

If a U-Hub has been previously configured for static IP it can quickly be set to dynamic using the IP reset switch. The reset is a recessed front panel switch a short press will return the U-Hub to dynamic IP configuration. It can then be discovered via Vu-Net using Device Discovery, see the Vu-Net chapter for more details.

## Accessories

### Cables

A full range of U-Net cables in various lengths are available for connections within an MLA series system; -



All cables use Belden 1305A tour grade CAT5E cable and feature the 8-pin ODU connector which is fitted with a unique over-moulded strain relief making them incredibly robust. The part numbers are as follows; -

- |       |                 |  |
|-------|-----------------|--|
| 800mm | <b>PWA00038</b> | Used to link between MLA or MLA Cabinets in an array   |
| 3m    | <b>PWA00039</b> | User to link MLX, DSX or MSX Subwoofers  |
| 5m    | <b>PWA00051</b> | General purpose cable, often used to link from a U-Hub to the first subwoofer where the racks are in close proximity to the subs   |
| 15m   | <b>PWA00063</b> | General purpose cable, often used to link from a U-Hub to the first subwoofer in an array.   |
| 35m   | <b>PWA00040</b> | Most commonly used as part of an array loom to go from a rack up to a flown array and back and as cross-stage Ethernet links   |
| 50m   | <b>PWA00077</b> | Extra-long Array looms.  |
| 75m   | <b>PWA00052</b> | Supplied on a cable drum, used for Ethernet connection to Front of house or extra-long cross stage Ethernet links on large festival stages.  |
| 125m  | <b>PWA00041</b> | Supplied on a cable drum. 125m is the maximum cable length between nodes on a U-Net network so can be used for the ultimate array loom in situations where the cable pick has to be virtually invisible and therefore is likely to be particularly long. |

### Adaptors

There are several adaptors available to assist with cabling up a system; -



**PCX00048** This is a U-Net coupler for extending cables. It is housed in a Neutrik D shell Barrell and has an ODU connector at each end wired together.

**PCX00043** This is housed in an identical Neutrik housing to the U-Net coupler but has an EtherCon connector at one end and ODU connector at the other. This allows to mix the cable infrastructure between ODU cables and low cost CAT5E cable which would be a more cost-effective solution for installed systems.

**PWA00056** This is a 10m CAT5E cable terminated one end in an ODU connector and the other in an RJ45 connector. As above this offers a cost-effective solution for certain applications.

### Audio/U-Net Splitter

The U-Hub audio integration features will allow audio and network signals to be fed to an array using a single cable. To split the combined U-Net and audio signals the dedicated adaptor assembly part number **PWAxxxxx** is used.



This receives the combined U-Net and audio feed from the U-Hub and splits it into independent ODU and XLR cables to connect to the U-Net port and audio input on all MLA series products.

## Tablet PC

MLA and MLA Compact systems are supplied with a high specification tablet PC to control and monitor systems. Original systems were supplied with a Lenovo ThinkPad which has since been superseded and current systems are supplied with a Panasonic Toughbook. The notebook can be quickly configured for standard laptop use or the screen swivelled and used in tablet format with the supplied stylus which is conveniently stored in the body of the computer.



All necessary software is supplied fully installed on the Tablet and it is pre-configured to connect wirelessly with the system Master rack. In addition there are some additional utilities files installed for routine system maintenance. The tablet is supplied in a flightcase which houses its power supply, a Leica Disto D8 laser measure, a U-Net to RJ45 barrel adaptor and with the Mk1 system it also holds the WAP antenna.

### Software

The Lenovo tablet is supplied with the two key applications ready-installed to design systems, create optimisations and upload them to a connected system. The operating system is Microsoft Windows 7 at present.

#### Display 2.1

The latest version of Display 2.1 is installed. This is the application used to create a show project, drawing a 2D slice of the venue, positioning your array and specifying the audience plane(s) and other areas that you do not wish to cover including those which you particularly want to keep at the lowest level possible defined as "Hard Avoid". Goals are set for the required spl contour from the start of the audience coverage to the furthest point, and for the relative importance between the audience target, non-audience and hard avoid areas. The application first calculates the inter cabinet and array angles so you can proceed with rigging the array, and then creates the optimisation EQ files to be uploaded into the system DSP.

#### Vu-Net

Vu-Net is the application that interfaces between the tablet PC and the system utilising the Merlin processor as a network Hub. The system is "discovered" and arranged on the desktop to suit your requirements and the optimisation files created in Display 2.1 uploaded. The system can be fine-tuned with user DSP available including gain trim, delay, zoning and a 10 band parametric EQ. There is full monitoring of all cabinet cell amplifier and DSP parameters including level metres and temperature monitoring. Vu-Net offers a complete package for set-up, control and monitoring of a system making additional output equipment largely unnecessary.



## Xirrus WiFi Monitor

The Xirrus Wi-Fi monitor is a Windows desktop gadget offering a “radar” simulated graphic representation of Wi-Fi signals in proximity of the tablet. This is very useful when connecting to the MLA or MLA System wirelessly and to check how crowded the Wi-Fi band at the venue is allowing you to make an informed decision on whether to switch to a hard-wired connection if the wi-fi network is over-crowded.

## Files & Utilities

A number of additional files and utilities are installed to optimise the PC performance for running an MLA System.

### Power Settings .bat file

This file installs a system power setting optimised for system control, saving power where possible when running from the tablet battery but without compromising the usability of the PC.

### Matlab Components

This application is the base on which Display 2.1 is built and is a powerful high-level language and interactive environment for complex numerical computation of which Display 2.1 is a typical example. It is proven to be more processor efficient and faster than similar applications such as C/C++ or Java™. This enables the vast number-crunching required for the EQ optimisations to be completed in a reasonable time frame, usually no more than around ten minutes for a complex venue and frequently much quicker.

### Java Runtime

Java is used for Vu-Net as it doesn't require the high-level computational processing but is used to provide an ergonomic and comprehensive application offering every possible element of control required to run an audio system.

### Martin Audio Software Backup

A shortcut to a folder containing a back-up of all installed software is included

### Network Information

A shortcut to a text file with system network information is included.

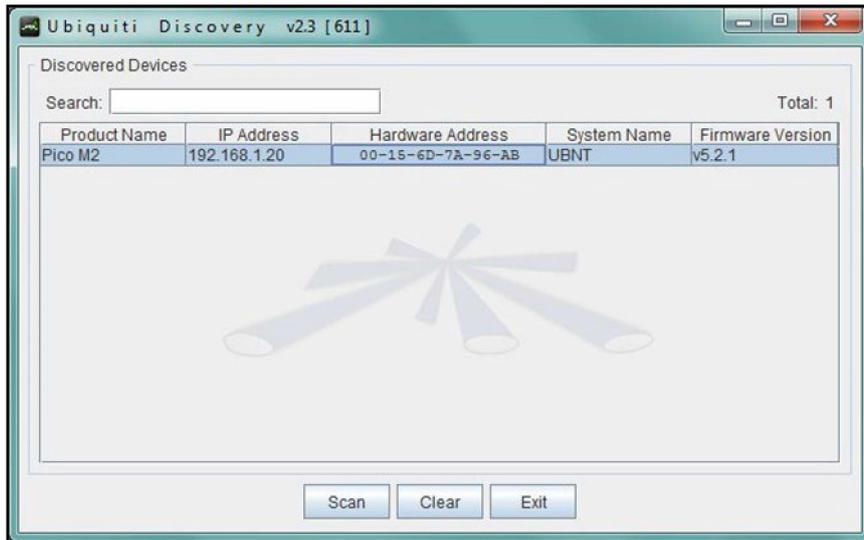
### Picostation Configuration

Files are included for configuration of the PicoStation devices used in Mk 1 MLA and MLA Compact systems. These are used both for DHCP support in the Master rack and as the Wireless Access Point (WAP). Should either of these lose their configuration Firstly, disable the wireless network adapter on the computer, if you have it, so that the only connection you will use is the RJ45 wired connection.

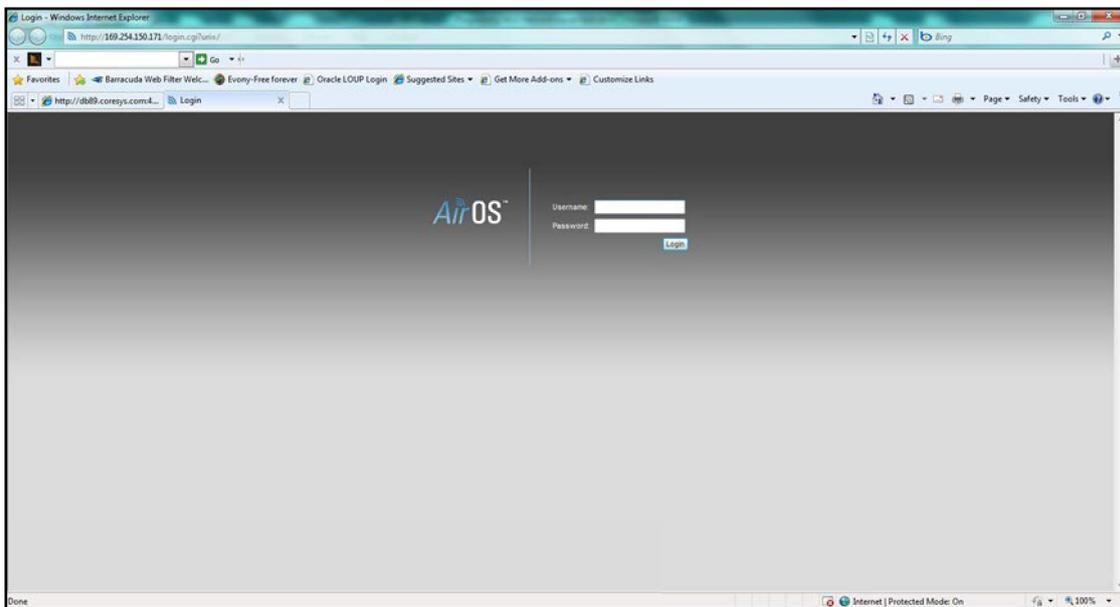
### Standard Configuration

To configure each of the 2 PicoStations you need to load a preset configuration and then change the relevant passwords. A copy of the settings can be found at the bottom of this document if you want to change them manually.

1. Connect your computer and a PicoStation to the Ethernet switch
2. Load up Ubiquiti Discovery software
3. Press the Scan button to discover the Picostation
4. Double click on the PicoStation entry



5. Select the line that has an 192.168.1.20 IP address and click the Web UI button
6. Web browsers opens on the login screen;



**Username: ubnt**  
**Password: ubnt**

Click login button

7. Click on the System tab. Under Configuration Management click the browse button and find the file called MLA WAP Config v1.
8. Click the upload button, and then Apply.

The WAP has now been configured.

Disconnect the newly configured WAP and then connect the PicoStation that will be the DHCP server.

Follow the above steps but at point 7 upload the file called MLA DHCP Config v1.

The DHCP server has now been configured.



## Manually Configuring the Wireless Access Point (WAP)

1. Connect your computer and the Picostation that will be the Wireless Access Point (WAP) to the switch
2. Load the Ubiquiti Discovery tool, scan for the connected Picostation. Once found, double click on the Picostation, select the IP address which isn't 192.168.1.20 and click the Web UI button
3. The logon screen is then displayed in your web browser. Login using the following credentials:
  - Username – ubnt**
  - Password – ubnt**
4. Click on the Wireless tab and enter the following information:
 

Wireless Mode	=	Access Point
SSID	=	MLA System
Country Code	=	United Kingdom
Security	=	WEP
WEP Key	=	Enter a 10 digit hexadecimal combination
5. Click on the Network tab and enter the following information:
 

IP Address	=	10.10.10.2
Netmask	=	255.255.255.0
Gateway IP	=	10.10.10.1
Primary DNS IP	=	10.10.10.1
6. Click on the Change button at the bottom of the screen
7. Disconnect the WAP and the computer from the switch, wait 10 seconds for your computer to lose its network connection, and then reconnect both
8. Load the Ubiquiti Discovery tool, scan for the connected Picostation. Once found, double click on the Picostation, select the IP address which should now be 10.10.10.2 and click the Web UI button
9. The logon screen is then displayed in your web browser. Login using the following credentials:
  - Username – ubnt**
  - Password – ubnt**
10. Click on the System tab and enter the following information:
 

Device Name	=	MLA WAP
Administrator Username	=	admin
Current Password	=	ubnt
New Password	=	[Enter the same password used for the DHCP server]
Verify New Password	=	[Enter the same password used for the DHCP server]
11. Click the change button

The Wireless Access Point (WAP) has now been configured; they can be re-configured using the files installed on the tablet PC

### Specification

Please note that as with most computer systems, specifications change extremely frequently so please contact Martin Audio if you have any questions regarding the latest specification for production systems.

#### Processor

Intel® Core™ i7-2640M 2.9 GHz, 4MB L3, 1600Hz FSB

#### Operating System



Microsoft Windows® 7 Professional 64 bit

## Hard Drive

128GB SSD SATA

## RAM

8GB PC3 – 12800 DDR3 SDRAM 1600 MHz

## Display

12.5"Outdoor (Pen-Only) HD 300 NIT Wide-Viewing (IPS) Panel (Direct-Bonded, Gorilla Glass) 1366 x 768

## I/O (Input/Output) Ports

- 1 x Mini Display port w/ audio
- 1 x VGA
- 2 x USB 3.0
- 1 x Always on USB 2.0
- 1 x 4-in-1 SD Card Reader (SD/SDHC/SDXC/MMC slot)
- 1 x Express Card 54mm
- 1 x Smart Card Reader

## Wi-Fi

Intel Centrino Wireless N-2200 2x2 BGN

## Dimensions

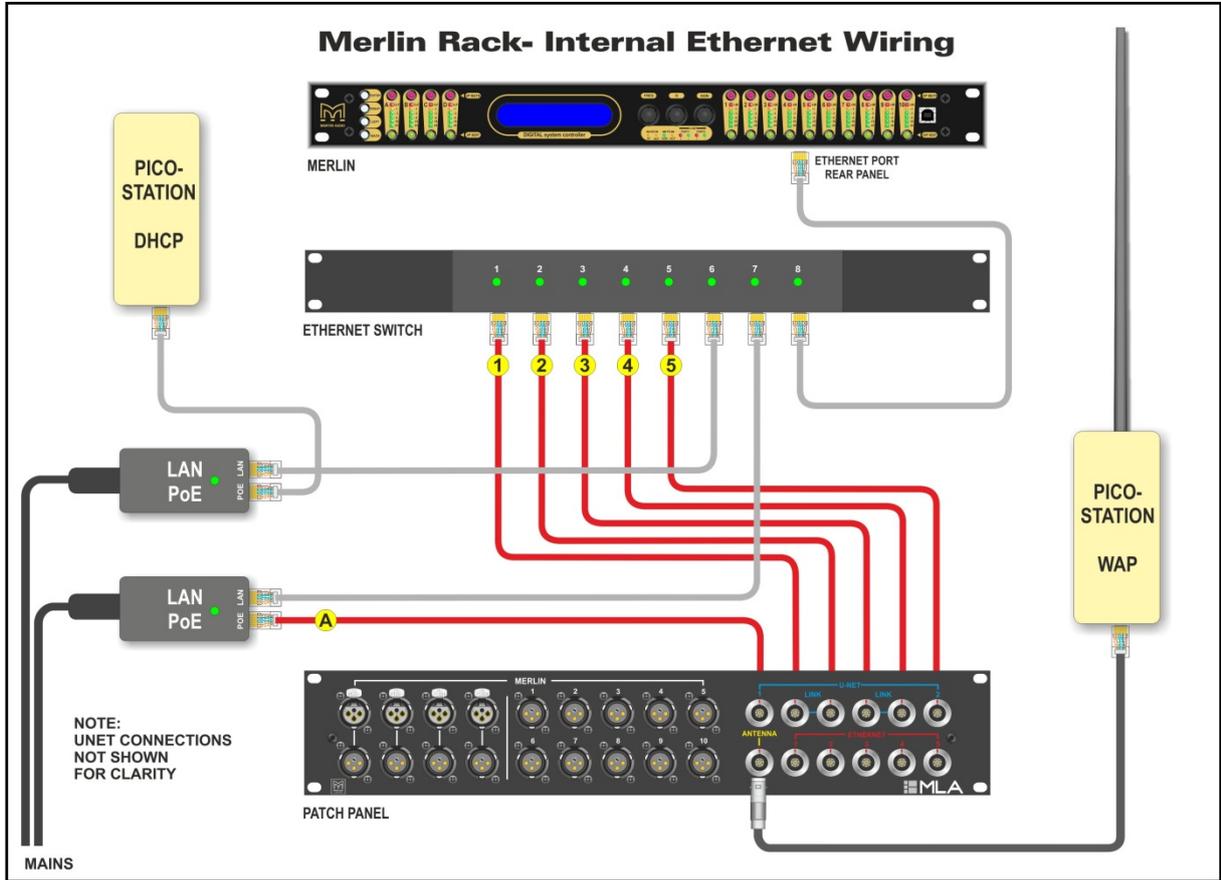
305.0mm x 228.7mm x 270 - 31.3mm (12"x 9"x 1.06"- 1.23")



# MLA Master Rack

## Mk1 Master

The Master rack is housed in a 16U 19" rack flightcase and is the principal control for any MLA or MLA Compact System. It houses either one or two Mains distros to power up to four arrays, a Merlin processor, a Pakedge Ethernet switch, Merlin Patch Panel and the Picostation DHCP server and associated power supplies. System wiring is as follows;-



This also shows the Picostation WAP and antenna which are supplied with the Front of House Tablet PC assembly. The two Ubiquiti Picostation devices are identical however one is configured as a DHCP server and the other as a Wireless Access Point (WAP). Both are powered via their Ethernet ports using a PoE (power over Ethernet) mains PSU which is in line with their Ethernet connection. The DHCP server is connected to one port of the Pakedge Ethernet switch another port is connected to the connector designated for use with the WAP. Note that the PoE adds 48V to the connection; do not connect any other Ethernet devices to this connector as damage could occur. The first 5 ports of the Switch are directly connected to the Ethernet outputs on the patch panel for connection to slave racks or a cable connection to the tablet PC.

Not shown in the diagram are the two U-Net connections from the patch panel which are terminated in Neutrik Ethercon connectors to connect to the two ports on the Merlin.

All input and output audio connections on the Merlin are connected to the patch panel with short cables.

The mains cables for the two PoE devices, the Ethernet switch and Merlin are run down the back of the rack to the 13A outlets on the Mains Distro. These are powered from breakers 3, 6, 9 and 12 on the Mk1 distro.

All Networking and Wi-Fi wiring is identical on the low voltage (USA) version of the Master rack; the only difference is the mains distro and flightcase.

Mk 2 Master

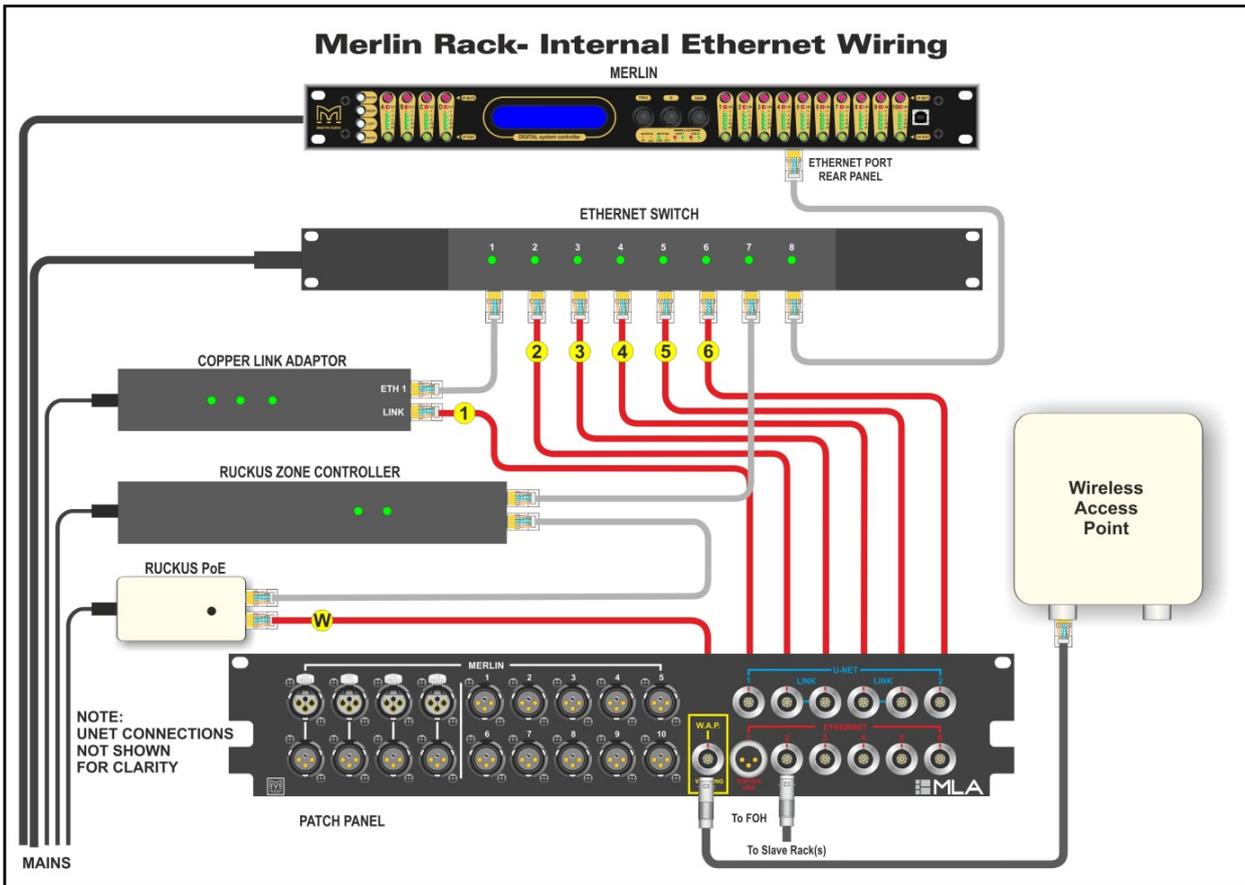


The Mk2 Master rack is a substantial step up from the first incarnation of the system. The first and most obvious improvement is the mechanical deployment. The patch panel is now a slide-out tray secured by the top pair of rack bolts. This slides out to access all network and wi-fi components which are secured to the tray which also features a dedicated 4-way mains board so power to all network products is via a single inlet. The patch panel wiring loom has been modified to allow the tray to easily slide in and out with all connections now fed through a bulk umbilical down one side which is dressed with expandable braided sleeving for additional protection.



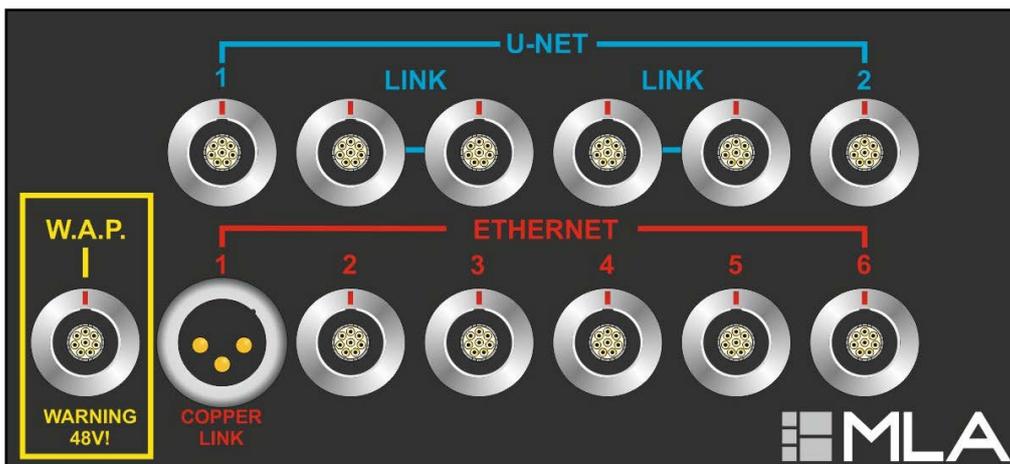
The Wi-Fi system is now built around the Ruckus Enterprise Class Smart Wireless LAN controller. This system operates on the 5GHz band but is auto switching to the conventional 2.6GHz band if it finds the band to be very congested. It allows seamless meshing by adding additional WAPs without any cabling to greatly expand the wireless coverage in difficult areas.

The other improvement is the addition of the Patton Copper link extender. This resolves the problem of providing a hard-wired Ethernet connection to Front of House from stage given the limitations of standard Ethernet protocol. Ethernet is transmitted over simple twisted pair over distances of up to 1,500m (5,500ft). As the connection only requires a simple twisted pair it will work perfectly well via standard microphone cable so the connection is brought out onto the patch panel on an XLR so the feed can be routed over any existing audio lines that are run from Front of House to stage. A receiver is housed in the new Front of House rack, details below.



This shows the WAP which is supplied as part of the FoH rack. There are similarities with the Mk1 system with the Ruckus Zone Director replacing the PicoStation DHCP Server. The feed to the WAP is via the WAP PoE and goes to a dedicated antenna connector on the patch panel. This also has 48V present so should not be connected to other Ethernet devices.

The Copper Link adaptor uses one of the Switch ports and feeds the patch panel copper link adaptor XLR. This is still an Ethernet connection so is colour coded red but is differentiated from the standard Ethernet connections by virtue of using an XLR and not the ODU connectors used for all other Ethernet connections;-



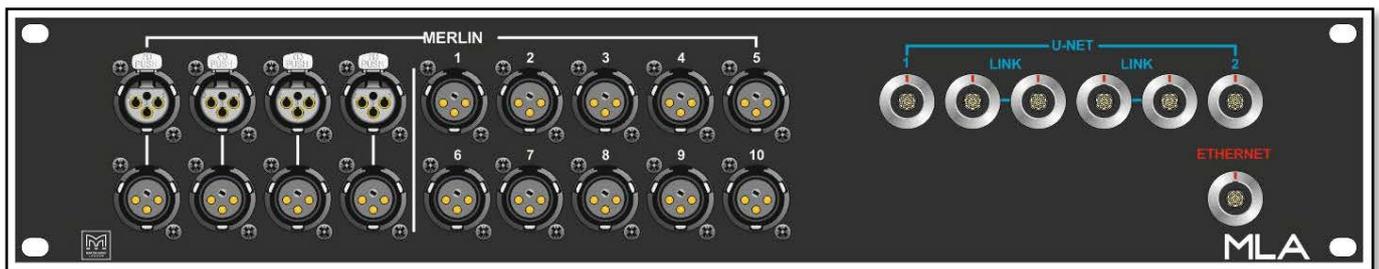
## MLA Slave Rack

### Mk1 Slave Rack

The Slave Rack is essentially identical to the Master rack but without the wi-fi and network components. It is housed in an identical 16U 19" rack flightcase which can house either one or two mains distros (high voltage version only). It has a Merlin controller and the same patch panel as the Master rack but all but one Ethernet ports are blanked off leaving a single connection which goes directly to the Merlin Ethernet port. The 1U space where the Ethernet switch would be on a Master rack is fitted with a blank panel.

### Mk2 Slave Rack

The New version of the Slave rack whilst housing identical components has a dedicated patch panel as the new Master panel is such a departure. This eliminates the unused Ethernet connection leaving the single Merlin Ethernet port which is now labelled accordingly on the silk screen;-

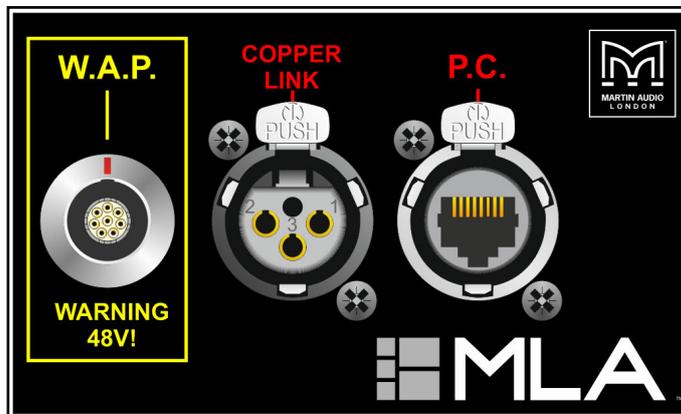




## MLA FoH Rack



A new addition to the system is the Front of House (FoH) rack which accompanies the new Ruckus Master rack. It is housed in a 4U 19" rack flight case. It has two principal purposes; first it houses the receiver for the Copper link Ethernet extender system so a long twisted pair cable can be used to offer a wired Ethernet connection from the Master rack offering better reliability than a wi-fi connection. There are two Ethernet ports available, one intended for connection to the WAP to give an excellent position for the antenna virtually in the centre of the venue to maximise the reliability of the wi-fi connection when walking the venue to check coverage. The second Ethernet port is brought out on a Neutrik Ethercon connector to allow an easy cable connection to the Tablet PC using a standard Cat 5e patch cable.



The other use for the rack is to house the WAP. The assembly is built around a 4U slide-out draw. The left side of the internal draw is sectioned off and has a CNC machined foam cut out to hold the WAP complete with the 5m RJ45 to ODU cable. This may remain connected to the WAP using the weatherproof bush supplied to ensure a reliable connection when the WAP needs to be positioned outdoors exposed to the elements. The right side of the draw holds the Copper Link components at the bottom protected by a metal plate. This leaves a space for storing additional cables, Sharpies, PVC tape et cetera.





## MLA Flying Grid



The MLA flying Grid is the principal system for deployment of MLA systems. When used with a two point suspension system it can be used to fly up to 24 MLA or 15 MLX or a maximum of 6 MLX with 12 MLA flown below in a combination array (note that this configuration requires two grids). The grid features a central spine which allows single point rigging of up to 10 MLA.

The grid is also used for ground stacking up to 6 MLA. This can be either directly on the ground or on top of an MLX sub to which the grid can be attached for additional stability.

The grid has an inclinometer sensor attached with an XLR output for connection via a weatherproof XLR cable (as supplied with all systems in lengths of 35m) to the Inclinometer reader for extremely precise adjustment of the array angle. The reader is calibrated to the sensor and both are given a unique number to ensure that they are always used as a matched pair. The calibration is to 0.1°. Never mix sensors and reader; you will not get accurate results. We recommend re-calibrating the inclinometer system annually to ensure consistent accuracy which is crucial to ensuring that an array covers the area you intend. A large MLA system could comfortably cover distances of over 150m and an inaccuracy of a fraction of a degree could make a difference of 20 to 30m at the furthest point of the coverage.

The Flying grids are supplied flightcased in pairs with the following accessories;-

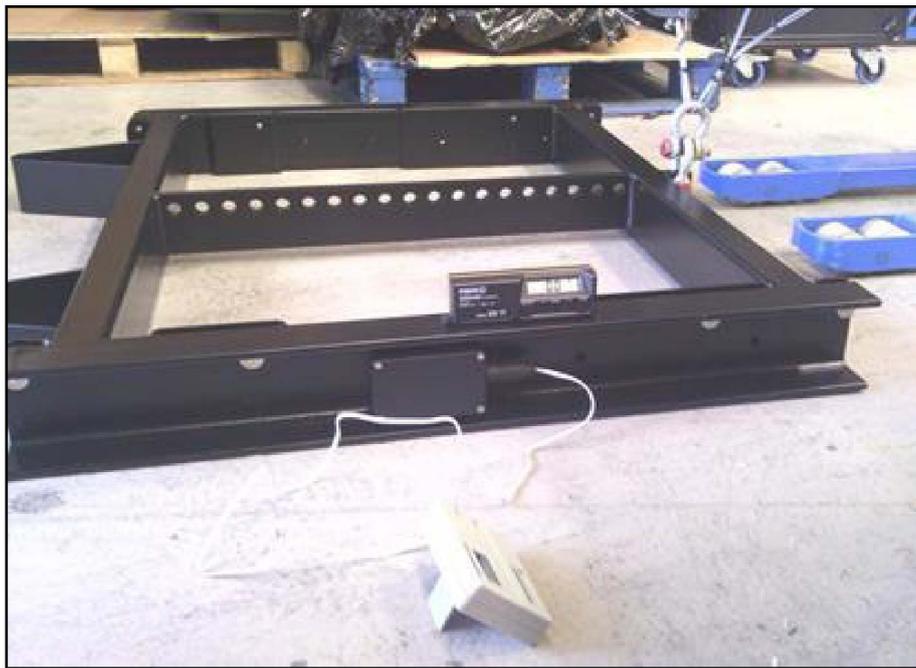
1x	CAR00042	“Nosecone” style flightcase.
2x	ASF20032	Breakout distro hanger assembly
2x	SEN00002	Inclinometer reader
2x	ASF20033	Ground Stack Bar
4x	HTK300	3.25 tonne Crosby shackle
2x	HAM09107	4mm wire rope distro hanger extension
2x	HAM09106	0.5 tonne shackle

### Calibration

There are two stages to calibrate the inclinometer system. First it is necessary to match the reading to an accurate test reference clinometer, then to ensure that the span is correct by checking the adjustment with the grid at a large angle. Note that all calibration is done to the reader, there is no adjustment required whatsoever to the sensor mounted on the grid

The Test reference level must of course be highly accurate and calibrated; it should be capable of measuring to at least a resolution on 0.1°.

The first stage is to place the flying grid on a flat surface, connect the reader to the sensor;-



Note that the cable length between them is immaterial, accurate readings however depend on good battery strength so if you are calibrating a grid as part of routine maintenance it is worth replacing the battery in the reader for a new, alkaline PP3 style 9V battery. See the chapter on battery replacement for details.

As mentioned, ensure that the sensor and reader are a matched pair. If this is not possible, calibrating a replacement reader for example, you should label them after the calibration procedure so they are always used together in future;-

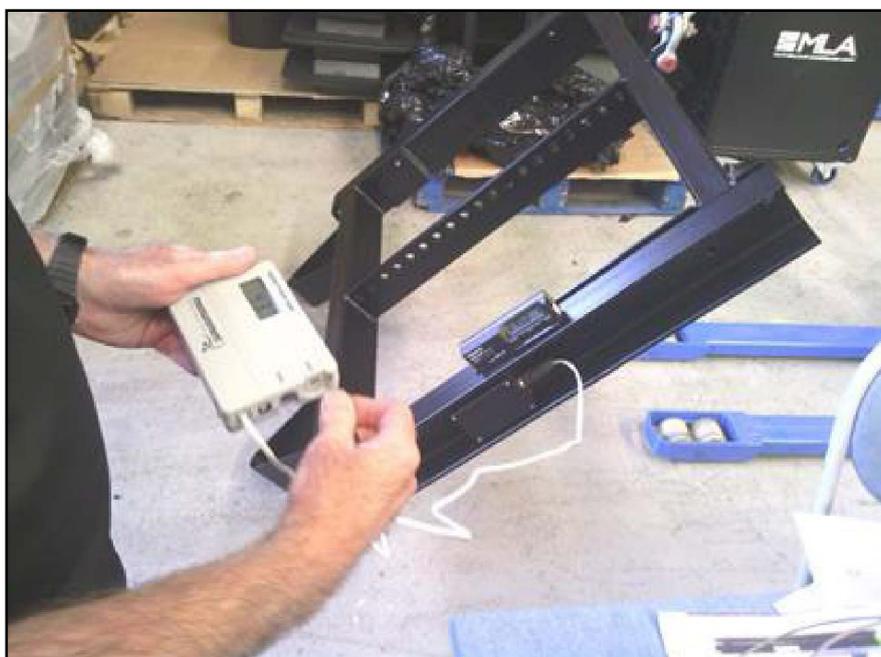


With the flying grid flat, place the test inclinometer on the grid in the centre and switch on. Ideally it should show the grid at 0° if the floor is flat. It is not vital that it is totally flat so don't waste time propping up the grid at either end to get a zero reading, as long as it is close it will be fine. Now turn on the reader and check the reading. It needs to be calibrated to exactly match the test reference. Adjustment is done using the 'ZERO' control on the right hand end of the reader;-



This is supplied by the manufacturer with an adjustment knob but this may have been removed by Martin Audio so that once calibrated the controls can be covered with a label to prevent accidentally changing the calibration. If the knob is still present carefully remove it as you will need it out of the way for the span calibration. Using a small screwdriver, adjust the control until the read-out exactly matches the reference level.

Next raise the rear of the flying grid until the reference level reads approximately  $-45^{\circ}$  (a downward tilt is shown as negative, an upward tilt is positive);-



**Take extreme caution handling the flying grid, it weighs close to 80Kg and injury could easily occur if it is dropped. Never attempt to lift it on your own or without mechanical assistance and always ensure that it is adequately supported when lifting the end to calibrate the span.** Check the actual angle with your reference level and adjust the span potentiometer on the reader. This is found through a small hole next to the zero adjustment pot and can be accessed with a small screwdriver or trimmer tool;-



Carefully adjust the pot until the display matches the reference. Next lower the grid to around  $-30^{\circ}$  and  $-20^{\circ}$  checking each time that the reference and reader displays match. It may be necessary to re-adjust the zero measurement following calibrating the span, in which case check the span calibration again.

Once completed you should fix a label over the two controls to prevent accidental adjustment and mark the date of calibration. Make a note in your diary, calendar or smart phone for 12 months' time to check the calibration again.

### Battery Replacement

If the Inclinometer display fails to power up, shows a dim read-out or a low battery warning you need to replace the internal battery. The display uses a 9V PP3 style battery; always use an alkaline replacement from a reputable manufacturer such as Duracell, Maxell, Energiser et cetera.

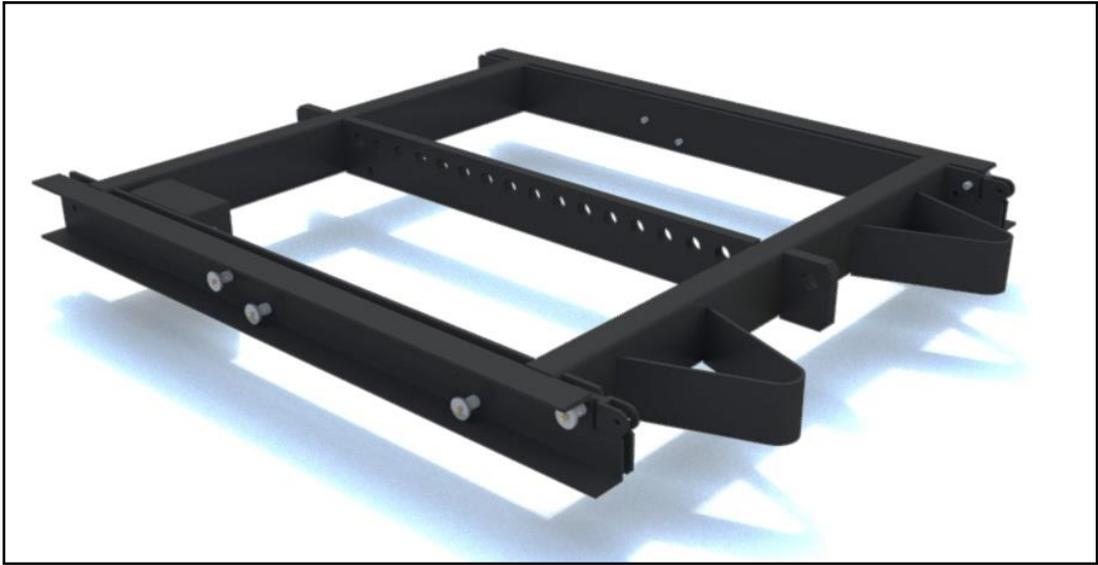
The battery is accessed by opening the reader case completely; there is no dedicated battery compartment. The case separates into two halves dividing down the middle. The case clips together, there are no screws to remove. The best tool to use is a medium (around 5mm) flat blade screwdriver. Insert the blade of the screwdriver into the slot at the left hand end of the case and carefully twist to ease the case apart. Now move the screwdriver to the top of the case around three quarters of the way along towards the right hand end and twist the blade again in the slot to ease the case further apart. Repeat this at the bottom and the case should be unclipped sufficiently to make it easy to pull completely apart. The battery is in the upper half with the rest of the circuitry, with the reader top half face down it is in the bottom right corner;-



Ease the battery out, pull the clip off the terminals, clip the new battery onto the battery lead and replace it in the upper half of the case. The bottom is fitted back on and clips into place. Turn the reader on to check the new battery has been fitted correctly and is working ok.



## MLA Compact Flying Grid



The MLA Compact flying Grid is supplied in pairs with all MLA Compact systems. It enables flying of up to 24 MLA Compact when using a two point lift, or 12 enclosures from a single point. Ground stack systems of up to 6 Compact can also be employed using the same grid with the addition of ground stack bars which as supplied as part of the system.

The grid has an inclinometer sensor attached with an XLR output for connection via a weatherproof XLR cable (as supplied with all systems in lengths of 35m) to the Inclinometer reader for extremely precise adjustment of the array angle. The reader is calibrated to the sensor and both are given a unique number to ensure that they are always used as a matched pair. The calibration is to 0.1°. Never mix sensors and reader; you will not get accurate results. We recommend re-calibrating the inclinometer system annually to ensure consistent accuracy which is crucial to ensuring that an array covers the area you intend. A large MLA Compact system could comfortably cover distances of up to 150m and an inaccuracy of a fraction of a degree could make a difference of 20 to 30m at the furthest point of the coverage.

The Flying grids are supplied flightcased in pairs with the following accessories:-

1x	CAR00040	MLA Compact Flying Frame Flightcase
2x	ASF20032	MLA Compact Distro Hanger assembly
2x	SEN00002	Inclinometer reader
2x	ASF20042	MLA Compact Short Ground Stack Bar
2x	ASF20044	MLA Compact Long Ground Stack Bar
4x	HTK300	3.25 tonne Crosby shackle
2x	HAM09107	4mm wire rope distro hanger extension
2x	HAM09106	0.5 tonne shackle

### Calibration

The Calibration for the MLA Compact Flying frame is exactly the same procedure as that for the MLA Flying grid, please see the relevant chapter for details.

Fortunately the MLA Compact Flying Frame is not anything like as heavy as the MLA flying grid but caution should still be taken when angling the grid to check the calibration at steep angles. Make sure it is adequately supported before taking measurements; the grid could still easily cause injury if it falls.



## **MLA to MLA Compact Transition Grid**

Coming Soon



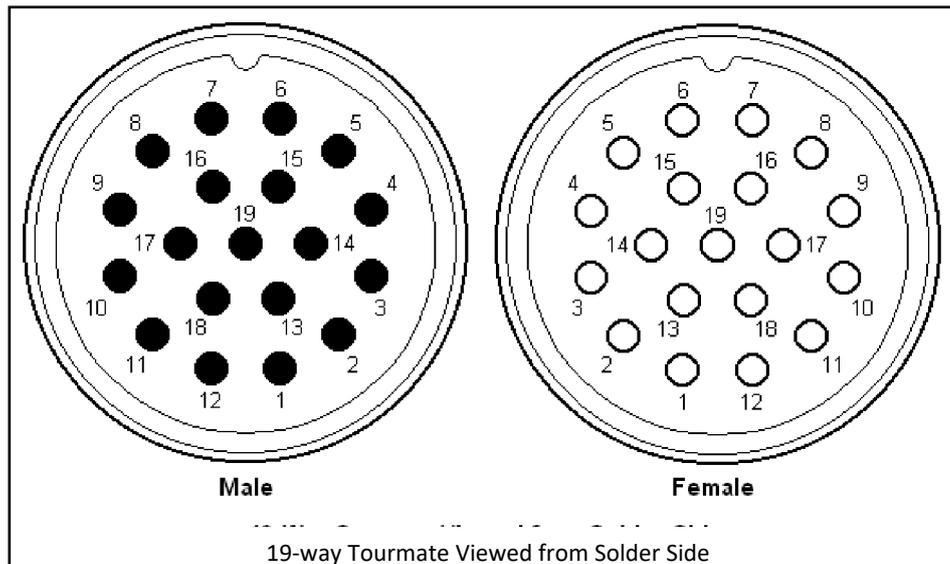
## Mains Distro- High Voltage

### Distro Mk1

The Mains Distro for territories with a high mains voltage (above 200V AC) is housed in a 6U tall 19" rack-mount enclosure and features a 32A three phase Ceeform inlet. There are three mains LEDs which show the presence of mains on the three phases. This is fed to two rows of six double pole 16A combined residual current breakers the outlet of which feeds two Tourmate 19-pin female outlets, one from the top row of breakers and the second from the bottom row each delivering 6 channels of mains. The three phases are split across the outlets with Phase 1 fed to breakers 1 and 2, phase 2 to breakers 3 and 4 and phase 3 to breakers 5 and 6. The top row are labelled circuits 1 to 6 and the bottom row 7 to 12.

The Tourmate wiring configuration is the same standard as used for Socapex style connectors in the lighting industry and is as follows;-

Circuit Number	Phase	Live	Neutral	Earth
1 & 7	P1	Pin 1	Pin 2	Pin 13
2 & 8	P1	Pin 3	Pin 4	Pin 14
3 & 9	P2	Pin 5	Pin 6	Pin 15
4 & 10	P2	Pin 7	Pin 8	Pin 16
5 & 11	P3	Pin 9	Pin 10	Pin 17
6 & 12	P3	Pin 11	Pin 12	Pin 18



The Distro also has four 13A outlets on the rear to power the control electronics within the Master and Slave racks. These are fed individually from circuits 3, 6, 9 and 12.

### Distro Mk2

The latest version of the Distro has a few enhancements following feedback from MLA partners. The 32A Ceeform inlet has been rotated through 90° anticlockwise as it had been found that the cover on the cable mount mating connector would obstruct the connector panel above in racks with two distros. The cover now harmlessly sticks out to the left of the panel when mated.

There is also an additional 16A breaker on the top row which is a dedicated independent feed for the 13A outlets on the rear of the distro. This allows mains isolation of all cabinets without disturbing the mains feed to the Merlin and network products.

## Mains Distro Low Voltage



For territories with lower mains voltage supplies below 200V AC, a high current mains distro is available. All MLA products have switch mode power supplies so they can be used at any mains voltage anywhere in the world however the lower the mains voltage the higher the current draw for consistent power output therefore the distro is required to cater for a much higher current draw.

The low voltage distro is very different from the high voltage version. It is no longer a 19" rack mount unit but is built into a flightcased rack. The distro takes up 12U of rack space in the flightcase leaving 4U free for the Merlin and network products. It has a capacity that matches a high voltage system with two distros installed in a rack.

Mains inlet is via 200A Camlok connectors with parallel outlets immediately above each connection. There are fused indicator lights for each of the three phases.

Above the inlet panel is the first of two outlet panels each of which has a 19-pin Tourmate at either end with twelve 20A RCD breakers. The top outlet panel is labelled 1 to 12, the second panel 13 to 24. Wiring for the Tourmate connectors is identical to the high voltage distro.

There is an additional 1U breaker panel with a single 20A RCD which feeds rear panel mounted Edison connectors to power the Merlin and network products.

## Flightcases

MLA Systems are designed to be a complete package including everything that is required for a touring system including high quality rugged touring grade flightcases to transport and protect all parts of the system

### Merlin & Distro Rack

#### Mk1 High Voltage Rack Case

The Mk1 case is a 16U 19" rack case. It is a floating design with the 16U 19" rack as a separate timber assembly floating in high density Etherfoam within the flightcase. The 19" rack has pressed steel rack extrusion with a return mounted front and rear in the case. The front lid is held in place with four side-mounted butterfly catches, the rear is closed. There are two flip handles on the side to ease handling. The flightcase moves on a wheelboard with four 4" "blue wheel" casters, the front pair are braked types. The flightcase is fabricated from laminated ply with a distinctive black textured laminate. All aluminium extrusions and steel fittings; butterfly catches, handles and ball corners are finished in black. The case is silk screened with the MLA Logo in white.

#### Mk2 High Voltage Rack Case

Although access to the rear of the rack is needed very infrequently, to make this easier a rear access panel was fitted hinged at the side with two slam latches to open. In all other respects the Mk2 is identical

#### Mk3 High Voltage Rack Case



As the black extrusions and fittings have not proved to be sufficiently rugged they have been replaced with standard silver, natural finish parts. The opportunity has also been taken to upgrade many of the fittings for more rugged versions to improve the overall quality of the finished case.

## Low Voltage Rack Case



The low voltage rack case has remained unchanged since its introduction and is a 15U floating rack flightcase into which the mains distro is permanently built leaving a 4U space at the top for the Merlin and network products. It is constructed from black laminated ply and has always used natural, silver extrusions and fittings. It has front and rear lids both secured with four butterfly catches.

Cable Trunk  
Mk1 Cable Trunk



The Cable trunk is based on a standard "Eurotrucker" to make packing in a standard European truck easy as they will comfortably fit two across in a truck. It has a lid hinged upon the long side secured by two butterfly catches. The inside of the lid is lined with a shallow foam layer to meet the tray dividers to ensure that cables stay in their designated sections. The interior of the trunk is permanently divided with a slight offset so the right hand space is slightly larger to house array looms. Both ends have a hinged flap to allow cable access with the lid down. There are lift-out trays in both halves of the case which have movable dividers to allow cable storage to your own specification. The exterior is finished in black textured laminate with black extrusions and fittings. It has four 4" blue wheel casters with two braked versions at the front of the case.

### Mk2 Cable Truck

As with all cases in the range, all fittings have been upgraded and switched to natural silver finish. The hinged flap has been completely removed from the left hand end and there is a simple opening at the right hand end with no flap which is deeper than the previous version to allow cable access with the lift-out tray in place.





## Grid Cases

### Mk1 MLA Grid Case

The Flying grid flightcase is a simple upright case with a removable side to access the two grids that are held in place with Velcro hook and eye straps. There is a storage box at the bottom of the case to hold the accessories. The lid is held in place with four butterfly catches and has two flip handles which are mirrored by two more handles on the rear and finally one more at each end of the case. The castors are 2" miniature wheels to keep the centre of gravity as low as possible to maintain the best stability. As with all other cases it is finishing in black textured laminate with black anodised extrusions and fittings.

### Mk2 MLA Grid Case

The Mk1 case was found to be unstable particularly when one of the two grids was removed so a new design was created to make a significant improvement. The size of the case was enlarged to add stability and now has an identical footprint to the MLX to help with the truck pack. The case is similar in style to a mixing console case using a "nose cone" at the top which can be removed to expose the top of the two grids so the grids can be easily attached to a hoist whilst still in the flightcase minimising the manual handling required. Each side of the case is also removable to enable easy access to the grids. The grids are positioned in the centre of the case each side of a central divide. They are held in place with a pin and clip through the upper most flying point secured by a short length of chain. There are two storage boxes on each side to hold all accessories; one has a compartment which houses the inclinometer reader in a cut-out foam block. The second houses all other hardware such as the distro hanger and shackles. The storage boxes have lids secured with Velcro hook and eye straps. The "nose cone" lid is secured with four butterfly catches; two each side and has two flip handles at each end to make removal and replacement easy. The two side lids are also secured with four butterfly catches and have two handles both to allow easy removal and to help guide the case when fully loaded. There are an additional two flip handles, one at each end to help guide the case. The case is fitted to a robust wheelboard with four 4" blue wheel castors two of which on one side are braked versions. The case still retains the black textured laminate and black fittings finish.

## Mk3 Grid Case



As with all cases in the range the MLA Grid case has been upgraded with more rugged fittings all of which are natural silver finish.

## Mk1 MLA Compact Flying Frame Case

The Compact flying grid case is similar in principal to the MLA case but is scaled down as befitting the smaller, lighter grid. It is a shallow trunk-style case with a tall lid. With the lid removed the two grids are located on each side with a central partition which has storage at the top in the gap between each grid position. The storage boxes locate the inclinometer readers in cut-out foam sections and all additional hardware. The grids are lifted into each side where timber locators hold them securely in place. Foam inserts in the top of the lid add further stability once the lid is fitted. The lid is secured with two butterfly catches each side and there are two flip handles at each end for lifting and guiding the case. As with all other cases it is finishing in black textured laminate with black anodised extrusions and fittings.



## Mk2 MLA Compact Flying Frame Case

As with all cases in the range the MLA Grid case has been upgraded with more rugged fittings all of which are natural silver finish.

Tablet PC Case  
Mk1 Tablet PC Case



The Mk1 Tablet PC Flightcase is a briefcase style flightcase which houses the Lenovo tablet PC, its power supply, the Disto D8, WAP Antenna, Picostation WAP, RJ45 to ODU adaptor barrel and an RJ45 to ODU Cable. The case has a lift-out tray in which the PC, Disto and adaptor barrel are held in cut-out block foam. Under the tray is another foam layer with cut-outs for all other parts and cables. The lid is hinged down one side and secured with two small butterfly catches. A single flip handle is fitted for transportation. The exterior is finished in black textured laminate with black extrusions and fittings with the MLA logo silk screened on the lid. There is a pair of ply skids on the base to avoid damaging surfaces with the ball corners.

Mk2 Tablet PC Case

The tablet case was redesigned to fit in with the improvements to the wi-fi system which includes a front of house rack. This meant that the case wasn't required to carry quite as many parts so has been scaled down so it is smaller and more "tour bus friendly". It now just holds the tablet PC, power supply, Leica Disto D8 and the adapter barrel. As with all other cases the hardware has been switched to natural silver finish.



MLA Compact Twin Case



The MLA Compact Flightcase is a combined wheelboard and flightcase for transporting a pair of MLA Compact. The Compact attach to the wheelboard face down and are pinned together using the front rigging bracket. The wheelboard has a pair of butterfly latches at each end and bumpers along the sides to allow the flightcase lid to locate securely. The lid is trapezoidal to allow front / back packing in a truck to maximise the number that will fit across the width. There are a pair of flip handles at each end to assist in removing and replacing the lid. The lid also has shaped timer sections at each end to allow extremely stable stacking when the cases are stacked up on end.

### Front of House Case

The latest addition to the range is a 4U 19" rack case to house the network and wi-fi components usually used at front of house in conjunction with the tablet PC. It is a very straightforward case with rack fittings attached to the inside of the flightcase. The front and rear lids are removable with a butterfly catch at each side and there are a pair of flip handles on the side to assist lifting with the case up on end. As a new flightcase to the range it is manufactured from textured black laminated ply with high grade fittings and extrusion in natural silver finish;-



## Cabling

MLA and MLA Systems are supplied with all necessary cabling so that all is required is to supply mains power to the racks and an audio source to the arrays and the system is ready to go. High grade cables are essential; there is little point in designing the most revolutionary speaker system in the world if it fails due to cables not up to the rigors of touring.

### Mains

There are a number of different types of mains cable supplied with the system from simple 16A extension cables to multiway break-out looms.

#### 16A extension

**PWA0053** is a 2.5m (8ft) 16A Ceeform male to Ceeform female using IP67 rated connectors suitable for use outdoors. Cable is 3-core 2.5mm<sup>2</sup> with a toughened rubber outer sheath. These are supplied as an extension for use with rear-facing MLX or DSX in Cardioid sub arrays.

#### 30m Tourmate multicore



**ASF12002** is a 30m 18-core multiway mains cable terminated with Tourmate 19-pin connectors, one male, one female. Tourmate is based on the popular Socapex pattern but is rated at IP67 when mated so is suitable for use outdoors in all weather. The cable has 18 cores each 2.5mm<sup>2</sup> and has a tough, flexible outer sheath. Other lengths are available to special order. The Tourmate is used to connect a Master or Slave rack to an array.

#### 12-Way Breakout loom

**ASF12003** is a six circuit, 12-way breakout loom to interface between one of the Tourmate multicore cables and a flown array. The inlet is a Tourmate 19-pin chassis male connector mounted in a diecast box which has a large eye bolt fitted to allow suspension from the rear of the flying grid using the distro hanger. There are 12 glanded outlets each with a length of 3-core 2.5mm<sup>2</sup> toughened rubber cable terminated with an IP67 rated 16A Ceeform female connector to connect to the cabinets. The 12 outlets are wired in pairs to the six channels that are available from the Tourmate connection. The cables are labelled 1 to 12 and the lengths are staggered to allow neat connection down the array. Cable 1 is the shortest and connects to the top speaker. The increase in length between each channel is the same as the height of an MLX or DSX which as the tallest of all cabinets is the

longest cable run that may be required. This will result in excess cable when used with MLA or MLA Compact but this can be neatly taped behind the array when all connections have been made.

6-way breakout loom

**ASF12006** is a six channel breakout loom with six cable outlets of equal length intended for ground stacked systems. The inlet is a Tourmate 19-pin female connector and six cables, one per circuit, exit directly from the Tourmate via a waterproof gland. All six cables are 3-core 2.5mm<sup>2</sup> toughened rubber cable terminated with an IP67 rated 16A Ceeform female connector to connect to the cabinets. All six are 10m in length.





Network

Network cables fall into two categories, U-Net and Ethernet. U-Net is the network protocol that is used to communicate with all MLA devices; the Merlin Processor and all cabinet types; MLA, MLD, MLA Compact, MSX, MLX and DSX. The protocol is broadly similar to Ethernet but with a number of significant enhancements. Communication is over Cat5e cable.

Ethernet is used for communication between the control PC and all Merlins and as any Ethernet network uses Cat5e.

It is essential that all network cables are just as robust as any other cable being used which applies both to the type of cable and connectors used. Cable therefore on all network cables is Belden 1305A rugged tour grade Cat5e. The standard connector for Ethernet is RJ45 however this is completely unsuitable for touring applications as it is not designed for frequent connection and disconnection and is not IP rated for use outdoors. After considerable research the connector chosen was a Lemo K Series pattern 8-pin connector manufactured by ODU. This is specially designed for high-speed data, is extremely rugged and rated at IP67. It is also very quick and easy to connect and disconnect with a very positive latch. Lemo style connectors have been used very successfully in the touring industry, with radio microphone transmitter packs as the most obvious example, so they will be familiar to most system technicians. The ODU version has a particularly rugged over-moulded cable restraint which has proved to make the cables incredibly resilient. They cannot be user-maintained but historically failures have been minimal. The K Series was recommended to Martin Audio as it is used for data telemetry in Formula One racing cars. They withstand the vibration, dust, dirt and moisture in that most challenging of environments so should withstand the rigors of the touring industry very easily.



All network connectors are identical whether they are used for U-Net or Ethernet. The relevant connections are brought out onto chassis mount ODU connectors on the patch panel installed in Master and Slave racks. There are several lengths available to suit all applications;-

- PWA00038** This is an 800mm (2.5 ft) cable used to link MLA or MLA Compact cabinets in an array.
- PWA00039** This is a 3m (10ft) cable for linking MLX or DSX subs.
- PWA00051** A 5m (16ft) cable for short runs to ground stacked systems where a rack is positioned close to the cabinets
- PWA00063** A 15m (50ft) cable for longer runs from racks to ground stacked arrays. Also suitable for Ethernet linking between Master and slave racks across stage in smaller venues.
- PWA00057** A versatile 35m cable for U-Net connection from a Master or Slave Rack up to the first and last cabinets in a flown array, usually as part of a loomed cable bundle. It is also frequently used as an Ethernet cross-stage link between stages in larger venues and even as an Ethernet connection from the Master rack to Front of House in smaller venues.
- PWA00052** This is a 75m (246ft) cable supplied on a drum. It can be used to build longer array looms for very large arenas or those where a cable pick has to be employed to avoid site-line issues. It can also be used as an Ethernet cross stage link between racks for very large stages at Stadium or festival events. Finally it can be used as the Ethernet connection to Front of House from the Master rack.
- PWA00041** This is a 120m cable (390ft) that is available as an optional accessory; it is not supplied with any standard systems. It may be used for U-Net connections where exceptionally long cable runs are required. It is the longest run that U-Net supports so cannot be joined to make it longer or via the parallel link connection on the patch panel. It **MUST NOT**, under any circumstances be used for Ethernet connections, Ethernet is not supported over cable lengths greater than 100m.

## Adaptors

There are three adaptors available for use with Network cables to assist with connectivity.

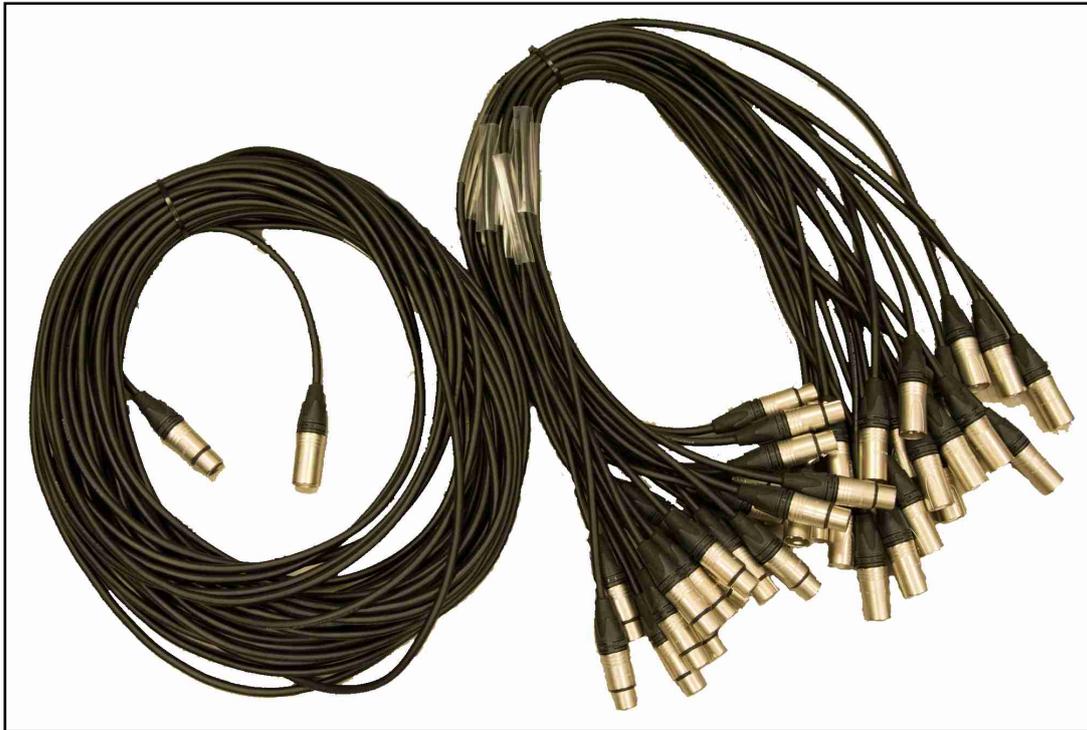


- PCX00048** This is an ODU to ODU barrel connector housed in a Neutrik D-Type module housing. This can be used to extend U-Net or Ethernet cables.
- PCX00043** This is an ODU to RJ45 barrel connector also housed in a Neutrik D-Type module housing. Typically this would be used to connect to the PC at Front of house using the 75m ODU network cable connected to the Master rack and using the PCX00043 in conjunction with a short Cat5e patch cable to connect to the Ethernet port on the PC.
- PWA00056** This is a 10m rugged Cat5e cable, one end is terminated in an ODU connector, the other in a standard RJ45. This can also be used to connect a PC to a Master rack, either directly when the PC is close to the rack during set-up or using the

PCX00048 barrel connector in conjunction with a long network cable such as the PWA00052 75m cable. It is also used with both Mk 1 and Mk2 wi-fi systems to connect to the WAP.

## Audio

Whilst you would expect touring companies to hold a substantial inventory of audio cables, MLA and MLA compact systems are shipped with all the audio cables that you need to use with a system in common with the philosophy of ensuring that the system is supplied with everything required to operate it. As MLA and MLA Compact systems can be operated with standard analogue balanced audio or AES digital, all audio cables are AES specification. All connectors are genuine Neutrik 3-pin XLR NC3 XX series.



**PWA00060** This is an 800mm (2.5ft) cable designed for use linking the audio feed between MLA or MLA Compact cabinets in an array.

**PWA00054** This is a 3m (10ft) cable for linking the audio between MLX or DSX subs.

**PWA00058** Is the principal audio cable for feeding audio up to a flown array. It is 35m long and it will usually be loomed with network, inclinometer and mains cables.

**PWA00057** Whilst not strictly an audio cable this cable has identical specification to the 35m audio cable (PWA00058) but is fitted with Neutrik NC3XX HD series which are fitted with a waterproof rubber sealing jacket. Rated at IP67 when mated with the equivalent cassis connector, this series are specifically designed for outdoor use and are supplied for use connecting to the inclinometer sensor on the MLA and MLA Compact flying grids. All audio connections are protected by the cabinet rain cowl but the inclinometer sensor is completely exposed which is why the additional protection is required for the connectors.

## Looming Cables

It is common practice to loom cables together where they are commonly used in conjunction with each other. The two examples with MLA systems are the cabinet links and flown array connections.

### Cabinet Links

There are two lengths of cables used to link cabinets, 800mm and 3m. The links comprise an ODU U-Net network cable and an XLR audio cable. The connections for these are on the same panel so it makes very good sense to loom them together to speed up rigging and de-rigging arrays. The cables should be joined at regular intervals leaving around 150-200mm (6 – 8”) free at each end so it is easy to make connections.

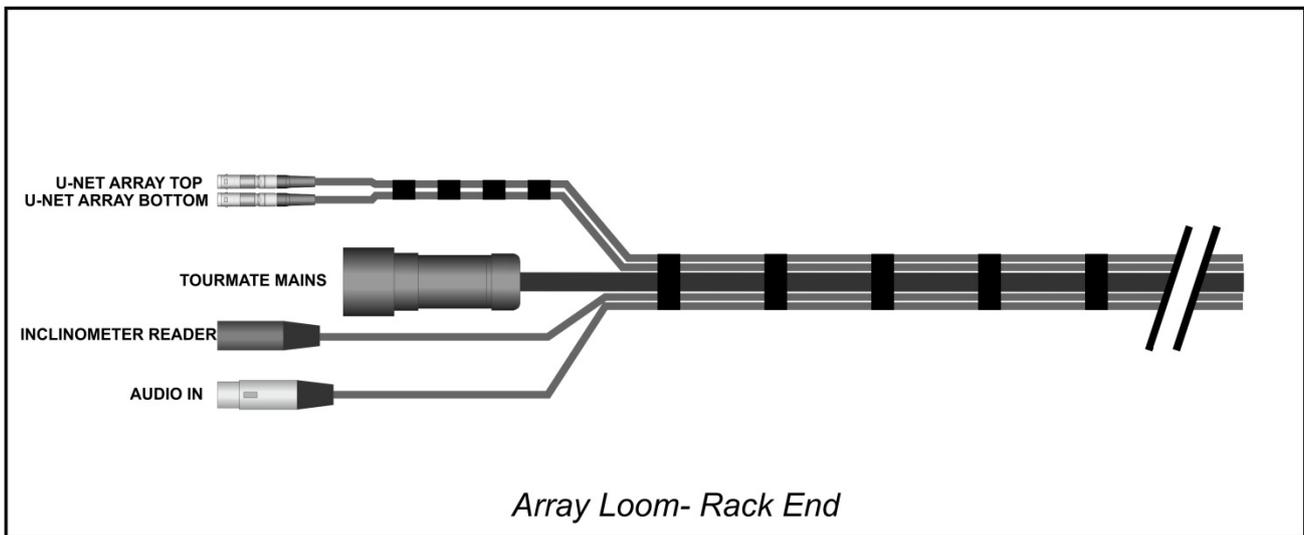
Every rental company has their own preferred method for looming cables. The quickest, cheapest and most easily maintained (although arguably the least robust) method is to use standard black PVC electrical tape.

Another method is to use expandable braided sleeving ("snakeskin" as it is widely known) perhaps with some adhesive lined heatshrink sleeving at each end to keep the braiding tidy. This makes for very professional and hard-wearing looms albeit with a slight loss of flexibility.

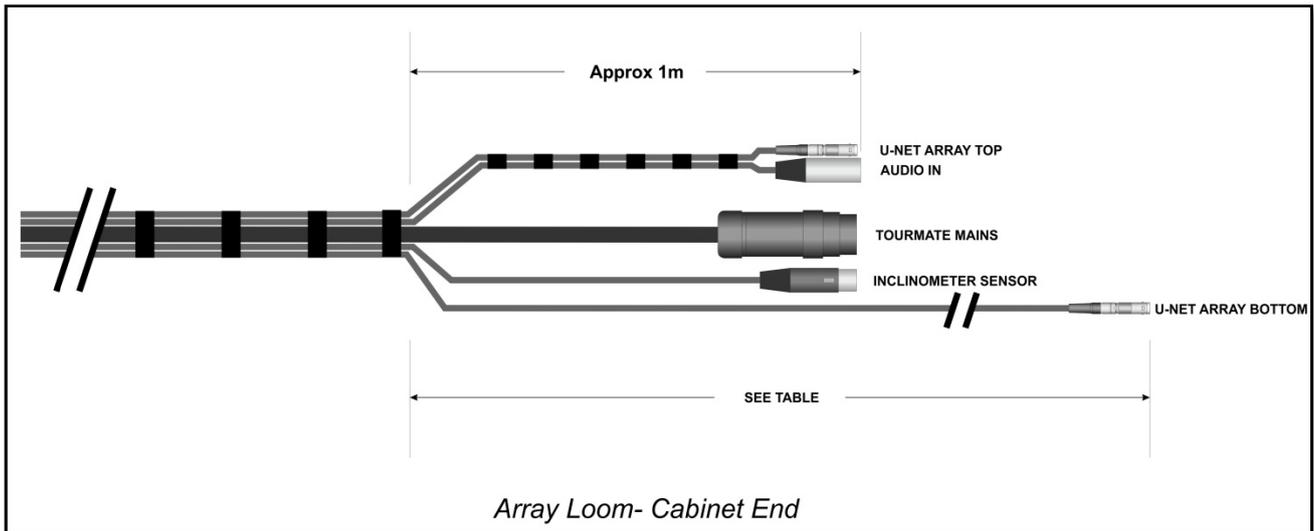
Finally short lengths of either heatshrink or Neoprene sleeving can be used in a similar way to PVC tape but offering a neater and harder wearing finish. Heatshrink sleeve is available in a number of different thicknesses and obviously looming cables needs the thickest available to offer the most rugged solution.

### Array Looms

Rental companies will also be familiar with having to build looms for longer cable runs; perhaps a returns system will have an audio multicore, an optical or coaxial digital console feed and a mains run to power front of house. These will often be loomed together to speed set up and breakdown. Similar techniques can be used with the cables which need to reach from the Master and Slave racks up to flown arrays. Cable lengths and exactly how the cables are loomed needs careful planning. The diagram bellows shows a typical array loom at each end:-



At the rack end of the loom the two network cables are loomed together as they are destined for connection close together on the patch panel. The Inclinator reader can be placed on top of the rack so the cable can be loomed with a similar free length of around a meter. The audio input may be connected to one of the Merlin outputs on the patch panel so could be loomed with the U-Net network cables. The Mains feed via the Tourmate connector is at the bottom of the rack so can be a little shorter than the other connections. The Tourmate array cable is 5m shorter than the 35m network, audio and an inclinometer cables so is naturally going to be the shortest run. There is likely to be some excess cable which should be coiled and taped into the loom at the rack end prior to the break-out.



The loom at the cabinet end has the U-Net cable destined for the top cabinet and audio input loomed together as they go to the same input panel. All cables require around 1 meter of free cable from the break-out with the exception of the network cable destined for the bottom of the array. This will need to be long enough to reach down the array. If your loom is destined to be used this one size of system this can be easily calculated however it is always worth allowing a little extra to keep the loom versatile for dry hires or for occasions where you have had to increase the compliment of cabinets at larger events.

The table below shows the length of arrays for the most common quantities of cabinets which should assist in determining how long to allow for the bottom U-Net cable;-

No of Cabinets	MLA		MLA Compact		No of Cabinets	MLX/DSXF	
	metres	feet	metres	feet		metres	Feet
6	2.04	6' 8"	1.57	5' 1.8"	2	1.21	3' 11.6"
8	2.78	9' 1.5"	2.14	7'	4	2.43	7' 11.7"
12	4.26	13' 11"	3.28	10' 9"	6	3.64	11' 11"
16	5.73	18' 9.6"	4.42	14' 6"	8	4.86	15' 11.3"
20	7.19	23' 7"	5.55	18' 2.5"	10	6.07	19' 11"
24	8.65	28' 4.5"	6.67	21' 10.6"	12	7.28	23' 10.6"

**Length of array based on a dead hang with all angles at 0.5° in the case of MLA and MLA compact or 0° for MLX and DSX. Array will of course get shorter as intercabinet angles are increased**

This picture shows a typical array loom in the larger end of the Cable Trunk. The rack end of the loom is left with three or four metres out of the case and the rest of the loom wound on top of it. A "figure-of-eight" system will avoid twists in the cable. Once all of the loom is wound in place in the case the rack end can then be placed on top. This way, when the cable needs to be deployed the rack end is removed first and connected, the array end is then taken out and it is only necessary to remove as much as it is required to reach the top of the array once flown. The remainder of the loom stays in the case and by using the flap at the end the case lid can be closed keeping the stage extremely tidy;-



# Display v2.1

## Introduction

Display 2.1 is the application that is used in conjunction with Vu-Net and a Martin Audio Multicellular System, either MLA, MLA Compact, MLA Mini or a combination of any of these systems to generate the inter-cabinet angles and the DSP optimisation parameters which can then be quickly and easily uploaded to the hardware over the U-Net system network or in the case of MLA Mini directly using a USB connection. It also shows accurate analysis of the system response in the venue.

The application has an entirely straightforward, logical workflow; in fact it does not allow jumping to advance stages of the design, it is necessary to complete each stage in a logical order.

Display 2.1 uses numerical optimisation to arrive at the resulting cabinet angles and DSP coefficients. Taking the cabinet angles as an example, to explain the process in slightly crude manner this means that it tries a great many combinations of possible angles, checks the result using the computer model of the array response and compares it to the desired response. It continues to check through a huge number of possible combinations until it arrives at the closest match to what has been asked of it. In the case of the cabinet angles, it has the facility to “polish” the array which means it does a second pass having arrived at a set of angles to fine tune the array angles. This process although highly complex, actually only takes a few minutes, certainly no longer than a conventional line-array prediction application. Having specified the cabinet angles the array can be rigged and whilst that is being done the second stage of the optimisation process is done. This also uses numerical optimisation but this time addresses the EQ, FIR, gain and phase parameters available in the DSP, going through the hundreds of thousands of possible combinations possible until the output is as close as possible to the desired response. With a large array and complex venue this could take up to ten minutes to complete however this will be far quicker than the time it takes to rig all arrays so in no way slows down the show build-up. To actually try every possible combination of DSP would take months even on the most powerful computer- there are millions of possible combinations and that is where the unique digital algorithm comes into play, examining batches of results to see if certain parameter changes are taking you closer or further from your desired performance characteristics. It will reject a series of parameter changes that are heading towards a “dead end” and instead will focus on those which get you closer to the desired result, gradually honing all parameters until it reaches a result which is as close as possible to the specifications that the technician has requested. This method allows phenomenal accuracy in a highly realistic and practical length of time. The accuracy of the resulting design hinges on the computer model which predicts how the array will perform for a given set of cabinet angles and DSP coefficients. The computer model devised for Display 2.1 is one of the most sophisticated and accurate ever devised for an audio system and is capable of achieving results to closer than 1dB of actual measured parameters.

A Display design can easily be done prior to arriving at the venue in the comfort of your office. If you have drawings of the space and details of the flying position and the trim height of the arrays you can complete the rigging and DSP design which makes set-up on site extremely quick and efficient. It is possible to try several different DSP optimisations with priority given to a variety of performance characteristics. These can be uploaded to the array and stored in snapshots to be recalled in a few seconds.

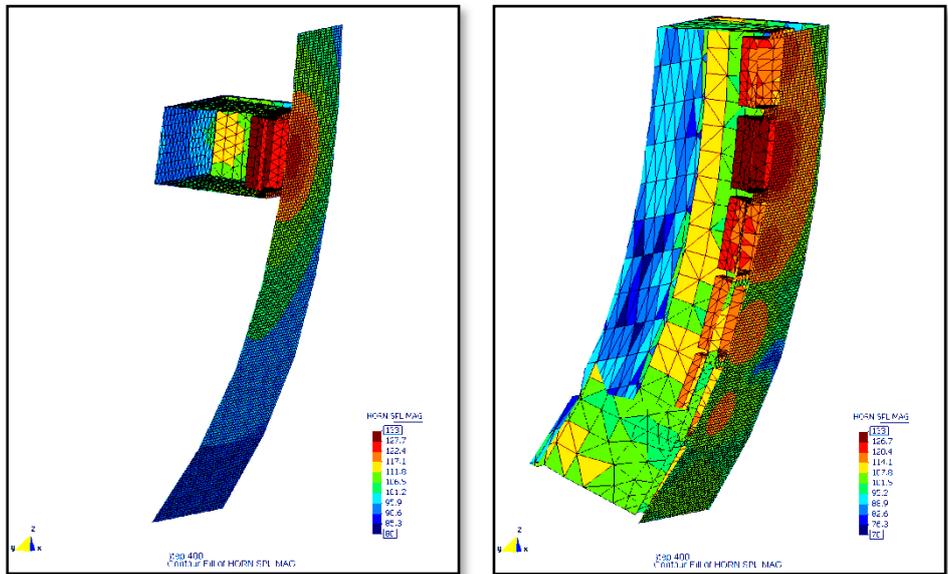
## Numerical Optimisation

At this point it is worth taking a moment to explain in detail one of the concepts behind how Display operates; Numerical Optimisation is an easily misunderstood concept, a few people make the incorrect assumption that it is some sort of “averaging” system meaning that the result is a compromise which couldn’t be further from the truth.

What made multicellular systems possible was the development of a phenomenally accurate computer model of the system which works hand in hand with the precision acoustic design of the cabinets. There are a colossal number of factors that affect an array performance; the performance of individual drivers, the horn design, the angle between enclosures, the number of enclosures et cetera. Martin Audio have taken the analysis of array performance to the most advanced level ever attempted, including boundary effect modelling which includes the effect that all other cabinets in an array have on a single driver; essentially each individual cabinet has a baffle extending above and below it formed by the other enclosures in the array. For cabinets in the middle of the array this is fairly symmetrical but for cabinets towards the top and bottom it becomes more and more asymmetrical which has a highly significant effect on the individual module performance and therefore the overall array performance.

The diagrams below show the response of a single array element which is the second box down in a six box array. The first picture ignores the effect of its neighbouring enclosures. The second picture shows the dramatic effect that the enclosure above and

the four below have on the response. Ignoring this effect will clearly compromise the ability to accurately predict how the array will perform, in fact measurements show that ignoring the boundary effect can result in inaccuracies of up to 8dB which fairly obviously would make the system unusable.



Martin Audio have perfected the computer model for our Multicellular systems to such a degree that the predicted performance can reach accuracy of as close as 1dB of measured results which has made the whole system not only possible but extremely accurate.

Numerical optimisation uses the computer model to check the performance for a given mechanical orientation or DSP configuration, and compares the result on the venue slice to what you have asked the system to achieve. It will then try an alternative option to see if it is getting closer or further from the desired result. If it is further from what you want it to achieve it will ignore that configuration and pursue the more successful angles or EQ curves, trying configuration after configuration before it has attempted close to every possible combination and has got as close as possible to the desired result.

If you consider the first optimisation which calculates the splay angles, for an MLA system there are eight possible angles available between each cabinet; 0.5, 1, 2, 3, 4, 5, 6 and 7.5° if you have a reasonable size array of say 16 enclosures that means a total of 8 x 8 x 8 x...x8, (fifteen 8's!) or 35,184,372,088,832 possible combinations of angles between all cabinets. Clearly analysing each of these combinations involves a substantial amount of processing but pales into insignificance compared to the hundreds of thousands of calculations required when running numerical optimisation for the DSP; every band of EQ frequency, bandwidth and gain, phase and FIR filters for every one of the cells of every cabinet. This is why a powerful PC is required and the EQ optimisation can take up to fifteen minutes or so for a large array in a complex arena. Even the most powerful PC available today couldn't try every possible combination in a reasonable time scale so complex algorithms are used so that when a certain sequence of filter parameters are consistently demonstrating results further from the goals that have been set, the system will abandon those avenues and try others. With this system highly accurate parameters can be produced that are as close as possible to the desired goals in a reasonable time frame. This is a very basic explanation, in fact it is Martin Audio's development of the revolutionary but phenomenally complex digital algorithm that the application uses to refine the optimisation which give the best possible results in a reasonable time frame. Not only that but key parts of the optimisation process are multithreaded which means that the system is able to exploit the latest 64-bit, quad core processors to speed up the entire process.

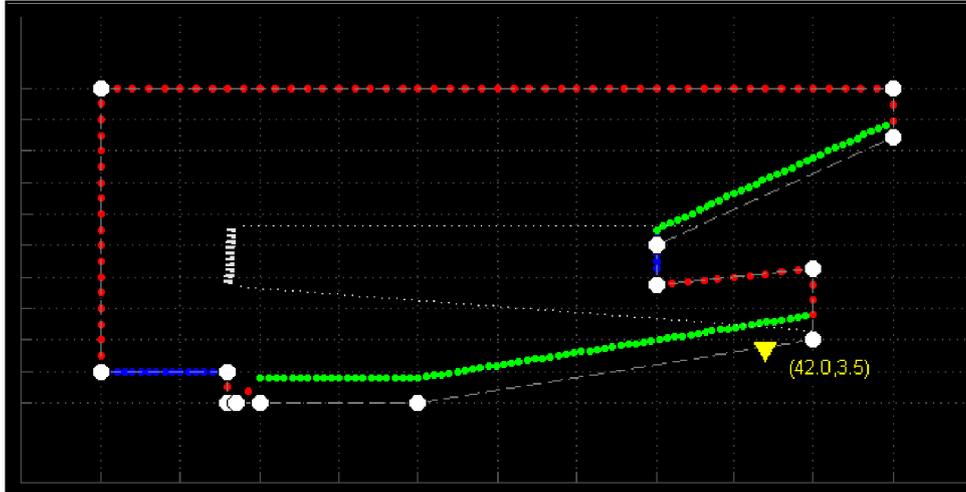
Whilst this system is processor hungry clearly it is a very realistic and practical method to obtain the best possible results from an array where so many variables are at your disposal. Trying to manually adjust several thousand DSP parameters is obviously not going to be realistic however good a system technician believes his ears might be.

### Index Plots

The other concept which Martin Audio developed as part of the MLA system is the index plot. We needed a method to display the results of the system optimisation that was clear and easy to interpret. Because the whole basis of the system is that the radiated signal is coherent where it arrives at all parts of the audience as opposed to when it leaves the array we needed a method of displaying the frequency response at dozens of positions simultaneously. There are a few methods in existence for

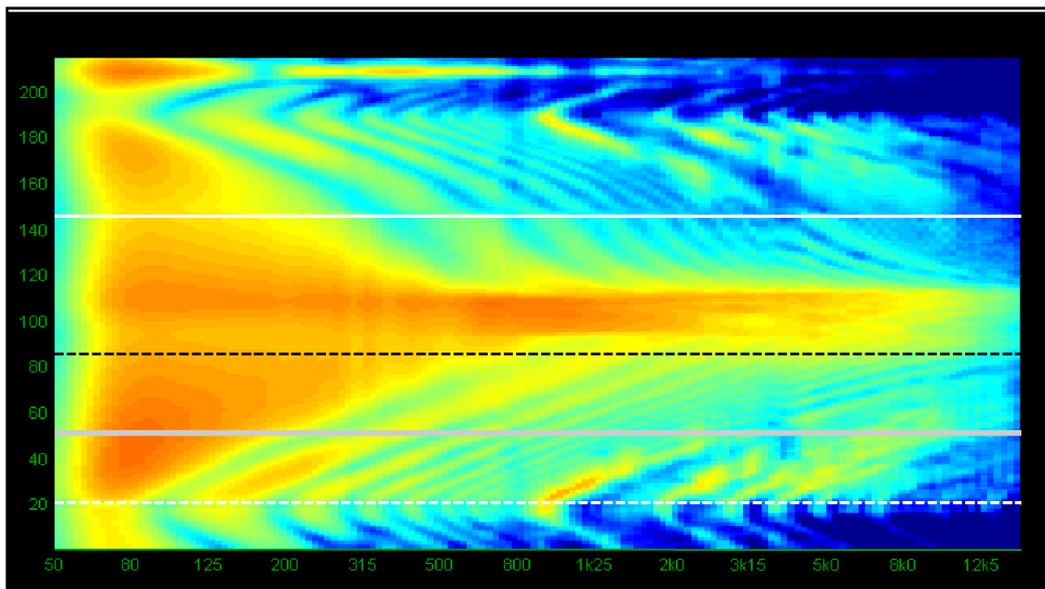
achieving this, 3D graphs for example but they don't really meet the brief of being quick and easy to interpret. The Index plot solves this problem.

As we will see when we look at the application in more detail, we draw a two dimensional slice of the venue in which we are deploying our array. It then gets presented in Display like so;-



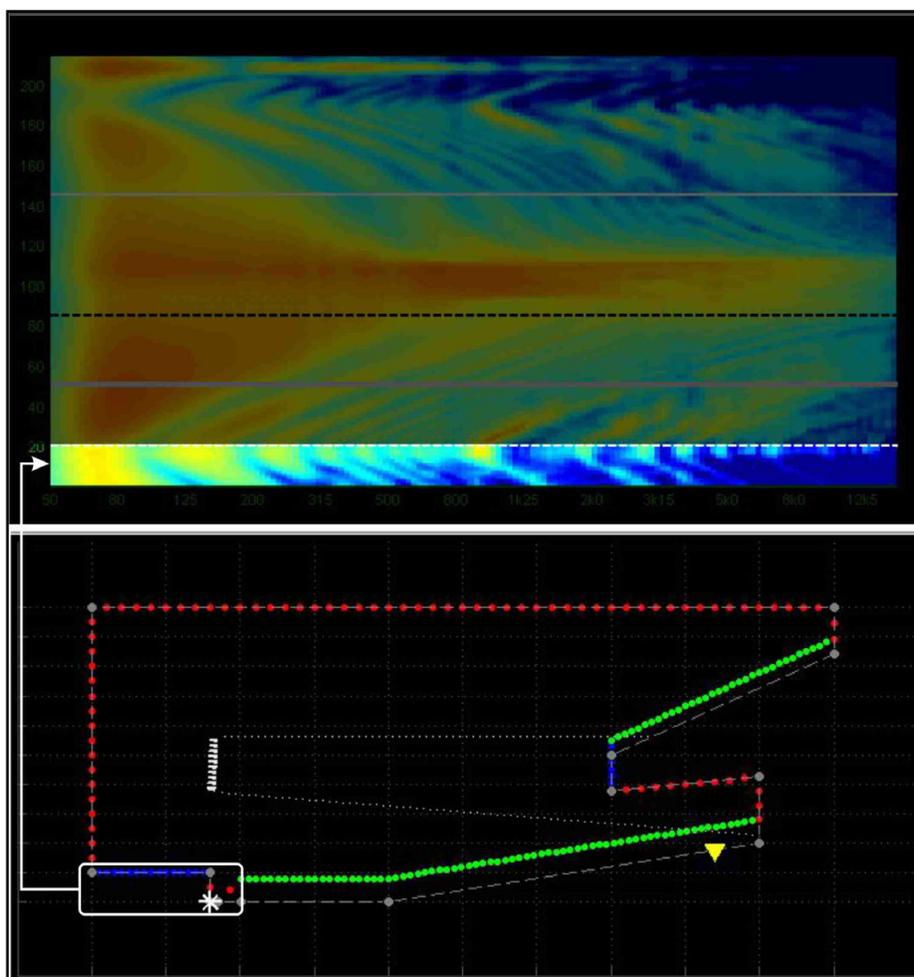
The colours represent the three types of plane; the audience area are green, non-audience, areas around the venue which we are not concerned about are red, and finally areas where we would like the system to actively steer sound away from known as hard avoid are blue. By default the hard avoid is the stage but this could also be reflective back walls or balcony fronts, or noise sensitive areas beyond an arena at an outdoor event. The planes are represented by a series of dots. These are spaced closer together in the audience region where we need the most detail. Ideally we would like to be able to view the frequency response at each of these dots so each becomes a sort of virtual measurement mic.

The normal way to present a graph of frequency response is of course for the horizontal 'x' axis to be frequency, usually from 20Hz to 20KHz, and for the vertical 'y' axis to display magnitude, usually in dB. If however we display magnitude with colours we can easily show many response plots simultaneously. If we make red the highest magnitude- the loudest- and blue the quietest, by running through the colours in the spectrum we can very easily identify the peaks and troughs in a response. This frees up the vertical axis which we can use for all of our "virtual mics";-

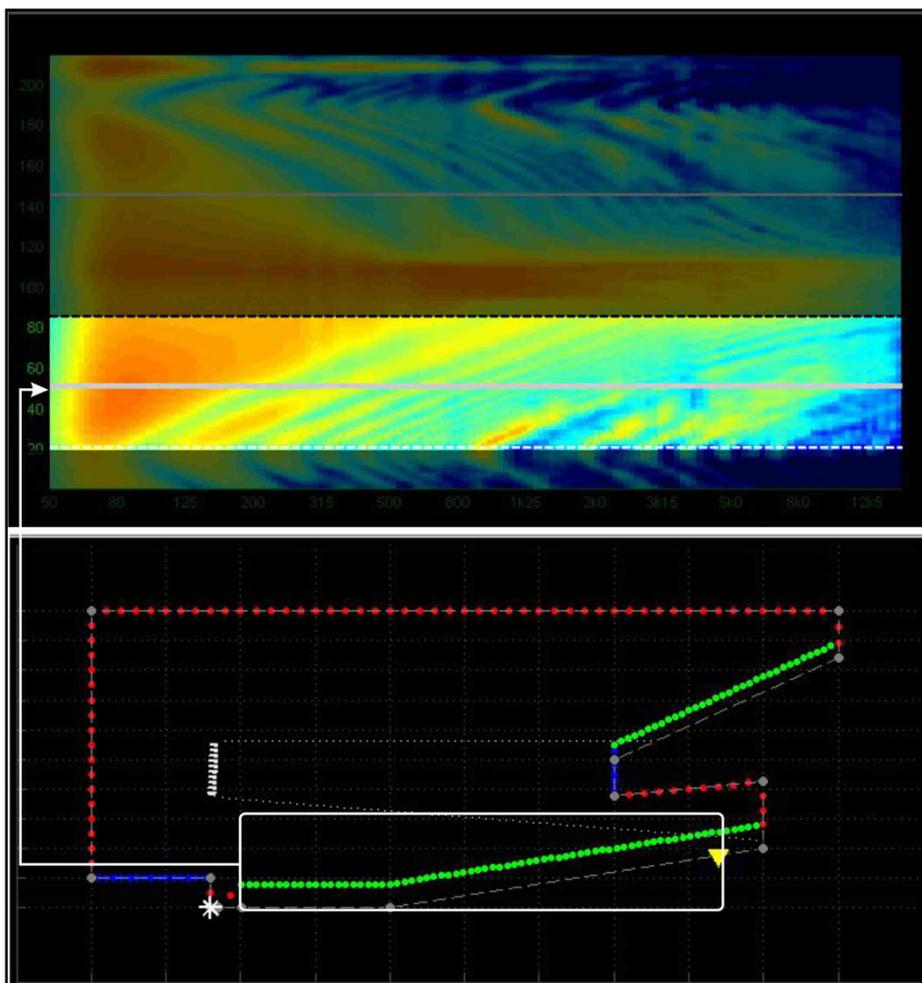


This is the Index plot of a completely un-optimised system. The horizontal axis as mentioned is frequency. As we cannot optimise very low frequencies the graph starts at 50Hz going all the way up to 20KHz. The vertical axis is now the 2D slice of the venue

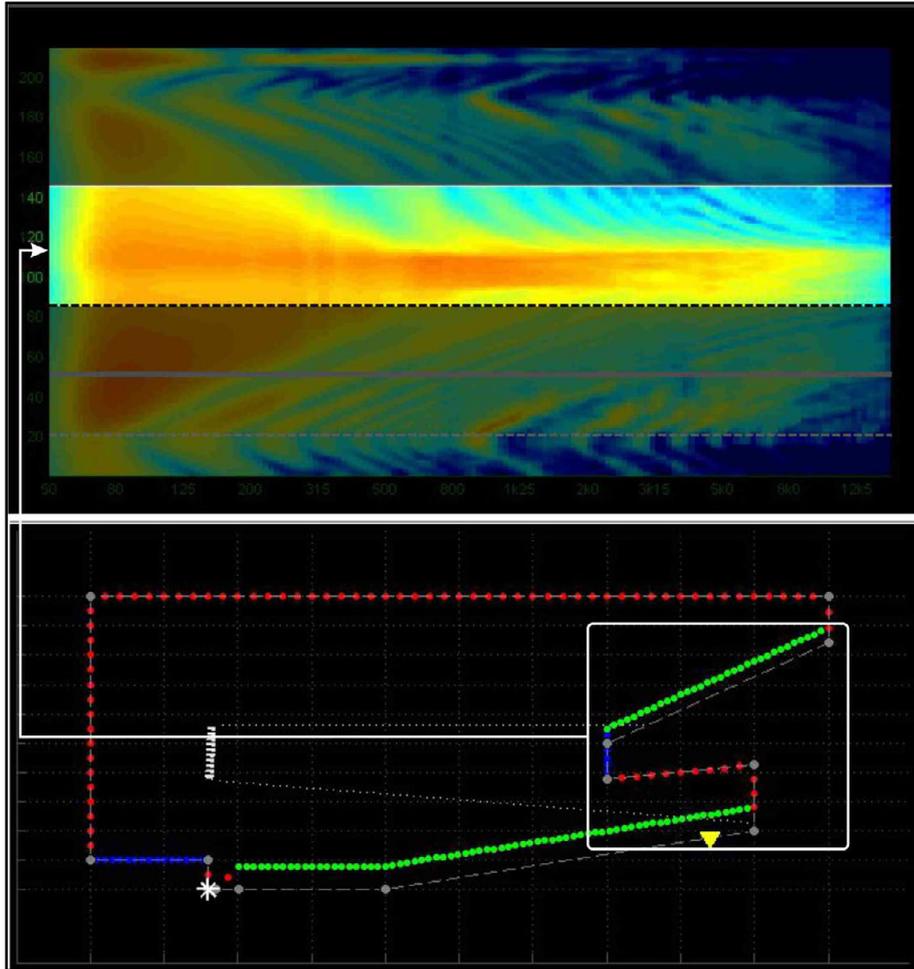
“unravalled”. At the bottom is the starting point for our 2D slice at the back of the stage then move vertically upward and at point 20 we see a dashed white line which represents the audience start point that we identify on our venue slice. We continue upwards moving back through the audience, the thick grey line is where we have placed our cursor which gives us the facility to obtain a standard frequency response graph. Continuing up the axis going further back in the venue we find a dashed black line which is a reference point which we also determine. The solid white line is where the audience coverage finishes. Just above this is the back wall and then up to the number 200 is the venue ceiling and the last section of the graph is the back of the venue behind the array;-



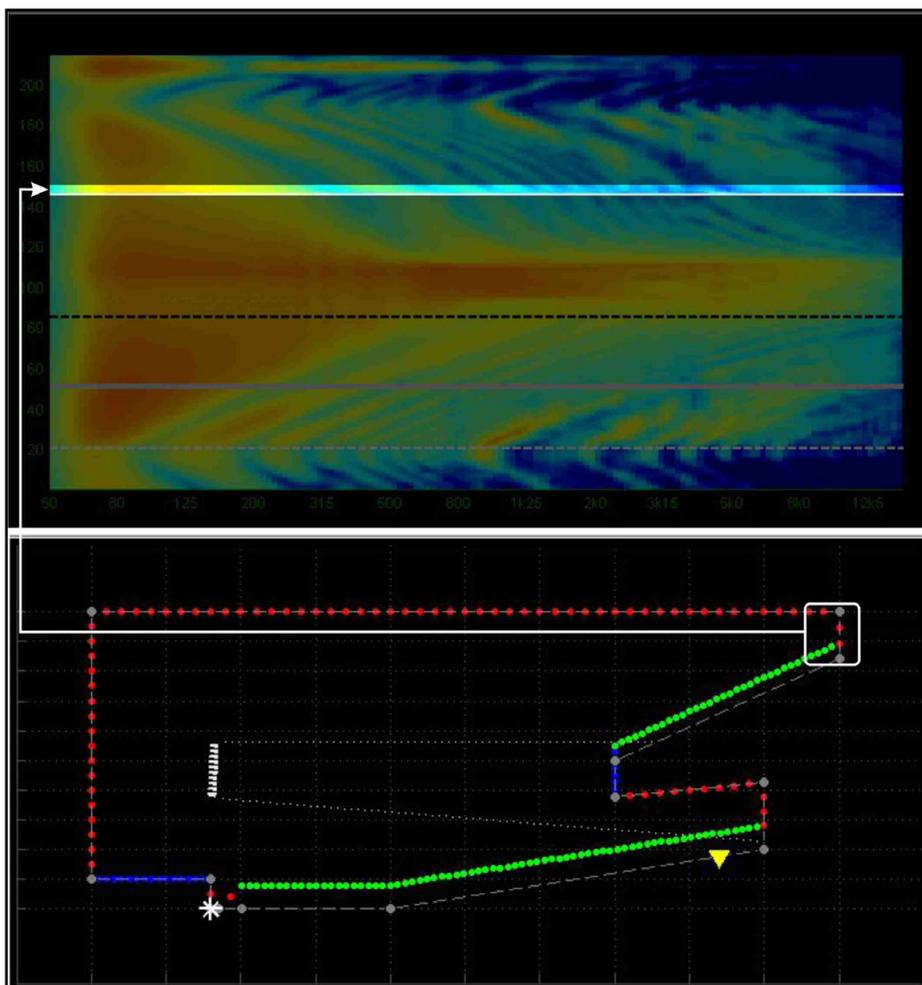
This shows the bottom portion of the index plot corresponds to the stage and “pit” leading up to the start of the audience coverage.



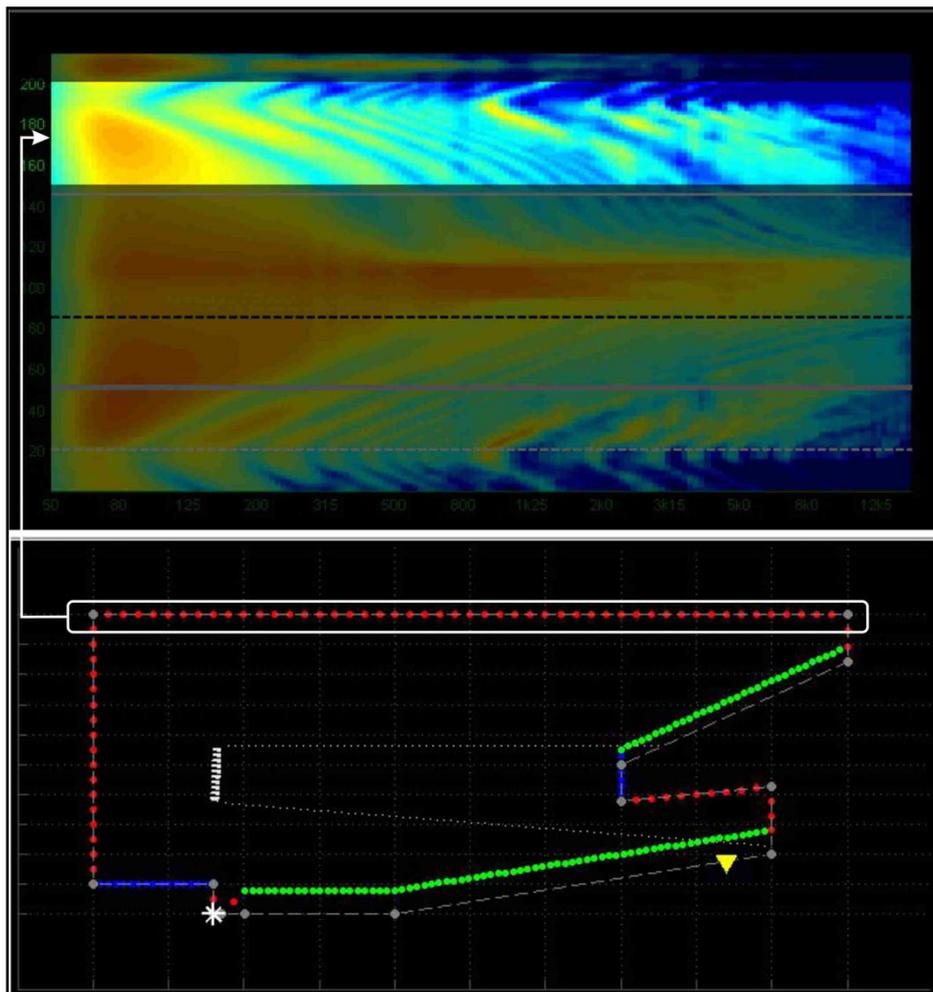
This section of the index plot corresponds to the first portion of the audience plane up to the reference point.



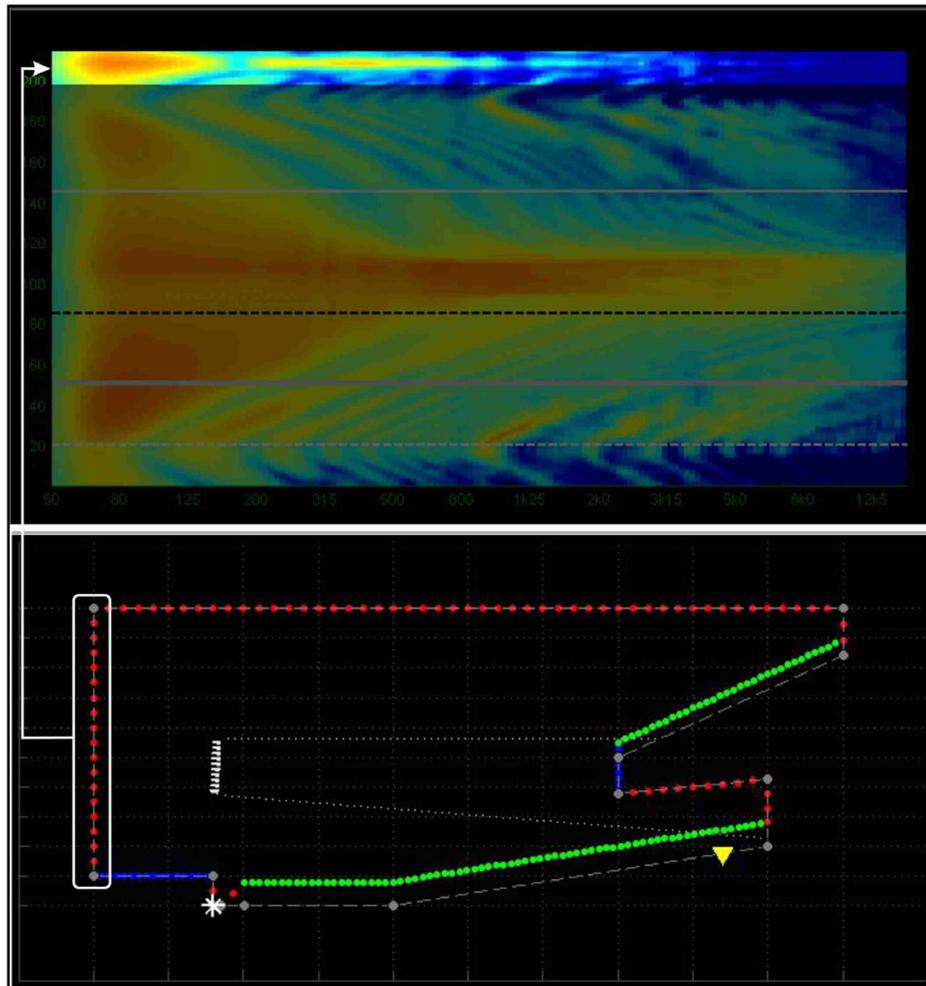
This is the section from the reference point to the back of the audience area. The strong band of red indicated the front of the balcony which is getting a great deal of direct sound prior to optimising the system.



This is the narrow section corresponding to the rear wall.

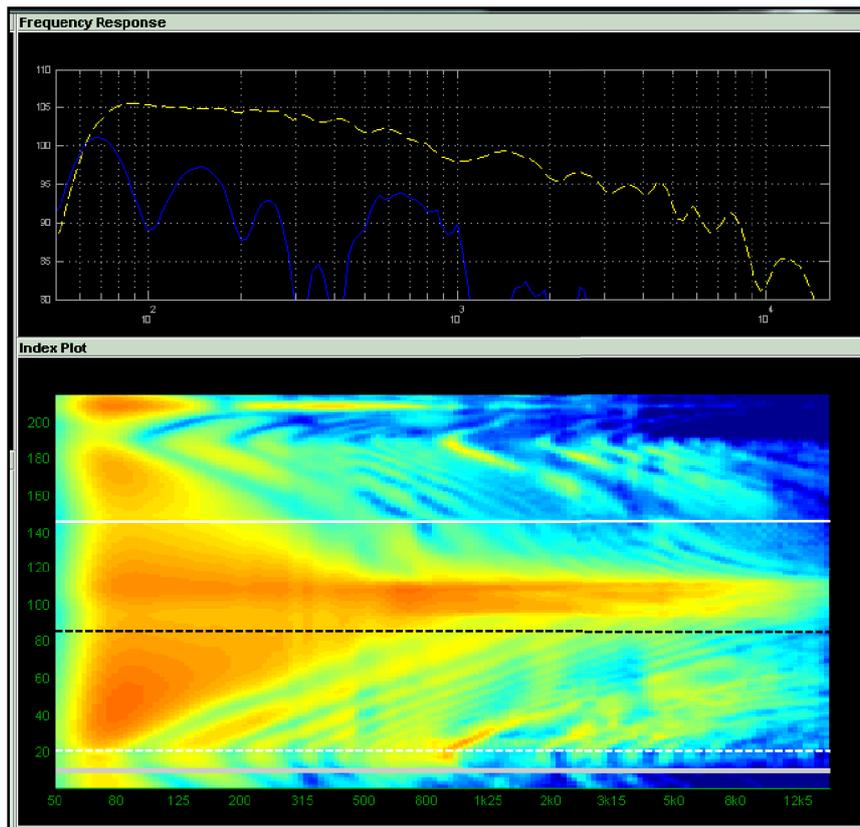


This is the response on the ceiling



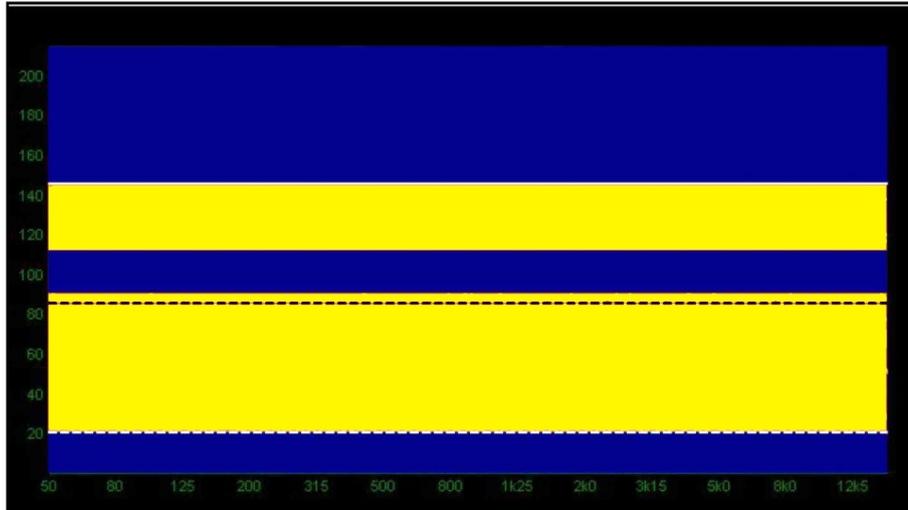
And finally the rear wall.

We can also take a look at the actual frequency response on a conventional graph at any specific point on the plot to better understand what we are looking at. Just to re-emphasise, these plots are prior to any system optimisation; they show the response of an array flown with all angles at 0.5°!

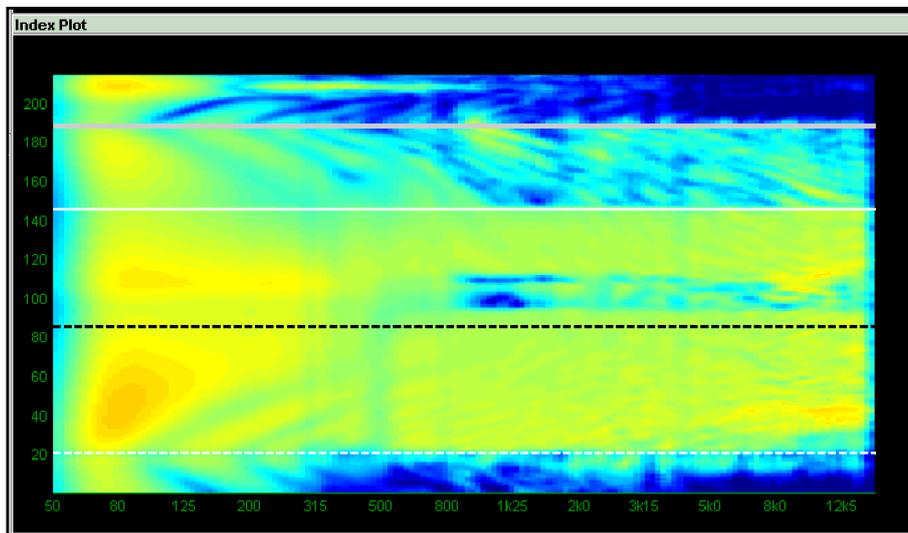


The plot at the bottom now has the thick solid white line at the bottom indicating that the cursor is over the stage area. The frequency response graph at the top shows two traces. The dashed yellow line is the response at the reference position indicated by the dashed black line on the index plot. The blue response is on stage where our cursor position has been placed. It is easy to see from these how the colours respond to the peaks and troughs on the graph. The on stage response for example has little or no high frequency, it is not even registering anything above around 2.5KHz, on the index plot it is an even band of blue in this region. The response at the reference position is reasonably flat in the low frequencies, gradually tapering off as the frequencies increase. On the index plot we see a block of orange which gradually fades through yellow, green and indigo to blue at the highest frequencies.

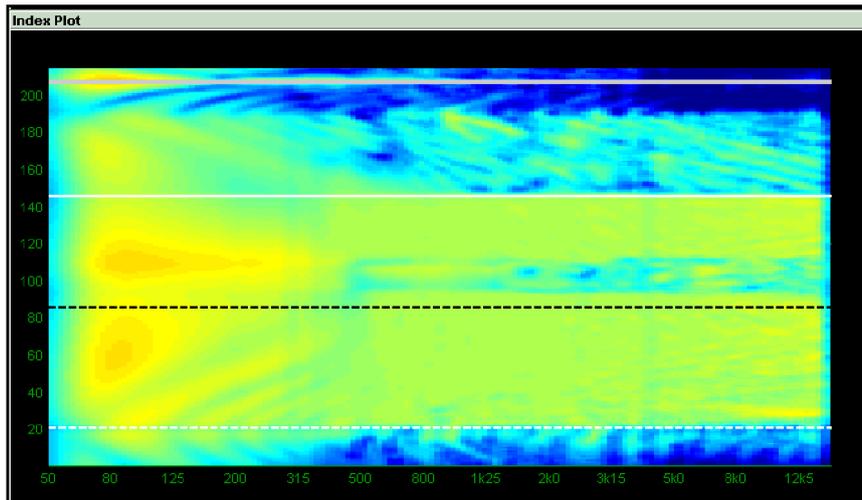
We can now look at an optimised system, this is what a perfect system would look like if it wasn't for little inconveniences such as the laws of physics, the impossible dream of perfect coverage at all frequencies for the entire audience with no spill whatsoever anywhere else;-



Here we have a real world optimisation with a 10 box system;-



And to demonstrate how close the system can get to the perfect coverage, here is the same venue with an array consisting of 16 MLA plus 1 MLD optimised to obtain a front to back differential of 0dB- exactly the same spl everywhere. The audience target has been given maximum priority ignoring non-audience and hard avoid areas;-



As you can see the vast bulk of the audience region is a consistent green with a band of blue indicating the underneath and front of the balcony. Quite a respectable result.

Note that using the hard avoid feature whilst extremely useful does have some limitations, whilst superb at rejecting sound behind the array on stage, if used for a balcony front for example it relies on the array being physically positioned exactly as it is depicted in the software to a fraction of a degree, not easy to achieve with standard electric hoists, plus if the array is not directly in front of the balcony the hard avoid region which will form an arc from the array, may miss the balcony at the extremes of the horizontal coverage giving some members of the audience a very poor experience.

## Application menu

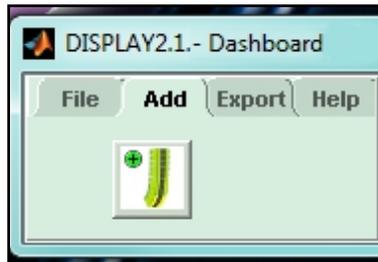
When Display 2.1 is first launched, the Dashboard below is shown. This remains visible at all stages of the project design and as will be seen, tabs will appear in a logical order to prompt you to enter the required data at each stage of the design process.



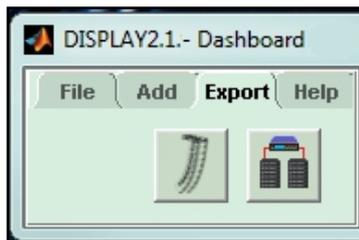
As you can see, the application prompts you to enter the details of your array as the first step however it is worth taking a look at the options available under each menu item first.



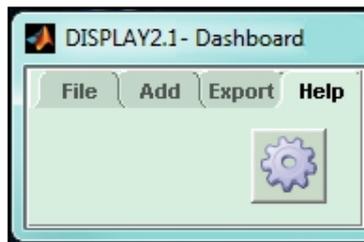
The file menu offers three options; first you can load an existing project to continue working on something you have already created. Next you can save the current project and finally you can start a new project. Note that until you have actually started on a project and saved it, the 'create new project' option will have no effect.



The Add menu prompts you to add the details of your Multicellular array.



The Export menu is where the finished optimisation(s) and 3D models are uploaded to a file. This is the final stage of the design process and we will look at this process later in this guide.



The Help menu brings up a set of options for the project which can be selected to suit the design you are working on



### Getting Started

The Options in the Help menu are a good place to start to ensure that the design process is tailored to how you would like to work for a given project. Clicking on the icon in the help menu brings up this window, the options selected are the defaults for all new Display 2.1 installations;-



**General** The General section allows you to select metric or imperial measurements.

Equal scale refers to the x and y scales for the 2D slice drawing required of the venue. For a venue with say a very long x axis and very little height, it may be easier to depict the layout with unequal scales.

**SPL View** The SPL View allows selection of the Decibel per division on the optimisation of either 5 or 10.

Show extreme will display the response at the extremes of the audience coverage regions.

"Num Aud Plots" dictates the number of Audience plots to show if the Multi-plot option has been enabled.

**Slice** The Slice option allows you to turn off the display of the coordinate number for each node on the drawing. This might be useful for a very complex drawing where the numbers would clutter the view but for the vast majority of projects this should be left on.

**Splay** Auto Use Splay will instantly apply to optimised angles to the array model. With this disabled you can review the array shape before applying the angles to the project. In most cases this can be left enabled.

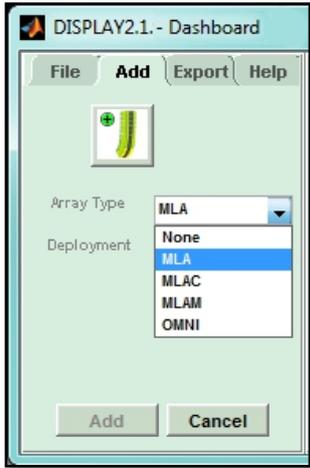
**EQ Tool** The EQ tool can be selected to display the percentage achievement that the optimisation has produced related to the goals that you have set. With this disabled it will display raw figures for equalisation.

Auto use EEQ acts in the same way as the auto function for optimised splay angles, it will instantly apply them to the project as soon as the optimisation is complete. If you wish to review the optimisation before applying the filters you can leave this disabled and an additional 'Apply' button will appear when the optimisation is complete.

**Export** The Export option ensures that the exported filename matches the array name making it easier to identify which optimisation corresponds to a given Display optimisation when uploading to the system via Vu-Net.

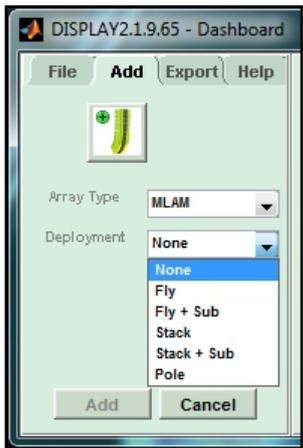
### Add an Array

Once you have selected the preferences that you wish to use, the first step is to add an array. Go to the 'Add' tab and click on the array icon. The following window will appear:-

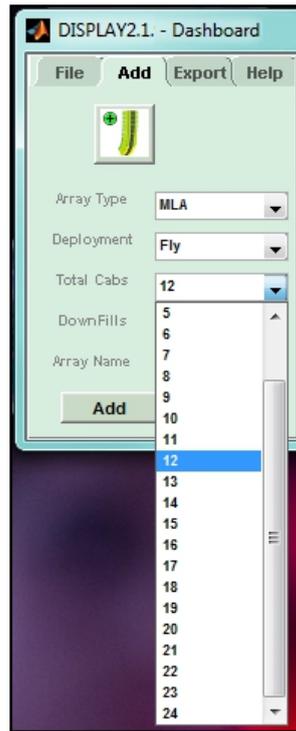


In the first drop-down you must select the type of array, either 'None' MLA, MLAC (MLA Compact) or 'MLAM' meaning MLA Mini. Select MLA Mini, "None" has very limited use (perhaps for silent discos?).

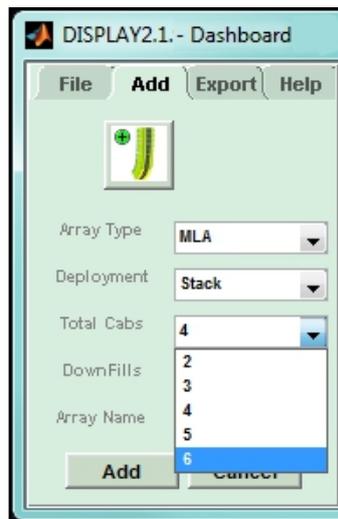
Next you need to select your method of deployment which will in turn determine a number of other factors in how the design process operates. The options for MLA and MLA Compact are flown or stack and for MLA Mini, flown with sub, ground stacked, ground stacked on sub and pole mount;-



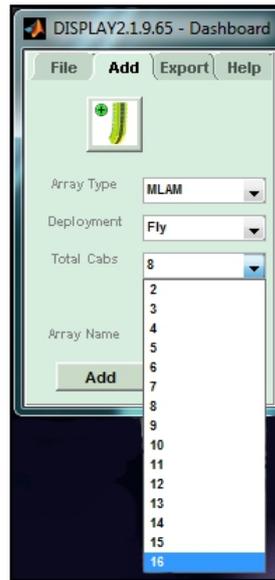
Next you need to select the total number of cabs. The options change according to the maximum number for each type of deployment. For MLA and MLA Compact you can fly up to 24 cabinets;-



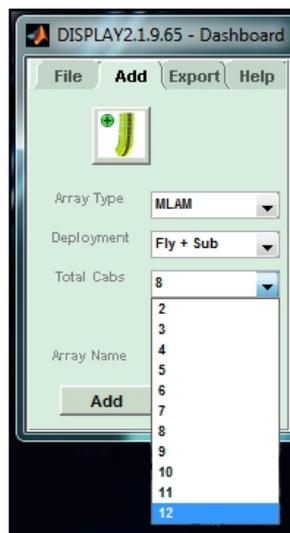
And ground stack up to six;-



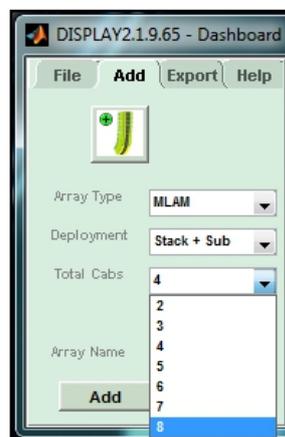
For MLA Mini there are more variations, for a flown system with the MSX ground stacked or rack mount amplifier modules you can fly from 2 to 16 in increments of one cabinet;-



When flying with subs the maximum is 12 MLA Mini;-

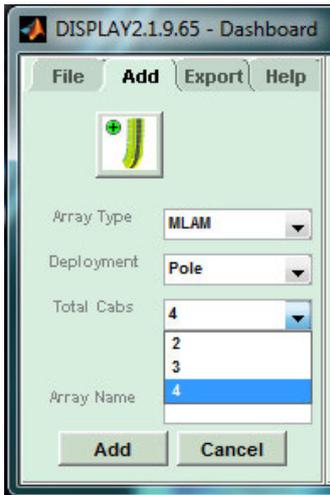


For ground stacked systems either on the floor or on top of the MSX, the maximum is 8 cabinets;-





And finally for a pole mount system the maximum is 4 cabinets;-



Note that it is essential that the array design in Display 2.1 matches the physical array being used. The optimisation files that Display creates can only be uploaded to an array that exactly matches the file. The option to create arrays that are not multiples of four is to future proof the system for developments in system hardware that may allow powering of arrays that are any number from two to sixteen

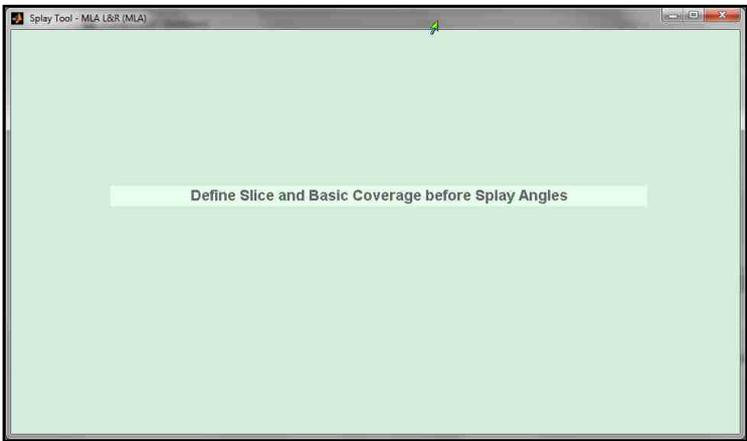
Finally you need to give the array a name. This is important as the D2P file created with the optimisation for that array will have the name that you assign at this point. If you wish to try several optimisations one method is to duplicate the design adding another array and entering the same venue and array properties but to give the array a different name that is appropriate to the optimisation that you are attempting.

Once you have entered the array details the dashboard will change, the array details section will turn green and the design process tabs will appear;-



You will notice on the right hand side the 'Rename' box. This gives you the opportunity to rename your array. Simply click in the box, type in the new name and press return. The Rename box will briefly turn green and the array name will change on the tab.

Next try clicking on any of the icons other than the 'Slice'. You will find that a window appears as shown;-



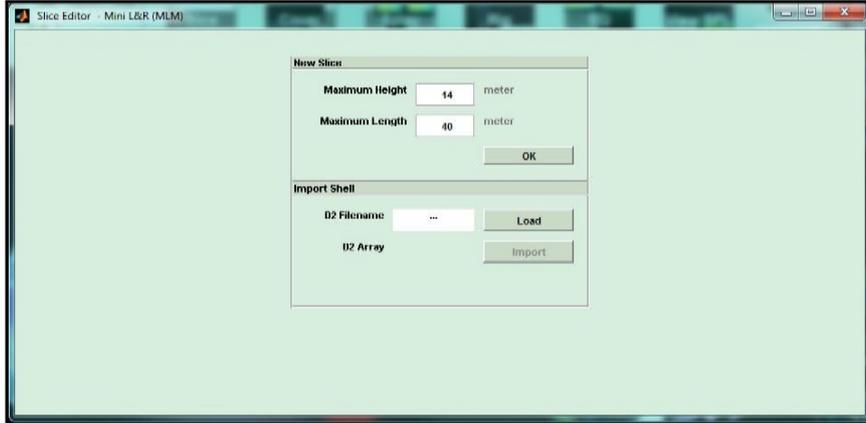
This window will appear if you attempt to access any of the process icons out of sequence, meaning before the preceding process has been completed. This feature forces you to complete the project design process in the correct, logical order. Once you have completed each section you are then able to go back and access any of the completed parts of the design.

## Slice Tab

### Slice Setup

The first stage is to draw a 2D slice of the venue. For most cases with a conventional stereo pair of arrays this can be a slice down the centre of the venue and many venue architects plans will include a suitable side view.

Clicking on the 2D Slice icon will initially bring up a window prompting you to enter the basic length and height of the venue. This only needs to be approximate; enter a figure larger than the biggest dimension (but it's not a problem if you don't know the dimensions at this stage and the initial figures are too small).

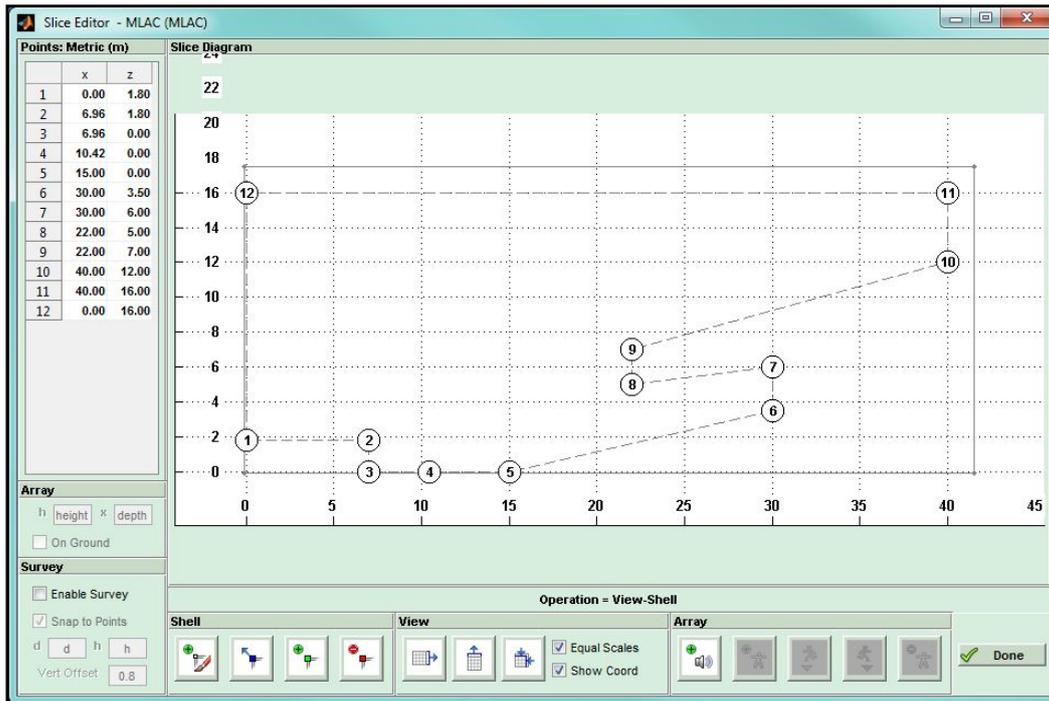


The other option is to import a Shell from an existing D2 file, this is extremely useful when creating designs for venues in which you have already deployed a multicellular system and still have the designs. It is also very useful when you wish to try several optimisations in a project as we will see later.

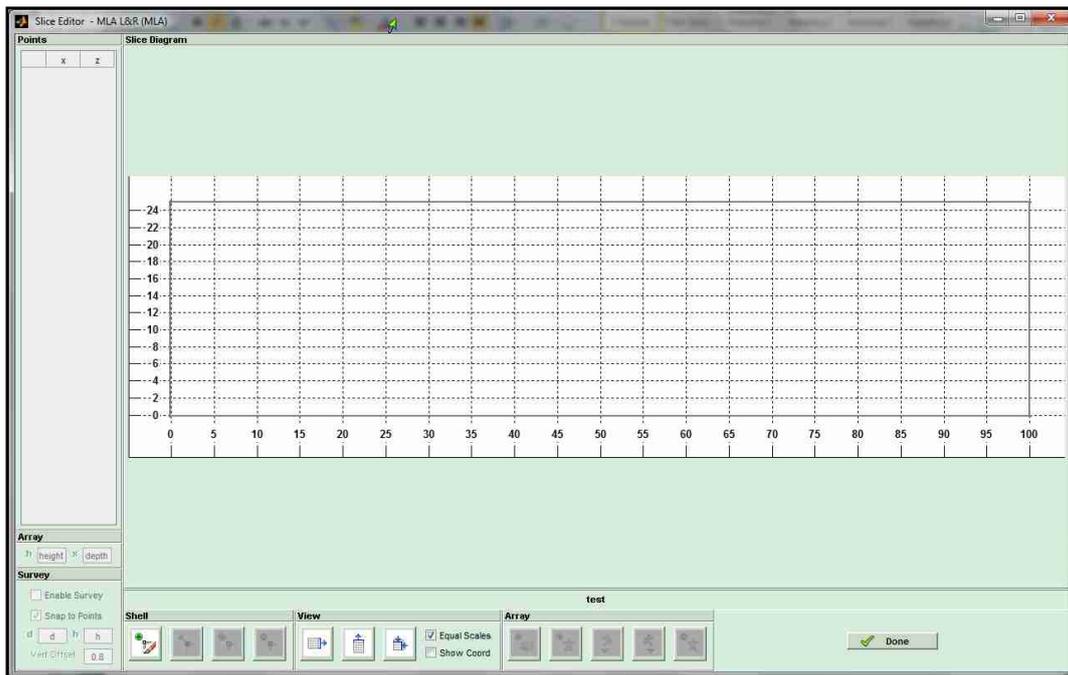
To load a Shell simply click on the 'Load' button, navigate to the file containing the shell you wish to use and click on it. The filename will appear in the D2 Filename box. A drop-down box will appear next to the 'D2 Array' which will contain a list of all the arrays in the project you have selected. Choose the one which has the shell you wish to use. Note that only the shell data is imported, the array and other optimisation parameters are ignored;-



Click import and the Slice Editor window appears with the shell already drawn;



However, if we assume that we have to draw a shell from scratch, ignore the 'Import Shell' section, enter very approximate maximum dimensions for the length and height of the venue and click OK, the 2D Slice window will appear;-

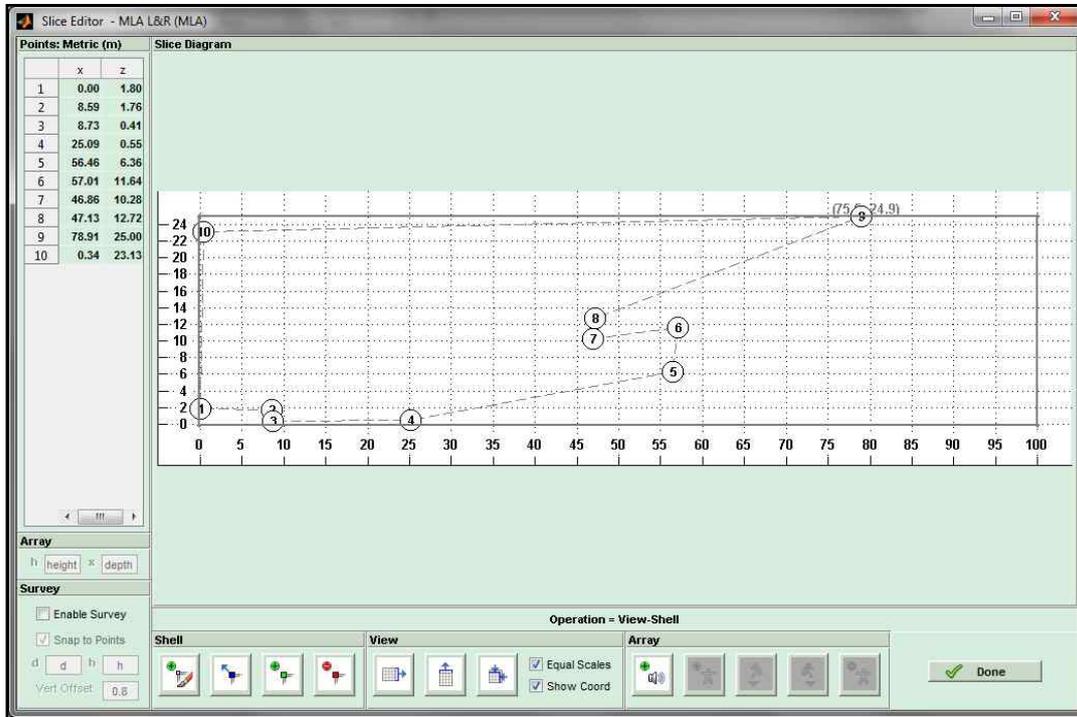


**Draw a Shell**

Note that the window opens as a floating window and can be enlarged or maximised as any standard Windows application, this is obviously worth doing if you are working on a notebook PC or Tablet PC. As you can see, most of the controls are greyed out and remain so until you have drawn the venue slice. To do this click on the Shell icon and move your mouse over to the drawing grid. A starting node - added at the zero point on the x axis but at 1.8 metres on the y axis to represent the back of a stage that is 1.8 metres high (this can be edited once you have completed the drawing). Next move the mouse in an ***anticlockwise direction*** moving the mouse to the approximate position of each node and click to add the node. You MUST draw the shell anticlockwise,

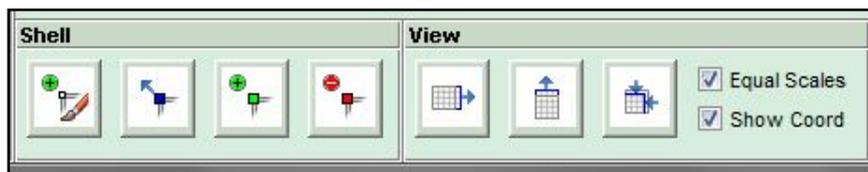
the optimisation will be completely wrong if the venue is drawn clockwise. When you arrive at the final node double click which will complete the drawing.

Note that you do not need to spend time or effort positioning the nodes in exactly the right position as it is extremely quick and easy to edit the precise node coordinates to match your measurements.



You will now see that a number of additional buttons are active and these can be used to perfect the venue drawing.

**Edit the shell**



The first button is the shell entry that you have already used. If you have completely messed up the venue drawing you can click on this and start again, the initial drawing will be completely replaced.

The next button enables you to move any of the nodes. Click on the button and move your cursor over to the drawing. You will find that the cursor changes to a cross over the drawing area and when you hover over one of the nodes the circle around the node number will turn green. Click on the node that you need to move and drag and drop it to its new position.

The next button gives you the opportunity to add nodes if you missed any out in your initial pass. Click on the button and move your cursor over the drawing, as you move over the dashed lines between nodes you will see a small green circle appear. When you have the circle in the desired position single-click and a new node is added and the numbering shifts to accommodate the new node. If necessary you can use the move node button to reposition the new node however there is a much quicker way to precisely position the nodes as we will mention shortly.

If it's not entirely obvious the red  $\ominus$  button is for removing unwanted nodes than can easily appear if you accidentally clicked whilst drawing the slice. As with the 'move' button, click on the Delete button then move your cursor over the offending node and left click to consign it to history.

The View buttons help to maximise the drawing, to either the width of the slice, the height, or to fit the drawing into the extents of the available window. There are also two check boxes, the first by default makes the horizontal and vertical scales equal so you get a good proportional view of the venue shape hover if you have a situation where this makes it difficult to place the array for example a very long venue with a low ceiling, uncheck this box and the vertical and horizontal scales will maximise to the



window to allow the maximum detail to be visible. Finally you can uncheck the Show Coordinates button which removes the numbering from all nodes.

As mentioned, there is no need whatsoever to enter the nodes accurately when first drawing the slice, it is time consuming, particularly on a small screen, and inaccurate. Instead, you can edit all points shown on the top left list of nodes;-

Points: Metric (m)		
	x	z
1	0.00	1.80
2	6.96	1.75
3	6.87	0.24
4	10.42	0.33
5	18.77	0.15
6	43.29	3.88
7	43.12	9.21
8	31.48	7.35
9	31.21	9.92
10	48.62	16.85
11	48.62	21.56
12	0.92	21.38

Click on the x coordinate for node 1, in most cases this is likely to be 0.00 but if not type the correct value and hit the Tab key. The z coordinate for the node 1 is highlighted and you can type the correct value. Tab again and the x figure for node 2 is highlighted and so on. You will get very quick at tabbing through all the coordinates entering the correct values to give you a perfectly accurate 2D slice drawing. This obviously is a far quicker method of working.

**Using Survey**

The process of drawing a shell as described above is fine particularly if you have architects drawings of a venue and are able to create a Display 2.1 project in advance of arriving on site, but in a touring situation this luxury is rarely available and therefore you may need to measure the venue when you get to site. The best method is to use a laser measure such as the Leica Disto D510 which is supplied as part of full MLA and MLA Compact systems and is available from Martin Audio as an optional accessory. The Distos have been in widespread use for accurately measuring venues for line array software so most technicians are familiar with their operation and accuracy. The D510 is one of the most advanced models and has a host of functions to make getting an accurate interpretation of the venue as quick and easy as possible.

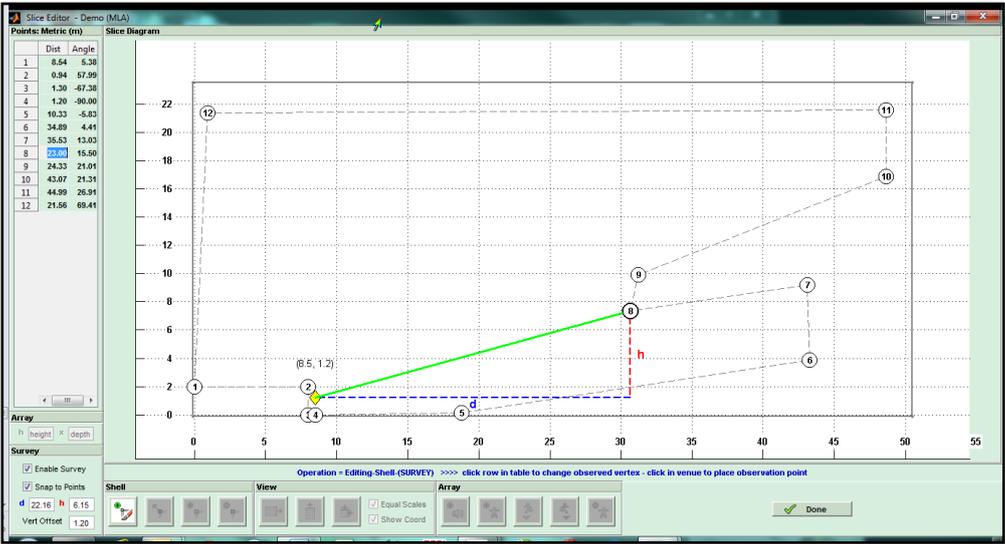
Display 2.1 Mini allows entry of points using a Survey method instead of entering points as distances on the x and y axis which may be impossible or at least very difficult to measure on site. Survey allows you to enter the distance to a specific point and the angle from where you are taking the measurement. This means that you can stand say directly under where the array points are and measure from there to all of the nodes in the venue taking note of the distance and angle which the Disto can display by selecting the angle display option. (See the guide supplied with the D510 for more details).

To enter the measurements you first need to enter an approximate 2D slice with the correct number of nodes as described above. Now click in the Enable Survey check box. By default leave the Snap to Points box checked. You will notice that the points list has now changed to Distance and Angle for each node;-

Points: Metric (m)		
	Dist	Angle
1	10.45	3.68
2	3.52	10.17
3	3.66	-14.04
4	0.80	-90.00
5	8.41	-6.68
6	32.98	4.79
7	33.68	13.89
8	21.95	16.45
9	22.57	22.93
10	41.31	22.37
11	43.32	28.14
12	22.37	64.86

You now need to enter the vertical offset from which you are taking your measurements, a tripod is strongly recommended to keep things accurate, the only other way to keep a constant accurate figure is to measure from the floor in which case enter zero for your vertical offset but sitting around on cold venue floors is an over-rated pastime so invest in a reasonable tripod and the job becomes far more civilised. Measure from the ground to the tripod height you have set up and enter this figure into the Vertical Offset box. Now click on whichever point you intend to take your measurements from, you will see the measurement point selected shown as a yellow diamond. Having checked the Snap to Points box you can select any position on the slice and drag along it but when you get close to the nodes the measurement diamond will jump directly onto the node, without it you can select any point along the venue without the snap action close to the nodes.

Now click on one of the positions on the list of points top left that you wish to enter the dimensions, in the following picture, the stage is 2 metres high and 8 metres deep with the flying points 0.5 metres off stage. All points were entered very quickly and using the method described above, the first 4 nodes were corrected. Enable Survey was then selected and the array flying point node 4 was selected. We want to measure to node 8 at the bottom of the front of the balcony so we click on the distance figure for that node:-



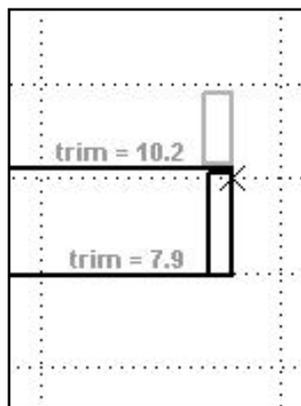
You can now enter the distance figure that the Disto has measure from that point to the bottom of the balcony, hit Tab and enter the angle. You will see the drawing adjust to your figures and in the Survey box you will see the distance and height coordinates from your measurement position to what you are measuring calculated from the diagonal distance and angle you have entered. If desired you can enter figures into these boxes if you do not have the facility to measure angles. This makes it more convenient than measuring from the back of the stage if that area is crowded with lighting techs or backline crew etc. As before you can quickly tab between node figures to enter all of the measurements first typing the Distance figure followed by the angle. Once you have finished entering all figures you can un-check Enable Survey to return to standard mode and you will be able to add the array. Once your drawing is perfectly accurate, click on the Fit drawing to Extents button to maximise it in your window.

### Position the Array

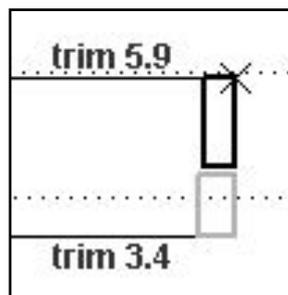
Now click on the array button and move your cursor into the drawing window. You will see a rough rectangular representation of the array showing the x coordinates and the top and bottom trim heights. Once again, there is no need to worry about being 100% accurate when placing the array, put it in an approximate position and left click to drop it in place. If for any reason you want to start again just click on the array button again and have another go. Once positioned you will see over on the left the array position coordinates.



This is where you can accurately correct the position of the array. Note that the height figure is to the centre of the upper flying pin on the top cabinet in the array, what is shown in the *slice* drawing is the figure for the trim height to the **top of the flying hardware** and the lower trim from the lowest point on the array, so effectively the maximum and minimum rigging positions. The 'On Ground' option is available for any array that has been specified as a ground stack. This will ignore the figure for the height and lock the array to the lowest point on the slice according to where the x position is specified. If for example the stage is 5 metres deep and the x figure is 3m the array will be positioned on stage, if the x position were 6m the array would be on the floor. For MLA Mini systems a grey box will appear above the array if flown with sub has been selected;-



Or below the array if stack with sub has been selected;-



It shows the space occupied by the MSX subs. The size of the rectangle expands depending on how many MSX may possibly be above the MLA Mini, one for four Mini, two for eight Mini and so on. The rigging tab allows accurate calculations when this mode is selected as we will see.

### Add the Audience Region

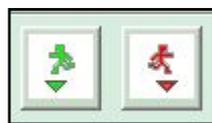
Now you need to determine the audience area that we need to cover. Click on the Add Audience button;-



Then hover over the slice drawing. You will see a green inverted triangle moving left and right along the slice outline corresponding to the left and right movement of your cursor. Position the triangle where the audience position starts and click once. Now move the cursor to the right tracing the slice along the audience area and you will see a green line following your movement with a red inverted triangle at the end of the line. When the red triangle is over the furthest point of the audience region click again and the audience area is defined. Don't worry at this point that it includes underneath and on the front of balconies et cetera that is corrected at the next stage.

### Editing the Audience Region

If you didn't get either the start or finish points correct it is easy to adjust them by using the Move Coverage Marker buttons, either the green one for the start position or the red one for the stop position.



Just click on either of the buttons and move the cursor to the correct position, the triangle marker will move for whichever point you are adjusting without disturbing the other. When you have the point in the correct new position click again to finalise it.

You can also delete the audience region entirely but clicking on the 'Add Audience' button again automatically deletes what you have already entered allowing you to start again, or click on the Delete Audience button which removes the audience region you have drawn but you have the option to re-draw a new region at a later time.

Assuming you have drawn an accurate representation of the venue (and remember that the more accurate the D2 project, the better the audible results), you have now finished entering the venue slice and can click on 'Done' to close the window.



## Coverage Tab

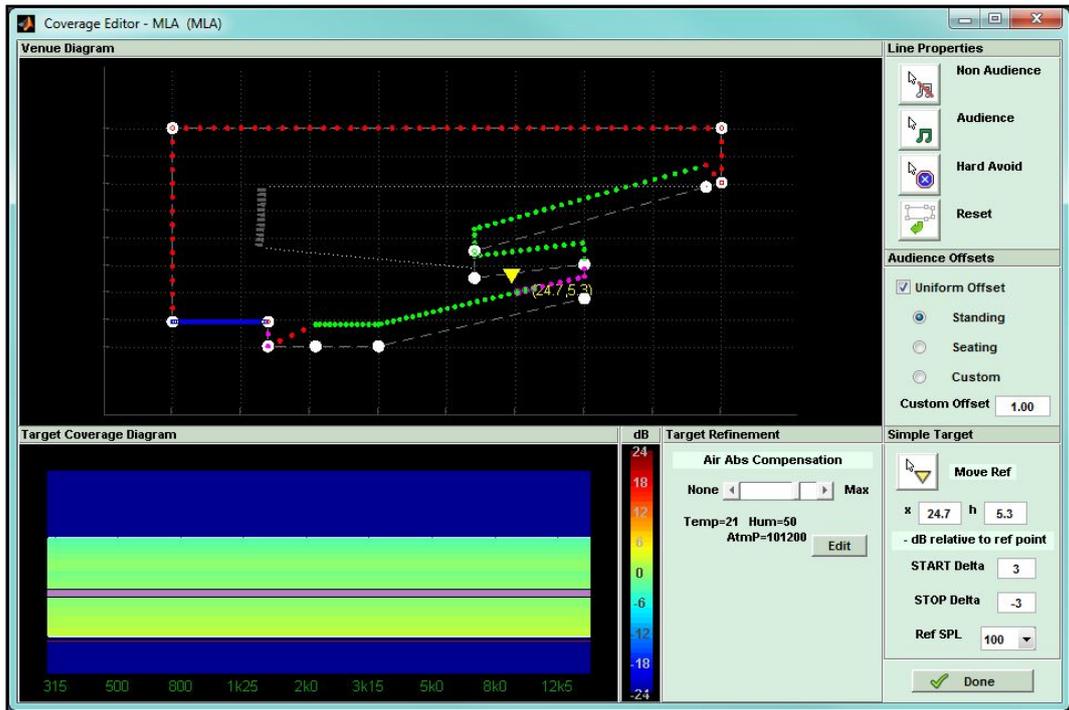
The next step is to precisely define the coverage but as with any application it is very good practice to save your project as you go along. Click on File on the Dashboard if it is not visible and click on the Save icon. Choose a suitable file location, you might wish to create a dedicated folder for a given show to hold all files in one place, then name the file and click save.

Having completed the venue slice, the Coverage (“Cover”) tab will now be active. A single mouse click will open the Coverage Editor window.

### Defining venue planes

As with the Slice Editor, the Coverage Editor will open as a floating window, this is definitely worth maximising as you may need to work on quite small sections and there is no zoom function in the current version (it is on the wish list for a future version)

You will see the venue that you have previously drawn looking as shown;-



Each node entered in your Venue slice is shown as a white circle with each plane now allocated a colour between the nodes. There are three types of plane, Audience which is shown green, non audience which is red and hard avoid which is blue. The system by default makes the stage hard avoid, the coverage planes from where specified in the venue slice start to finish will be audience and all other planes non-audience. The first step is to edit these to reflect exactly how you need the system to react to the venue.

In the example above, the audience area includes the stalls, the wall at the back of the stalls, under the balcony, the front of the balcony and the balcony itself. Clearly this is not correct and we need to change some of these planes.

At this stage we have to make a decision on where our priorities lie. There is a temptation to make all areas other than the genuine audience planes hard avoid to try and make the system reduce spill onto anywhere other than the audience, however we have to be realistic about what can be achieved. Whilst we have a tremendous amount of processing power available, we cannot change the laws of physics so there is a limit to just how much we can get the system to do. We are more likely to get good results if we are sensible with how much demand we put on the DSP. In the example we have shown, we are obviously not going to get any direct sound arriving under the balcony, it is essentially in “shadow” so there is little point in making this area hard avoid, likewise it clearly shouldn’t be defined as audience or the system will waste DSP attempting coverage over an area it cannot reach so it should definitely be non audience. With a little experience you will learn what works well and what not to attempt. In our example I would keep the stage as hard avoid, perhaps also have a hard avoid on the balcony front which could give problems with a slap-back echo on stage and make all other areas non audience. The default setting usually has the stage hard avoid also including the stage front and the “pit” between the stage and audience start as hard avoid. This is not only

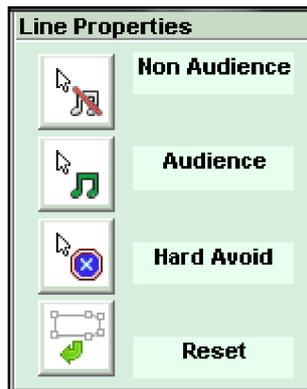


unnecessary but trying to get the DSP to get the signal from hard avoid immediately to audience is expecting far too much, it is much more realistic to keep the stage floor as hard avoid and the front of the stage and pit non audience.

You will also notice a pink area at the back of the stalls in our example. This indicates any part of the venue plane that is not in line of site of the array, essentially in "shadow". In many venues, particularly theatre style rooms with one or more balcony, this is very common and additional balcony fills may need to be deployed. You can of course close the Cover tab and return to the Slice tab to try alternative array positions to try and minimise any such shaded areas if audience areas are affected. In our example it is only under the balcony and on the rear wall at the back of the stalls that are not in line of site and so there is no need for any remedial action.

### Changing Plane Properties

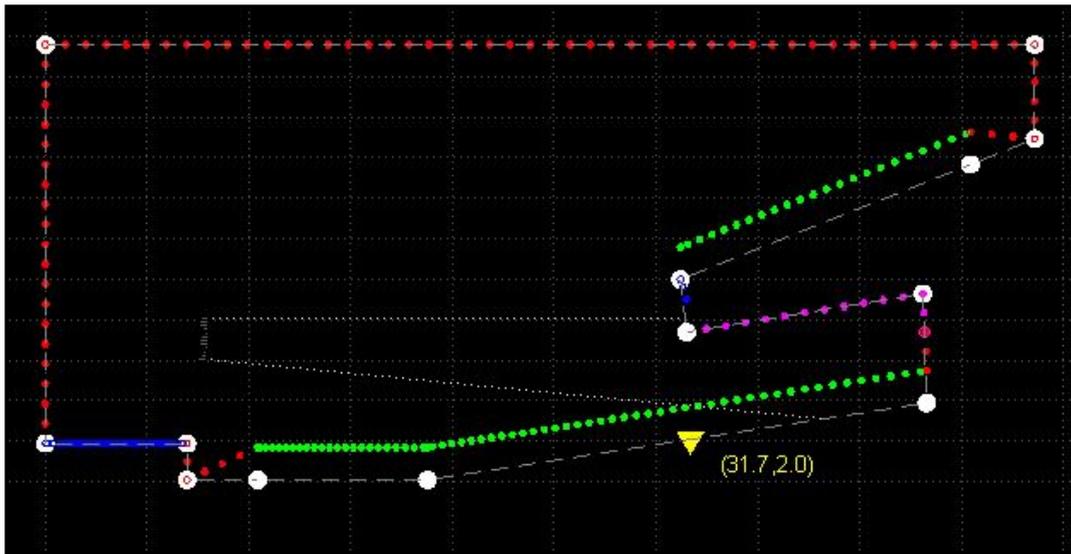
On the right hand side of the window is the section for adjusting the plane line properties;-



Each plane between nodes needs to be adjusted individually, to do this, click on the required plane property first, and then select the line you wish to change. For example, on our example, we want to make the balcony from hard avoid and under the balcony non audience. As it's the top button, let's do the non audience first. Click on the Non audience button and then hover over the planes, as you hover over each line you will see the faint dashed lines turn a bright white, thick dashed line. When you are over the plane you need to change, under the balcony in this case, a single mouse click changes the plane colour to red. Now we can do the same for the balcony front, click the Hard Avoid button and then select the small vertical balcony front which will change to blue to show it is now hard avoid.

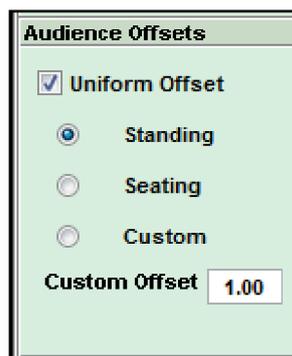
You can click on the Audience button to change any planes to audience but this is rarely required as long as you initially defined the audience areas correctly in the Venue slice, you are more likely to have too many audience planes rather than not enough although you may need to change a plane back to audience if you have accidentally changed it to something else. If you get several wrong you can click on the Reset which returns all planes to the default that you started with.

Here is our example with all planes changed to what we need;-



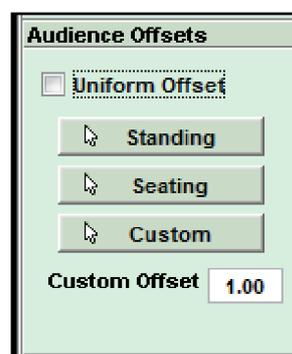
### Audience Offsets

You will notice that the green lines showing the audience area are hovering above the planes which is to represent the offset of the position of the audience members' ears. By default this will be a uniform offset for all audience areas set to standing. Changes are made using the Audience Offsets panel;-



If for example the entire audience is seated, you can simply click the seating button and you will see the green audience line drop accordingly. The Standing offset is 1.6m and the Seating is 0.8. If you have a particularly unusual audience, very tall standing or perhaps very low seats, you can use the Custom offset to define the offset height in metres.

You will often encounter venues where you have a non uniform offset, for example a room with a seated balcony but standing downstairs in the stalls. In these instances you need to un-check the Uniform Offset button and define the offset for each plane individually. When you uncheck the box the controls change and look like this;-

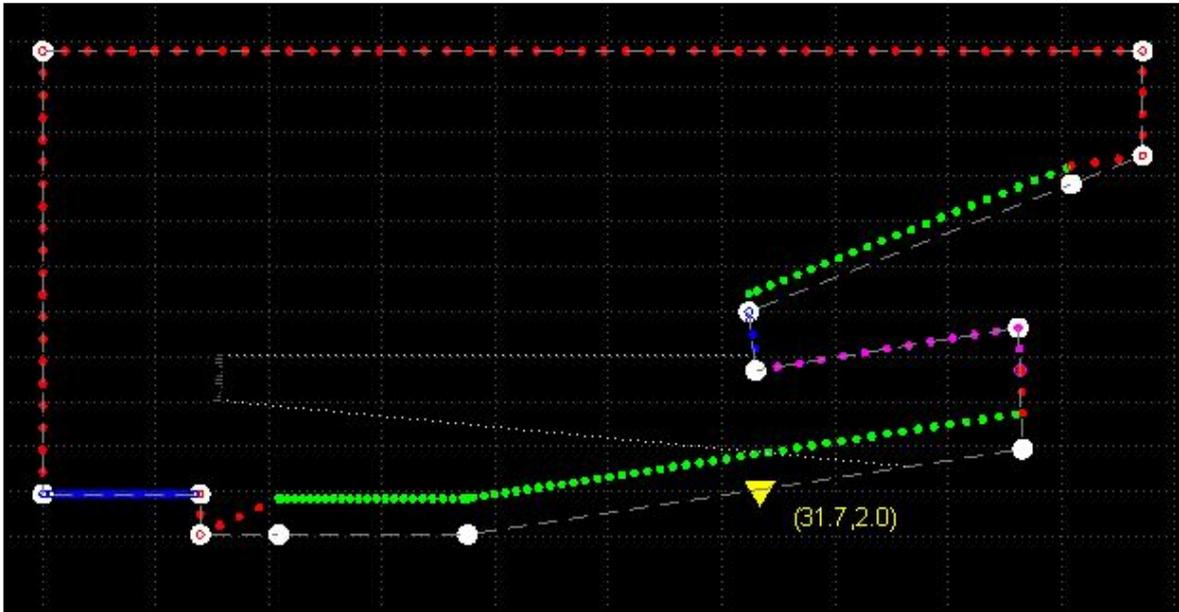


In a similar fashion to changing Plane properties, you click on the Offset type first, and then hover over the required audience plane and click when the correct plane is highlighted with the same bold white dashed line. Note that all planes have to be



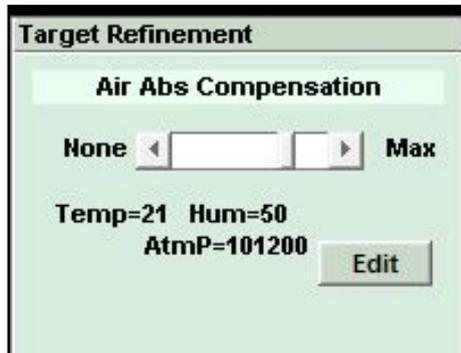
defined individually, in our example for instance, the stalls audience area comprises two planes, the flat section at the front, and the raked section rising towards the back. Both of these will have to be changed to whatever the desired offset is. This can be useful as there are plenty of venues with a standing area down at the front and seating towards the back. When you are using Custom offsets, you can define a different custom height for each plane if required, you are not restricted to a single global figure.

Our example now has a standing audience downstairs and a seated upstairs;-



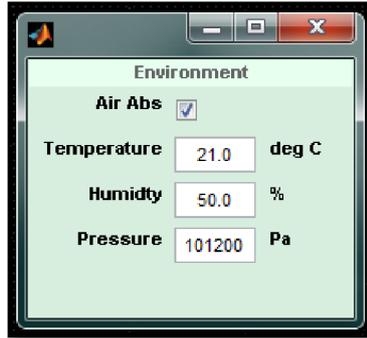
### Air Absorption Compensation

Display 2.1 can compensate for the effects of air absorption which can have a very significant effect on the upper frequency bands. The compensation is added in this section on the Coverage page;-



The fader bar adjusts the amount of compensation from zero to a maximum level. This is best used for higher amounts where weather conditions are extreme or where you have particularly long throws as the compensation will help ensure that higher frequencies are not lost. However, be careful not to overdo it if not really necessary as you could run the risk of running out of headroom in the upper frequency bands.

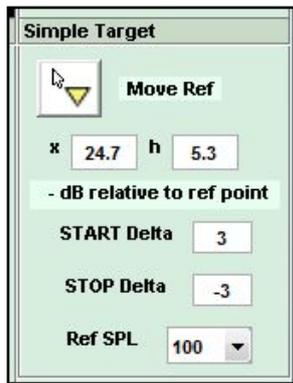
The Edit button brings up the window into which you can enter the necessary environmental conditions;-



If you un-check the air absorption there will be no compensation applied to the optimisation, you can still enter the Temperature, Humidity and Pressure so if you need to create a new optimisation including air absorption it is as quick and easy as checking the box. Be aware that environmental conditions change drastically throughout the day! A 6.00 am load-in is going to give very, very different readings compared to a packed, 8.00pm show with all lighting, smoke machines and pyrotechnics going full tilt!

### Target Delta Selection

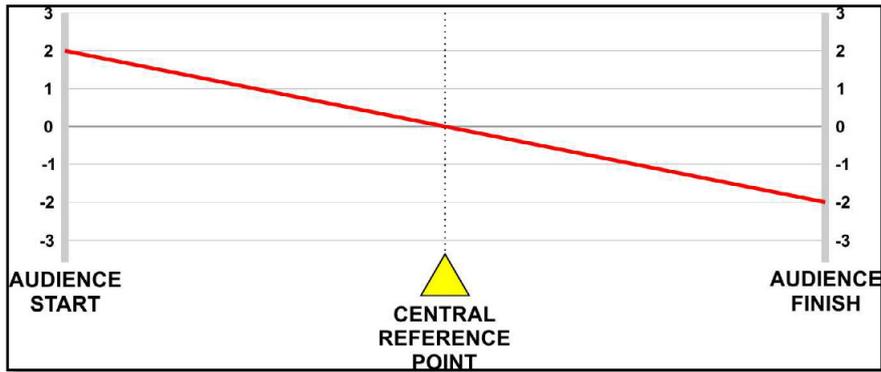
The target Delta selection is located in the bottom right corner and is where the SPL variation from audience start to finish is entered;-



This unassuming little box is one of the most powerful features of Martin Audio multicellular systems, whilst all other systems on the market are trying desperately to achieve a 3dB drop in level for every doubling of distance away from their arrays, with MLA Mini you can simply specify exactly the loudness contour across the venue. If you want the back row to be as loud as the front then you simply type 0 in both the start and stop delta positions and the system will give you exactly that. It can even make it louder at the back than the front if that is what you want.

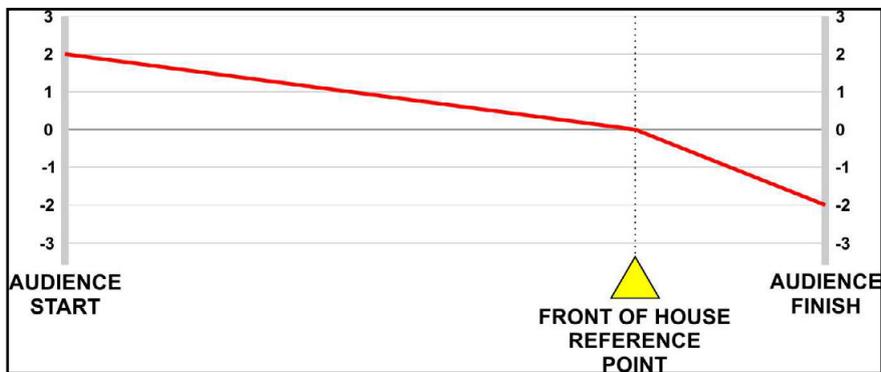
The start and finish deltas are referenced to the yellow triangle which nominally is placed in the middle of the audience region when you enter the coverage area in the venue slice. You have the opportunity to move it and if you didn't do so in the venue slice you can click on the 'Move Ref' button and move your cursor around the venue planes. The triangle will follow your cursor sticking to the planes until you are happy with its position and a further mouse click will cement it in its new position. Alternatively you can enter either an x or h figure to specify the horizontal position or height of the reference point and it will jump to the closest position on the venue shell that corresponds to the coordinates you have entered.

It is tempting to automatically position the reference position wherever front of house is positioned but this is not in the least bit necessary. The reference is used to adjust the contour so its position should be dictated by how you want the volume to change from the start to the finish of the audience region. Take a look at the following diagrams;-



This shows a system that has been set up with the reference point in the centre of the audience region and a start and finish delta of + and – 2dB respectively. Because the reference point is central, the SPL drops evenly from start to finish, down 4dB from the loudest point at the start of the coverage.

The next diagram shows a system where the front of house position is around three-quarters of the way back from the front but the start and stop deltas are still at +/-2dB;-



As you can see, the level drops gradually over three quarters of the venue back to front of house and then drops rapidly back to the audience finish. Decidedly strange and in most (but not necessarily all) circumstance, unwanted. To get the same smooth 4dB drop you should enter the start delta as +3dB and the finish at -1dB. But that only works if front of house is exactly three quarters of the way back! In the majority of cases you are far better of leaving the reference at the halfway point to make it easier to easily calculate how the loudness contour will flow from start to finish.

Of course they are many applications when it may be desirable to have the spl rapidly drop off behind the reference point, at outdoor events where noise pollution is an issue, the ability to move the reference point to dictate the contour in front and behind it individually is another very useful tool at the system technicians disposal to create the ideal coverage for difficult environmental conditions.

The default setting is +/-3dB with the reference point in the centre, this is unquestionably a very good place to start and works very well, unless you have a very large array or need to try something slightly unusual it is advisable to stock with these settings.

As mentioned, setting the start and stop delta is simply a case of entering the required figure in dB. As with entering hard avoid regions, it is prudent to be mindful of how hard your DSP is going to have to work to achieve the results you have requested. With a huge array of 22 MLA enclosures, it was possible to achieve a 0dB start/stop delta in the Tokyo Dome, the furthest seat being around 550 feet from the array. It would however be very difficult to get such an astonishing result from say an eight box MLA Mini array. The height of the array also has a significant effect, a ground stacked system will not be able to achieve low figures for start and stop as a flown array. In actual fact, a 0dB start/stop sounds very unnatural and because you are used to hearing an array get louder as you get closer, you actually get the distinct impression that it is getting quieter as you get closer to the array. The other issue is that multicellular optimisation is only effective down to around 300Hz, low and sub frequencies will still behave as you would expect reducing in SPL by 6dB for every doubling of distance. If the optimisation from front to back is set to a target of as little as a few dB this will obviously differ drastically from the behaviour of low frequencies meaning that there will be a very noticeable difference in tonal balance across the audience coverage with the loss of low frequencies being very apparent as you go towards the back as the mid and high frequencies hardly drop in level. It is recommended therefore that



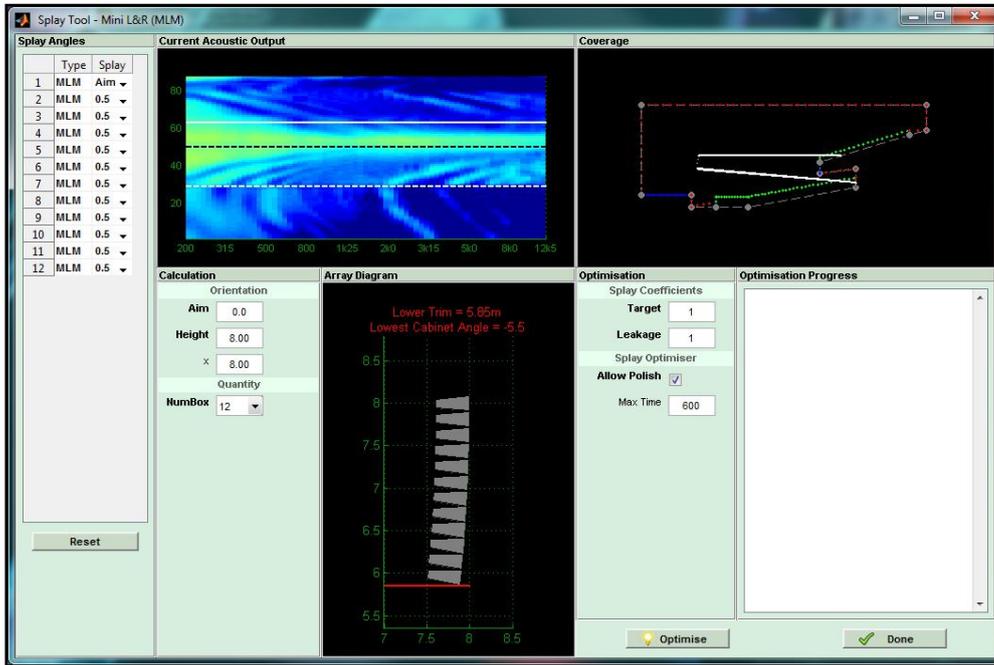
unless you have specific reasons to do otherwise, that you use figures of +/-3dB. For most medium to large sized array this should be easily achievable and will leave plenty of DSP power for other tasks and will retain a far more natural and subtle change of tonal balance throughout the audience.

The final option is to set the reference SPL at which Display 2 will attempt to achieve the smoothest coverage as close as possible to the targets that you have specified. If you select 85dB you stand a better chance of achieving the system goals as it gives the option to allow great cancellation or gain shading to reduce levels in areas closer to the array thus making the coverage as even as possible and potentially closer to your SPL deltas. If however you need as much SPL as possible and have set your SPL deltas to allow a greater variation from start to stop you can select a higher SPL, 100 or 105dB and you will achieve a higher output from the system.

Once you have determined your Start and Stop Deltas you can click on Done to close the Coverage window and you can move on to the Splay tab.

## Splay Angle Tab

Having completed the Coverage you will be able to open the Splay tab and the default window will appear as follows;-



There are a number of sections to the window, these are;- Splay angles, Current Acoustic Output, Optimised Acoustic Output, Calculation, Array Diagram, Optimisation and Optimisation Progress.

### Splay Angles

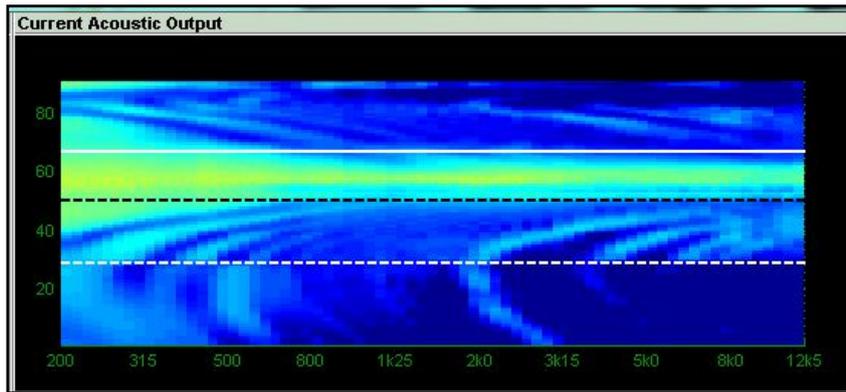
This shows a list of all cabinets in the array and initially this will show all angles between cabinets at the default of 0.5°;-

Splay Angles		
	Type	Angle
1	MLM	Aim ▼
2	MLM	0.5 ▼
3	MLM	0.5 ▼
4	MLM	0.5 ▼
5	MLM	0.5 ▼
6	MLM	0.5 ▼
7	MLM	0.5 ▼
8	MLM	0.5 ▼
9	MLM	0.5 ▼
10	MLM	0.5 ▼
11	MLM	0.5 ▼
12	MLM	0.5 ▼

There is a drop-down arrow next to each cabinet allowing you to manually select a cabinet angle. We will discuss this option later. At the bottom of the list is a rest button which will return all angles to 0.5°.

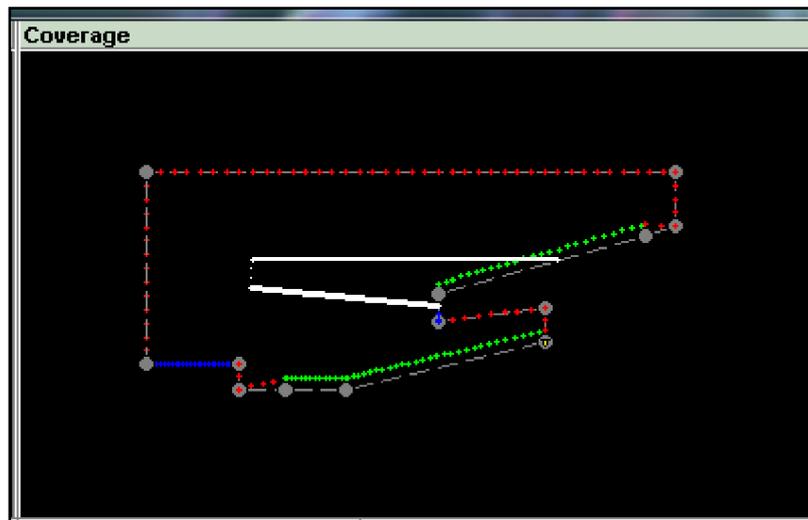
### Current Acoustic Output

This shows an Index Plot of the system prior to the optimisation process.

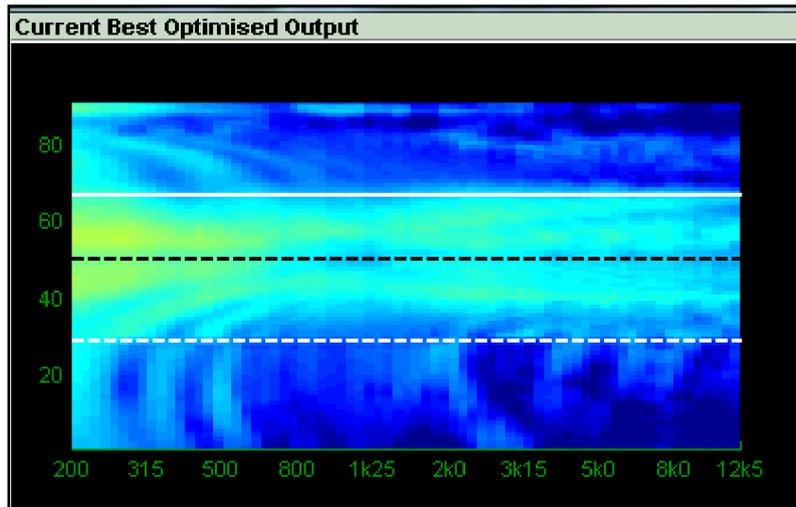


### Coverage / Current Best Optimised Output

Prior to starting the optimisation this shows the coverage diagram with the array shown with all angles at the default 0.5°. Note that the white lines from the top and bottom of the array are the acoustic centres of the top and bottom cabinets, NOT the furthest points of the coverage which will be 3.25° beyond the upper line and 3.25° lower than the bottom line for MLA or 10° lower if MLD are used at the bottom of the array. For MLA Compact and MLA Mini it will be 5° higher and 5° lower. The lines are not intended to show the vertical coverage, just where the array is actually mechanically pointing by default.

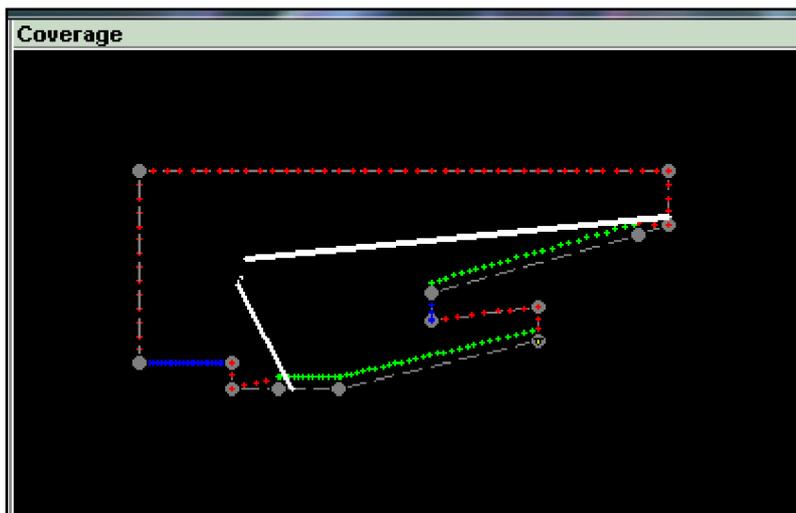


When you start the optimisation process which window switches to an index plot showing in real time the acoustic performance as different inter cabinet angles are tried;-



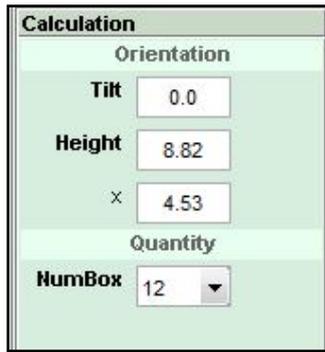
This gives you an instant comparison to the Current Acoustic Output; essentially a "before" and "after" to see how manually articulating the array has improved the coverage.

Once completed the window reverts to the coverage diagram showing the articulated array with the white lines from the centre of the upper and lower cabinets again showing where the acoustic centres are pointing:-



### Calculation

The Calculation section shows the physical orientation of the overall array. From here the number of boxes is defined and can be changed if for any reason the initial array size was incorrect. You have the option to change the number of cabinets. You can however only change the number to a quantity that is appropriate to the deployment method selected so a maximum of 6 for ground stacked MLA or MLA Compact, 8 for ground stacked MLA Mini 12 for MLA Mini flown with MSX.



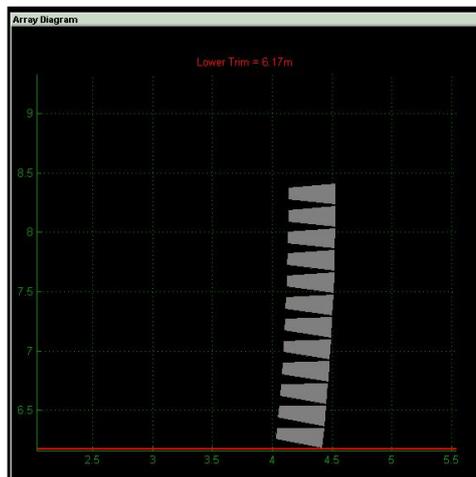
The height to the top of the array and distance from the origin is also shown and can be edited to match the physical deployment of the system, very useful if for example it wasn't possible to fly the array exactly where you planned, perhaps the points couldn't be placed as high as you wanted.

The tilt of the entire array is shown and will be automatically generated as part of the optimisation process. It is also possible to overwrite this if necessary to match the actual tilt of the array, given the resolution of most chain hoists it is frequently difficult to exactly match a given tilt angle even with front and back motors.

The number of enclosures can also be edited at this stage. Perhaps a cabinet has been damaged in transit and won't physically attach to the array or perhaps you decide to add MLD cabinets to the bottom of an MLA array you can over-type the number shown to the maximum number allowed.

### Array Diagram

The Array diagram shows a representation of the array and most importantly for flown arrays shows the lower trim point, the distance from the lowest point on the array to the ground. The diagram will adjust in real time when the optimisation is taking place and the lower trim will change accordingly. In most instances the lower trim at the start will be lower than when the optimisation is complete. This is because the array starting point is with an almost straight array with all angles at 0.5°, once the optimisation is complete some of the angles will inevitably be higher thus reducing the overall height of the array and raising the lower trim height



### Optimisation

The Optimisation section is where the optimisation characteristics are defined. The splay coefficients determine the priority given to either the target response or the leakage. The actual numbers entered are not important, it is the ratio between them that determine how much priority is given to each coefficient so if you want the Target coefficient to be twice as important as Leakage you can enter '2' in Target and leave leakage as '1' or you could leave Target as '1' and change Leakage to '0.5' the result would be exactly the same.



Allow Polish lets the software take a second run at refining the inter-cabinet angles after it has completed the first pass. It re-starts the optimisation when it has completed the first attempt with the angles it has already calculated as a starting point and further refines them to get the best possible result. If you are in a rush you may want to disable this feature, particularly for very large arrays which may take some time to optimise.

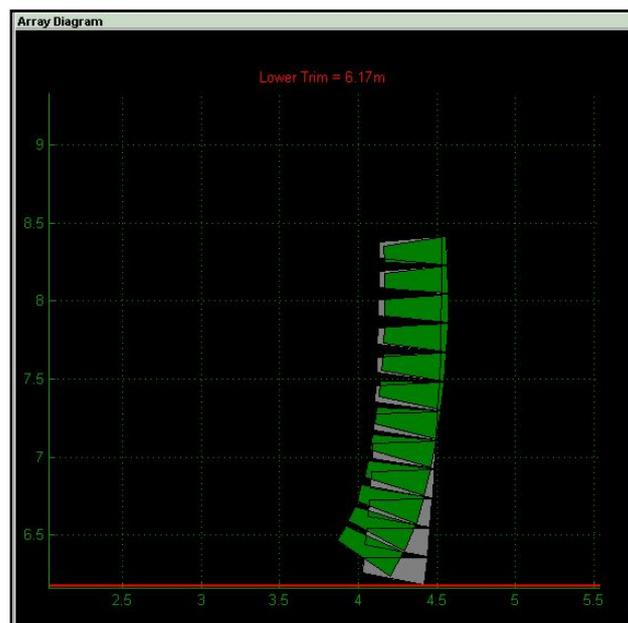
The Max Time is the time in seconds that the system will allow for the optimisation to run. For the vast majority of systems the default setting of 600 seconds (10 minutes) will be more than adequate, particularly when Display 2.1 is run on a high spec PC. With very large arrays in complex venues you may need to increase this time to get the best optimisation assuming you have the time at your disposal. If you don't have sufficient time the optimisation will time out and you will see a warning suggesting that you increase the Maximum Time. You can however, accept the angles it has calculated at any stage or even enter your own angles manually and the Equalisation optimisation will work from these angles albeit with a slight compromise on the system performance. Whilst some array angles may look strange to those used to working with conventional line arrays, **always trust the software!** Multicellular systems are NOT line arrays so don't try and use them in the same way.

### Optimisation Progress

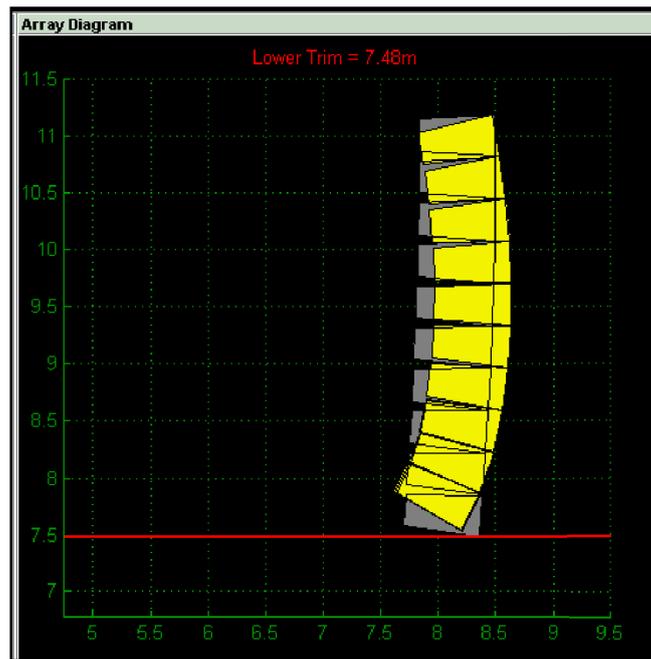
The Optimisation Progress shows the code trying all possible angles of the array cabinets in real time as the optimisation is running. This is simply a reference so you can see that the software is actually doing something!

### Run the optimisation

Click on the Optimise button and the system will run through all possibly array angle configurations. The drawing will show the array moving through the various positions and will be green;-



When it has completed its first pass it will start again on its polish cycle if you have checked this option. The array will change colour to yellow. When the optimisation is finished you will see the array diagram with the array now stationary. The yellow polished version will be superimposed above the green un-polished version. The accurate lower trim height is also displayed;-



In the Optimisation Progress you will see a list of code corresponding to all the attempts it has made to perfect the angles. At the bottom of the list it will display “Finished”;

```

Optimisation Progress
Initialising Optimiser
Starting Optimiser
1: Trys:19 Mesh:2
2: Trys:38 Mesh:1
3: Trys:56 Mesh:0.5
4: Trys:74 Mesh:0.25
5: Trys:92 Mesh:0.125
Finished
    
```

If you have de-selected the Auto Use Splay option in preferences, a new button will appear on the bottom right of the window;



If we click on ‘Use’ the angles calculated will be imposed onto the Splay Angles list. With the Auto Use Splay enabled we will see the calculated angles immediately applied to the array. Here we see a “before” and “after”;

Splay Angles		
	Type	Angle
1	MLM	Aim
2	MLM	0.5
3	MLM	0.5
4	MLM	0.5
5	MLM	0.5
6	MLM	0.5
7	MLM	0.5
8	MLM	0.5
9	MLM	0.5
10	MLM	0.5
11	MLM	0.5
12	MLM	0.5

Splay Angles		
	Type	Angle
1	MLM	Aim
2	MLM	0.5
3	MLM	2
4	MLM	2
5	MLM	2
6	MLM	2
7	MLM	4
8	MLM	4
9	MLM	6.5
10	MLM	10
11	MLM	10
12	MLM	10

We also have the Calculation window showing the complete mechanical articulation of the array including the array tilt;-

Calculation	
Orientation	
Tilt	0.0
Height	8.82
x	4.53
Quantity	
NumBox	12

The tilt figure is reasonably logical; a positive figure means the array is tilting up at the top, a negative figure means the array is tilting down. The touring array grids feature an integral inclinometer system so these figures can be matched when the system is flow.

One major advantage of the MLA family of systems optimised with D2.1 is that real-world figures for the rigging can be entered if they don't actually exactly match what the system has recommended. If for example there are constraints on the curvature of the array you can click on the down arrow for each of the intercabinet angles you need to change and select the angle you would like to use from the drop down. It is always best to accept the splay optimisation results wherever possible (always trust the software!) but there will always be a few venues where there are physical limitations on exactly how you can deploy the system.

Likewise with the enclosure quantities and orientation. Most common is perhaps array height; it is very common for flying points to end up lower than you have originally been told. It is vital to make any changes in Display 2.1 to match as closely as possible the actual physical deployment of the system. The EQ optimisation will use the data on this page regardless whether it was entered automatically by the splay optimisation or manually by you. Simply overwrite the number for tilt, height, 'x' position or box quantities and press enter. If the number entered is a valid entry the box will briefly flash green and your new value will be displayed. If you enter an invalid number, for example if you try and enter more than 16 MLA Mini, the box will briefly flash red and will default to the maximum value.

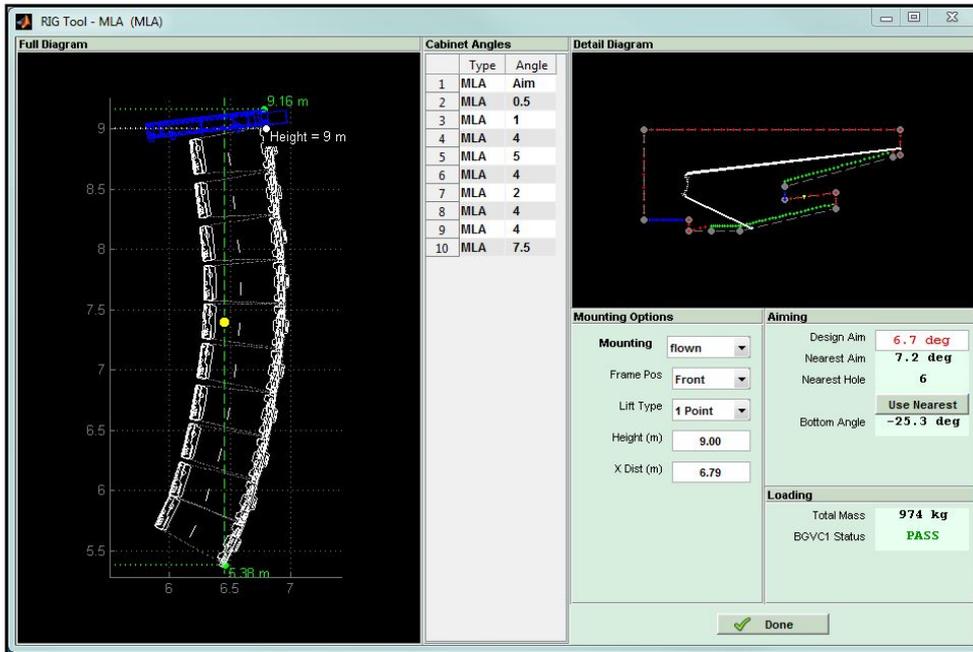
We have completed the Splay optimisation so can click 'Done' to close the window and move to the next stage.

## Rig Tab

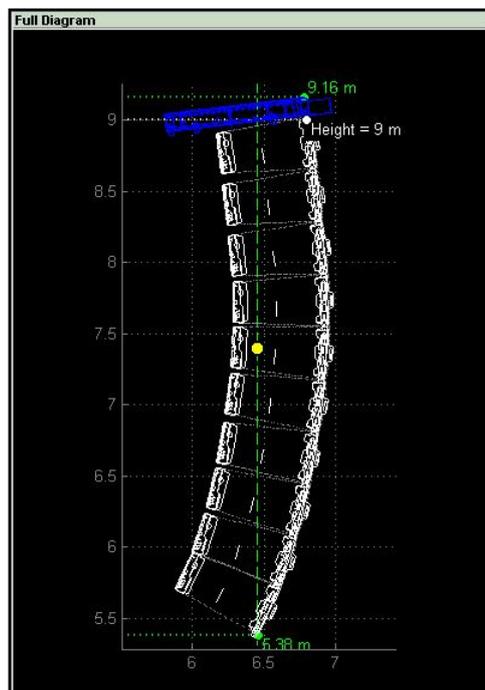
The rigging tab displays all the mechanical information required for rigging a system including the array height, lower trim, mass and all splay angles. As the rigging hardware is different for the three types of MLA System there are variations in how the Rig Tab appears so we will look at the types of system individually starting with MLA

### MLA

The left hand section shows the system flown by default using the flying frame from a single point.



There are a number of important sections to the screen. First is the array diagram showing a scale picture of the flown array accurately displaying the physical deployment of the array;-



This is useful so you can quickly see if there are any mechanical issues with the array that might make flying in a particular venue difficult; perhaps the rear of the array is hanging back further than you initially thought and might impede something else that

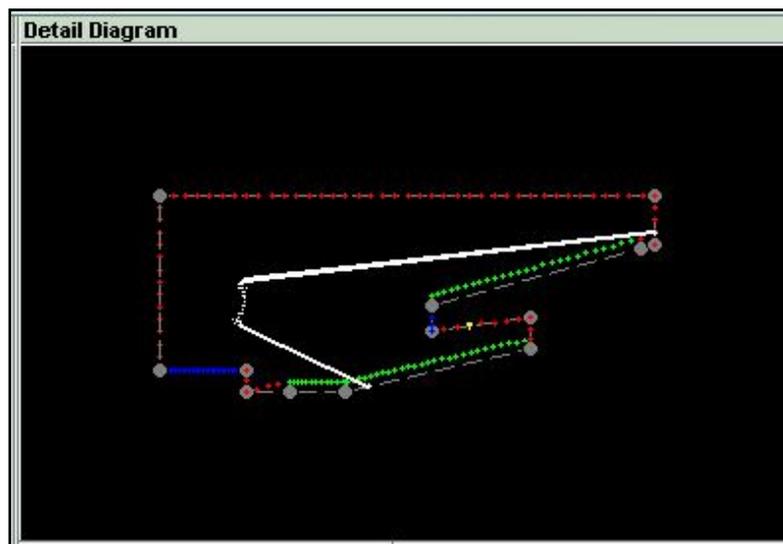
is flown close to it such as lighting or scenery. The lower trim point is also displayed so the array can be accurately flown to the correct height. It can be measured either by the time-honoured method of attaching a tape measure or using a laser measure such as the Leica Disto D8. The green cross with dotted lines shows the centre of gravity of the array.

Next is a list of the splay angles;-

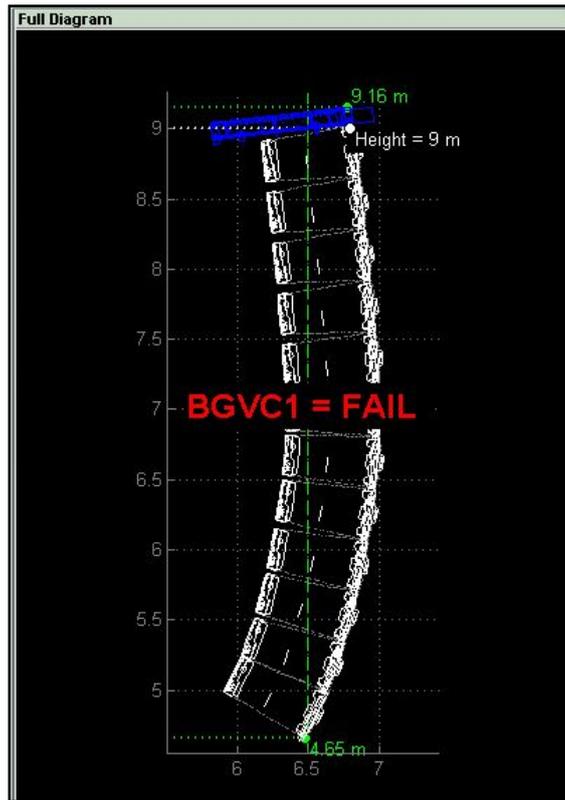
Cabinet Angles		
	Type	Angle
1	MLA	Aim
2	MLA	0.5
3	MLA	1
4	MLA	4
5	MLA	5
6	MLA	4
7	MLA	2
8	MLA	4
9	MLA	4
10	MLA	7.5

This gives you all the information you need to set the intercabinet angles when you are flying the system.

There is a thumbnail diagram of the entire venue which will update as you make changes to the rigging;-



Note that the examples shown are for an array which is possible to fly. If the optimisation creates an array that is impossible to realise within the capabilities of the flying frame the array diagram will show a warning flag as shown here;-



In this case it is necessary to change the height and possibly coverage area of the array until a “legal” array shape is produced or in the case above, reduce the number of cabinets or switch to a two point hang.

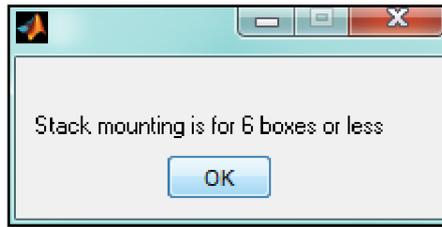
The final section shows the mounting option and results;-

Mounting Options		Aiming	
Mounting	flown	Design Aim	7.8 deg
Flown Subs	<input type="checkbox"/>	Nearest Aim	7.9 deg
Frame Pos	Front	Nearest Hole	8
Lift Type	1 Point	Bottom Angle	-58.7 deg
Height (m)	8.32	<b>Loading</b>	
X Dist (m)	8.49	Total Mass	182 kg
		BGVC1 Status	PASS

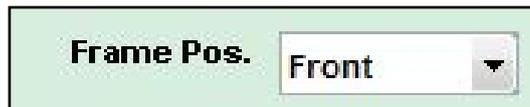
The first option for mounting determines how the array is to be deployed Using the Mounting drop-down;-



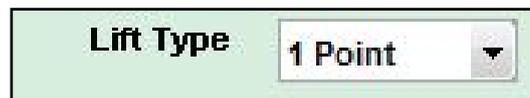
For MLA there are only two options, flown or ground stacked. Ground stack is only available for an array of six boxes or less, if the array is larger than six you will see this message;-



There are options for the flying of systems, when flying MLA there are two positions on the flying grid from which they can be fitted; front and rear. This gives different angle options depending on whether the array has a steep upward or downward tilt. Front and rear can be selected using the Frame Pos. drop-down;-



The 'Lift Type' refers to the number of hoists used to fly the array which can either be one using one of the holes along the spine of the flying frame, or two attaching one to the front-most point and the second to the rear-most point. This is selected with the drop-down;-



The Aiming and Loading sections will change depending on the various options selected. Here we have the results for a single point hang of three MSX and twelve MLA Mini;-



This shows the total mass of the array including the flying frame to be 974Kg (Note that the Rig tool does not yet show imperial measurements even if Metric is un-checked in preferences). It shows that the optimisation specified an upwards tilt (a down tilt will be signified with a minus number) of 6.7°, by using the Nearest Hole as displayed, in this example hole 4, the actual tilt created is 7.1°. If we click on the 'Use Nearest' button the array tilt will be changed to match what the actual flying grid will achieve. This means that when you proceed to the next stage of optimising the equalisation, Display 2.1 will optimise for the array positioned exactly as it will be in the real world giving the most accurate optimisation possible. When you click 'Use Nearest', the Design Aim will change to match the actual Aim angle and will turn green;-



Aiming	
Design Aim	7.1 deg
Nearest Aim	7.1 deg
Nearest Hole	4
Bottom Angle	-14.4 deg

Note that if by a happy coincidence the 'Nearest Hole' gives an angle which happens to match the Design angle the identical angles will automatically be green.

The Aiming section also displays the angle of the bottom cabinet making it easy to check the angle of the array before it is flown out using a portable inclinometer, or the inclinometer option on a Disto laser measure.

The Loading box displays the total array mass including the flying grid and cables and whether the flying system meets BGVC1:-

Loading	
Total Mass	974 kg
BGVC1 Status	PASS

If you select the 2 Point option the Aiming changes to simply show the required aim and the Bottom cabinet angle as you can adjust the array tilt by raising and lowering front or rear hoists:-

Aiming	
Design Aim	7.1 deg
Bottom Angle	-14.4 deg

The loading section will also change to show how the total array mass is distributed between the points:-

Loading	
Total Mass	974 kg
Front Load	833 kg
Rear Load	141 kg
BGVC1 Status	PASS

This shows the mass that each point will see, in this example 833Kg for the front point and 141Kg for the rear point.

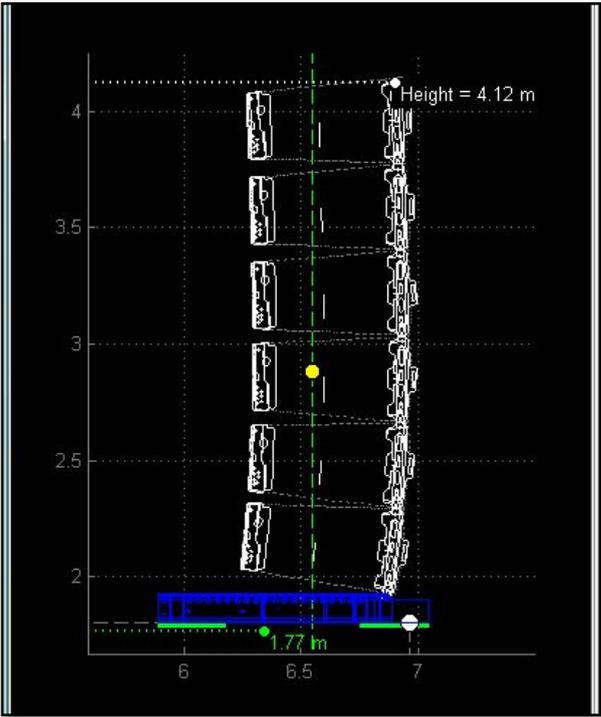
### Ground Stacking

Assuming you have 6 MLA or less you have the option of ground stacking.

If you select 'On Ground' you will first see a warning that the array height may change and that it is advisable to re-calculate the splay angles back in the splay tab;-



Click 'Yes OK to proceed and the array diagram will update accordingly;-



'On Ground' refers to the lowest point on the venue slice available for the horizontal (front to back) position for the array. If for example the array is placed on a stage, selecting 'On Ground' will result in a Lower trim equal to the stage.

For either option the results section will also update showing the total array mass and the required ground stack bar and number to use to get the closest angle to the design figure;-

Aiming	
Design Aim	2 deg
Nearest Aim	2 deg
Bottom Angle	-6 deg
Bar Angle	-6 deg
Bar Type	A4

---

Loading	
Total Mass	611 kg

The MLA ground stack bar has three holes, one which locates in the flying frame and two holes labelled 'A' and 'B' which are used in the rear rigging bracket holes to achieve the desired up or down tilt. In this this example hole A is used in the 4° hole to achieve the aim angle of 2°. The bottom angle is also shown, clearly in most ground stack applications you could easily check the angle of the top cabinet but you have the option of checking the bottom cabinet if for some reason the top cabinet cannot be easily or safely reached, a system stacked on top of several subs or a high piece of staging for example.

In the above example the nearest aim matches what is achievable with the ground stack bar in the appropriate hole therefore the Design Aim is automatically green. If this was not the case there would be exactly the same option available as with a flown system of using the nearest angle available which will adjust the array angle ready for the EQ optimisation

### MLA Compact

The rigging options for MLA Compact are almost identical to MLA as it has exactly the same constraints; a maximum of 24 flown cabinets and 6 ground stacked. The rigging windows therefore look pretty much the same. A flown system appears like this:-

Cabinet Angles	
Type	Angle
1 MLAC	Aim
2 MLAC	0.5
3 MLAC	0.5
4 MLAC	4
5 MLAC	6.5
6 MLAC	2
7 MLAC	4
8 MLAC	4
9 MLAC	4
10 MLAC	10
11 MLAC	10
12 MLAC	10

Mounting Options	
Mounting	flown
Frame Pos	Front
Lift Type	1 Point
Height (m)	8.07
X Dist (m)	7.50

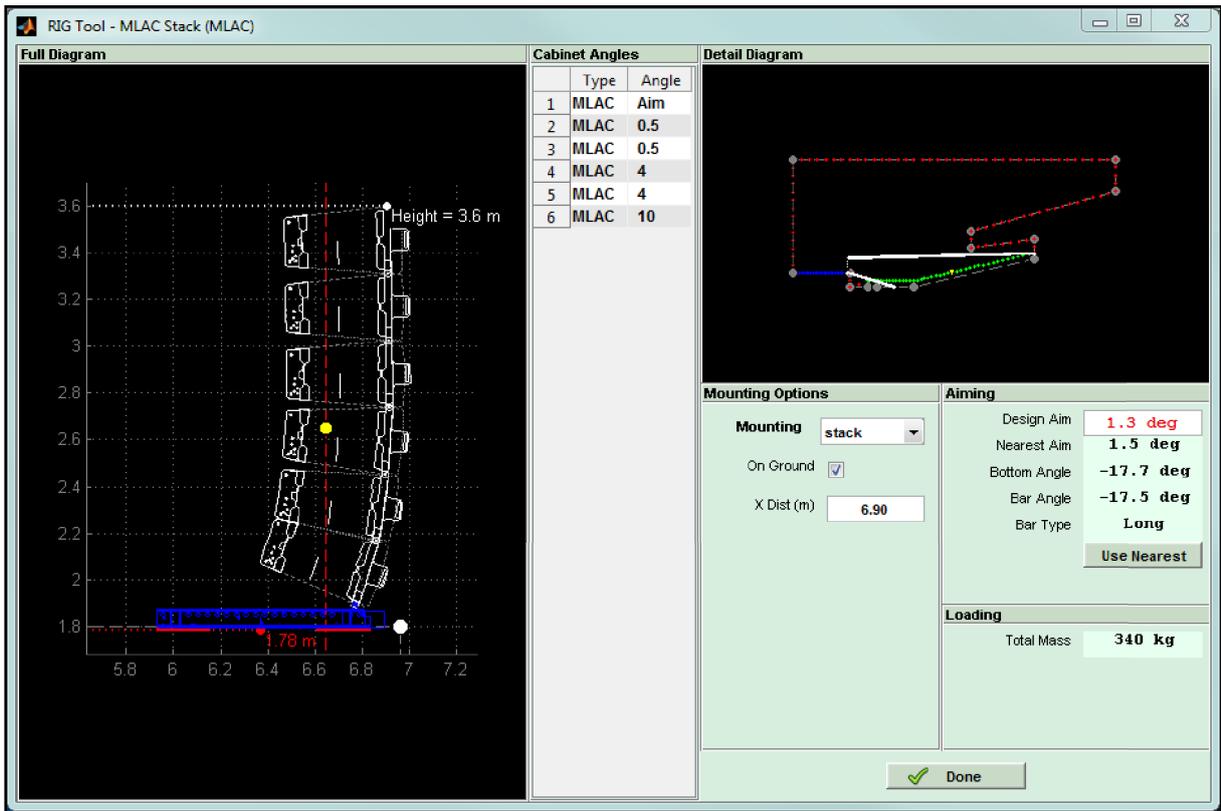
  

Aiming	
Design Aim	8.2 deg
Nearest Aim	7.5 deg
Nearest Hole	7
Bottom Angle	-47.3 deg

Loading	
Total Mass	636 kg
BGVC1 Status	PASS

And a ground stack system like this;-



The principal difference is how the ground stack information is displayed. MLA Compact has two versions of ground stack bar, a long bar for arrays requiring a down-tilt as shown in the example above, and a short bar for arrays that require an up-tilt. As the example above shows, the Aiming panel shows which type of bar;-



Rather than specifying which hole in the bar is shown the bar angle as the bar itself has a label with shows which holes to use to achieve the desired angle. Once again where there is a difference in the design aim to that which can be achieved with the ground stack bar the design aim is shown in red with the 'Use Nearest' option available. If clicked the design aim and array diagram will be updated;-

**Aiming**

Design Aim **1.5 deg**

Nearest Aim **1.5 deg**

Bottom Angle **-17.5 deg**

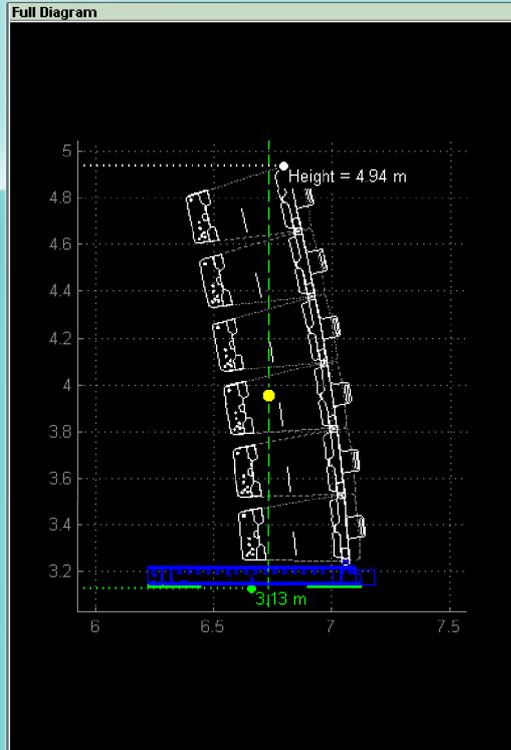
Bar Angle **-17.5 deg**

Bar Type **Long**

Here we see a ground stack array which has an up-tilt;-

RIG Tool - MLAC Stack (MLAC)

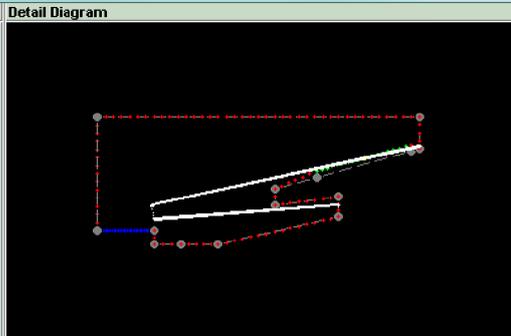
**Full Diagram**



**Cabinet Angles**

	Type	Angle
1	MLAC	Aim
2	MLAC	1
3	MLAC	1
4	MLAC	2
5	MLAC	2
6	MLAC	2

**Detail Diagram**



**Mounting Options**

Mounting: **stack**

On Ground:

Height (m): **4.94**

X Dist (m): **6.79**

**Aiming**

Design Aim **12.4 deg**

Nearest Aim **12 deg**

Bottom Angle **4.4 deg**

Bar Angle **4 deg**

Bar Type **Short**

**Use Nearest**

**Loading**

Total Mass **340 kg**

**Done**

The aiming panel looks similar but is specifying the short ground stack bar;-

**Aiming**

Design Aim **12.4 deg**

Nearest Aim **12 deg**

Bottom Angle **4.4 deg**

Bar Angle **4 deg**

Bar Type **Short**

**Use Nearest**

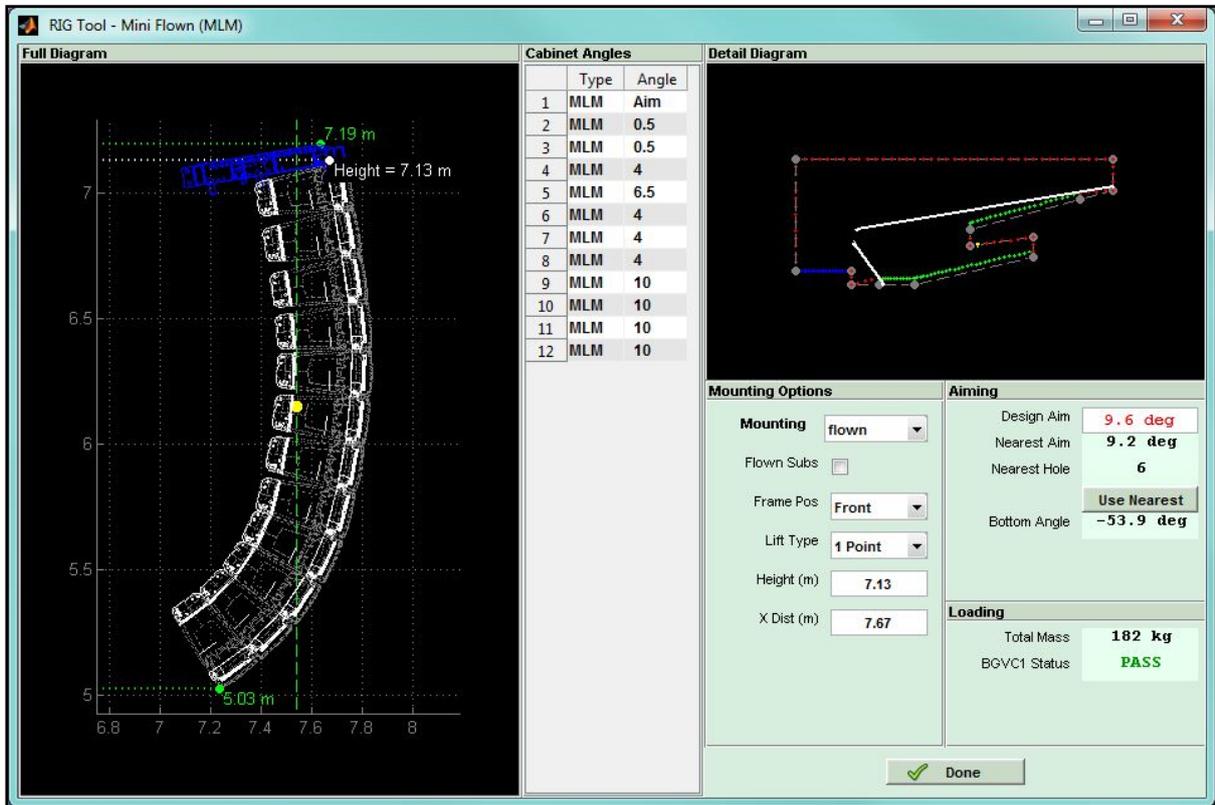


MLA Mini

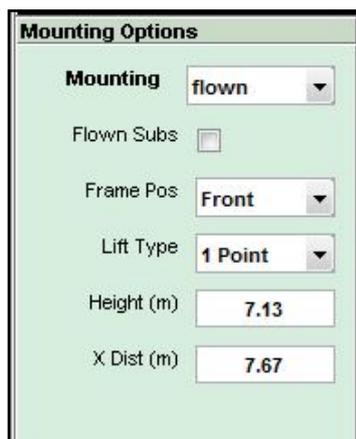
MLA Mini has several deployment option for both flown and ground stacked systems. This changes the options and information in the rigging panel

Flown system

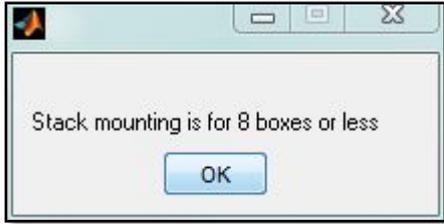
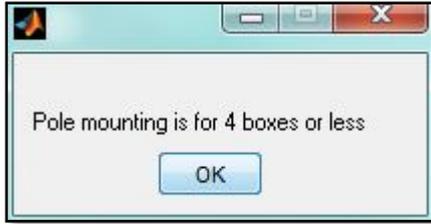
The Window for a flown MLA mini system appears like this;-



If we look first at the Mounting panel we have a number of options;-



First we have the 'Mounting' drop-down which gives us the option of flown, stacked or pole mount. Availability of these modes is dependent on the number of boxes. Flown can be the full complement of 16, ground stacked up to 8 and pole mount up to 4. As the array in the example has 12 enclosures we cannot select stacked or pole mount, if we try we will see the following windows;-



Next we have the option to fly the MSX subs with the arrays if this wasn't selected when the array was initially added to the project. This again has the limitation that it is only available for up to 12 enclosures, if the array is more than 12 cabinets the flown subs option will not appear.

Here is the system above with flown subs;-

**RIG Tool - 16 Mini (MLM)**

**Full Diagram**

Height = 9.27 m

**Cabinet Angles**

	Type	Angle
1	MLM	Aim
2	MLM	0.5
3	MLM	0.5
4	MLM	2
5	MLM	10
6	MLM	6.5
7	MLM	2
8	MLM	6.5
9	MLM	10
10	MLM	10
11	MLM	10
12	MLM	10

**Detail Diagram**

**Mounting Options**

Mounting: **flown**

Flown Subs:

Lift Type: **1 Point**

Height (m): **9.27**

X Dist (m): **7.04**

**Aiming**

Design Aim: **6.3 deg**

Nearest Aim: **6.5 deg**

Nearest Hole: **4**

Use Nearest: **Use Nearest**

Transition Grid: **0 deg**

Top Grid: **6.3 deg**

Bottom Angle: **-61.7 deg**

**Loading**

Total Mass: **357 kg**

BGVC1 Status: **PASS**

**Done**

As with MLA and MLA Compact systems you can select 1 or 2 point hangs, the difference is that even with the maximum flown MLA Mini, either 16 alone or 12 with 3 MSX, they will still be within BGVC1 limits from a single point. 2 point does of course give you the flexibility of trimming the array angle by fine adjustment of one or other hoists.

As with MLA and MLA Compact the Aiming panel shows the array design angle and what is achievable with the nearest hole on the flying grid;-

Aiming	
Design Aim	6.3 deg
Nearest Aim	6.5 deg
Nearest Hole	4
	Use Nearest
Transition Grid	0 deg
Top Grid	6.3 deg
Bottom Angle	-61.7 deg

Again by clicking on 'Use Nearest' the Design Aim will change to match the available angle and will turn green;-

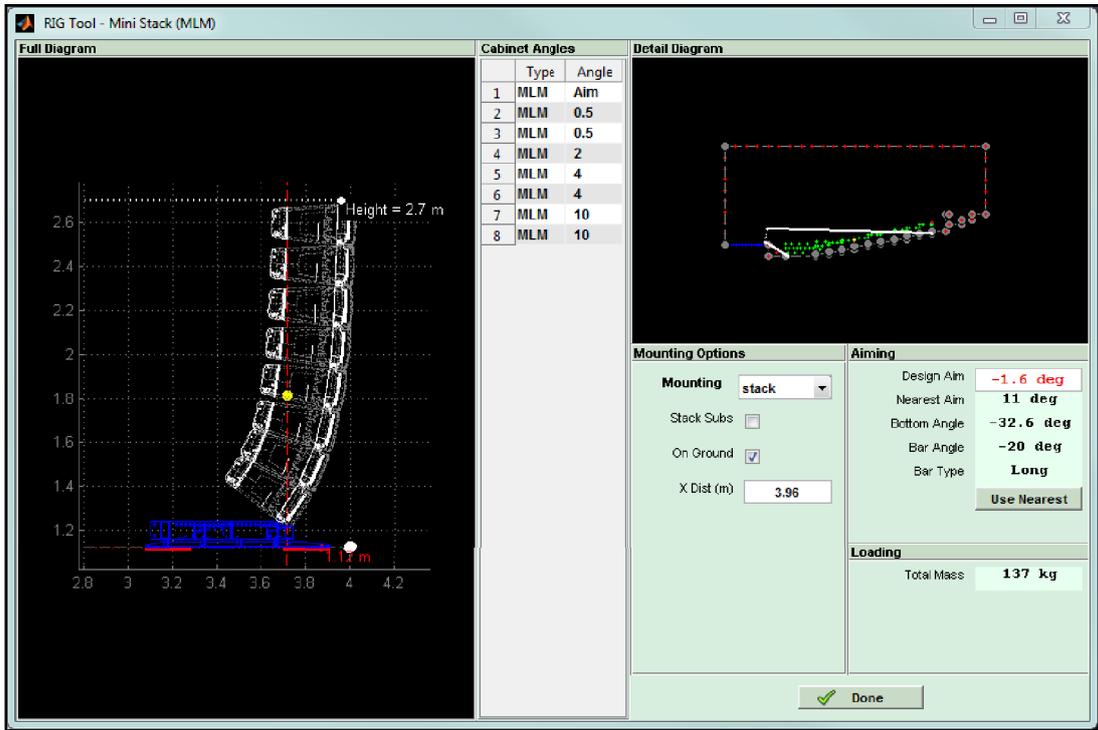
Aiming	
Design Aim	6.5 deg
Nearest Aim	6.5 deg
Nearest Hole	4
Transition Grid	0 deg
Top Grid	6.5 deg
Bottom Angle	-61.5 deg

Note that there are two angles that need to be defined when flying with MSX subs. The main array angle set by using the appropriate hole in the flying grid, and the angle between the MSX and the MLA Mini which is set using the rear rigging bracket on the MLA Mini Transition frame. There are three positions, the angle will be shown in the aiming panel. The example above is zero degrees but Display will attempt to keep the MSX subs as close to horizontal as possible so will add the additional tilt that may be required by using the extra angles that are available from the transition frame.

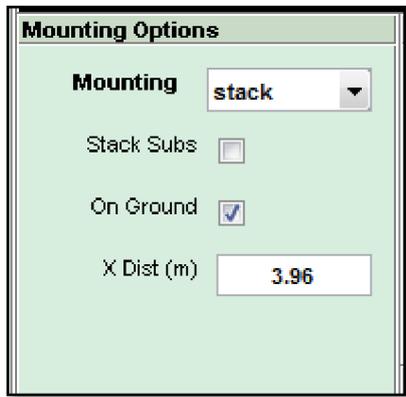


Ground Stacking

Here we see an eight box MLA Mini ground stack;-



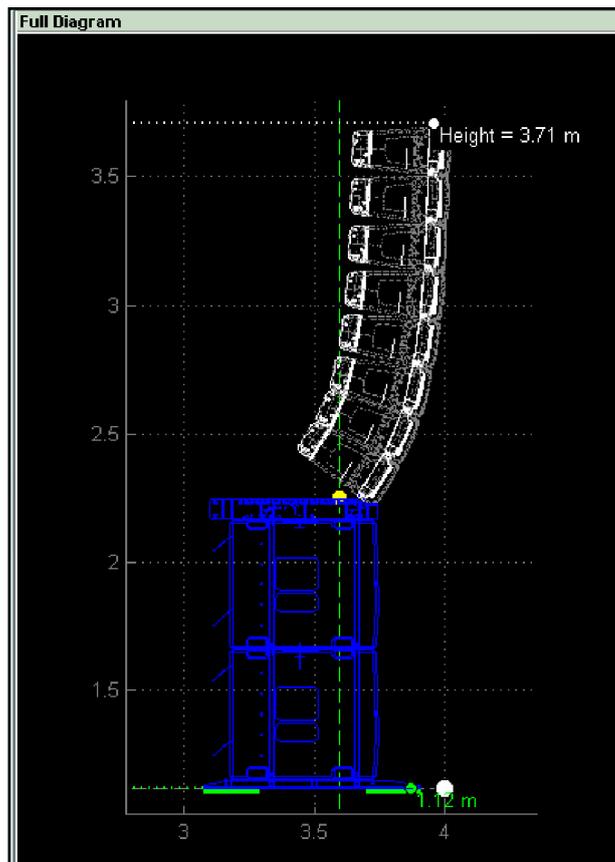
The principal difference with MLA Mini is in the Mounting Options;-



We now have the option to stack on top of the subs. This option will add the MSX subs below the array, a single sub for 1 to 4 cabinets and two MSX for 5 to 8 cabinets. This will naturally change the height of the array so you will see this window to prompt you to recalculate splay angles in the splay Tab.



The Array Diagram will update to show the Subs;-

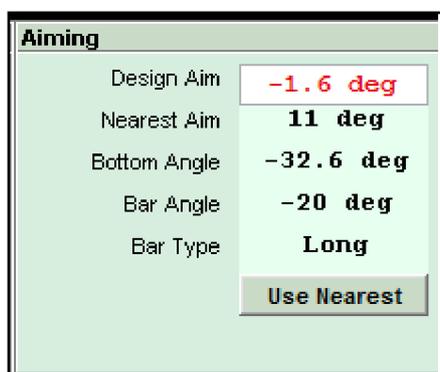


As with ground stacked MLA and MLA Compact ground stacked systems, if the array is not already locked to the ground using the option in the Slice tab, you can select it here;-



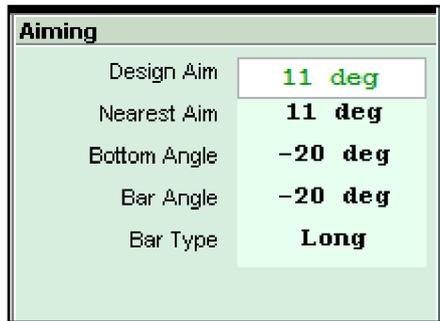
As this may change the array height you will see the same pop-up window prompting you to re-calculate splay angles.

The Aiming panel is virtually identical to the MLA Compact;-

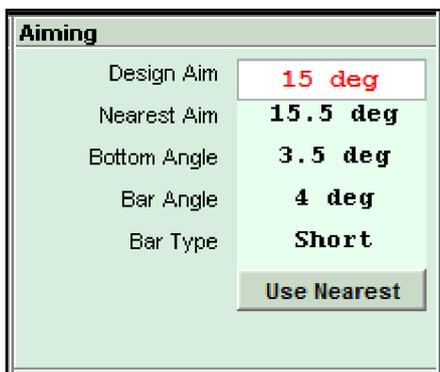




As with Compact, Display will calculate the closest angle available using the ground stack bar and if this doesn't match the Design aim it will be displayed in red with the option to 'Use Nearest'. Once again this option will change the Design angle to match the actual angle of the array so the EQ optimisation will be based on exactly where how the array is angled;-



As with Compact there are two types of ground stack bar, a long and a short. For ground stack arrays which require a down-tilt on the bottom enclosure the long bar is used as in the above example, for array which require an up-tilt the short bar is used;-

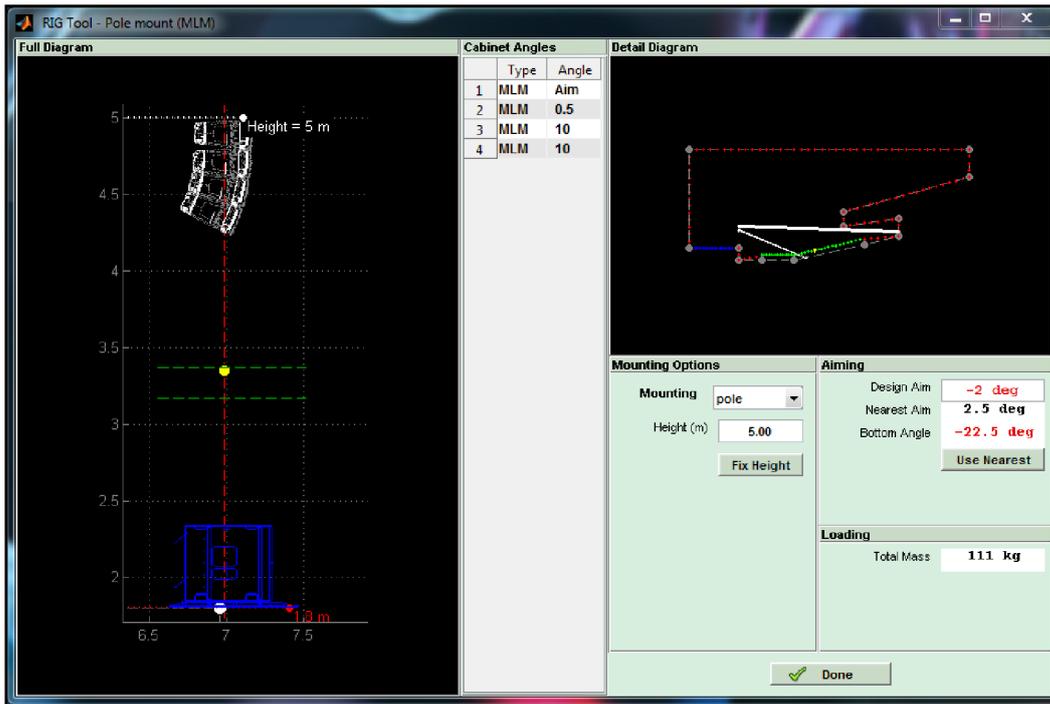


Also in common with MLA Compact, the ground stack bars are labelled with the angles that they can produce so that is shown in the Aiming panel rather than which particular holes in the bar and cabinet to use.

### Pole Mount

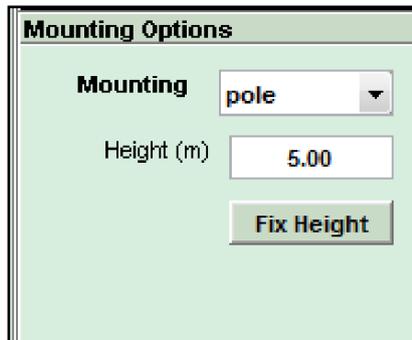
The final option for rigging is pole mount available for two to four MLA Mini on top of a single MSX using the ASF20071 wind-up distance pole which is supplied with either the fixed or adjustable pole mount assemblies or can be purchased as an accessory and used with the MLA Mini Universal Bracket (ASF20051) and the Pole Mount Adaptor (ASF20045).

Here is an initial Rig Tool Window for a pole mount system following a 4 cabinet optimisation;-

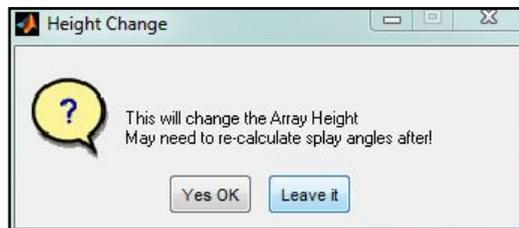


	Type	Angle
1	MLM	Aim
2	MLM	0.5
3	MLM	10
4	MLM	10

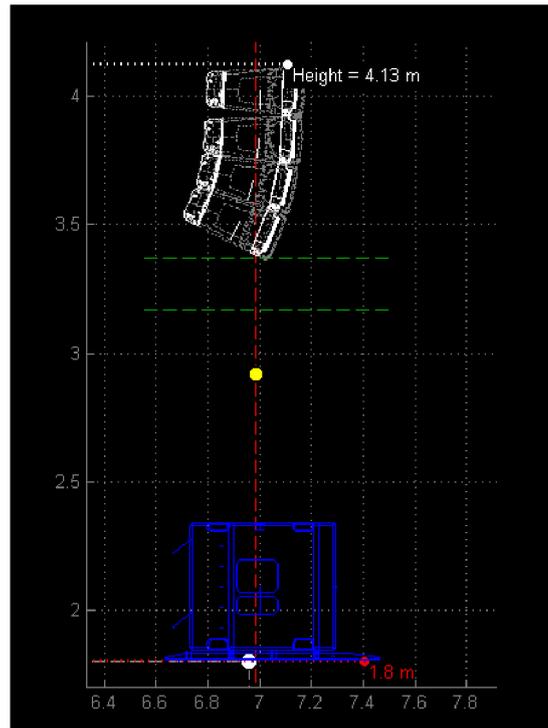
We can see that the array is far too high to fit on the standard pole so the first job is to correct the height to something that is usable in the real world. This is provide for pole mount deployment by the 'Fix Height' button;-



Clicking this will lower the array, again showing the warning pop-up that the array height will change;-

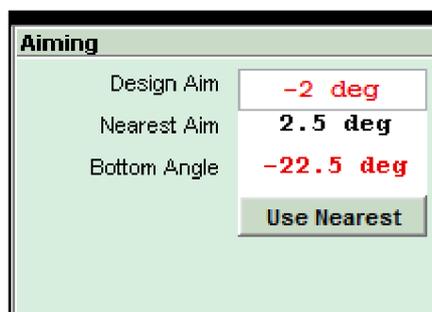


The array is now at a sensible height above the MSX;-

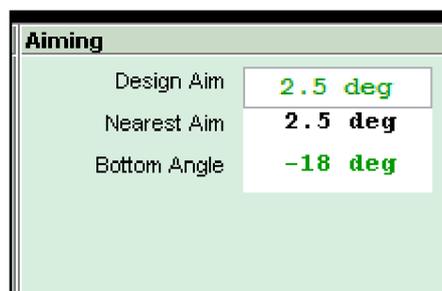


Note that the array height displayed is the height from the ground NOT above the MSX. You can see that the MSX is at 1.8m, perhaps on a stage so the top trim of the array is at  $4.13 - 1.8 = 2.33\text{m}$  above the surface on which the MSX is placed.

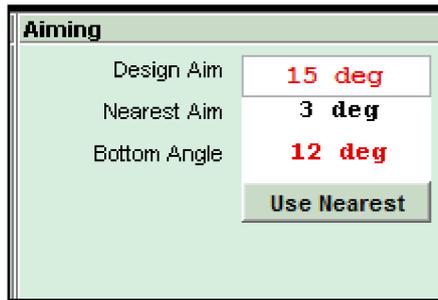
The next issue is the array angle. The Universal bracket allows for a tilt from 0 to  $-18^\circ$  ( $18^\circ$  down) if the optimisation has created an angle greater than  $-18^\circ$  the angle will be displayed in red with the option to 'Use Nearest';-



By clicking 'Use Nearest' the angle will revert to  $-18^\circ$  the array diagram will update and the design aim will update and turn green;-



The same applies in the unlikely event of the optimisation arriving at an array angle that requires the bottom cabinet to have an angle greater than  $0^\circ$ , an up-tilt in other words;-



Clicking on 'Use Nearest' will change the Bottom angle to zero and update the diagram and Design Aim;-

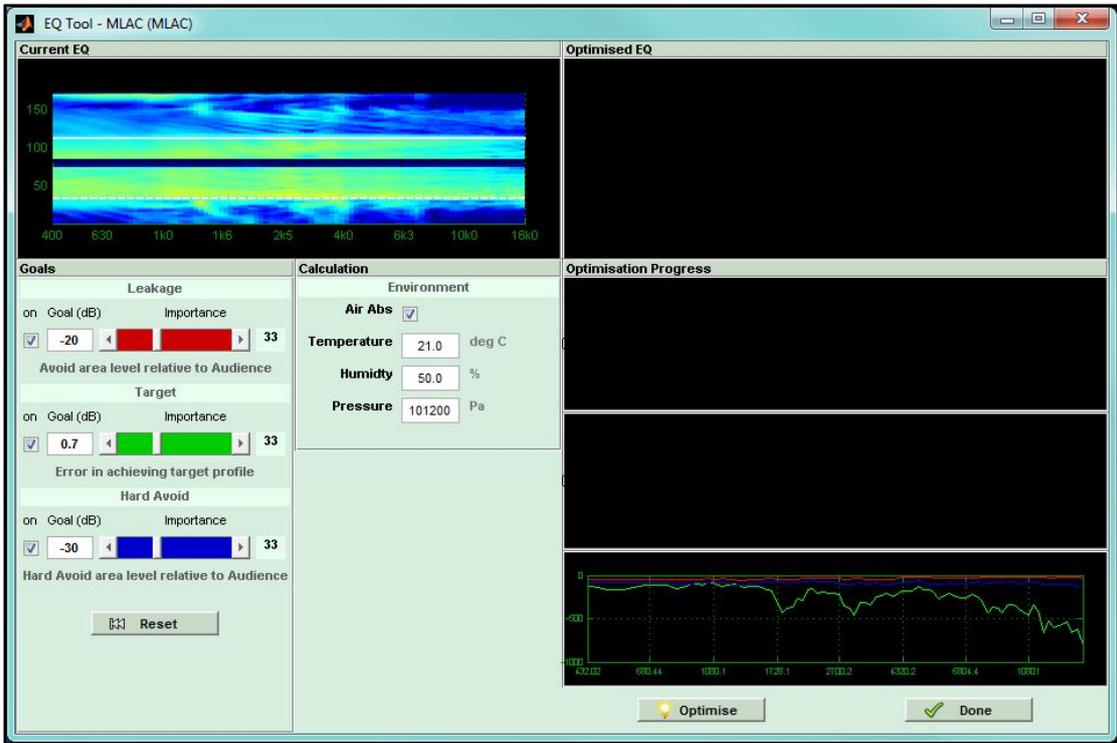


Once you have finished with the Rig Tool, click '✓Done' to close the window so you can advance to the Equalisation optimisation using the EQ tab.

### EQ Tab

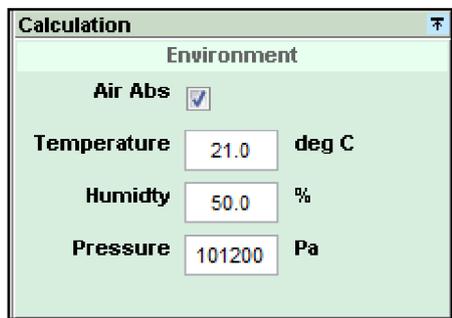
The EQ tab is where we make the decision on how we want the system to perform. In a perfect world we could get the system to achieve an even coverage over the audience area with absolutely no spill whatsoever outside of this. Of course the laws of physics dictate that this is impossible to achieve even with the colossal processing power available in a multicellular system. We therefore have to balance our requirements between the three principal objective functions; our audience target, the spill into non audience areas and spill onto areas defined as hard avoid.

This is the EQ Window;-



The Current EQ section shows the system response that we saw when we had finished the splay optimisation. The blank windows to the right will show the Optimised response as the optimisation is taking place.

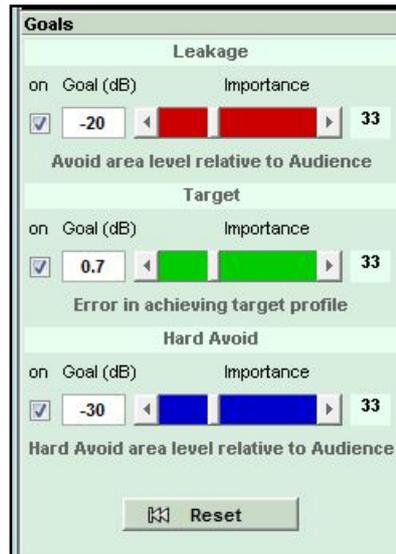
### Air Absorption



The Environment window allows you to activate the air absorption system which will compensate for the environmental conditions in the same way as the system did for the splay angles. The temperature, humidity and pressure can be entered into this window

### Goals

The Goals section is the critical point where we activate and set the values and balance of goals for the EQ optimisation.



The three goals are Leakage, Target and Hard Avoid. The relative balance for each of these is controlled by the horizontal faders with the numeric percentage value of each showing to the right. The default starting position is each with equal importance so a level of 33% for all three (yes that equals 99% not 100, get over it...).

Leakage is the spill onto non-audience areas the importance slider is coloured red to match the red non-audience planes in the Coverage tab. It can be deactivated by un-checking the 'on' box. The default value is 20 which means that the system will attempt to achieve a level at least 20dB below the audience level.

Target controls the audience level, as with the other goals it can be deactivated. The option is primarily there for consistency, it would be highly unusual not to want to optimise the audience area but not impossible, for example, if you had an area off site where it was crucial to keep levels to an absolute minimum you would make the area hard avoid and give maximum priority to the Hard Avoid goal by deactivating Leakage and Target. Target is shown with a green slider also to match the green audience region in the Coverage tab. The goal figure is 0.7dB by default so the optimisation will attempt to match the magnitude contour set in the Coverage Tab to within 0.5dB.

Hard Avoid also has an 'on' check box and a blue importance slider. The default Goal is 30dB lower than the audience level for any plane selected as hard avoid.

The importance sliders allow you to set the relative importance of each of the three goals, two if you have one of the goals switched off. If you have two switched off the fader for the remaining function will automatically go to 100% and will no longer be adjustable. If you attempt to switch off all three goals the system will automatically turn Target back on (see, it's not so easy to break it!). When you adjust any of the three sliders, the other two will automatically compensate for example if you move target to the right towards the maximum, both Leakage and Hard Avoid will move down. If you think in percentage terms, all three start with equal precedence at 33%. If you move Target up to say 70%, Leakage and Hard Avoid will decrease equally to 15%. Now if we move Hard Avoid up to 35% both Leakage and Target will move down an equal amount from their previous position so will end up at 5% and 60%. The actual figures are not particularly vital, what the sliders give you is a quick, easy way of balancing the relative importance of the three goals to achieve the results you want at a glance. There is a reset function which will turn on all three goals and return all three faders to the default, 33% position. It will not however reset the figures for the goals, if you have changed these you will need to change them back manually.

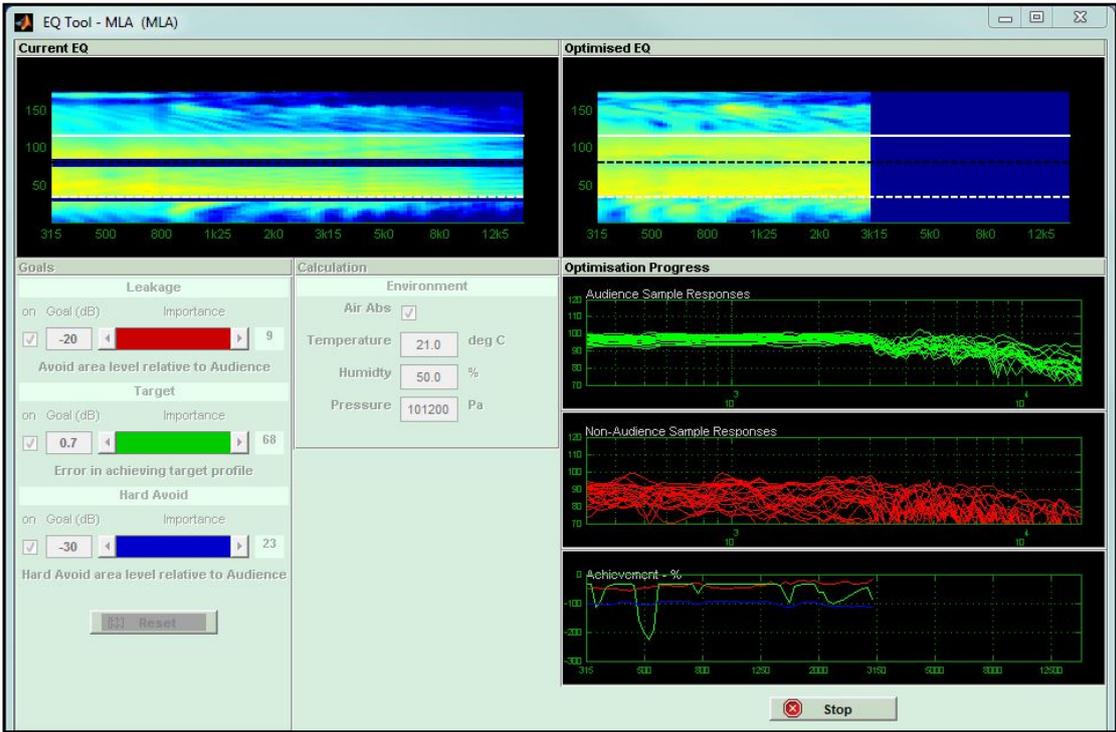
To show the optimisation results, we have set the faders as follows:-



We have given the target the greatest importance, hard avoid comes second with little importance to leakage. We want to get the best coverage for our audience whilst minimising sound on stage and reflections from the balcony. The rest of our venue is not too reverberant so we are not too concerned about spill onto non audience areas.

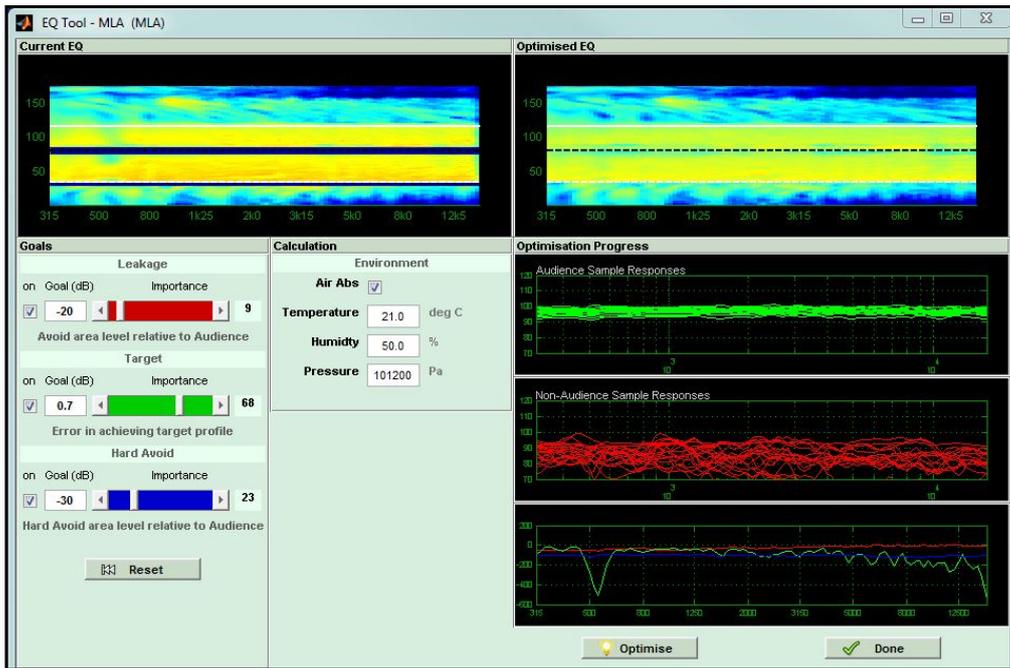
Optimise EQ's

Once we are happy with the goals we have set we can start the optimisation process by clicking the Optimise button;



The Optimisation starts with low frequencies and moves up, displaying the result on the upper index plot as well as showing plots for the response in the audience and non audience areas. As we have given the audience a high priority we can see the individual measurement points previously wildly varied, starting to cluster much closer together. We have requested a start to finish differential of +/- 3dB and the spread of magnitude certainly looks close to 6dB. The non-audience plot shows that the response is still quite varied which is expected as it was low priority on our goals setting. The lowest plot shows how close to the requested goal each of the three parameters has got to as a percentage. The levels closely match the relative importance that was allocated to each of the three objective functions, target in green is close to 100%, hard avoid in blue hovering around 80% and non-audience around the 50% mark.

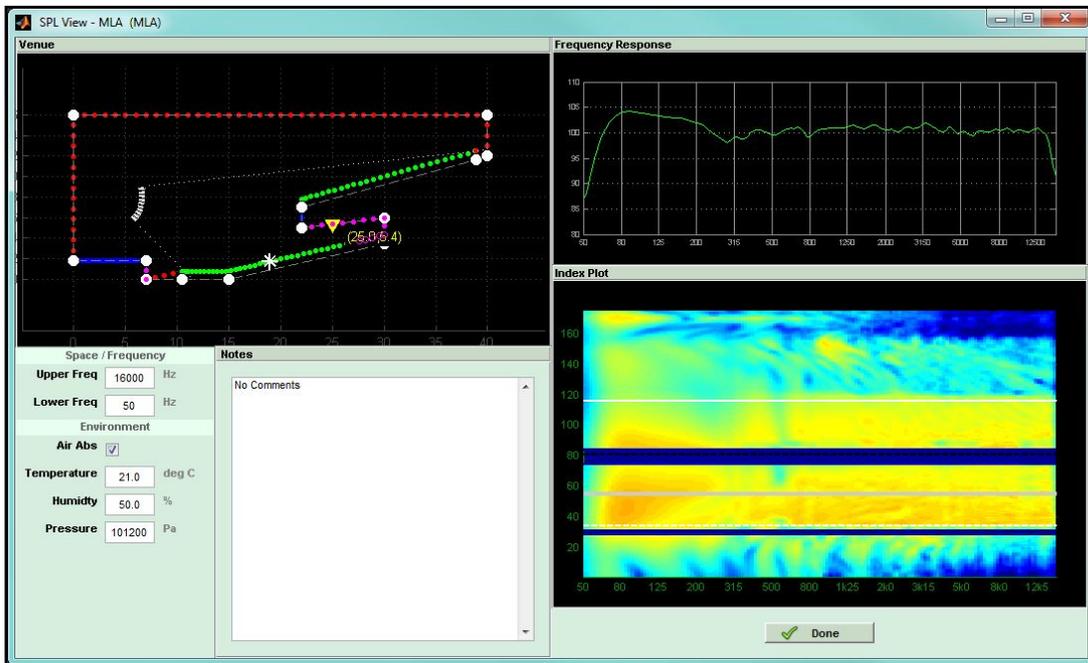
Here is the finished optimisation



This looks like a very good achievement with an even block of orange over the audience region and a decent band of blue both on stage and where the balcony front is. If we are not happy with the optimisation we can go back and change some of the objective functions and click 'Optimise' again. If you are happy with the results click 'Use' which will store the EQ files ready for export then click 'Done' and we can look at the result in more detail.

### View the SPL

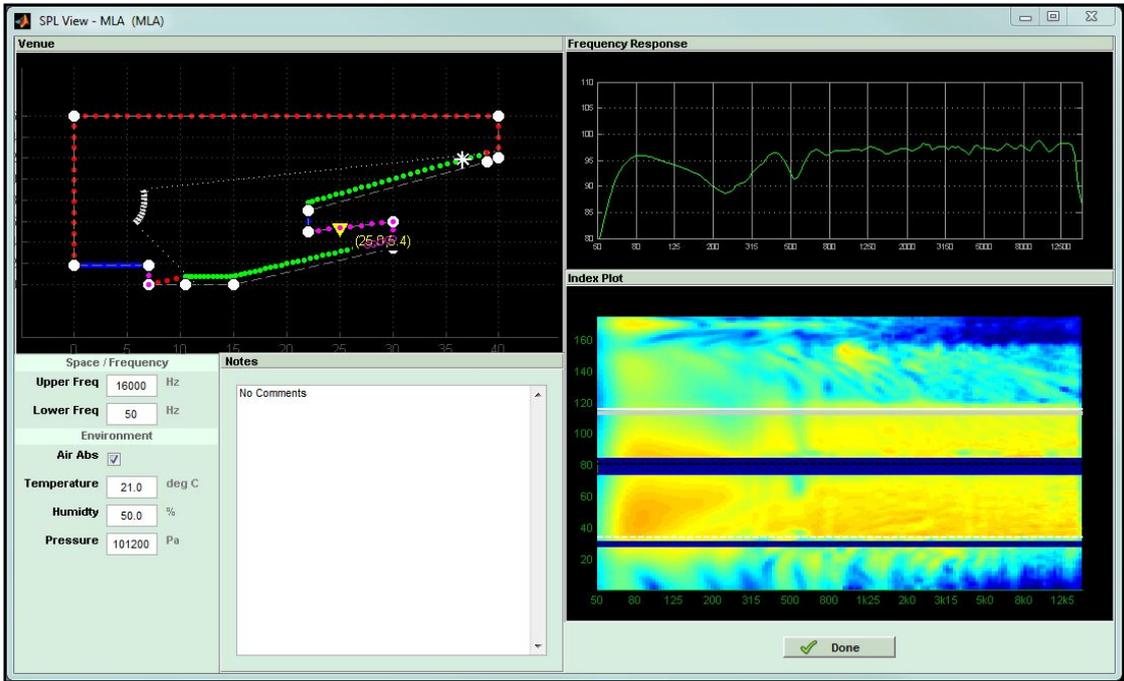
The final tab is the SPL View which gives us the opportunity to view the optimised result in more detail. Here is our test venue:-



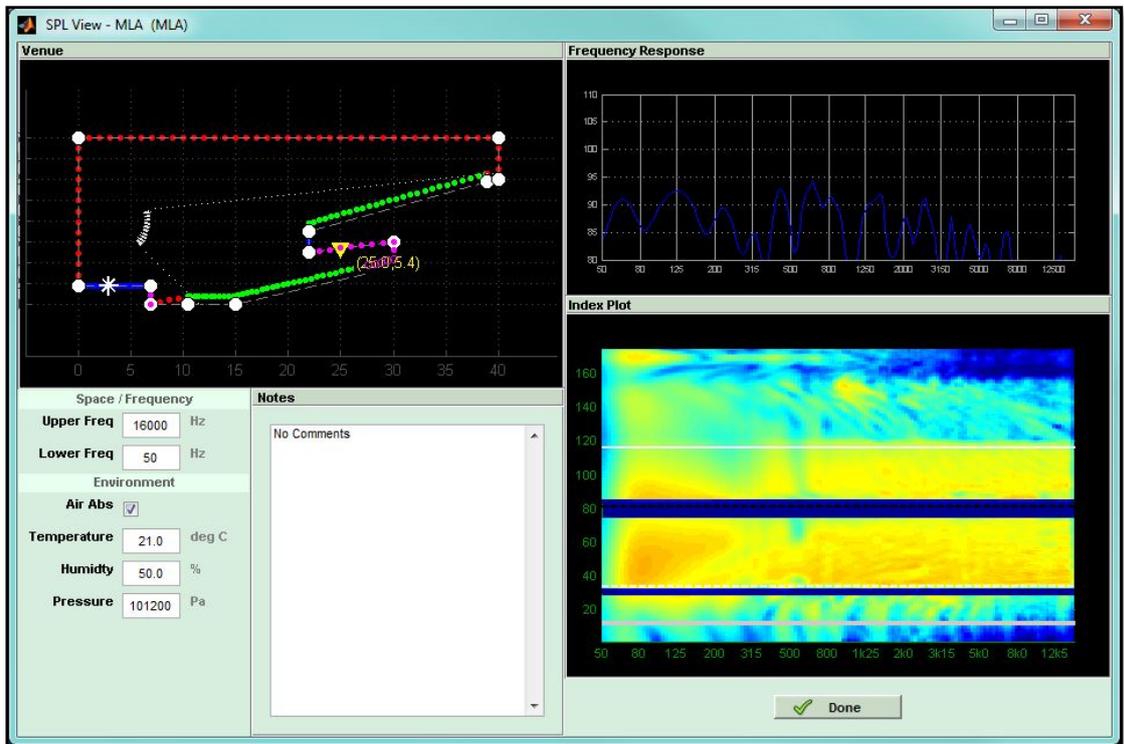
On the top left we see our coverage slice, the bottom right is the index plot and the top right shows the frequency where our cursor is placed on the index plot which will show green when the cursor is over an audience area, red when it is over a non-audience area and blue when over a hard avoid area. The cursor is shown as a thicker grey line on the Index plot. The cursor position is also shown on the venue slice as a white asterisk. As you move your cursor position on the index plot the white asterisk

moves on the Venue diagram and the frequency response plot updates instantaneously. If you are using a mouse with a scroll wheel you can change the vertical axis on the frequency response plot to reposition the plot.

The performance looks very good, a slight low frequency lift which we would expect as the lower the frequency the more difficult it is to optimise, the response form around 600Hz and above is extremely flat. Let's take a look at the results in other positions;-

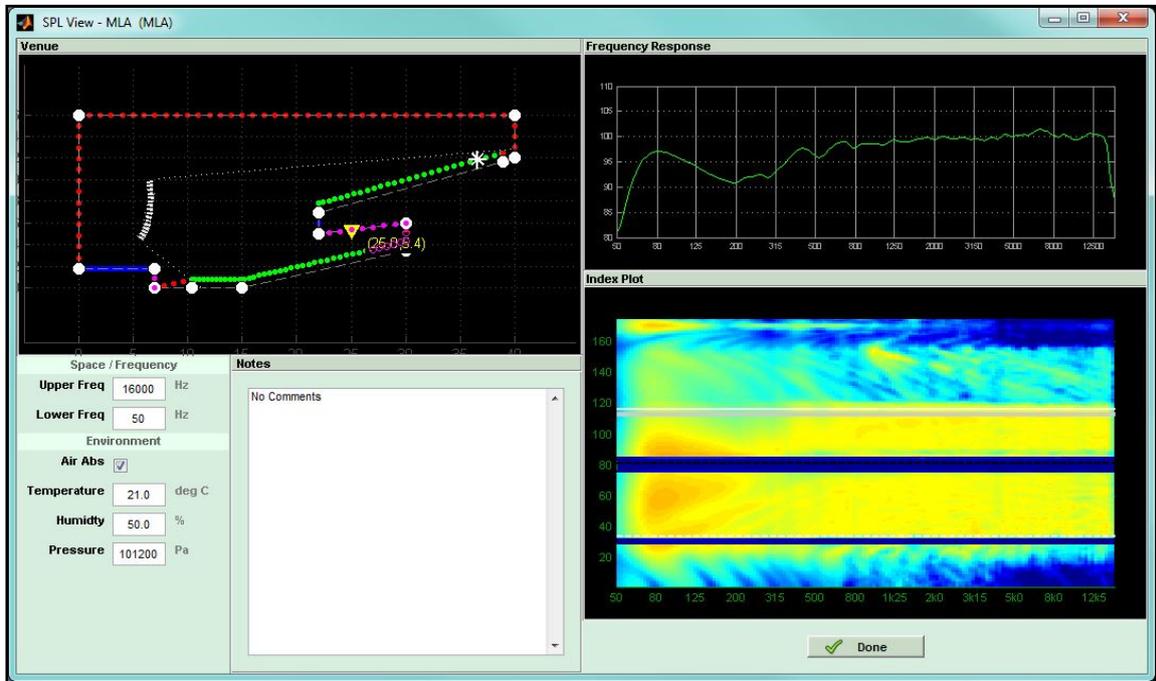


Here we see the response right at the back of the balcony which is still quite astonishingly flat. We can be very satisfied that we have achieved an extremely good even coverage for all audience members in this venue. It is also worth taking a look at how well we have avoided the stage;-



This shows the response on stage and the hard avoid here has done an astonishing job of reducing levels on stage, the attenuation is dramatic, it is fair to say that the array will be almost inaudible on stage.

A ten box system is actually a little bit of a stretch for this venue so here is the optimisation shown in the chapter on index plots with a 16 box system, first optimised purely for the target ignoring non-audience and hard avoid. The SPL profile has been set to 0dB from audience start to finish;-



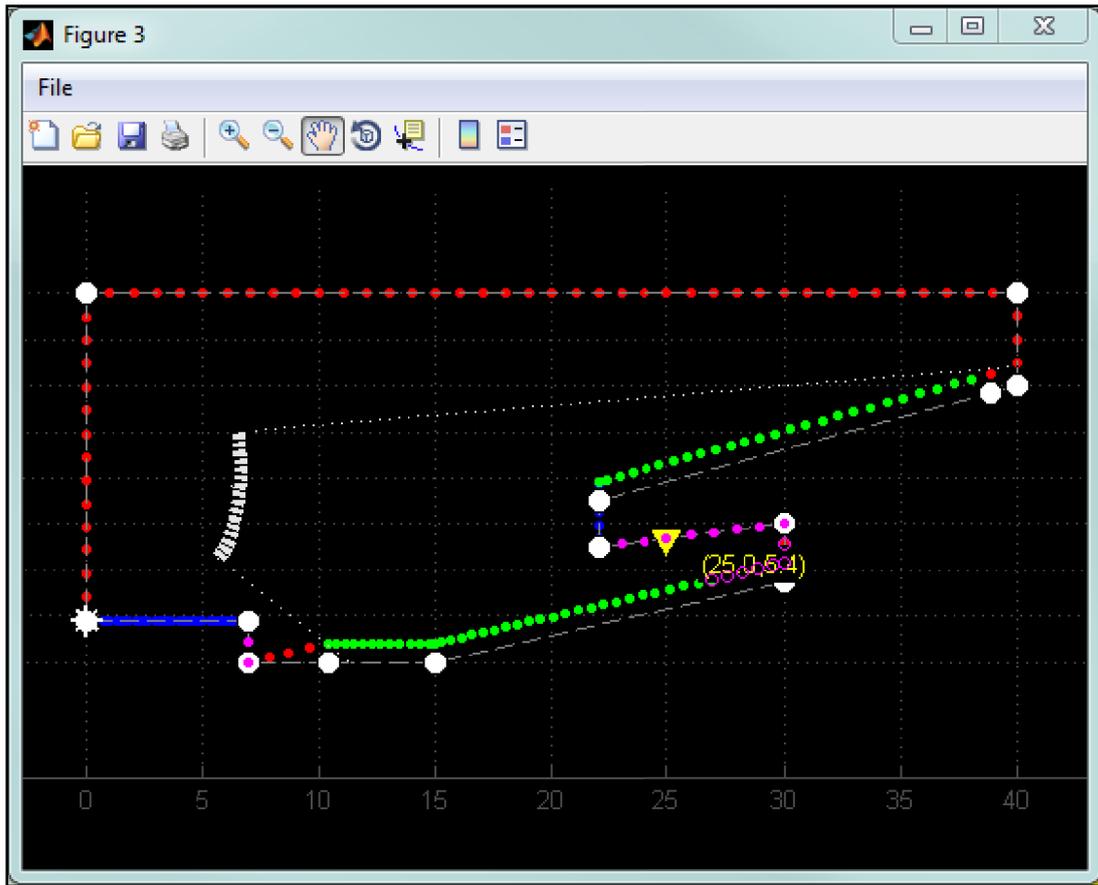
As you can see, the response right to the back of the balcony is incredibly flat from around 500Hz and above. Below the frequencies at which the optimisation is effective there is the expected low frequency roll-off but the mid-top response is incredibly consistent

### Individual Graph Windows

Many of the graphical views produced in Display 2 can be opened in an independent floating Window and the file saved as a file. This includes the following views;-

- Coverage Tab**
  - Venue Diagram
  - Target Coverage Diagram
- Splay Tab**
  - Current Acoustic Output Graph
  - Array Diagram
- Rigging Tab**
  - Full Array Diagram
- EQ Tab**
  - Current EQ Index Plot
  - Optimised EQ Index Plot
  - Audience Sample Responses Graph
  - Non-Audience Sample Response Graph
  - Goal Achievement Graph
- View SPL Tab**
  - Venue Diagram
  - Frequency Response Graph
  - Index Plot

The Window can be very useful for comparing graphs from different optimisations, storing them for future use or looking at them in more detail. The window is opened by right clicking on any of the views listed above, this is an example of a Venue Diagram from the Coverage Tab;-



The Window has the following menu bar which is the same regardless of which view is opened;-



This offers a host of extra functions for further manipulation of the graph. The first icon is for creating a new figure as they are referred to, this obviously has little use within Display 2;-



Next you have the option for opening a file, this would be used for opening a figure you have saved previously.



The save function allows you to store the current figure in a file location of your choice. Navigate to a suitable location, the name will default to a highlighted "untitled" prompting you to give it an appropriate name before clicking 'Save' to store the file.



Print will open the Print dialog for your default printer.



The zoom function, as you would expect the + allows zooming in, click on the + symbol then click on the graph and you will zoom in 100% (double the original size), further clicks will zoom in by another 100%. Clicking on the – has the reverse affect, each click will reduce the size by half (-100%). A more useful zoom function is available using click and hold. This function is available by selecting either the + or – zoom buttons. If you click and hold and move the mouse forward you will gradually zoom in, move the mouse backward you will zoom out.



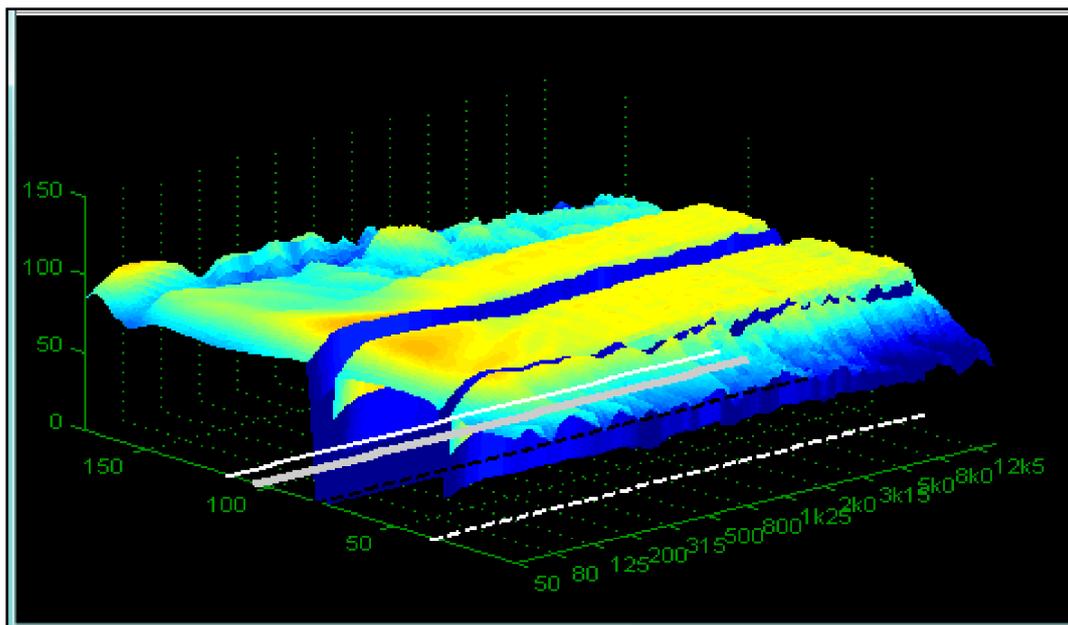
The Pan icon allows you to click and drag the graph to a new position, useful for examining areas of the graph once it has been enlarged using the zoom command.



The Rotate 3D command is extremely powerful for certain types of graph. In particular an Index plot quite literally has an extra dimension when viewed using this command.



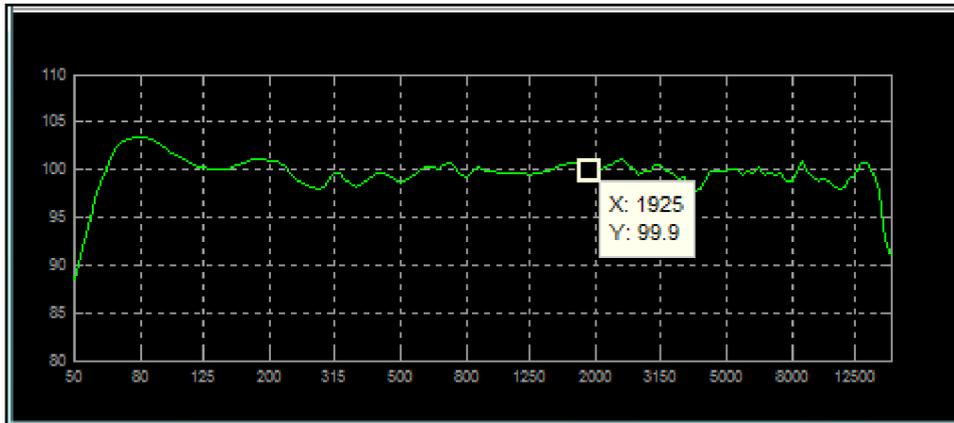
By clicking on the graph and dragging you can manipulate the 3D view to give a very helpful view to assist in visualising the system performance. The 3D view below is one of our sample venues. The spl colours now also correspond to the vertical axis "z" axis of the graph so you can very easily identify peaks and troughs in the spl profile.



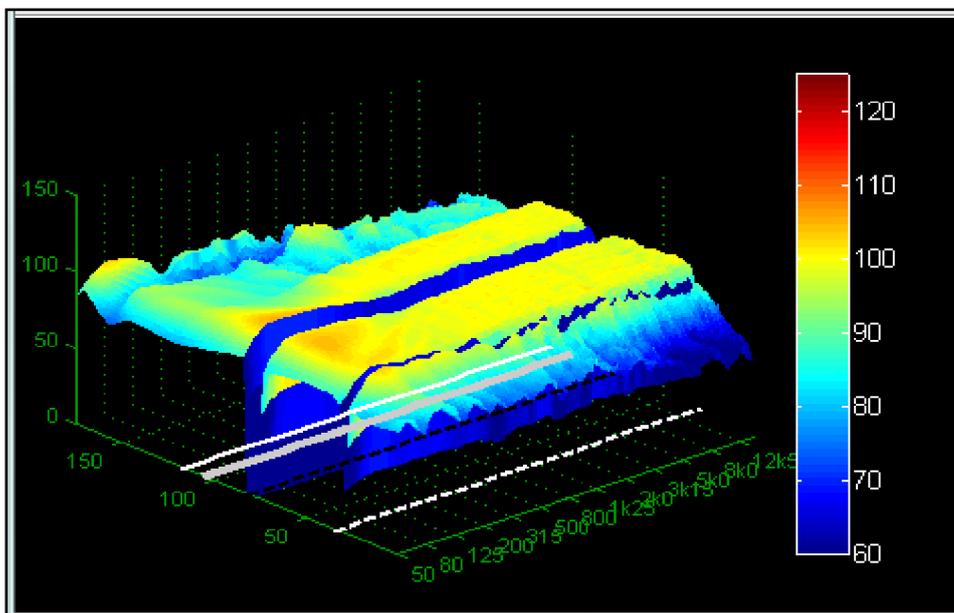
The Data Cursor is useful on graphs such as the frequency response as you can click on any point of the graph and see a value for both x and y positions;-



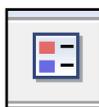
You can continue to click on new positions on the graph to obtain readings for as long as the Data Cursor button is selected.



Insert Colorbar adds a reference bar to the graph;-



Insert Legend is a function to add a key to the graph but this has not been adopted in Display 2.1

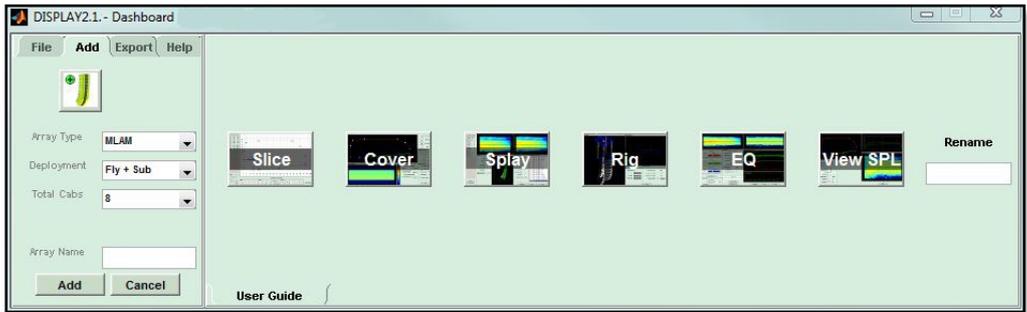




### Adding additional arrays

It is very common to have additional arrays deployed at a venue, particularly side hangs in venues where the stage projects out into the arena and there is perhaps banked seating either side of stage. With MLA Mini having a horizontal dispersion of 100° it is obviously impossible to achieve coverage right round the sides of a stage so side hangs are often essential. You may also have to deploy delay hangs larger auditoriums. These can all be catered for in the same Display 2.1 Mini project by adding the extra arrays as required and going through the same design process we have already used for each array.

If we select the Add tab and click on the add array button, we will see the same dialog window open that we used when we created the original array. You will notice however that the tab for the first array is still present;-



We will add a second array of eight MLA Mini to be used as side hangs so will name them "Sides". Once you have entered the name, click on Add and a new tab will be created;-



You can now go through the same design process defining the 2D slice, array position, audience planes and optimisation coefficients exactly as we did for the main array, we can return to edit the main array at any time by clicking on the tab. As mentioned previously, we can rename either of the arrays by selecting the correct tab, typing the new name in the Rename box and pressing enter.

You can enter dozens of arrays, only seven will be visible at any one time as the dashboard cannot be expanded on the present version. Arrays added above seven cannot be accessed until you delete one of the visible arrays.

### Deleting an array

To keep your Display project tidy and the file size reasonable you may need to delete arrays that are no longer required. This is very simple, select the array by clicking on its tab and type 'delete' in the Rename box and press Return. The array tab will disappear. Note that you must type 'delete' or 'Delete', if you or type the whole word in upper case you will simply rename the array "DELETE".



## Exporting the Optimisation

Once you have completed your array designs you need to export the file so it can be uploaded into the system via Vu-Net. Note that you MUST click "Use" when you have finished an EQ optimisation to make it possible to export the files. On the Dashboard select the Export tab, you will see three options, the first is to generate a TXT balloon file, the next will produce a DXF wireframe model of the array and the third will export D2P files of your optimisation which can be uploaded into the system via Vu-Net.



### Exporting D2P Files

First we will look at Exporting D2P files of your EQ Optimisations. Click the Export to VUNET button



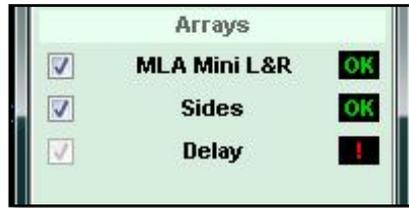
You will see the export window open;-



The First step is to create a file into which the D2P optimisations will be loaded. The Export Root defaults to your PC C: drive but it is good practice to save your files to a dedicated folder which can be used to store all files created for a particular project. Click on the small box on the right of the Export Root section, navigate to a convenient file location, and if necessary create a new folder first to drop the file into. The Export Root will show the file location;-



You have now created a file but until you run the next stage there will not be any optimisation files present! You will see a list of all the arrays you have created which will have a green OK symbol if the optimisation files were saved by pressing 'Use' when the optimisation was completed. If the design process was incomplete for any reason there will be a red exclamation mark showing:-



If this is an array that is not required you can continue, if it is one that is needed you should click 'Done' to close the Export window and return to the array to complete the optimisation process.

If you have all the required arrays present you can select them for export using the check box on the left. By default this will be all completed arrays but if there are some which were unsuccessful attempts you can un-check them so they cannot accidentally get used.

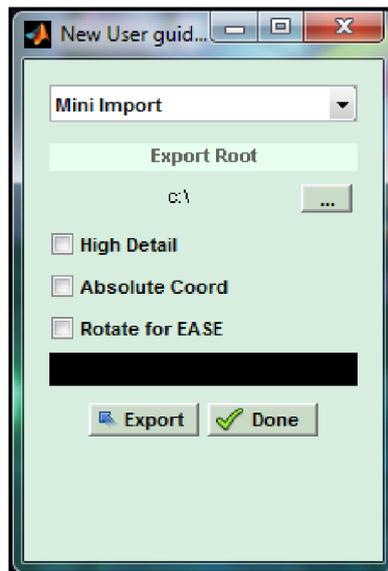
Click Export and a line of text in green appears at the bottom of the window showing the export process taking place. Once this disappears the export is complete and you can click done to close the window.

### Exporting to DXF

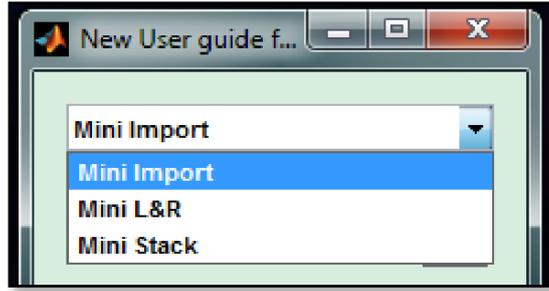
The final button on the Export section allows the exporting of a wireframe model of the array for use with AutoCad;-



Clicking on the button brings up the following Window;-



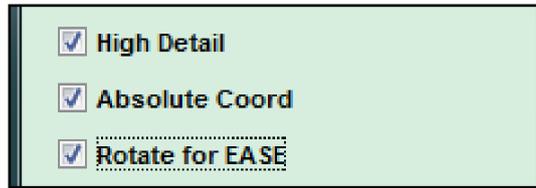
As with Balloon Exports the first stage is to select which of the arrays in your project you wish to Export using the drop-down at the top of the window;-



Next click on the box on the right to navigate to a suitable file location in which to save the exported file;-



Next you have three options to adjust the parameters of the exported DXF;-



High detail will produce the best quality of drawing but with a larger file size, with large arrays it may be necessary to select standard detail to keep the files size manageable.

Absolute coordinates will position the model according to its position within the venue. With this un-checked the model will not have any location parameters specified, it will essentially be free-floating.

Finally, if you intend to import the DXF into EASE you need to click the Rotate for EASE option to ensure that the model will be correctly orientated which used with EASE.

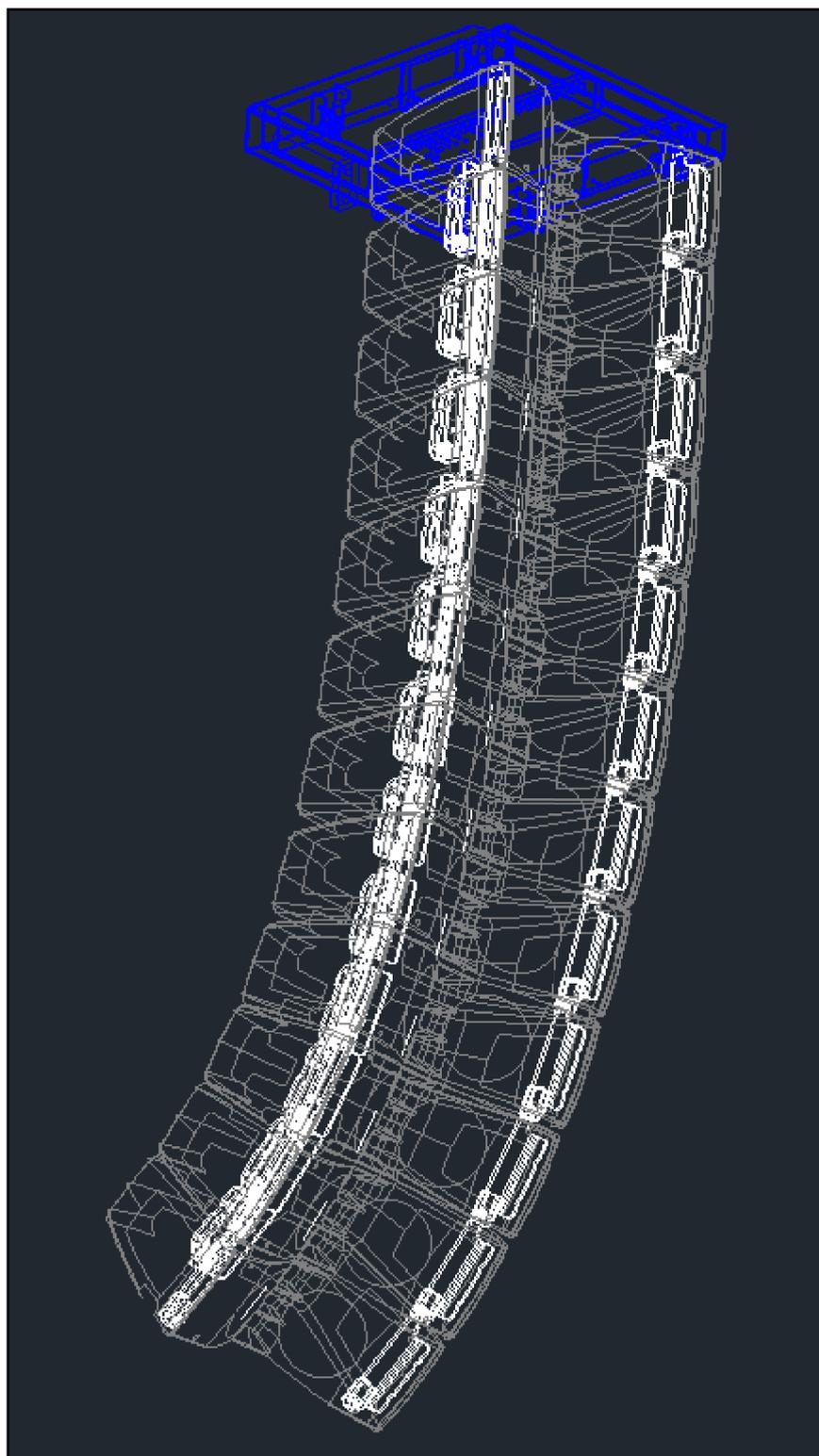
When you are happy with your choice of parameters, click the Export button. The black window will show the progress of the Export;-



When the Export is finished you will see an indication in the widow;-



Click the ✓Done button to close the Export window. Here is an example of a DXF export viewed in AutoCad;-





## Vu-Net

### Introduction

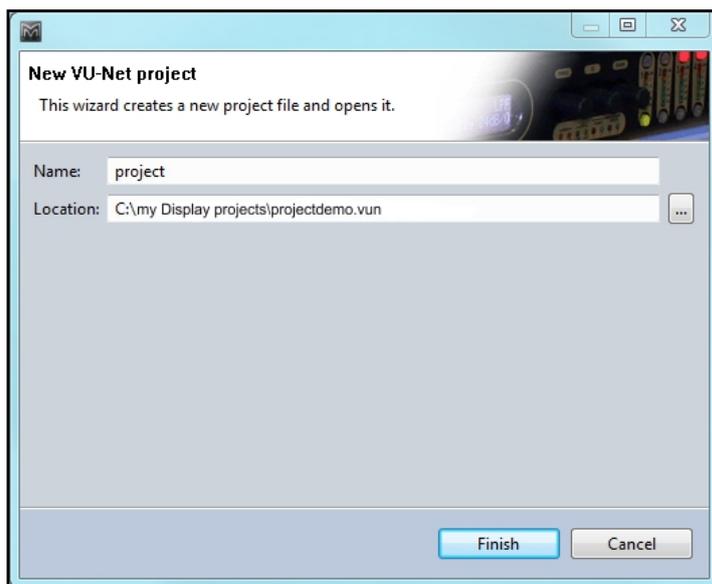
Vu-Net is the application used to connect to a U-Net enabled device such as the multicellular family of products, the DD12, PSX or Merlin processor. Connection to the cabinets is achieved using the U-Net network protocol. Vu-Net is used to monitor and control the system, EQ optimisations are uploaded from the program and cabinet firmware is checked and updated. Vu-Net is supplied ready installed on the Lenovo tablet PC supplied with MLA and MLA Compact systems. It is an optional method of control for full use of MLA Mini and DD12.

### Menus

Before we look at the design process that is used with a system it is worth taking a look at the file structure which we will refer back to throughout the chapter. When you run Vu-Net you will see the following Window;-

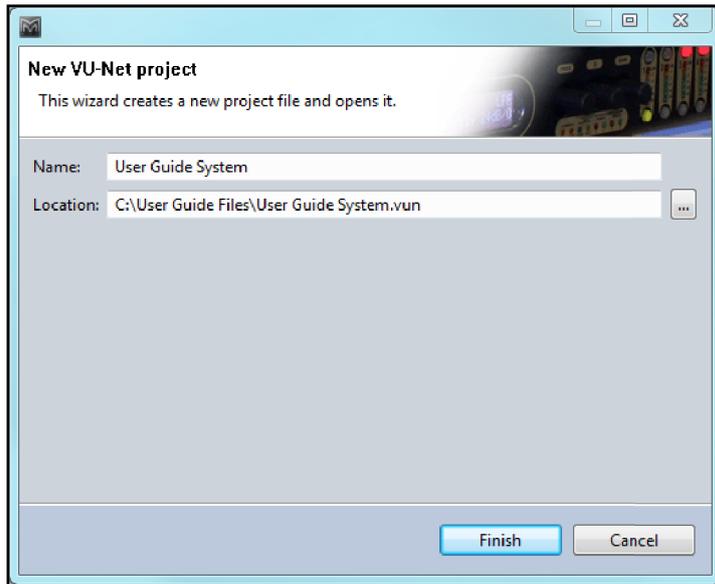


This is a blank screen with only 'New Project' and 'Open Project' active prompting you to start by using one or the other. Start by clicking on 'New Vu-Net project'. You will see the following window;-





Type a name for your project and select a suitable file location. As with Display 2.1 we would recommend creating one folder for all related files for a given event.



Once you have selected an appropriate name and file location click finish and a new project will be created;-



You will notice that the top left of the main window has your project name and a number of options on the toolbar are now available.

### Window components

The window has a number of distinct sections with their own function;-

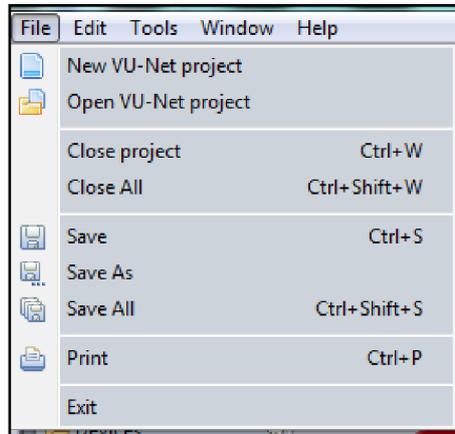
#### Menu and Toolbar





Along the top of the window is a standard file menu and tool bar which gives quick access to a number of functions;-

File



The File menu controls all file management tools. The 'New VU-Net project' duplicates this function on the tool bar and is how you create a new project. Note that you can have several projects open simultaneously although it is not something you will need to do particularly often.

'Open Vu-Net project' enables you to open a project you have previously created and saved. As Vu-Net does not have an auto-save function it is wise to save your work at every step as is good practice for any PO application.

'Close project' closes the presently active project leaving open any others that are also open in the file.

'Close All' closes all projects enabling you to start from scratch without closing and reopening the application.

'Save' is the standard Windows function to save the project, if it is the first time you have saved the project a window will appear giving you the opportunity to give the project a name and to choose a convenient file locations. As with Display 2.1 it is sensible practice to save the file in a folder dedicated to a specific event. All subsequent Saves will overwrite the existing file. As shown, the keyboard shortcut Ctl+S can be used to save a project. It is a good idea to frequently save your work. Vu-Net files are saved with a .vun file extension.

'Save As' gives you the facility to save your project with a different file name, retaining the original project. This could be useful if you wanted to try something but still have the option of returning to you original project file.

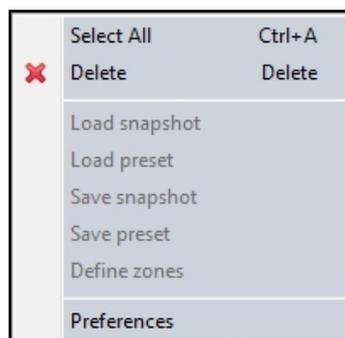
'Save All' will save all projects running in the file simultaneously.

'Print' will print the system layout in the main system overview window.

'Exit' will close the application

Edit

The Edit menu has a number of functions available;-



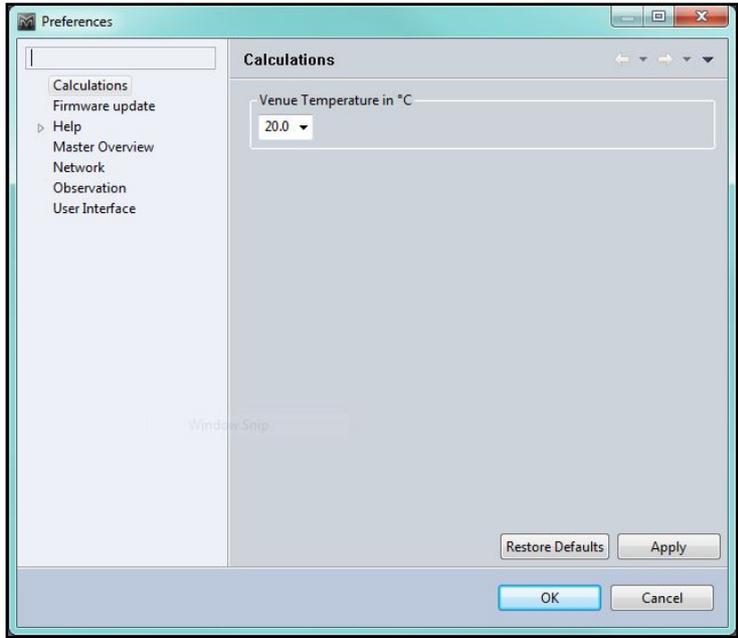


'Select All' selects every item on the main project window. All selected items will show four square black dots in the corners around the object or objects.

Load snapshot, Save snapshot, Save Preset and Define zones are functions relating to the arrays in the project and will be covered later in this manual.

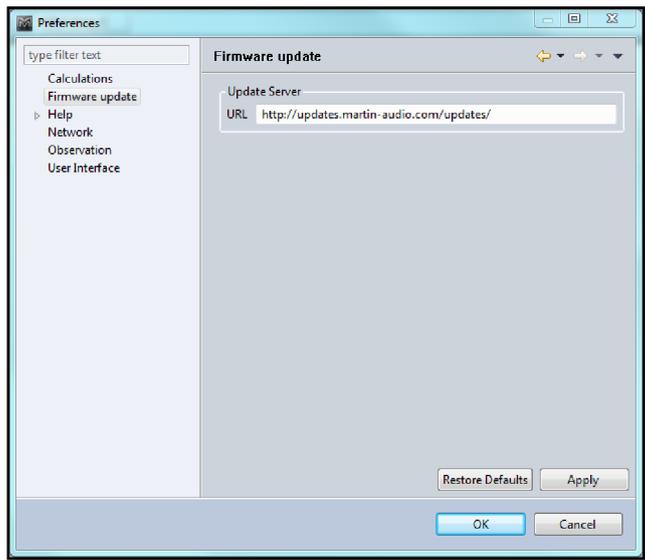
### Preferences

Preferences have some important options for how Vu-Net operates;-



**Calculations:** The first option is labelled 'Calculations' and allows you to select the venue temperature in steps of 5°. This is used when the option is selected in the Merlin Controller to read delay figures as a distance as opposed to time. The temperature adjustment calculates the delay time according to the speed of sound at that temperature. Select the desired temperature using the drop down box or an exact value may be typed directly into the box and click 'Apply'. Note that if you have a Merlin open in the project window the change will not be visible until you close it and reopen.

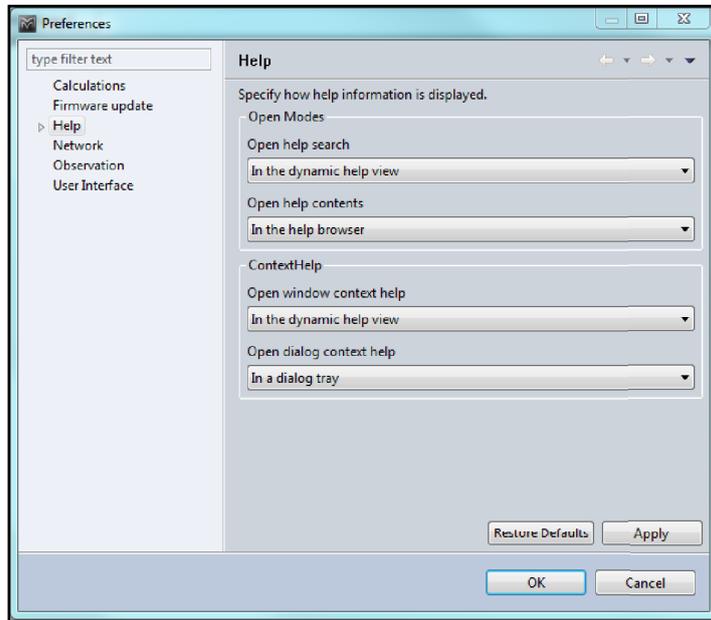
**Firmware update:** The next option is Firmware update;-





This shows the web URL for the system to search for firmware updates which will be covered in the Firmware chapter. This should not be changed unless notification is received from Martin Audio to do so. If however it accidentally gets changed or deleted it is possible to reset all Default parameters by clicking on the Restore Defaults button. Note that this restores ALL Preferences so any that you wish to retain will have to be re-entered.

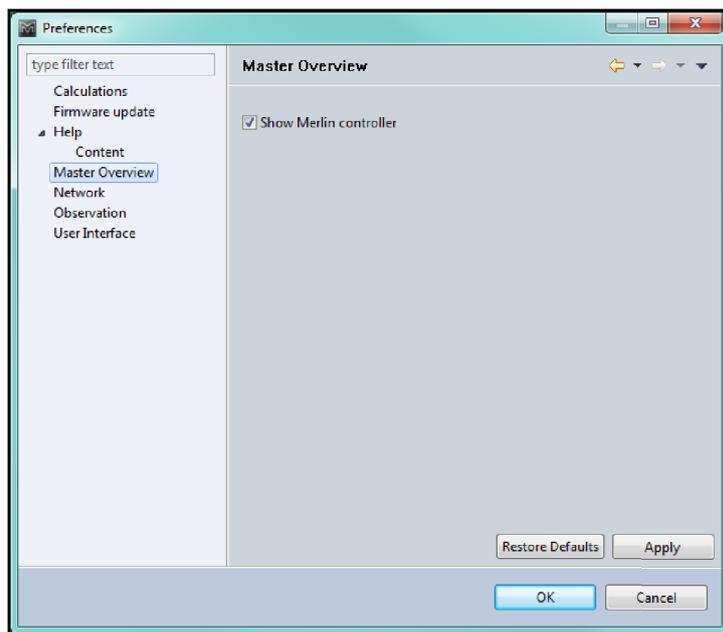
**Help:** Next are options for how the Help menu is displayed;-



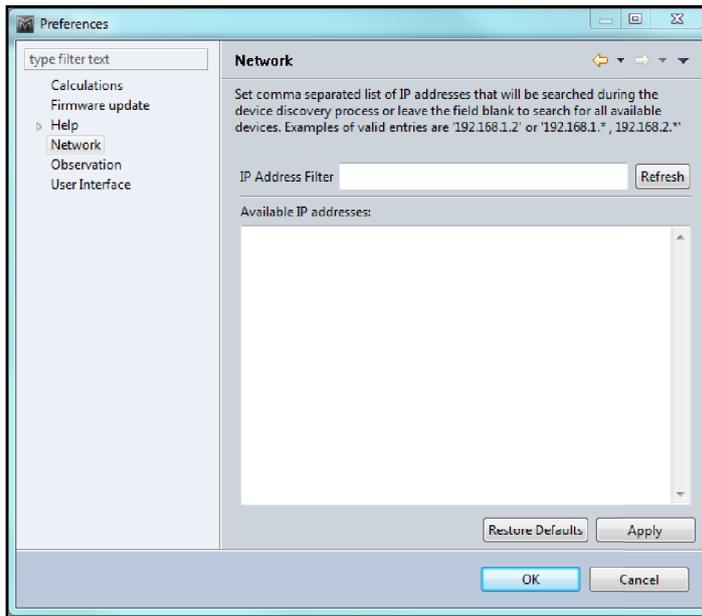
By default the help window is displayed in a dedicated help browser but you can select it to open in your default Internet Browser. Context help which responds dynamically to objects selected can be displayed as a window on the application or as an “Infopop”

Help includes a sub-menu for accessing help from remote infocenters. This is not currently operational and will be a future upgrade.

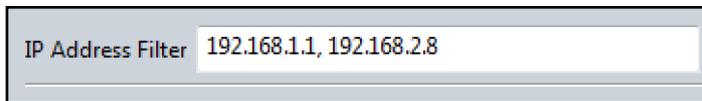
**Master Overview:** There is an option within Master Overview to show the Merlin Controllers in the system in the Overview tab. This is for systems where Merlins are used purely as a network interface with no audio passing through them which would make it unnecessary to monitor them in the Master Overview screen;-



**Network:** The Network option is an important section for determining how devices are found on the Ethernet network;-



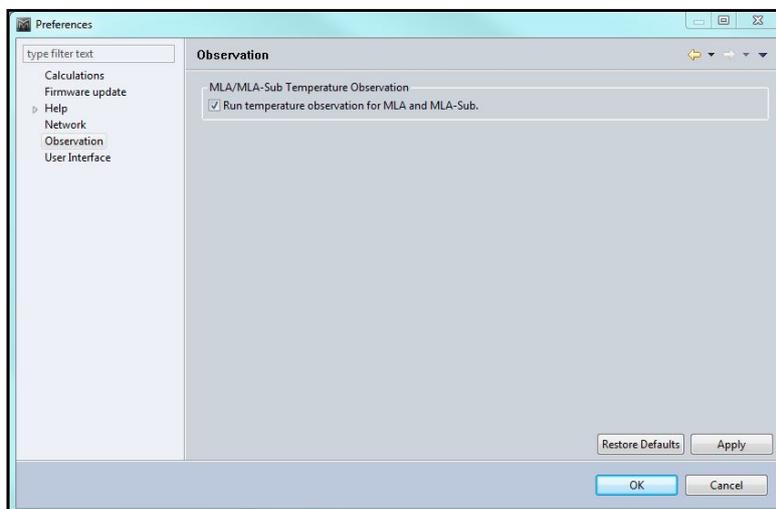
Running the application off line will display a blank window as shown. When you have one or more (usually at least two for MLA and MLA Compact systems) Merlins connected their unique IP address will appear listed in the bottom 'Available IP addresses'. You can set an IP address Filter in the smaller window which will search only for IP addresses within the range of values between the two entered which should be separated with a comma;-



This could be used if you have two systems running on the same Ethernet network and need to control them independently. Only devices with their IP address set to within the filter range will be found and the system will work completely independently as if there were no other devices on the network.

Note that if you are connecting to MLA Mini, DD12 or PSX via their integral USB port, no IP address will be visible. This function is only applicable to networks supported by Merlins.

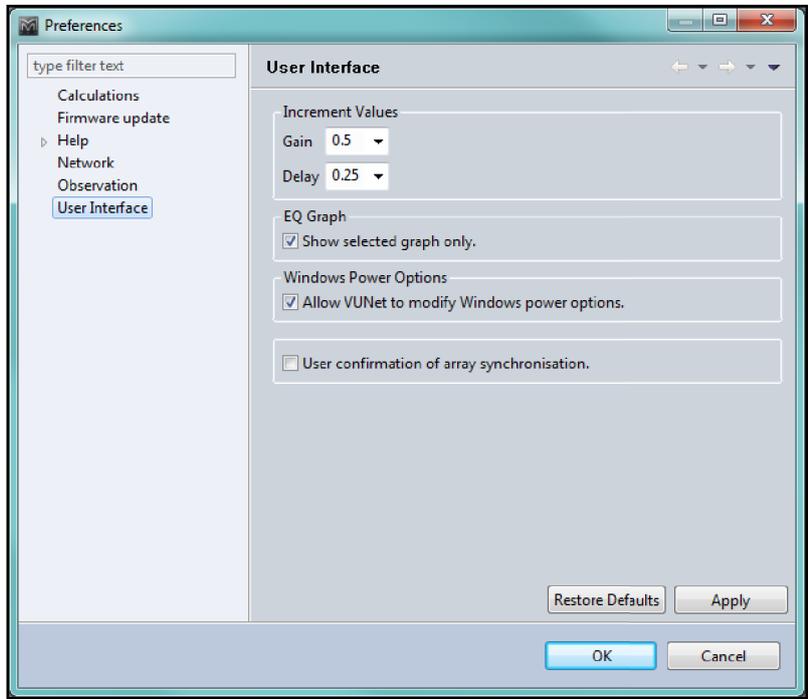
**Observation:** The next available option is Observation;-





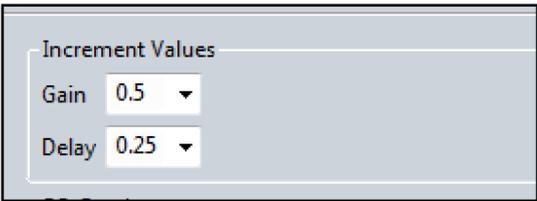
This enables two options for connected cabinets. The first is to run temperature monitoring for all amplifier and DSP modules displayed in the array windows. These display two temperatures, the hottest of the amplifier modules, the module concerned indicated by a number from 1 to 3 for MLA and MLA Compact (the amplifier modules are two channel). The second value is the temperature of the module DSP section. This can be disabled to speed up network traffic for large, complex systems.

User Interface: The final option in the Preferences window is User interface;-



This allows customisation of certain functions within the application.

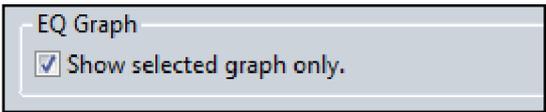
Increment Values;-



These allow the default increment values for both Gain and Delay to be changed as required. The default for Gain is 0.5dB but the options are for increments of 0.1, 0.2, 0.25, 0.5 or 1dB.

For delay, the default is 25ms, the options are 0.1, 0.2, 0.25, 0.5 or 1ms.

EQ Graph controls how the various parametric EQ filters are displayed in the array and Merlin windows;-



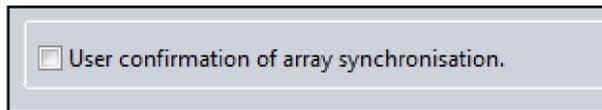
By default the graph will display the selected filter band that is being adjusted and the overall frequency response which keeps the display from getting too cluttered. If you un-check the box the response of every active filter is displayed individually as well as the overall response.

The Windows Power Option;-



Allows Vu-Net to prevent Windows from implementing changes to the power settings that can effect network operation. This should be left checked unless there is a very specific need to do otherwise

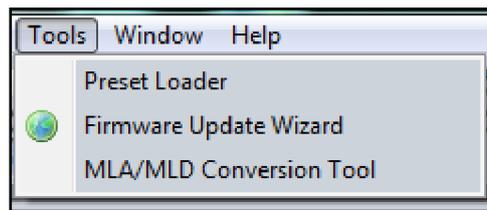
User confirmation of array synchronisation;-



This may be used when synchronising an array during the Device Discovery process. In normal use all cabinets are synchronised to the first cabinet found in the array. By checking the User confirmation box a message will be displayed if the discovery finds devices that are not synchronised.

### Tools

The tools menu;-



This has three important functions for system operation.

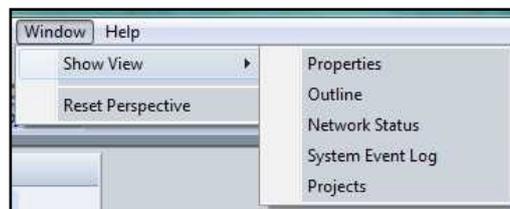
**Preset Loader** is used to upload EQ optimisations into the arrays.

**Firmware Update Wizard** is used to check and upload the latest firmware into the system components.

**MLA/MLD Conversion Tool** is used to convert the amplifier modules used in MLA and MLD cabinets from one type to another. Mechanically and electrically these are identical, they simply need a firmware conversion so the system is aware of what type of enclosure they are powering. An MLD module can be converted to an MLA or more commonly an MLA module to an MLD.

### Window

The Window menu is used to determine which sections of the project window are displayed;-



The System Diagram is always visible but the other windows can be closed and reopened as required. By default they are all open but if closed they can be reopened by selecting them from the Window menu. The Reset Perspective option will restore the project layout to the default view.

### Help

The help menu has a number of options;-



Welcome opens the splash screen that is displayed when Vu-Net is run for the first time;-



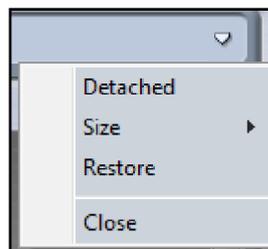
The lines 'Go to Martin Audio website' and Go to MLA website are hyperlinks and clicking on them will take you directly to the respective website if your PC is connected to the internet.

The window can be closed in one of three ways;-

1. Click on 'Start using the software'
2. Click on the x in the Welcome box in the top left of the window;-



3. Click on the drop down arrow in the top right of the window and select 'close';-



Any of these will close the welcome screen to reveal the project window.



**User Guide:** This is essentially a link to this very guide slightly rearranged for use in the field when running the software. The contents page features links directly to the specific subject so you can very quickly navigate to where you need to be to discover the answer to something you don't fully understand.

**Tool bar**

The toolbar has a number of icons which offer either quicker access to commonly used functions from the file menus or specific functions which are essential to system set up and operation.

The first 4 icons are file management tools;-



These are New Project, Open existing project, Save and Save As.

The next group are graphic alignment tools for making your system diagrams look neat;-



The first, second, fourth and fifth of these are only active when two or more components are selected; the third is only active when one or more Merlin controllers are selected.

The first icon aligns all selected components horizontally on the page. The second aligns all selected objects vertically. The third tool is used with the Merlin. When a system is discovered its network connections are drawn in place. The two U-Net nodes on the Merlin, usually run as a closed loop will go off to the first cabinet in the array and back from the last cabinet. Depending on the layout of your system diagram this may mean that network cables are crossing over looking a little messy. This tool reverses the two network nodes in the diagram to try and neaten the diagram. Note that it is only adjusting the graphic representation; it is not making any electrical changes to the U-Net nodes in the Merlin.

The final pair of icons will reverse the position of any selected objects. Perhaps you have an MLA array to the right of an MLX array and you would rather position them round the other way, you just select both arrays and click on the 'Reverse order horizontally' button and their order will be reversed maintaining their connections and keeping them aligned. Likewise if you wish to reverse the vertical order, position DSX subs under an MLA Compact array when the diagram has the subs on top, select the required components and click the 'Reverse order vertically button'

**Discover Devices** is the method by which U-Net connects to all system components once all hardware connections have been made;-



This will interrogate the U-Net network and find all connected devices opening Wizards for each type of device; MLA & MLD, MLX, MLA Compact, DSX, MLA Mini, MSX, DD12 and Merlin. All devices on the same U-Net loop will be grouped together by type by the discovery process.

**Master Overview;-**





Gives an overview of all devices in the project displaying all bargraph level meters giving access to essential functions such as gain, mute and Delay and with a link to EQ functions. This is designed to be used once a show is in progress to allow easy monitoring of an entire system from a single page. The Master Overview is opened as another tab next to the Project System diagram and any other open arrays or components.

Show Mode;-



As the name suggests, this is intend for use during a show once set-up is complete. It changes the operation of the Mute function for all products. When disabled, all mutes can be selected and de-selected freely, when show mode is active;-



Any click on a mute button will bring up a pop-up window asking you to confirm that you want to Mute or Un-Mute that array or channel. It also disables the output cell check function, see later in this guide for details

The zoom function;-

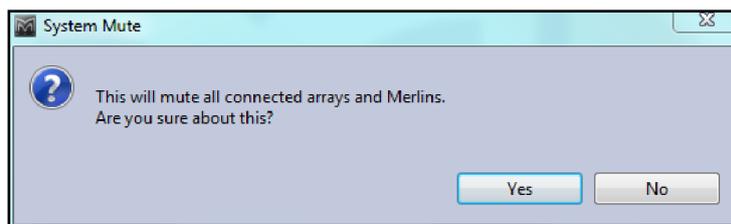


Allows you to adjust the system diagram size to suit the complexity of the system on your PC display. The '-' and '+' buttons will decrease or increase the zoom in increments of 25%. Alternatively you can use the drop-down box to select either 10%, 25%, 50%, 100%, 125%, 150%, 200%, 300%, 400%, 600% or 800%. Particularly useful are 'Page' which will zoom to the maximum size that the page will allow, 'Width' which will zoom to the maximum width of the diagram and 'Height' which will maximise the size to fit the height of the diagram.

Mute is essentially an "emergency" function if something is causing severe noise through the system you can click on the mute button;-



This will bring up the flowing window;-



As you can see it is a very drastic measure which will shut down the entire system which is why it should be considered as an emergency measure only and not an everyday means for muting the system. If you are sure you wish to proceed you can select 'Yes' if not click on 'No' and the window will disappear, the audio will remain routed. This function mutes every input and output



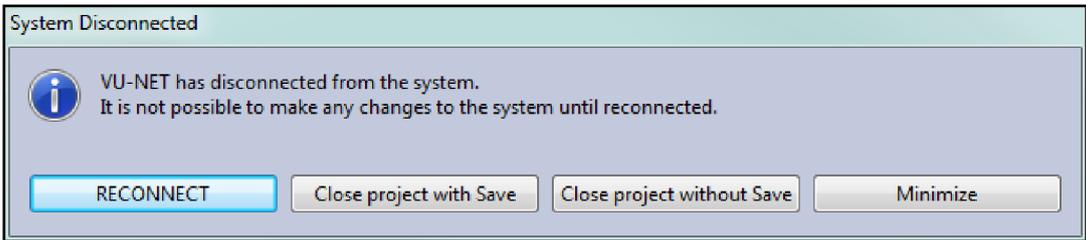
on connected Merlins and every zone on all arrays. Once used there is no global un-mute, all Merlins and arrays will have to be individually un-muted. Note that Show Modes does not change operation of the System Mute, the confirmation window will always appear.

Our advice is never to leave a system muted within Vu-Net, always use a mute that can be defeated manually such as a Merlin output. If a system has been muted within Vu-Net and for some reason you lose network connectivity you will be unable to un-mute and will have an unusable system!

**System Disconnect**



This will disconnect the project from the hardware in the system. A Window will pop up giving you a selection of options;-



As you can see, once you are disconnected from the system you are unable to make any changes to the project, this is to ensure compatibility and accurate synchronisation when you reconnect. You have the option to reconnect straight from the window or can close the project with or without saving. Finally you can minimise the project. This is particularly useful if you have disconnected to switch from a Wi-Fi to a hard-wired connection, having minimised to can access the PC network setting to make the switch to a cable Ethernet connection.

Once Disconnected the Disconnect button will change to reconnect also allowing you to reconnect to the project;-



**Project Workspace**

The workspace is divided into several sections which can each be opened, closed or in the case of the ancillary section, "detached" as a floating window.

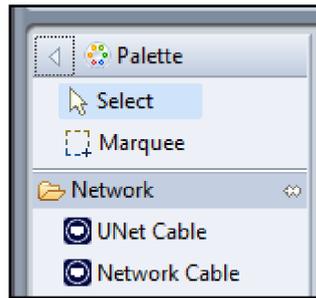
By default the workspace appears like this;-



There are three main sections, the first is the system diagram;-

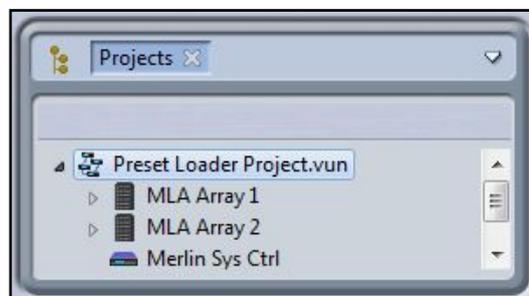


This window will show all array components on the network and is used for all configuration changes and system monitoring. The palette on the left is used to manually enter system components when working off line (in normal use, Device Discovery is used to find all connected components). If you need to maximise the workspace the palette can be minimised by clicking on the white triangle in the top left corner of the palette;-



The overall size of the System Diagram can be increased or decreased by clicking and holding on the gap between its right-hand edge and the left hand edge of the other windows. You can then drag either left or right to adjust the relative sizes of the windows. Alternatively, the white drop-down arrow gives you the option to maximise the screen. The other windows will not be closed; they will be represented by an icon on the right side of the page with the option to restore. Clicking restore will return the windows to their previous state.

On the right side of the window are two further windows;-



The first is a project overview window showing the open project. The window can be maximised, detached or closed by clicking on the white arrow in the top right corner. The project icon can be expanded if they have a small arrow to the left (a project that doesn't yet have any components added or discovered will not show an arrow). This will then show all connected components as in the picture above. Arrays will have a further arrow which if clicked will show all individual cabinets. This screen grab shows an enlarged project window in which the User Guide system has been expanded and one of the MLA arrays and one of the MLX arrays have also been expanded;-







### Working Offline

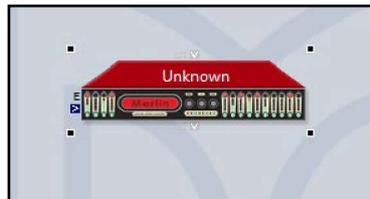
Before we move on to look at adding elements to projects it is important to understand the difference between working off line and normal on-line operation at an event. When working off line the Palette allows you to drop elements into the System Diagram, you can open arrays and Merlins as you would for an on-line system. This is useful as a means to get used to system operation in Vu-Net but very little beyond that. Unlike some systems you CANNOT create a system design off line and connect to a system on site. When connecting to a system you have to use Device Discovery which searches all available connected devices for system elements and automatically drops them into the system diagram showing their Ethernet and Vu-Net Connections. This is vital as every Vu-Net element has a unique factory set IP address which Vu-Net records so it can provide real-time monitoring of the system and can display the status of every device. If for example you re-connect to a system having used it on one day and shut down over night, Vu-Net will be able to detect that every cabinet has been turned back on and the status of all parameters of every DSP. We will show how to introduce all available elements into a project off line but will cover Device Discovery and on-line operation in a later chapter.

### Adding Merlin, MLA, MLD and MLX

Adding any devices to a System diagram is a simple case of clicking on the required item in the Palette;-

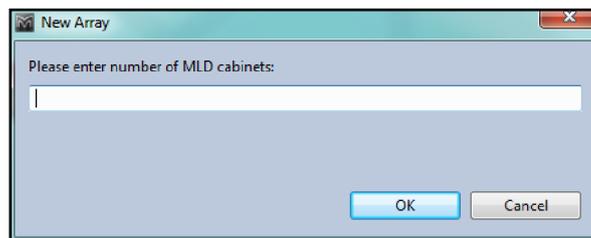


Then click on the System Diagram workspace. The cursor will have a small white box with a cross in the centre prompting you to click where you wish to deposit the device. Here we see a new Merlin added to a project;-



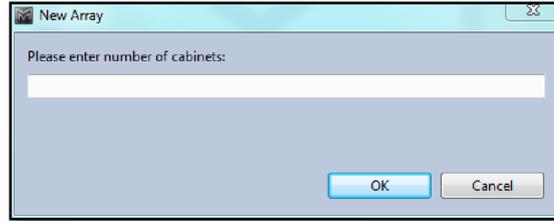
The four black squares in the corners indicate that the device is still selected which is the default when a new element is added to a project. The most useful thing about this is that it gives you the opportunity to move it to exactly where you need it simply by using a click-drag-drop movement. A click anywhere else in Vu-Net will de-select the Merlin.

Adding an MLA/MLD array is done by clicking on the icon and then in the project window, you will see the following window;-



Enter the number of MLD required in the array. In the majority of systems this will be one or two. They will automatically be added to the bottom of the array.

Next this window appears;-



Note that you must enter the total number of cabinets including the MLD, NOT the number of MLA. The array will appear in the workspace like this:-



The array is coloured red to show that it is off line. Note that the largest array that can be added is a total of 24 cabinets which matches the maximum flown array from the flying grid. If you enter a number higher than 24 Vu-Net will enter a 24 box array.

MLX is added in the same way, you will see the same window requesting the total quantity of cabinets. Here is a six box array of MLX, note that in off-line mode sub arrays are always entered a single column of cabinets as if flown. Device Discovery of an on-line system gives you the option to specify ground stacked and draw the array exactly as it has been physically positioned;-

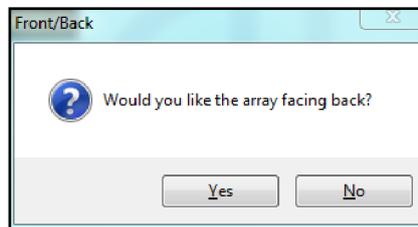


### Adding MLA Compact & DSX

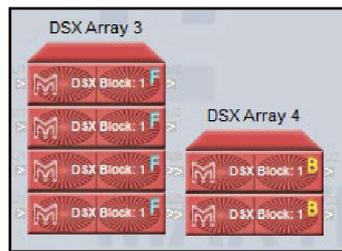
MLA Compact is added in exactly the same way, the only difference is that as there is no downfill enclosure you are simply asked the total number of cabinets;-



DSX has a slightly different option. When DSX Array has been selected, you will first see the standard window asking for total number of cabinets. When this has been entered you will see the following window;-



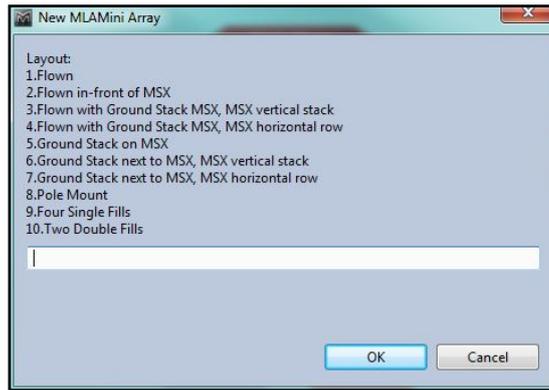
With MLX and DSX it is easy to build and operate directional sub arrays, one of the most popular of these being the gradient or "CSA" array with a third of the subs facing backward and phase inverted. When devices are discovered in normal use their LED badges can be flashed to help identify which actual cabinets correspond to the icons in Vu-Net. Both MLX and DSX are designed to be used either front or rear facing and there is a front and rear LED badge so you can still easily identify the cabinet even when facing backward. In on-line mode you can select front or rear badge during the Device Discovery process but off-line you can specify rear facing when adding the array, the idea being you would add all front facing cabinets as one array and all rear facing as a second. You will have noticed the 'F' on each cabinet on the MLX array, if you select rear facing for the DSX you will see a 'B' to indicate the back LED has been selected. Here is a typical Cardioid array comprising six DSX;-



In normal use this would be stacked two wide, three high with the middle two cabinets rear facing.

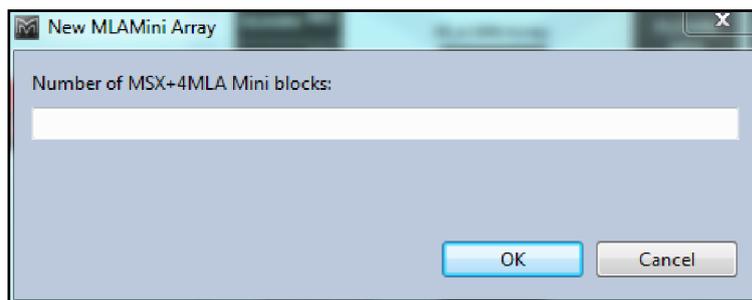
### Adding MLA Mini

MLA Mini is deployed in blocks of four MLA Mini plus an MSX sub or amplifier module to driver them. This makes entry to Vu-Net a little different. First you need to specify how the system is to be physically deployed, the following window appears when you select MLA Mini Array and click in the System Diagram workspace;-



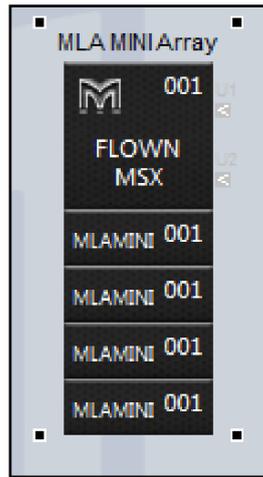
1. Flown refers to a system with MLA Mini flown below the MSX sub using the flying frame and transition grid. The maximum configuration for this mode is three sets of Mini and MSX (twelve MLA Mini cabinets).
2. Flown in Front of MSX allows the maximum flown array of MLA Mini which is sixteen cabinets and allows for configurations with the MLA Mini flown using the flying grid with up to four MSX on a second grid flown behind the Mini.
3. Flown with Ground stack MSX, MSX vertical stack is from four to sixteen MLA Mini flown using a Universal Bracket (maximum four cabinets) or flying grid with the MSX on the ground under the array stacked on top of each other vertically.
4. Flown with Ground stack MSX, MSX horizontal row is from four to sixteen MLA Mini flown using a Universal Bracket (maximum four cabinets) or flying grid with the MSX on the ground under the array in a row horizontally.
5. Ground Stack on MSX is possible with one or two MSX and four or eight MLA Mini.
6. Ground Stack next to MSX, MSX vertical stack allows ground stack arrays with the MLA Mini stacked directly onto the ground, perhaps at the front of a stage for example, using the flying grid and the ground stack base plate. Two systems (eight MLA Mini) can be used in this configuration. The MSX would be placed to one side of the MLA Mini array stacked on top of each other when two are used with eight MLA Mini.
7. Ground Stack next to MSX, MSX horizontal array allows ground stack arrays as option 6 but with the MSX to one side of the MLA Mini array placed horizontally in a row when two are used with eight MLA Mini.
8. Pole Mount adds a single system of one MSX with four MLA Mini above on a pole mount.
9. Four Single fills is for using the MLA Mini individually as stage front fills for example.
10. Two double fills pairs the Mini to create two fills for various applications.

If you have selected the deployment options 1, 2, 3, 4, 5, 6 or 7 you will next be asked to select the number of MSX + 4 MLA Mini systems;-

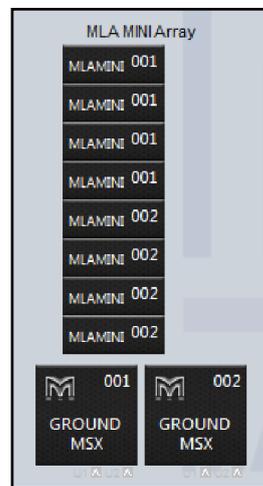


If you select a number greater than is possible for the desired deployment Vu-Net will automatically restrict the number to the maximum allowed.

Here are a few examples of MLA Mini arrays, first a single flown array;-



Next a systems with MSX ground stacked horizontally and MLA Mini flown;-



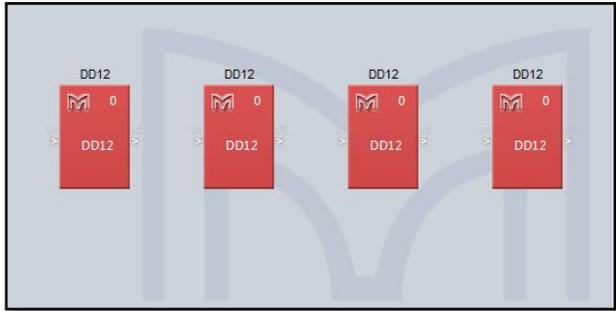
Finally a single system with the MLA Mini pole mounted;-





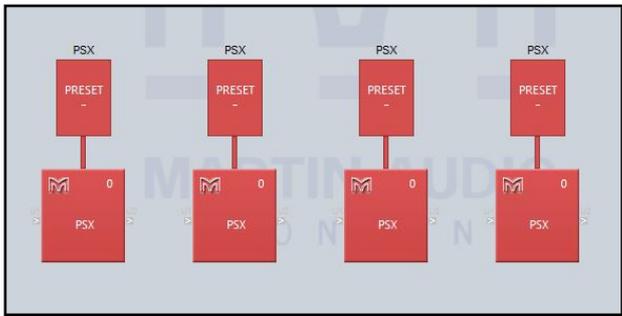
### Adding DD12

DD12 can be added individually dragged across from the device menu;-



### Adding PSX

PSX is also added in the same way, clicking on PSX in the Devices list and clicking in the system diagram workspace;-



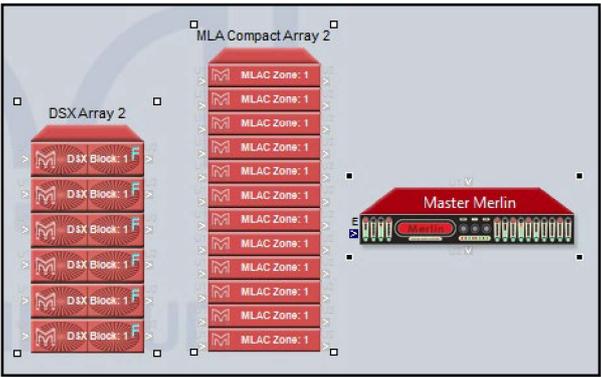
As the system is off line there is no preset showing and the satellite cabinet is a generic shape. When used on line and selecting one of the three factory presets for either DD6, CD12 or XD15 the thumbnail picture reflects the selected cabinet.

### Arranging the Array components

Vu-Net has a number of tools available to help keep the system diagram looking tidy.

Selecting elements can be done in a variety of ways. The most obvious is a single mouse click; the selected object will show the small black squares in the four corners around it. A subsequent click anywhere else will de-select the object, as will click on a second object. The selected element can also be changed using the left, right, up and down arrow keys, the object selected will jump in the direction of the keys.

Selecting multiple objects can be done two ways. First you can draw a box around multiple items. Click and hold in the corner of a group of objects and drag over all of them diagonally. A box will appear round all selected items until you release the mouse button whereupon all objects within the box will be selected. You can draw the box from any corner in any direction.



If you need to repeat this action several times you can select the Marquee tool from the Palette menu which changes the mouse cursor to a cross and enables box-drawing mode. Click on the Select icon in the Palette to return to normal select mode.

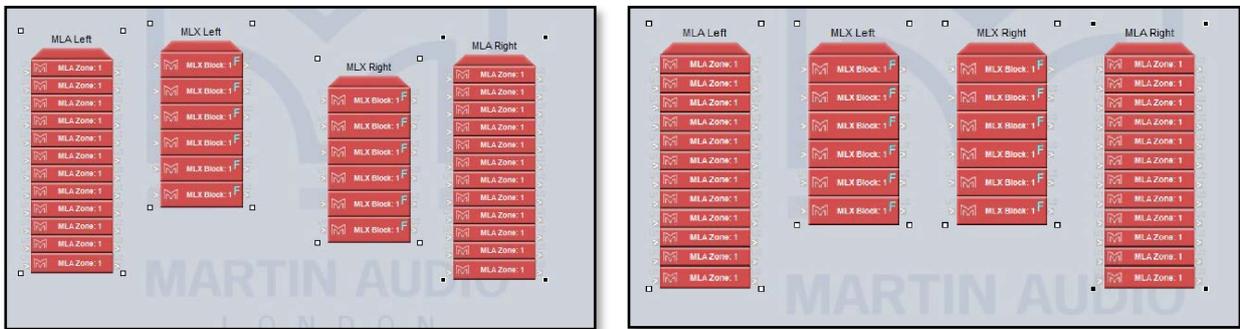
Secondly you can click to select an element then press and hold either Ctrl or Shift and click on all other elements you wish to select. Note that you can use a combination of selection modes if necessary; use the box-drawing method initially then Ctrl or Shift click to add additional elements to the selection.

Deselecting an element from a multiple selection must be done with Ctrl + click. With a multiple selection there is always one primary element, by default the last one added to the selection. This will have the familiar black squares in the corners; all other selected items will have white squares. You can change the primary element by a further Shift + Click on an object. Deselecting all objects is done in the same way as a single item by clicking anywhere on the work surface.

The icons on the tool bar offer quick and easy alignment of multiple objects, there are five tools available;-

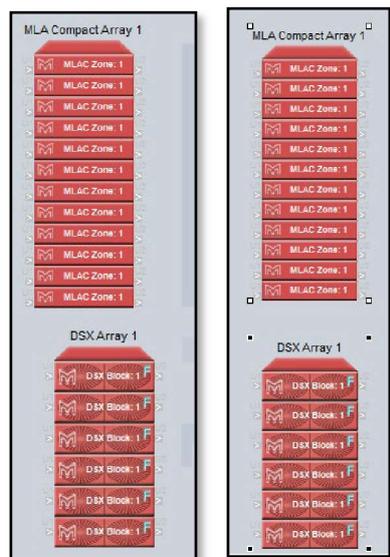


The first aligns objects horizontally, here is a before and after of four arrays that have been selected;-



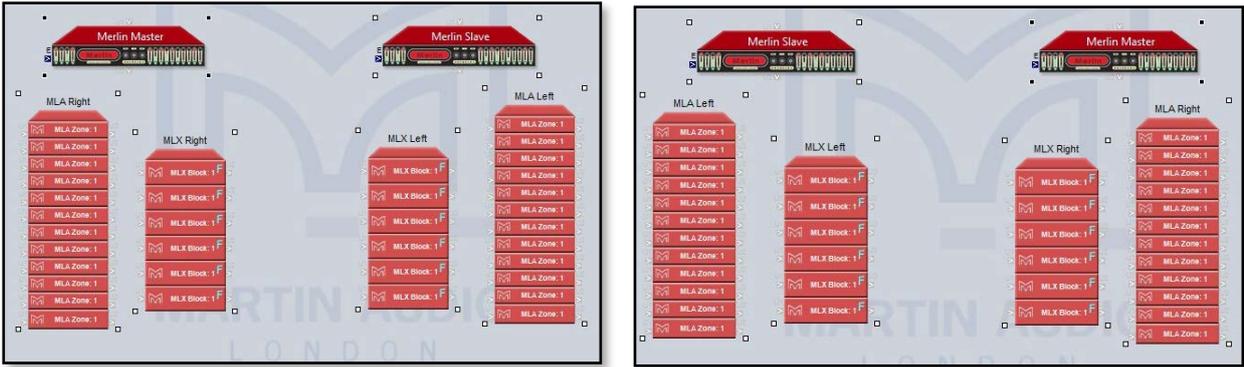
In the left hand shot the arrays have been positioned roughly in a line and all selected the right hand shot shows them all neatly lined up in a horizontal line.

The second allows alignment in the vertical;-



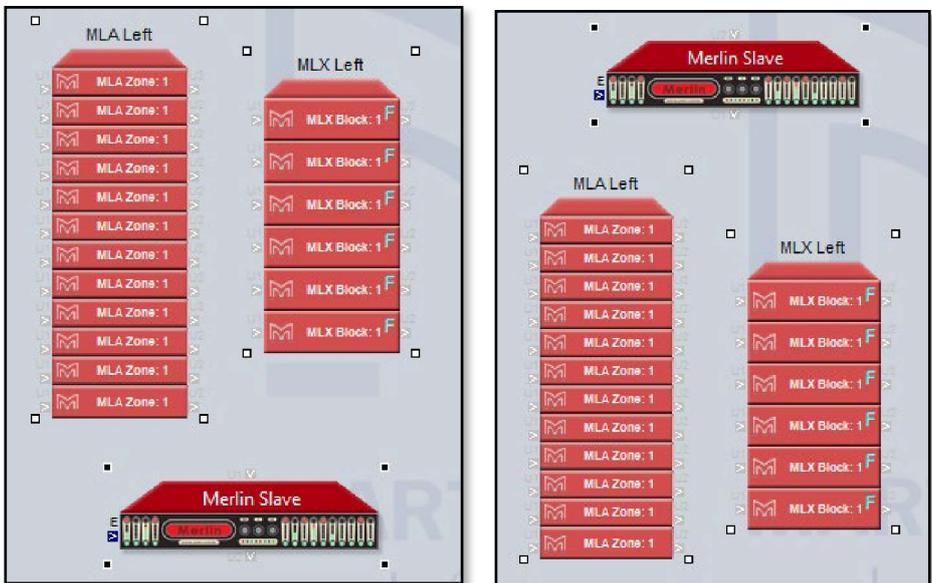
Again the arrays are not very well aligned but a simple click of the vertical alignment button and they are perfectly in line.

The fourth button will swap the horizontal position of all selected elements;-

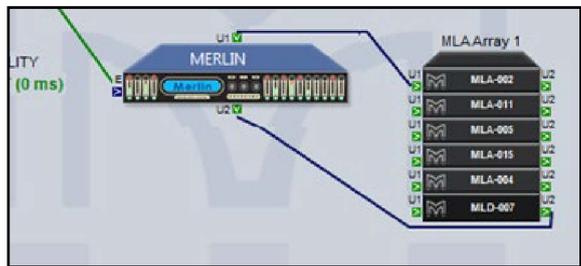


The left hand shot shows a system drawn with the left and right arrays placed on the wrong sides, the right shot has been corrected with the reverse order horizontally button.

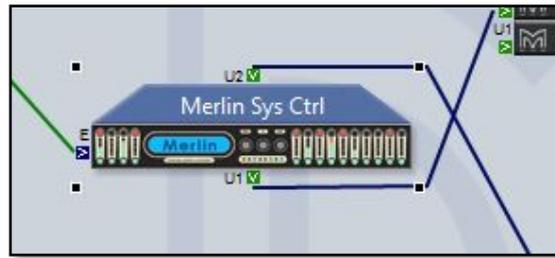
The fifth button swaps the order of all selected items in the vertical plane;-



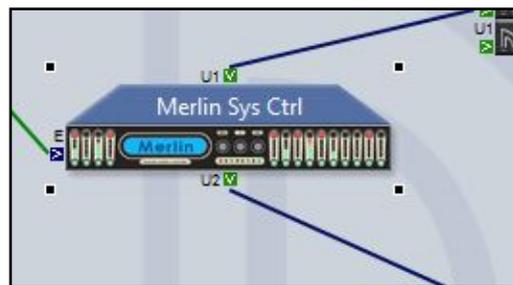
The third button applies only to the Merlin. When a system is discovered on line all U-Net connections are shown from the Merlin to all arrays;-



The U-Net ports on the Merlin are on the top and bottom of the Merlin icon, in most cases this allows Vu-Net to draw the system connections neatly as in the above example but they may be instances where the position of the arrays and complexity of the system means that the network connections cross and the system diagram looks untidy;-



If this is the case, select the Merlin and click on the 'Reverse U-Net ports' button and the port position is reversed in the system diagram hopefully making the network connections look neater;-



Note: this button reverses the port positions in the system diagram ONLY. It does NOT make any electrical changes to the two U-Net ports, it is purely and simply a graphical change.

### Device Discovery

The normal method for operating a system following completing the system rigging and connection is to run Vu-Net is to run Device Discovery. It is good practice to check your network connectivity, first by using the network icon on the PC task bar which should show connection to your system (it will flag that there is no internet connectivity which can be ignored). Then by going into Preferences and selecting 'Network' and making sure that the Available IP addresses window has an IP address for every Merlin in use with your system. If all is ok you can proceed by clicking on the Discover Devices button;-



Assuming everything is OK with your network connection you will see the following window;-



The meter bar will gradually move across until it is completely green and all devices have been found. This may take a few seconds on large systems with large arrays of many cabinets.

There are a couple of other windows that may appear at this stage, as well as discovering all devices on the network and identifying their type and IP address, Vu-Net also checks their Firmware to ensure it matches the latest version stored in its internal Firmware database. If it detects an older Firmware version you will see the following window;-



For more detail on Firmware updates please see the relevant Firmware chapter.

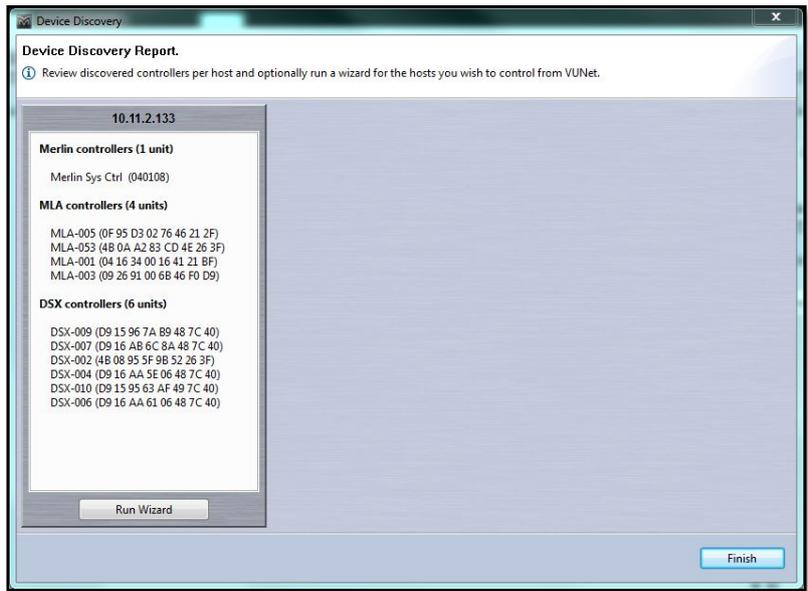
Finally, it is possible you may see this window;-



This would indicate a problem up-stream of the Merlin; are the cabinets powered? Are all the network connections made? Can you see two green U-Net LEDs on all devices including the Merlin? If everything is ok try power cycling the Merlin and run Device Discovery again.

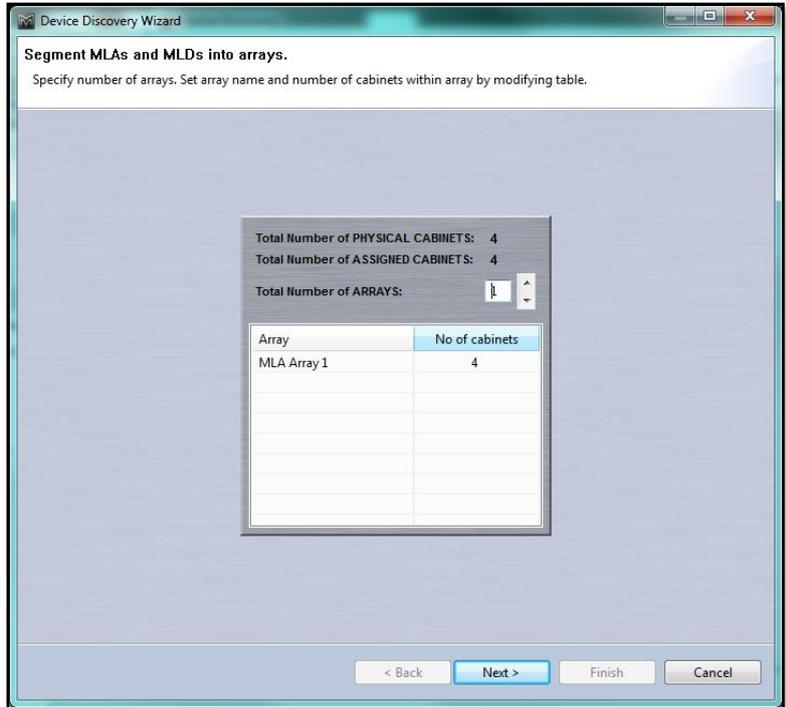
Note: It is not essential to have the complete system wired before you run Device Discovery; for example, you may wish to check each array individually as they are rigged so they can be flown out which is perfectly acceptable. Every subsequent press of Device Discovery will find any new elements that have been introduced to the network.

Once Device Discovery has completed its scan you will see the following window;-

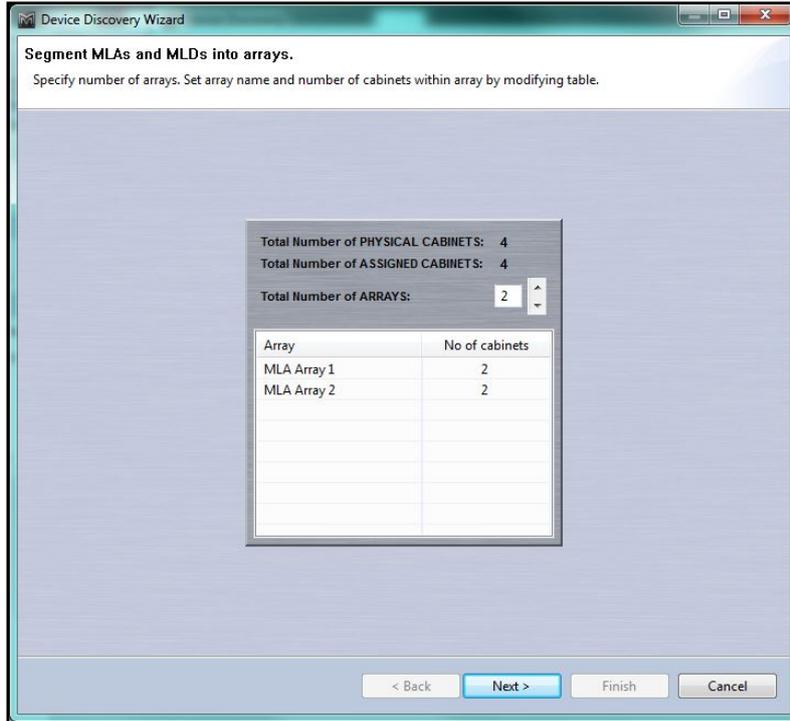


This shows a list of all connected devices found grouped into categories; Merlin Controllers, MLA, MLD, MLX et cetera. Each individual U-Net network created either by a Merlin or USB connected device (such as an MSX or DD12) will create an individual window with the IP address shown at the top. All devices connected to that U-Net loop will be listed grouped by type.

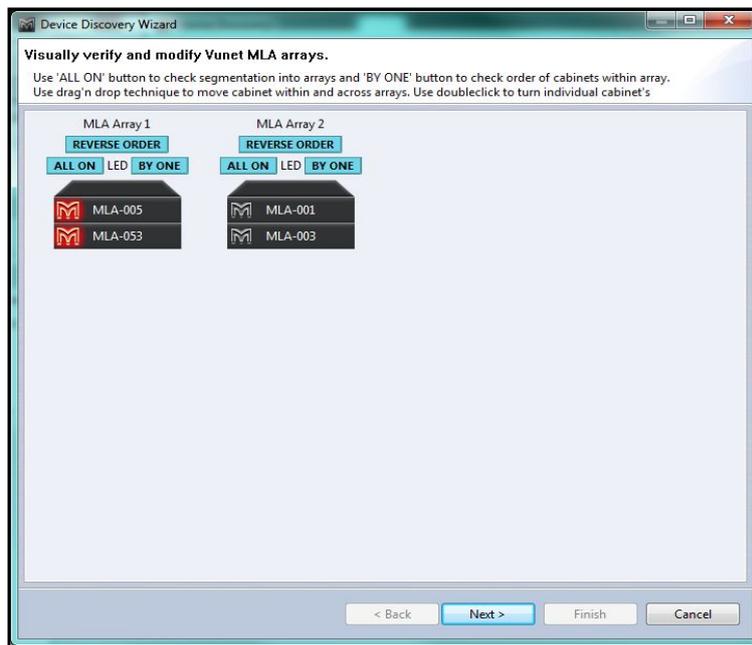
Next press the 'Run Wizard' button and an individual Wizard will run for all categories, the first will be MLA, MLD or MLA Compact;-



If you have more than one array of each type of cabinet on the same U-Net loop you have the opportunity to divide them into two or more arrays as required. Use the up/down button to select the number of arrays then change the number of cabinets in each array to match what you physically have connected;-



If the total does not match what Vu-Net has discovered the numbers will be flagged in red. Click next and you will see a new window showing the array or arrays;-

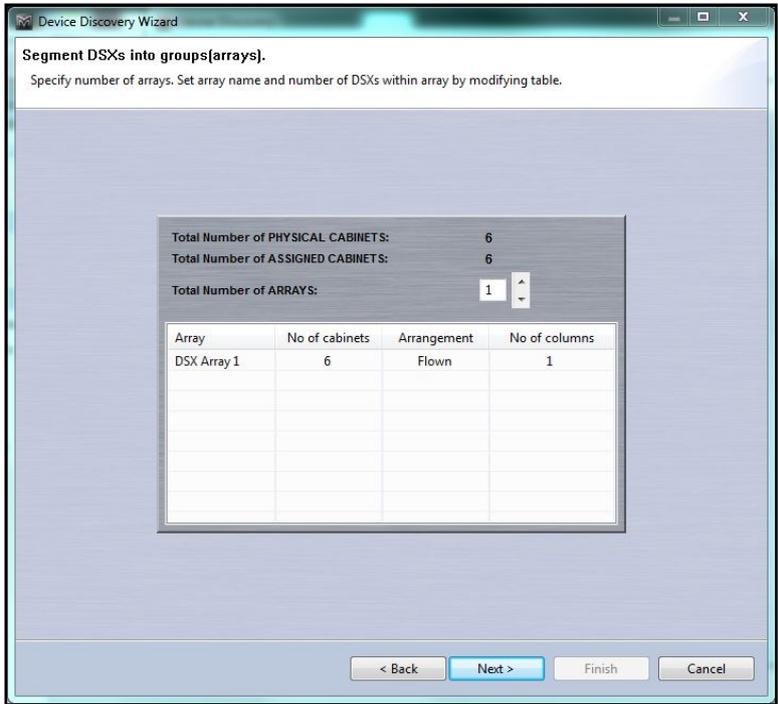


If you have more than one array the first step is to use the 'ALL ON' button which will illuminate all the LED badges on the array to check that the Vu-Net arrays match the physical deployment. If there are any errors the cabinets can be dragged and dropped to the correct positions or array. If you only have one array it is still worth flashing all LED's to see the look on the faces of the lighting technicians when they see LED lighting over which they have no control...

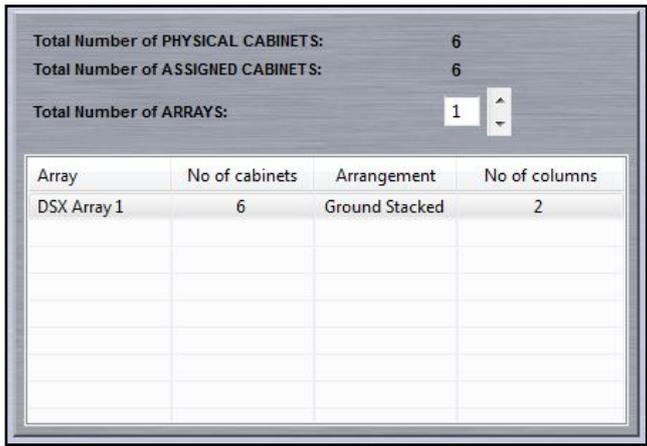
Next click the 'BY ONE' button. This will flash the LEDs in sequence from top to bottom. As the U-Net network is bi-directional it is entirely possible that the arrays could have been discovered starting with what is actually the last cabinet in the array. If this has happened you will see the LEDs on the actual cabinets flashing from bottom to top and you MUST click 'REVERSE ORDER' to

get it flashing the right way up. This is essential so that Vu-Net knows that the array is orientated the right way, failure to do this could result in an EQ optimisation being loaded upside down producing an array attempting to produce a coherent, flat response for an audience 30 meters or so up in the air!

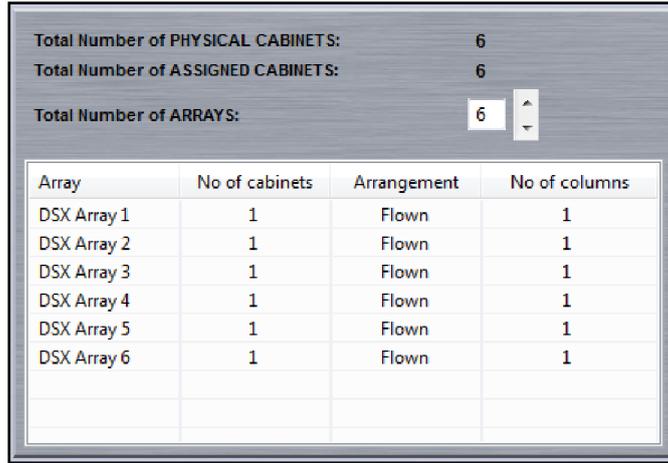
Next you will see the following window for any connected MLX or DSX;-



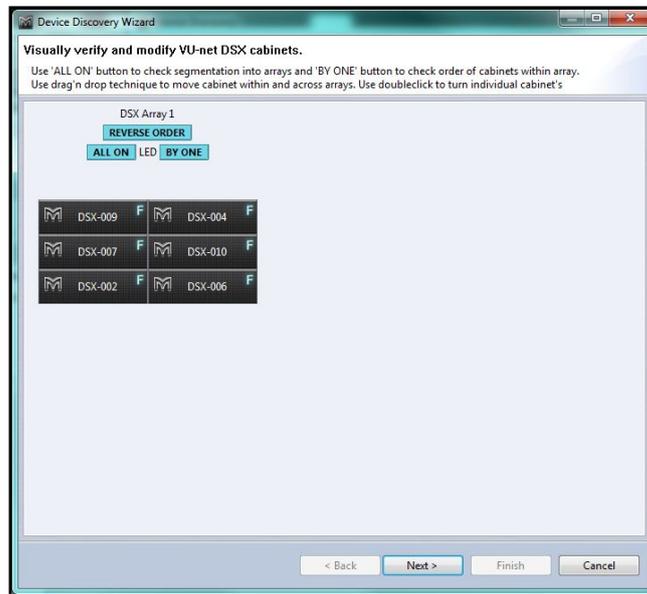
By default the 'Arrangement' will be displayed as 'Flown' therefore the 'No of columns' field will show 1. If you click on 'Flown' it will toggle to 'Ground Stacked' and if this is how your subs are deployed you can select the number of columns to reflect in Vu-Net exactly how they are positioned;-



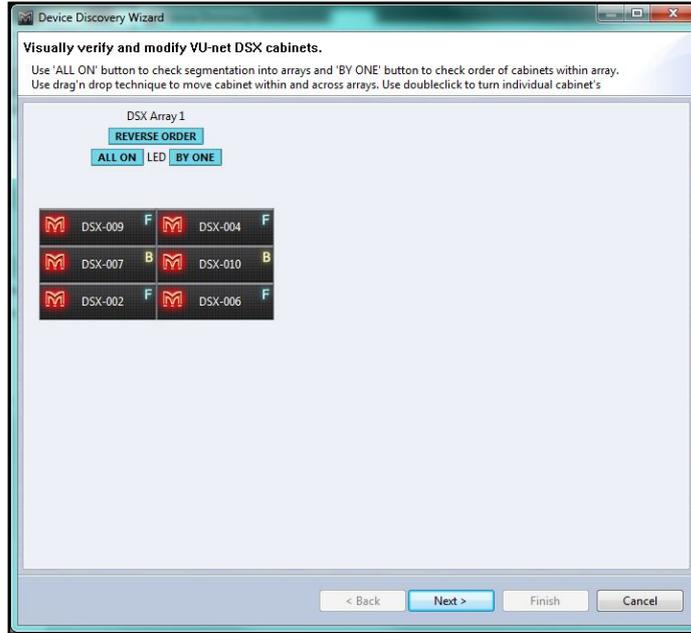
This could even mean making the columns equal the number of enclosures where a broadside array is being deployed;-



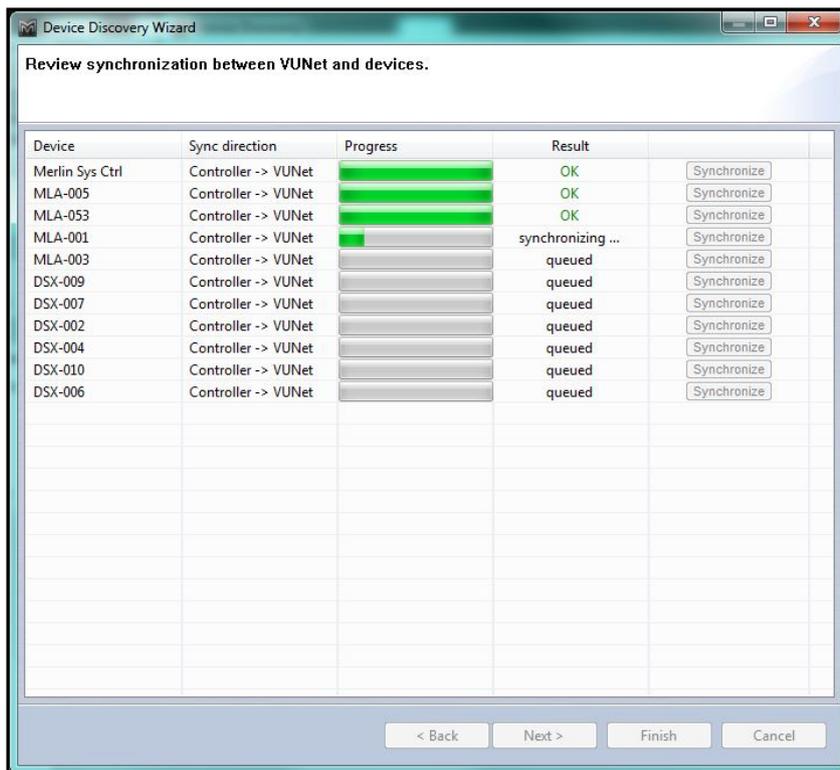
Once you have selected the array configuration select 'Next' and you will see a similar window to the one for MLA, MLD or MLA Compact;-



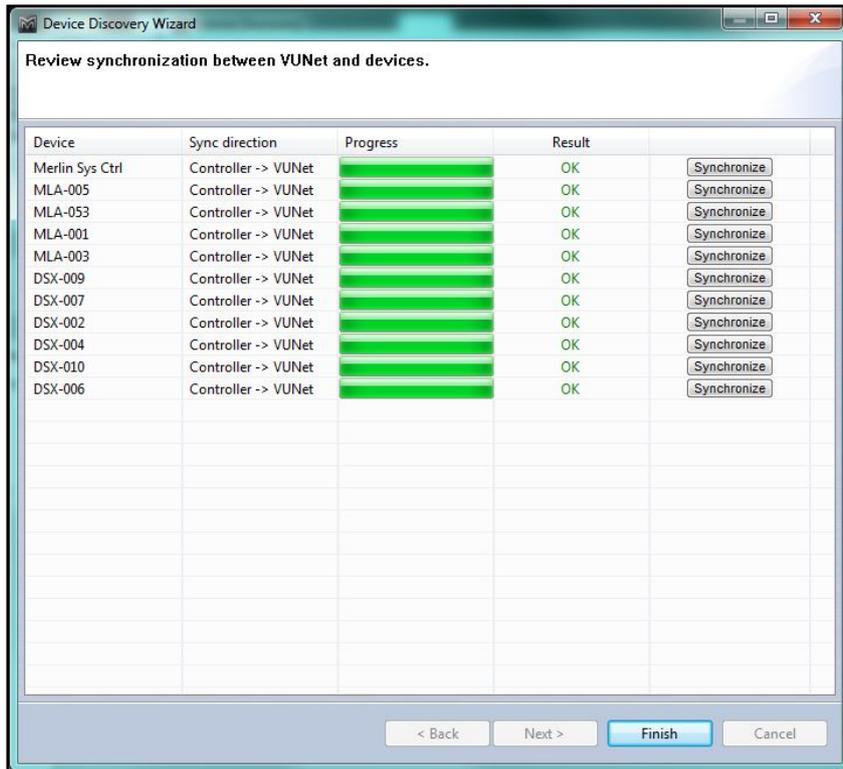
Repeat the process of flashing LED badges to ensure that the cabinets are in the correct order. If any are in the wrong position use drag and drop to reposition them. For a conventional sub stack this may not be vital as the parameters are likely to be identical for all cabinets but for cardioid or broadside arrays it is essential to ensure that they are correct so delay and other parameters applied are directed to the correct cabinet. At this stage you can also change the LED badge to flash on the rear. They are configured for the front LED by default signified by the 'F' on the thumbnails. Double click directly on the badge and you will see the 'F' become a 'B' to signify the back LED. This will flash instead of the front LED when selected. Note that selecting 'B' does not change any internal parameters that may be required for cardioid array operation, it simply changes the LED indicator from the front to the rear for cabinet identification. All parameter changes must still be entered manually;-



Once you are satisfied with the sub layout click on 'Next' and the synchronisation of all elements on the U-Net loop will commence;-

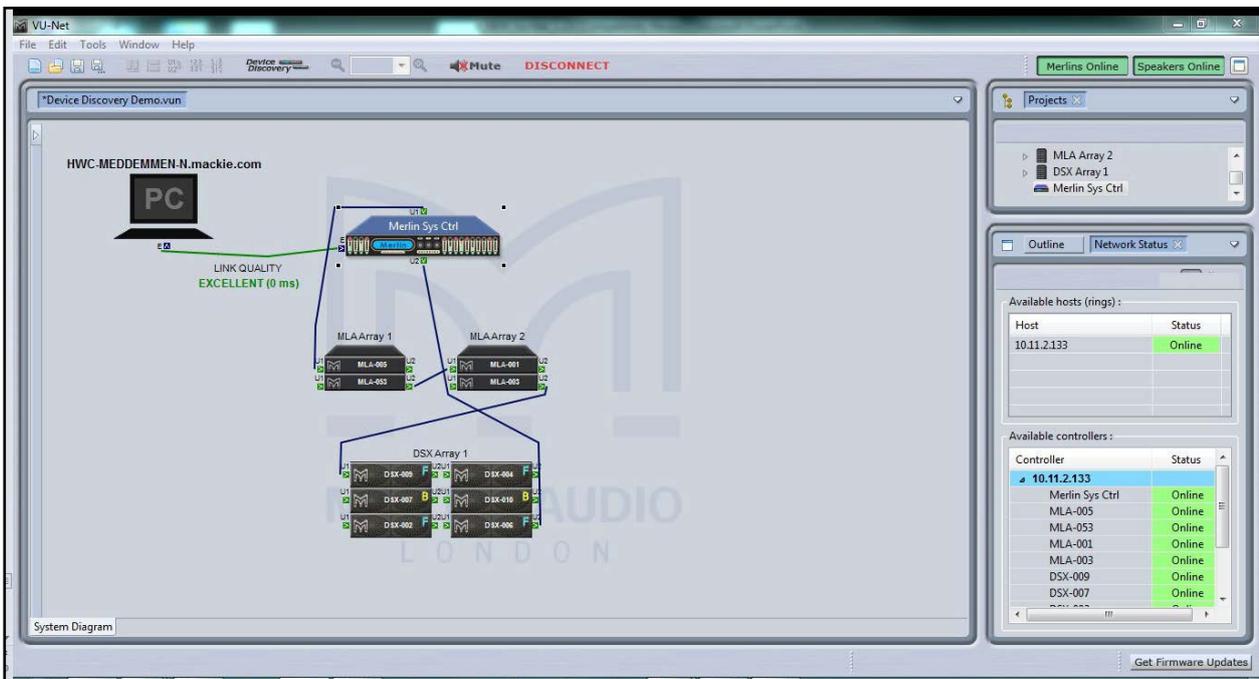


It possible (although unlikely) that one or more element will not synchronise correctly on the first pass in which case there will be a Red 'Fail' in the Result column for that device. If this occurs wait until the rest of the synchronisation is finished and click on the Synchronise button for that device in the extreme right column. The device will attempt a further synchronisation which should result in a success and a green 'OK'. A complete successful synchronisation will appear like this;-



This means that all settings residing in the DSP of all components have been uploaded into Vu-Net so you have a completely accurate picture of exactly how the system is configured on your tablet PC. You can click 'Finish' and a further 'Finish' on the Device Discovery Report window. Repeat the procedure for all connected Merlins which will all have their own U-Net ring of elements.

Once this is completed the Vu-Net workspace will appear as shown;-

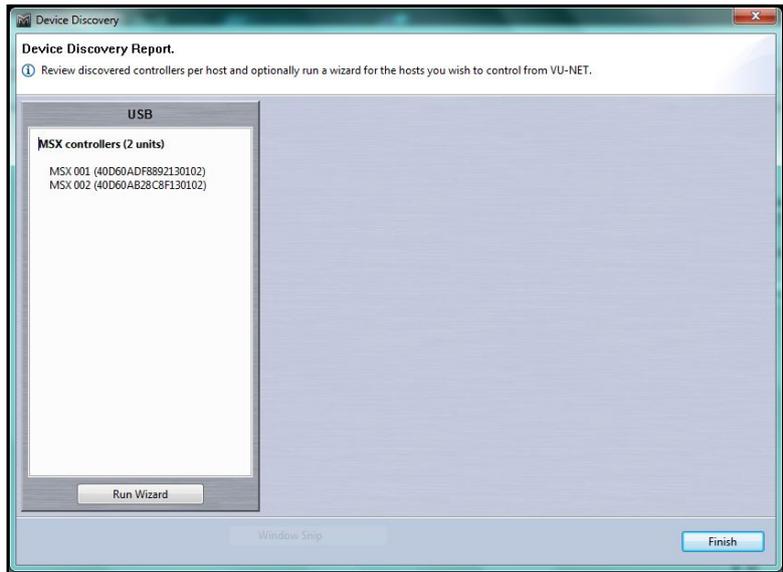




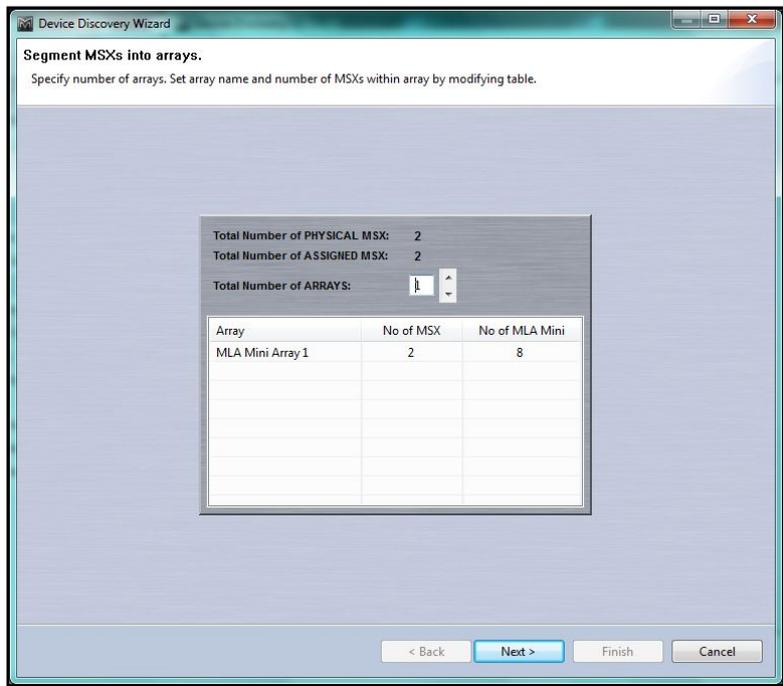
### Device Discovery MLA Mini

Device Discovery for MLA Mini is a little more involved as it is necessary to determine the deployment to ensure that the amplifier module is correctly configured, particularly between ground stacked and flown options as the software compensates for the fact that the cabling is done in different directions; for flown systems the cables attach from above so the longest NL4 on the Speaker cable loom going to the lowest cabinet, the opposite is true for ground stacked systems where the speaker loom comes from below with the longest NL4 reaching the upper-most cabinet.

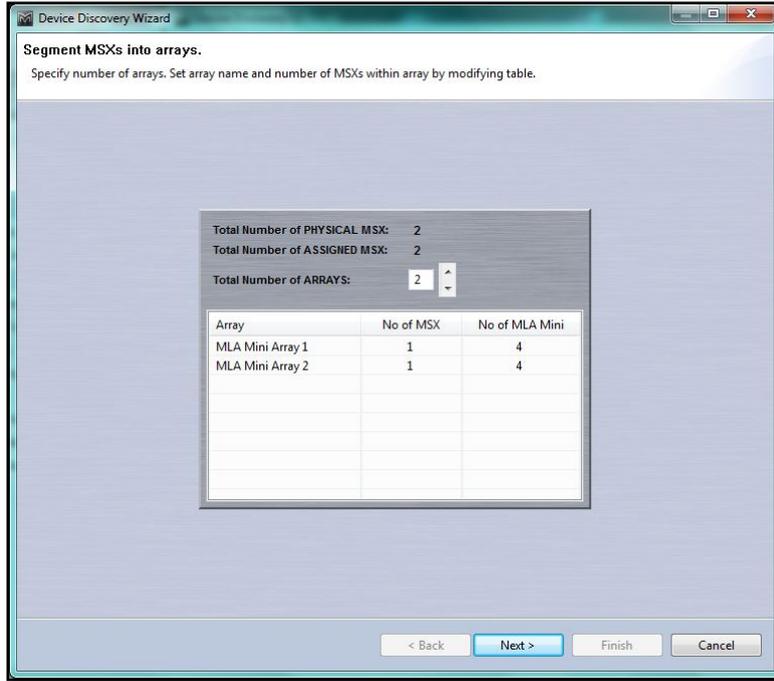
Here is a small MLA Mini system with a pair of MSX Subs and 8 MLA Mini. We have connected via the USB connection on one of the MSX and the two are linked together with U-Net cables;-



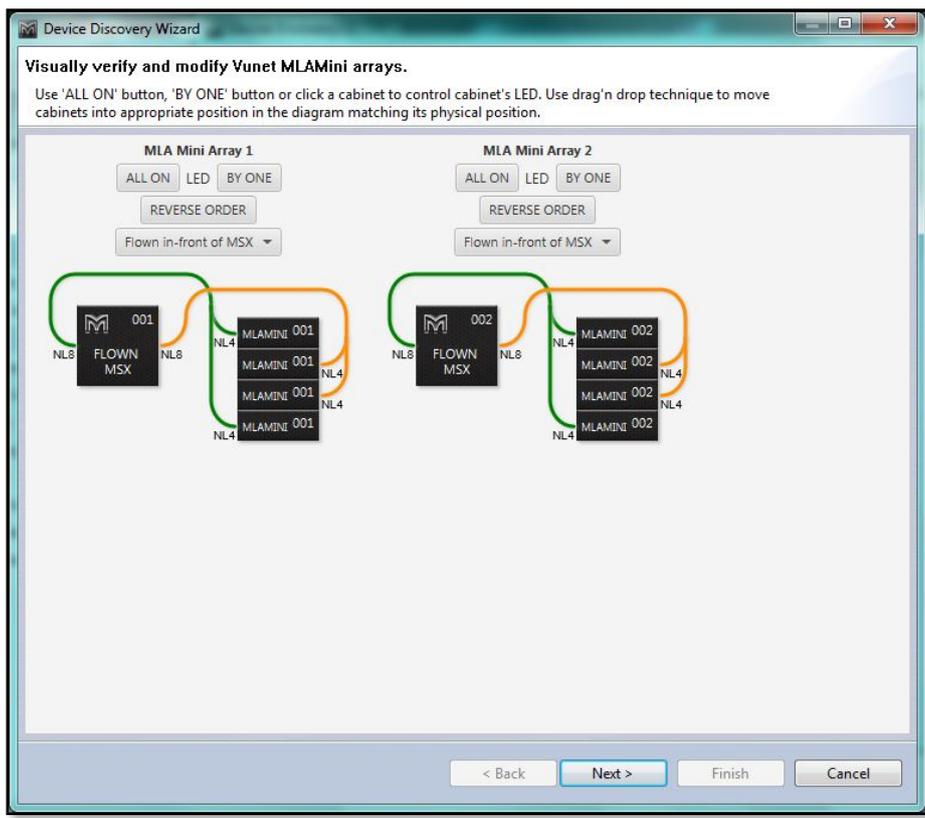
If we click on 'Run Wizard' we see the following Window;-



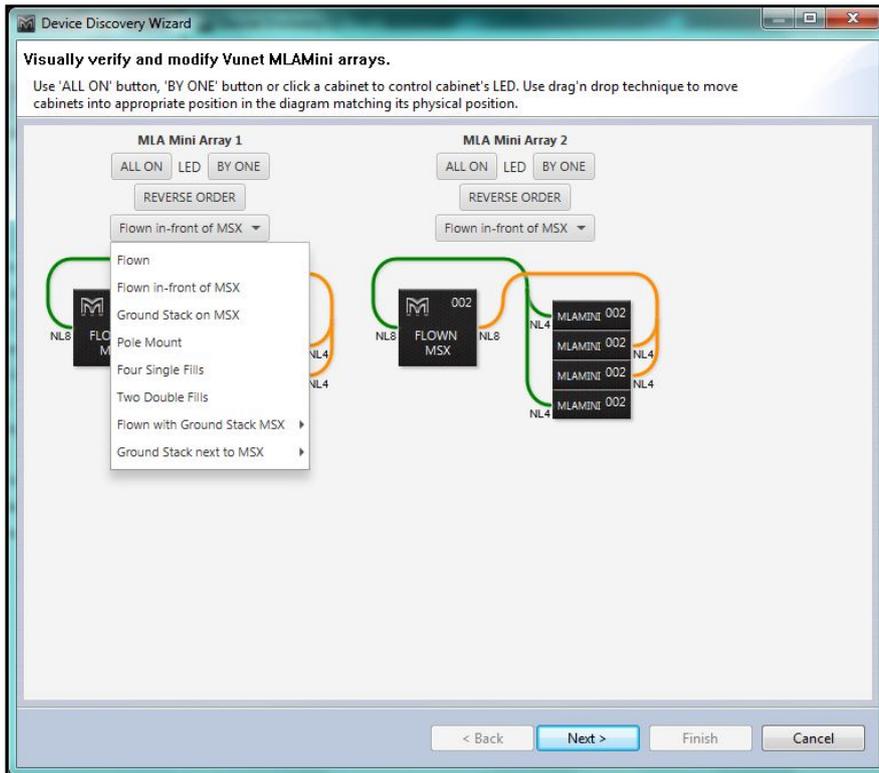
The first task is to determine how many arrays are deployed. By default Display assumes a single array comprising all of the MSX discovered, if the system is actually stereo for example we need to select 2 in the 'Number of ARRAYS' box;-



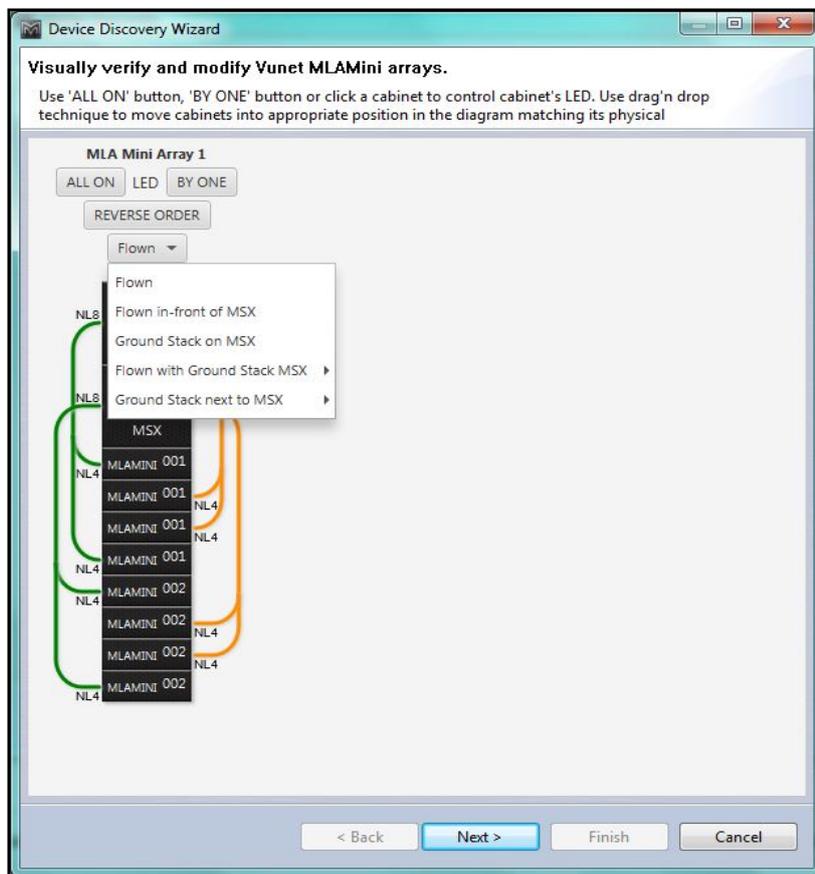
This now shows two arrays each comprising of a single MSX and 4 MLA Mini. Click 'Next' and the next window is where we select the desired deployment;-



This shows the two MLA Mini array which are deployed in the fault methods of Flown in front of MSX. The drop-down box shows all other options;-

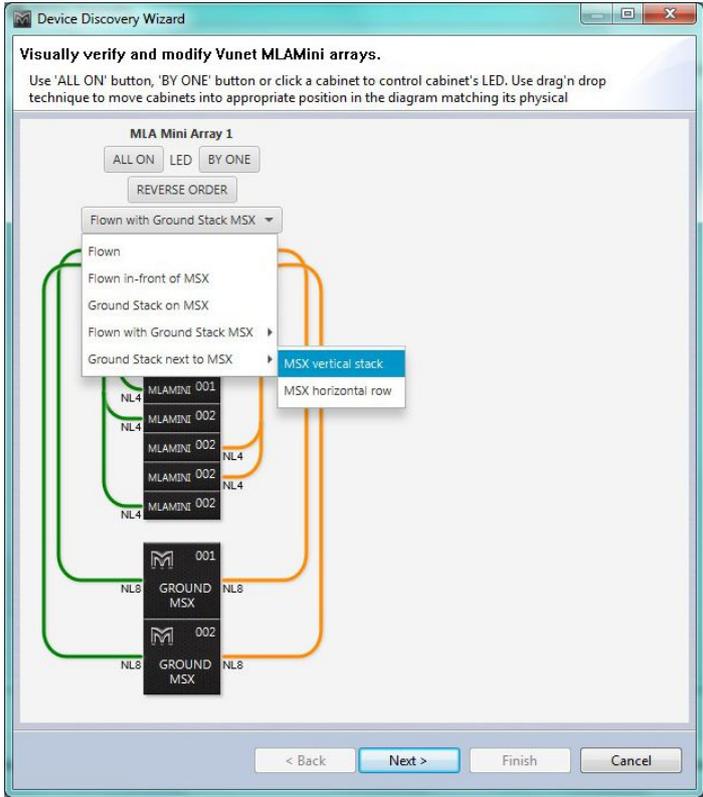


For a larger system the options will change, for example, as the maximum for pole mount is 4 cabinets, 8 or more in an array will remove this option;-

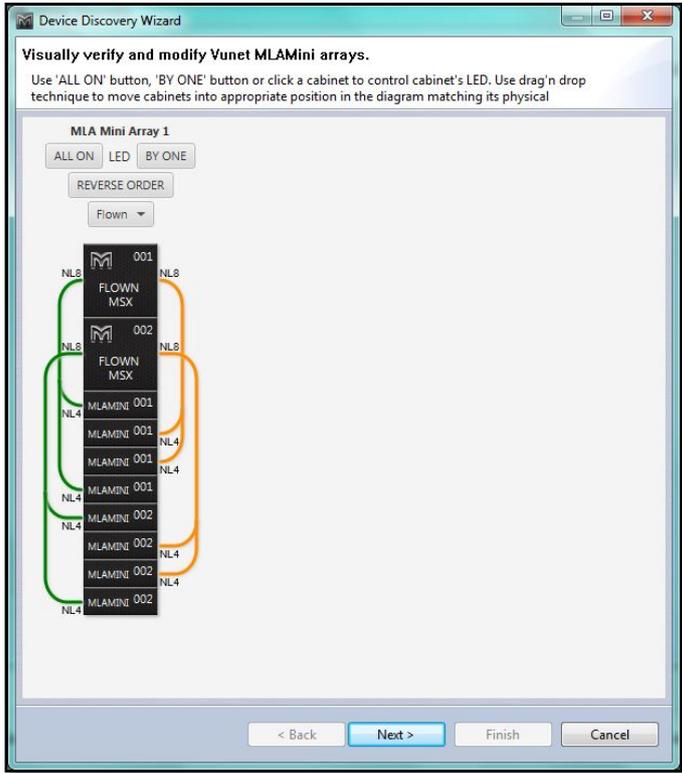




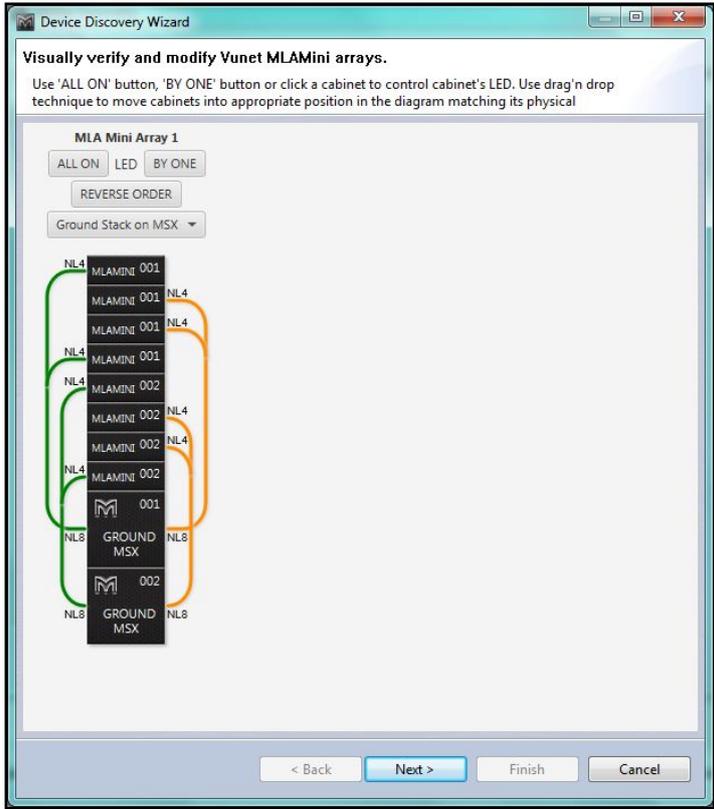
There are however additional options for ground stacked systems of eight or more MLA Mini, the black arrow against these brings out the option for stacking the MSX either horizontally or vertically;-



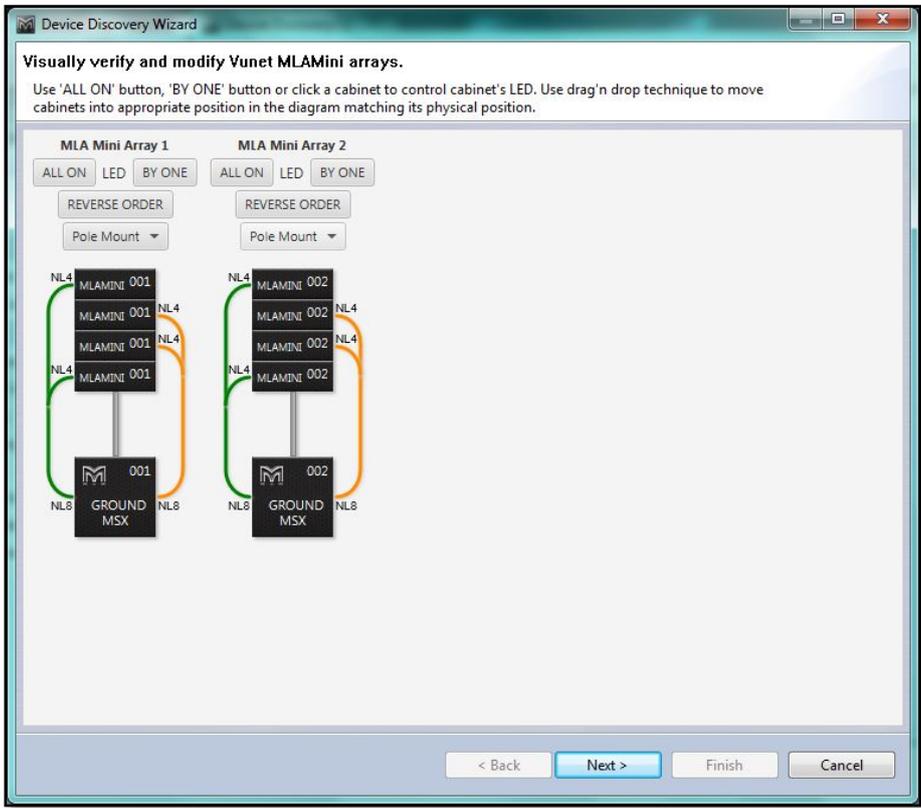
Selecting the various modes will change the array thumbnails accordingly and also importantly shows how the arrays should be cabled. This is particularly important as flown systems are cabled the opposite way to ground stacked with the longest NL4 cable reaching down to the lowest cabinet. For example Flown will appear like so;-



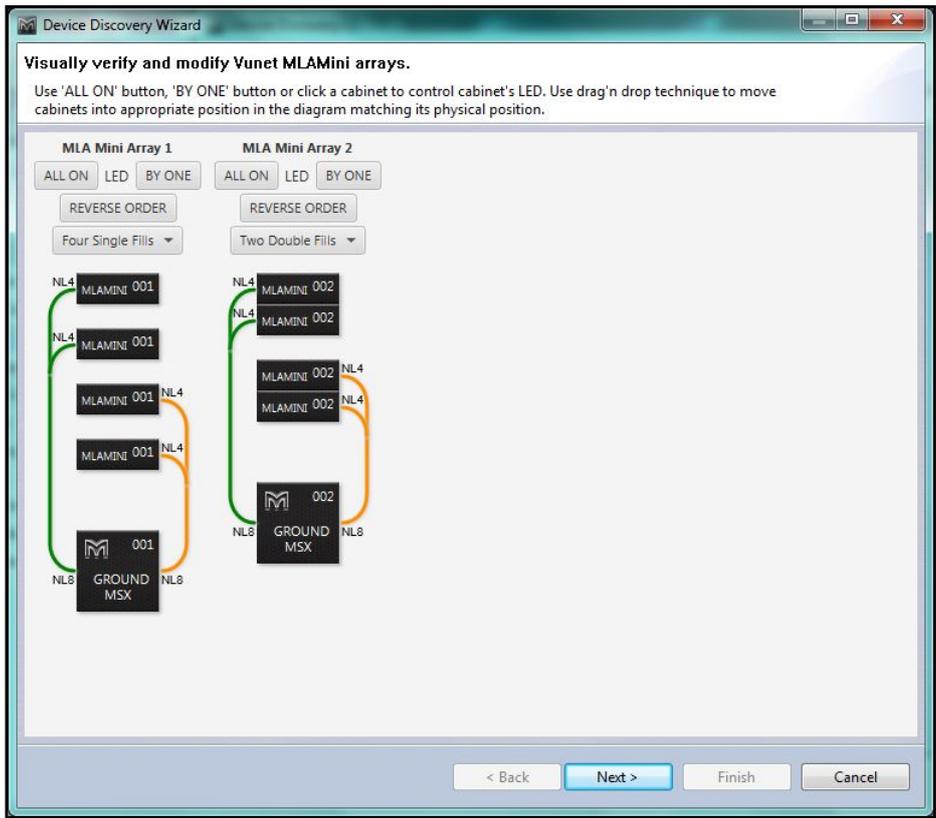
Ground stacked on MSX which is available for up to 8 cabinets appears like this, not the cable which unlike flown has the longer NL4s running up to the top cabinet;-



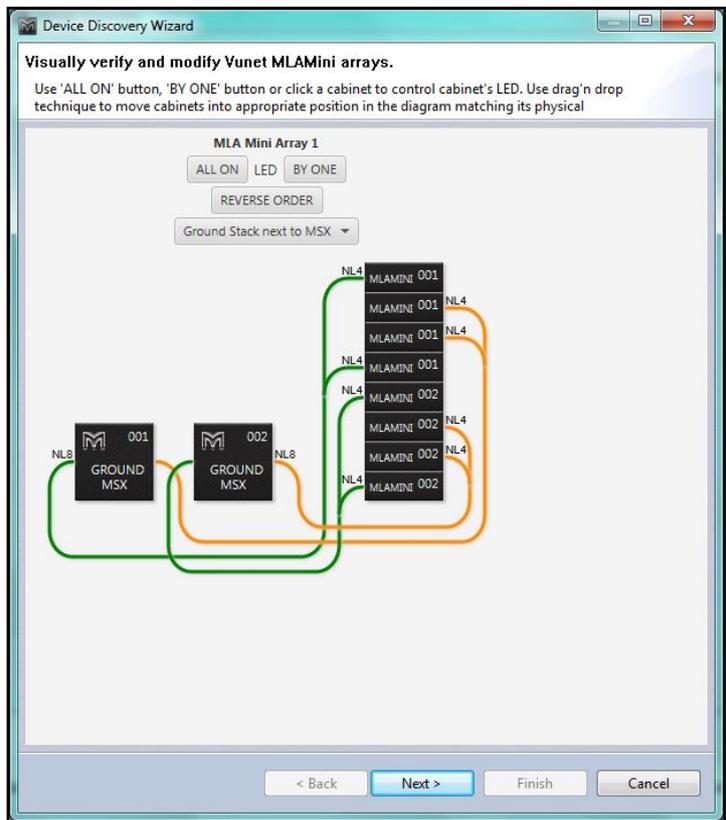
Pole mounted (only available for four cabinets), adds a pole;-



There are two options to use Mini as front fills, either as four single cabinets or two pairs;-

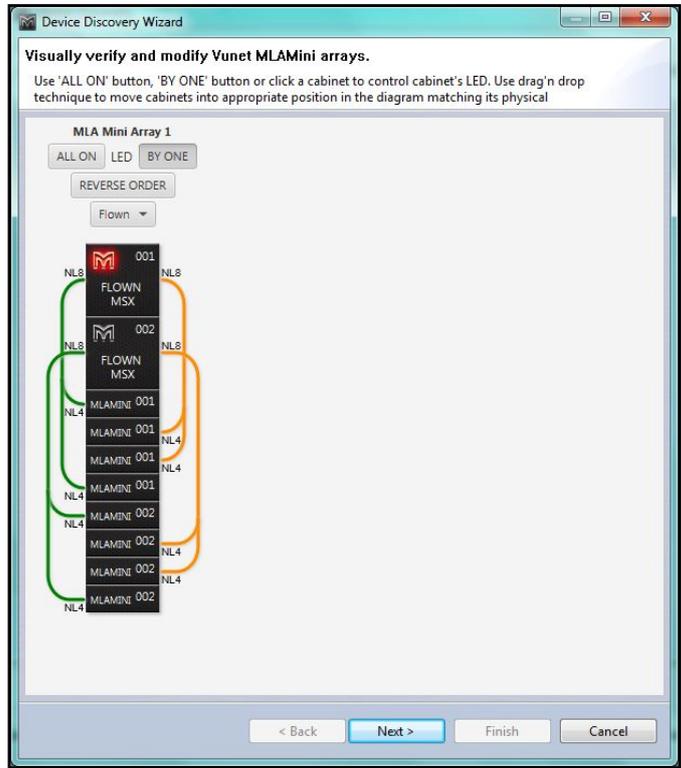


Finally you can ground stack the Mini next to the MSX;-

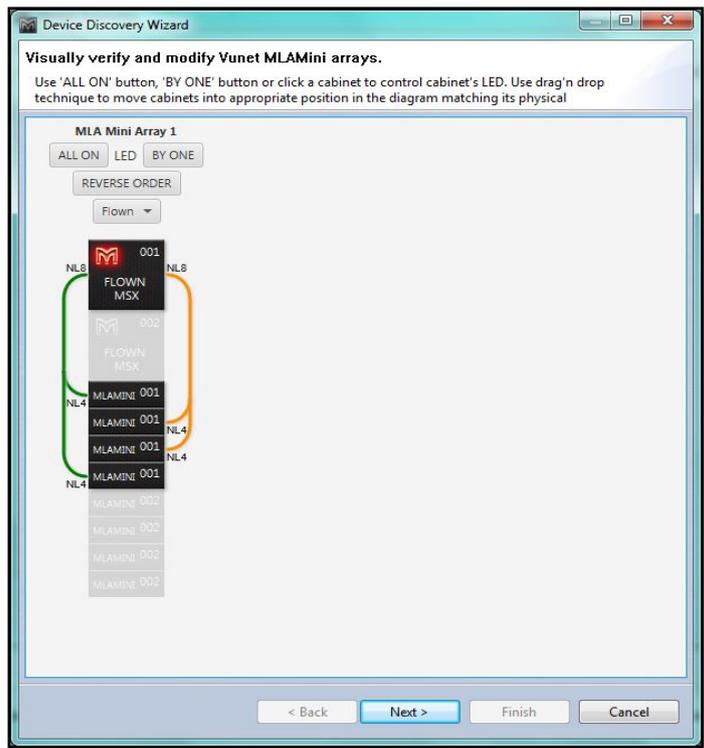


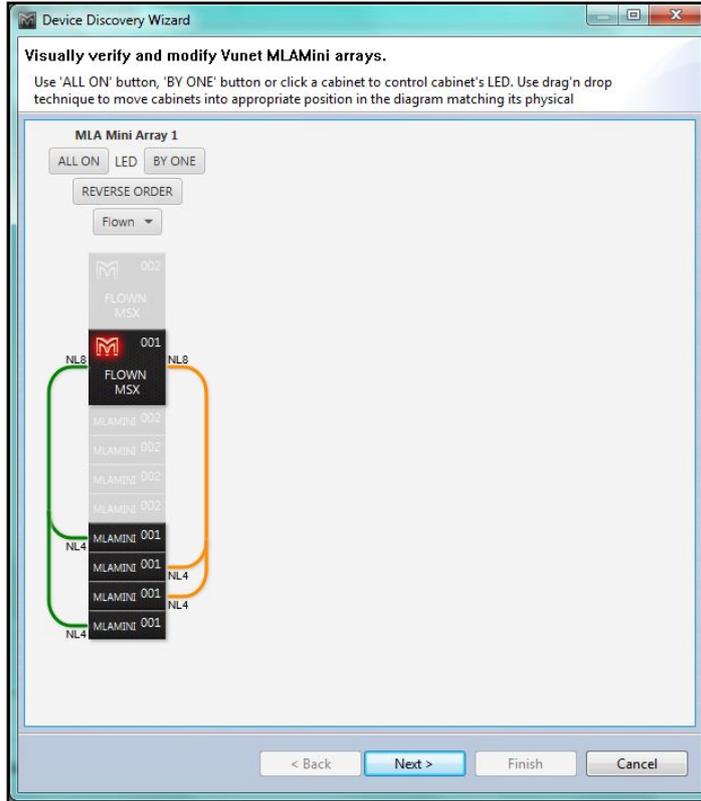


Once you have selected the appropriate deployment you can check the arrays by flashing the LED's on the front of the MSX as with MLA and MLA Compact cabinets. You can select 'ALL ON' to illuminate every cabinet in an array useful for identifying which array is which where two or more are in use, and 'BY ONE' which will flash all MSX in an array sequentially so you can check that they are in the correct order;-

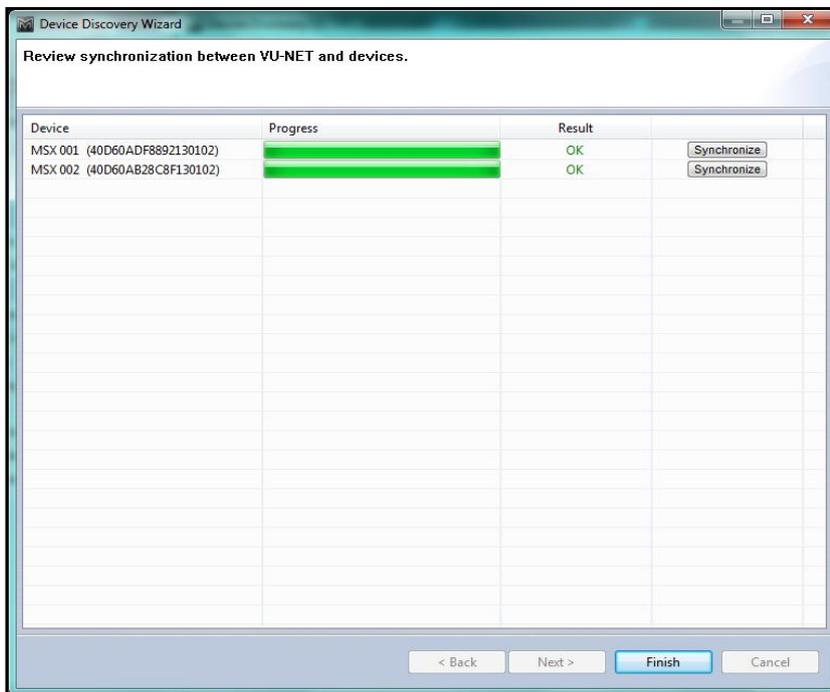


If they are not they can be drag and dropped into the correct positions until the Vu-Net flashing sequence matches the real-world cabinets. Clicking on one MSX will grey out all others until it has been dragged and dropped to the desired position;-

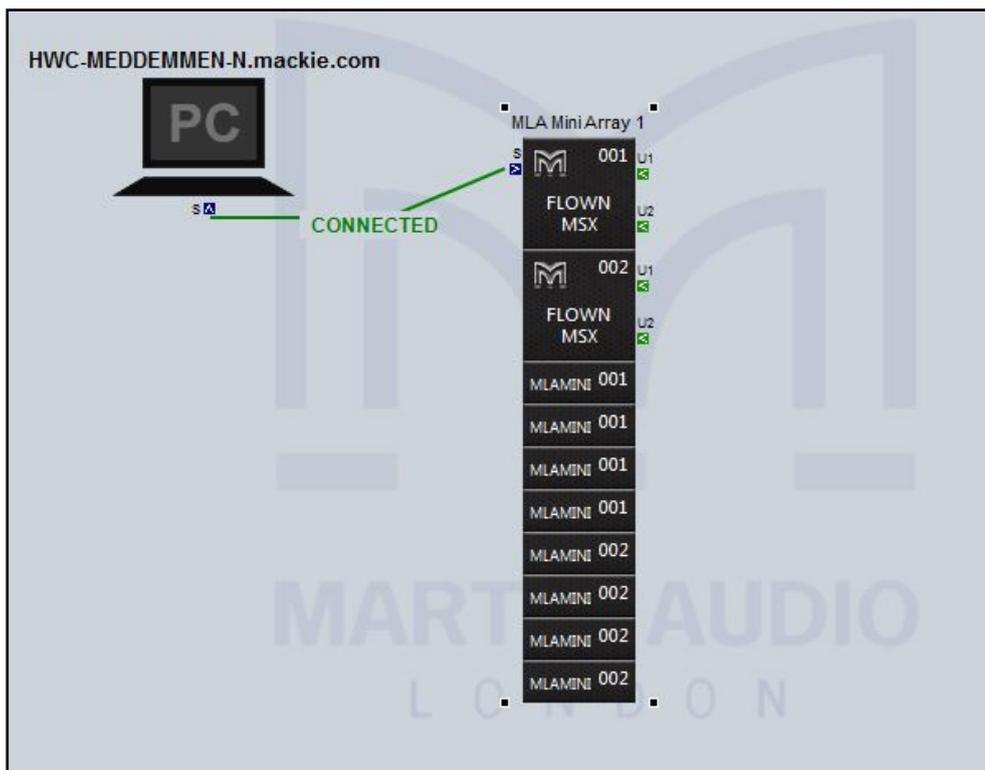




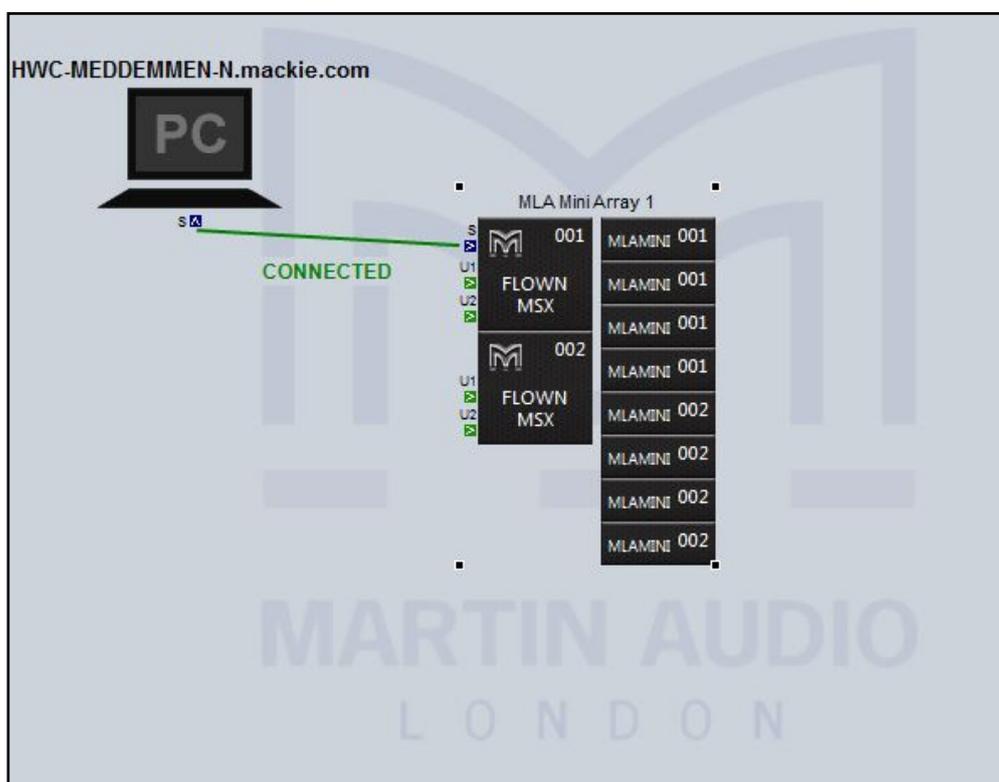
Once the cabinet sequence is corrected you can proceed by clicking next and synchronising the system;-



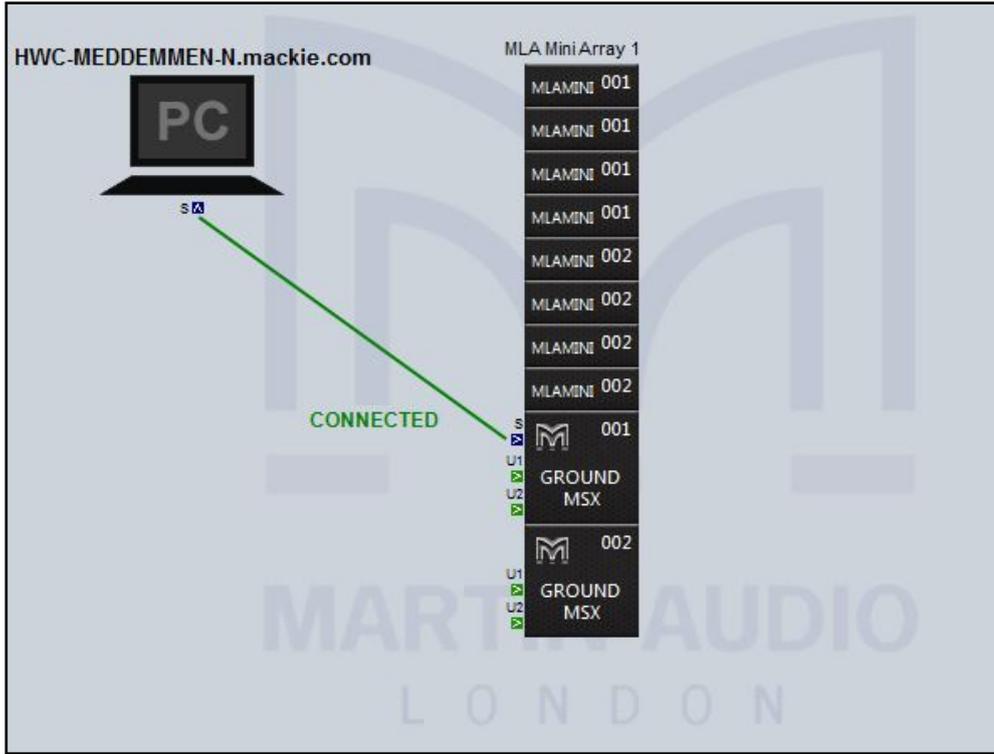
Once complete the arrays will appear on the System Diagram window with the thumbnail representing how you have selected the system deployment. Here is an eight box system flown from MSX;-



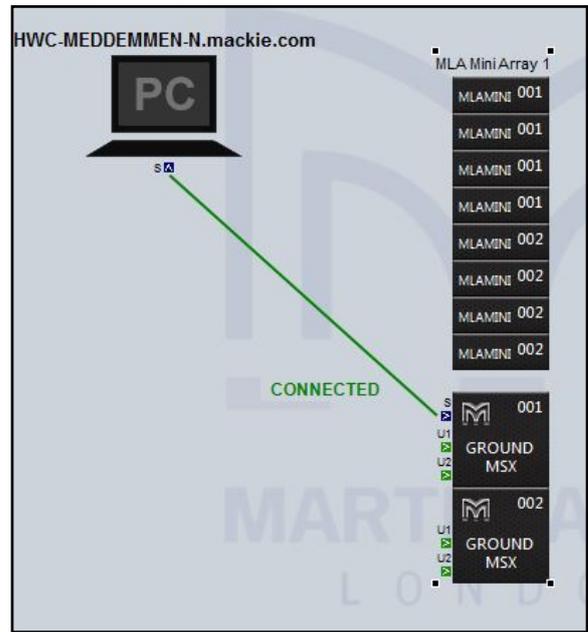
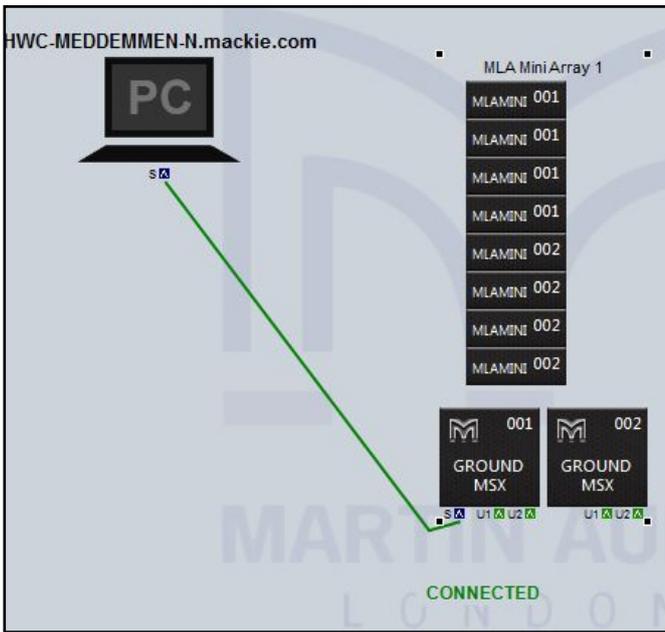
This is a flown system with the MSX flown behind the Mini;-



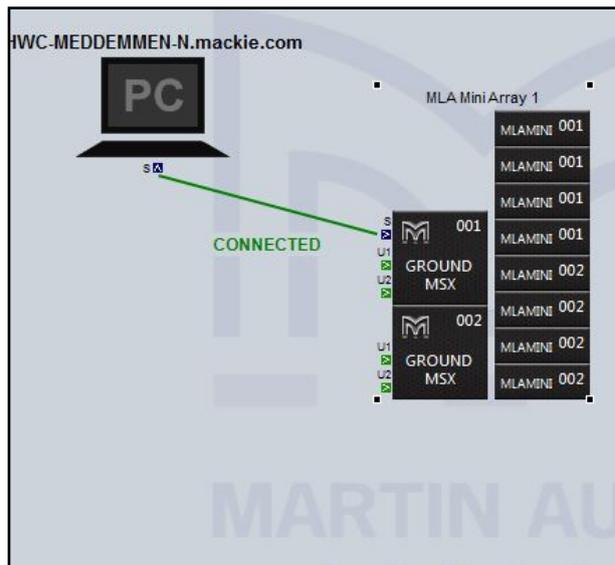
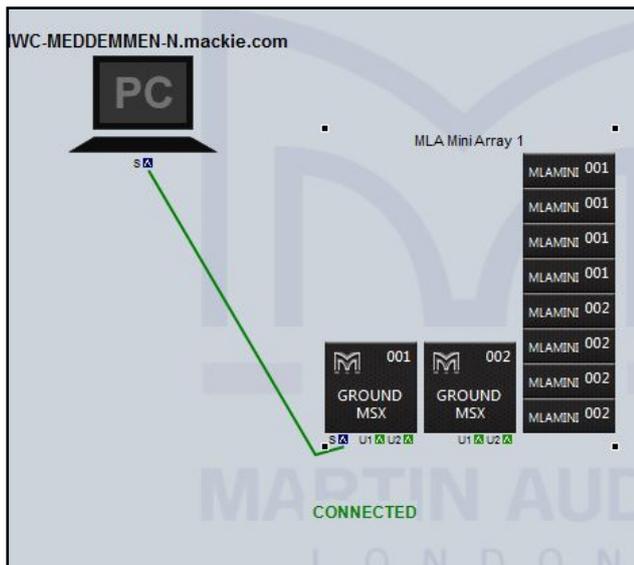
Eight mini ground-stacked on their MSX;-



Eight flown Mini with ground-stacked MSX stacked vertically and horizontally;-



Similarly ground stacked with MSX in both horizontal and vertical modes;-

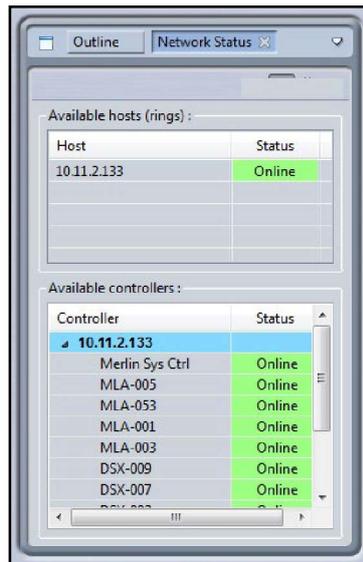


### On line operation

Note the differences from the off line mode of operation. First in the top right corner you can see the indication that the Merlin and connected speakers are on line;-



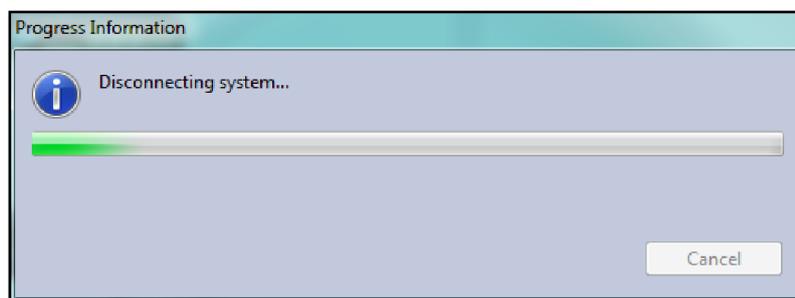
In the right hand corner we have selected network status and we now see all connected elements showing as Online;-



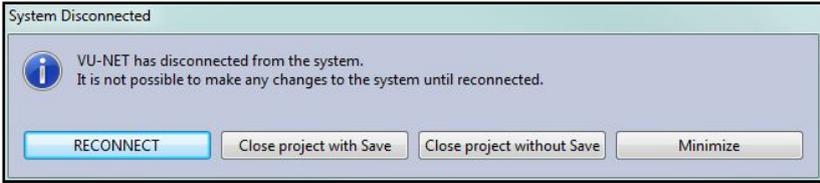
We now have the facility to Disconnect from the system whenever necessary, at the end of the night when a show is finished for example. Click on the 'DISCONNECT' button;-



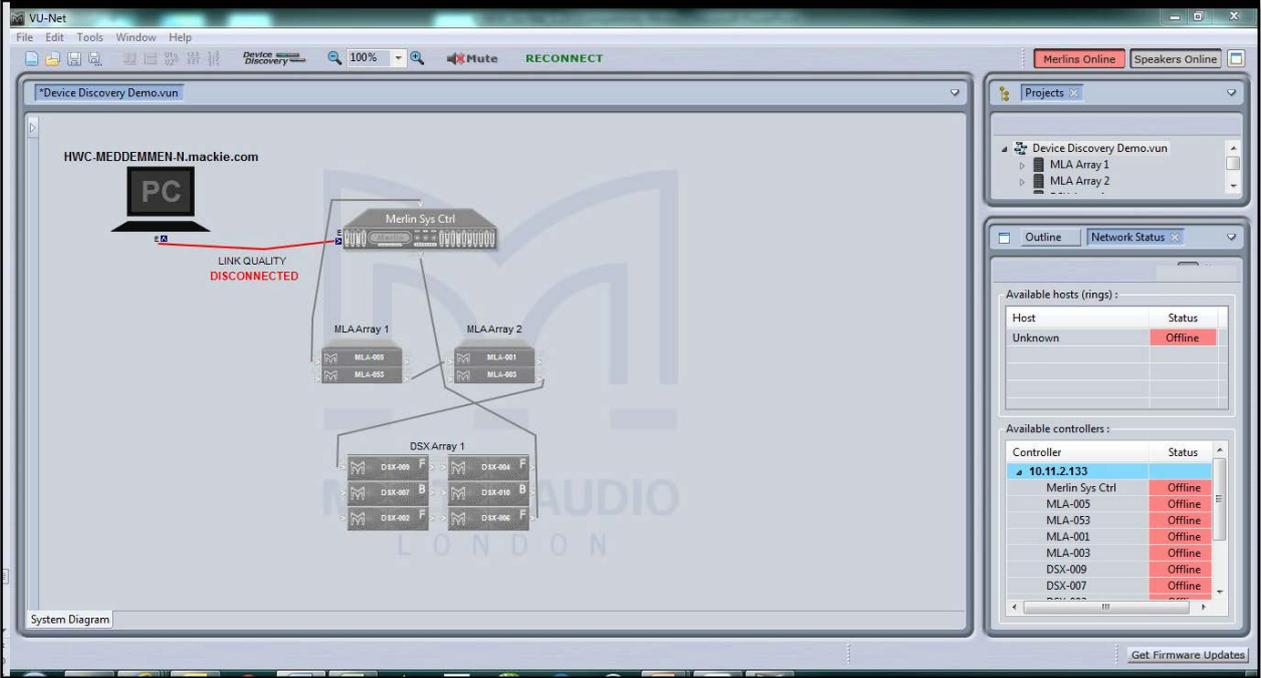
You will see the Disconnecting System Window appear;-



Next you will see the following message;-



The Vu-Net Window will now appear as follows, note that the connection between PC and Merlin is showing as 'Disconnected' and the system in the Diagram window is greyed out. As the pop up window mentions, it is not possible to make any changes to the system whilst the system is in this state. We recommend using disconnect and re-connect when changing from a wi-fi to a wired connection for example when set-up is complete before the show start;-



The 'DISCONNECT' button is now a 'RECONNECT';-



And a click will restore the connection to the system. If the project has been saved, when re-opened you will be prompted to re-connect immediately.

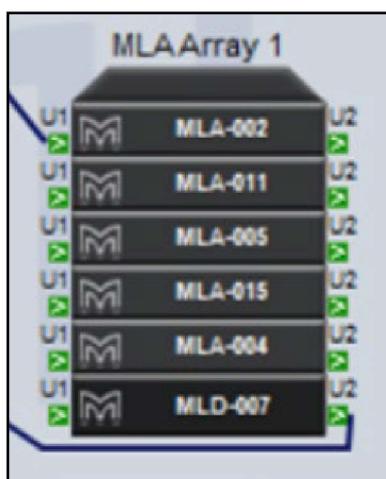
As you can see, the System diagram detects and draws all network connections. Note that Ethernet connections from PC to Merlins are shown as a line regardless of whether it is a hard-wired cable, copper link or wireless connection. The Unet ports on individual devices also show the network integrity. Good connections will show as a green U1 and U2 port. A faulty or missing connection between devices in an array will be shown as either a grey (no connection) or a red (connection with network errors) U-Net port. By hovering your mouse over a port displaying an error you will see details outlining the nature of the issue;-



In most cases this is not critical as a U-Net topology is a redundant ring so if there is a break in the network connection, every device will still remain on line as the A cabinet off-line will appear in red at the position in the array;-



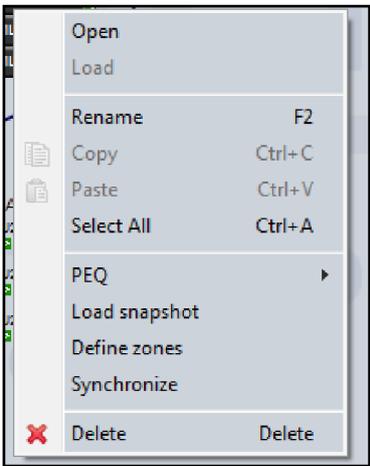
The network is monitored in real time so as soon as any network or cabinet issues have been resolved the connections and cabinets will return to the regular colour scheme;-



Right-Click menu



Access to array or Merlin functions are achieved in two ways; double clicking or right clicking, first we will look at the options available when selecting an element with a right mouse click as there are some configuration options that you may need to select first from this page. You will see the following menu;-



'Open' will open the full configuration page in exactly the same way as a double click

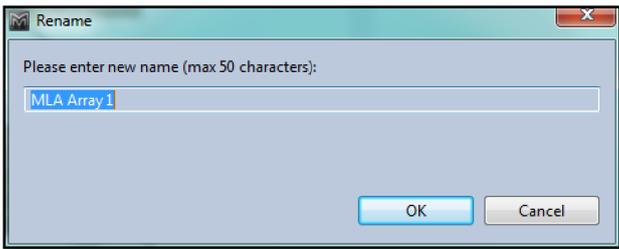
'Load' is a Merlin function for loading a configuration previously saved as a file.

'Save' is also a function available for Merlin. There are three options, 'All', 'Inputs' and 'Outputs'. These will save the Merlin configuration as a Merlin \*.meq file in a location of your choice on your hard drive. As the options suggest, 'All' will save the entire Merlin configuration, 'Inputs' just the input PEQ and delays and 'Outputs', all parameters from the output channels ignoring the inputs. The \*.meq file can be saved and re-used in future projects or distributed to other MLA partners for use with other systems. It is loaded using the 'Load' function.

'Select All' will select all components in the system design. The keyboard shortcut for this is Ctrl + A.

### Renaming

'Rename' allows you to give the array or Merlin a name to suit the event and location if desired. Function key F2 is a shortcut to this option. Once selected you will see the following window;-



Type the required name which can be up to 50 characters.

### PEQs

'PEQ' has two options, Load and Save. As we will see, it is possible to tailor the EQ of an array to suit personal preference. This is in addition to the array optimisation from Display 2.1 which will equalise the system to suit the response requested in the design. If there is a particular sound required for a style of music or requested by a sound engineer, the curve can be stored as a file and recalled for any future shows using these commands. Using the house EQ will be covered later in this chapter.

### Loading Snapshots

As we will see, system configurations including different optimisations can be stored as snapshots. These are stored in the DSP of each cabinet once uploaded so recalling is a simple network instruction to load whichever snapshot has been selected. It is

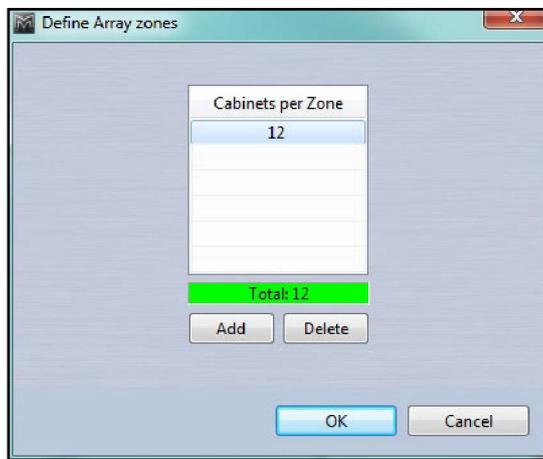


therefore quick to do and could easily be done between acts at a festival for example. This could be extremely useful if you have done a number of optimisations for an outdoor space with different environmental conditions to compensate for the variation in air absorption during the day as the conditions change from bright sunlight to cool evening. If you need to save or select snapshots for several arrays simultaneously you would select the necessary arrays as already described, then use the Load or Save Snapshots commands in the Edit menu, however if you just need to select snapshots in a single array you can do so using the menu functions available by right clicking. Snapshot creation and recall will be covered in greater detail in a later chapter.

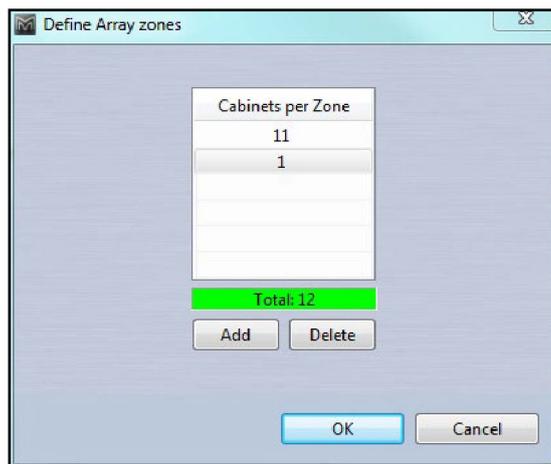
### Defining Zones

By default every array is discovered as a single zone but from this menu any array can be divided into up to six zones which can all be equalised and have their gain trimmed independently. Perhaps the most common use for this is to zone an MLD independently from the rest of the array as there is often a requirement for the near-filed coverage to have quite different equalisation. As an example, we will take a twelve cabinet array and divide it into three zones; the MLD, the lower six MLA and the top five MLA.

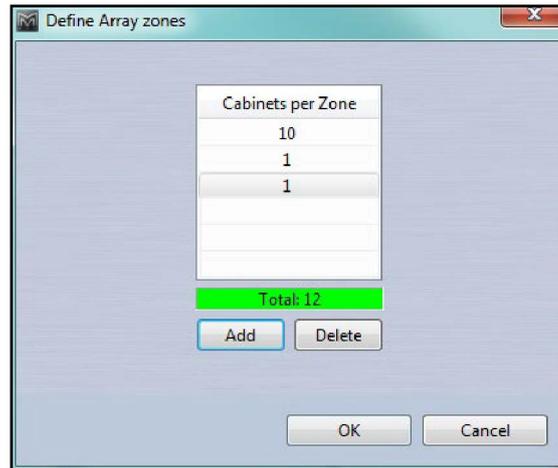
First click on 'Define zones' in the right-click menu. Will see the following window;-



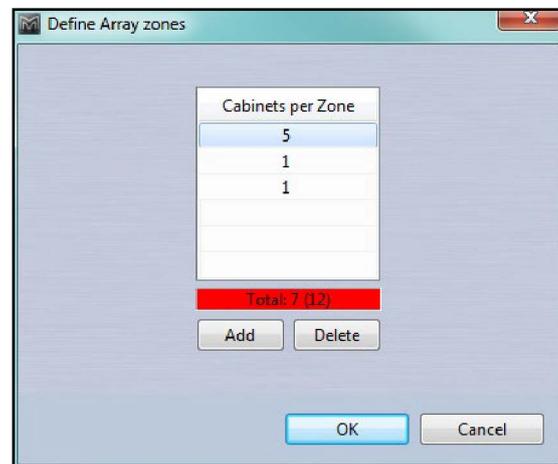
This shows a single zone of twelve cabinets, the total at the bottom is shown in green because it equals the numbers in all zones. We now click 'Add' and an additional zone is added of one cabinet below the first. The upper zone has its quantity reduced to eleven to maintain the total of twelve;-



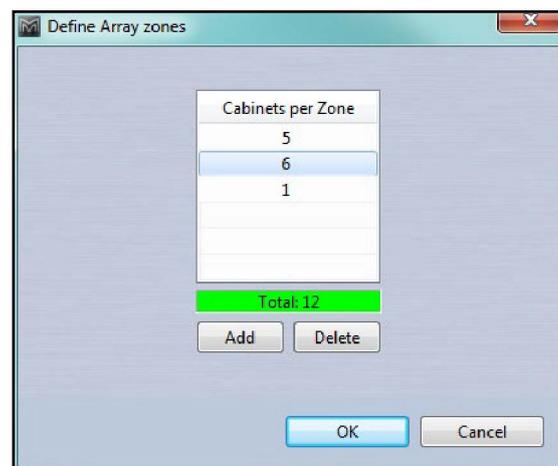
Click 'Add' a second time, it is necessary to create the desired number of zones first and then modify the quantities in each zone. New zones are always added below the previous and the position in which they are shown corresponds to the physical position in the array;-



We want our top zone to consist of five MLA to click on the 10 shown in the top array and type "5". The quantity of cabinets is no longer 12 so the total is flagged red;-



Now type a "6" in the middle zone, we have restored the total to 12 so the total is shown green once again;-



If we need to reduce zones at any time they can be deleted by clicking the delete button. Note that this will reduce the quantity of zones by one but will also reset the numbers in each zone. All zones will have a single cabinet up to the top zone which will have the balance of cabinets required to equal the total in the array. We have finished defining zones so can click OK. You will



be warned that any ganging already implemented will be removed which is why it is sensible to create zones prior to any other processing. Processing zones will be covered in later chapters.

Synchronize

When connecting or reconnecting to any system the cabinets will be synchronised, these is also the facility to re-synchronise at any stage using the right-click menu.

Delete

Any array or Merlin can also be deleted from the right-click menu. This can also be achieved by selecting the item or items and pressing the 'Delete' Key.

MLA/MLD & Compact Arrays

MLA/MLD and MLA Compact arrays are almost identical when controlled and monitored via Vu-Net with the only significant difference being that MLA Compact has five cells to MLA and MLD's six. This chapter will predominantly refer to arrays comprising MLA with MLD where the same functionality is available for MLA Compact. All differences between the two will be explained

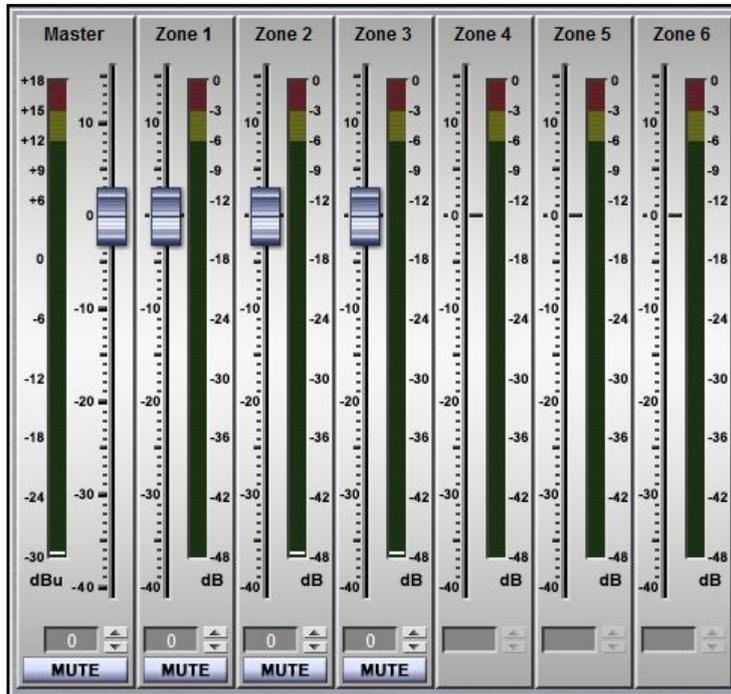
Double clicking on an MLA/MLD or Compact array or right clicking and selecting 'Open' will open a new window as an additional tab as shown;-



MLA compact arrays will appear almost identically, just under the MLA logo the name is "MLAC" and of course there are only five cells visible in the array thumbnail



This page is the Array Overview; each array also has a tab for Zone PEQ and Ganging. First we will look at the metering and gain faders. Here is a 12 box array that has been divided into three zones, the top five cabinets, next six and an MLD. The Master and Zone Section looks like this:-



The Master Gain allows up to +15dB of gain or 40dB attenuation of the input level to the entire array, the meter shows the absolute level to the input stage of the cabinets, it is pre-fader so if the level is clipping it is an indication that you need to attenuate the signal upstream of the array, at the mixing console for example. The Master level as with the zone faders can be adjusted in four ways, either dragging and dropping the fader knob to the required level, clicking just above or below the fader knob which will increment or decrease the gain in steps specified in Preferences, clicking on the up/down arrows by the value window or by typing a specific gain into the box at the bottom of the fader. A value between 15 and -40 can be entered, is a value higher than 15 is typed, it will default to 15dB, if a value lower than -40 is typed it will default to -40.



Note that that the available gain and attenuation is combined for both the Master and Zone controls, for example if the Master is boosted by 15dB you will not be able to boost any Zones. If the Master is boosted by say 5dB you will have up to 10dB of boost available for the zones. If you attenuate the Master by say -30dB you will only have -10dB of attenuation for the zones and so on.

At the bottom of the Master fader is a Mute button which will mute the entire array. The button and all zone mutes will turn red when activated.

Next are the Zone faders which allow gain trim and mute for each of the zones that have been configured, in the example above there are three. The maximum number is six. Gain may be adjusted exactly as described for the Master fader, dragging the fader knob or typing a value. All zones may be adjusted completely independently. The zones also have a Mute button which will instantly mute a zone. A further click will un-mute the zone.

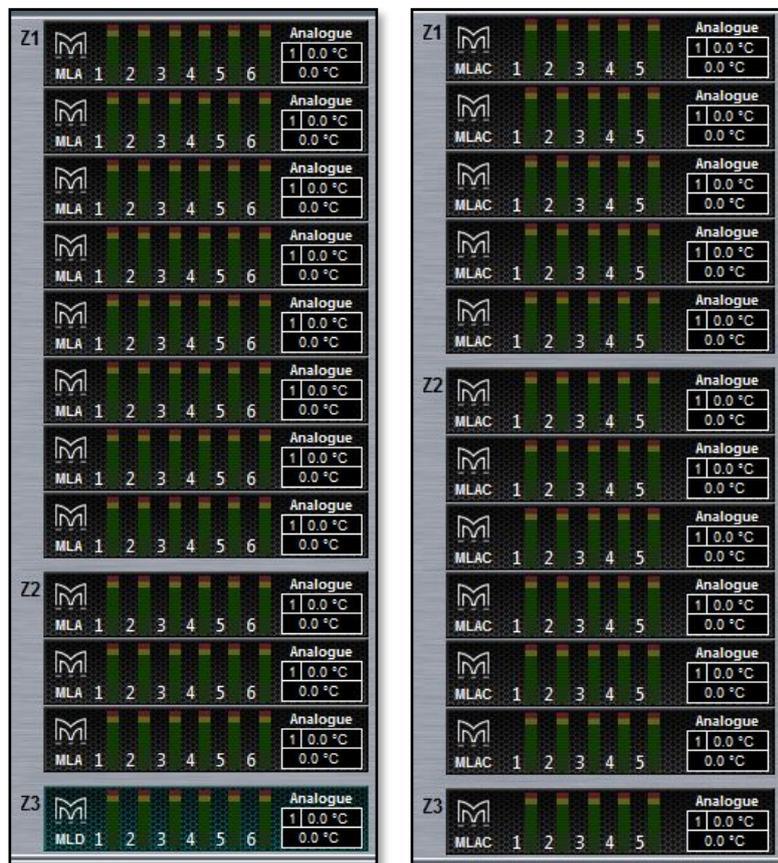
All zone mute buttons will also turn red to show they are all muted;-



The Mute buttons can be freely changed whilst in normal mode, during set-up for example but when in Show Mode you will be prompted to confirm a mute function to avoid accidentally muting something while a show is in progress. See the Show Mode chapter for more details.

The zone metering is post PEQ, each zone can be equalised independently so the metering will show the effect this has had in addition to the effect that any gain trim has contributed. The zone meters differ from the Master in that they display headroom rather than absolute level. 0dB at the top of the scale indicates clipping the signal level reached will show how much headroom is available before clip.

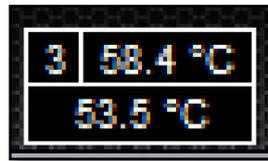
The entire array is shown as a thumbnail diagram with each cell shown on every enclosure, on the left is an MLA/MLD array, on the right is MLA Compact, both have been zoned in the same way;-





The enclosures are grouped in their zones which are labelled on the left. The type of cabinet is shown on the left under the Martin Audio logo, the MLD is also a slightly different greenish colour. The cells in each enclosure are labelled next to their meters. The metering is post PEQ and pre amplifier and indicates level prior to limit. The yellow 0dB segment indicates that the limit threshold has been met, the Red LEDs illuminating show progressive amounts of gain reduction in each limiter.

In the right corner of each element you will see the temperature readout-



This displays two readings simultaneously, the top reading is the amplifier module that is showing the highest temperature, the number on the left shows which module, in the example above it is number three which is the final two HF cells. The bottom reading is the temperature of the DSP section.

Just above the temperature read-out is a display showing the input setting for each individual cabinet. Here we can see a cabinet set to AES Digital and one set to Analogue;-



This will display the last input setting used with each cabinet so you can see at a glance if you have a miss-match of input modes. When uploading EQ optimisations together with a house PEQ file all inputs are reset to analogue. Alternatively you can change the input mode manually and all cabinets will match, if for example you are running the system with an analogue feed and have one cabinet showing AES, select AES from the input selection (see below) then select analogue to change all cabinets back to analogue inputs. This indication is particularly useful if you have had to change a cabinet or amplifier module after loading optimisations, whilst you will need to reload the optimisation at some point, it is reassuring to be able to rapidly check the input mode if you hear any particularly strange sounds; a mix of analogue and AES inputs can sound extremely unpleasant.

Just below the zone level and metering is LED control if you need to identify a cabinet or cabinets again once you have completed Device Discovery;-



Pressing the 'play' triangle will start the LED running sequence from top cabinet to bottom. The play button then changes to a pause and the 'Next' and 'Previous' buttons are greyed out;-



Clicking the pause button will freeze the LED badge, the 'previous' and 'next' buttons can then be used to scroll the illuminated LED badge between the cabinets. Clicking the square 'Stop' button will extinguish the LEDs.

Below the LED buttons you will find the Delay section which will add a delay to every cabinet. The delay displayed will be that which was already residing in the array DSP when the devices were discovered and synchronised;-



The delay can be entered in two ways, either by scrolling up and down using the up/down button on the right of the value box. The increments are determined by the options in the Preferences menu, either 1.0, 0.5, 0.25, 0.2 or 0.1 milliseconds. Values can also be directly typed into the box. The maximum value is 1,000.00ms (1 second).

Next to the delay is displayed the currently active snapshot:-

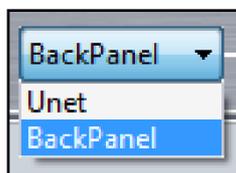


In this case the factory default snapshot A. This display will automatically update when a new snapshot is loaded.

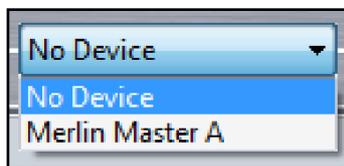
The final section on the System overview is the Input selection:-



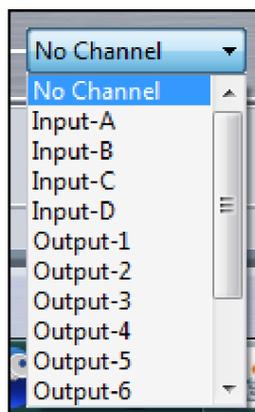
This is divided into three sections, the first selects the source from either the rear panel XLR input or via U-Net:-



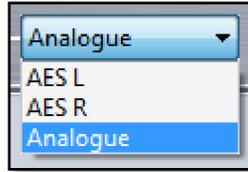
Note that digital audio over U-Net is not yet supported so this option should NOT be selected. When this option is active, the second section is used to select the U-Net source from one of the Merlins discovered on the network:-



Once you have selected a Merlin, the final box gives you the choice of which channel from which to route the input to the array:-



However, as mentioned, until notified otherwise, ALWAYS keep 'Back Panel' selected. The second panel will display 'No Device' and will be greyed out, the third panel will allow selection of either Analogue (the default selection) or AES3 Digital:-



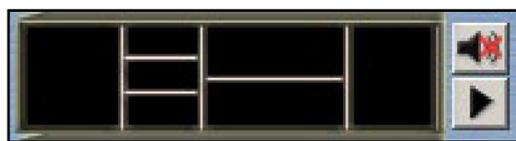
As AES feeds two interleaved digital channels you have the option to select either AES L or AES R. The initial display will match what the array was set to when the system synchronised until you use the Preset Loader and load one of the default PEQ's which will set the input to Analogue. See the chapter of Preset Loading for more detail.

### Array Cell Check

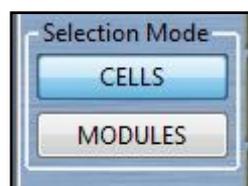
Double clicking on the array diagram brings up a new diagnostics screen which enables testing of individual cells, an extremely useful tool for checking an array over either just before it is flown or back in the shop when a system is checked over. Note that this function is not available when in Show Mode;-



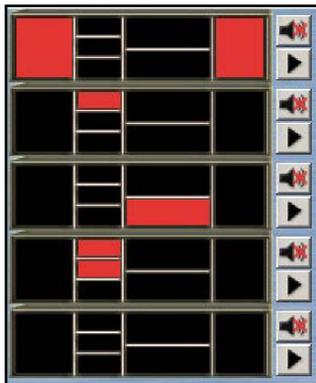
This is how the window appears, the array diagram is still visible on the right but it is now also shown on the left with each cell shown but with a representation of its physical location in the cabinet;-



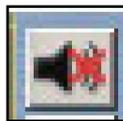
Each cell can be muted from this section, this can be done by individual cells or the entire cabinet depending on the selection mode selected;-



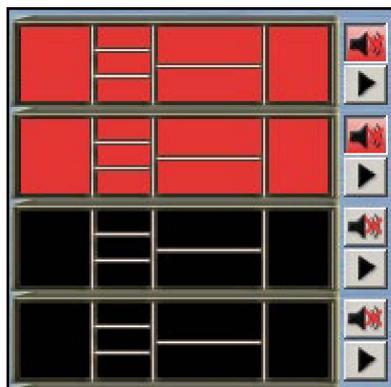
In 'MODULES' mode clicking on any cell will mute or unmute all calls in the cabinet. In 'CELLS' mode you can mute and unmute individual cells by clicking on them;-



Or an entire cabinet can be muted by clicking on the button to the right of each enclosure regardless of which mode you have selected;-



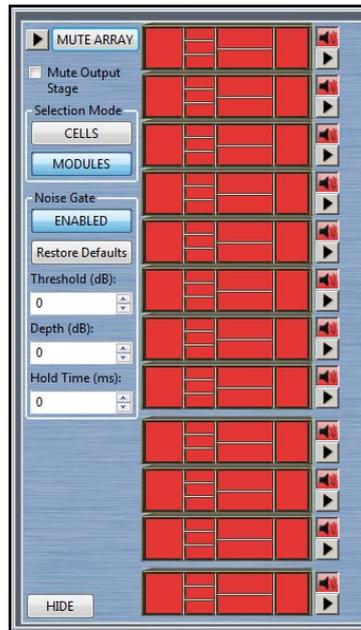
This is how an entire muted enclosure is shown;-



Pressing the Mute Array button;-



Will mute every cell in the array;-



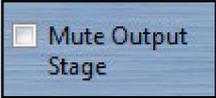
There is a further function for each enclosure activated using the “play” arrow by each enclosure;-



This mutes all cells except the low frequency and then cycles through all six cells in sequence, unmuting the next cell at the same time as muting the previous. The idea behind this is that you can mute the entire array, apply a test signal such as pink noise to the input and then use the Mute Cycle function to un-mute each cell to listen for the test signal to make sure that you have output from every cell offering an audible test that all amplifiers and drivers are operating. It is good practice if you intend to use this test, to recall the default snapshot 'A' first. Without doing this all cells will have the last parameters used still loaded so the sound from each cell when heard individually will vary enormously making it difficult to judge if they are operating correctly. When you have checked all six cells in the first cabinet, click on the “play” arrow a second time to stop the mute cycle. You can then move on to the next cabinet and so on until you have checked the entire array. This is a very quick and easy test for the system; it can be completed in the shop or on an array that has just been rigged prior to flying the system into place. The big advantage is that there is no need to wait until front of house has been set up or any other part of the system, each array can be tested individually the only additional equipment that is required is a simple signal generator which can even be an app on a smart phone.

When the system has been tested and the signal source disconnected or switched off the system can be un-muted by a further click on the MUTE ARRAY button.

In addition to muting cells, you can also completely disable a cabinet by switching off the amplifier. This is designed for emergency situations if for example an amplifier module has a fault and is generating unwanted noise. If you have tried the mute function and the noise persists it is being generated by the amplifier not anything upstream in the audio path such as the DSP. In that instance the only option is to switch off the amplifier. The mains distribution system has a breaker on each pair of cabinets so if that were to be used to isolate a cabinet you would also unnecessarily switch off its neighbour so the mute output stage function allows independent isolation of a single cabinet without disrupting any other functions. The big advantage of this compared to physically powering off the entire cabinet is that the input and network sections are still powered as normal so no other functions are disturbed, the U-Net array and network will still appear functioning as normal just with the indication that the cabinet amplifiers are off. To use the function first click in the Mute Output Stage box in the top left of the window;-

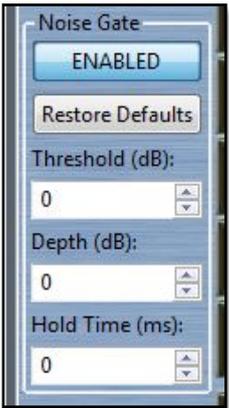


Now click on either the thumbnail or the Mute all channels button of any cabinets which need to be isolated. All cells will appear muted and on the array view you will see AMP OFF appear above the temperature table;-

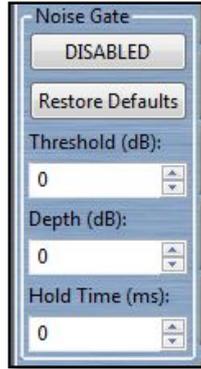


Note that the Mute Output stage box must remain checked; if it is unchecked the cabinets will revert to the standard mute function and the AMPS OFF flags will disappear.

Also on the test page is the array noise gate control;-

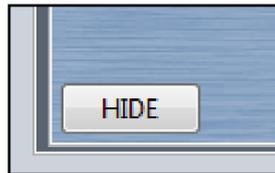


Each amplifier module has an internal noise gate set to keep the amplifier and DSP noise floor as inaudible as possible. By default it is enabled but it is possible that with very low levels of program material the gate operation may be audible and so the gate can be defeated by pressing the ENABLED button. The button will then display 'DISABLED';-

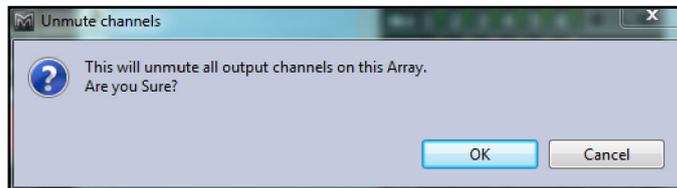


The threshold, depth and hold time have been carefully calculated to give the best balance between making the operation as inaudible as possible and maintaining a silent system but the parameters may be modified by either directly typing a value or by scrolling up or down using the arrows to the side of the value windows. The Threshold can be any value from +20 to -120dB, the depth from 0 to 120dB and the Hold time can range from 0 to 5,000 milliseconds. Default values are threshold of -84, Depth 10 and Hold time of 5000 for MLA and MLD and -67, 10 and 5000 for MLA Compact. These can be restored at any time by clicking the Restore Defaults button.

To return to the main window click on the HIDE button in the bottom left;-



If you have any muted output channels (muted not disabled), you will see the following window;-



This ensures that you do not suddenly unmute all output channels while you have a test signal applied; pink noise at full volume through an entire array is not something you want to suddenly subject a venue to. If you click OK you will return to the main window and all output channels will be un-muted. If you have disabled cabinets they will show AMPS OFF in the array thumbnails;-



PEQ Tab

All types of array have a PEQ tab which offers multiple bands of equalisation plus a high pass filter that can be used as a means of tailoring the system sound to suit any preferences of the sound engineer or to deal with any peculiarities of the venue acoustics. It is important to note that this is completely independent to the Optimisation parameters which include parametric, FIR and all pass filtering. These parameters which are created in your Display 2.1 project are uploaded to a completely separate section within the cabinet DSP. They cannot be accessed manually. The PEQ section can be compared to the “grab” EQ in a conventional system which is commonly a third octave graphic equaliser at front of house and is used for subtle adjustment once a system has been configured in the system processors. This is the EQ window which is common to MLA, MLD and MLA Compact;-



The window has three sections, the buttons along the top, the graphic display window and the controls on the right of the window. First we will look at the buttons along the top.



First there are ten parametric EQ buttons plus the high pass filter;-



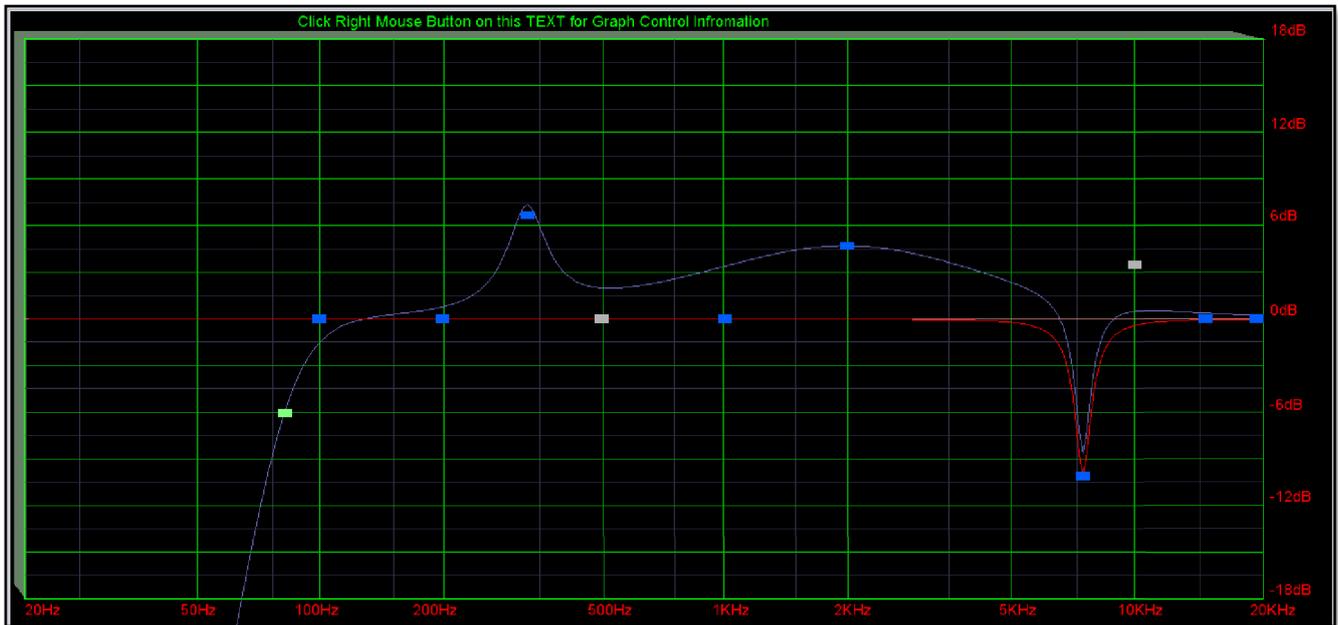
As you can see there are a number of colour variations for these buttons. Unused bands are pale blue until they are selected for editing by clicking on them in which case the colour goes to a brighter blue and the image shows the button depressed. Unused is defined as the gain left at 0dB. A red button indicates that the band has been bypassed, irrespective of whether any gain change has been made. Bypassed bands will change to a pale red when selected. Green buttons indicate a band that has either cut or boost applied, these will go a pale green when selected. Note that the high pass filter is always active so will always appear green.

Next there are the zone buttons;-



In this example the array has three zones with zone 1 selected. As well as individual gain as already discussed, zones each have completely independent PEQ to allow precise adjustment, most commonly used with the MLD which often requires a different equalisation to the rest of the array. Clicking on the zone number brings up the PEQ page for that zone. If the array has not been divided into zones there will just be one button with a number 1, essentially the entire array is a single zone.

The graphic view of the equalisation is a relatively standard frequency response graph;-



The horizontal axis is frequency in Hertz from 20Hz to 20KHz, the vertical axis is gain from -18dB up to +18dB. Colour coding is also used on the graph to represent the various modes.

First there are two traces, one red, and the other blue. The red trace is the response of the band that is currently selected; the blue trace is the overall response of the entire PEQ.

Each small rectangle represents the position of each of the ten bands plus the high pass. For all of the EQ bands the position on the horizontal represents the EQ centre frequency, the vertical position is the cut or boost applied. A blue rectangle is an active EQ, a grey rectangle is an EQ that has been bypassed. The green rectangle identifies the cut-off frequency of the highpass filter.

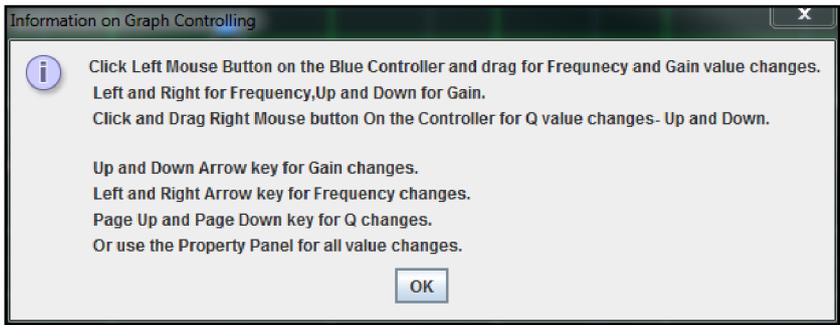


In common with most PC controlled equalisation systems it is possible to make adjustments by dragging and dropping the filter curves. Left-click on any of the band rectangles and holding down the left mouse button, drag the icon horizontally to change the centre frequency or vertically to change the gain. Right-click and drag up and down to adjust the filter Q factor. You can also use the left and right keyboard buttons to adjust the selected band frequency, up/down buttons to adjust gain and Page Up and Page down buttons which will adjust the Q factor. The graph will adjust and the audio adjustment will be made in real time.

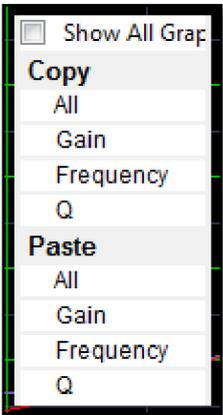
If at any stage you need a reminder of how to control the PEQ, right click on the text at the top of the graph;-

**Click Right Mouse Button on this TEXT for Graph Control Information**

This will bring up the following window;-



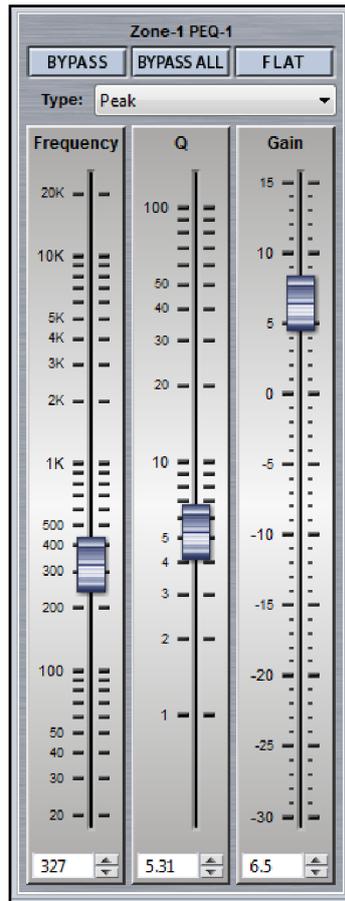
There are also other functions available by right-clicking elsewhere in the graph window (i.e. not when the cursor is over one of the filter rectangles). This is the window that appears;-



The first option is to display all graphs which displays the response of every filter band in grey. The active, selected band remains coloured red with the overall response still blue.

Next is a copy function which will copy the selected band. You can select 'All' which copies Gain, Frequency and Q, or any of these individually. You can then select a different band on the same or another graph (on a different zone or even different array) and paste whichever parameters have been copied. If you have for example copied 'All' you have the option to paste 'All' or just paste Frequency, Gain or Q. If however you copied only say 'Frequency', when you go to Paste you will find that only 'Frequency' is available with 'All', 'Gain' and 'Q' greyed out.

The final section on the right of the window is the Properties panel;-

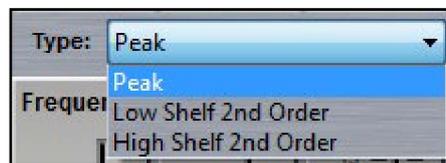


This shows all properties of the selected band. At the top you will see some text indicating which zone and which band the properties apply to. Below this are three buttons;-



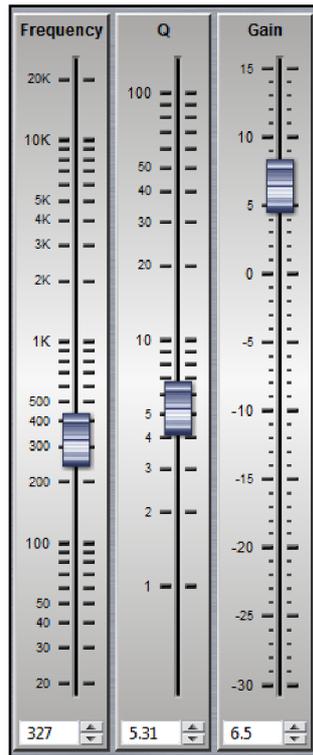
BYPASS bypasses the individual band you have selected turning the BYPASS button and the filter button red. BYPASS ALL bypasses every band. FLAT will instantly change the gain to 0dB.

Next is a Filter type. Click on this and the drop down shows the options for each filter band;-



The default is 'Peak', a standard parametric EQ; the other options are 2<sup>nd</sup> order Low Shelf and 2<sup>nd</sup> order High Shelf.

Below are the three principal faders for adjusting the filter parameters;-



Parameters can be changed on the properties panel in three ways. The faders can be drag and dropped to a new value, the value can be scrolled up or down using the up/down buttons to the right of the value windows, and finally values can be directly typed into the value windows. The response graph will adjust according to the new values and vice versa, adjustments in the graph window will be reflected in the fader positions and values in the properties panel.

The High pass filter only has a single fader for the corner frequency. This may be adjusted in exactly the same way as the faders for the PEQ's. The 'Type' drop down offers three types of filter and slopes from 6dB up to 48dB per octave;-



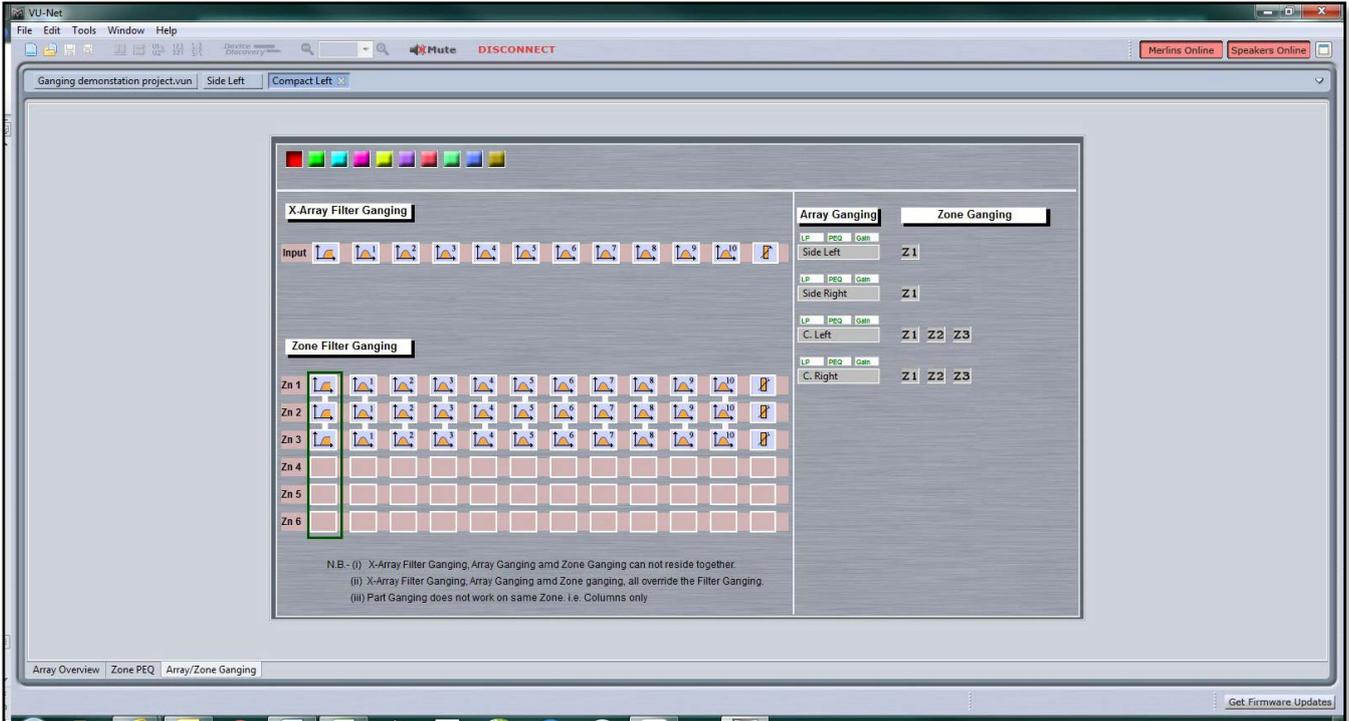
To summarise, there are FIVE ways to adjust filter parameters;-

1. Click and drag on the graph
2. Use the arrow and page up & down buttons
3. Click and drag the properties faders
4. Use the up/down value buttons
5. Directly type values into the value boxes.

Whilst this might seem over-versatility, it is intended to offer several options to suit the way that the system is being operated. If adjustments are being made with a tablet PC in tablet mode with a stylus whilst walking around a venue, certain options may be easier to use than if you were sitting at a desk with a mouse plugged in to the PC.

### Array & Zone Ganging

MLA Systems have a highly versatile set of ganging options to help make system set-up consistent across arrays or zones. This is the ganging page for a project consisting of two main MLA Compact arrays each of 12 enclosures and divided into three zones, plus two side hangs each of six MLA Compact. This is how the Array/Zone Ganging tab appears;-



There are four principal types of ganging available, Array ganging, Zone ganging, X-Array Filter Ganging and Zone filter ganging;-

**Array ganging**

This gangs all parameters in an entire array and is activated by clicking on the Array description in the Array Ganging column;-



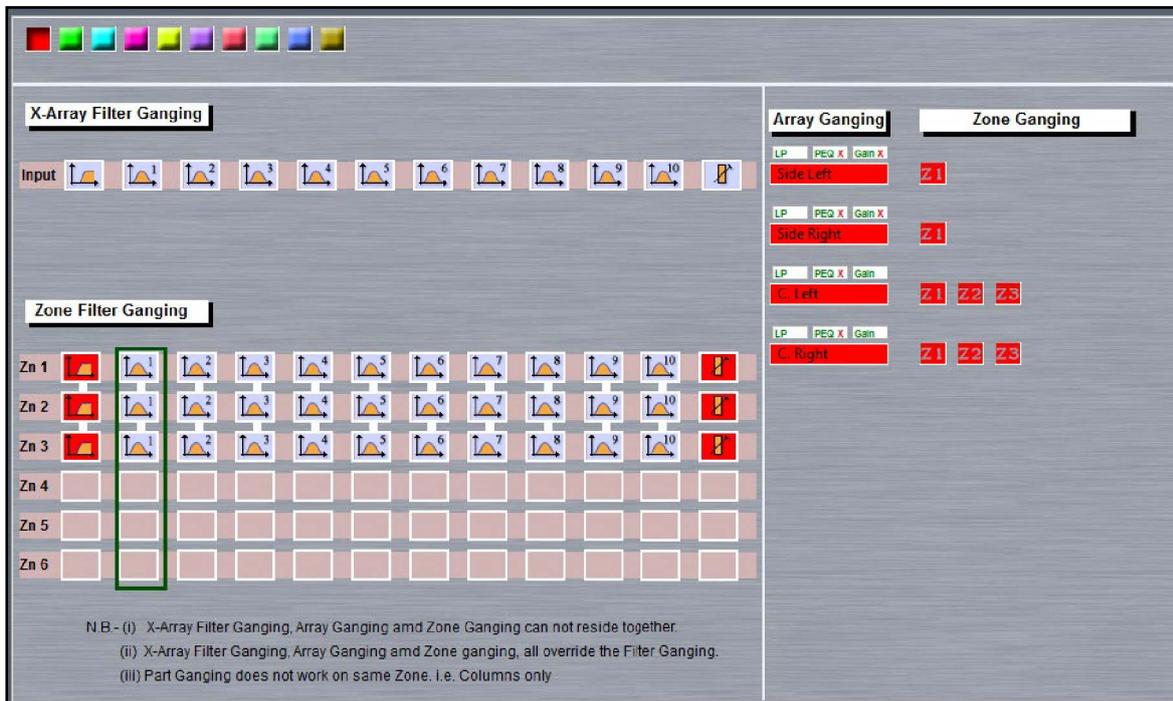
Array ganging has the option of excluding the Lowpass filter, equalisation or gain from ganging. That is the purpose of the small white boxes above each. Clicking in any of the boxes will exclude that parameter from the ganged array. This array has PEQ excluded from all arrays and gain from the two side hang arrays;-



There are up to ten independent gangs available for each ganging variation. These are selected using the coloured squares at the top left of the ganging window;-



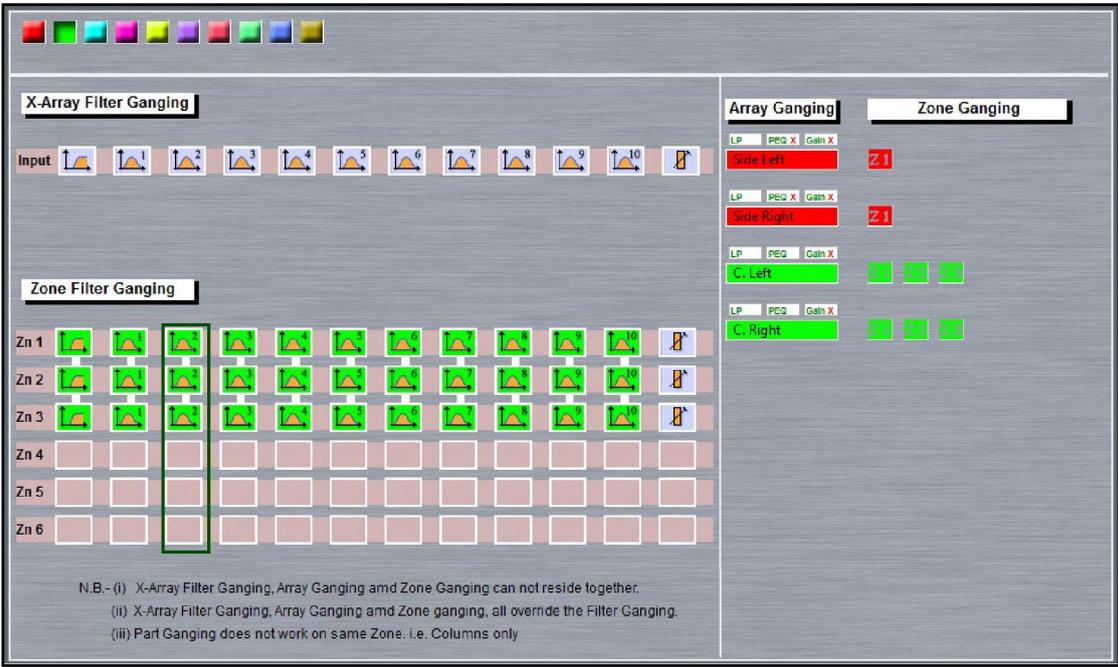
If for example we want to gang the Low pass filters on all four of the above arrays, with gains ganged on the main left and right arrays we simply click on one of the squares to select a gang group, let's say group one which is red. Then click on the Array name boxes they are now all ganged. Note that as the entire array is ganged, all zones are also ganged. We have however excluded the PEQ therefore in the Zone Filter section the PEQ's are not red;-



If we click on the tab for one of the side hangs, the ganging tab looks similar but as we also excluded the gain, that is also not coloured red to show that it is not part of the ganging;-

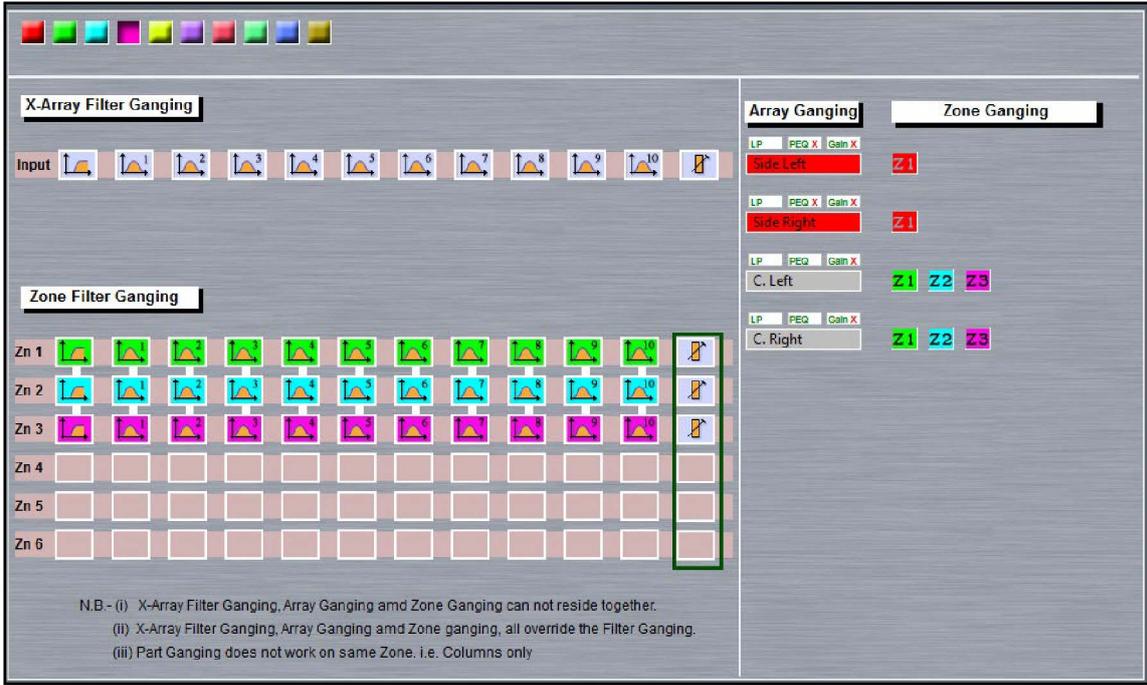


Another option might be to gang both the main arrays together and also independently gang the two Side hangs. This is simply achieved by clicking on gang one, the red square and clicking on both the side array, then selecting an alternative gang, say gang two which is green, and clicking on the two main arrays. In this instance we have included the PEQ in the gang but still excluded the gain;-



**Zone Ganging**

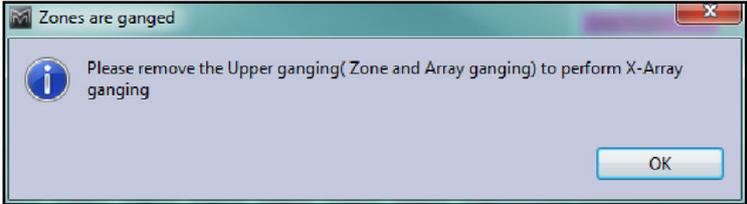
It is also possible to independently gang zones in the arrays, note that array ganging over-rides this function so you will need to un-gang any arrays in which you would like to gang zones. You have the option to select any of the ten gang groups, there are a further ten gangs available for zones which are completely independent from the array gangs. We will however use a different colour to make things a little clearer. This system has the entire side hangs ganged and all three zones ganged across the two main arrays. Not that the parameter exclusion still apply to zones so in this example gains are not ganged;-



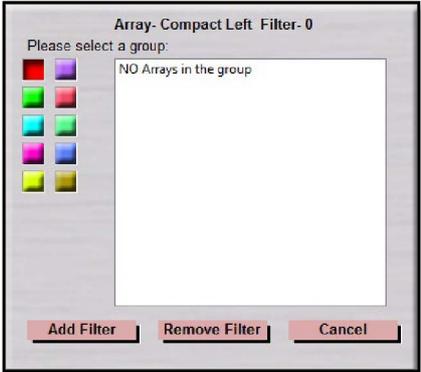
This is particularly useful for example giving you the option to EQ an MLD down fill independently from the rest of the array but ensuring that the EQ is matched on both left and right arrays.

**X-Array Ganging**

X-Array gangs are groups of a single parameter in any included arrays. X-Array ganging is not possible on arrays or zones that are already ganged. In this example we will gang only the high pass filter on all four arrays of the previous system example. With the ganging tab for one array selected, click on the parameter we wish to gang in the X-Array Filter Ganging section. If there is already an upper level gang (array or zone) in use you will see the following window;-

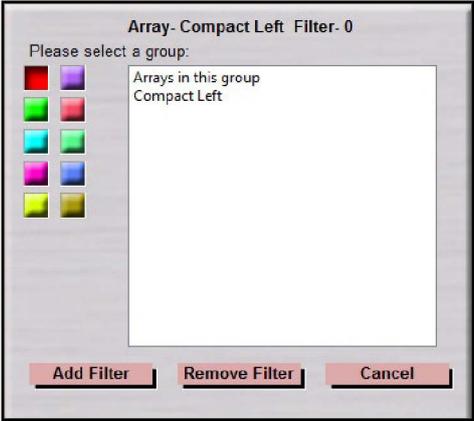


You will need to remove any gangs by clicking again on the array name or zone number boxes. Once this is done, click on the parameter again, you will see this window;-

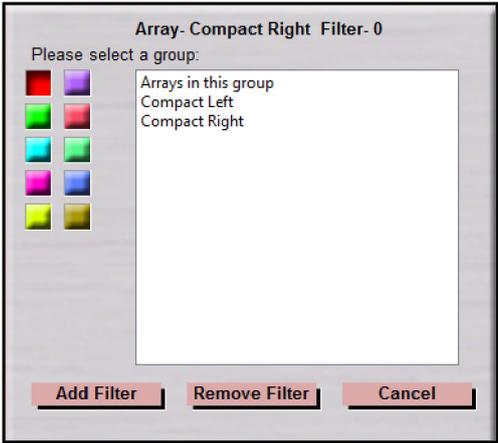




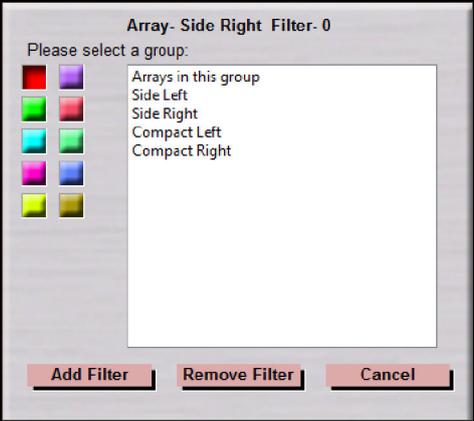
Click on 'Add Filter' and in our example the high pass filter for the Compact Left Array is added to the group. Note that you again have ten gang groups to select from by clicking on the desired coloured square;-



Now click on the tab for any of the other arrays that we would like to include in the group (if they are not already open, go to the project system diagram and double click on the array you wish to include). Select the ganging tab for the array and click on the same parameter in the X-Array Filter Ganging section and click on Add Filter. You will now see both the array you have just added and the first array in the list of arrays. If you select the wrong parameter you can click on remove filter to exclude the array;-



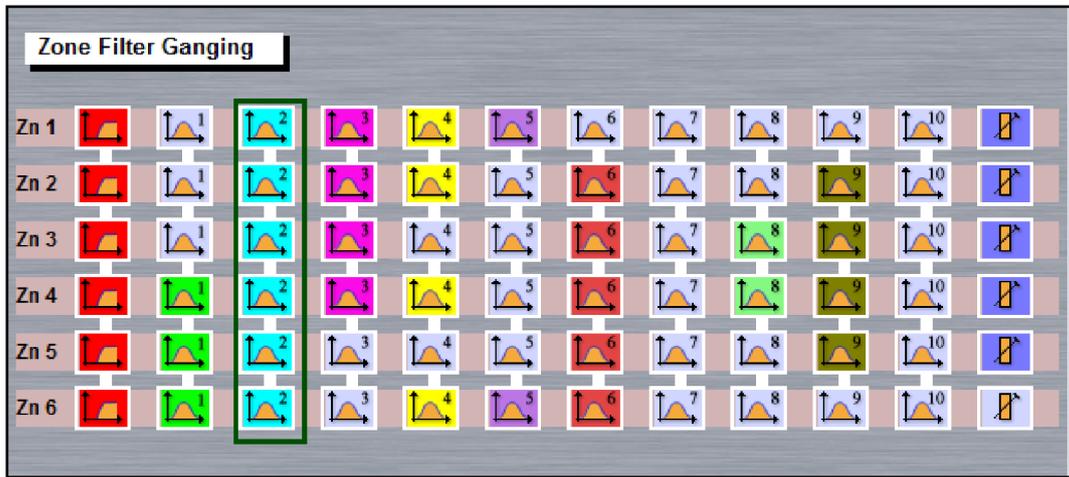
You can repeat this for every array you wish to include. For example if we wanted to have the high pass filter ganged for all four arrays in our previous example we would end up with the following;-





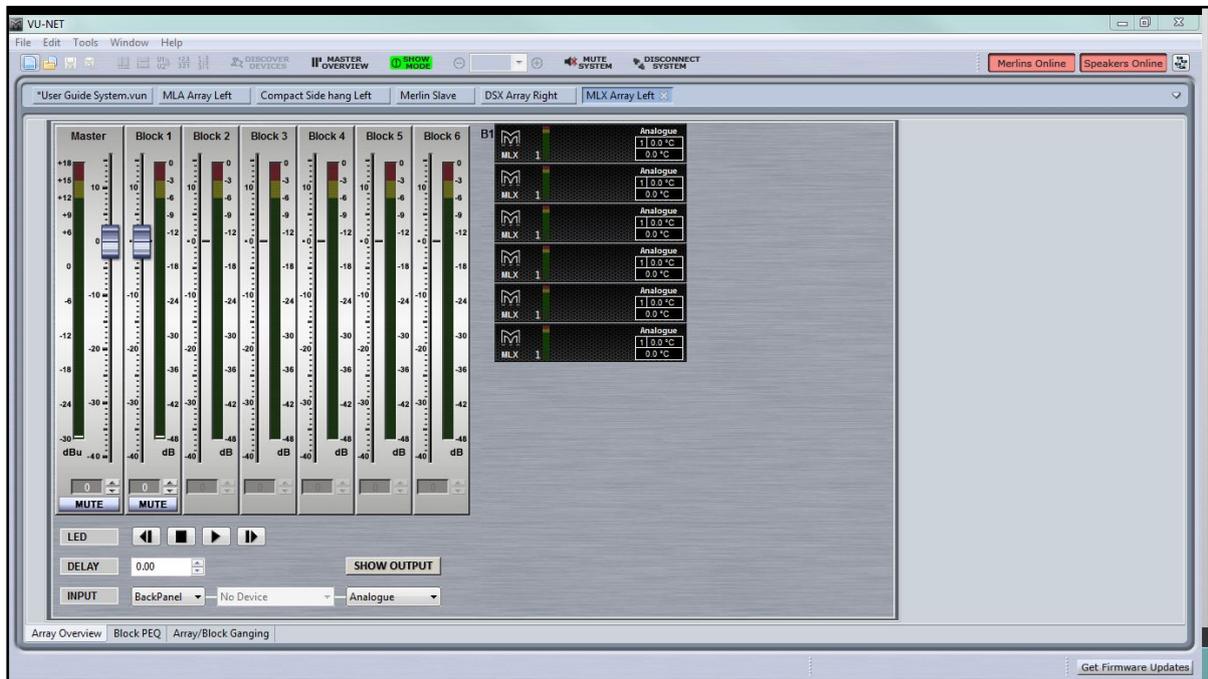
### Zone Filter Ganging

The final ganging option is Zone Filter ganging. Unlike all other ganging options, this only affects parameters in a single array. It cannot therefore be used if any of the other higher-level gangs across several arrays have already been used although it can be if X-Array Filter Ganging has been used but not on any of the parameters that are already in an X-Array group. Once again you have ten independent gangs to choose from, completely unaffected by any of the groups used to gang other arrays or zones. As few as two zones or all six if that is how many zones are present. Note that this example is VERY extreme!



### MLX & DSX Arrays

MLX and DSX share many similar features to MLA, MLD and MLA Compact and are virtually identical to each other with regards to Vu-Net operation. Double clicking on a six box MLX array brings up this window;-

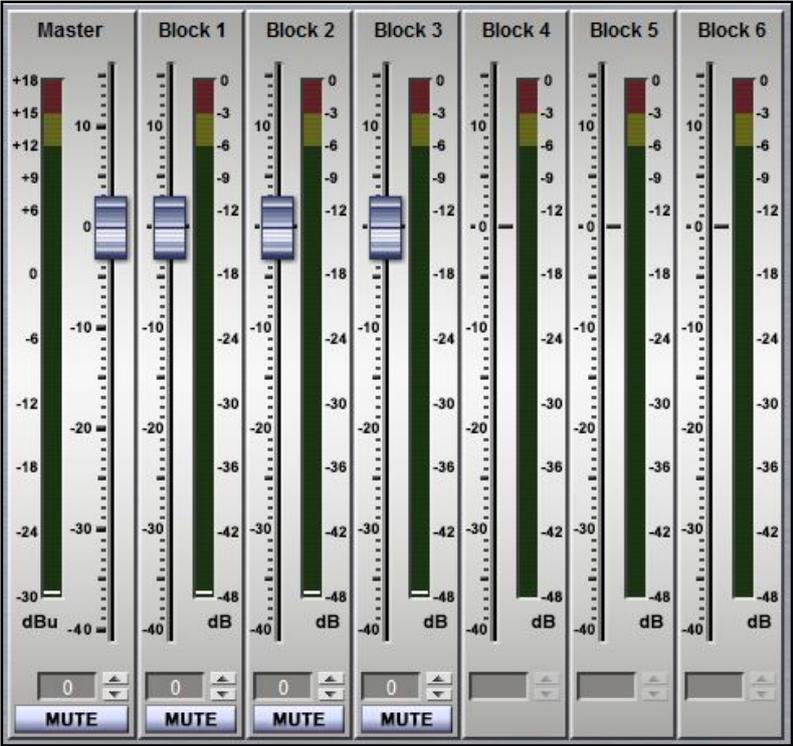


And DSX looks like this;-



Almost identical with just a minor difference in the position of the Led bargraph in the array diagram and of course the name under the Martin Audio logo.

The input gain and muting is identical to other cabinets and sub arrays can be zoned in exactly the same way giving independent gain and mute on the Overview page;-

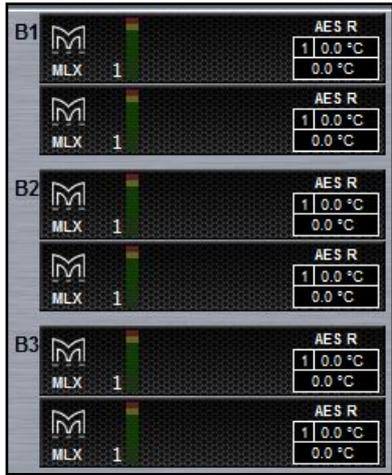


Sub arrays when zoned are referred to as 'blocks' rather than zones.

The array thumbnail is almost identical to the MLA/MLD and MLA Compact just with a single LED level meter to reflect the single cell. The temperature readout will always show '1' and display the temperature of the single amplifier channel on the top line



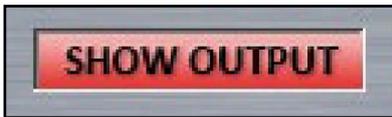
and the DSP on the lower line. Input mode is also displayed above the temperature read-out. If the array has been zoned the zones or "blocks" are numbered from top to bottom;-



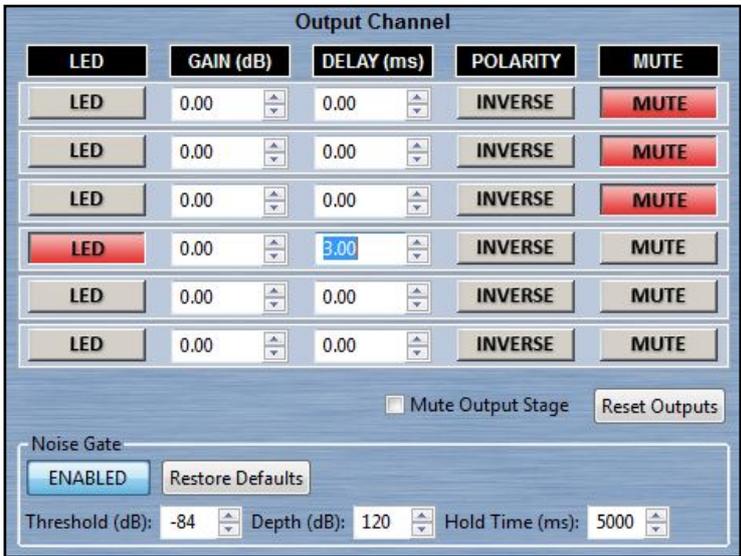
Both subs have exactly the same LED, Array Mute, delay and input routing as for MLA, MLD and MLA Compact;-



There is however the significant difference of there being no snapshot name as subs do not have snapshot capability and there is an additional button "SHOW OUTPUT" which replaces the double click on the other products to bring up additional features;-



Clicking this button brings up the following window on both MLX and DSX;-

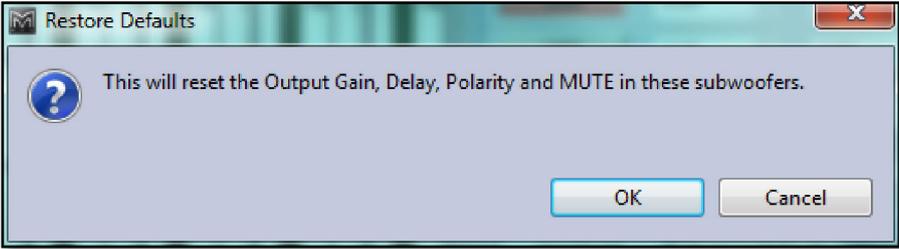




This allows individual control of gain, phase, polarity and mute for each sub in the array. Most often used when creating cardioid arrays with a third of the subs rear facing and requiring independent control of the rear facing subs to the front. The LED button gives you the option to flash the LED of each sub to ensure that you are applying parameters to the correct cabinet. If at any stage you wish to reset the parameters, perhaps immediately after device discovery where the subs may still be displaying values from their previous use, you can click on the 'Reset Outputs' button;-

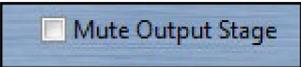


A warning window will appear;-



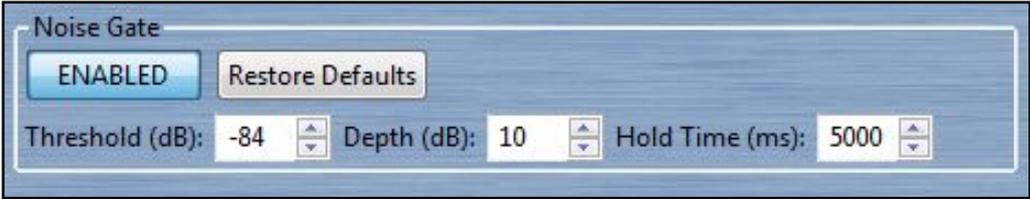
If you click on OK, all gain and delays will be restored to zero, any inverted outputs will be re-inverted and any muted outputs will be un-muted.

Subs also have the facility to turn off any troublesome amplifiers by checking the 'Mute Output Stage' box;-



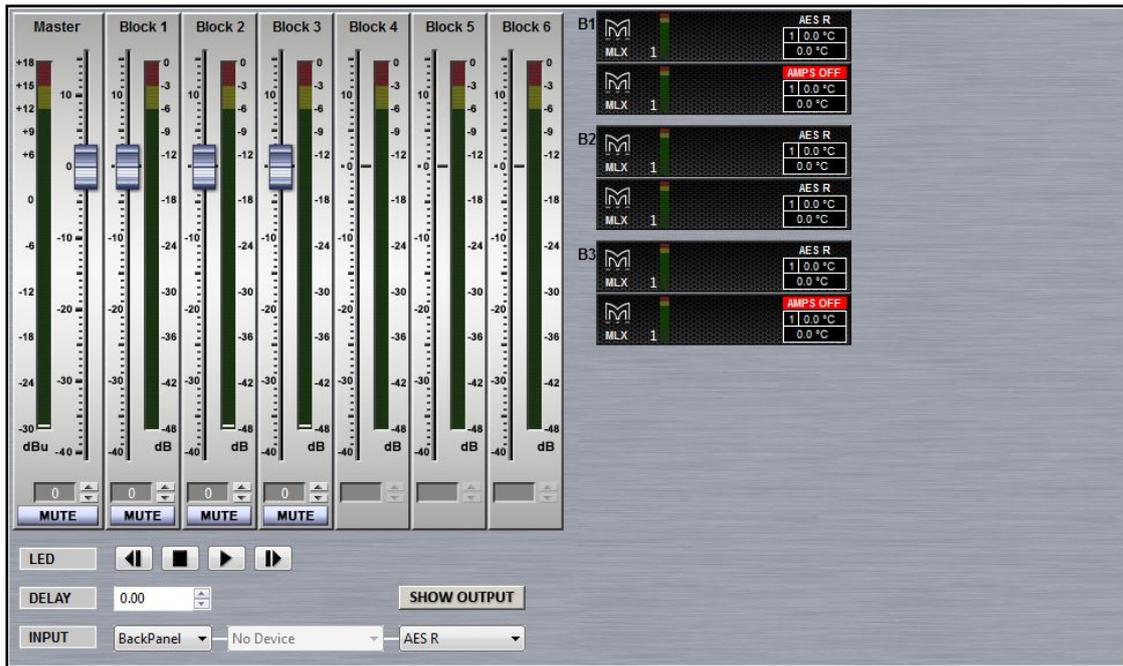
Then clicking the Mute button on any sub you wish to turn off.

As with other cabinets there is a noise gate which has the Threshold and Hold Time available for modification. The Default values can be restored at any time by using the Restore Defaults button;-



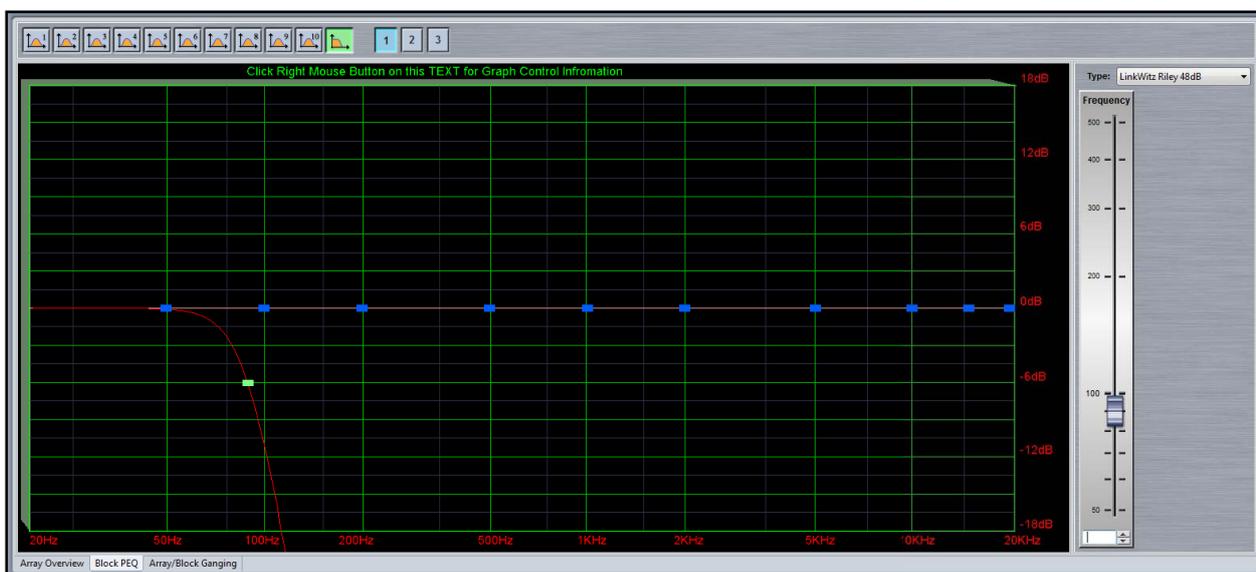
Both MSX and DSX have default values as shown above of a threshold of -84dB, a Depth of 10dB and a hold time of 5000ms.

When you have finished setting output parameters you can close the output window with a further click on the SHOW OUTPUT button. Any amplifiers that have been switched off will have the AMPS OFF indication above the temperature read-out;-



### Block PEQ

Equalisation in the subs is referred to as 'Block PEQ' on the tab. It is almost identical to the EQ page for the MLA, MLD and MLA Compact with a low pass filter replacing the high pass as you might expect;-

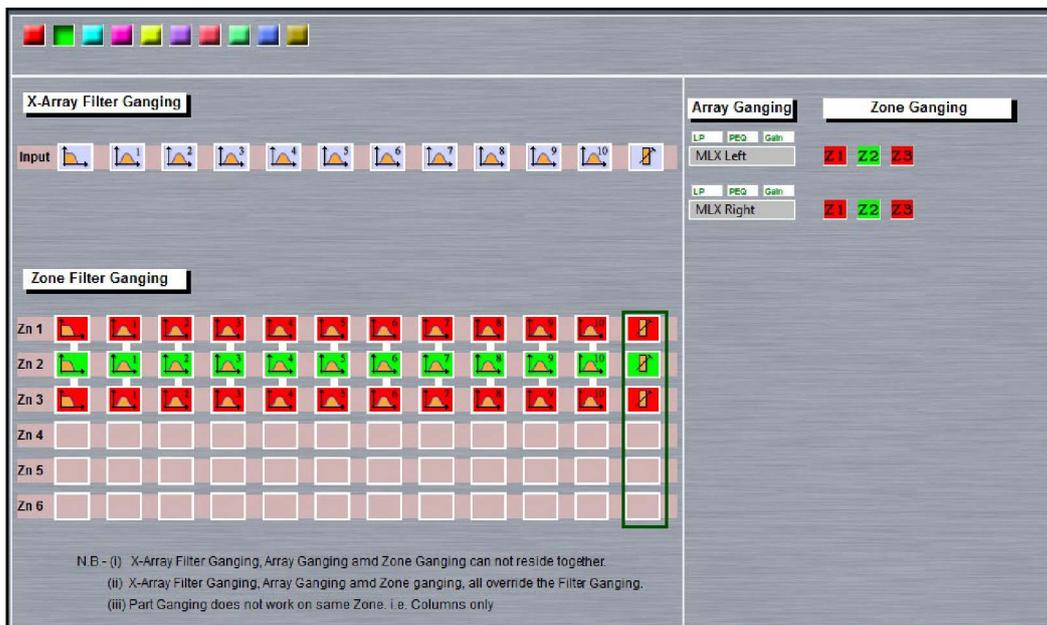


There are also ten PEQ filters at your disposal, each with exactly the same functionality and control. The low pass filter in common with the high-pass in the MLA, MLD and Compact, can be either Bessel, Butterworth or Linkwitz Riley with slopes from 6dB per octave up to 48dB per octave. The frequency can range from 50Hz up to 500Hz;-



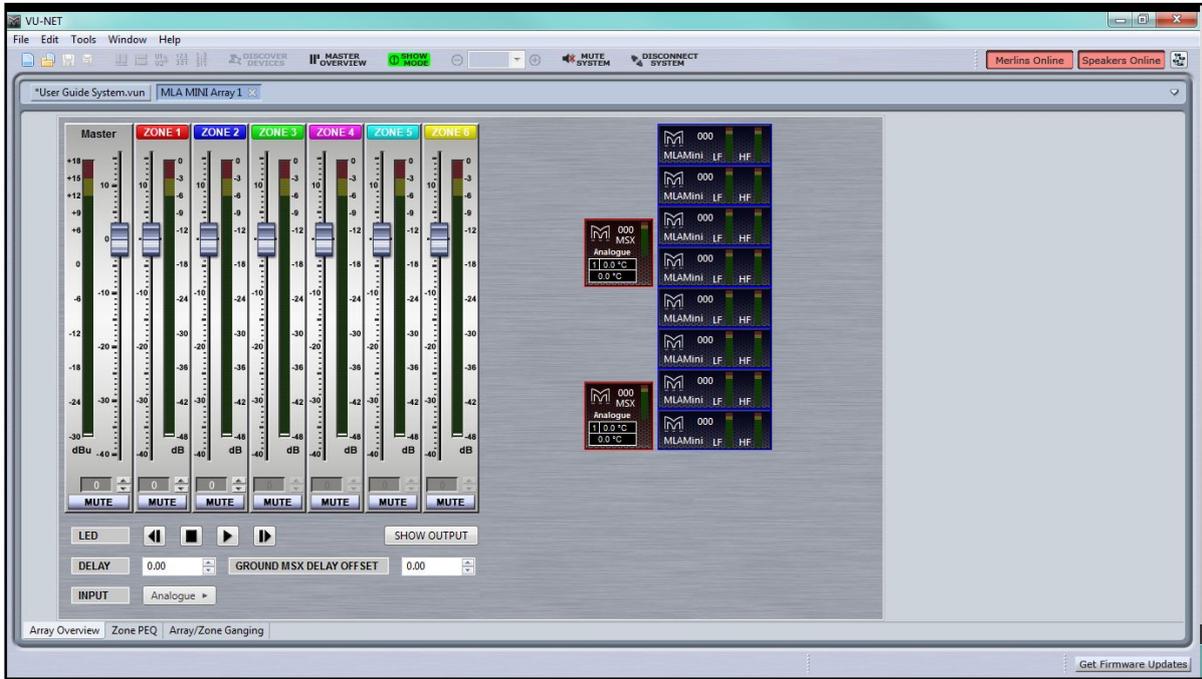
### Sub Array/Block Ganging

Sub arrays can be ganged in virtually identical fashion to MLA, MLD and Compact, either by entire array, Zones (blocks), X-Array filters or individual zone filters. Ganging can be very useful for Cardioid arrays but it is important to remember that delays and polarity are NOT ganged; they must be individually modified in the array output page.

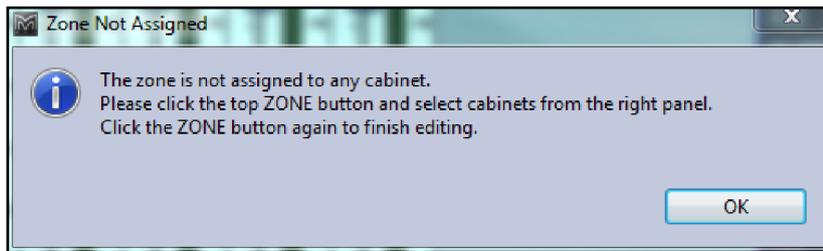


### MLA Mini

MLA Mini retains many of the network features of its bigger brothers but with a slightly different approach to the implementation within Vu-Net. Double clicking on an array (regardless of how the system has been deployed), brings up the following Window;-



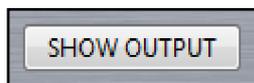
As you can see, the main array window is almost identical to the other MLA System components; there are the usual six zones available each with a gain fader and mute switch. Unlike other cabinets the faders are present at all times regardless of whether anything is assigned to them. The difference is that un-assigned zones have the gain read-out above the mute button greyed out. If you attempt to adjust gain or mute an un-assigned zone you will see the following window;-



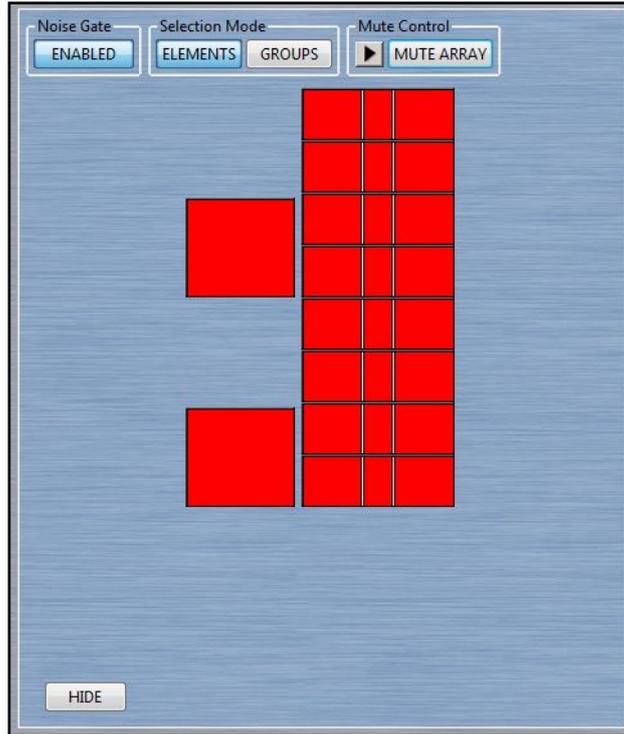
There is the same LED badge option, up to 993ms of delay and the standard input select from either the back panel or U-Net (not presently implemented) and back panel input can be either Analogue, AES3 Left or AES3 right. In common with sub arrays there is a SHOW OUTPUT button to access array utility functions rather than double clicking on the array thumbnail.

### MLA Mini Cell check

As long as Show mode is not active, clicking on the SHOW OUTPUT button;-

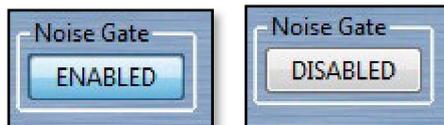


Brings up an array diagram with each cell individually accessible as with MLA and MLA Compact systems. Clicking on the MUTE ARRAY button will mute every cell;-



A test signal such as Pink Noise can be applied to the array and each cell can be individually un-muted by clicking on it to test that everything is operating correctly and all components are in the correct position in the array. This can be done by individual cells if the Selection mode is in the 'Elements' position or by an entire MLX and 4 Mini group if you click on 'Groups'. This is particularly important as the amplifier modules are all in the MSX sub, it is possible to incorrectly wire from the MSX to the MLA Mini. You can either click on cells manually to unmute them and there is a "play" function to cycle through all cells in the array. Unlike the other systems, unmuting a cell will mute all others which speeds up the testing process as you no longer need to manually re-mute the last cell you listened to.

As with the other cabinets, the array noise gate is accessible but in MLA Mini there is only the option to Enable or Disable the gate;-



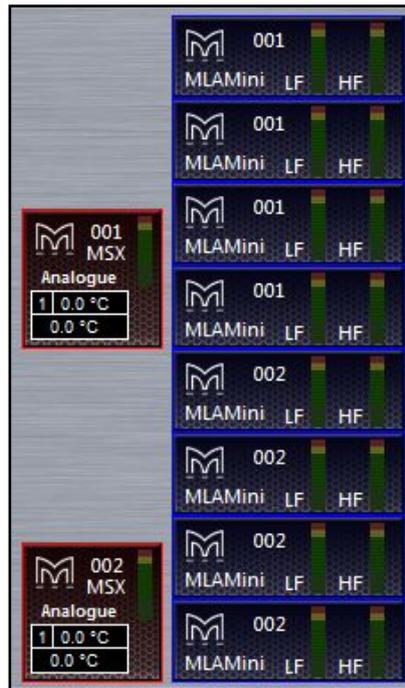
When you have completed any testing, click on the HIDE button;-



Which will un-mute all cells and return you to the main array window.

### Assigning Zones in MLA Mini

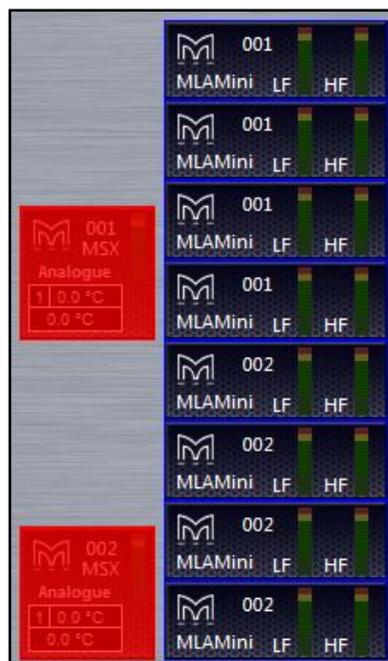
As with MLA, MLD and MLA Compact, there are up to six zones available for the system as the Array Overview shows. How these are defined is however different from the other MLA components. You may have noticed that the right-click function in the System diagram does not allow zone definition for an MLA Mini Array. Instead, zones are defined using the zone faders. If you look at the Array Overview thumbnail, you will notice that the MSX (two in our example) have a red border and the 8 MLA Mini have a blue border;-



By default, MSX are assigned to zone 1 and all MLA Mini to zone 2. Reassigning zones is extremely simple. In our example we will keep the MSX assigned to zone 1, the top four MLA Mini to zone 2, the next two to zone 3 and the final two to zone 4. First click on the Zone 1 label;-



You will notice All components that are already part of the zone will turn red;-



Click the Zone 1 button a second time and the two MSX will return to the normal view. Click on Zone 2 and you will see all of the MLA Mini turn blue;-



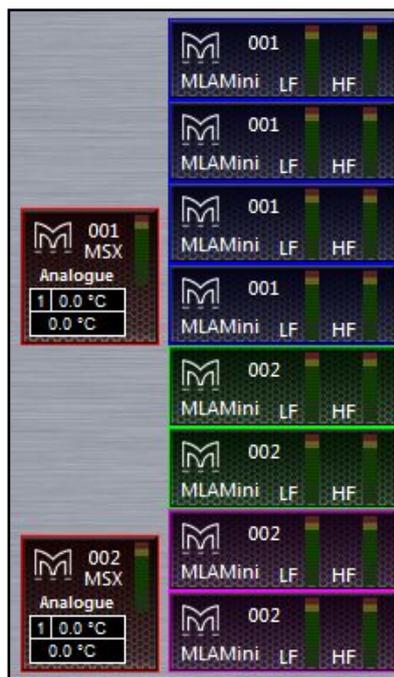
Now click on Zone 3 and there will not be any illuminated cabinets. Next click on boxes five and six, these will turn green;-



This indicates that these cabinets are now part of zone three. Finally click on Zone 4 and then the final two MLA Mini;-

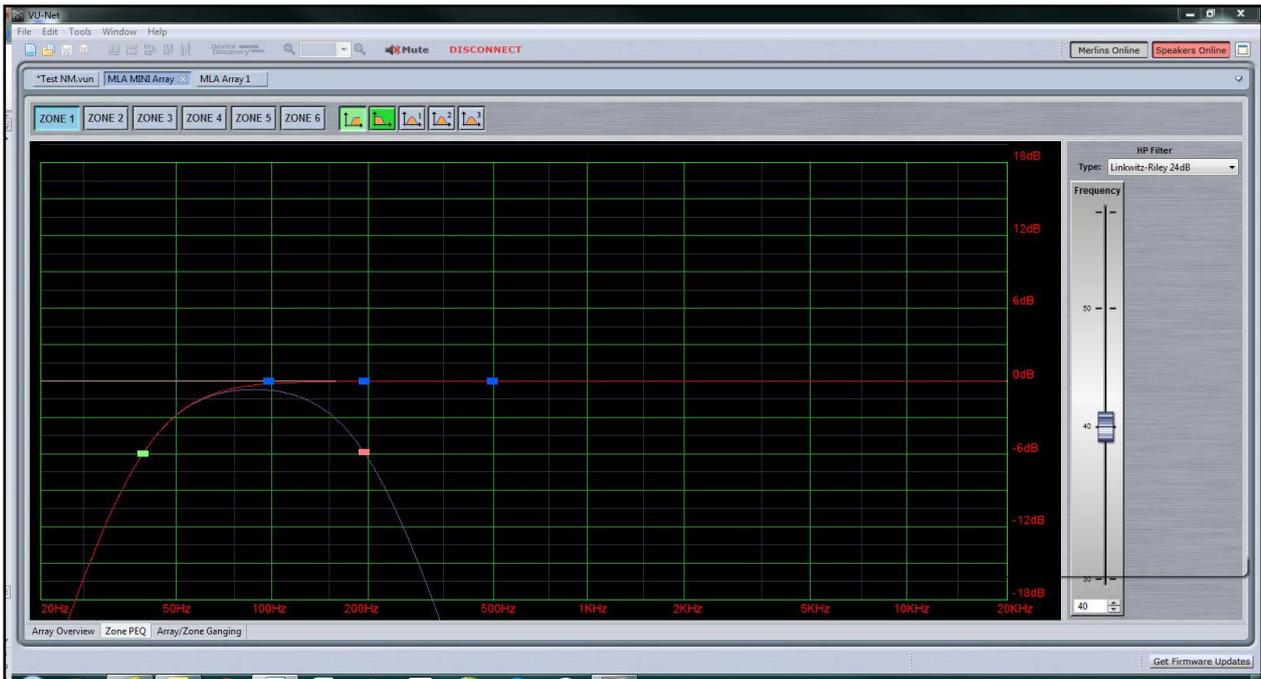


If we click again on zone four the solid block of colour disappears leaving just the coloured outline to show which boxes are members of which zone. The array is now fully zoned as we wanted it;-

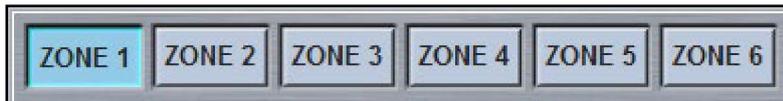


### MLA Mini PEQ

The MLA Mini Zone PEQ window appears like this;-

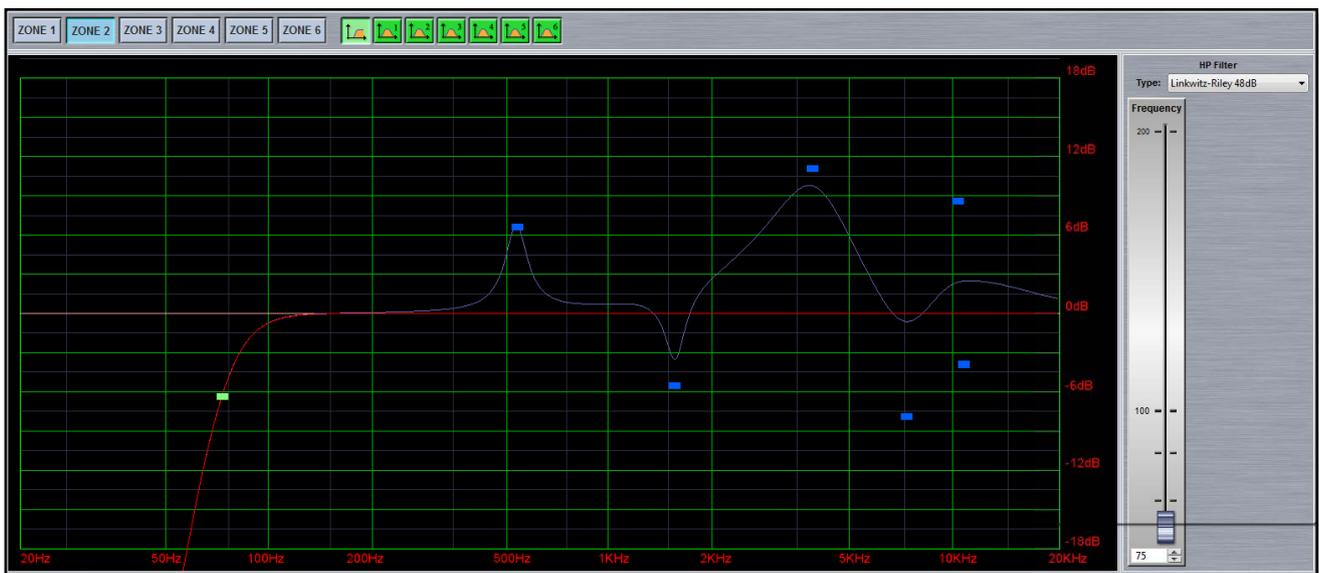


It is a slightly simplified version of the PEQ Tab that is available in all other array components. The six available zones can be selected by using the Zone buttons at the top of the window;-



Zone 1 is always the MSX sub so the EQ bands available are slightly different. There is a high pass filter, low pass filter and three bands of PEQ all of which may be adjusted in the same way as the PEQ in all other array types; grabbing the points on the graph, adjusting the controls in the EQ panel on the right or directly entering the required values in the windows at the bottom of the EQ panel.

Zones 2 to 6 all have a high pass filter and six bands of PEQ;-





### MLA Mini Ganging

Ganging for MLA Mini is also handled in a simplified manor. If you select the Array/Zone Ganging tab we see the following view. Note that for this example we have a Vu-Net project consisting of two main left and right arrays each with two MSX and eight MLA Mini, plus two "side" arrays each with a single MSX and four Mini. The larger array has four zones; one for MSX and three for the array, the side arrays have three zones with the Mini divided into two;-



The first option is to choose either Array Ganging or Zone ganging, note that you can only employ one type of ganging; they cannot reside together in the same array.

There are 10 independent groups available for both types of ganging, these are selected by the Group buttons along the top of the window and can be identified when in use by their colour; red for Group 1, blue for Group 2, green for Group 3 and so on.

### Array Ganging

To gang an entire array, first click on one of the Group buttons, say Group 1, and then click on all arrays you wish to be ganged together. In our example we will gang the main left and right arrays and on a second group the two side arrays;-



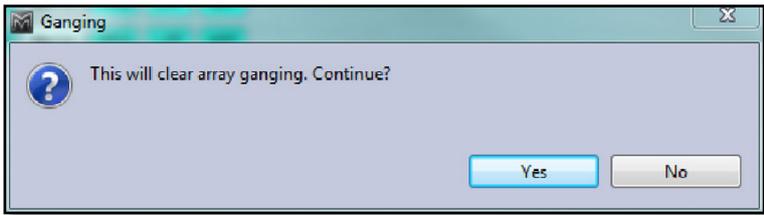


The filters are also available for you to exclude any of the parameters shown from ganging. A typical example might be to gang everything other than mute so you can ensure that arrays are matched left and right but have the ability to mute them independently, useful during set-up. All parameters are included by default so click one any you wish to exclude. Here we have removed Mute from the ganging for both main and side arrays;-



**Zone Ganging**

To select Zone ganging click on the ZONE GANGING button. If you have already used array ganging you will see the following window;-



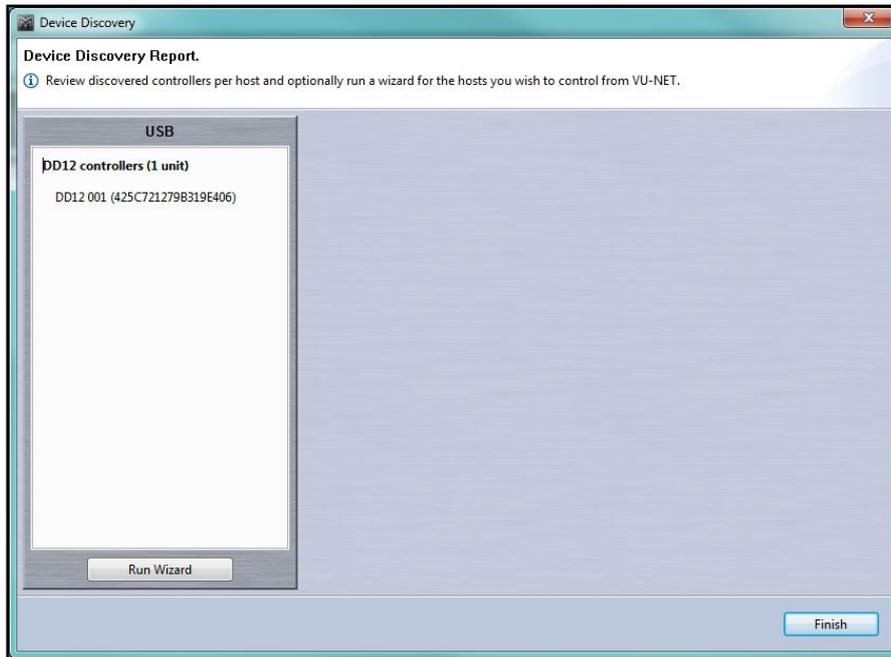
As previously mentioned, Array and Zone ganging cannot reside together so if you are happy to clear any previously ganged arrays click 'Yes'.

Zones are ganged in exactly the same way by first selecting a group and then clicking on the required zone. Ganging can run across the zones of all arrays or just across some. In this example we have ganged all of zone 1 (the MSX sub) with Zone 2 of the main arrays also ganged but independently ganged zone 2 of the side arrays. Zone 3 is ganged across all four arrays and finally zone 4 on the main arrays have also been ganged (the side hangs do not have a fourth zone). We have excluded Mute from the ganging of all four arrays;-

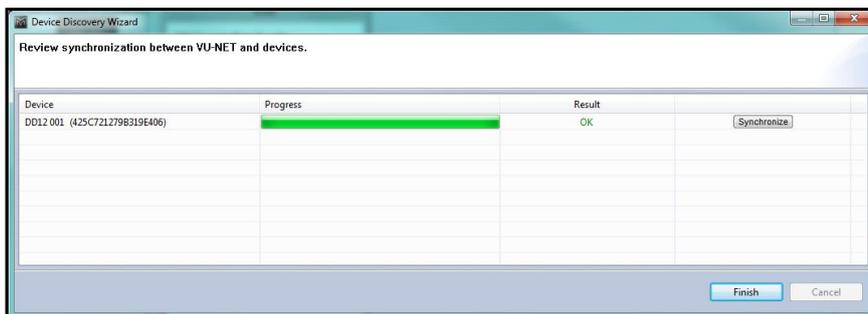


### DD12

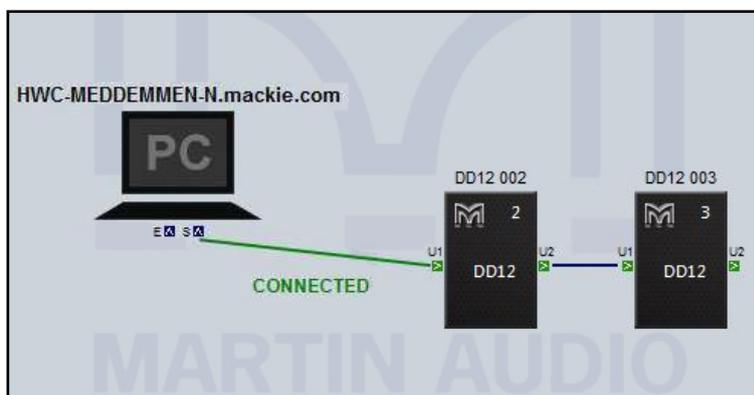
DD12's are discovered in exactly the same way as any other device regardless of whether they are connected via a full U-Net network to a Merlin or directly via USB. The Device discovery will show all connected cabinets;-



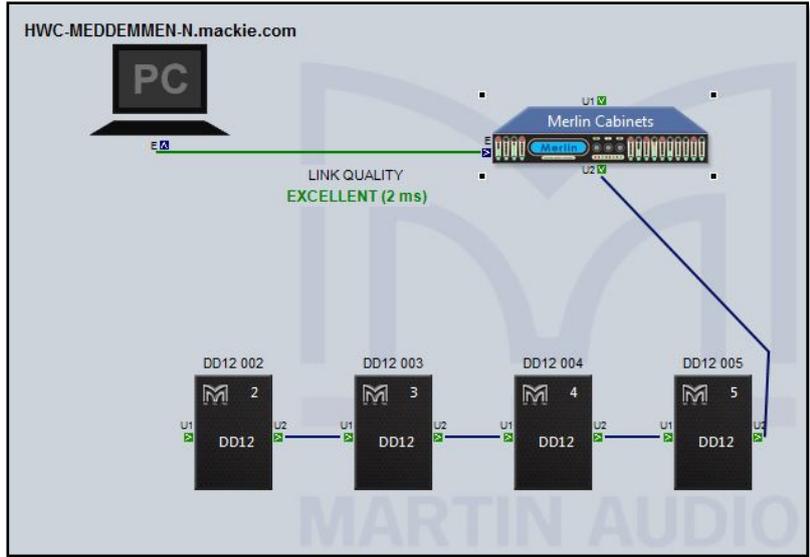
As there are no array-related options with the DD12 the 'Run Wizard' merely synchronises with all connected cabinets so the software reflects the settings in the devices.



A system connected via USB will appear like this;-

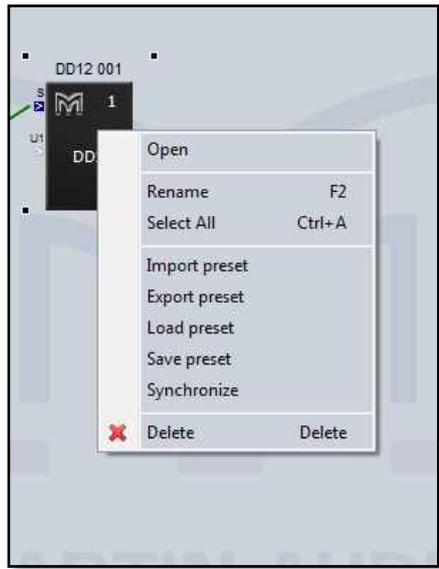


A system connected via Merlin like this;-



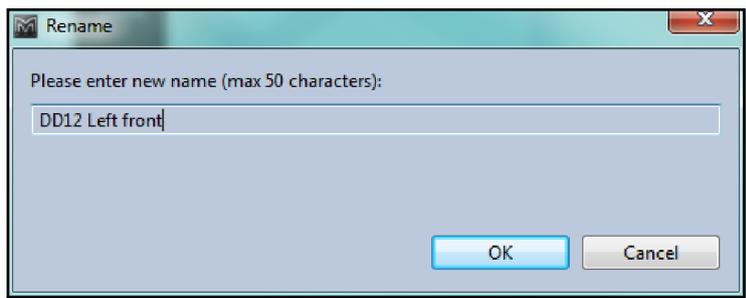
Each DD12 icon in the overview screen features a Martin Audio logo. Double-clicking on this will illuminate the LED on the cabinet front grille to assist in identifying each DD12 which is very useful when multiple units are deployed.

There are a number of functions available by right clicking on a cabinet icon;-



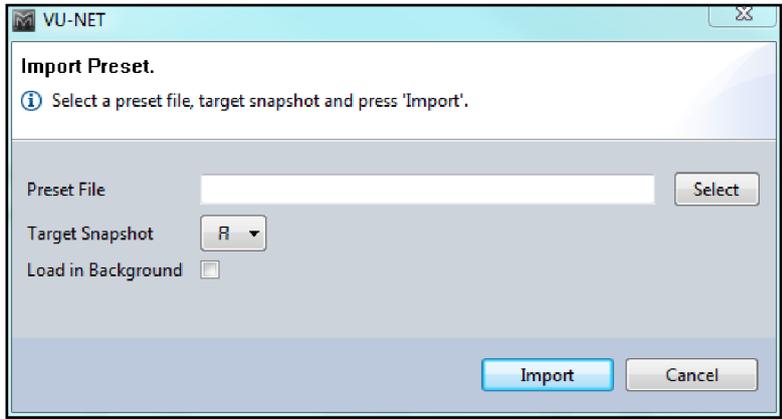
'Open' functions in exactly the same way as double clicking on the cabinet icon and opens the DD12 overview screen to allow detailed control and monitoring

'Rename' as with any other device allows the cabinet to be given a name of up to 50 characters;-



'Select All' selects all devices in the system Diagram, the keyboard shortcut for this is Ctrl + A.

'Import Preset' allows importing of a preset previously saved as a file;-

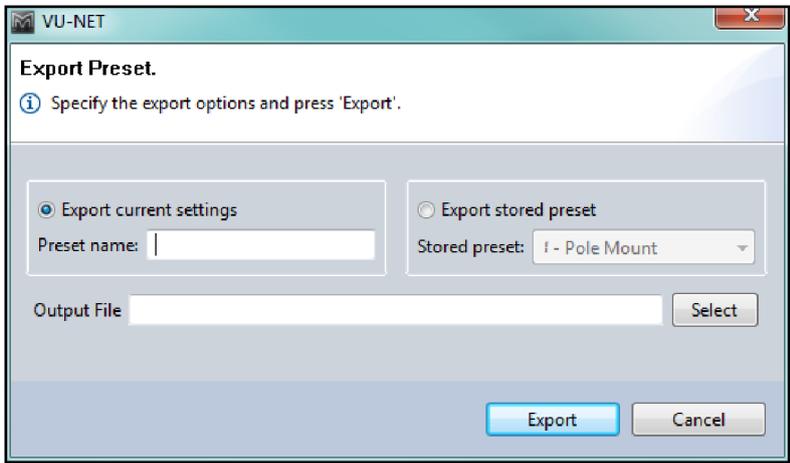


Clicking on 'Select' allows you to browse to the file location where preset files have been stored. This could be a specific preset for a regular venue or type of program material.

'Target Snapshot' determines which of the User Snapshot locations the file will be stored to.

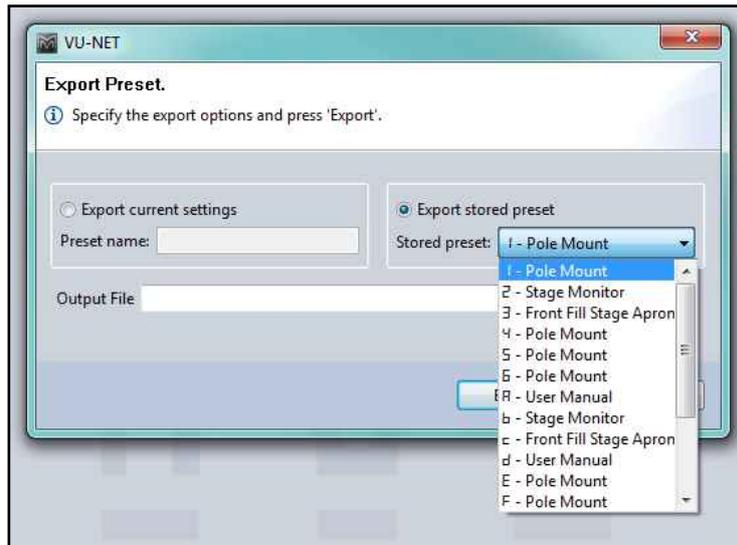
'Load in background' when checked allows you to select a snapshot location and upload a new file without disturbing the active snapshot, this can be done while audio is running through the system and will be completely inaudible. This way specific snapshots can be uploaded ready to be recalled when required. This includes uploading to the currently selected snapshot, there will still be no audible effect, you will need to recall the same snapshot for the changes to take effect. If 'Load in Background' is not checked the DD12 will automatically revert to the new snapshot.

'Export Preset' allows you to save any of the presets loaded into the DD12 as a file for future use;-



The default choice is to export the current setting. You have the option to give the Preset a dedicated name and then to browse to a suitable file location and give the file and easily remembered name.

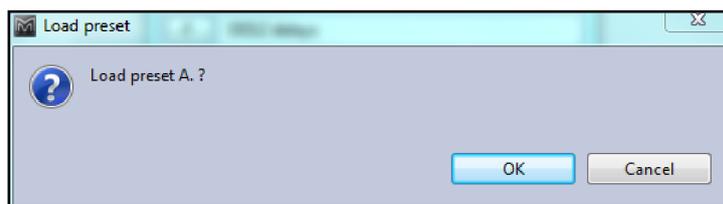
If you select 'Export stored preset' you can select any of the presets – factory or user – stored in the DD12 and save them to file;-



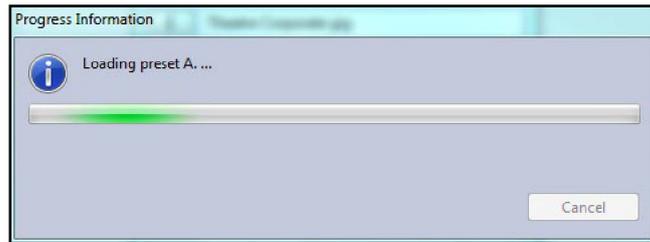
‘Load Preset’ allows you to load one of the already stored Presets. The Preset window appears;-



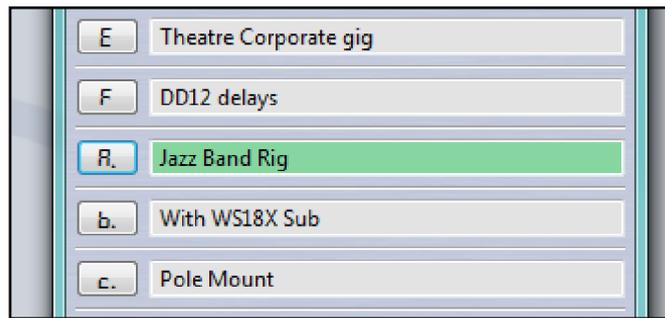
Click on the required preset and you will see a Window asking you to confirm your selection;-



If you clicked on a preset accidentally or change your mind you can click on ‘Cancel’, otherwise select ‘OK’. You will see the following window;-



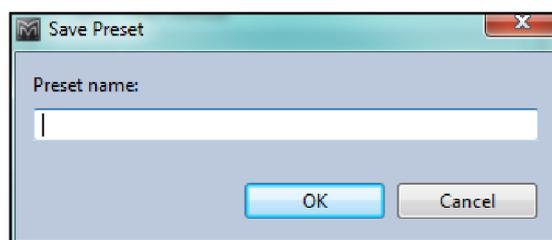
After which your newly selected prest will be highlighted in green;-



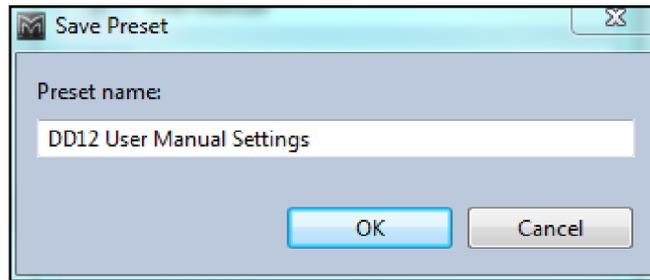
'Save Preset' allows you to store the current configuration including all settings that you may have modified. It brings up a similar window showing all User Locations;-



Click on your required location and select 'Save', this brings up this window;-



Type in your desired name and click 'OK',

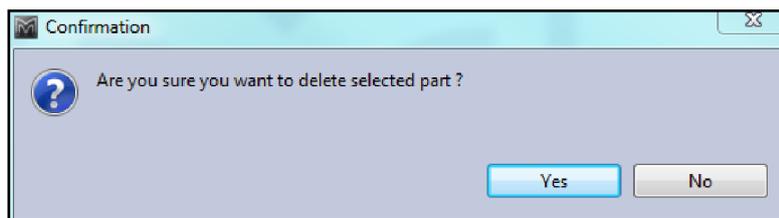


The current configuration will be saved to the chosen location and will appear as the highlighted (active) preset when you next load a setting;-



'Synchronise' will repeat the synchronisation process that occurs during Device Discovery and is used if a network error such as a network cable disconnection has caused the device and Vu-Net to no longer be synchronised.

'Delete' removes the selected DD12. You will be prompted with the following Window to confirm the delete;-

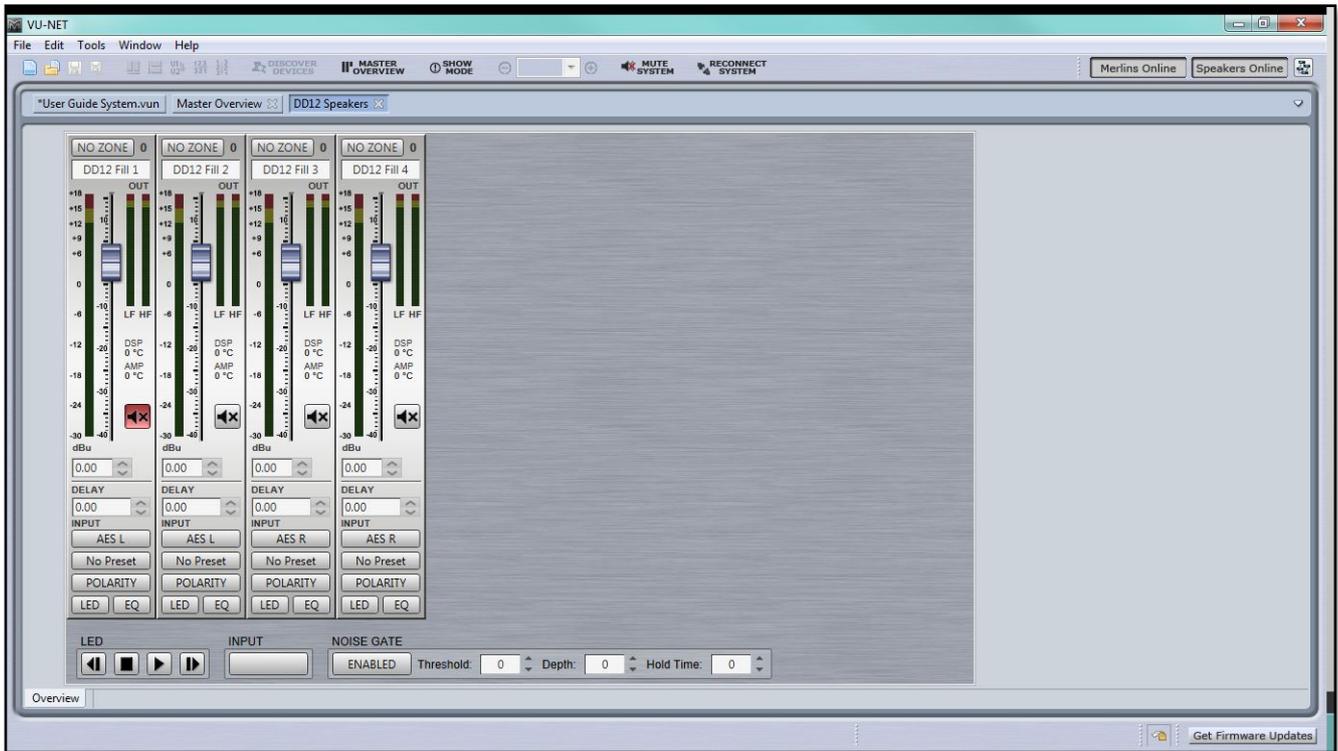


If you selected Delete accidentally or have changed your mind, click 'No', otherwise click 'Yes' and the DD12 will be removed from the project.



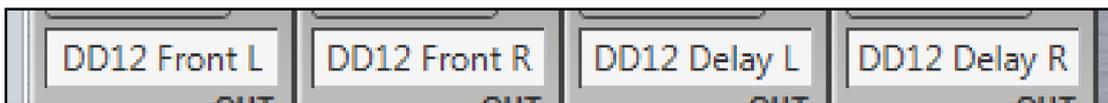
Overview

Either double clicking or right clicking and selecting Open will bring up the overview option for the DD12 which shows all DD12s in the project;-



This gives an overview of the state of all DD12’s allowing comprehensive monitoring of the system.

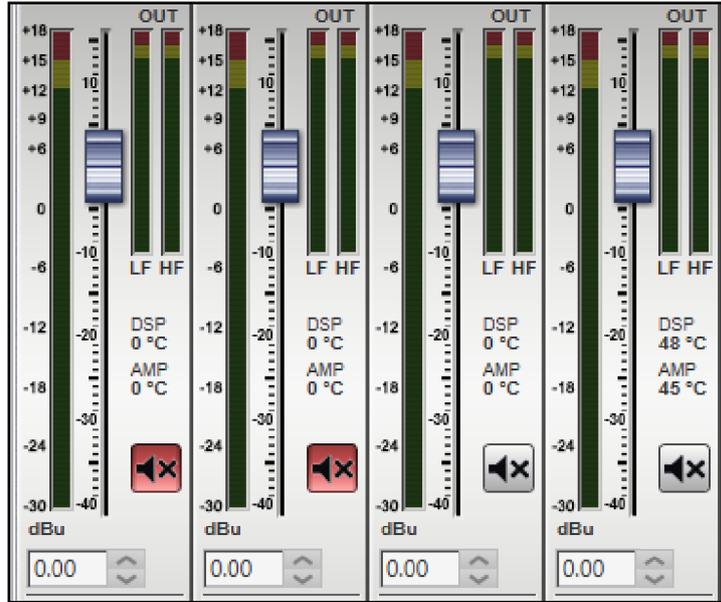
The box at the top will show any names that have been assigned to the cabinets by right clicking and selecting rename (or selecting and pressing F2 in the System Diagram;-



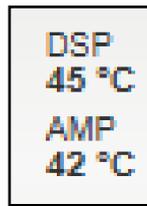
The gain fader allows gain adjustment from -40 to +15dB. Precise values can be entered by typing directly in the box below the fader or values can be scrolled up or down using the up/down buttons. The increments that the up/down buttons will step is determined in the Preferences section, by default it will be 0.25dB.

The mute button will mute the cabinet irrespective of the position of the gain fader and will turn red when active.

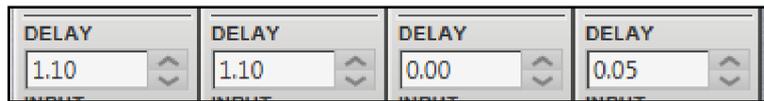
There is comprehensive metering available. The bargraph to the left of the fader shows input level up to the maximum before input clip of +18dBu. The smaller meters to the right show the amplifier output levels for both the low frequency amplifier driving the 12" driver and the high frequency amplifier driving the compression driver and show level prior to limit. If the levels reach the yellow segment you have reached the limiter threshold. A red segment indicated 3dB of gain reduction in the limiter.



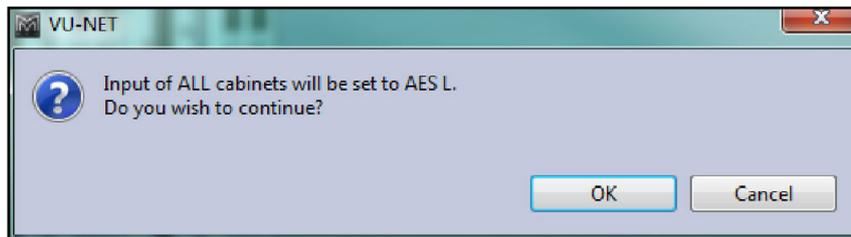
There is also a temperature read out showing the temperature of both the DSP and amplifier module;-



There is delay available which is very useful for time aligning the DD12 when used as an extra fill with a larger mains system. The maximum delay available is 1 second. Values can either be typed directly into the Delay field or scrolled up and down using the arrow buttons. These increase or decrease the delay in increments of 10µs.



The Input allows the connection mode to be changed from the default which is Analogue to AES/EBU taking its feed from either AES left or AES right. This can either be done individually for each DD12 or globally using the Input switch at the bottom of the DD12 overview Window. A global change will bring up the following window;-



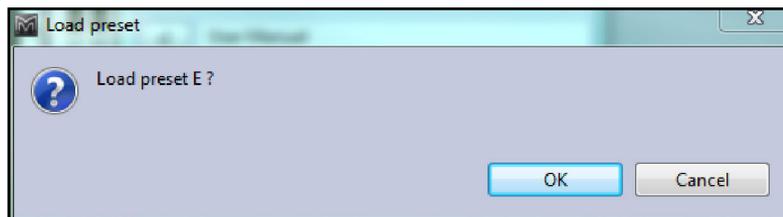
Click 'Cancel' if you have changed your mind or 'OK' to accept the change of input mode. All DD12's will display the new input selection.



The Preset button acts in the same way as the Load Preset function which is available from the right-click menu in the Project System Diagram. It will bring up the Preset Menu with the currently active Preset shown highlighted in green;-



Clicking on a new Preset will prompt you to confirm your selection;-



Clicking 'OK' will confirm the selection and the preset will load. The Preset select window can be closed. The currently active Preset is displayed on the Preset button;-



Polarity will invert the phase of the cabinet. A confirmation window will appear;-



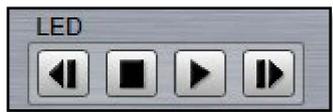
On clicking 'OK' the phase will be inverted and the Polarity button will turn blue;-



Clicking the LED button will illuminate the front grille LED to help identify the DD12 under control in multiple deployment applications. This can be done individually for any cabinet;-



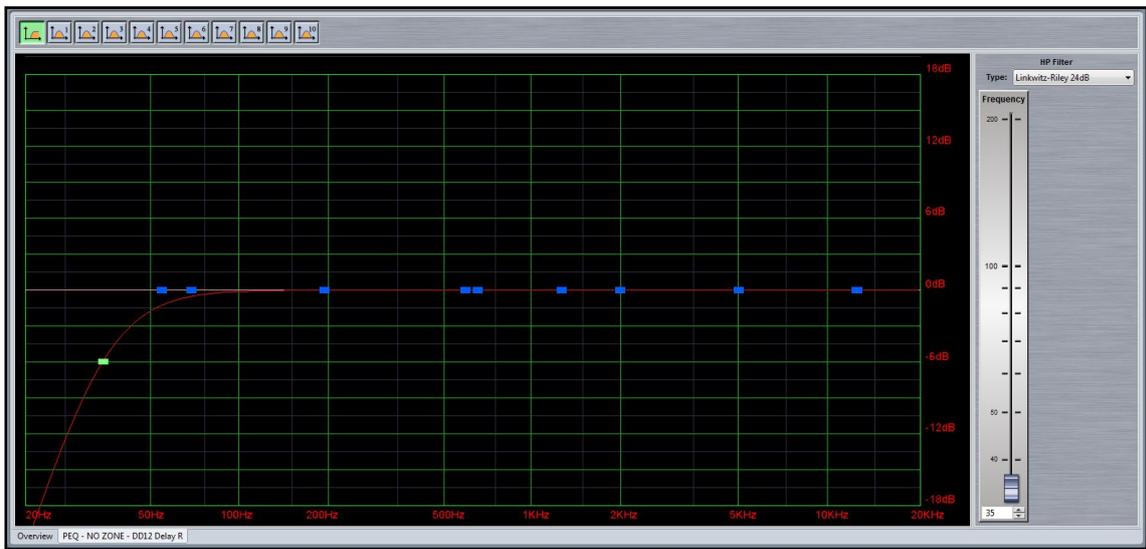
Or globally using the LED controls at the bottom of the DD12 Overview window;-



Pressing the "play" arrow  will make the LEDs of all DD12s illuminate in sequence, cycling round continually until you click on the stop button  Note that the global LED switches will overwrite any LEDs which have been activated on an individual DD12. The back and forward buttons   allow manual cycling of all cabinet LEDs, each click will extinguish the currently illuminated LED and light the LED on the next or previous DD12.

### EQ

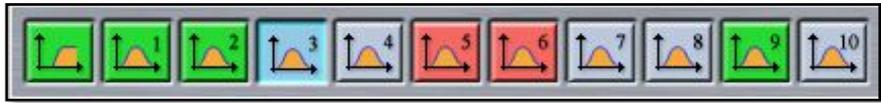
The EQ button will open the EQ tab for that particular DD12. The EQ window is virtually identical to all other Vu-Net controlled devices;-





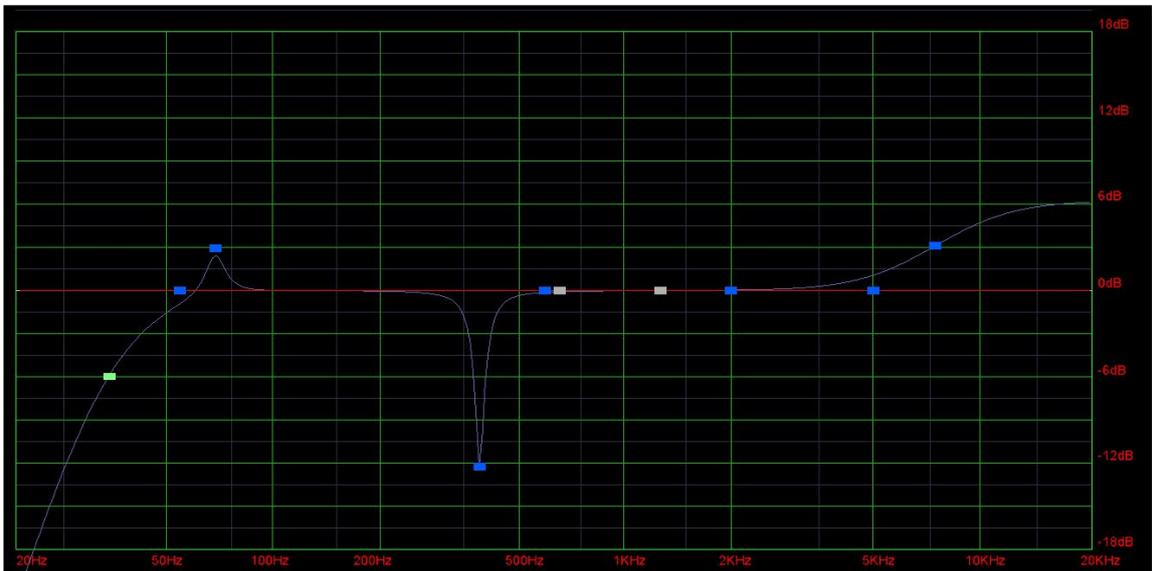
The window has three sections, the buttons along the top, the graphic display window and the controls on the right of the window. First we will look at the buttons along the top.

First there are ten parametric EQ buttons plus the high pass filter;-



As you can see there are a number of colour variations for these buttons. Unused bands are pale blue until they are selected for editing by clicking on them in which case the colour goes to a brighter blue and the image shows the button depressed. Unused is defined as the gain left at 0dB. A red button indicates that the band has been bypassed, irrespective of whether any gain change has been made. Bypassed bands will change to a pale red when selected. Green buttons indicate a band that has either cut or boost applied, these will go a pale green when selected. Note that the high pass filter is always active so will always appear green.

The graphic view of the equalisation is a relatively standard frequency response graph;-



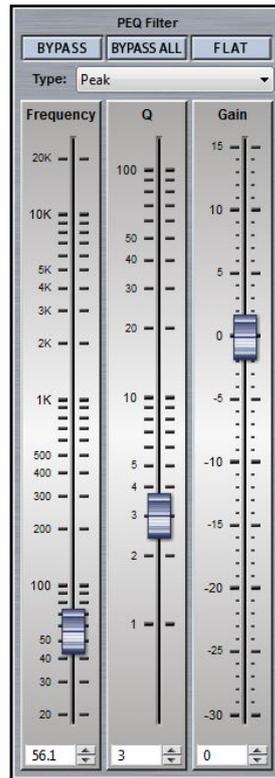
The horizontal axis is frequency in Hertz from 20Hz to 20KHz, the vertical axis is gain from -18dB up to +18dB. Colour coding is also used on the graph to represent the various modes.

First there are two traces, one red, and the other blue. The red trace is the response of the band that is currently selected; the blue trace is the overall response of the entire PEQ.

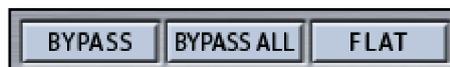
Each small rectangle represents the position of each of the ten bands plus the high pass. For all of the EQ bands the position on the horizontal represents the EQ centre frequency, the vertical position is the cut or boost applied. A blue rectangle is an active EQ, a grey rectangle is an EQ that has been bypassed. The green rectangle identifies the cut-off frequency of the highpass filter.

In common with most PC controlled equalisation systems it is possible to make adjustments by dragging and dropping the filter curves. Left-click on any of the band rectangles and holding down the left mouse button, drag the icon horizontally to change the centre frequency or vertically to change the gain. Right-click and drag up and down to adjust the filter Q factor. The graph will adjust and the audio adjustment will be made in real time.

The final section on the right of the window is the Properties panel;-

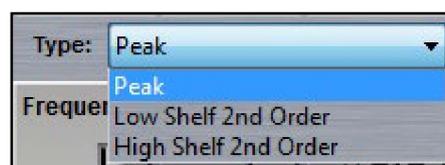


This shows all properties of the selected band. At the top are three buttons;-



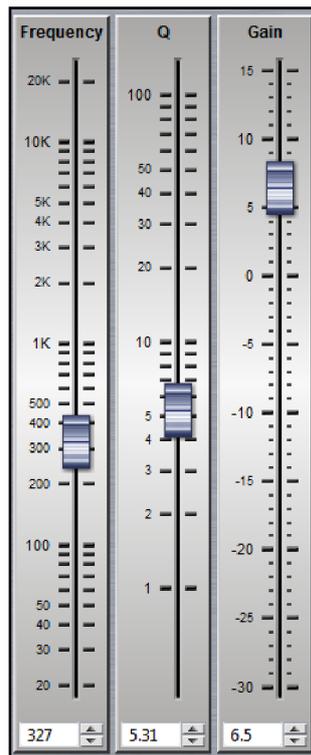
'BYPASS' bypasses the individual band you have selected turning the BYPASS button and the filter button red. 'BYPASS ALL' bypasses every band. 'FLAT' will instantly change the gain to 0dB.

Next is a Filter type. Click on this and the drop down shows the options for each filter band;-



The default is 'Peak', a standard parametric EQ; the other options are 2<sup>nd</sup> order Low Shelf and 2<sup>nd</sup> order High Shelf.

Below are the three principal faders for adjusting the filter parameters;-



Parameters can be changed on the properties panel in three ways. The faders can be drag and dropped to a new value, the value can be scrolled up or down using the up/down buttons to the right of the value windows, and finally values can be directly typed into the value windows. The response graph will adjust according to the new values and vice versa, adjustments in the graph window will be reflected in the fader positions and values in the properties panel.

The High pass filter only has a single fader for the corner frequency. This may be adjusted in exactly the same way as the faders for the PEQ's. The 'Type' drop down offers three types of filter and slopes from 12dB up to 48dB per octave;-



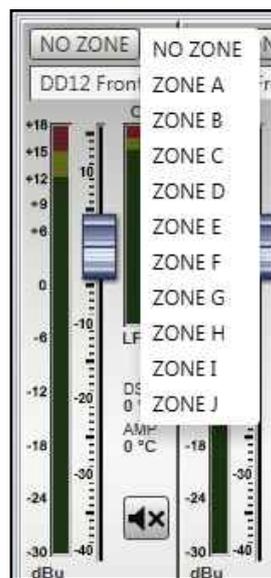
To summarise, there are four ways to adjust filter parameters;-

1. Click and drag on the graph
2. Click and drag the properties faders
3. Use the up/down value buttons in the properties section
4. Directly type values into the value boxes.

Whilst this might seem over-versatility, it is intended to offer several options to suit the way that the system is being operated. If adjustments are being made with using a wireless tablet PC with a stylus whilst walking around a venue, certain options may be easier to use than if you were sitting at a desk with a mouse plugged in to the PC.

## Zones

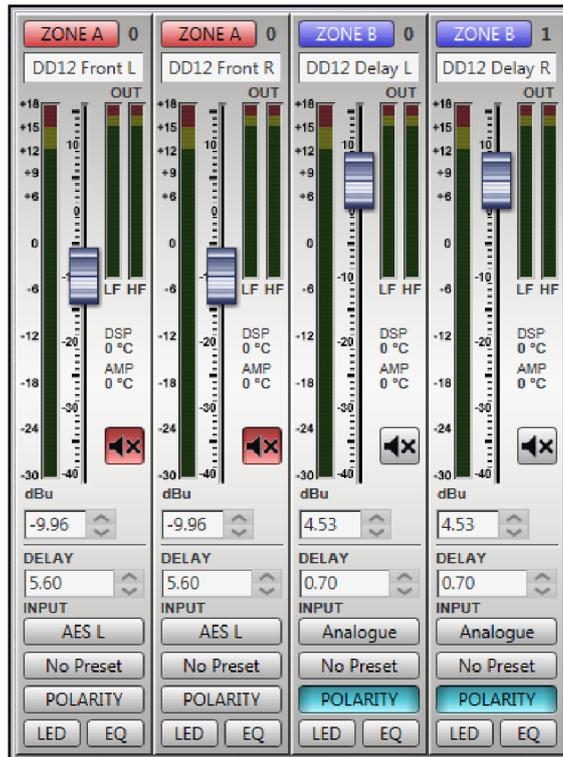
DD12 has a unique method for zone selection. Any cabinet can be a member of any (or none) of the ten zones available which are labelled A to J. To select a zone click on the Zone button at the top of the Overview page;-



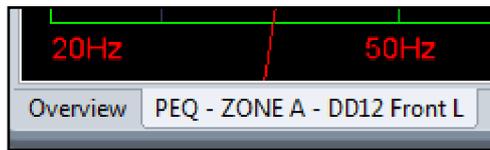
Click on the desired zone and it will be displayed on the zone button. The zones are colour coded to make it instantly obvious which cabinets are on the same zones. Colours are as follows;-

- A is red,
- B is blue,
- C is green
- D is magenta
- E is cyan
- F is yellow
- G is dark green
- H is purple
- I is orange
- J is black

All functions on cabinets in the same zone will be duplicated regardless of which cabinet in the zone is used to make adjustments;-

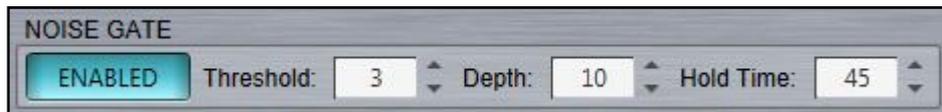


The zone being adjusted is also displayed on the tab at the bottom of the EQ Window;-



### Noise Gate

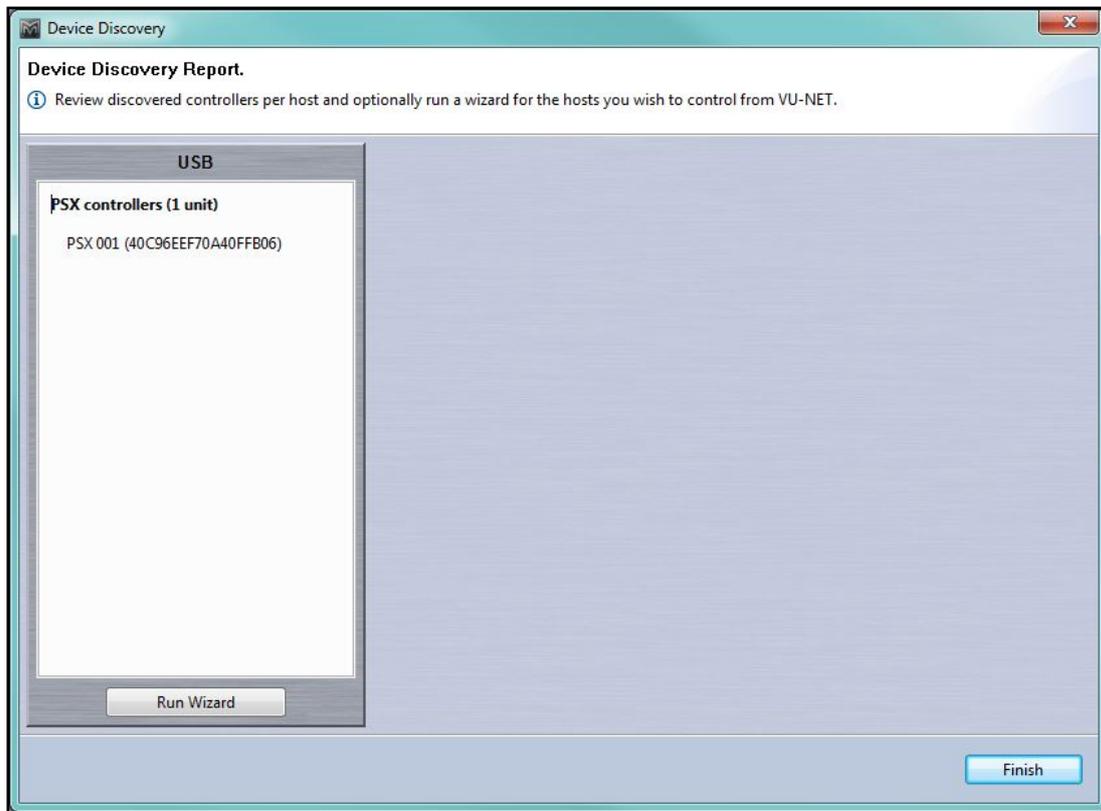
The DD12 has a noise gate that is applied globally to all DD12's in the project. This is controlled using the section at the bottom of the overview window;-



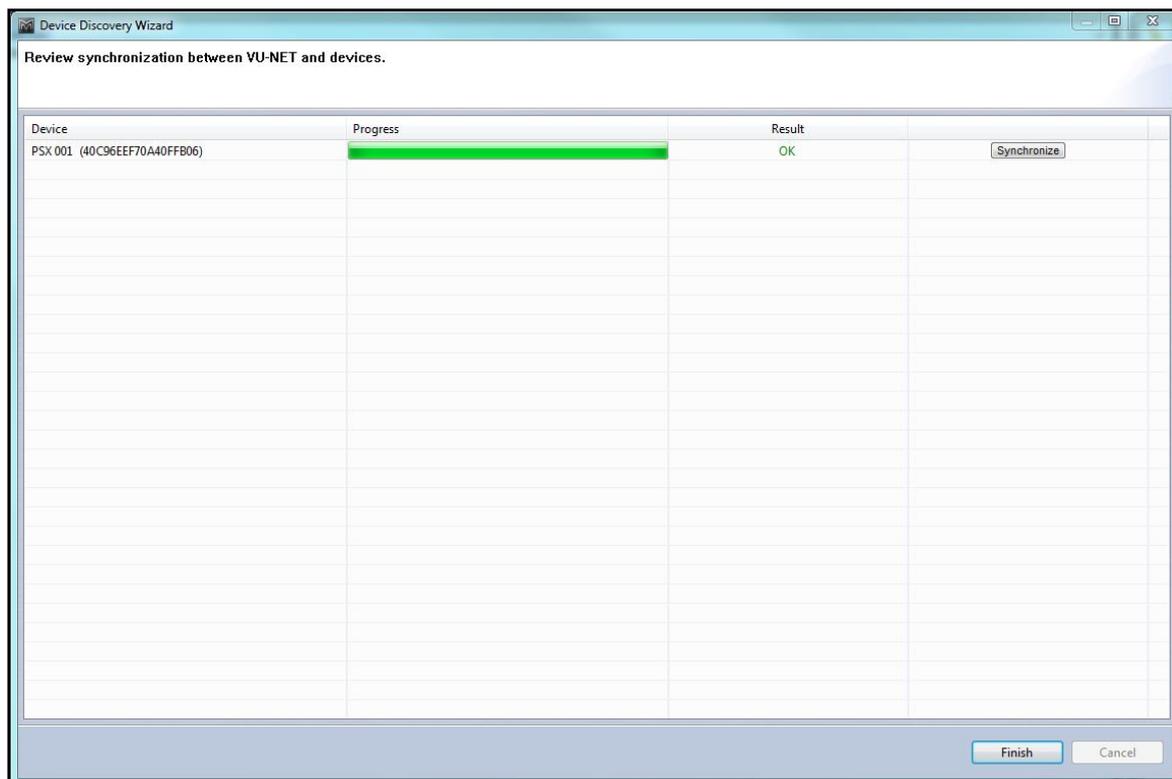
Once enabled the Threshold, Depth and Hold Time can be adjusted, either by manually typing a value or using the up/down arrows to scroll through values. The default values are Threshold at -67dB, Depth of 10dB and Hold time of 5000ms.

### PSX

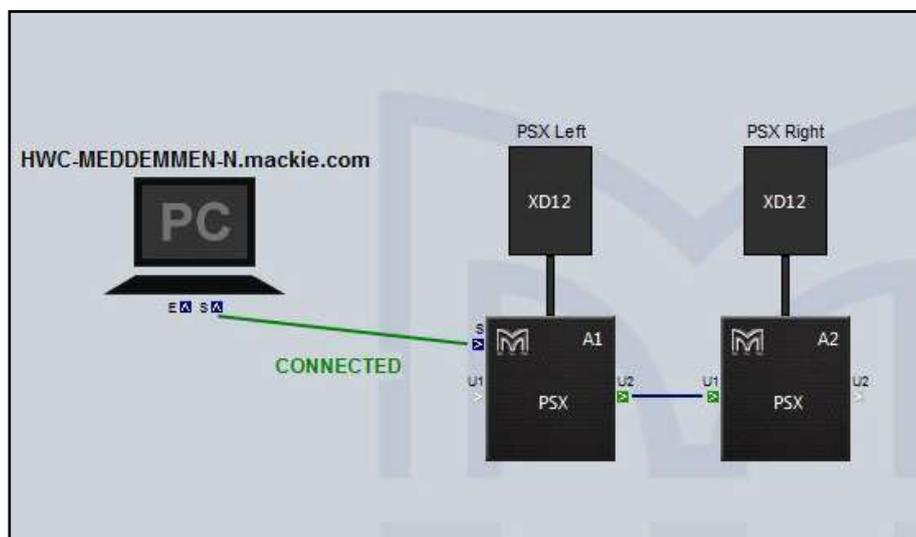
PSX's are discovered in exactly the same way as any other device regardless of whether they are connected via a full U-Net network to a Merlin or directly via USB. The Device discovery will show all connected cabinets;-



As there are no array-related options with the PSX the 'Run Wizard' merely synchronises with all connected cabinets so the software reflects the settings in the devices.

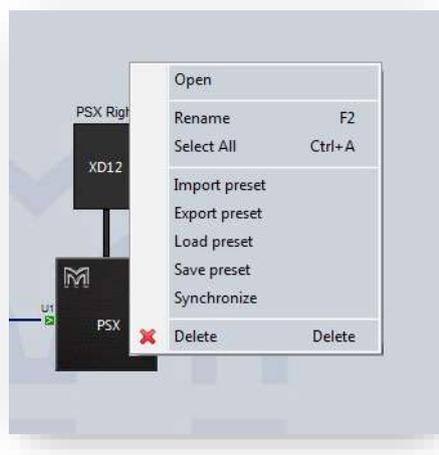


A system connected via USB will appear like this;-



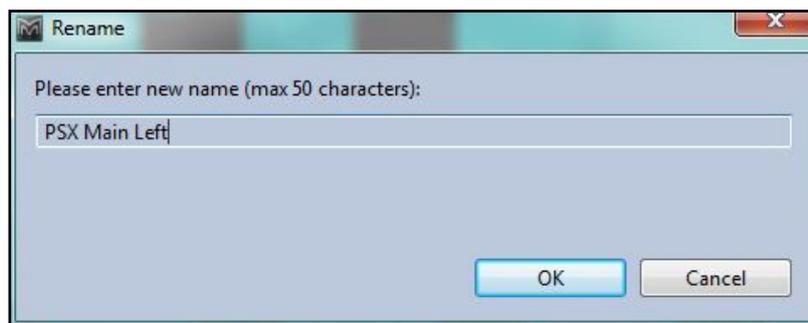
Each PSX icon in the overview screen features a Martin Audio logo. Double-clicking on this will illuminate the LED on the cabinet front grille to assist in identifying each PSX which is very useful when multiple units are deployed.

There are a number of functions available by right clicking on a cabinet icon;-



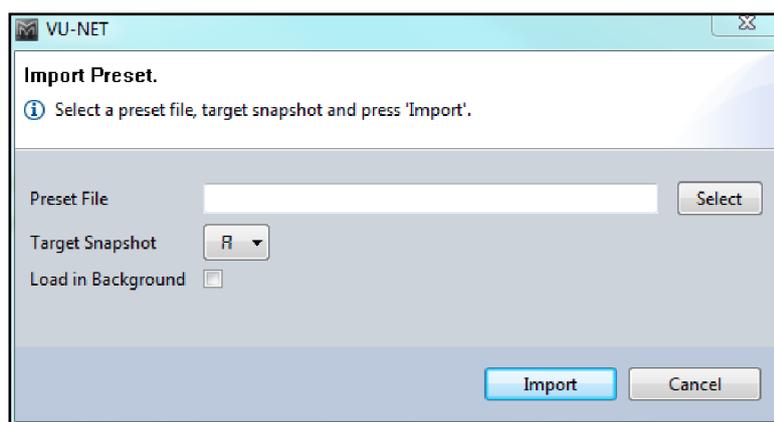
‘Open’ functions in exactly the same way as double clicking on the cabinet icon and opens the PSX overview screen to allow detailed control and monitoring

‘Rename’ as with any other device allows the cabinet to be given a name of up to 50 characters;-



‘Select All’ selects all devices in the system Diagram.

‘Import Preset’ allows importing of a preset previously saved as a file;-



Clicking on ‘Select’ allows you to browse to the file location where preset files have been stored. This could be a specific preset for a regular venue or type of program material.

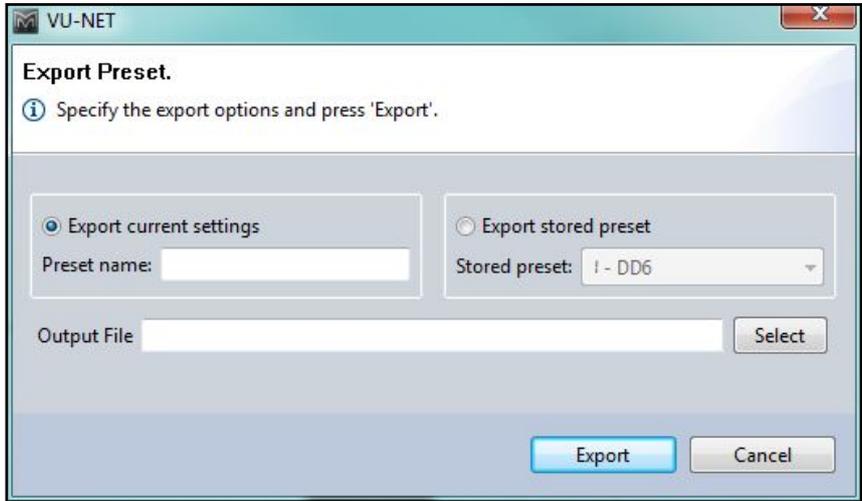
‘Target Snapshot’ determines which of the User Snapshot locations the file will be stored to.

‘Load in background’ when checked allows you to select a snapshot location and upload a new file without disturbing the active snapshot, this can be done while audio is running through the system and will be completely inaudible. This way specific



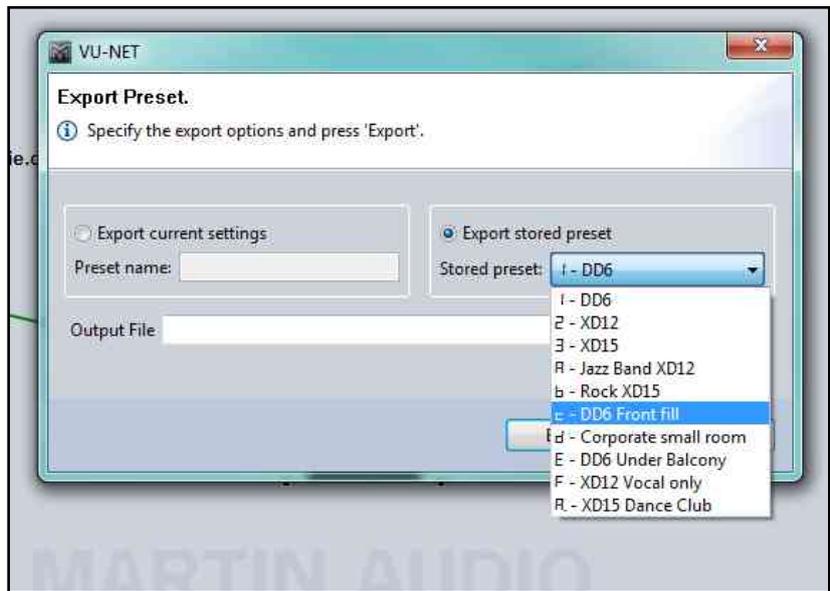
snapshots can be uploaded ready to be recalled when required. If 'Load in Background' is not checked the PSX will automatically revert to the new snapshot. If you choose to upload to the active snapshot Load in Background will have to effect.

'Export Preset' allows you to save any of the presets loaded into the PSX as a file for future use;-



The default choice is to export the current setting. You have the option to give the Preset a dedicated name and then to browse to a suitable file location and give the file and easily remembered name.

If you select Export stored preset you can select any of the presets – factory or user – stored in the PSX and save them to file;-

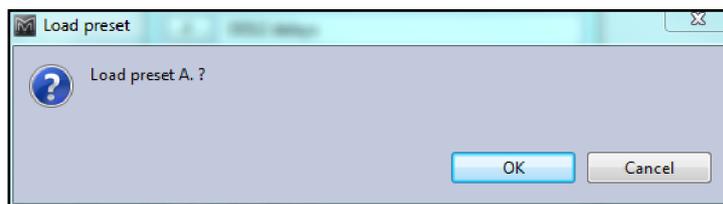


Note that you will see Factory Presets 1, 2 & 3 but only User Preset locations where a setting has been stored will be shown.

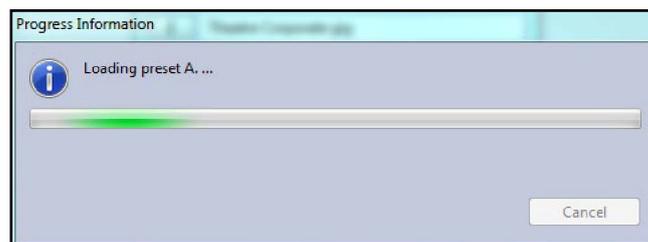
'Load Preset' allows you to load one of the already stored Presets. The Preset window appears;-



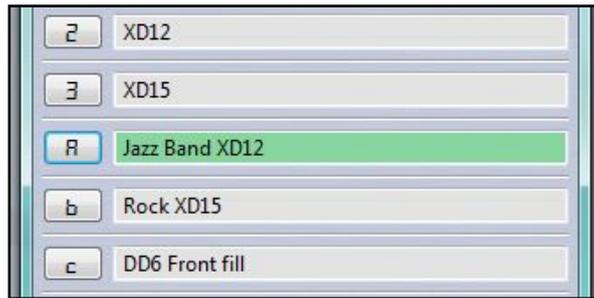
Click on the required preset and you will see a Window asking you to confirm your selection;-



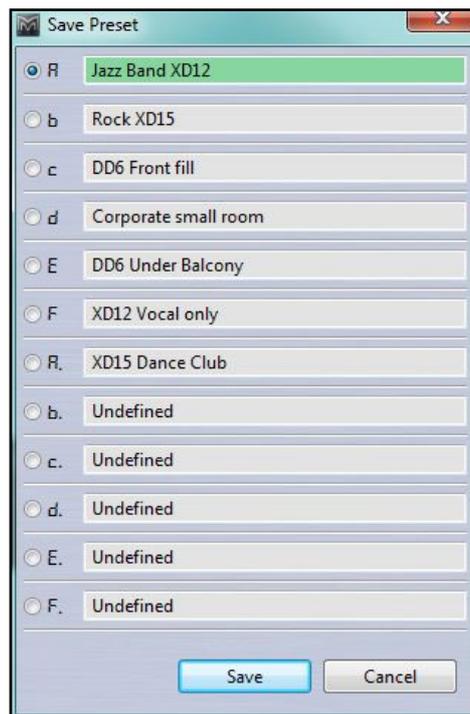
If you clicked on a preset accidentally or change your mind you can click on 'Cancel', otherwise select 'OK'. You will see the following window;-



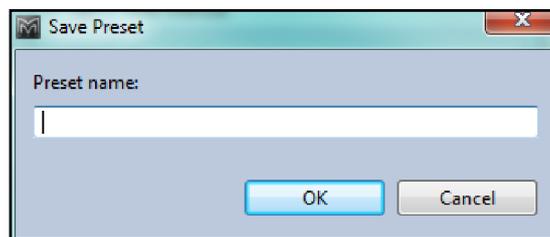
After which your newly selected prest will be highlighted in green;-



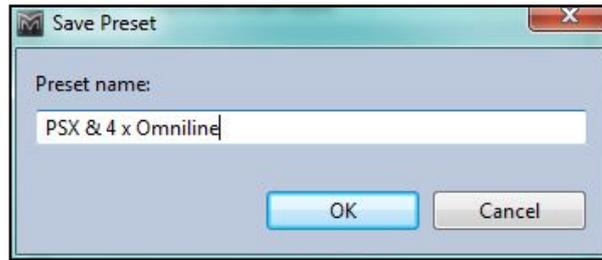
'Save Preset' allows you to store the current configuration including all settings that you may have modified. It brings up a similar window showing all User Locations;-



Click on your required location and select 'Save', this brings up this window;-



Type in your desired name and click 'OK',

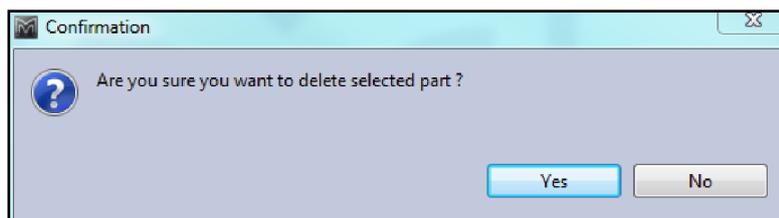


The current configuration will be saved to the chosen location and will appear as the highlighted (active) preset when you next load a setting;-



Synchronise will repeat the synchronisation process that occurs during Device Discovery and is used if a network error such as a network cable disconnection has caused the device and Vu-Net to no longer be synchronised.

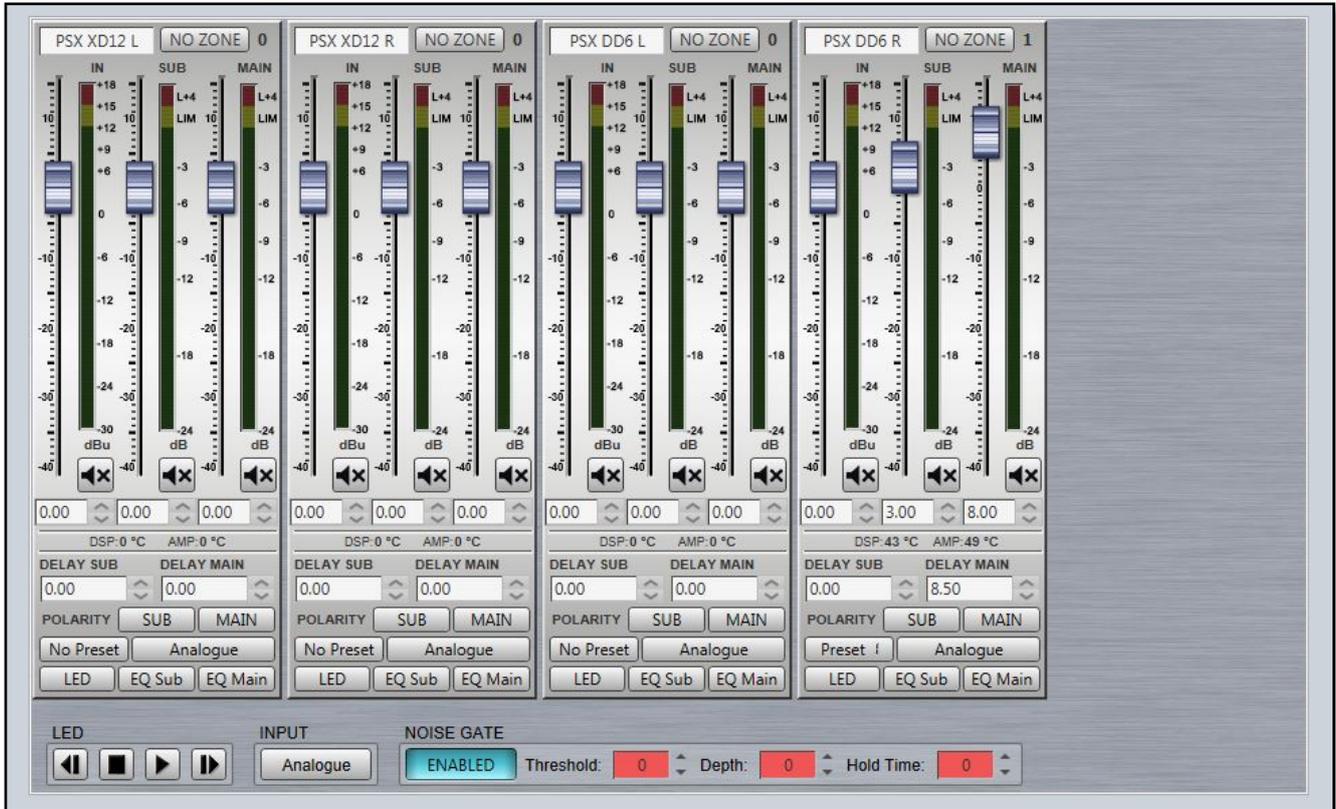
'Delete' removes the selected PSX. You will be prompted with the following Window to confirm the delete;-



If you selected Delete accidentally or have changed your mind, click 'No', otherwise click 'Yes' and the PSX will be removed from the project.

Overview

Either double clicking or right clicking and selecting Open will bring up the overview option for the PSX which shows all PSXs in the project;-



This gives an overview of the state of all PSX's allowing comprehensive monitoring of the system.

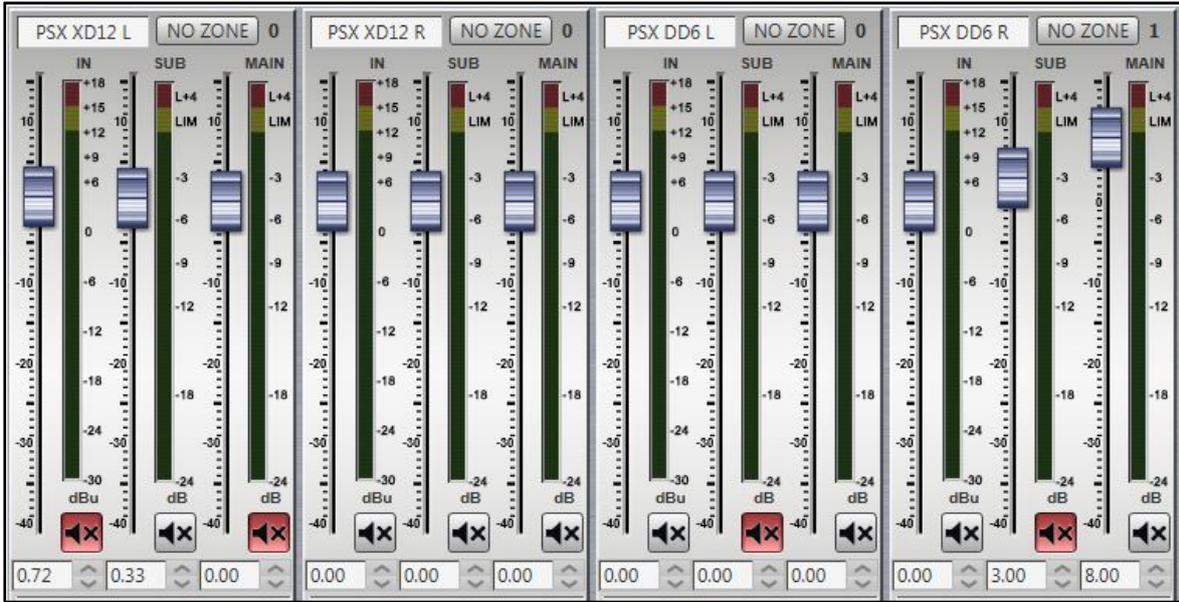
The box at the top will show any names that have been assigned to the cabinets by right clicking and selecting rename (or selecting and pressing F2 in the System Diagram;-



There are three gain faders, one for Input level and one each for control of the output of the internal sub and the external amplifier output. Each fader has a range of +15 to -40dB. Precise values can be entered by typing directly in the box below the fader or values can be scrolled up or down using the up/down buttons. The increments that the up/down buttons will step is determined in the Preferences section, by default it will be 0.25dB.

The mute button will mute the cabinet irrespective of the position of the gain fader and will turn red when active.

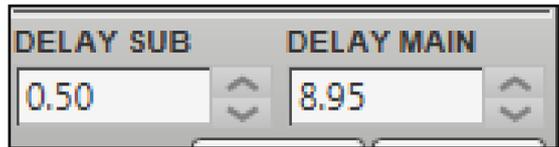
There is comprehensive metering available with a bargraph meter for input, Sub out and Main out. The input meter registers the level applied to the PSX up to the maximum of +18dB, the yellow and red segments indicating that the level is getting close to the maximum. The output meters indicate level prior to limit. The yellow segments indicate the onset of limiting; the red segment indicates 4dB of gain reduction.



There is also a temperature read out showing the temperature of both the DSP and amplifier module;-



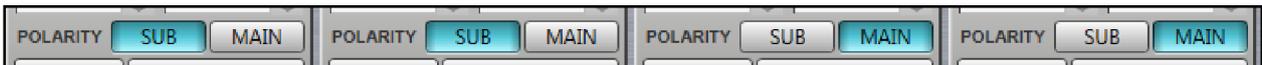
There is independent delay available for both the Sub and main outputs which is extremely useful for time aligning the PSX and the mid-top speaker that it is powering, particularly when used as a delay fill with a larger main system. The maximum delay available is 1 second. Values can either be typed directly into the Delay field or scrolled up and down using the arrow buttons. These increase or decrease the delay in increments of 10µs.



Polarity can be inverted independently for the sub and main outs. A confirmation window will appear;-



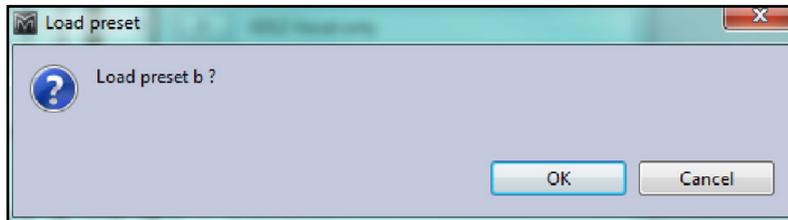
On clicking 'OK' the phase will be inverted and the Polarity button will turn blue;-



The Preset button acts in the same way as the Load Preset function which is available from the right-click menu in the Project System Diagram. It will bring up the Prest Menu with the currently active Preset shown highlighted in green;-



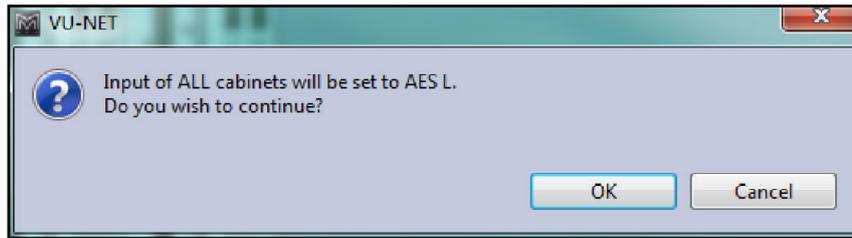
Clicking on a new Preset will prompt you to confirm your selection;-



Clicking 'OK' will confirm the selection and the preset will load. The Preset select window can be closed. The currently active Preset is displayed on the Preset button;-



The Input allows the connection mode to be changed from the default which is Analogue to AES/EBU taking its feed from either AES left or AES right or a "split" mode which feeds AES Left to the Sub and AES Right to the Main out thus allowing individual control from two sends. This can either be done individually for each PSX or globally using the Input switch at the bottom of the PSX overview Window. A global change will bring up the following window;-



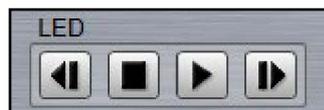
Click 'Cancel' if you have changed your mind or 'OK' to accept the change of input mode. All PSX's will display the new input selection.



Clicking the LED button will illuminate the front grille LED to help identify the DD12 under control in multiple deployment applications. This can be done individually for any cabinet;-



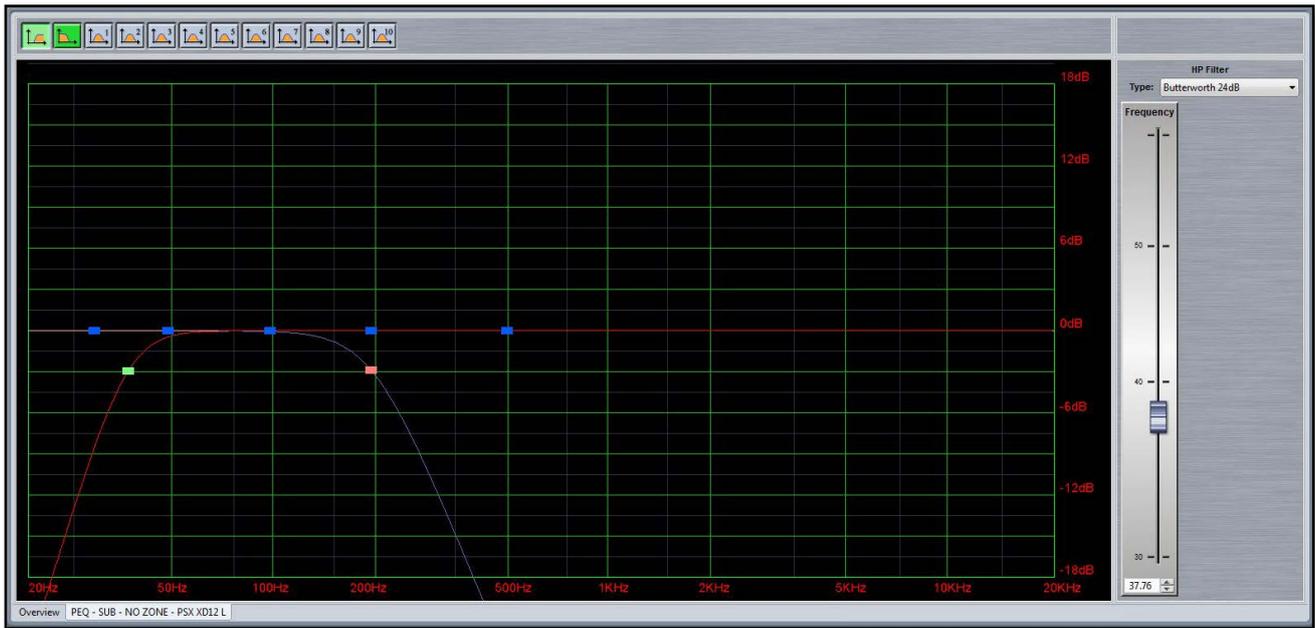
Or globally using the LED controls at the bottom of the PSX Overview window;-



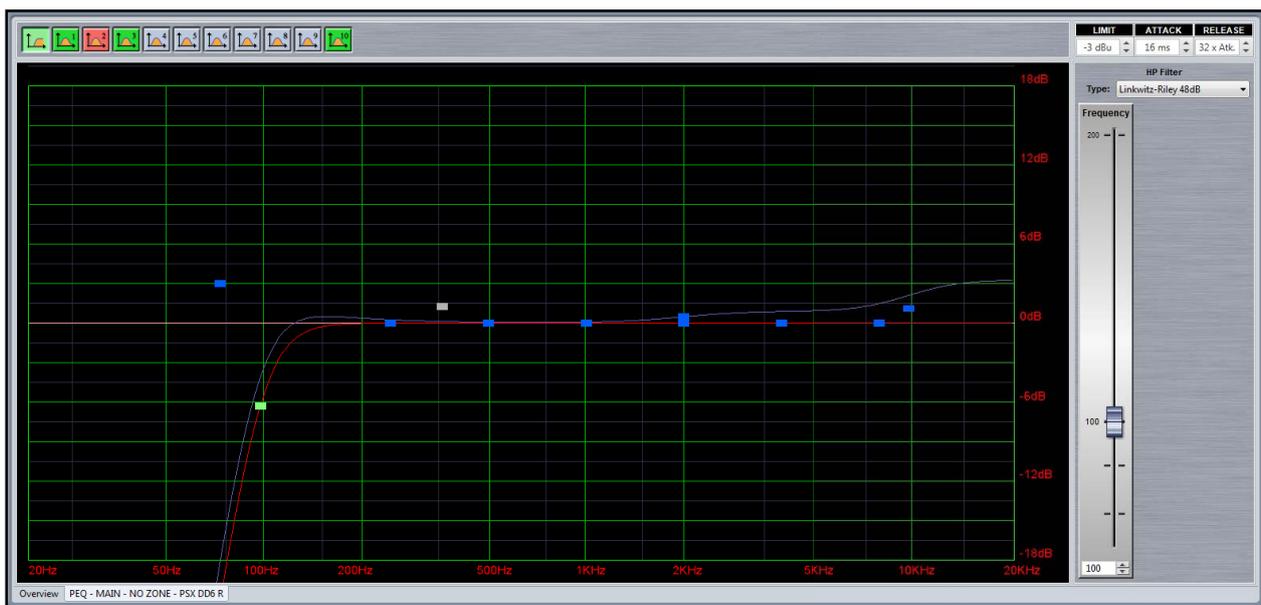
Pressing the "play" arrow  will make the LEDs of all PSXs illuminate in sequence, cycling round continually until you click on the stop button  Note that the global LED switches will overwrite any LEDs which have been activated on an individual PSX. The back and forward buttons   allow manual cycling of all cabinet LEDs, each click will extinguish the currently illuminated LED and light the LED on the next or previous PSX.

### EQ

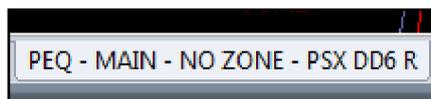
There are two buttons available for applying equalisation to the system, one for the Sub output and one for the Main. Clicking on either button will bring up an EQ Window virtually identical to other Vu-Net controlled devices, this is the Sub EQ window;-



And this is the Main EQ window;-

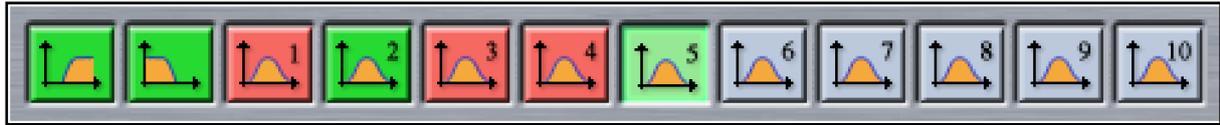


The tab at the bottom of the window indicates which EQ you are using, if the cabinet is part of a zone, and the preset in use;-



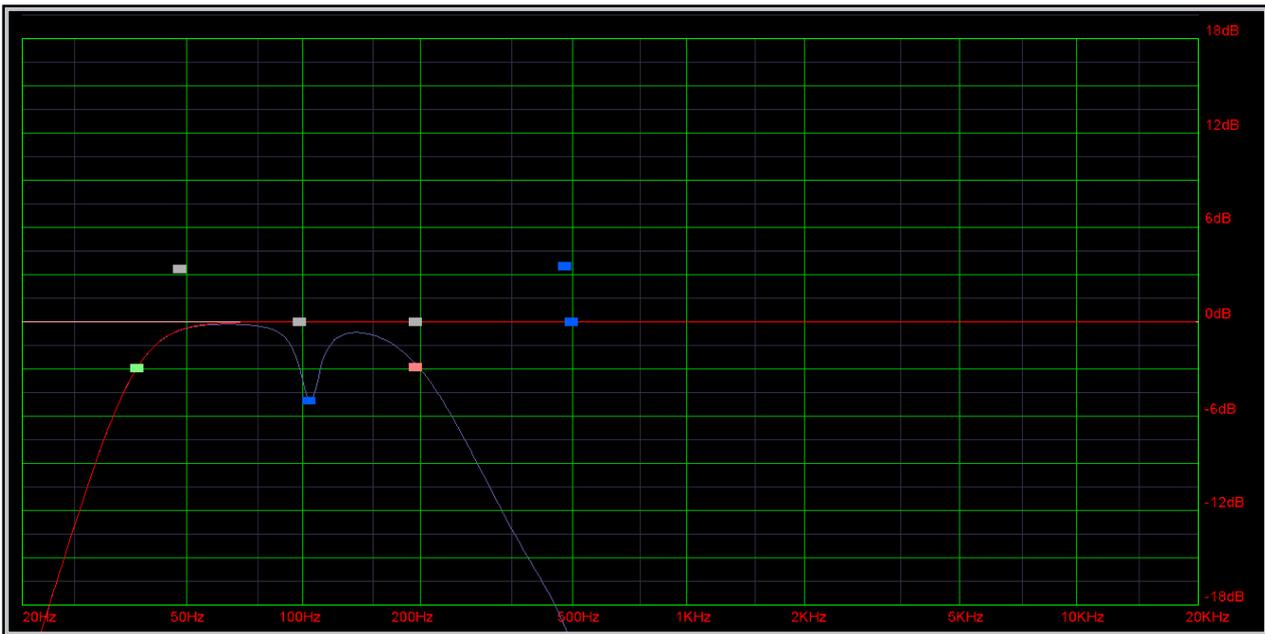
The window has three sections, the buttons along the top, the graphic display window and the controls on the right of the window. First we will look at the buttons along the top.

First there are ten parametric EQ buttons plus the high pass filter for both EQ windows and low pass filter for the Sub EQ;-



As you can see there are a number of colour variations for these buttons. Unused bands are pale blue until they are selected for editing by clicking on them in which case the colour goes to a brighter blue and the image shows the button depressed. Unused is defined as the gain left at 0dB. A red button indicates that the band has been bypassed, irrespective of whether any gain change has been made. Bypassed bands will change to a pale red when selected. Green buttons indicate a band that has either cut or boost applied, these will go a pale green when selected. Note that the high pass filter is always active so will always appear green.

The graphic view of the equalisation is a relatively standard frequency response graph;-



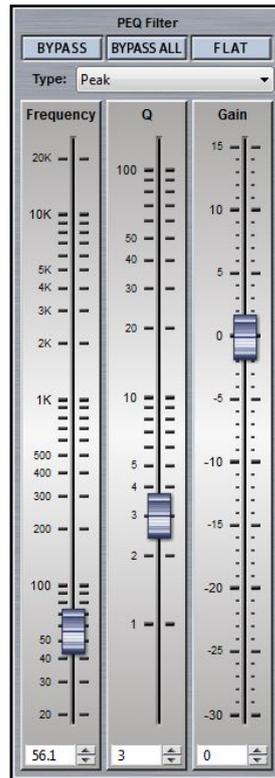
The horizontal axis is frequency in Hertz from 20Hz to 20KHz, the vertical axis is gain from -18dB up to +18dB. Colour coding is also used on the graph to represent the various modes.

First there are two traces, one red, and the other blue. The red trace is the response of the band that is currently selected; the blue trace is the overall response of the entire PEQ.

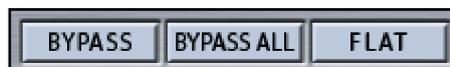
Each small rectangle represents the position of each of the ten bands plus the high pass. For all of the EQ bands the position on the horizontal represents the EQ centre frequency, the vertical position is the cut or boost applied. A blue rectangle is an active EQ, a grey rectangle is an EQ that has been bypassed. The green rectangle identifies the cut-off frequency of the highpass filter, the red rectangle the low pass filter (Sub EQ only).

In common with most PC controlled equalisation systems it is possible to make adjustments by dragging and dropping the filter curves. Left-click on any of the band rectangles and holding down the left mouse button, drag the icon horizontally to change the centre frequency or vertically to change the gain. Right-click and drag up and down to adjust the filter Q factor on any of the peak or shelving bands. The graph will adjust and the audio adjustment will be made in real time.

The final section on the right of the window is the Properties panel;-

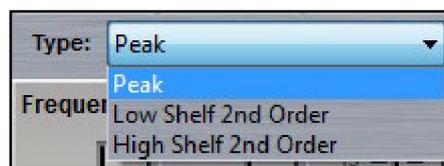


This shows all properties of the selected band. At the top are three buttons;-



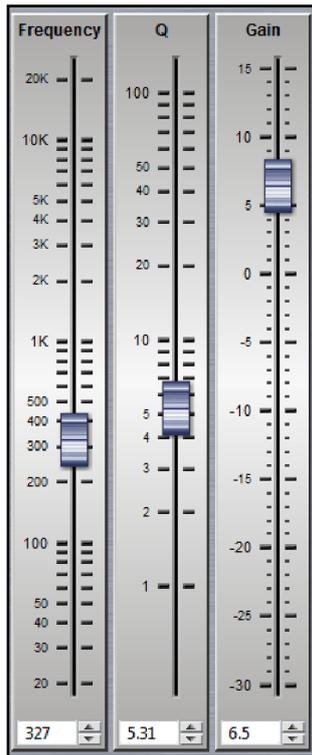
BYPASS bypasses the individual band you have selected turning the BYPASS button and the filter button red. BYPASS ALL bypasses every band. FLAT will instantly change the gain to 0dB.

Next is a Filter type. Click on this and the drop down shows the options for each filter band;-



The default is 'Peak', a standard parametric EQ; the other options are 2<sup>nd</sup> order Low Shelf and 2<sup>nd</sup> order High Shelf.

Below are the three principal faders for adjusting the filter parameters;-



Parameters can be changed on the properties panel in three ways. The faders can be drag and dropped to a new value, the value can be scrolled up or down using the up/down buttons to the right of the value windows, and finally values can be directly typed into the value windows. The response graph will adjust according to the new values and vice versa, adjustments in the graph window will be reflected in the fader positions and values in the properties panel.

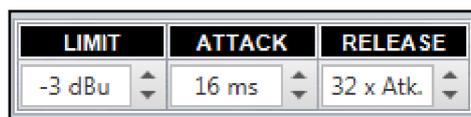
The High and Low pass filters only has a single fader for the corner frequency. This may be adjusted in exactly the same way as the faders for the PEQ's. The 'Type' drop-down for the high pass offers two types of filter and slopes from 24dB to 48dB per octave, for the low pass Butterworth, Bessel and Linkwitz Riley are available with slopes from 6 to 48dB per octave. The high pass for the main out is 48dB per octave Linkwitz Riley only.

To summarise, there are four ways to adjust filter parameters;-

1. Click and drag on the graph
2. Click and drag the properties faders
3. Use the up/down value buttons in the properties section
4. Directly type values into the value boxes.

Whilst this might seem over-versatility, it is intended to offer several options to suit the way that the system is being operated. If adjustments are being made with the Lenovo tablet PC in tablet mode with the stylus whilst walking around a venue, certain options may be easier to use than if you were sitting at a desk with a mouse plugged in to the PC.

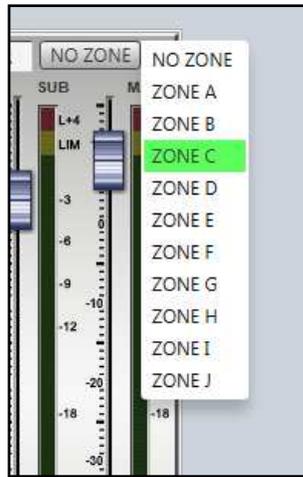
The Main out also has a limiter to protect the connected mid-top cabinet from excessive power. This is located at the top right of the EQ window above the properties section;-



The Limit is the threshold point in dB and can be adjusted from -18dBu to +2dBu. The Attack time can be adjusted from 0.3ms up to 90ms and the release is a factor of the attack time, either x2, x4, x8, x16, x32 or x64.

Zones

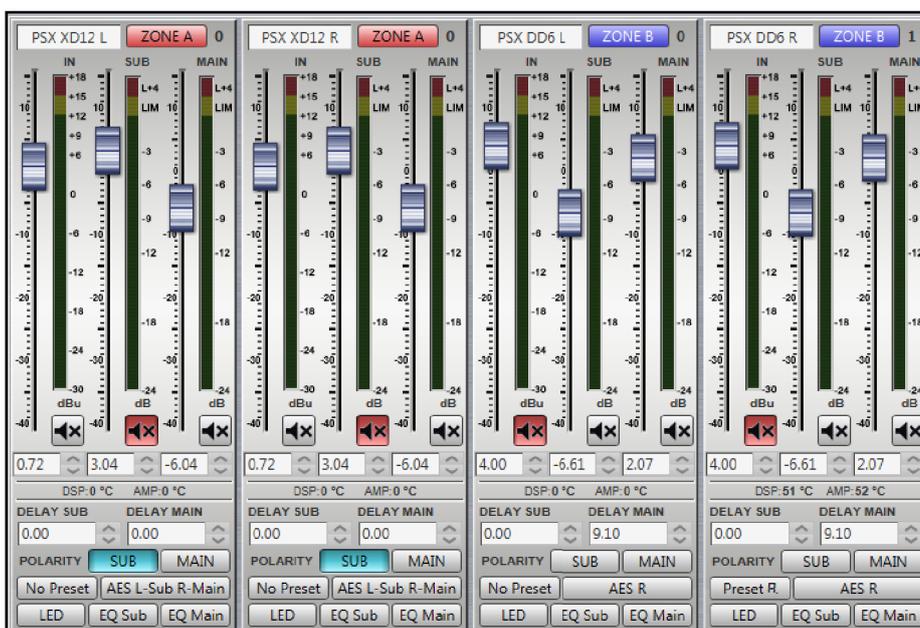
PSX has a very simple method for assigning cabinets to zones. Any cabinet can be a member of any (or none) of the ten zones available which are labelled A to J. To select a zone click on the Zone button at the top of the Overview page;-



Click on the desired zone and it will be displayed on the zone button. The zones are colour coded to make it instantly obvious which cabinets are on the same zones. Colours are as follows;-

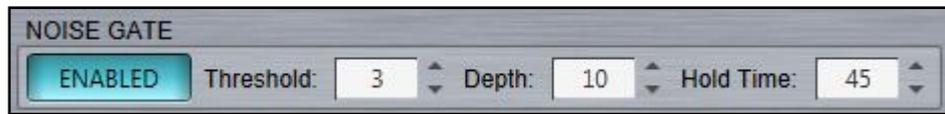
- A is red,
- B is blue,
- C is green
- D is magenta
- E is cyan
- F is yellow
- G is dark green
- H is purple
- I is orange
- J is black

All functions on cabinets in the same zone will be duplicated regardless of which cabinet in the zone is used to make adjustments;-



## Noise Gate

The PSX has a noise gate that is applied globally to all DD12's in the project. This is controlled using the section at the bottom of the overview window;-



Once enabled the Threshold, Depth and Hold Time can be adjusted, either by manually typing a value or using the up/down arrows to scroll through values. The default values are Threshold at -67dB, Depth of 10dB and Hold time of 500ms.



### Merlin

The Merlin system controller is most often employed in MLA systems as a PC to U-Net interface however the Merlin is a four input, ten output audio processor with a host of extremely powerful functions available, all of which can be controlled via Vu-Net on exactly the same platform as MLA, MLA Compact, MLA Mini and other U-Net compatible systems . As well as being used as a simple matrix for controlling main arrays, side hangs and subs, it could easily be deployed to control conventional non-powered speaker products in use at events as stage front fills for example. The fact that everything can be controlled on the same tablet PC running Vu-Net makes system alignment and trim very straightforward indeed.

### Gain, Mute & Limiters

Double clicking on the Merlin in the System overview page opens the Merlin System Control window which by default opens on the first Gain/Mute/Limiter tab;-



This has all input and output channel faders, meters and mute buttons available. As with the gain control on other Vu-Net controlled devices there is up to +15dB of gain or -40dB of cut available on all inputs and outputs. Metering is different for input and output. Input shows absolute input level in dBu, the upper point is +22dBu which is the highest level signal which can be applied to the input prior to clipping. The output meters display level before limit therefore their range will be determined by the limiter threshold that has been set for that particular output. The metering shows green up until it reaches 3dB from the limiter threshold whereupon it shows amber and finally red when the limiter threshold is reached. The upper most point of the meter shows 3dB of gain reduction- essentially 3dB over the limit threshold.

Limiters are accessed by clicking on the 'SHOW LIMITERS' button;-



This brings the output limiter controls up at the bottom of the window;-



By default the time constants are set to Manual but they can be set to Automatic by clicking the Auto Time Constant button which will then grey out the Attack and Release windows. Auto Time constants select the most appropriate time constants for the frequency band that has been selected using the high and low pass filters in the PEQ window for each output. Parameters are set by clicking on the drop-down arrow and selecting the desired value from the list:-



Clip level is a clip limiter designed to catch very fast peaks that might exceed the input headroom and can be set from +2dBu to +34dBu in 1dB increments.

Peak Level is the principal limiter threshold with time constants determined by the Attack and Release controls. The threshold range is from -10dBu to +22dBu also in 1dB increments.

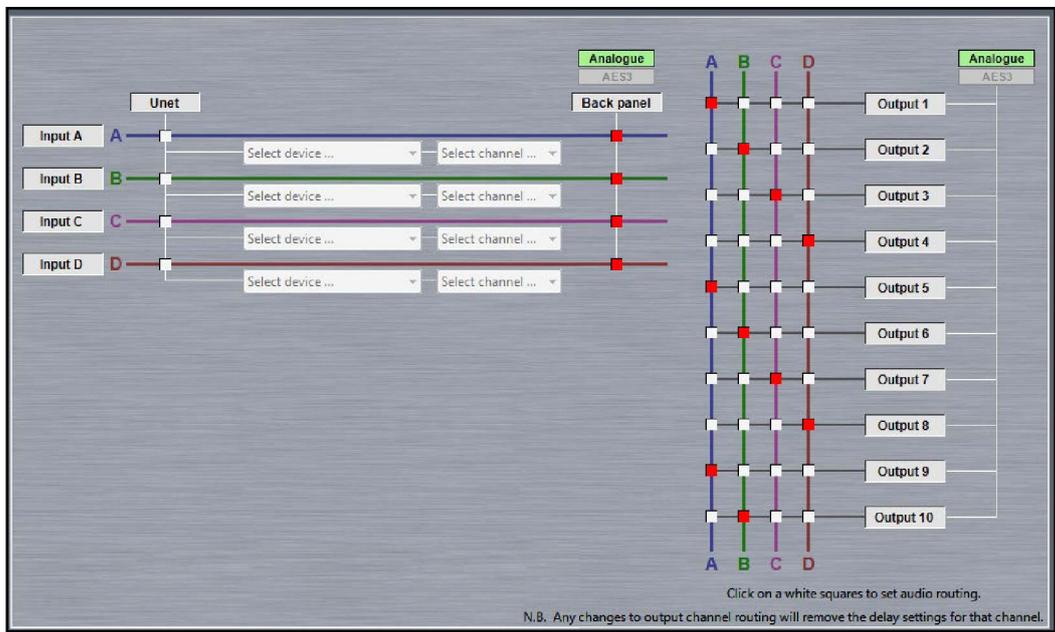
Attack time is in milliseconds and can be the following values; 0.3, 0.4, 0.5, 0.7, 1.0, 1.4, 2.0, 2.8, 4.0, 5.7, 8.0, 11, 16, 23, 45 or 45ms

Release is specified as a multiple of the selected attack time and can be either 2x, 4x, 8x, 16x, 32x or 64x.

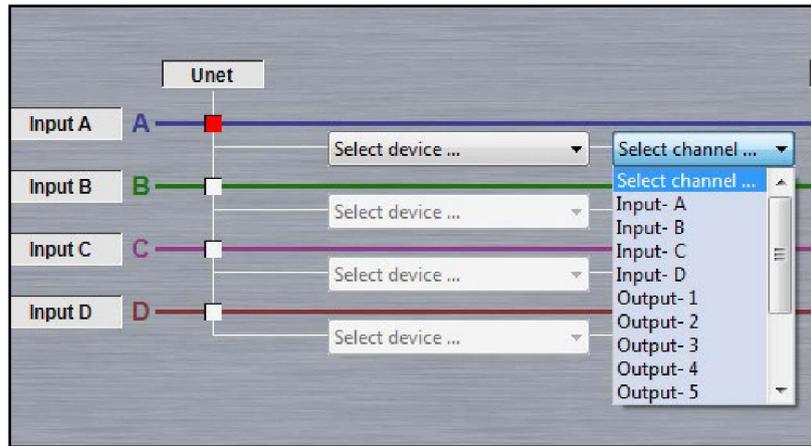
The limiter can be hidden again by clicking the 'HIDE LIMITER' button.

**Routing**

The Routing Tab brings up the routing matrix window which allows the input and output modes to be selected and the routing freely configured;-

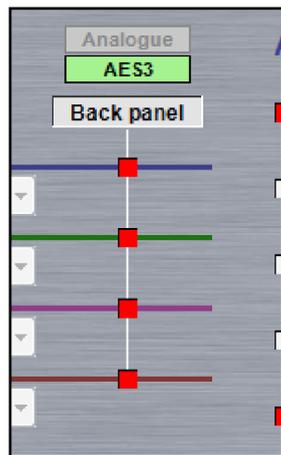


As with All other MLA devices, the Merlin has the facility to accept a digital input over the U-Net network ready for when this feature is implemented. This is achieved by selecting the Unet option which can be done individually for each channel;-



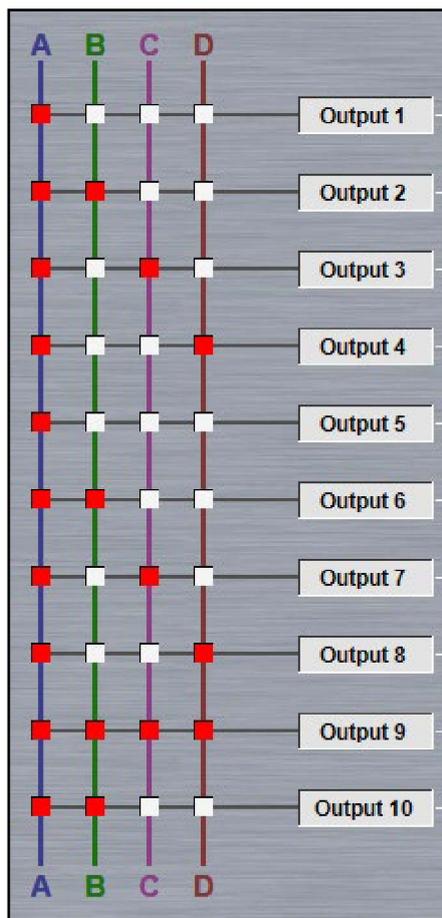
As with MLA, MLD and MLA Compact you will have the option to select a device and route from any of the available inputs or outputs on the network. This should be left un-selected until the feature is available in a future firmware upgrade.

To return to inputs from the rear panel XLR's which are bought out on the Merlin patch panel on the MLA Master and slave racks, you should ensure that the Back Panel option is selected. From there you can also select either Analogue or AES3 inputs;-

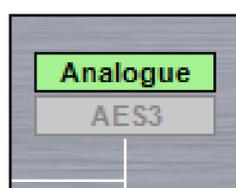


Note that selecting AES for either inputs or outputs changes how physical connections are made to the Merlin see the chapter on the Merlin for more details.

The routing matrix is shown with the inputs forming vertical columns and the outputs as horizontal lines. Each node can be selected to route any input to any or all output. This is entirely freely configurable, there are no restrictions on where or how many outputs and of the inputs are routed to. Note that any changes to the routing will remove any delay settings that have been configured for any of the output channels;-



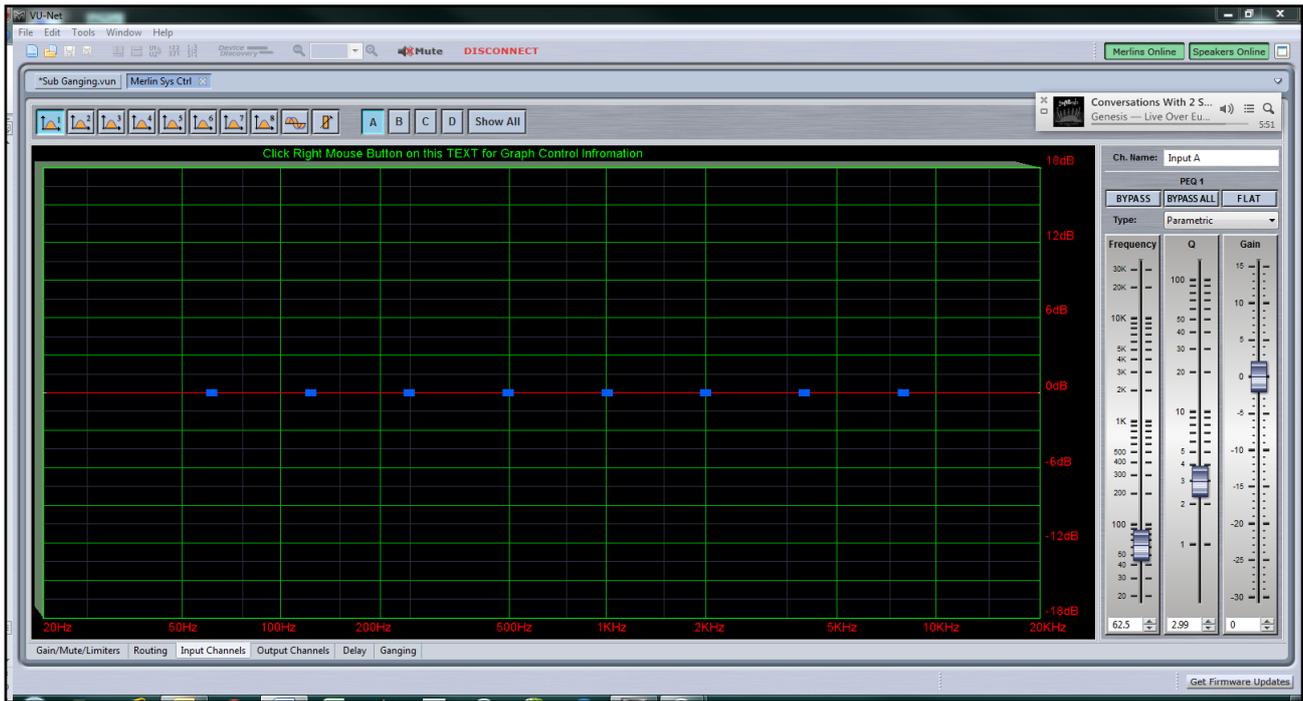
The outputs can also be selected to be standard balanced analogue or AES3. This is done completely independently of the input, it is perfectly acceptable to have the inputs and outputs set to different formats, analogue inputs from an analogue console and AES3 outputs to feed MLA arrays for example.



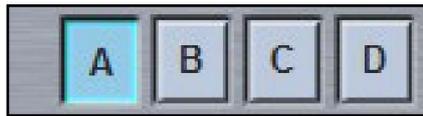
Note that the input and output names can be changed in the Input and Output tabs, the names will then be shown in the routing window.

### Input Channels

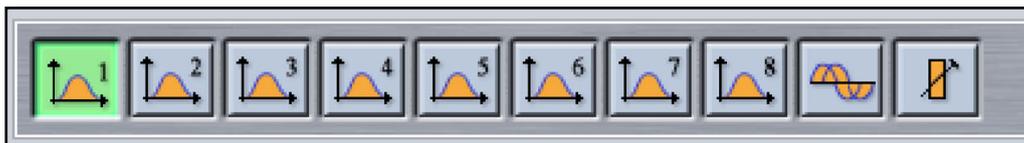
The input and Output channel tabs are very similar to the PEQ window for MLA, MLD and MLA Compact with a few notable differences;-



The input that is being controlled is selected by clicking on one of the four buttons labelled A-D;-

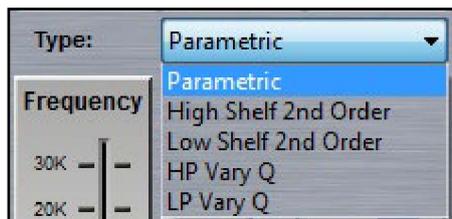


Each input has eight filters which can be selected from the buttons along the top. Also available are a delay and gain button which are "short cuts" to the delay and Gain/Mute/Limiter windows.

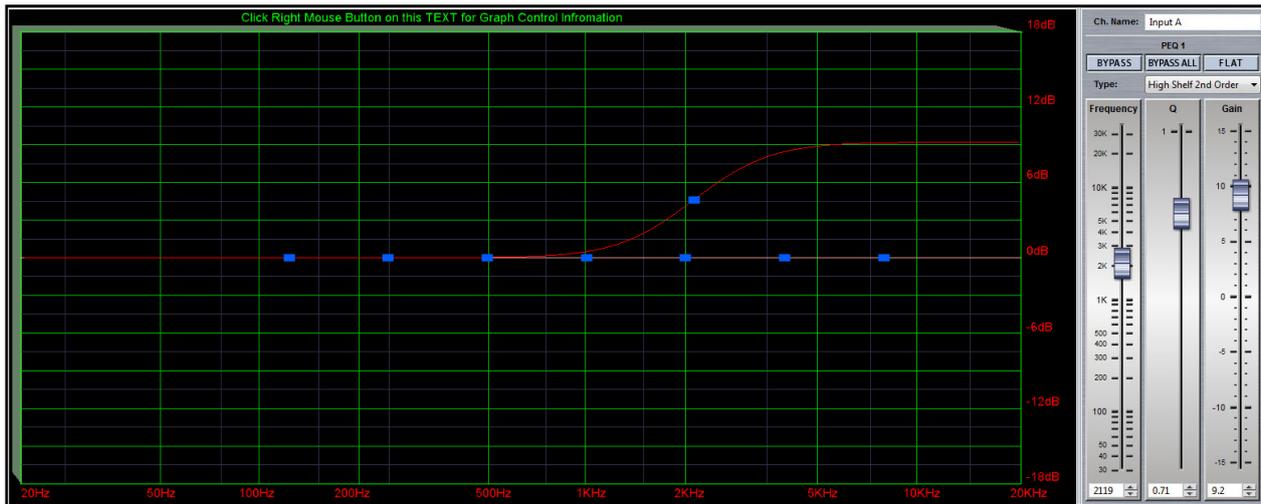


Filters may be manipulated in exactly the same way as the PEQ filters in the cabinets. The filter can be grabbed and drag and dropped to select the desired frequency and gain, using right click to modify Q factor.

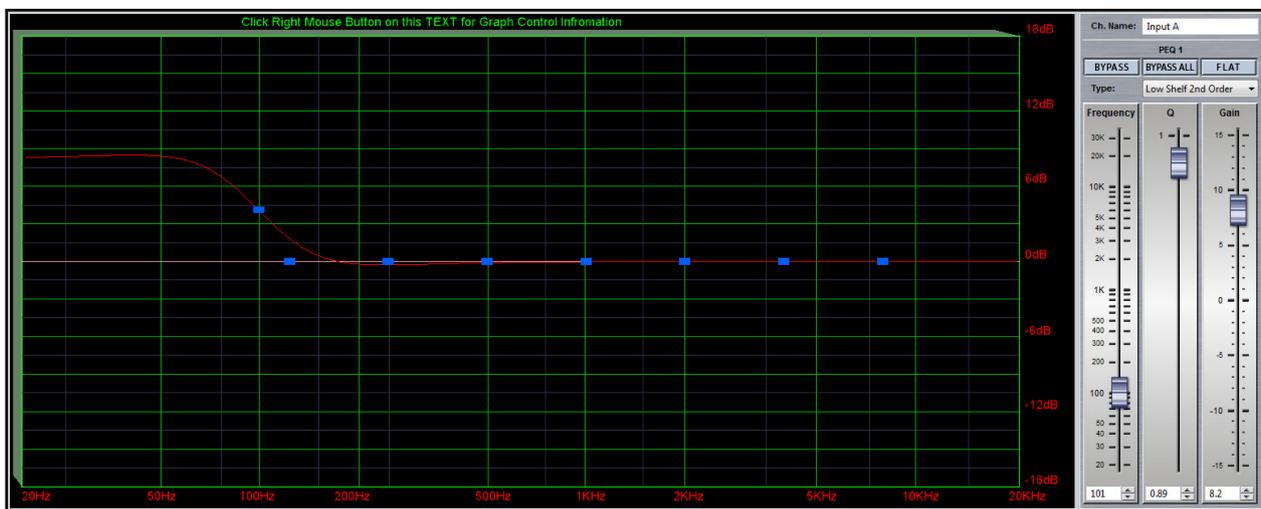
The parameter section allows precise values to be typed into the value windows, the faders drag and dropped or values cycled up or down using the appropriate arrows. There are additional options for the filter type selected by the 'Type' drop down;-



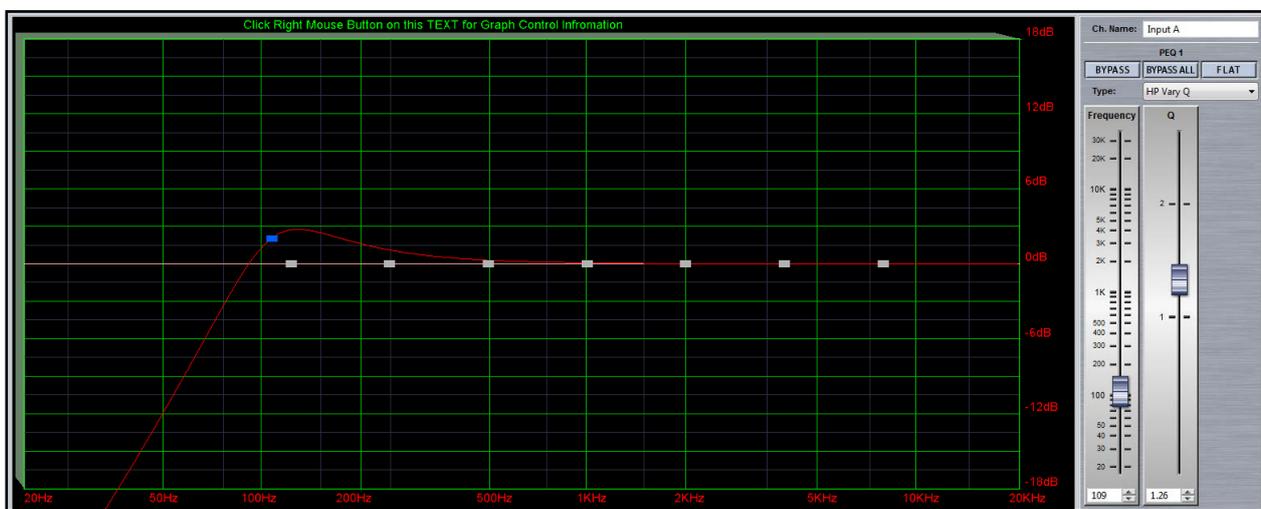
High Shelf 2<sup>nd</sup> order is a high shelf filter with gain available from -15dB to +15dB and Q from 0.25 up to 1.0;-

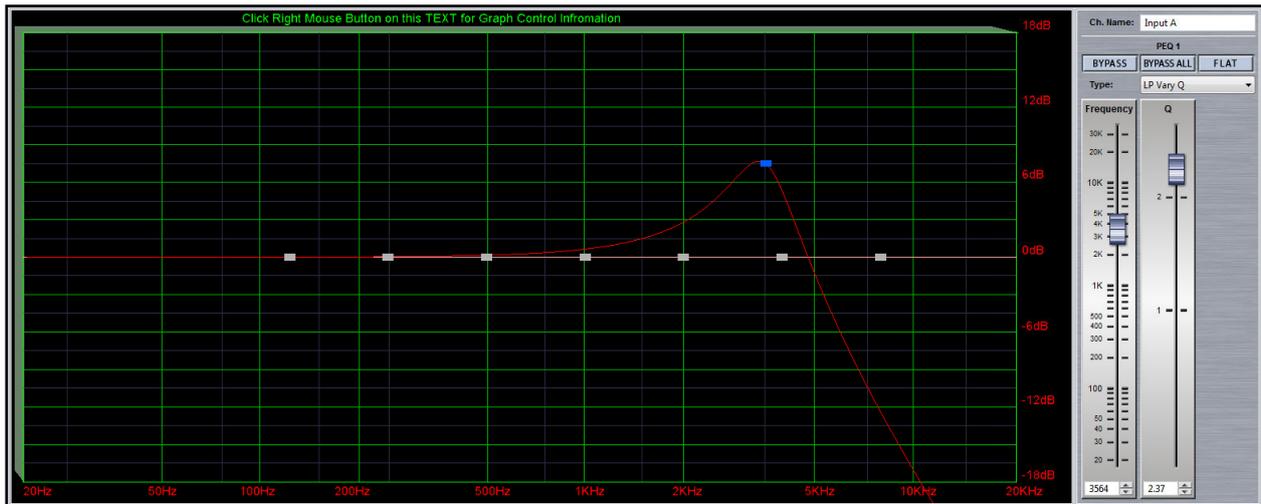


Low Shelf 2<sup>nd</sup> Order is a low shelving filter also with +/-15dB of gain and Q factor from 0.25 to 1.0;-

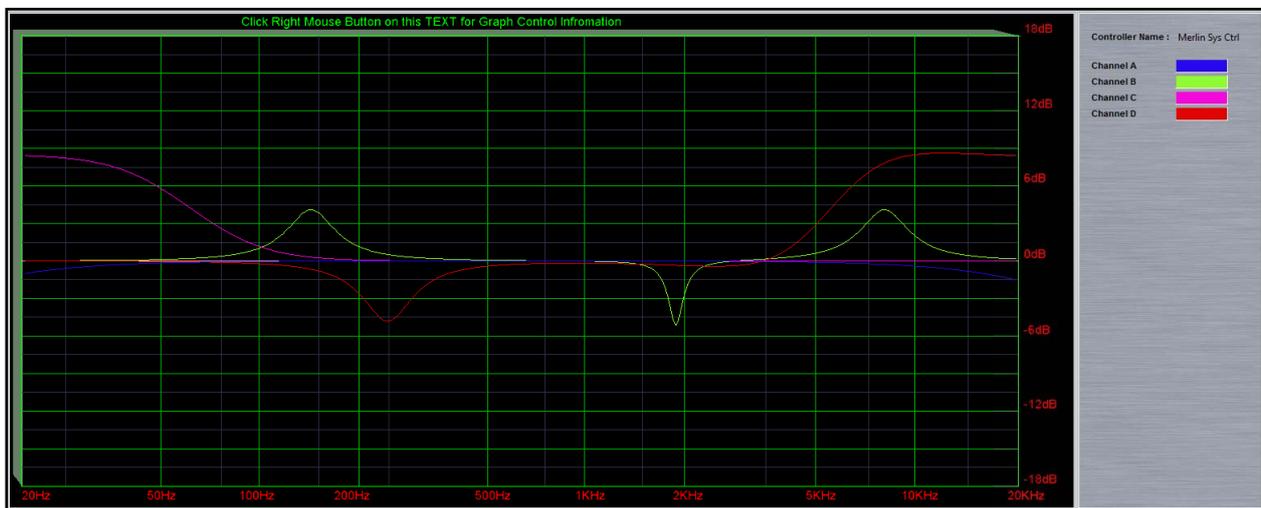


There are no dedicated high and low pass filters on the inputs but High pass and lowpass with variable Q are options for filter types;-





You can also select 'Show All' to display all four input channels overlaid with different colours for each;-



As well as eight bands of equalisation there are buttons for delay and gain;-



These are a shortcut directly to the tabs for those functions.

The other function that the Input Channel page features is the Channel name which can be edited in the box in the top right corner of the window;-





The name can be up to 12 characters and will appear in all other Merlin tabs within Vu-Net and on the unit itself but as there is limited space on some windows, the Gain/Mute/Limiters page for example, we would recommend keeping name as short and succinct as possible.

**Output Channels**

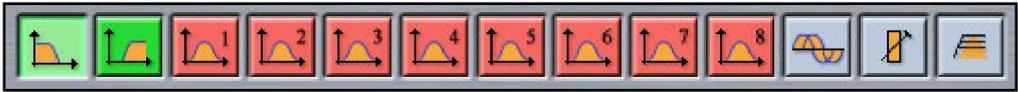
The output channel page is almost identical to the input pages;-



There are naturally a few differences, the output channel being viewed is selected by the 10 buttons at the top of the window;-

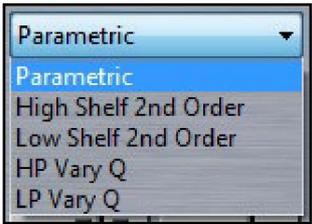


There are also eight filters available selected by the buttons top left but in addition there are also dedicated high and low pass filters;-



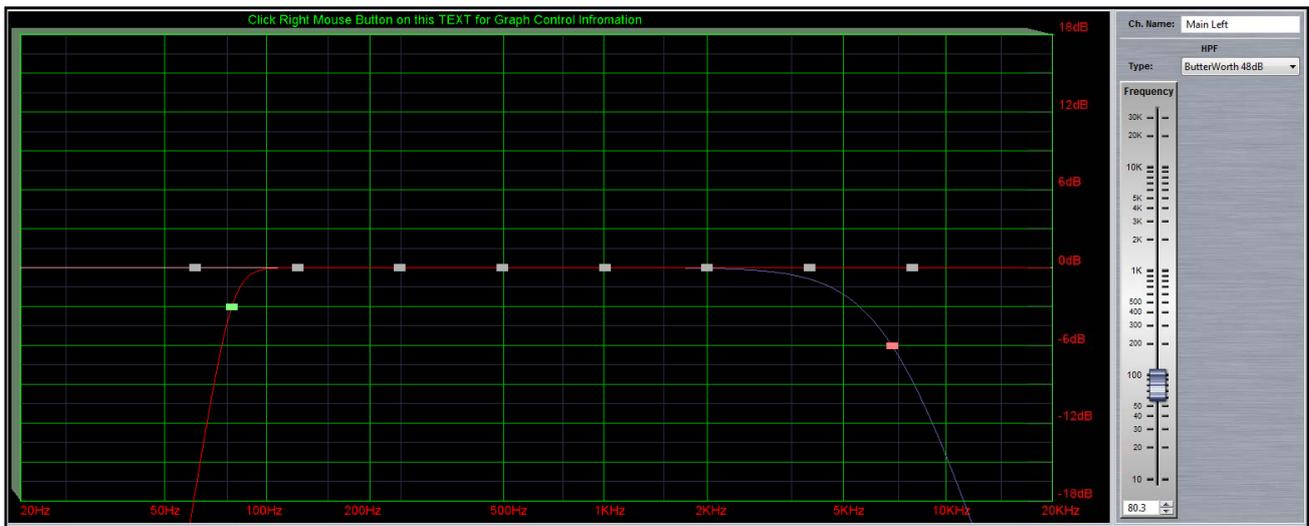
The last three buttons are short cuts to the delay, gain and limiter sections.

The parametric EQ have the same options as the input channels, parametric, high and low pass 2<sup>nd</sup> order shelving EQ and high and low pass filters with variable Q;-





The High and lowpass filters can be configured as either Bessel, Butterworth or Linkwitz Riley types with slopes of either 12, 18, 24 or 48dB per octave (48dB/oct is only available on Butterworth or Linkwitz Riley);-



As with the input channels, the output channel name can be edited on the Channel pages;-

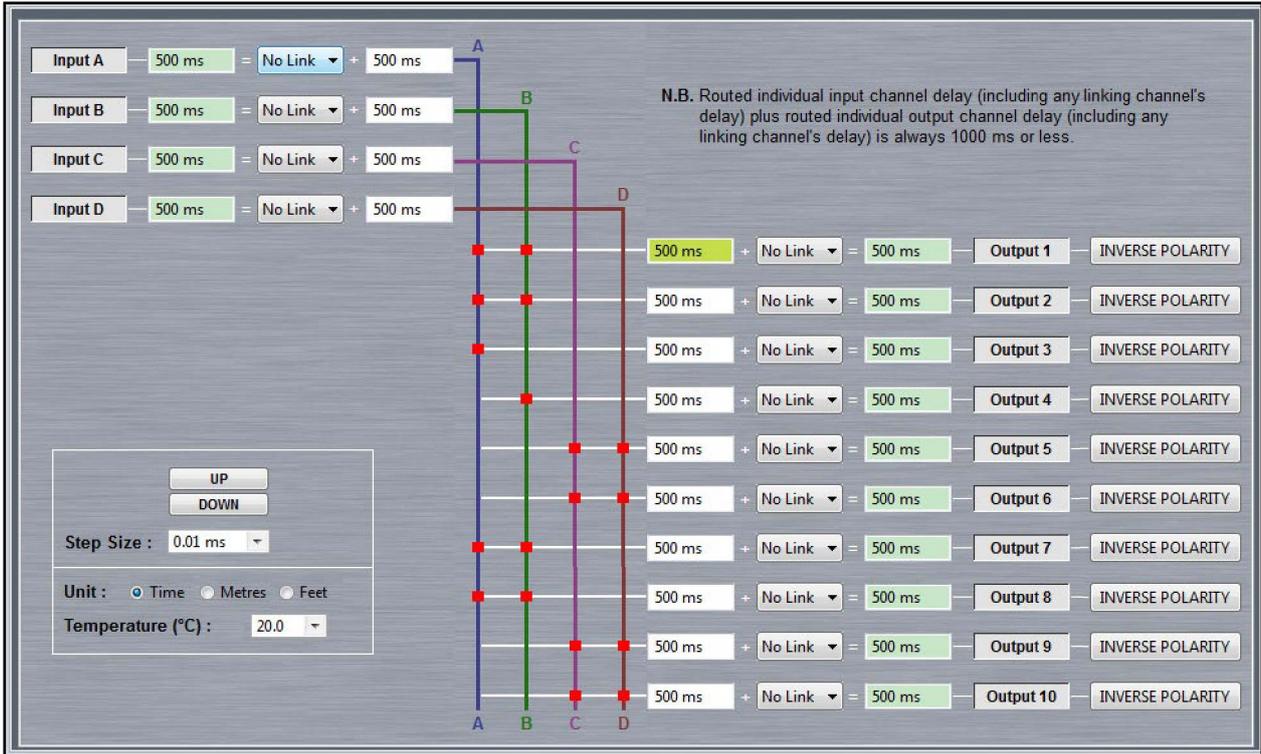


### Delay

The delay window offers a sophisticated system for controlling time alignment if all systems routed via the Merlin. The maximum through delay from input to output is 1 second so for example you can add 999.99ms to an output but then you will not be able to add any delay to the input and vice versa, or you could have up to 500ms on the input and the same on the output.

It is important to note that if you make any changes to routing after you have set delays, all delays on a re-routed channel will be reset to zero.

This is how the routing window appears;-

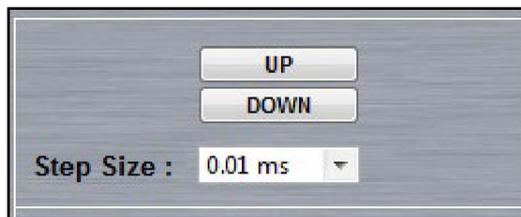


Delay times can be specified by time in milliseconds, or distance in either Metres or Feet. This is set in the bottom left of the window;-



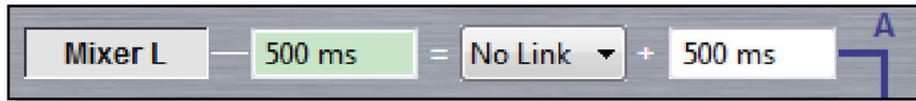
The temperature can be set to match the ambient temperature at the venue and will compensate for the variations in speed of sound through the air as temperature varies when distance has been selected. The temperature adjustment does not affect delay times when Time has been selected as the unit of display. The temperature is selected from a drop-down list from -20 to +40°C. You may wish to consider cancelling any shows where the ambient temperature is -20°C; ticket sales are likely to be poor...

The other option available is the step size selected from the box just above the units selection;-



As well as entering an absolute value, any selected delay may be stepped up or down using the 'UP' or 'DOWN' buttons. This is particularly useful when time aligning systems by ear, perhaps using an audible click, the delay can be gradually adjusted until the clicks are perfectly in sync. Step size can be selected from the drop-down and can be 0.01, 0.1, 1.0, 10.0 or 100.0 milliseconds.

The delay window displays the entire routing matrix and input and output channel names so it is easy to see where delays need to be applied. The input and output sections are broadly similar, first here is an input channel;-



This is Input A as shown by the designation to the right. It has been re-named in the Input Channel tab as “Mixer L”. The first box with a pale green fill is for display only and shows the total delay applied to that input. The total comprises the delay added by virtue of a link to another channel (which will be explained in a later chapter) added to the delay in the final box which is where the required delay for the channel is entered. To enter a delay the input (or output) needs to be selected with a single click whereupon the box fill will change from white to a brighter lime green;-



The existing value can then be selected and over-written with the new value following which it can be scrolled up and down if required using the ‘UP’ and ‘DOWN’ buttons. Note that only one delay can be selected at any time but multiple delays can be changed simultaneously by using the link function as we will see.

The output channels are very similar;-

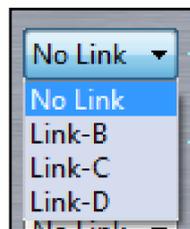


The order of the boxes is reversed. The first box is the active box in which the delay for the output is entered. Next comes the link drop-down. Then the delay display box shows the total delay allocated to that particular output. The output channel name is next and finally a phase button to invert the polarity of the output. The button changes colour to a pale blue when Inverse Polarity has been selected;-

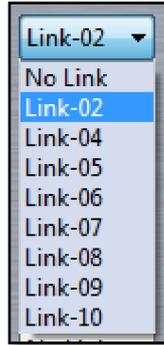


### Delay Link

As the name suggests, the delay for multiple inputs or outputs can be linked together to allow simple set up without having to enter the same figures several times. Input link and output link work in the same way but you cannot link an input to an output or vice versa. In its simplest format, you can link several inputs or outputs together. Inputs for example can be linked to any of the other three, in this example, the drop down for input A shows it can be linked to input B, C or D;-

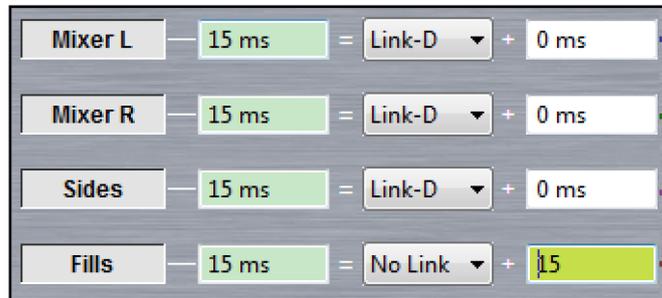


Similarly, Outputs can be linked to any of their other neighbours; here is the link drop-down for output 1



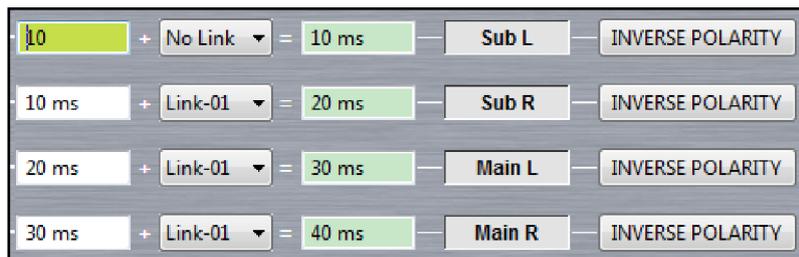
Note that if you link a particular input to another, the “master” input cannot be linked to another channel. This also applies to outputs.

In its simplest use, you can link one or more inputs or outputs to one other and use that to simultaneously change the delay of all linked channels. Here inputs A, B & C have been linked to input D and a delay of 15ms has been applied to input D;-

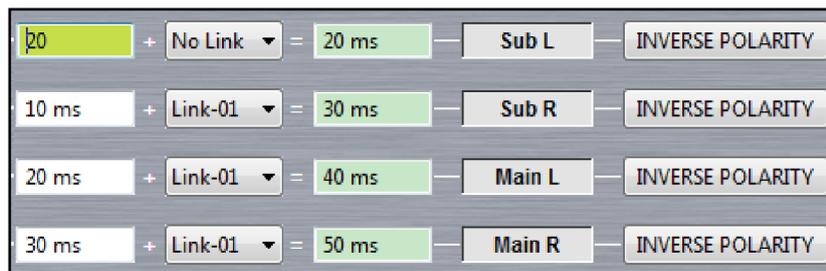


As you can see, although the individual channels A, B & C have nothing entered, the delay display shows 15ms for all inputs.

In addition to this simple matched delay, channels linked to others can also have a delay entered and the total delay will equal the delay entered for the “master” channel plus whatever delay is entered for that channel. Any changes to the “master” delay will be tracked by any channels linked to it. In this example, Output channels 2, 3 & 4 are linked to output 1. Output two has its own delay of 10ms, output three 20ms and output four 30ms. We add 10ms to output 1 and see the following;-



If we now increase the delay on Output one to 20ms we see this;-





The delay on Output one will always match what is entered, the other three outputs will always match output one plus their individual delay. Linking works in identical fashion to output channels.

**Ganging**

The Merlin has an extremely comprehensive ganging capability accessed from the Ganging tab. The Ganging window appears like this;



There are three types of ganging available, whole input and output ganging, Part input and output ganging and cross device ganging which enables you to mirror the parameters programmed into one Merlin across one or more other Merlins on the same U-Net network. Ganging duplicates the settings on ganged channels or parameters. There is no “Master” and “Slave” system parameters can be adjusted on any channel, parameter or device and any ganged channel will match the setting.

**Whole Input / Output Ganging**

This is dealt with by using the panel on the right hand side of the window;-

**Output Whole Channel Ganging**

01: 1 2 3 4 5 6 7 8 9 10

02: 2 3 4 5 6 7 8 9 10

03: 3 4 5 6 7 8 9 10

04: 4 5 6 7 8 9 10

05: 5 6 7 8 9 10

06: 6 7 8 9 10

07: 7 8 9 10

08: 8 9 10

09: 9 10

10: 10

**Input Whole Channel Ganging**

A: 1 2 3 4

B: 2 3 4

C: 3 4

D: 4

N.B.- Right Click on the first column to set Cross-Device channel ganging

In the default state there is no ganging, each input and output is essentially ganged to itself as indicated by the red squares in the left hand column. To gang output channel 1 to channels 2, 3, 4, 9 & 10 for example, click on the relevant squares in the horizontal line by output channel one;-

**Output Whole Channel Ganging**

01: 1 2 3 4 5 6 7 8 9 10

02: 2 3 4 5 6 7 8 9 10

03: 3 4 5 6 7 8 9 10

04: 4 5 6 7 8 9 10

05: 5 6 7 8 9 10

06: 6 7 8 9 10

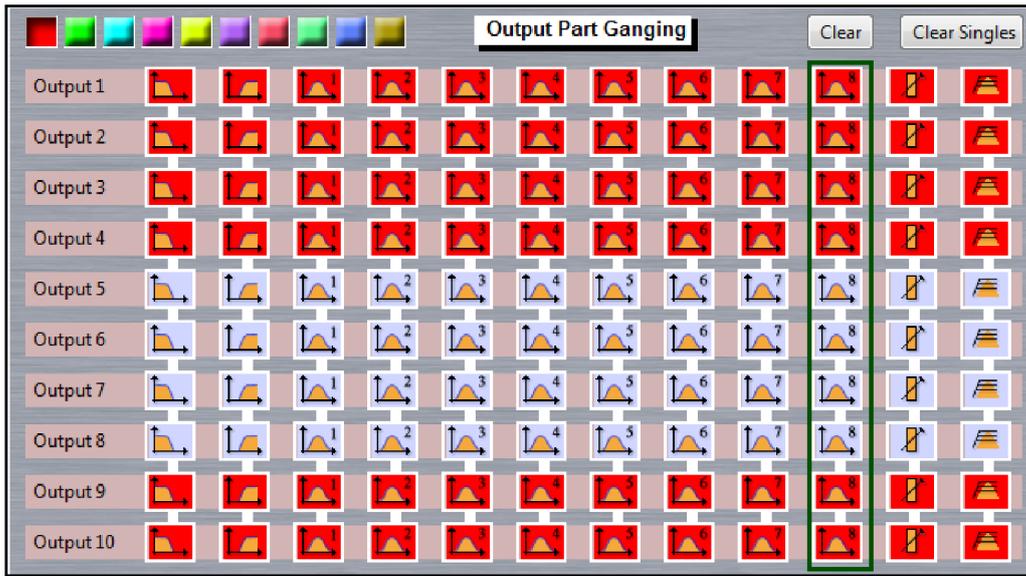
07: 7 8 9 10

08: 8 9 10

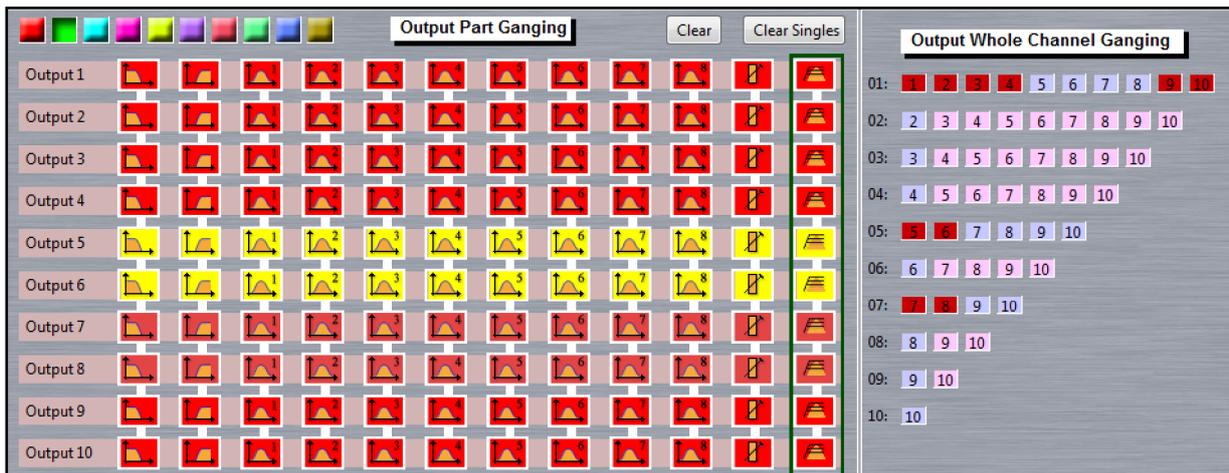
09: 9 10

10: 10

You can see that the red squares by the channels that have been ganged have disappeared from the vertical column and are now in the horizontal line from channel one. You will see on the part ganging screen that all parameters for the ganged channels are now coloured red to indicate that they are all ganged together;-

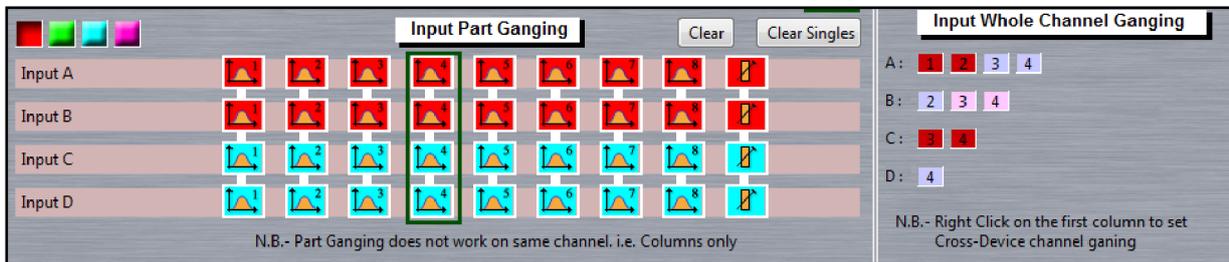


We can add a more, totally independent gangs, for example we will now gang channels 5 & 6 and also 7 & 8;-

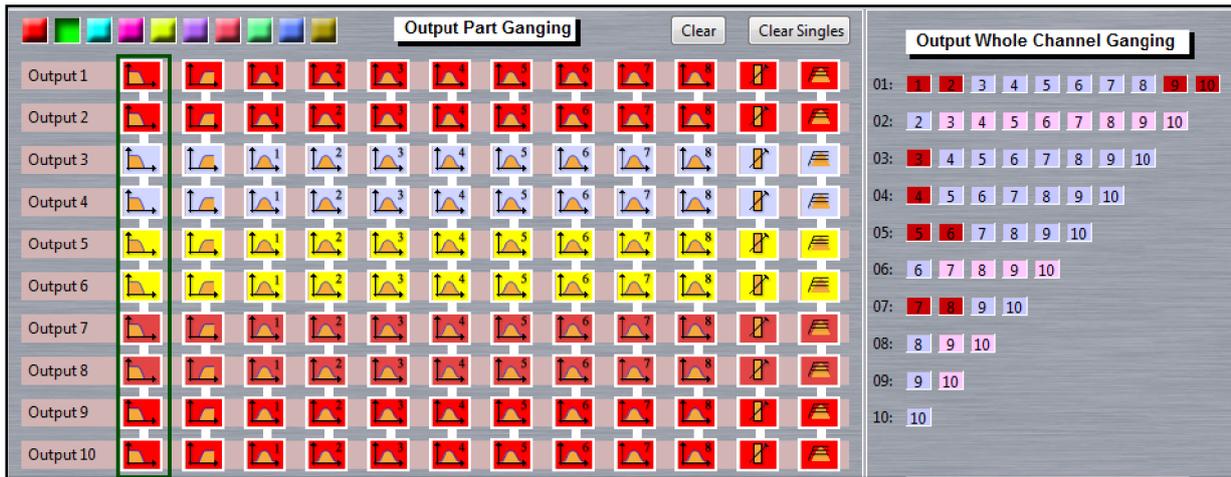


You can see that the parameters for Outputs 5 & 6 are all coloured yellow and 7 & 8 are all orange/brown.

Input ganging works in exactly the same way, here we have ganged inputs A&B and C&D;-



To clear a gang just click in the left hand column for any ganged channel and the ganging will be removed. Here we have removed channels three and four from the previous gang;-

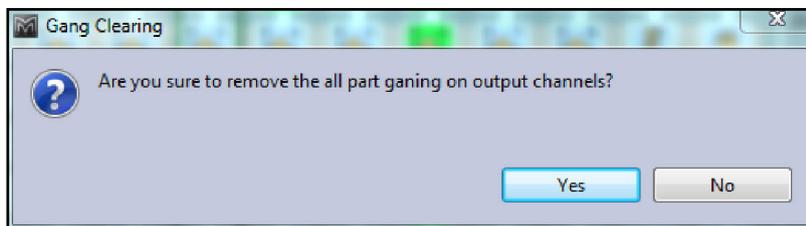


Note that you cannot freely change the ganging channel when using Whole Channel ganging of outputs and inputs. The channel is determined by the base channel to which everything is ganged. Therefore anything ganged to channel 1 will be coloured red, anything ganged to channel 2 will be coloured green, channel 3 light blue and so on.

You can also remove all ganging by using the 'Clear' button for both output or input ganging;-



This will bring up a warning window to make sure that you definitely want to clear all gangs;-



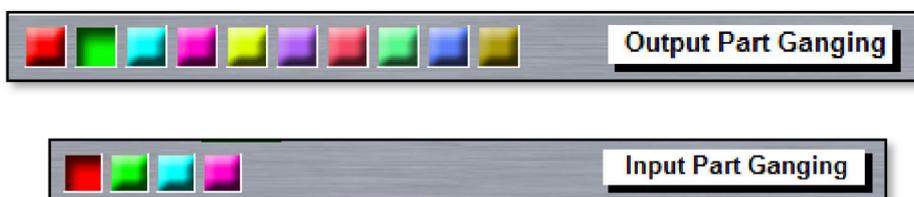
Click 'Yes' and all ganging is completely removed.

**Output Part Ganging**

It is also possible to gang individual parameters between channels. Note that you can only gang the same parameters together between channels, for example some or all of the output channel high pass filters or all of Parametric EQ 2. You cannot gang dissimilar parameters; as shown in the ganging window diagram, part ganging only works in vertical columns;-

N.B.- Part Ganging does not work on same channel. i.e. Columns only

There are 10 channels of ganging available for each output parameter and 4 for the input parameters as signified by the coloured squares at the top of each part ganging section;-



For example, if we want to gang just the low pass filter for the output channels in pairs, click on the red square, then click on the low pass filter icon in the diagram. Now select the green square and click on the low pass for channels 3 and 4, then the cyan square and click on low pass for 5 and 6 and so on. This is the result:-



We could now do the same thing for the high pass filter;-

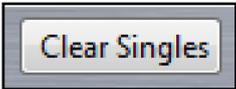


Now we have each pair of low pass filters ganged, changing the slope or frequency of either channel will be matched by its pair, we have also ganged the high pass and even though the channel colour is the same the high and low pass are NOT ganged in any way, vertical columns of parameters act completely independently.

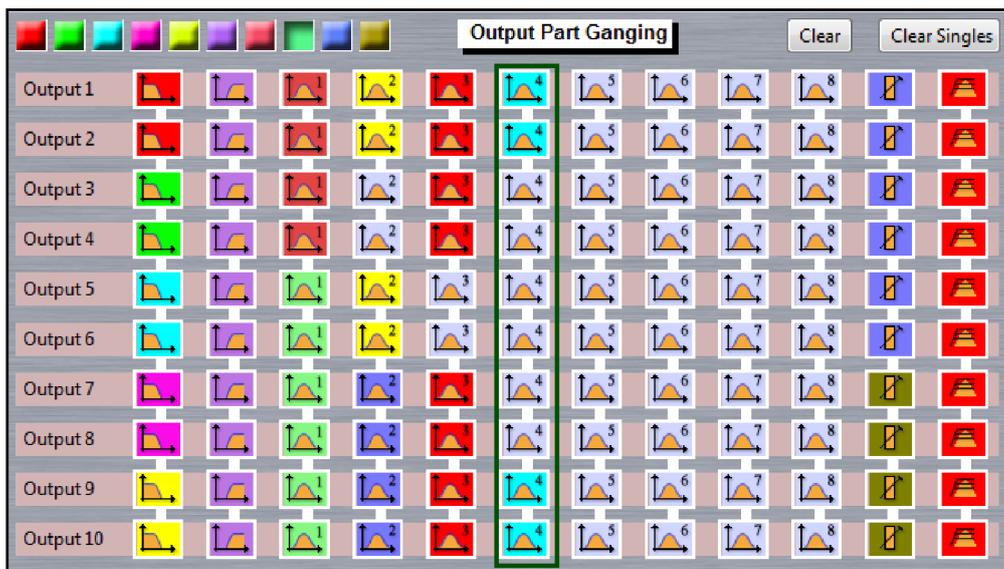
Part ganging is very versatile and highly complex ganging is possible using one or more of the available channels for each parameter. Note that this is a decidedly extreme example;-



If you have accidentally left some single selected parameters after building your gangs, these can be quickly and easily removed without disturbing any of the "genuine" gangs. If we look at the example above, there is a single green gang in PEQ 2, a purple in PEQ 4 a pale green in PEQ6 and a pale purple in PEQ 8. As there is just one of each they are clearly not ganged to anything. They can be removed individually with a second click on each parameter however they can all be removed instantly by clicking on the 'Clear Singles' button;-



All single gangs are removed but all "genuine" gangs with two or more selected parameters are untouched;-

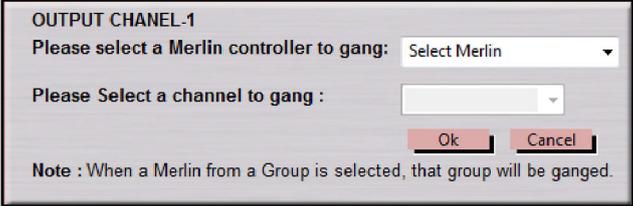


### Cross Device Ganging

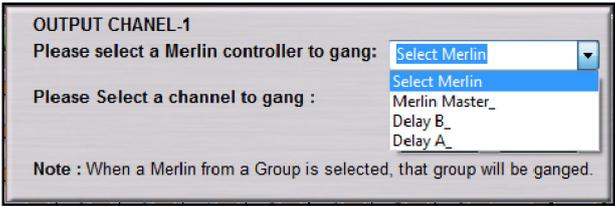


A very powerful feature of Vu-Net is the ability to gang channels between other Merlins on the same U-Net network. Cross device ganging over-rides all other ganging. In our example we have a project with 4 Merlins named “Merlin Master”, “Merlin Slave”, “Delay A” and “Delay B”. We will gang output channel 1 of all Merlins together with the Master as the base.

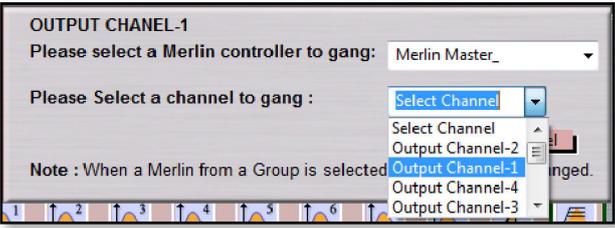
First if we open the Merlin Slave and click on the Ganging Tab, we right click on the Output Whole Channel Ganging channel 1. This window appears;-



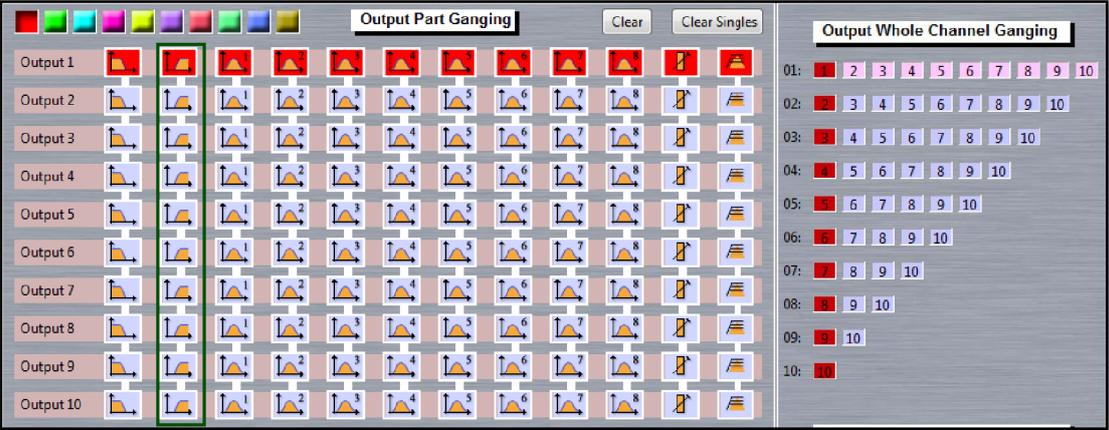
Click on the ‘Select Merlin’ drop-down and select “Merlin Master”;-



Now click on ‘Select Channel’ and click on “Output Channel-1”, note that the channel order in the list is not sequential;-



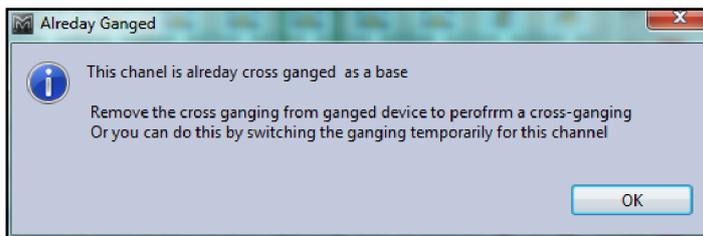
Click ‘OK’ and Channel 1 is now ganged between both the Slave and Master Merlins. The Ganging Window on the Slave Merlin shows that it is ganged;-



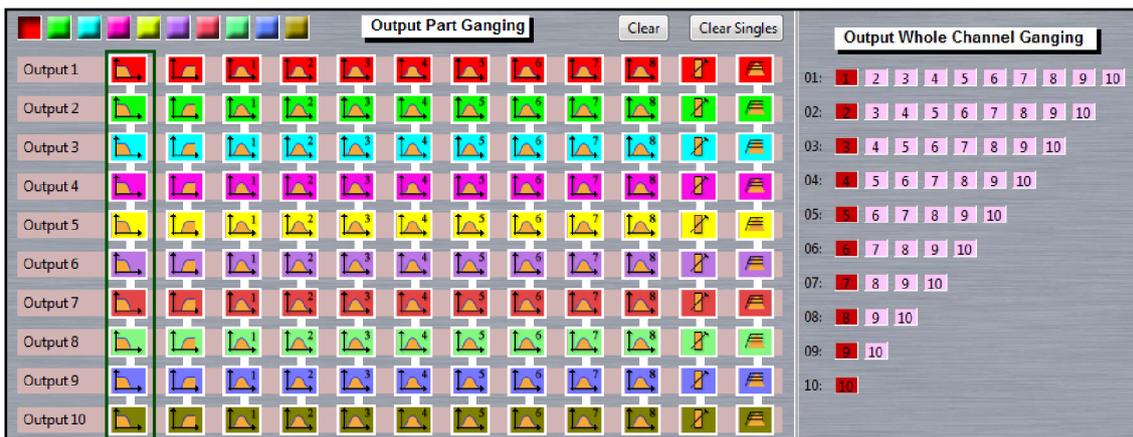
Now repeat the same operation for the other two Merlins, “Delay A” and “Delay B”. If you return to the Master Merlin and hover the cursor over output 1 we see this;-



Which shows that channel 1 of all four Merlins are ganged. If we right-click on the Merlin Master Output 1 we will see this window;-



Each channel can be ganged to another device independently if required; here is the Merlin Slave with every output ganged to its counterpart on the Merlin Master. You will see that each gang is assigned a different colour so it is easy to identify that the gangs are independent;-



The Merlin Master will also show the same ganging. Input channels can be ganged across devices in exactly the same way.

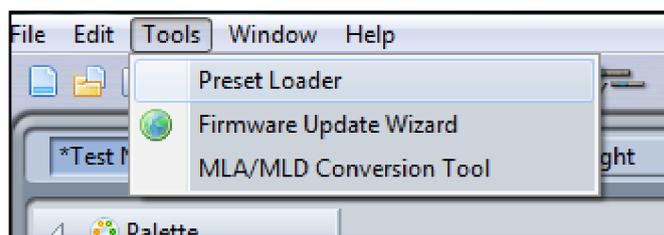
To remove cross device ganging, either right click on the input or output you wish to remove and click the 'Remove' button;-



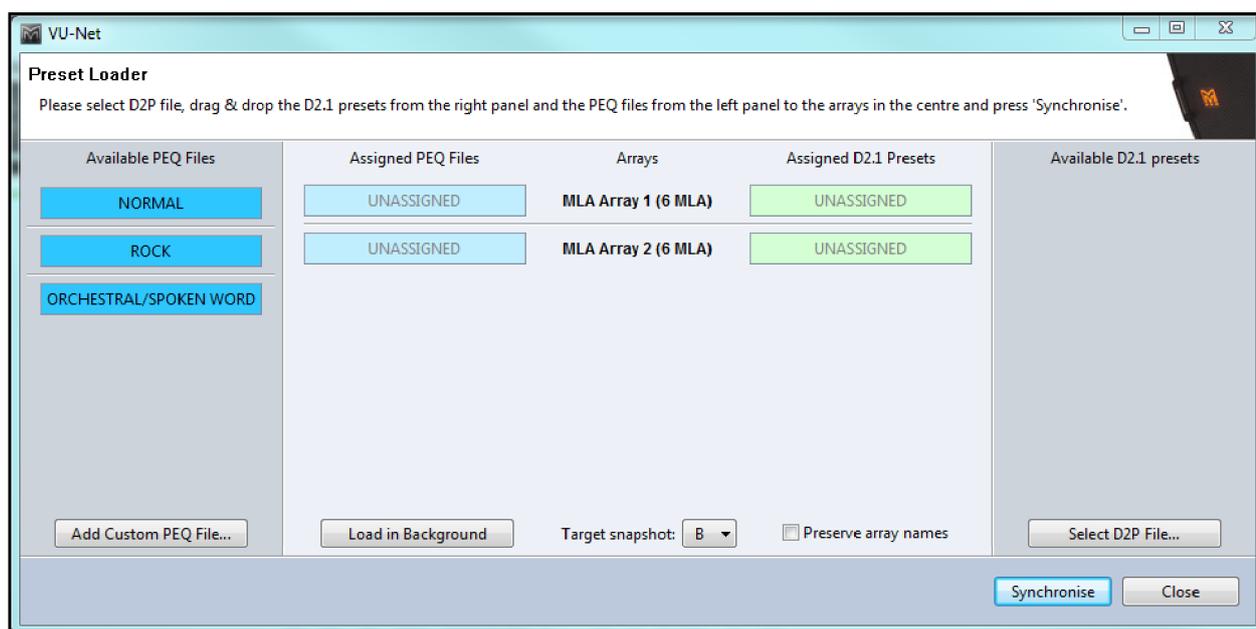
If you wish to clear all cross device ganging you can click the input or output Clear button as for all other types of ganging.

### Loading Presets

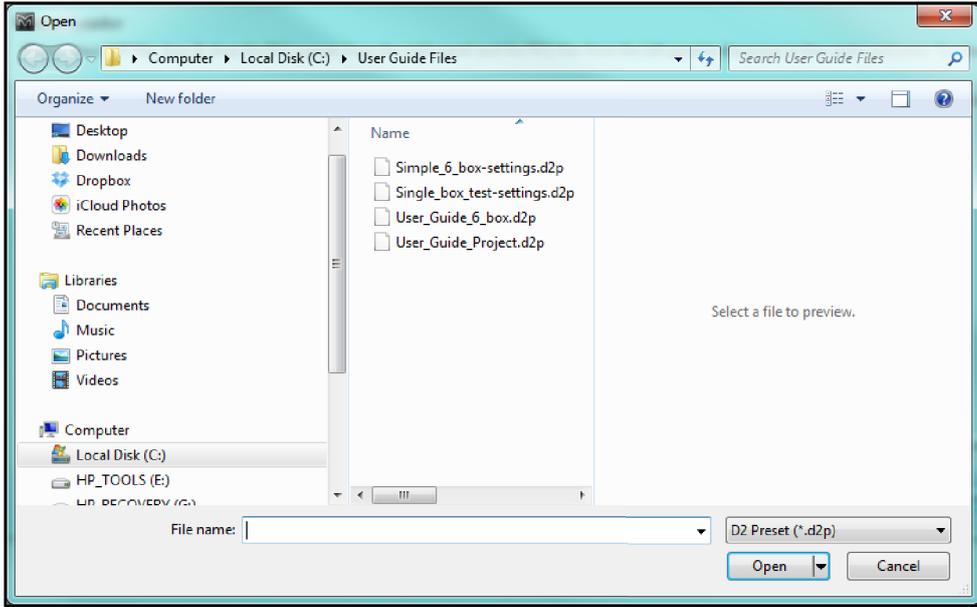
Once an array has been discovered and tested, the next stage is to upload the optimisation file that has been created using Display 2.1 or Display2 Mini. This is done using the Preset Loader which is found in the Tools menu;-



This brings up the Preset Loader window. In this example we have a small MLA system with two 6 box arrays;-

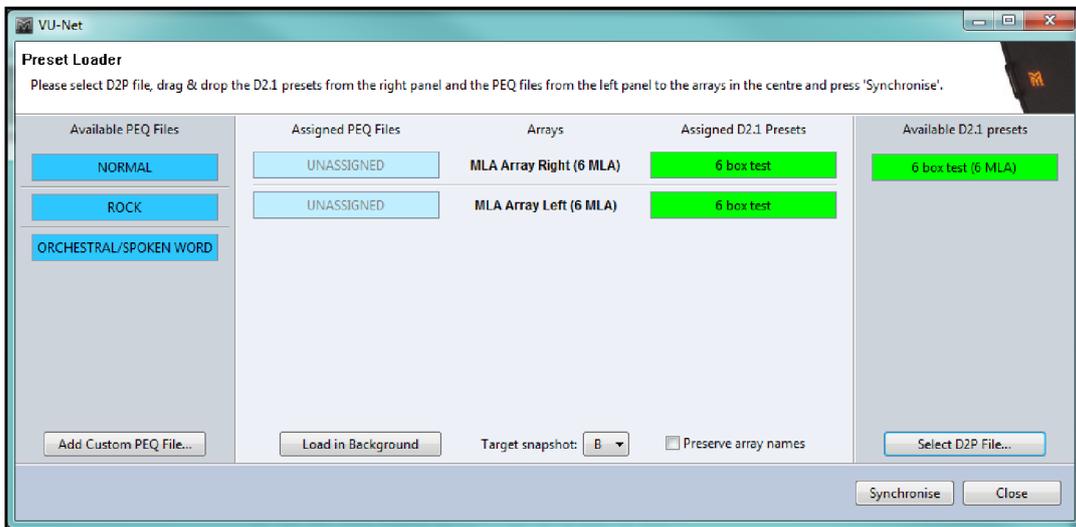


There are a number of options available but particularly when loading the first preset into an array the first step should always be to click on 'Select D2P File' to navigate to wherever you have saved the D2P file saved when you did your Display 2.1 optimisation (See Display Chapter for details);-



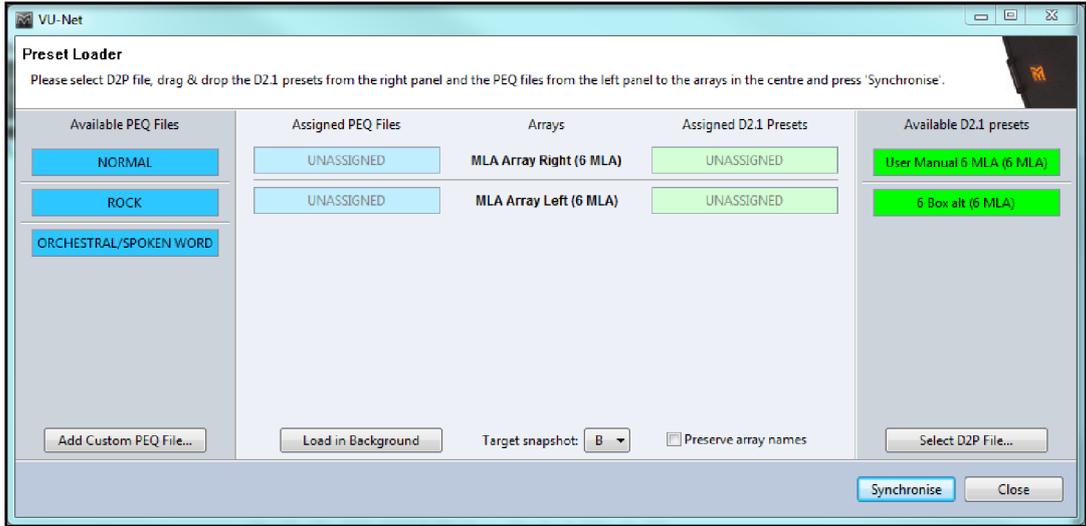
**It is essential that you select a d2p file which matches the array configuration size and type that matches the array to which you wish to upload optimisations. You cannot load a non-matching d2p file!**

There are a couple of possible outcomes when you have selected a d2p file. If you have only created one optimisation for your project it will be automatically placed in the array thumbnails ready for synchronisation. In the above list of d2p files, "Simple 6 box setting" is an example of this. Note that the optimisation will always specify the type of cabinet, in this case MLA. You will be able to select any d2p file but will not be able to synchronise a file created for the wrong type of cabinet. The Window will appear like this;-

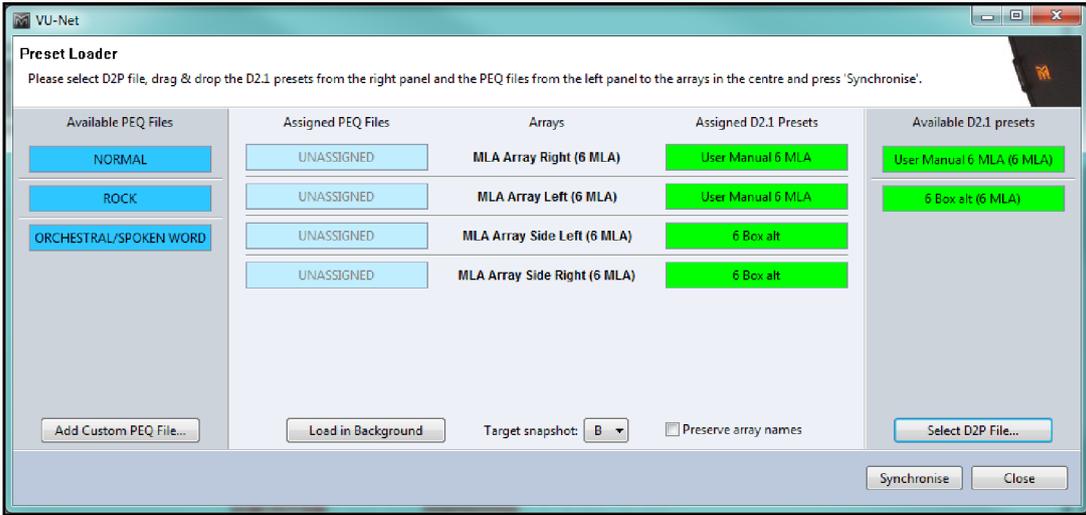


You can see that the optimisation contained within the file called "6 box test" appears in the Available D2.1 presets list on the right. It is also already showing in the Assigned D2.1 Presets for both of the left and right arrays in our system.

If we created several optimisation for the array, trying a few different goals for example which was done in the file "User Guide 6 Box" in our examples, this is how the window will appear;-



This example has two optimisations contained within the file, “User Manual 6 MLA” and “6 Box alt”. At this point you are able to select which file you would like to use by simply clicking and holding with the left mouse button and dragging and dropping from the available list onto the Assigned Presets boxes. Note that you do not necessarily have to load the same optimisation into each array. In the following example, we now have side hangs also of six cabinets, our d2p file is the same as the previous example and contains two optimisations. We have dragged “User Manual 6 MLA” over to the Main left and right arrays, and “6 Box alt” over to the side hangs;-



**PEQ files**

On the left side of the Window you can see three available PEQ files, Normal, Rock, and Orchestra/Spoken Word. Note that the available list of PEQ files may change depending on the product, MLA Mini for example only has a ‘Normal’ PEQ available. These may also be dragged over to the Assigned PEQ file position;-



Available PEQ Files	Assigned PEQ Files
NORMAL	UNASSIGNED
ROCK	UNASSIGNED
ORCHESTRAL/SPOKEN WORD	UNASSIGNED
	UNASSIGNED

It is important to do this not only to add some tonal EQ to the system but the PEQ synchronisation also performs a reset function on certain parameters in the array. It matches the input setting for every cabinet in the array to the first enclosure and resets the array delay to the default setting. Here we have applied the Rock PEQ to all arrays;-

Available PEQ Files	Assigned PEQ Files
NORMAL	ROCK
ROCK	ROCK
ORCHESTRAL/SPOKEN WORD	ROCK
	ROCK

There is also the option to load a Custom PEQ file;-

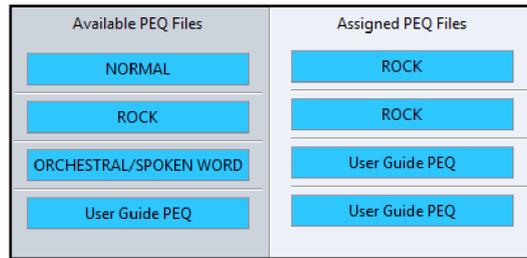


A PEQ file that has been created in an array can be saved as a file by right-clicking on the array in the System Diagram window. To up-load the file at the same time as synchronising Optimisations, click on the 'Add Custom PEQ File...' button and navigate to the file location where the .mlap PEQ file is saved. Click on the file and it will appear in the list of available PEQ files and can be dragged across in the same way as any other;

Available PEQ Files	Assigned PEQ Files
NORMAL	User Guide PEQ
ROCK	User Guide PEQ
ORCHESTRAL/SPOKEN WORD	User Guide PEQ
User Guide PEQ	User Guide PEQ

It is important to understand that a Custom PEQ will NOT perform the same system reset as one of the factory PEQ's so we would always recommend using a Factory PEQ for your first Sync and then add your own PEQ if you load any subsequent new Optimisations or use the right-click 'PEQ- Load PEQ' function in the array thumbnail on the System Diagram Window.

Note that you do not have to have the same PEQ applied to every array and if you wish to change the file prior to Synchronisation just drag the new file over to the array and it will replace the existing file type;-



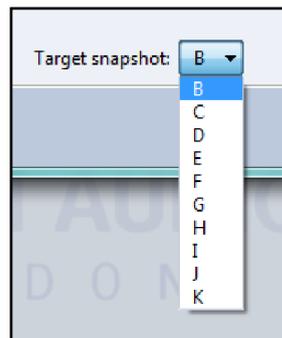
### Other options

There are some other options available in the Preset Loader. From right to left you will find 'Preserve array names';-



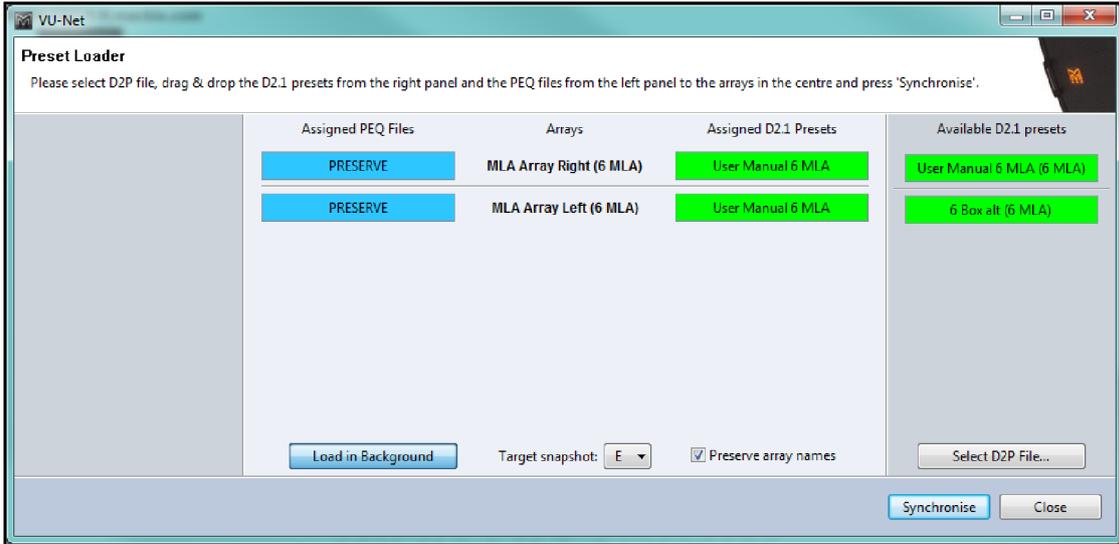
If you have already named your arrays check with box prior to synchronisation. Without it the arrays will be renamed with the same name as the D2.1 optimisation.

Target snapshot allows you to select the cabinet snapshot into which an optimisation will be loaded;-



There are ten available labelled from B to K. A is the default factory preset with basic box EQ which may be used whilst checking a system or in an emergency, all other are available for your optimisations and once uploaded can be selected in a few seconds. Select the desired location using the drop down button.

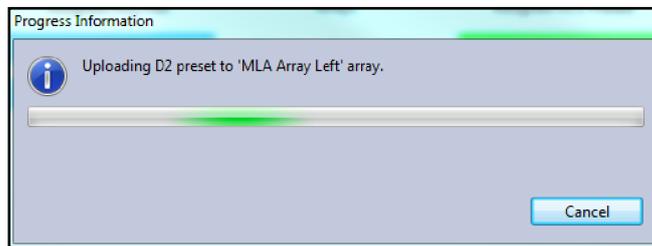
Load in Background is very useful for uploading new optimisations after your first files have been synchronised. Clicking on the Load in Background button removes the PEQ options and the window appears as follows;-



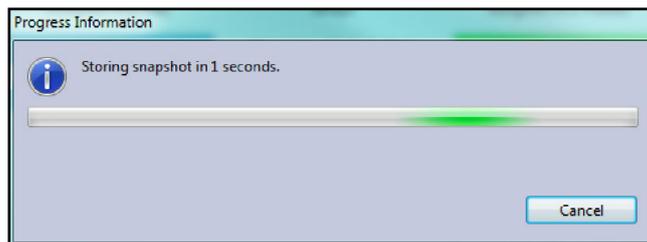
The PEQ already uploaded will be preserved and if you select an alternative snapshot to the one currently being used you can even synchronise while the system is in use. It will synchronise in the background as the name suggests without disturbing system performance and you can then wait for an appropriate break in a show or rehearsal to select the new snapshot.

### Synchronise

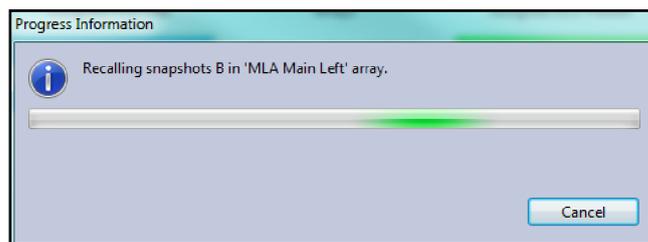
Once you have completed your selection of the available options, the final step is to click on the Synchronise button to start the Preset upload. You will see a series of Windows that show the process of the upload including the following:-



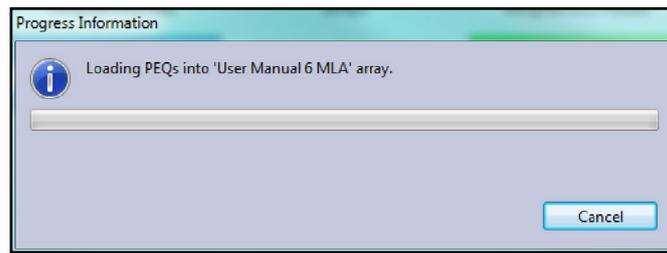
The presets are loaded to each array in turn, in our example first the left array. The optimisation is then stored in a snapshot:-



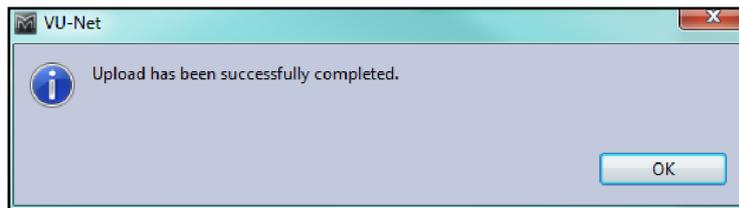
The snapshot will be recalled:-



The PEQ's will be loaded. This step will not take place if you selected 'Load in Background';-



It will repeat these steps for all arrays on the network. Once finished you will see this window;-



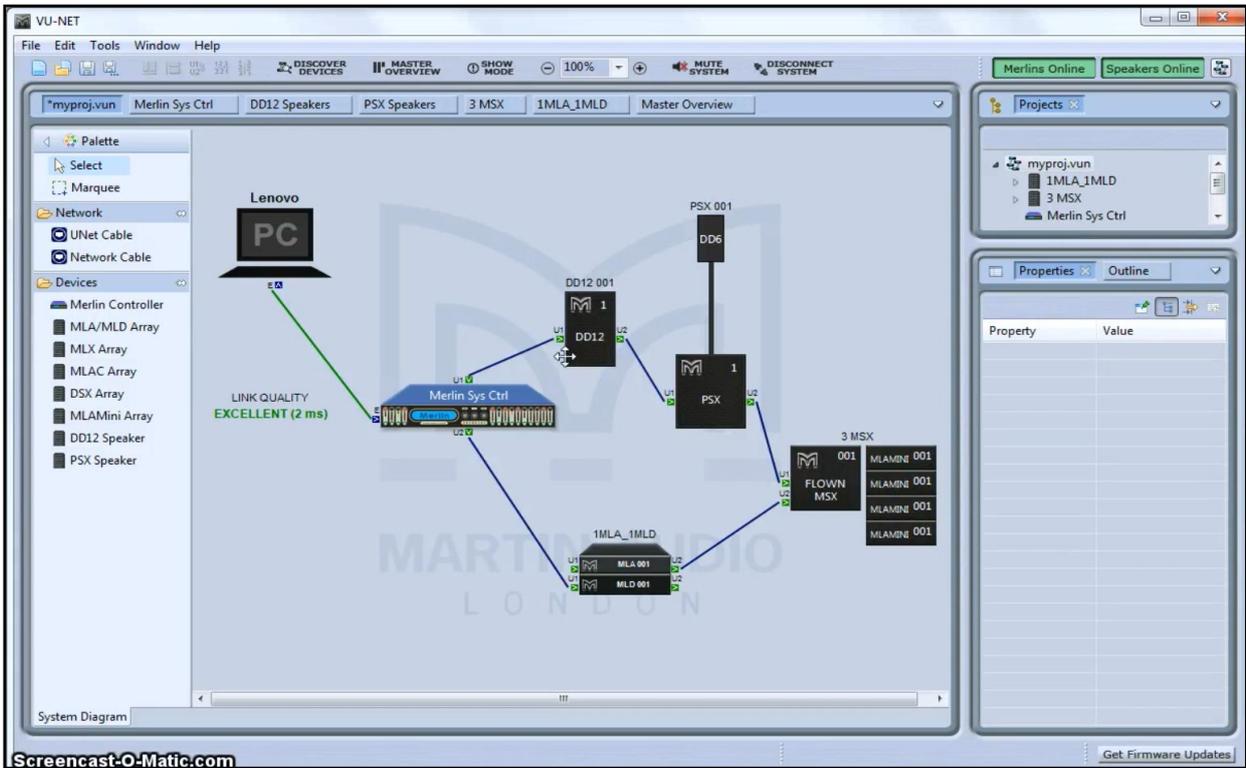
You can then close the Preset Loader. It can be re-used whenever you wish to upload new optimisations.



### Master Overview

Vu-Net features a Master Overview window intended for use following set-up when it is useful to view the entire system on a single page with the ability to monitor all levels and make changes to essential functions.

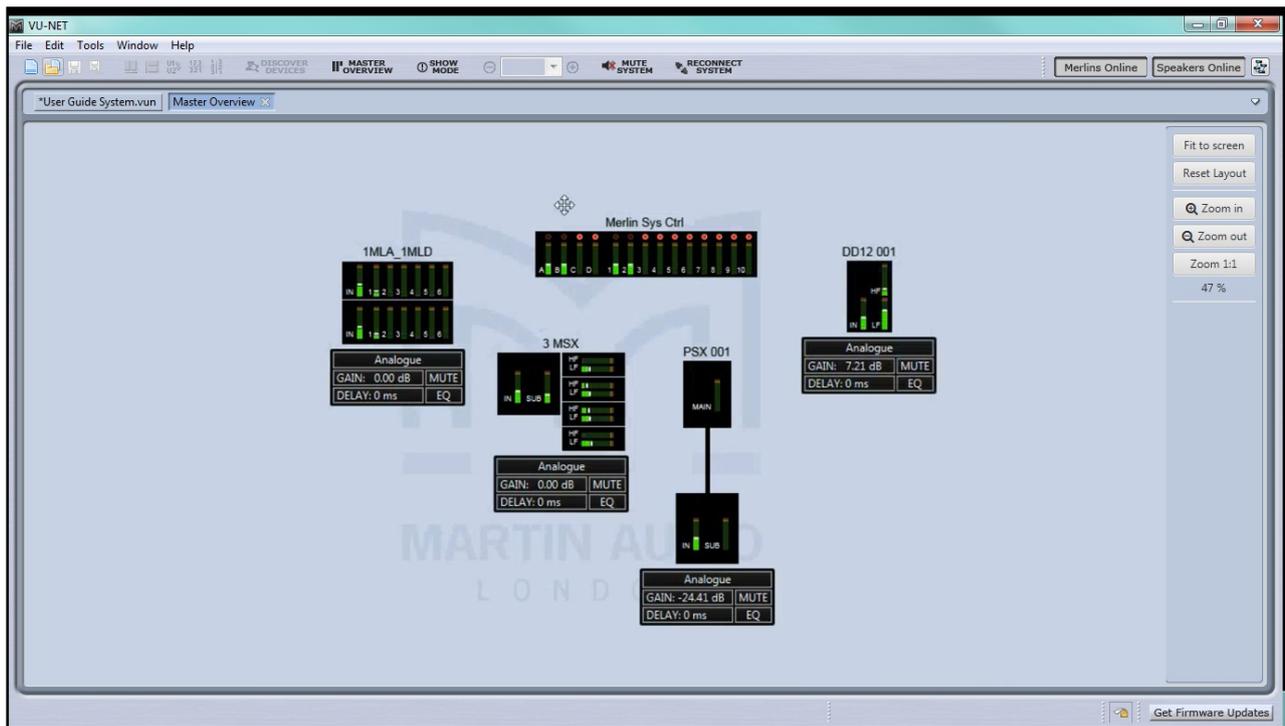
Here we see a project with a variety of U-Net enabled devices connected including an array of one MLA and an MLD, a flown MLA Mini system, a PSX, DDD12 and a Merlin;-



If we click on the Master Overview button;-



A new tab is opened with a window showing all devices in operation;-



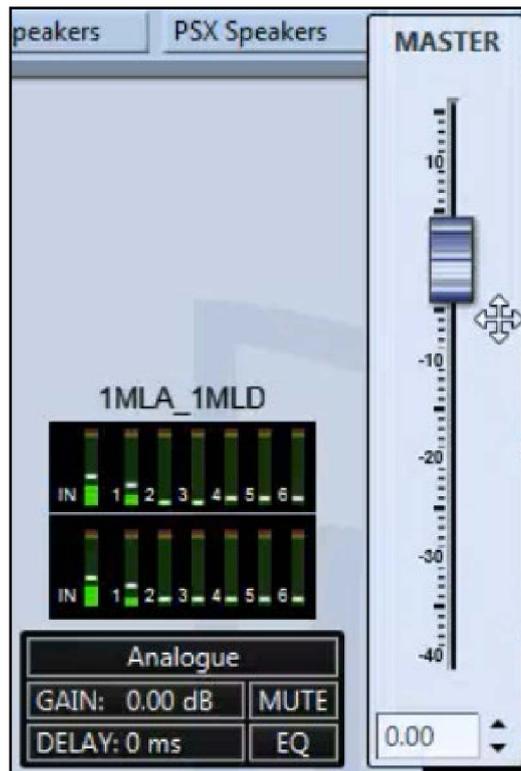
The MLA array shows the input bargraph plus all Cell output bargraphs for all cabinets in the array, all other arrays and speakers show input and output levels and all Merlins display input and output meters. All bargraphs are updated in real time which makes monitoring an entire system very easy from a single page.

In addition to monitoring the meter response, essential features are accessible. The function control is the same for all Array and speaker types;-



The top line shows the input configuration for the array, if this needs to be changed clicking on the top line takes you to the array input overview screen where you can change the input configuration. If the array isn't already open it will be opened by clicking on this button.

On the second row is GAIN. Gain adjustments can be made by clicking on this button. A pop out fader appears which can be adjusted in real time, either by dragging and dropping the fader knob until the desired gain value is displayed,



Using the up/down arrows to adjust the gain up or down in 0.1dB increments;-

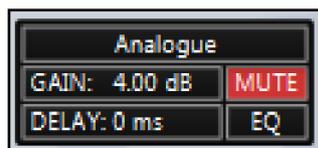


Or by directly typing the gain figure you need;-



A click anywhere in the Master Overview Window away from the gain control will close it once you have made any necessary adjustments.

Next to the gain is Mute, clicking on this will mute the array and the button will turn red;-



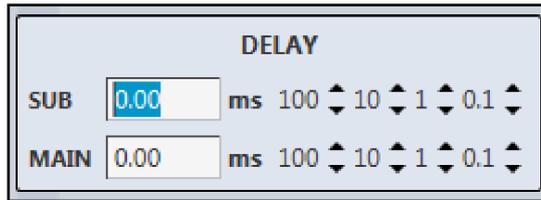
Note that when in Show Mode a pop-out Window will appear to confirm that you want to mute the array.

Clicking on Delay opens a pop-out window showing the gain figure with a series of arrows for adjustment;-



Clicking on the arrows will adjust the delay up or down by either 100's, 10s, individual or tenths of a millisecond making it very quick and easy to enter a precise figure. As with gain, clicking anywhere else once you have completed adjustments will close the window.

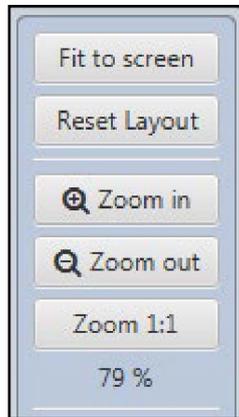
The Window for PSX is slightly different in that it has individual delay adjustment for both the sub and main outputs;-



The EQ button will take you directly to the EQ Window for the array, opening it in a new tab if it is not already present.

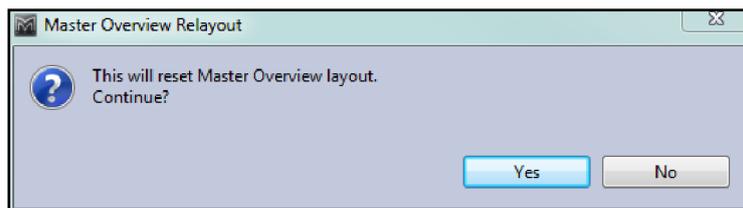
Double clicking on Merlin will also open it in a new tab, the tab on view will be the last tab that was in use if the Merlin has already been opened, or the Gain/Mute/Limiters tab if it is not already open.

The layout of the Master Overview screen will by default show the arrays in size order. This will automatically re-size to ensure that all elements fit in the window. Elements can be dragged and dropped to arrange the system to match the physical layout of the system as in the Array Overview window. A series of buttons and a display on the right hand side of the window allow adjustment of the view and shows the current zoom;-



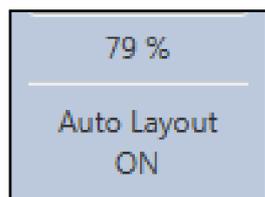
'Fit to screen' offers a quick method of re-sizing the window to ensure that all elements are visible.

'Reset Layout' will return all elements to the default positions in size order. You will see a prompt to confirm this action;-





Clicking 'Yes' or pressing Return will reset the layout to the default and the display will confirm the new zoom and that Automatic layout has been activated;-

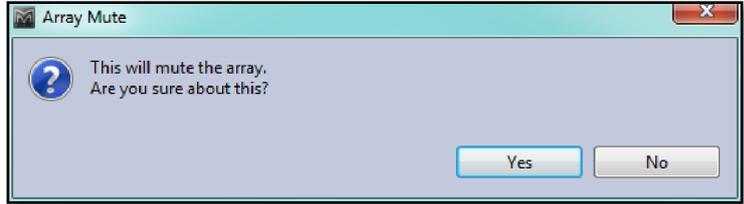


As soon as you move any elements or zoom in or out the Auto Layout will disappear.

The Zoom in and out buttons will change the zoom in steps of 10% up or down. This can also be achieved if you have a mouse connected with a scroll wheel. Zoom 1:1 restores the window to 100% regardless of whether any elements will be outside of the view.

### Show Mode

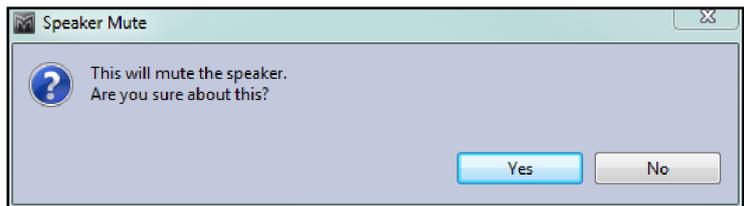
Show mode is designed to offer a degree of protection once set-up is complete and a show has started to prevent the user from muting part of the system accidentally. With Show Mode inactive during set-up, all mutes can be used as and when required with a simple mouse click; the array will mute and unmute instantly under command of the button. When Show Mode is activated, clicking a Mute button anywhere in the system will bring up a confirmation window;-



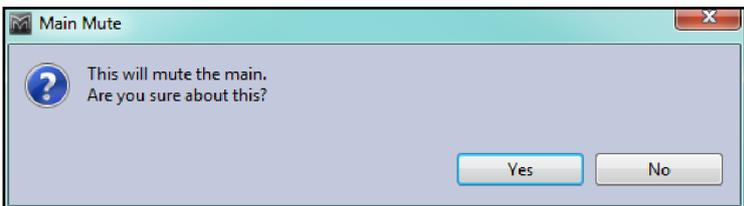
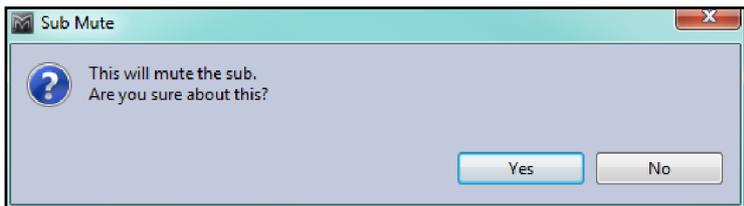
The window is slightly different for a zone mute;-



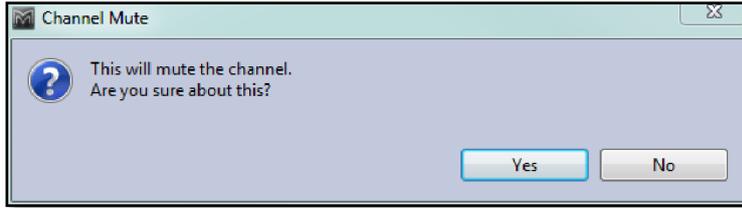
For a DD12;-



The Sub and main Mutes for the PSX have different mute messages;-

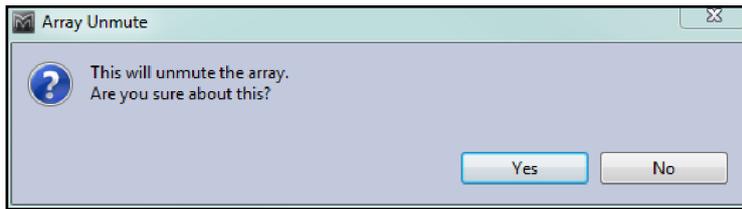


And finally the input and output channels on a Merlin;-



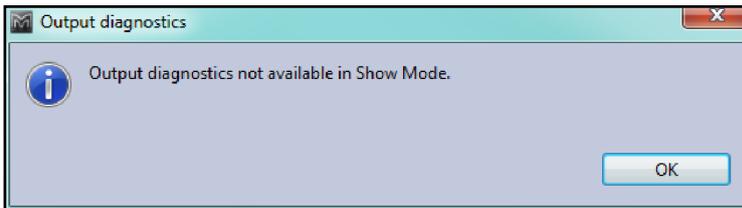
If you definitely want to mute the array, zone or speaker, click 'Yes' or press Return. If you accidentally clicked on a Mute, click 'No' and the window will disappear with no change to the mute state.

Un-muting part of the system could also potentially be destructive so a similar message will prompt you to confirm the action;-

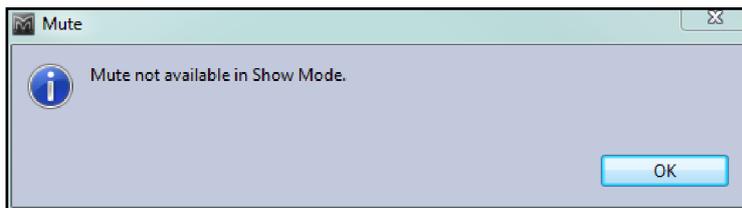


Note that the Master system Mute on the toolbar is not affected by Show Mode, as it is so destructive it always produces a prompt to verify that you wish to proceed.

The Output diagnostics for MLAS, MLA Compact or MLA Mini is also unavailable in Show Mode. Double clicking on the array thumbnail will bring up the following window;-



If an array has the diagnostics window already open before activating Show Mode, the Mute Array button and individual cell mutes for each cabinet will be unavailable, you will see the following window if you click on any of these;-



You will however be able to click on the 'Hide' button to close the diagnostics screen and any muted cells will be un-muted. You will not be able to go back to the diagnostics page until Show mode is switched off.



### Module Replacement

As it is not a perfect world there may occasionally be failures in the amplifier modules of systems which will require a complete swap-out of the module. This is perfectly straightforward back in a workshop but if it has to be done at an event or in an installed system it will be necessary to restore the settings that had been uploaded to the module being replaced. This chapter deals with each step in detail to make sure that this is accomplished successfully.

#### Replace the module

The module needs to be disconnected and removed from the cabinet. This is a straightforward process even with a cabinet deployed in a flown array as long as you can access the rear of the cabinet safely. See the specific section in the MLA and MLA Compact chapters for more details.

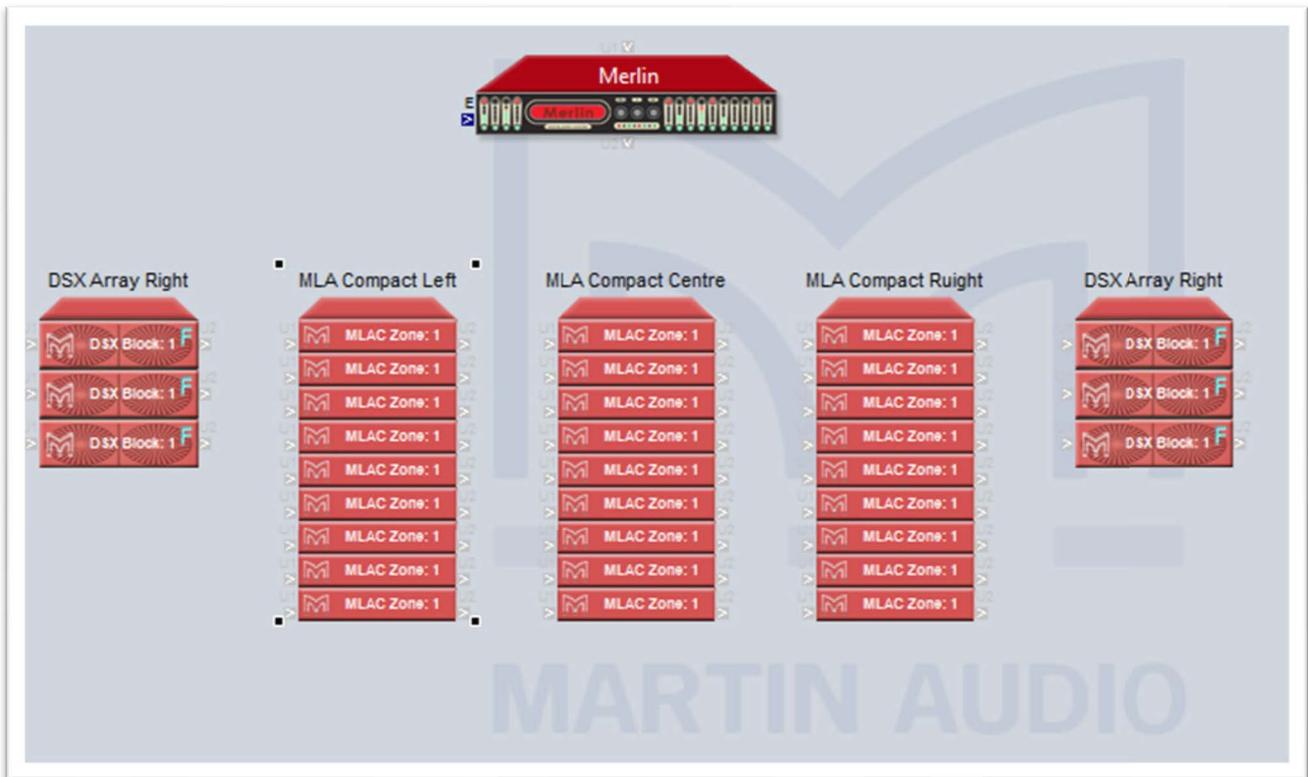
#### Reconnect the module

Reconnect all connections, ensure that the module powers up, the fan will briefly run at full speed and the red power LED will light. Connect U-Net cables to the two ports and ensure that both U-Net LEDs light green. Connect audio input and if required output connections.

#### Discover the array

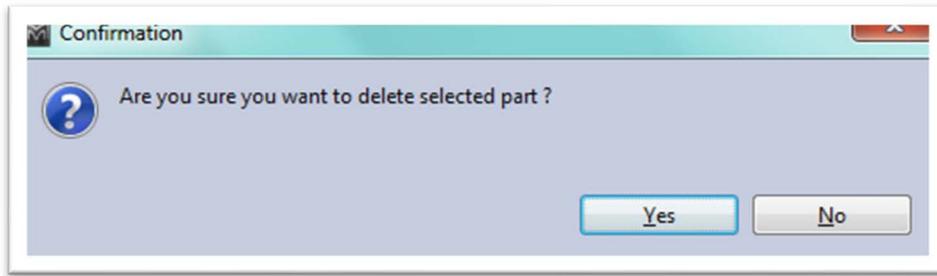
The cabinet can be discovered by using the Device Discovery button in Vu-Net however it will be found as an individual cabinet, essentially a single box array but in most cases it will be part of an array so the entire array will need to be re-discovered.

First select the array in which the module has been replaced by click and dragging around it so all cabinets are selected;-



Note that all cabinets are shown red as for the purposes of this guide the project is off line.

Now press delete, you will see the following Window;-

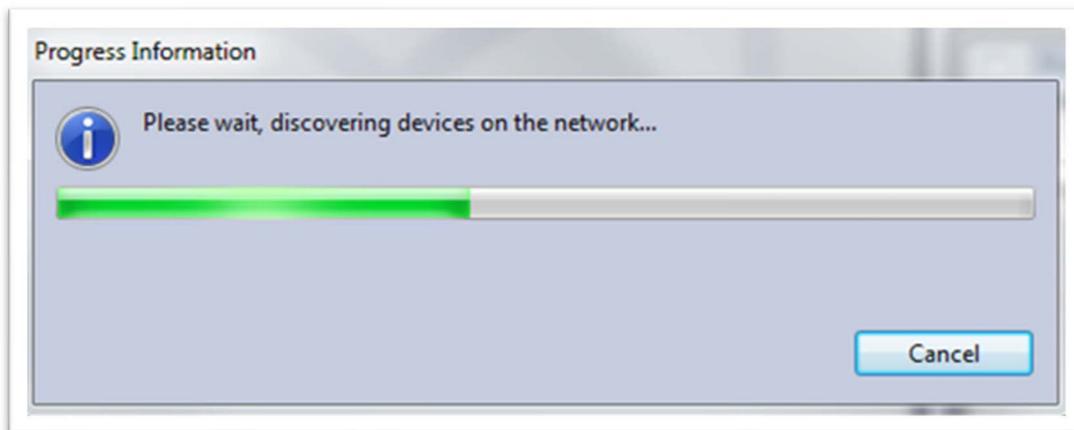


Click 'Yes' or press Return and the array will be deleted.

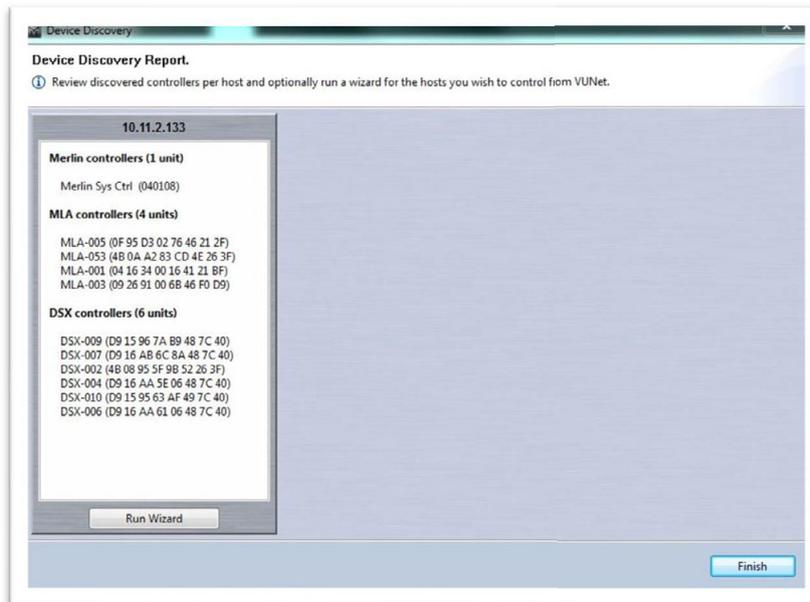
Click on the Device Discovery Button;-



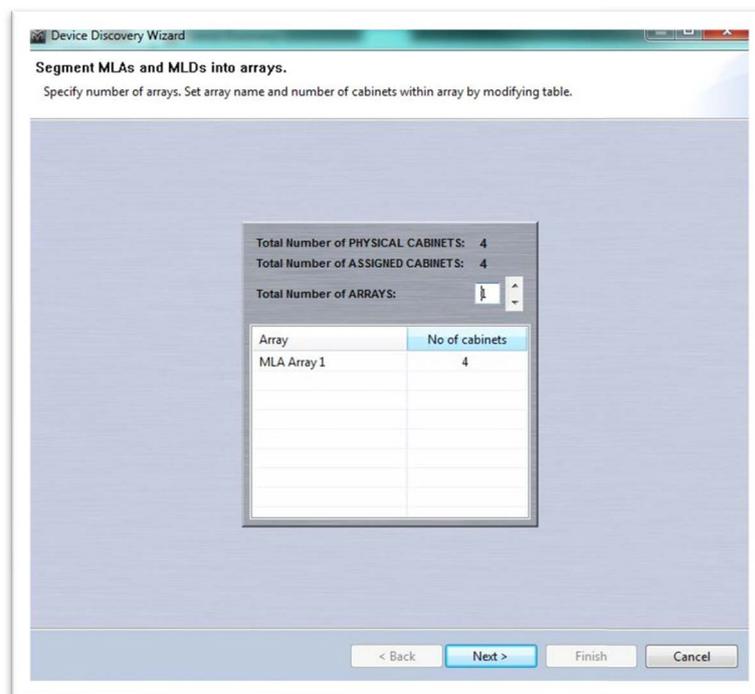
You will see the following Window;-



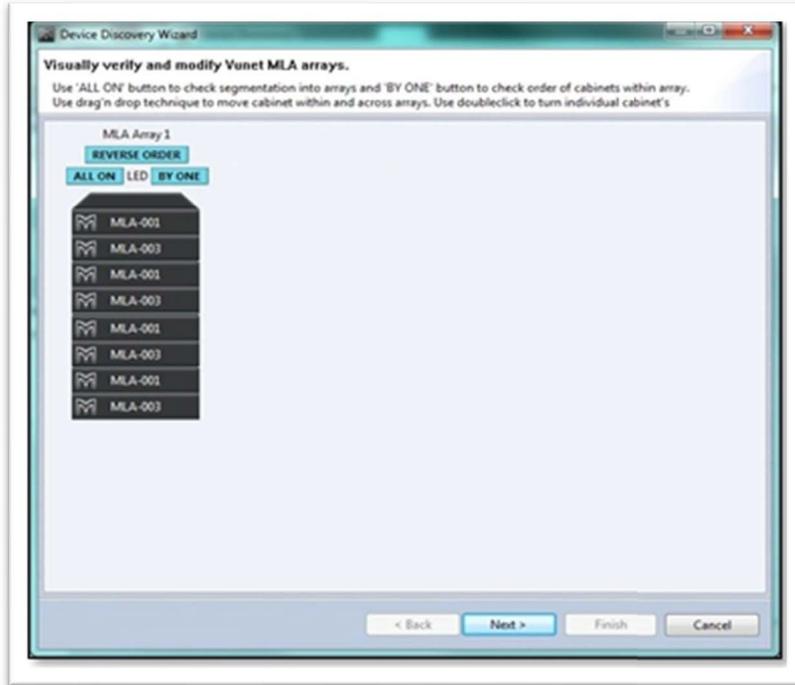
When this is finished you will see the Device Discovery report, in this example there is a mixture of speakers, if you are just discovering a single array you will just see a list of all cabinets in the array and nothing else, other cabinets already established in the project will be ignored;-



Click on 'Run Wizard' and you will be able to configure the cabinets into the appropriate arrays;-

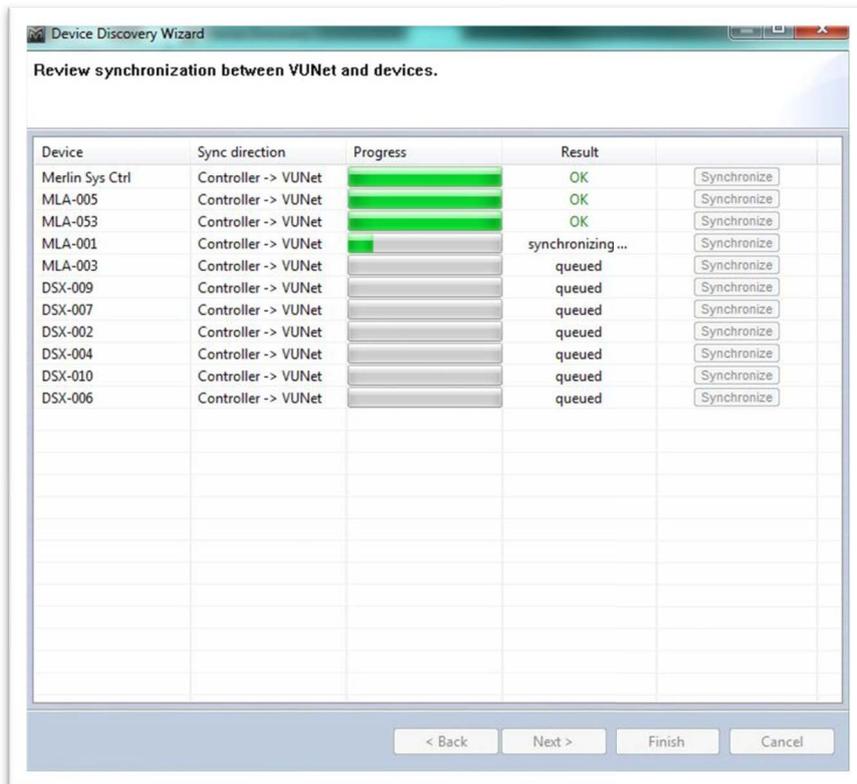


If you are discovering a single array make sure that the number in 'Total Number of ARRAYS' is set to 1 then click 'Next' or press Return

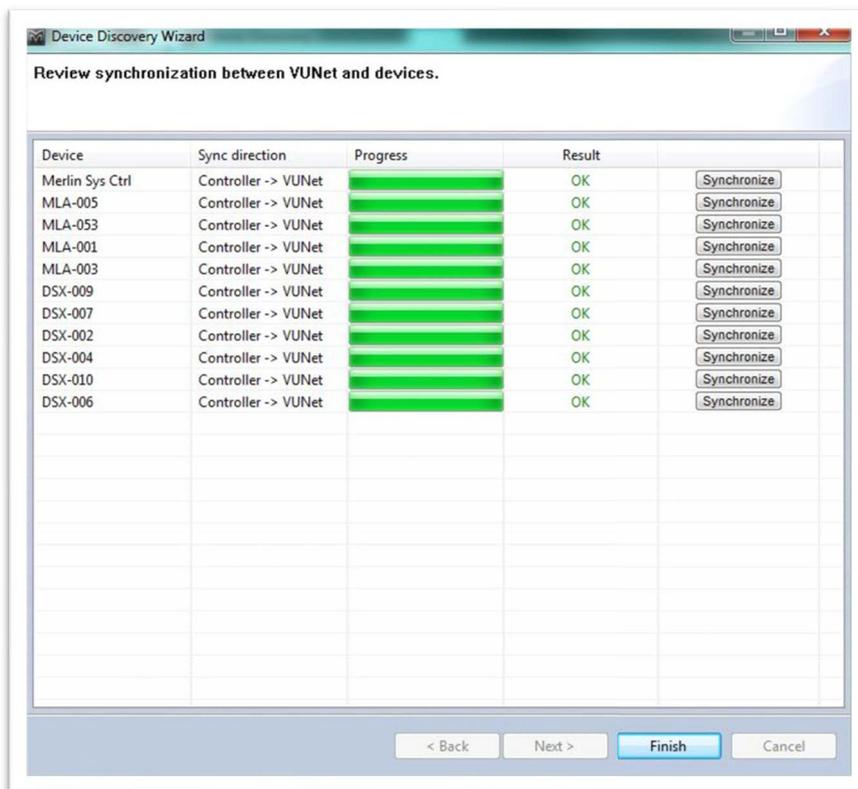


You will see the array and can check the orientation by clicking on the LED 'BY ONE' button. All being well the LEDs should flash sequentially starting with the top cabinet running down to the bottom and repeating until you click on the button again to stop it. If the network cabling has been reversed at some stage so the LEDs are running bottom to top you need to click on 'REVERSE ORDER'. It is essentially that the system knows that the array is up the right way or optimisations will be loaded into the array upside down with horrendous results. You can also click on the "ALL ON" button to flash all cabinet LEDs in the array, this is guaranteed to irritate the lighting department who like to think that all lighting is under their control...

Once this is done click 'Next' or press Return and the cabinets will Synchronise;-



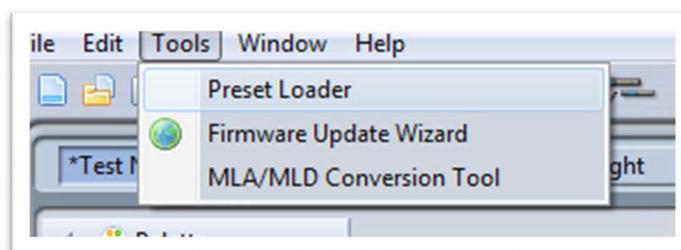
A complete successful synchronisation will appear like this:-



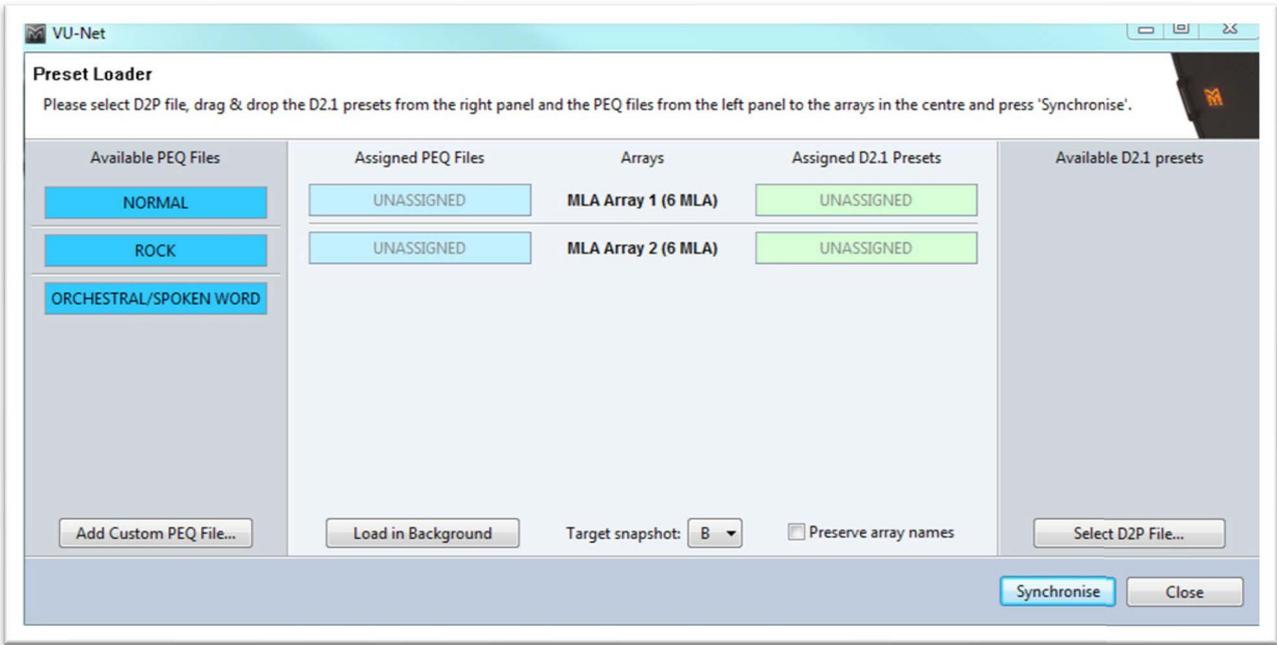
Click on 'Finish' or press Return, the array is now ready to have the Display 2.1 optimisations restored.

### Restore Optimisations

To upload the D2 optimisations click on the Tools menu and select 'Preset Loader';-

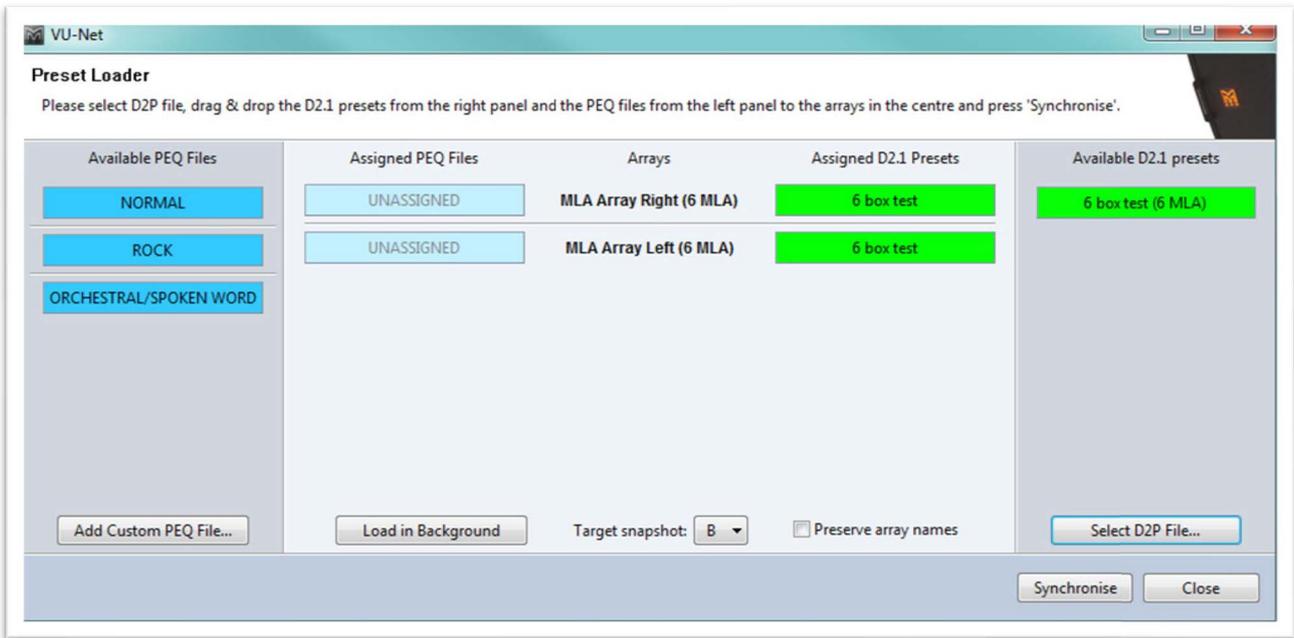


This will bring up the Preset Loader window showing all arrays on the network, in this example there are two MLA arrays on the network;-

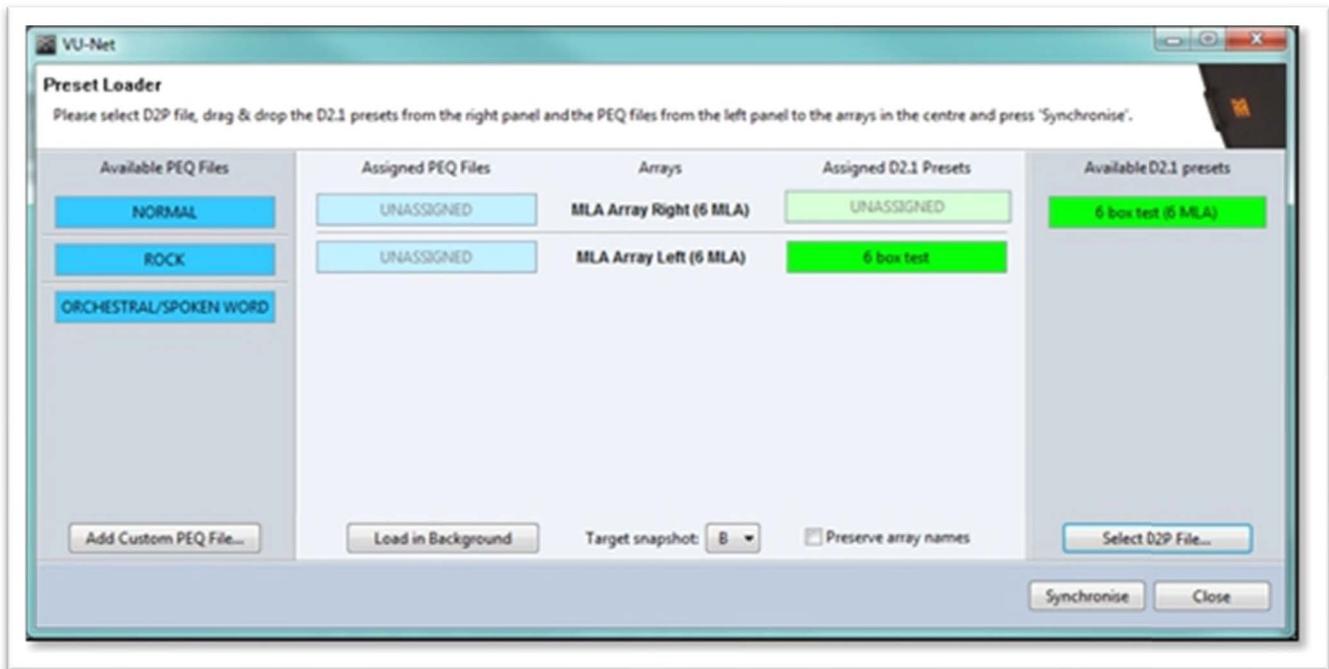


The first stage is to load the D2P file created for the project using Display 2.1. Click on the 'Select D2P File' button and navigate to the file location.

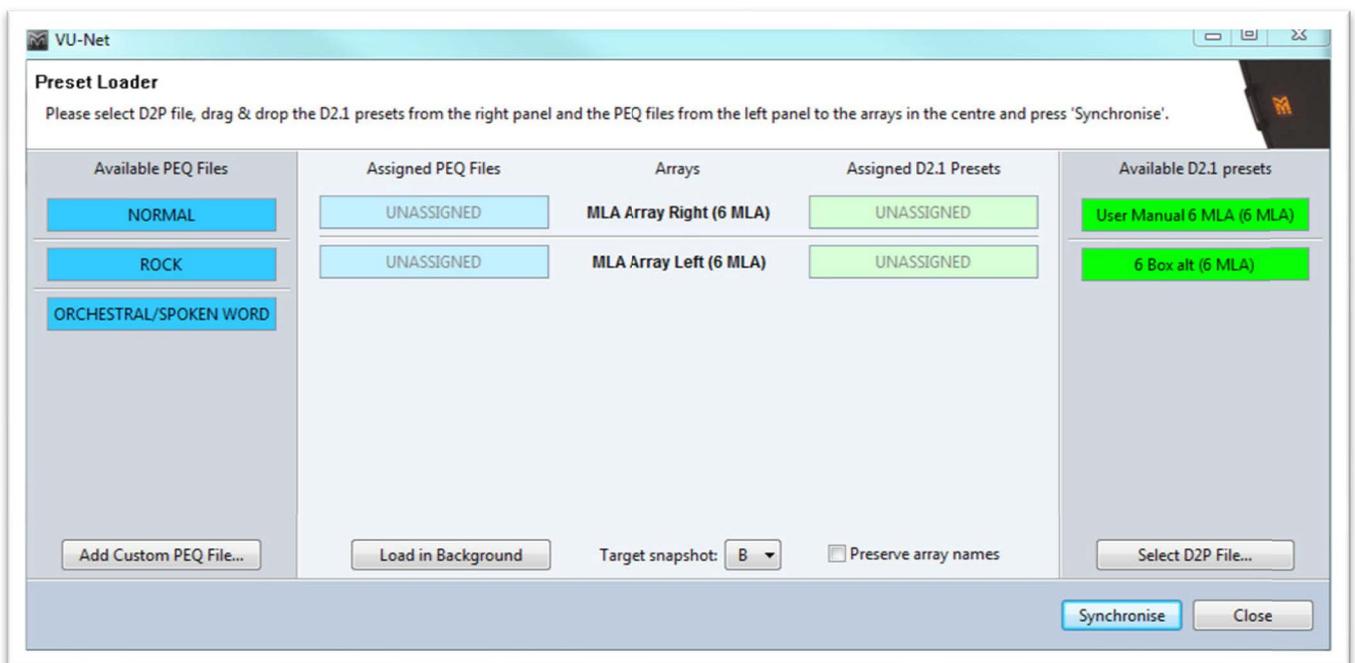
There are a couple of outcomes once the file has been loaded. If there is only one optimisation and all arrays are the same size the files will automatically be loaded into the arrays, the greyed out "Assigned D2.1 Presets" boxes will appear bright green showing that a Preset is assigned ready to be synchronised;-



As we may not want to disturb the arrays that are working perfectly well we may want to just upload the optimisation to the new array with the module we have replaced. In this case drag the optimised file out of the array back to the "Available D2.1 presets" position and you will have the following;-

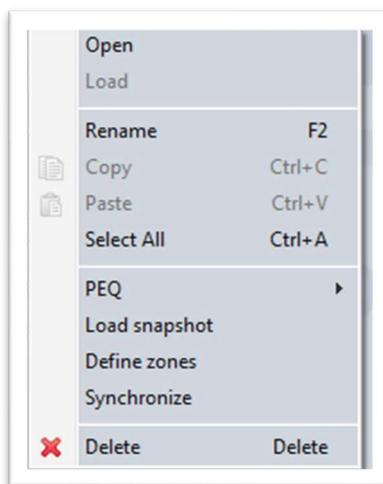


It may be that the D2.1 file has more than one optimisation, in which case the Window will appear like his;-

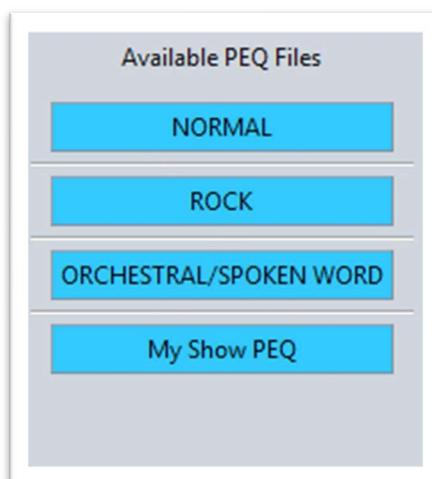


In this case, drag the relevant preset onto just the new array with the replaced module as the previous example.

There are just a couple of further steps before you Synchronise. First, if the system has not had any changes to the User PEQ you can select the 'Load in Background' option, however it is likely that the system will have had some EQ changes made and in this instance it is necessary to store the PEQ for the array which is done by returning to the main project page and right-clicking on the array in the project overview;-



Then select PEQ ▶ Export PEQ. The PEQ can be saved in a file location of your choice and then reloaded in Preset Loader by selecting the 'Add Custom PEQ File'. It will then appear together with the factory PEQ files;-

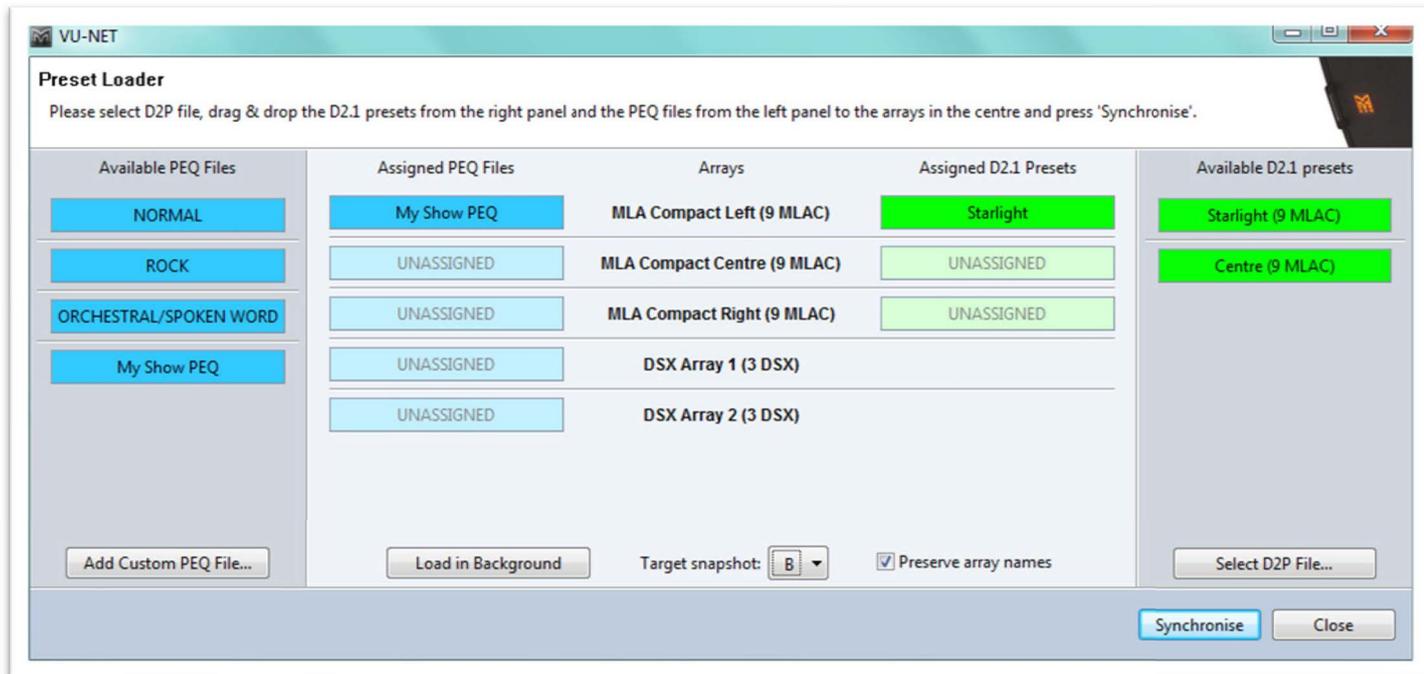


This can be dragged across to the array with the new module in the same way as the D2P preset.

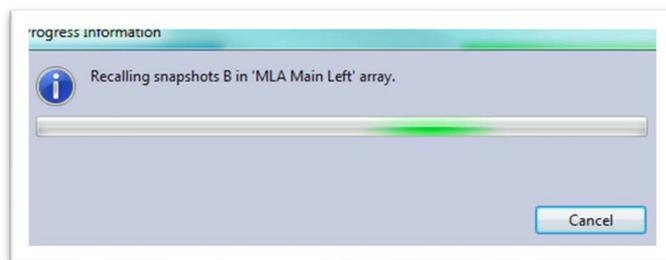
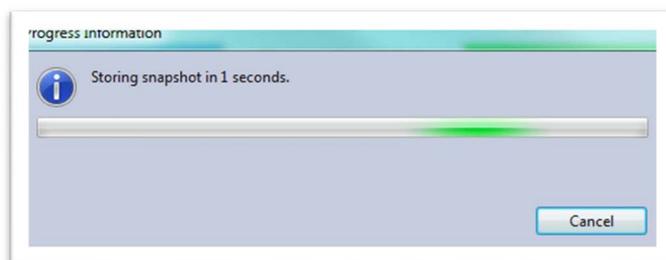
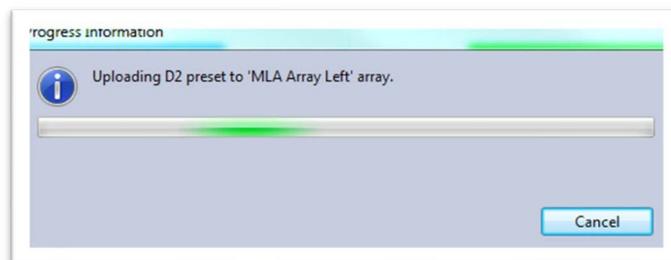
You can select which Snapshot the array is stored in using the drop down and finally click the 'Preserve array names' button;-

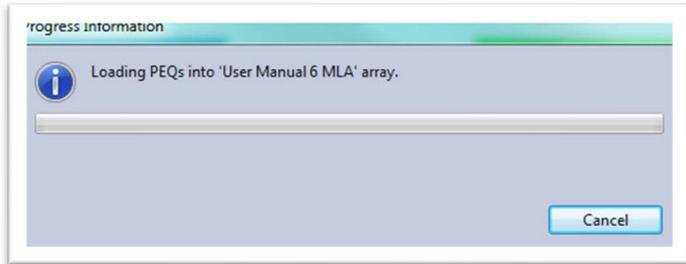


This will stop the Synchronisation overwriting the array name with the Preset name. The Window should look something like this;-

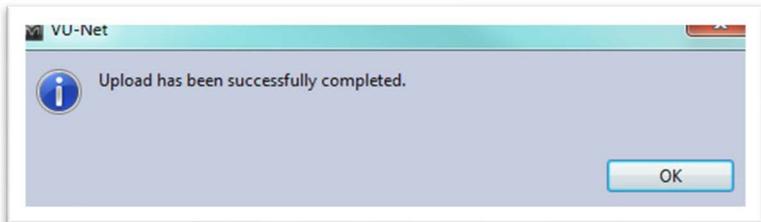


You can now click on 'Synchronise' and the synchronisation process will be displayed with a series of Windows;-





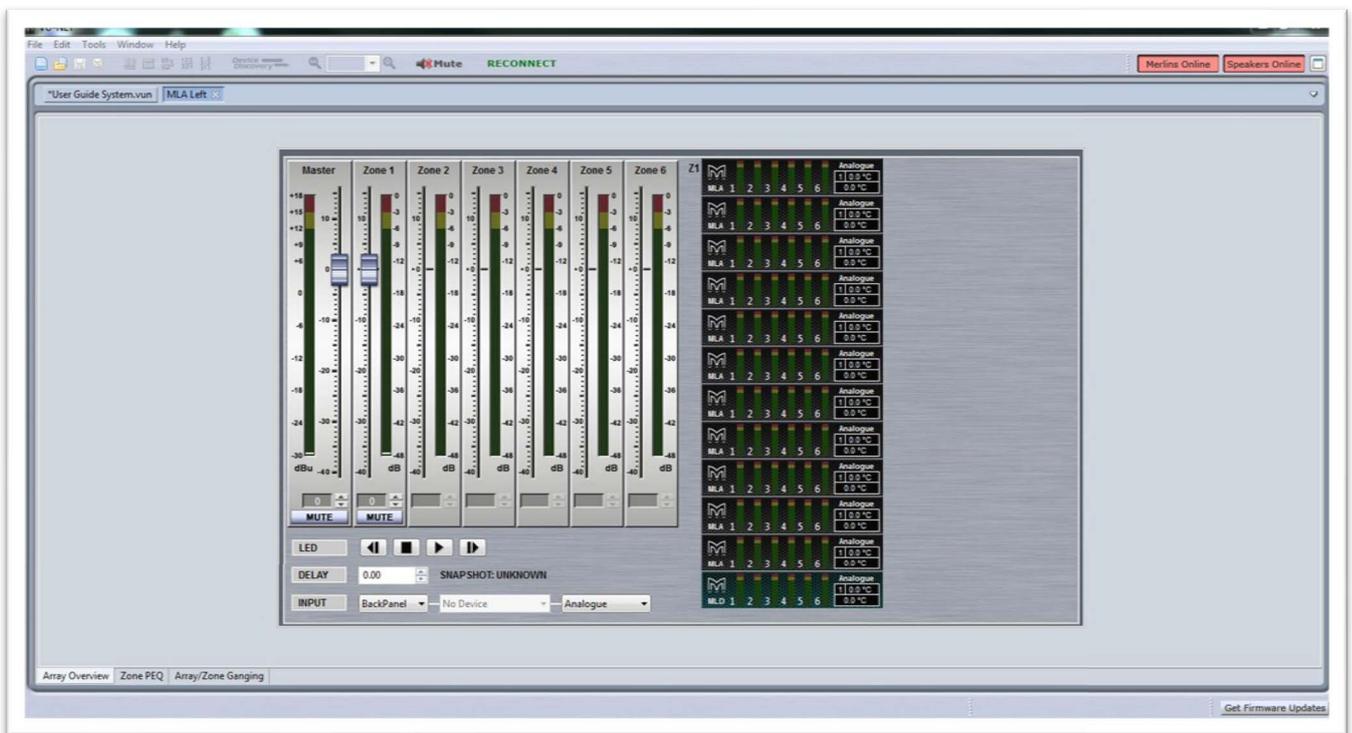
All being well you will see a confirmation message of a successful upload;-



You can close the Preset Loader window, the system is now ready to use.

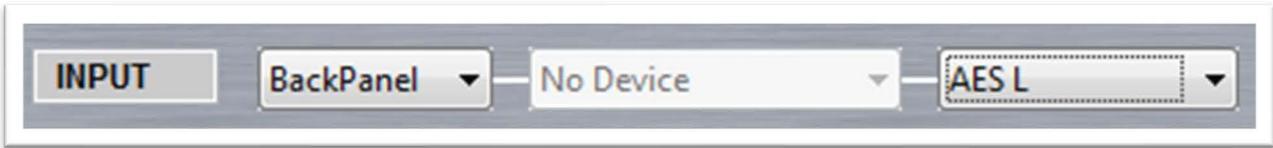
### Check Input Settings

There is just one final check to be made if your system has been switched to receive input from AES3 instead of the default of Analogue. When one of the factory PEQ's is loaded during the Preset Loading process, the inputs of all cabinets in the array are changed to match the first cabinet. This does not happen when a custom PEQ is loaded or if 'Load in Background' is selected. If therefore your array is using AES3 left or right for its input, the replacement module will still be set to Analogue. To rectify this, open the Array in Vu-Net by double clicking on it. You will see the array configuration in its own tab;-

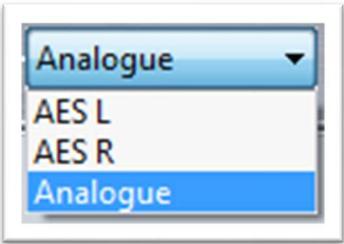




The array thumbnail will show the input settings for all cabinets so you will easily see if one is set differently to the rest. If you see the new cabinet still set to Analogue you need to toggle the setting for the entire array. The input selection is at the bottom of the window;-



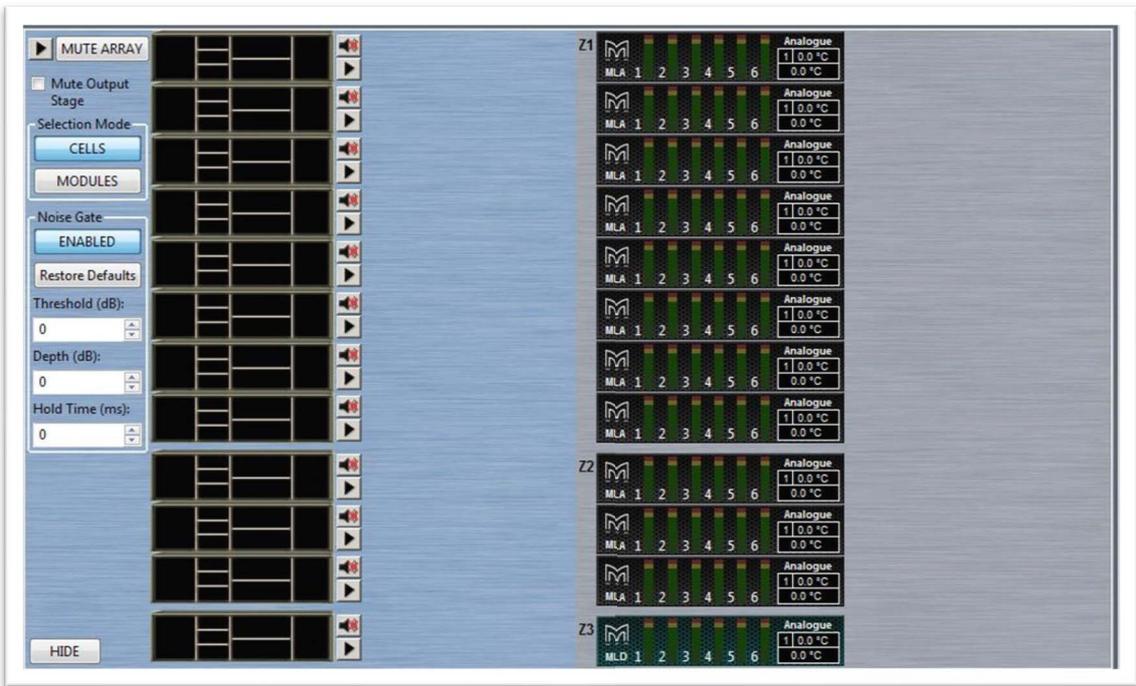
Click on the drop down on the right hand side to select the input mode. Select "Analogue"



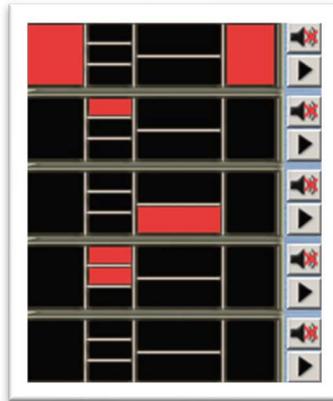
This will now mean that all cabinets in the array have the same setting. Now use the drop down again and re-select AES L or R as required. The entire array will now be set with the same input.

Test the Array

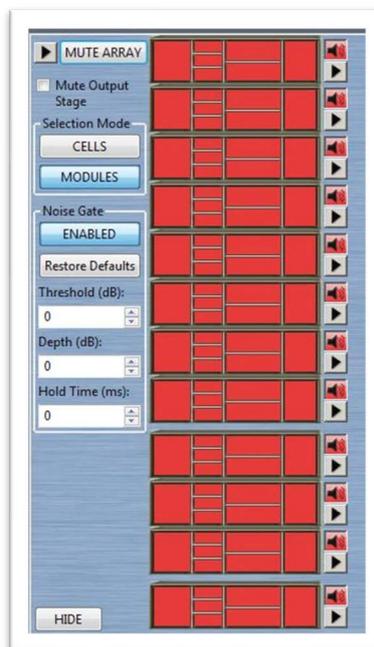
MLA and MLA Systems have a comprehensive test function available which is well worth using following a module replacement. Double click on the array in the Project overview then double click on the array thumbnail on the right hand side to access the output Window;-



This shows all cells in each cabinet individually and clicking on any of them will toggle between muted and un-muted. A muted cell will turn red.



Using the button at the top of the window you can mute the entire array;-

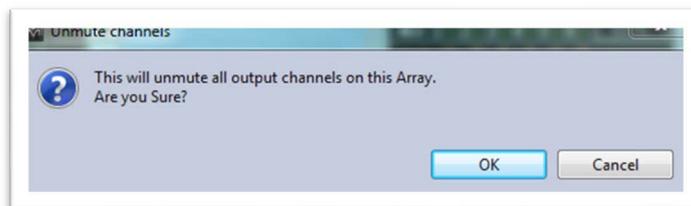


Apply a signal such as Pink Noise to the array and either click on each cell in turn to un-mute it to check for output, or use the "Play" arrow;-



This will sequence through all cells in a cabinet un-muting them one at a time so you can quickly and easily hear that all are working correctly. Don't be surprised if cells sound quite noticeably different, this is due to the phase and eq optimisation which is how an MLA system works. It relies on the cells working together to achieve the desired results so auditioned individually they can sound very strange.

Once you have checked all cabinets, switch off the pink noise source and click on "Hide" to close the output page. This will automatically un-mute the array, a warning window will appear;-



If you haven't already switch off the pink noise source DO IT NOW! A sudden burst of an entire array reproducing pink noise is not a pleasant experience!

The system is now fully functional and ready to use.



## Firmware Updates

Martin Audio is constantly striving to make improvements to the MLA family of products. The phenomenal processing power available makes them extremely future proof so as Martin Audio improve the optimisation capabilities of Display2 or add additional functions to Vu-Net The MLA Series will seamlessly run the improvements. Occasionally an update to the cabinet Firmware is needed which is catered for in Vu-Net using the Firmware update Wizard.

If you have sub-rented additional cabinets you may find that your rental partner has not been quite so diligent in keeping their system firmware up to date and device discovery will show some cabinets with differing firmware versions. In this instance it is essential to update firmware on the mismatched cabinets, do not try to run a system with a mixture of firmware, it could cause compatibility

In common with many digital systems, a firmware update puts the product in a venerable state known as “boot mode”. It is vital that the firmware update is not interrupted by either a mains outage, cable disconnect or closing Vu-Net. Any of these could render the product unusable which may mean a return to Martin Audio for repair therefore you should take every possible precaution before commencing a firmware update. ALWAYS use a hard wired connection from your PC to the system, do not rely on Wi-Fi. Always use your PC with its mains PSU, do not rely on battery power. Try and ensure that your mains supply is reliable and is not likely to fail mid-update. Finally, the update process takes around 13 minutes per enclosure so on a large system is very time consuming. It is strongly recommended that firmware is checked when a system is prepped prior to a show back at your warehouse, it is not a task for set-up on a show day.

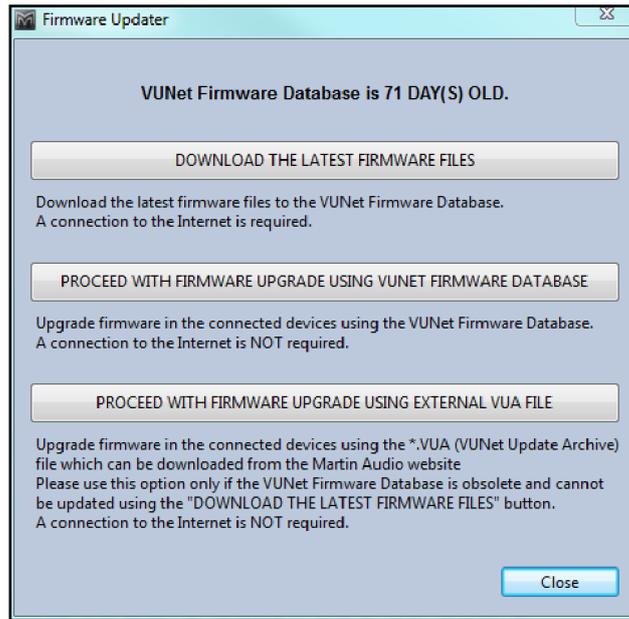
## Get Firmware Updates

To make sure that you are loading the latest updates Vu-Net includes a system for checking that you have the latest firmware files installed so they are available to upgrade your system. The files are held in a server at Martin Audio and are accessed over the internet so to get the latest files you will need internet connectivity to your PC. Note that you can get Firmware update files completely independently, you do not need to be connected to an MLA system, the simple method is to take the tablet PC supplied with your system to your office, connect to the web and check for updates. Note also that whenever new firmware is released you will be notified by e-mail.

The Get Firmware Updates button is in the bottom right corner of the Vu-Net window;-



Click on the button and the following Window gives you three options;-

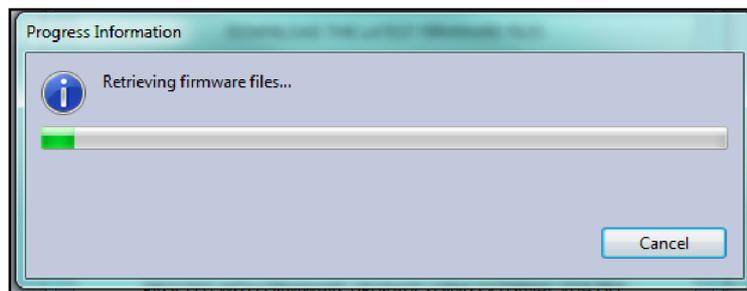


The first option as described accesses the firmware server via the internet. The URL for the Update file location is retained in the Vu-Net Preferences;-



Do not change this unless told to do so by Martin Audio!

Click on the 'DOWNLOAD THE LATEST FIRMWARE FILES' option and you will see the flowing window;-



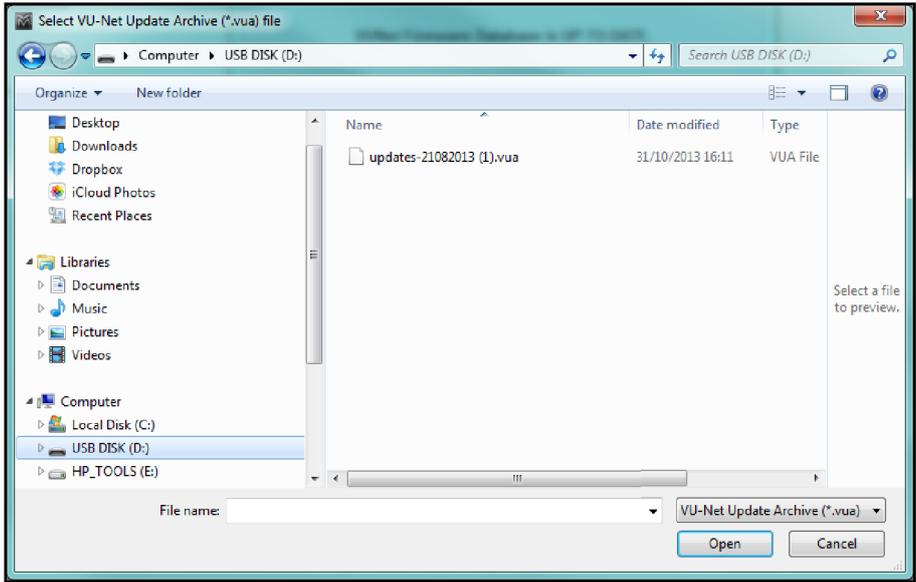
This is usually very rapid but depends on the speed of your internet connection. The latest files are now saved within Vu-Net ready for an upgrade.

The Second option is to proceed with the update using the already installed firmware files. This is perfectly acceptable if you have already uploaded the latest files following a message from Martin Audio that there is a new release, or if you have periodically gone on line to load the latest files routinely. Clicking the 'PROCEED WITH FIRMWARE UPGRADE USING VUNET FIRMWARE DATABASE' button and the window closes and the Firmware Update process starts.

The final option is to update the Firmware using an external VUA file. If for any reason you are unable to update the Firmware database via the internet if it is impractical to connect the Tablet PC for example, but have access to the web on another computer, it is possible to download the firmware file and transfer it to the system Tablet via a USB drive or similar.



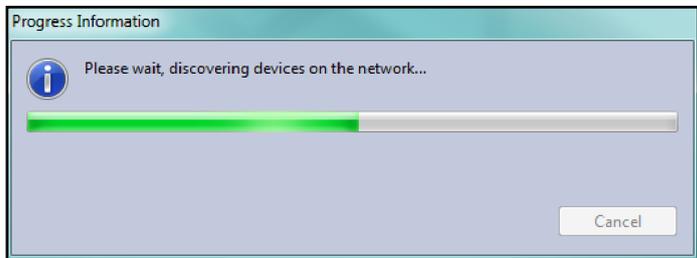
Clicking on the 'PROCEED WITH FIRMWARE UPGRADE USING EXTERNAL VUA FILE' button will bring up a file browser. Navigate to the drive where the VUA file is located, in this case on a Martin Audio USB Key;-



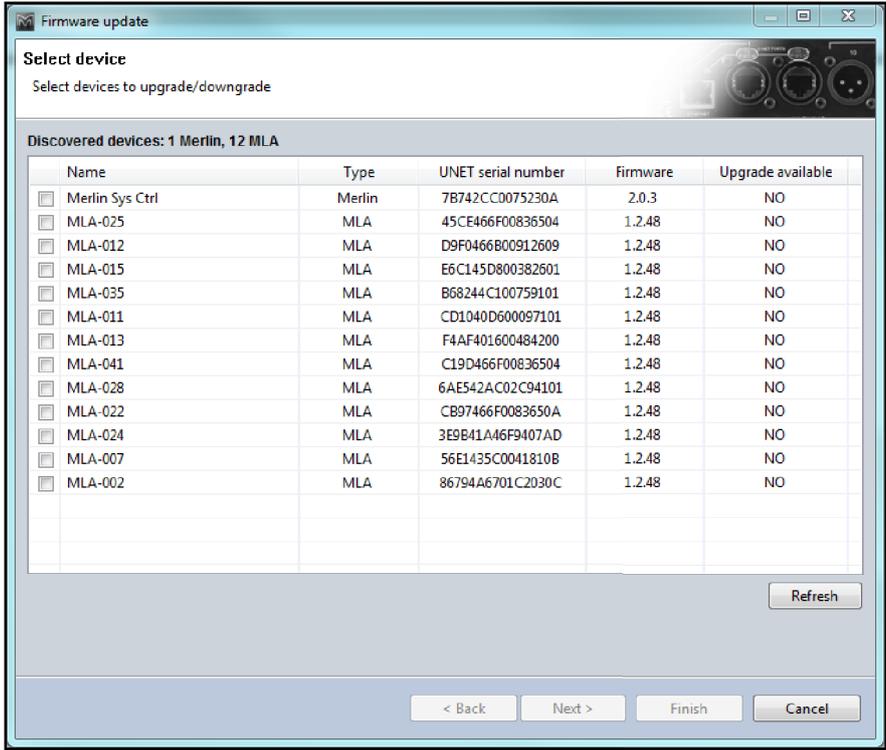
Select the VUA file, it will be saved and the update wizard will commence.

### Starting a Firmware Update.

Selecting the Firmware Update Wizard in the Vu-Net Tools menu opens the same window as the Get Firmware updates to double-check that you have the latest versions. Assuming that you have definitely installed the very latest versions you can click on 'PROCEED WITH FIRMWARE UPGRADE USING VUNET FIRMWARE DATABASE'. Vu-Net will scan the U-Net network for connected devices in the same way as a Device Discovery;-

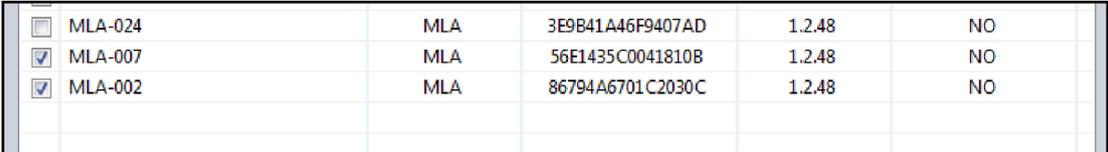


When the scan is complete, a window will appear with a list of all devices found together with their type, Serial number and the installed firmware;-

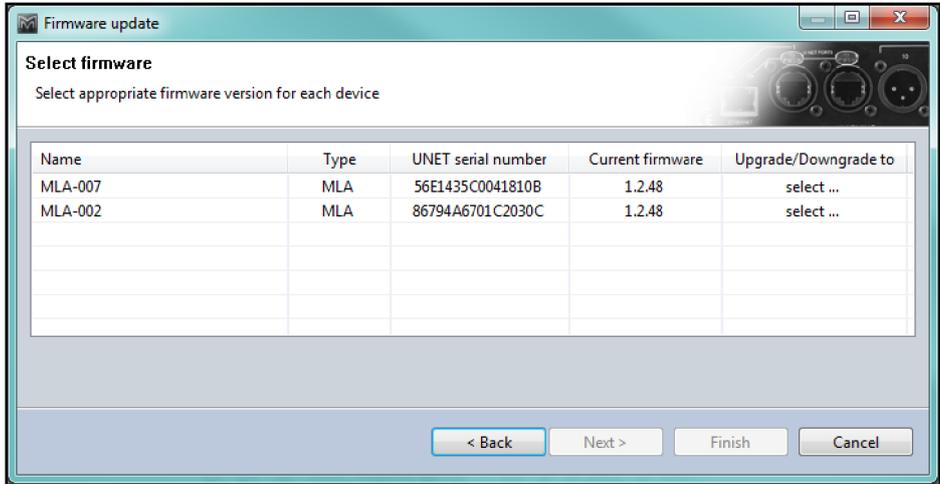


Vu-Net compares the discovered Firmware version with the latest version stored in its database and will indicate in the final column whether an upgrade is available. In this instance a single Merlin and twelve MLA have been found and all have up to date firmware however we can still proceed with an update to show how the process works.

In the left hand column there is a check box to select any device which you would like to update. We will do an update on the final two MLA;-

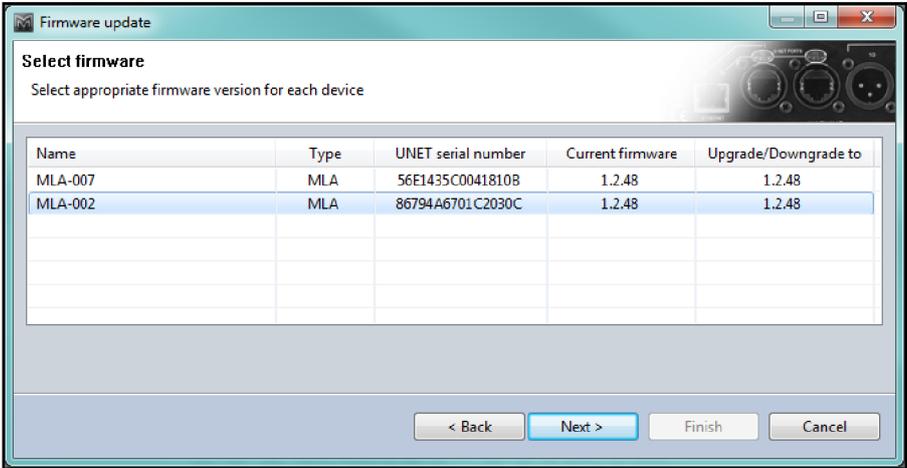


Click next and you see the following window;-

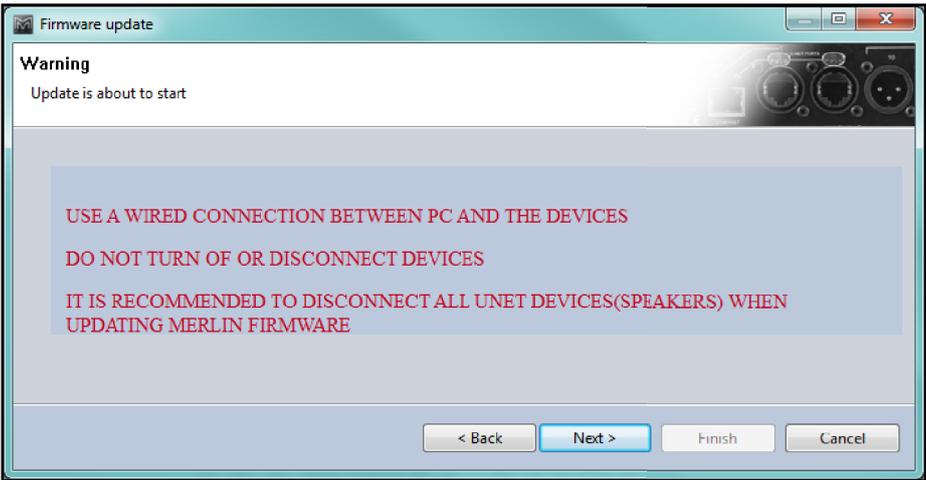




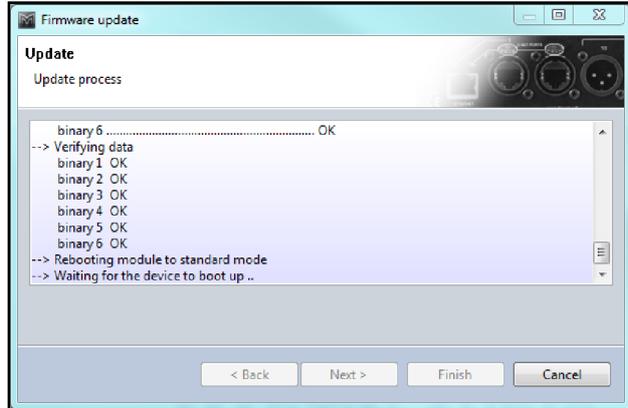
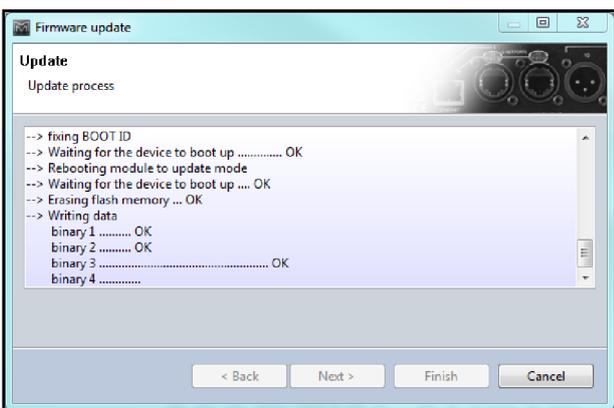
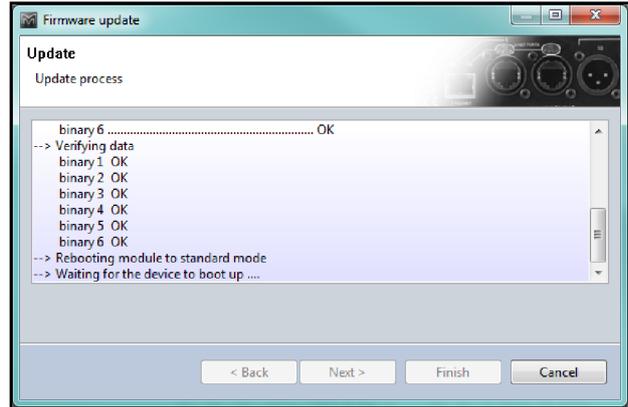
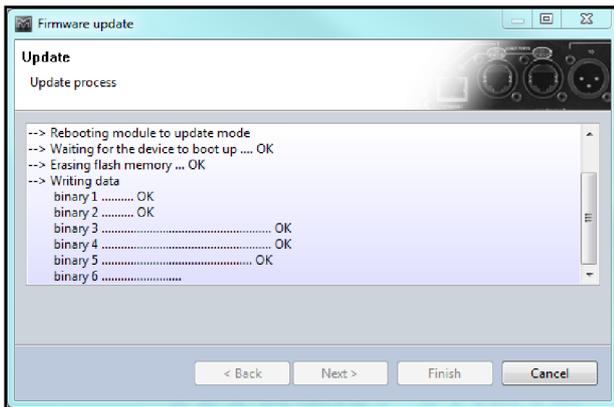
The current firmware is shown and the final column has an option to select the required firmware which in most cases would be a new version but could be an old firmware if say a bug has been found in a current version and it is necessary to downgrade to an earlier version. If there are several versions available, clicking on the Upgrade/Downgrade cell will bring up a drop-down showing the version numbers. Select the version you wish to use and it will appear in the final column;-



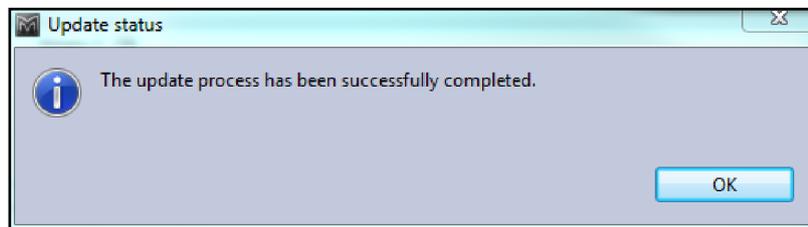
Click on 'Next' to start the update. You will first see the following warning to ensure that every measure has been taken to ensure that the update will complete successfully;-



Click Next and the upgrade will start. A progress window will appear showing the processes in the upgrade taking place. The system tackles one device at a time, placing it into Boot Mode, uploading the firmware and rebooting the device back into an operating mode;-



Once completed you will see the following:-



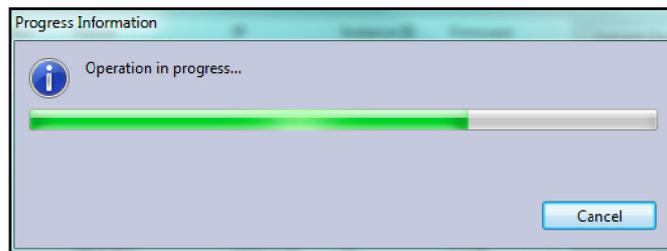
Click 'OK' and then click on 'Finish' on the Update Progress Window. The update is complete.



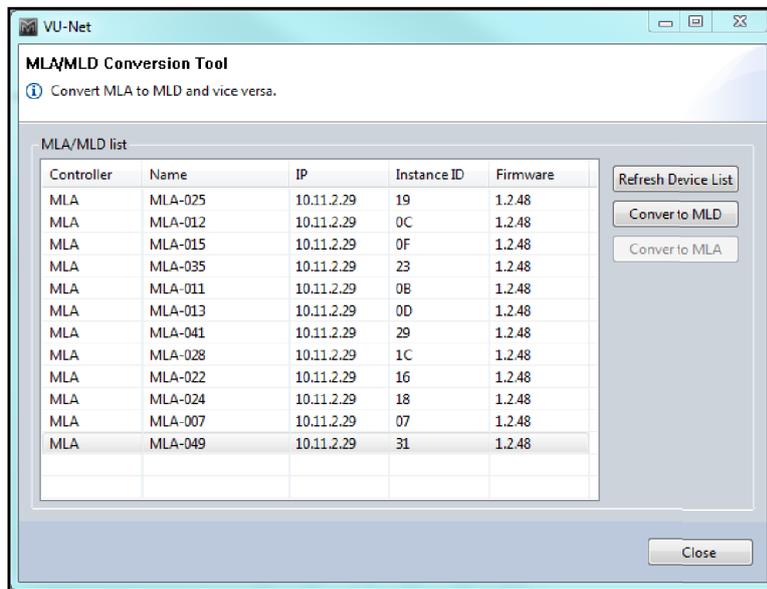
MLA/MLD Conversion Tool

The MLA and MLD use identical amplifier modules but require different firmware to be installed for correct operation. This utility function is fairly obviously best performed back in the warehouse when a system is prepped but may be necessary in an emergency if a module fails in an MLA and the only spare module is an MLD or vice versa. As with a Firmware upgrade, the process involves placing a cabinet into Boot Mode, deleting the currently installed Firmware and re-flashing the module with new Firmware. Whilst a conversion is taking place the module is in just as venerable a state as for a firmware upgrade so exactly the same precautions need to be taken. Make absolutely certain that the mains feed will not be interrupted. Use a hard-wired network connection and make sure that you have minimised the possibility of any cables being disconnected.

To use the tool your Vu-Net project cannot have any devices already in the System Diagram so either delete all devices (making sure you save your project first) or better still start a new project. Select the MLA/MLD Conversion tool from the Tools menu, you will see an 'Operation in progress' window while Vu-Net scans the U-Net network for all connected MLA or MLD in a similar way to a Device Discovery;-



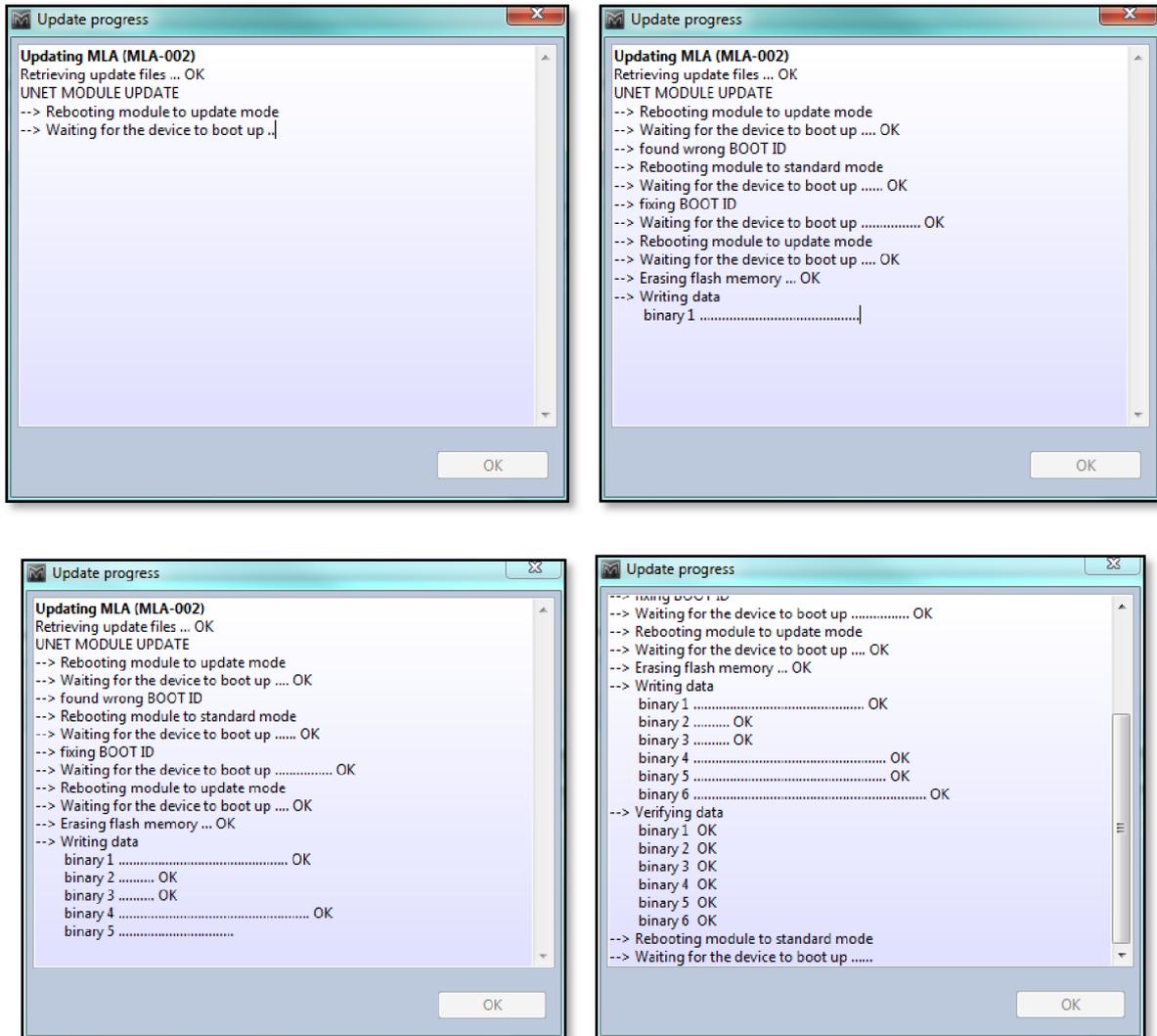
The following Window will appear once the scan is completed;-



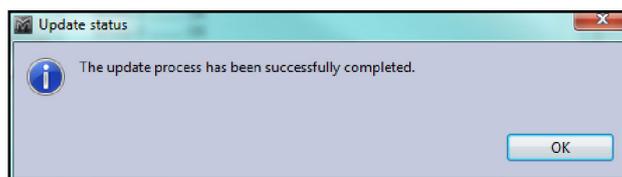
All devices will be listed showing their unique name the network IP and ID plus the firmware presently installed. Click on the cabinet you wish to convert, the Conversion Tool can only change one cabinet at a time although it is unlikely you will need to do more than one in most situations. If you select an MLA you will have the option to convert to MLD and vice versa. In this example we will convert the last MLA in the list (MLA-049) to an MLD. Once the box is selected click 'Convert to MLD'. You will see a window asking you to confirm which Firmware version you would like to use. Generally there will not be a choice but if there are still older firmware versions installed you have the option to down-grade to the older version;-



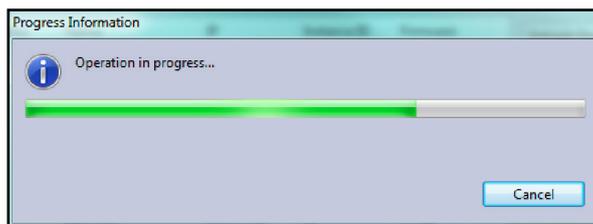
Once you have selected the firmware click on 'Upgrade', you will see a window which shows the progress of the firmware conversion;-



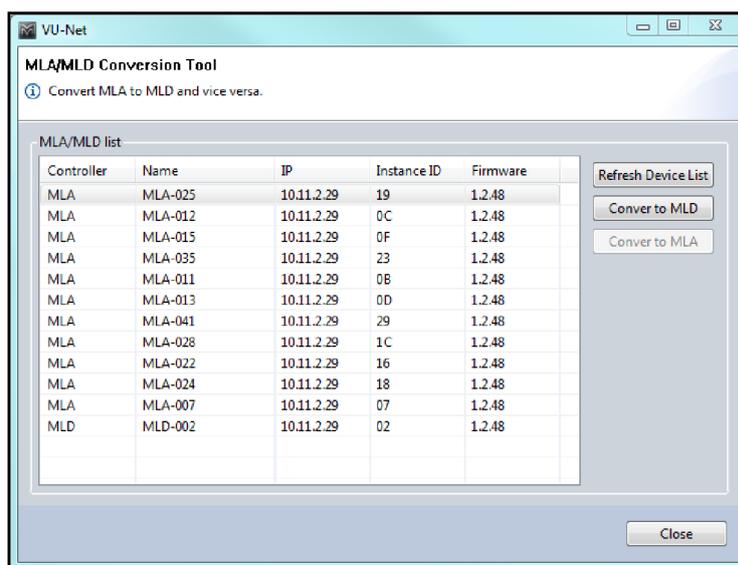
When the conversion is finished you will see a confirmation window;-



Click 'OK' and close the update progress monitor. Vu-Net will then re-scan U-Net to check all connected devices;-



You will then see the same Window as previously showing all connected devices, note how the last enclosure in the list is now an MLD;-



The window can be closed and a system discovered and used in the normal way.



## MLA Pick Load spreadsheet

As Display 2.1 does not yet offer rigging information, a simple spreadsheet rigging calculator is available to predict loading for single and tow point hanging of an array. The mechanical deployment of the system is entered and detailed information for the loading on each point is displayed. There is also a guide to ground stacking.

The Input tab is where all details are entered. Opening the spreadsheet looks like this;-

File: Combined forces Rev002      SINGLE POINT LIFT AND DUAL POINT LIFT      Date:6th July-2011

Cabinet position on grid		
Front mounting	Rear mounting	
<b>Rear Position</b>		
Number of twelve way distro breakouts	<b>one</b>	
Available Splay Angles (degrees)		
MLA to MLA: 0.5,1,2,3,4,5,6,7.5		
MLD to MLA: 13.75		
MLD to MLD: 20		
Array shape		
Cabinet Number	Angle	MLA/MLD
Grid and Cabinet 1	-4	MLA
Cabinet 2	0.5	MLA
Cabinet 3	0.5	MLA
Cabinet 4	0.5	MLA
Cabinet 5	0.5	MLA
Cabinet 6	0.5	MLA
Cabinet 7	0.5	MLA
Cabinet 8	0.5	MLA
Cabinet 9	0.5	MLA
Cabinet 10	0.5	MLA
Cabinet 11	1	MLA
Cabinet 12	13.75	MLD
Cabinet 13	0	
Cabinet 14	0	
Cabinet 15	0	
Cabinet 16	0	
Cabinet 17	0	
Cabinet 18	0	
Cabinet 19	0	
Cabinet 20	0	
Cabinet 21	0	
Cabinet 22	0	
Cabinet 23	0	
Cabinet 24	0	

neg=down tilt

Number of MLA Cabinets	<b>12</b>
Number of MLD Cabinets	<b>1</b>
Total Number of Cabinet	<b>13</b>

(including cabinets, grid, distro hanger, distro breakout) (kg)	<b>1239</b>
Weight in lbs	<b>2732</b>

Over specification, Dual point only	
Closest Hole for single point	<b>17</b>
Total load (kg)	<b>1239</b>
Approx. Hanging angle	<b>-3.5</b>

Dual point lift	
Load on front motor (kg)	<b>256</b>
Load on rear motor (kg)	<b>983</b>
Load on front motor (lbs)	<b>565</b>
Load on rear motor (lbs)	<b>2167</b>

The first option is to choose front or rear mounting on the MLA Flying Grid. All data entry is done on the cells coloured light yellow. Click on the "Position" cell and a drop-down is available to select Front or Rear;-

Cabinet position on grid	
Front mounting	Rear mounting
<b>Rear Position</b>	
<div style="border: 1px solid black; padding: 2px;">                     Front Position                      Rear Position                 </div>	
Number of twelve way distro breakouts	<b>one</b>



The selected option will be shown in cell and by the orange highlight above the thumbnail picture of the selected option, Rear mounting in the above picture.

Next you need to choose the number of 12-way distro break-out looms in use. For most systems up to 12 enclosures which will be one. In fact many systems up to around 16 cabinets will still use a single break out loom and expand the capacity with the use of 16A Ceeform 'Y' split cables. For large arrays approaching the maximum 24 cabinets you will need to use two break-out looms;-

Number of twelve way distro breakouts	one
	one
	two

The number of Distro break-outs in use is important as they add significant weight to the array which is added to the load calculations for each point.

The next step is to enter the angles of the grid and cabinets that comprise the array. The table shows the "legal" angles available;-

Available Splay Angles (degrees)	
MLA to MLA:	0.5,1,2,3,4,5,6,7.5
MLD to MLA:	13.75
MLD to MLD:	20

The actual angles need to be copied over from the Display 2.1 project including the angle of the grid. The spreadsheet will display the type of cabinet depending on the angle entered. If you enter a '0' it will display no cabinet. An angle of 0.5, 1, 2, 3, 4, 5, 6 or 7.5 will show as an MLA, entering 13.75 will add an MLD and entering 20 will add a second MLD. Enter all cabinet angles with no gaps between them;-

Array shape		
Cabinet Number	Angle	MLA/MLD
Grid and Cabinet 1	-4	MLA
Cabinet	2	0.5 MLA
Cabinet	3	0.5 MLA
Cabinet	4	0.5 MLA
Cabinet	5	0.5 MLA
Cabinet	6	1 MLA
Cabinet	7	2 MLA
Cabinet	8	0.5 MLA
Cabinet	9	2 MLA
Cabinet	10	4 MLA
Cabinet	11	6 MLA
Cabinet	12	13.75 MLD
Cabinet	13	0
Cabinet	14	0

The right side of the spreadsheet now displays all rigging information. First we can see the total quantity of cabinets;-

Number of MLA Cabinets	11
Number of MLD Cabinets	1
Total Number of Cabinet	12

Next the total weight of the array in both kilogrammes (kg) and pounds (lb):-



Total weight of array, (including cabinets, grid, distro hanger, distro breakout) (kg)	<b>1151</b>
Weight in lbs	<b>2538</b>

Note that as shown, this includes the weight of all cabinets, the flying grid, distro hanger and mains distro cables.

Finally the loading for each point is shown. For system over ten MLA, single point hanging is not possible so you will see the following;-

<b>Over specification, Dual point only</b>	
Closest Hole for single point lift	<b>13</b>
Total load (kg)	<b>1151</b>
Approx. Hanging angle	<b>-4.1</b>

A ten cabinet or less array will display as follows;-

<b>Single point lift</b>	
Closest Hole for single point lift	<b>11</b>
Total load (kg)	<b>974</b>
Approx. Hanging angle	<b>-3.3</b>

If you are using a single point hang you can use this information to fly the array from the hole in the central spine of the grid as shown. The actual hanging angle is shown and this can be entered into Display 2.1 and the EQ optimisation re-calculated to give a more accurate result as the array position entered will be "real world" exactly how it has been mechanically deployed.

For two point hanging the load for each point is displayed in both kilogrammes and pounds;-

<b>Dual point lift</b>	
Load on front motor (kg)	<b>489</b>
Load on rear motor (kg)	<b>662</b>
Load on front motor (lbs)	<b>1078</b>
Load on rear motor (lbs)	<b>1460</b>

Finally the safety specification is flagged showing whether the rigging complies with both BGV C1 and DIN 18800;-

BGV C1	<b>OK</b>
DIN 18800	<b>OK</b>

Here is an example with a fictitious 15 cabinet array with exaggerated cabinet angles. As the load on the front motor is showing a negative figure it is clear that this array is impossible to physically deploy and the BGV C1 flag is showing a fail. It is highly unlikely that Display 2.1 will produce such an extreme result however if it does you will need to change the angles until the array can be safely flown and re-enter the angles you have used back into Display 2.1 and re-optimize the EQ;-



Dual point lift	
Load on front motor (kg)	- 249
Load on rear motor (kg)	1674
Load on front motor (lbs)	-548
Load on rear motor (lbs)	3692
BGV C1	FAIL
DIN 18800	OK

Ground Stacking

Display does not allow direct entry of a ground stacked system, it is necessary to enter the array as if it were flown which will produce a set of angles which need to be entered on the input page as before;-

Array shape		
Cabinet Number	Angle	MLA/MLD
Grid and Cabinet 1	2	MLA
Cabinet	2	0.5
Cabinet	3	1
Cabinet	4	2
Cabinet	5	3
Cabinet	6	6
Cabinet	7	0

Now select the ground stack tab which appears as follows;-



	from INPUT page	adjusted, neg = down	cabinet to horizontal				
Cab 1 and grid	2	2	2				
Cab 2	0.5	-0.5	1.5				
Cab 3	1	-1	0.5				
Cab 4	2	-2	-1.5				
Cab 5	3	-3	-4.5				
Cab 6	6	-6	-10.5				
6 cabinet max.							
Angle of bottom box (ctr line)			-10.5				
Angle of bottom face of the cabinet			-6.75 neg = downtilt				
Ground stack bar connection - angle between cabinet and frame		3		3 B6	neg = downtilt		
				2 B5	neg = downtilt		
				0 B3	neg = downtilt		
angle of frame		-13.5		-2 B1	neg = downtilt		
				-3 A7.5	neg = downtilt		
				-4 A6	neg = downtilt		
				-5 A5	neg = downtilt		
				-6 A4	neg = downtilt		
				-7 A3	neg = downtilt		
				-8 A2	neg = downtilt		
				-9 A1	neg = downtilt		
				-10 A0.5	neg = downtilt		



The table at the top of the page shows the angles as they have been entered on the Input page with the actual angles with respect to the actual angle to the horizontal;-

	from INPUT page	adjusted, neg = down	cabinet to horizontal
Cab 1 and grid	2	2	2
Cab 2	0.5	-0.5	1.5
Cab 3	1	-1	0.5
Cab 4	2	-2	-1.5
Cab 5	3	-3	-4.5
Cab 6	6	-6	-10.5

The crucial information is the angle of the bottom cabinet;-

Angle of bottom box (ctr line)	-2
--------------------------------	----

This can be used to select the appropriate holes in the ground stack bar and bottom cabinet. A thumbnail of the bar is shown together with a table showing the holes required to achieve the desired angle;-

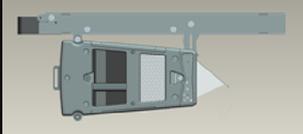
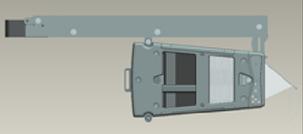




## MLA Compact Pick Load Spreadsheet

As with MLA, MLA compact requires a spreadsheet to calculate rigging loads. The operation is very similar to the MLA Pick Loads spreadsheet. This is the input screen;-

**File: MLA Compact pick loads Rev001**      **MLA Compact SINGLE POINT LIFT, DUAL POINT LIFT & BGV C1**      **Date:14th March 2012**

Cabinet position on grid	
Front mounting	Rear mounting
	
<b>Front Position</b>	

Inter cabinet rigging angles	
MLA Compact to MLA Compact: <b>0.5,1,2,4,6.5,10</b>	

Array shape		
Cabinet Number	Angle	Cabinets
Grid and Cabinet 1	3	<b>MLA Compact</b> <small>neg=downtilt</small>
Cabinet 2	0.5	<b>MLA Compact</b>
Cabinet 3	0.5	<b>MLA Compact</b>
Cabinet 4	0.5	<b>MLA Compact</b>
Cabinet 5	1	<b>MLA Compact</b>
Cabinet 6	1	<b>MLA Compact</b>
Cabinet 7	1	<b>MLA Compact</b>
Cabinet 8	2	<b>MLA Compact</b>
Cabinet 9	4	<b>MLA Compact</b>
Cabinet 10	4	<b>MLA Compact</b>
Cabinet 11	6.5	<b>MLA Compact</b>
Cabinet 12	10	<b>MLA Compact</b>
Cabinet 13	0	
Cabinet 14	0	
Cabinet 15	0	
Cabinet 16	0	
Cabinet 17	0	
Cabinet 18	0	
Cabinet 19	0	
Cabinet 20	0	
Cabinet 21	0	
Cabinet 22	0	
Cabinet 23	0	
Cabinet 24	0	

Number of MLA Compact Cabinets	<b>12</b>
Number of Distro breakout boxes	<b>1</b>

Total weight of array, (including cabinets, grid, distro hanger, distro breakout) (kg)	<b>656</b>
Weight in lbs	<b>1446</b>

Single point lift	
Closest Hole for single point lift	<b>7</b>
Total load (kg)	<b>656</b>
Approx. Hanging angle	<b>3.4</b>

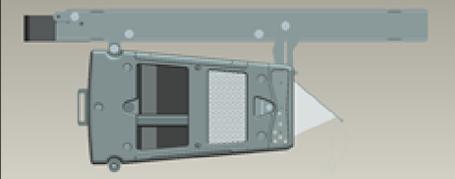
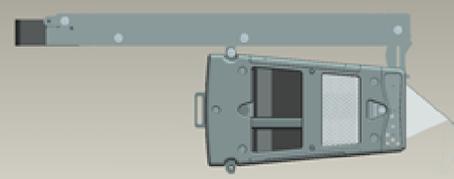
  

Dual point lift	
Load on front motor (kg)	<b>397</b>
Load on rear motor (kg)	<b>259</b>
Load on front motor (lbs)	<b>875</b>
Load on rear motor (lbs)	<b>571</b>

BGV C1	<b>OK</b>
DIN 18800	<b>OK</b>

The first stage is identical to MLA, you can select either front or rear mounting on the flying grid;-

Cabinet position on grid	
Front mounting	Rear mounting
	
<b>Front Position</b>	
<div style="background-color: yellow; padding: 2px;">Front Position</div> <div style="background-color: blue; padding: 2px;">Rear Position</div>	

Unlike MLA there is no option to manually select the number of Distro break-out looms; this is automatically changed to two for all arrays greater than 12 enclosures.



As with MLA you need to enter the angles specified by your Display 2.1 project. There is a cell showing all "legal" angles available;-

<b>Inter cabinet rigging angles</b>
MLA Compact to MLA Compact: <b>0.5,1,2,4,6.5,10</b>

Angles are then entered in the main table including the grid angle. For each cabinet entry, an angle between 0.5 and 10 will show "MLA Cabinet" in the Cabinet column, entering a zero will leave a blank in the column;-

Array shape		
Cabinet Number	Angle	Cabinets
Grid and Cabinet 1	3	<b>MLA Compact</b>
Cabinet	2	0.5 <b>MLA Compact</b>
Cabinet	3	0.5 <b>MLA Compact</b>
Cabinet	4	0.5 <b>MLA Compact</b>
Cabinet	5	1 <b>MLA Compact</b>
Cabinet	6	1 <b>MLA Compact</b>
Cabinet	7	1 <b>MLA Compact</b>
Cabinet	8	2 <b>MLA Compact</b>
Cabinet	9	4 <b>MLA Compact</b>
Cabinet	10	4 <b>MLA Compact</b>
Cabinet	11	6.5 <b>MLA Compact</b>
Cabinet	12	10 <b>MLA Compact</b>
Cabinet	13	0

neg=downtilt

The cells on the right hand side display all the rigging information. First is the number of cabinets and Distro breakout boxes;-

Number of MLA Compact Cabinets	12
Number of Distro breakout boxes	1

The total weight of the array is shown;-

Total weight of array, (including cabinets, grid, distro hanger, distro breakout) (kg)	656
Weight in lbs	1446

The closest hole to achieve the required angle for a single point lift is displayed. As with MLA, this angle should be entered into Display 2.1 over-writing the calculated angle and the EQ optimisation re-calculated to get the most accurate results possible using the actual angle that the array;-

Single point lift	
Closest Hole for single point lift	7
Total load (kg)	656
Approx. Hanging angle	3.4

Dual point suspension is also displayed with load on each point in both kilograms (kg) and pounds (lbs);-



Dual point lift	
Load on front motor (kg)	397
Load on rear motor (kg)	259
Load on front motor (lbs)	875
Load on rear motor (lbs)	571

The safety of the array is shown with the final table. If everything is within BGV C1 and DIN 18800 limits both cells will show "OK" with a green highlight;-

BGV C1	OK
DIN 18800	OK

### Ground Stacking

As with MLA there is no capability to directly create a ground stack array within Display 2.1 so any ground stack system has to be designed as if flow and the angles entered into the spreadsheet as usual. Once completed select the Ground Stack Tab which appears as shown;-

	D2.1 angles	Angle of cabinet to horizontal	
Cab - top cabinet in stack (6 cabinets max).	5	5 neg = downtilt	
Cab - second from top	1	4 neg = downtilt	
Cab - third from top	1	3 neg = downtilt	
Cab - fourth from top	1	2 neg = downtilt	
Cab - fifth from top	1	1 neg = downtilt	
Cab - connected to grid	3	-2 neg = downtilt	
angle of frame, usually zero degrees on flat ground	0	neg = downtilt	
Angle between flying frame and cab 1 (hole in GS bar)		-2 neg = downtilt	
	short ground stack bar		long ground stack bar
	0		-1
	1		-2
	2		-3
	3		-4
	4		-5
	5		-7.5
			-10
			-12.5
			-15
			-17.5
			-20

Note that the angles need to be manually entered on the Ground Stack tab; they are not automatically updated from the Input page. The column highlighted in yellow is where the angles are entered and includes an input for the flying grid. This will usually be zero but if there is no other option other than to place it on an angled surface (avoid this if at all possible and if there is no alternative make sure that the array is secured with ratchet straps or similar), you have the option to enter the angle of the grid. The column in blue shows the angle of each cabinet with respect to the horizontal;-



Cab - top cabinet in stack (6 cabinets max).	3	3 neg = downtilt
Cab - second from top	0.5	2.5 neg = downtilt
Cab - third from top	0.5	2 neg = downtilt
Cab - fourth from top	1	1 neg = downtilt
Cab - fifth from top	2	-1 neg = downtilt
Cab - connected to grid	3	-4 neg = downtilt

The key figure is the angle of the bottom cabinet with respect to the flying grid. This will equal the last figure in the blue column unless the grid is at an angle in which case the required angle is shown on the line below the table:-

Angle between flying frame and cab 1 (hole in GS bar)	-4 neg = downtilt
---	-------------------

This is the angle that needs to be selected using one of the two ground stack bars, for an upwards tilted array with positive angles the short ground stack bar is used, for arrays with a downward tilt to the bottom cabinet with negative angles the long ground stack bar is used. The final section on the Ground Stack tab shows the angles that can be obtained with both bars:-

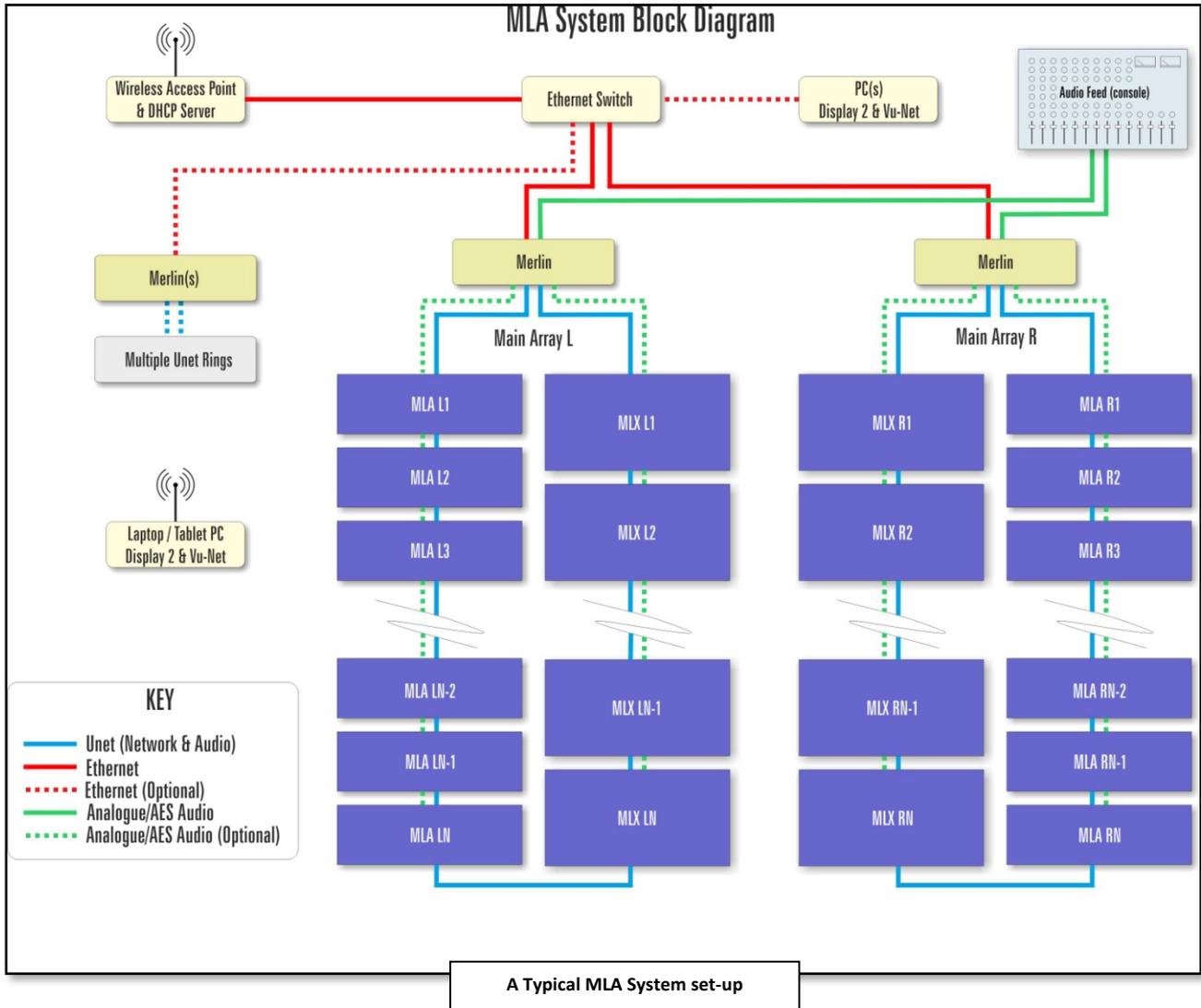
short ground stack bar	long ground stack bar
0	-1
1	-2
2	-3
3	-4
4	-5
5	-7.5
	-10
	-12.5
	-15
	-17.5
	-20

In our example we require a downward tilt of 4° on the bottom cabinet so the long ground stack bar is required using hole 4.

## System Wiring

The MLA is designed to be used in arrays and as part of a complete U-Net system. The diagram below shows a typical U-Net system including left and right MLA and MLX Sub arrays, Merlin processors and PC's connected to the Merlin via both Ethernet and wirelessly using off the shelf wireless routers.

For more details of the MLX, Merlin and System Software please see the relevant User Guides



All cables required to rig the system are supplied leaving only the mains input and audio feeds to be run from the remainder of the system.

Mains to the system will be via 32 amp three phase Ceeform connectors for territories with high mains voltages. For lower mains voltages the mains distro has Cam-lock style inlets

Audio into the system can be either standard analogue balanced signals or AES/EBU digital.

### Mains

Mains is connected to the system via the Master & Slave Racks. The minimum configuration is a single Master Rack or even Slave Rack, the maximum with a standard Master Rack is one Master and 5 slaves but as the slave racks all interconnect via Ethernet it is easy to expand this as required by using standard off the shelf Ethernet Switches.

For High Voltage Mains territories the inlet is via a 32 amp three-phase Ceeform to each mains distro, each rack has a single distro as standard with space for a second. Each distro requires an individual Ceeform connection. For Low Mains Voltage territories the inlet is via individual three Phase Cam-Lok connectors. Mains outlets from the distros are via 19-Pin Tourmate

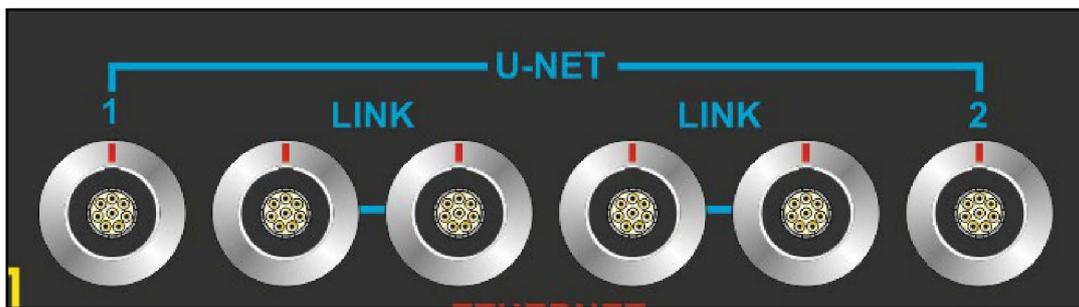


connectors in the popular Socapex pattern used very commonly with lighting systems. Each array whether it is a flown MLA, MLA compact or Combination array or a ground stack sub array requires a mains connection from one of the outlets. The most common configuration is with one Master Rack stage left and a slave rack stage right each with a single distro. A mains feed is routed from one outlet each side using a 30m Tourmate cable up to the flown array where it is connected to a 12-way breakout loom. The second outlet can either go directly into a six-way breakout loom to drive the MLX or DSX subs if they are sufficiently close by, or via a second 30m Tourmate cable and then into the six-way breakout. Each breakout loom is terminated in 16A CeeForm connectors which connect directly to the cabinets, all of which have a 16A IP67 rated inlet.

**U-Net**

All MLA components need to be connected to a U-Net Network to upload optimisation files and for control and monitoring. U-Net is a protocol not unlike Ethernet but with a number of enhancements and extra features. The cable used is rugged Cat5e using ODU connectors to the Lemo K Series pattern. The Merlin controller is used as a PC interface and has two U-Net ports with which to connect all system components. All components have a pair of U-Net ports labelled 1 7 2 and essentially used as an “in” and “out”. U-net is run as a redundant loop so that in the event of a cable failure communication will continue seamlessly. Up to 254 devices can reside on a single ring and cable runs can be up to 120m between nodes. It is important to note that every connection added to a cable run reduces the usable length by approximately 3.5m. For very large systems several Merlins can be employed each with up to 254 devices. Commonly a Merlin is used stage left and stage right to keep the network cabling easier to manage.

The U-Net ports on the Merlin are brought out on Neutrik Ethercon connectors so can be used with either Ethercon cable connectors or a simple RJ45. These are brought out onto the Merlin patch panel as ODU connectors in both Master and Slave racks as shown;-



The ports are labelled 1 and 2 and in addition there are two pairs of “link” connectors to facilitate tidy wiring to and from arrays, particularly where cables have been loomed together (see the chapter on cabling). A standard system would run the first U-Net connection from Port 1 up to the first cabinet at the top of an array. Short link cables (or looms including audio) would daisy-chain down between all cabinets in the array with a cable from port 2 in the final cabinet at the bottom of the array returning to the rack. If there are other cabinets in the system, perhaps a side hang or a sub array, this cable should run to the first cabinet of the next array however as you can imagine this would make for very messy wiring which is where the link connections are used. If loomed cables are used to each array, the “return” network cable goes into one of the link connections and the “send” cable for the next array goes into the other link connector. The return from the second array can either go straight to the Merlin port 2 on the patch panel or even to the next pair of links if there is a third array. As you have introduced two connections to the cable run between nodes the maximum cable run is now approximately 113metres however if you are using standard 35m U-Net cables to each array the cable run is only 35 + 35 or 70metres from the last cabinet in the first array to the first cabinet in the second array, well within limits. Even if you had a particularly long run to the main array and used the 75m U-Net cables, as long as you use a 35m cable to the next array you are still within limits (just!).

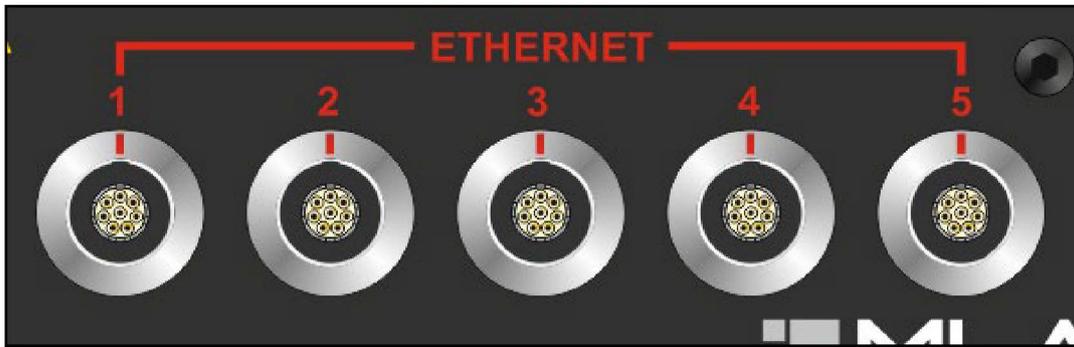
This system makes for very straight forward and tidy wiring with all connections; network, audio and mains going back to the rack so cable management is no more difficult than a conventional system, in fact given that for the majority of systems there is likely to be only a single rack at side of stage the system is very neat and economical in terms of truck space and venue real-estate.

**Ethernet**

The connection between PC and Merlin is by completely conventional Ethernet and uses standard, off the shelf Ethernet products other than cabling. To maintain the rugged cable connectivity the same touring grade Cat 5e and ODU connectors are used as for U-Net connections. The default Ethernet connection from the Lenovo PC is Wi-Fi directly to the Wi-Fi WAP connected to the Master rack however it is advisable to run a cable connection out to Front of House particularly with Mk 1 Master racks that use



the Picostation system as during the show when the venue is full of people with Smart Phones you will almost certainly find that Wi-Fi becomes heavily congested and range will be extremely compromised. Ethernet connections are available on the patch panel of the Master Rack just below the U-Net connectors;-



These are fed from the Ethernet switch which also connects the Merlin and Wi-Fi components so all are available on a single Ethernet network. From this connection point you can connect to the PC and to all slave racks being used, most frequently a single Slave on the opposite side of the stage. Any network cable can be used for Ethernet connections excluding the 120m PWA00041; the maximum cable length for Ethernet is approximately 100m.

Note that Mk1 Slave racks have the same patch panel but as there is no Ethernet switch the Ethernet connections are blanked off leaving just a single one available which is the Ethernet connection to the Merlin.

Note also that you cannot connect several Master racks together, each Master Rack has an integral DHCP device to assign IP addresses to all components therefore you can only have one Master. All other racks must be configured as slaves. This could still include a Master with the Ethernet switch if the DHCP support is disconnected (Picostation device in the Mk1 Master Rack). That way the system can be expanded to include more racks by using the Switch in its basic mode.

### Audio

Audio into an MLA system is extremely straightforward; a single balanced XLR feed to each array is all that is required. This can be standard analogue or AES3 Digital, the connection type is selected via Vu-Net. Audio cables to reach to the top of each array are supplied with the system as are the links to go between cabinets. The Merlin can also be used to process audio if required, even if just as a simple routing matrix. All audio connections are brought out on the patch panel;-



As well as all ten outputs being available there is a parallel connection to all four inputs to make it easy to daisy-chain audio feeds between racks if necessary.



## Rigging MLA

MLA is designed to be a practical touring system and as such features rigging that is intended to be quick, easy and above all safe to deploy. Anyone who has rigged a Martin Audio line array system will be instantly familiar with the MLA rigging. Whilst not a line array the system is deployed in exactly the same way mechanically so the rigging is an improved version of the system employed on existing products. This has proved to be popular and efficient in the past and MLA has already developed a reputation for flying very quickly and easily.

### Safety First

As with any flown system, the most important issue is safety. Hanging several tonnes of equipment up in the air, possibly above people's heads should not be undertaken by anyone without proper training and qualification. Rigging points must be approved positions in the venue. Mobile towers must be deployed in accordance with the manufacturer's instructions and must be rated to support a weight greater than that of the array. Points must be installed by a qualified rigger and all hoists used must have passed regular safety checks. All local safety regulations must be followed to the letter, particularly with regard to fitting secondary safety tethers. On no account use any rigging equipment; hoists, motors, shackles, flying grids et cetera which show signs of damage or have not had regular safety checks and re-certification carried out.

### Manpower

It is perfectly easy to fly MLA or MLA Compact systems with two people however if more crew are available it will obviously speed up the process. In an ideal world one experienced and trained MLA M-Tech can supervise the crew and wire the cabinets as the array is flown. Two crew would be used to attach the cabinets to the grid and array. Another would line up the next cabinet and remove wheel boards and finally a fourth would operate the hoists under command of the M-Tech.

### Wiring and rigging

MLA and MLA Compact differ from a passive system in that it is possible to do a very basic test for power and network connection as the array is flown. For this reason we recommend feeding power to the control rack and connecting the array to power and network feeds as it is rigged. You can see instantly if the cabinets power-up ok and the U-Net LEDs show you that you have a good network connection. Note that the high voltage Mains Distro has a 32A three phase mains inlet which unfortunately is the same power feed required for some of the most common motor control systems so it is not unusual to find that power is not available for the arrays until you have finished hoisting them into position which is far from ideal. If you have any authority to dictate the power being supplied for your event, make sure that you specify a three phase 32A supply for every rack you are using for EXCLUSIVE use of the audio system.

### Rigging the system- standard flown system

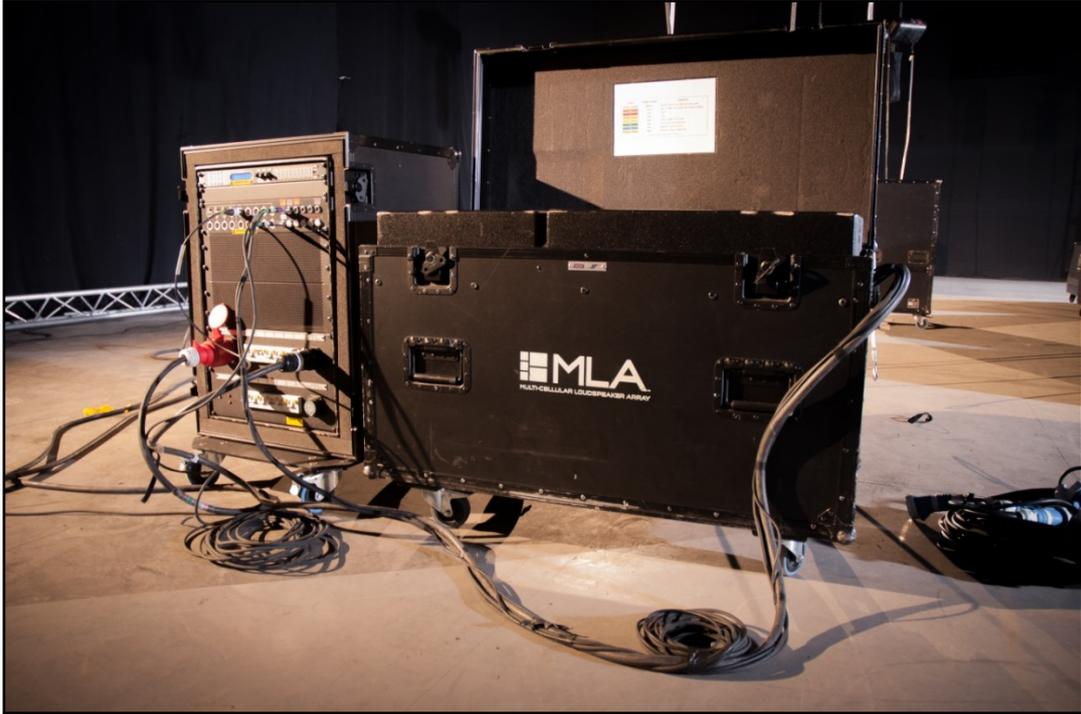
First you will need to get all of the components required together ready to rig. You will obviously need all the cabinets plus the flying frame, one of the cable trunks with all necessary cables and finally the control rack, Master or Slave as required;-



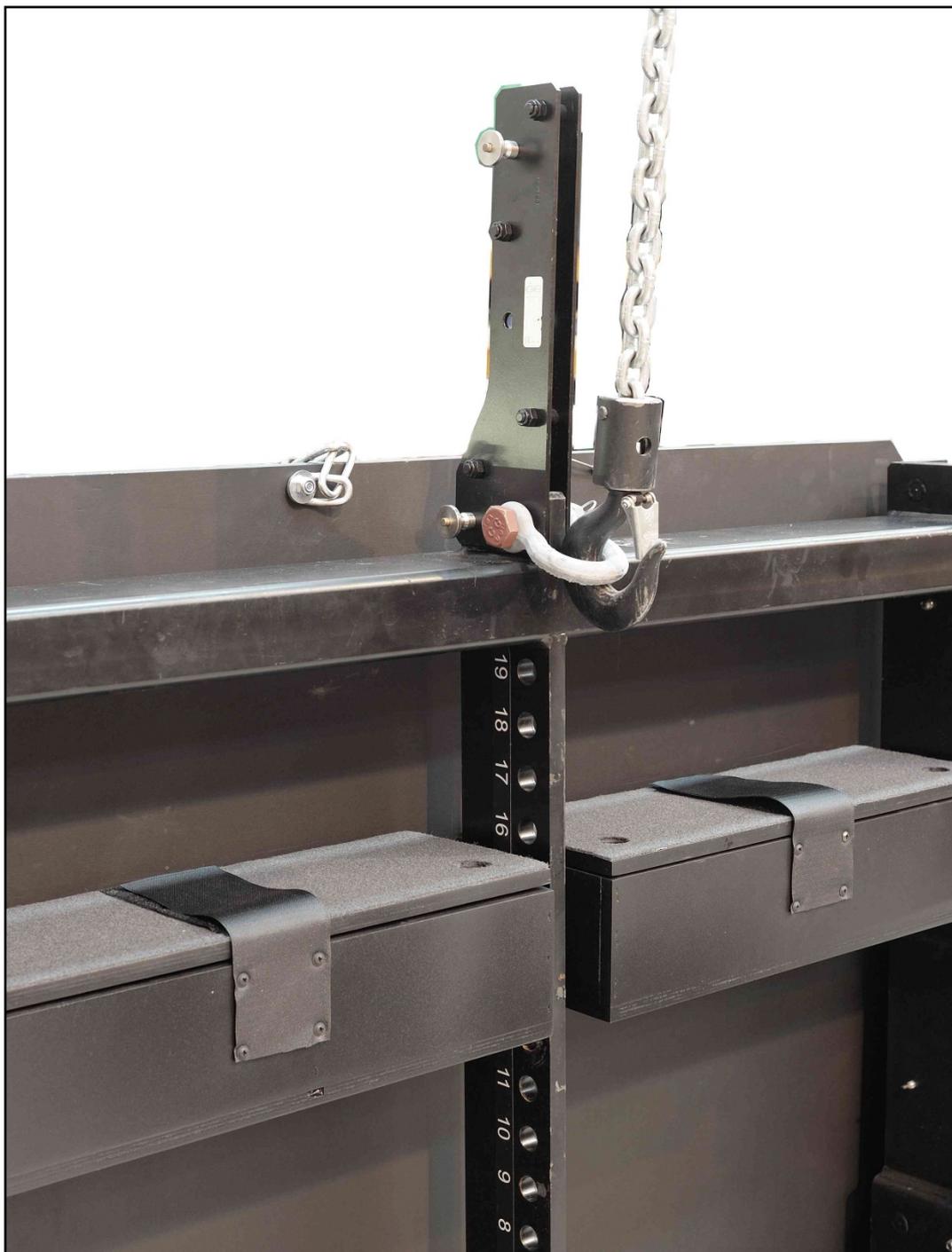
The first step is to remove the transit covers from all of the cabinets. The rain cowls can be raised as the cabinets are lined up ready to be rigged;-



The next step is to position the Control rack in a suitable position say at side of stage with the cable trunk next to it. Assuming the cables have been loomed and positioned in the trunk as mentioned in previous chapters, the rack end of the main array loom should be connected to the rack. The Tourmate mains connector should be connected to either the upper or lower Tourmate outlet, the upper and lower U-Net connections can be made to the Merlin U-Net outlets. Note that when subs or side hangs are added to a system you may disconnect one of the array network feeds and connected it to one of the parallel link connections but while rigging a system it is good practice to connect both U-Net feeds to a live node so the network wiring can be checked at all points. Mains can be connected and the breakers for the outlet being used turned on. If using a Mk 1 Master rack, you will also need to turn on breakers 3 and 6 for the other outlet to power all control electronics.:-



You can now start to rig the array. Position the flying grid under the flying point or points. Remove the “nose cone” top of the case and one side. The flight case is designed so that the grid can be lifted clear of the case using the motor hoist thus minimising the heavy lifting necessary. Connect the rear hoist to the rear rigging position. This is done with one of the supplied 3.25 tonne shackles first positioning the Distro hanger bracket so the bolt of the shackle goes through the fitting holes on the hanger before the rear rigging point on the flying grid;- If you are flying using a single motor, connect to the rear point at this stage, it can be moved to the final position once the grid is out of the flightcase;-



Raise the hoist until the grid is just clear of the flightcase. Roll the flightcase out of the way and lower the grid until it is just resting on the two 'V' shaped bumpers on the front. Do not allow the chain of the hoist to become too slack, not only will it get in the way but keeping it taught will provide additional support for the grid to prevent it falling over when it is upright;-



At this stage if you are flying from a single point add a second shackle to the required rigging point as calculated by the rigging spreadsheet and switch the hoist chain from the rear point to the middle. It is advisable to do this with a second person to support the grid as it will be completely unsupported without the chain attached.

Bring the first MLA up to the back of the grid still on its wheelboard. The V bumpers on the grid are designed to hold the grid at precisely the right height to match up to the rigging on an MLA on its wheelboard.

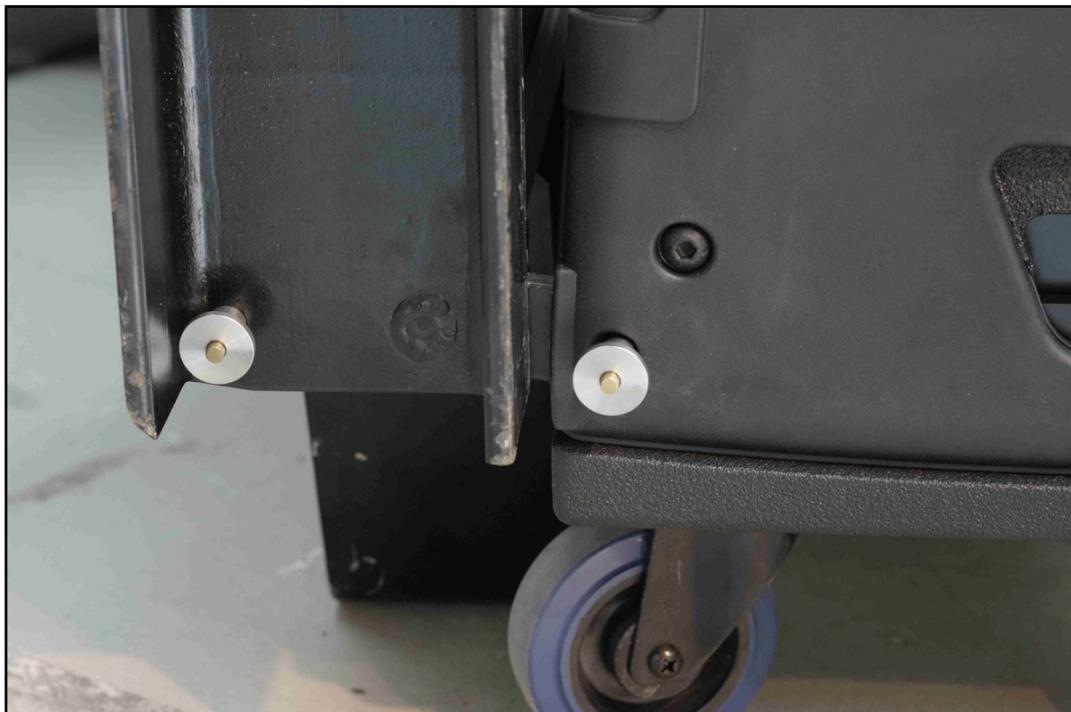
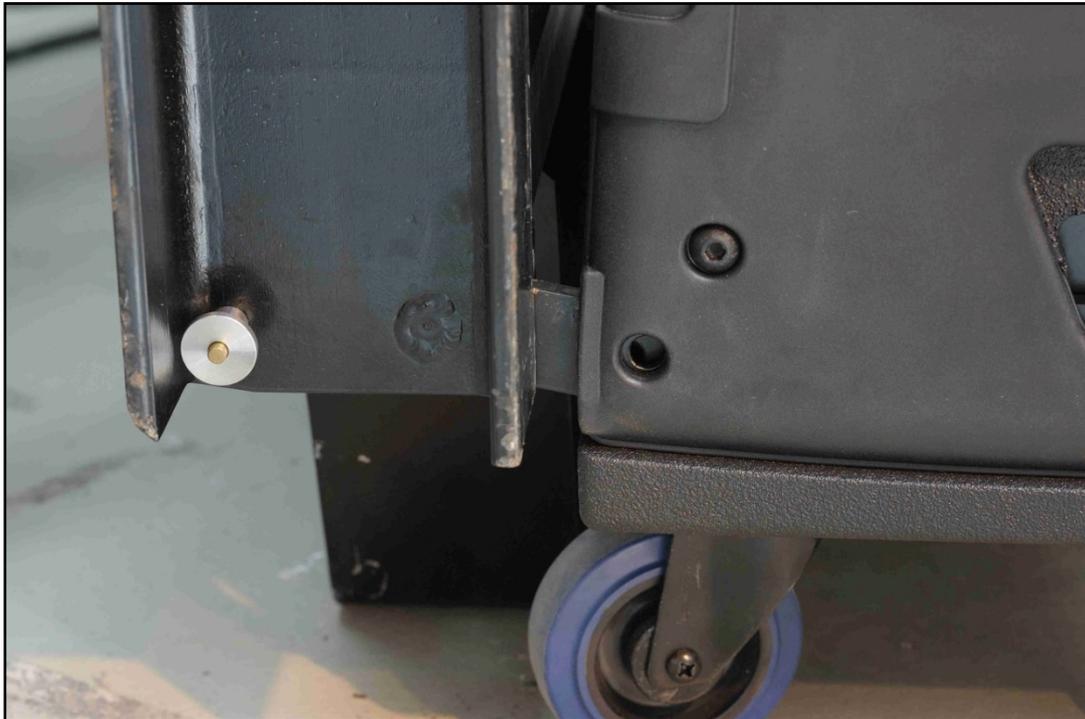
Next remove the flying pins from the front position at each side of the grid. The front is the end closest to the 'V' bumpers. The pins are removed by depressing the brass centre button and pulling out using the outer flange;-



A short steel bar will swing down on each side. With one person at each side of the grid, remove the flying pin from the front centre stowing position on the MLA and carefully wheel the cabinet up to the grid, directing the metal bar into the top flying point of the cabinet;-



It is important to make sure that this is done simultaneously on both sides, it is almost impossible to connect into the MLA if it is not square to the grid. The front rigging bracket on the MLA will be pushed out so it protrudes from the bottom of the cabinet. When the bar is fully inserted into the cabinet rigging point so that the holes line up, insert the pin that you removed from the cabinet;-



Make absolutely certain that the pin is properly engaged with the centre button out in the locked position. Give the pin a firm pull to make sure it cannot come out. All pins should be checked at every stage of the rigging process. Any with the centre button depressed;-

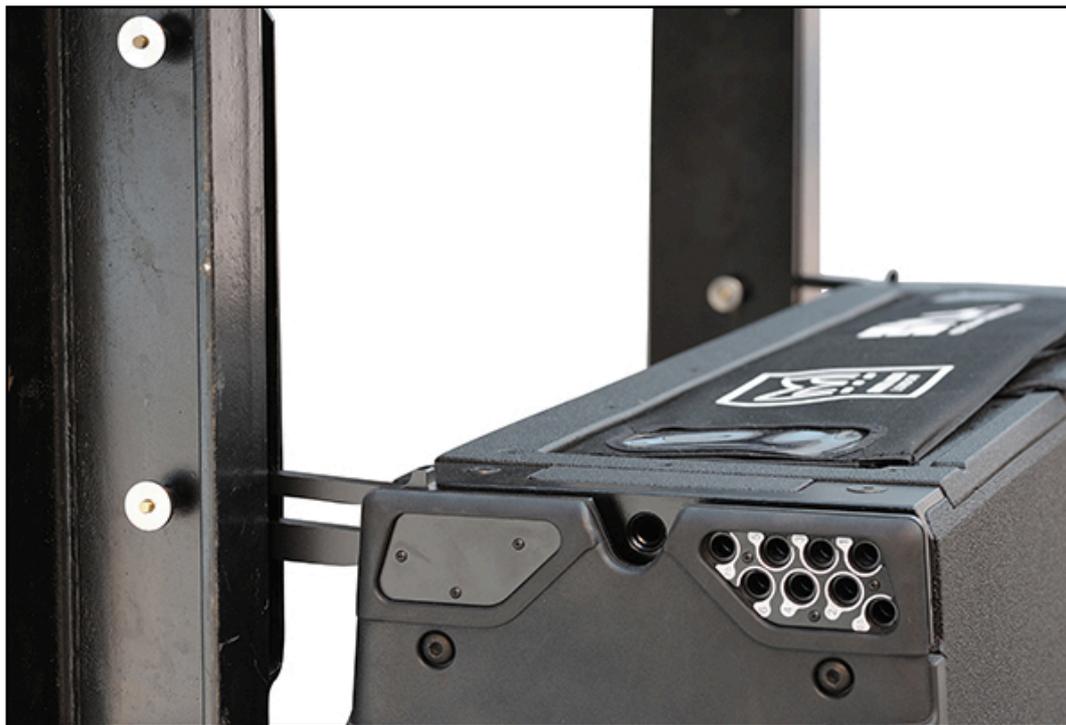
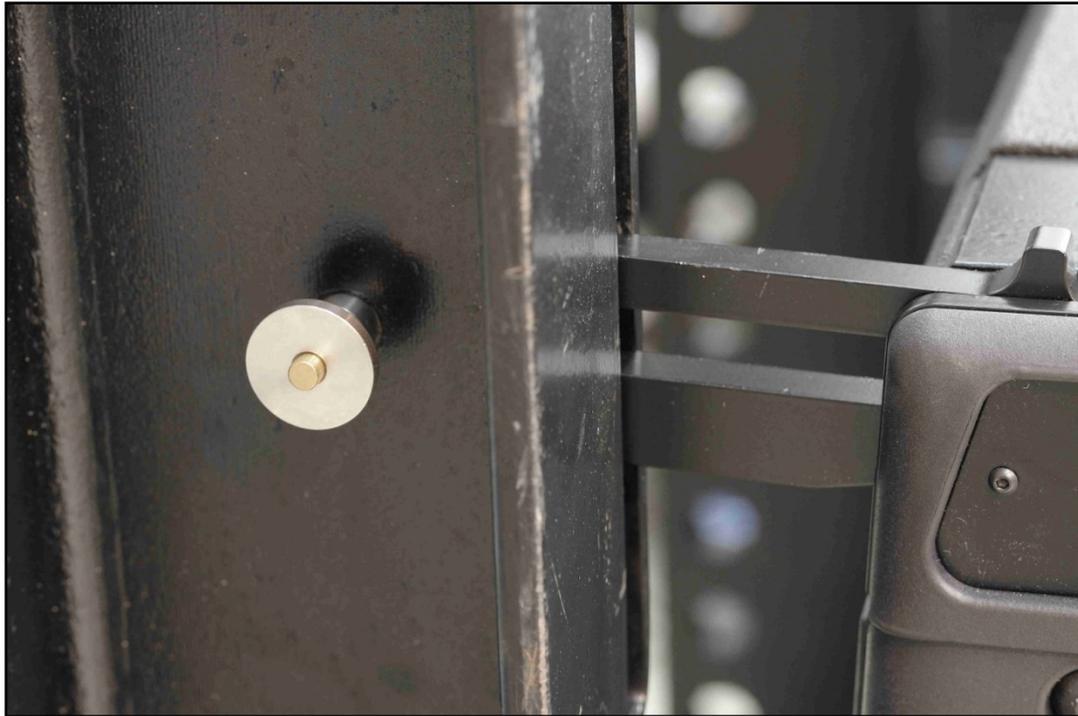


Are NOT SAFE and MUST be re-seated until the centre button pops out.

Next remove the flying pin stowing the rear bracket on the MLA and swing it out of the cabinet and into position on the grid. There is a small tongue on the rear bar to assist swinging it out of the stowed position;-



Align the holes in the rear bracket with the corresponding holes in the flying grid and pin them in place;-



The grid and first cabinet can now be flown. If using two motors, attach the second motor chain to the front point on the grid but first raise the rear motor until the cabinet is just off the ground. **BE VERY CAREFUL, THE ENTIRE ASSEMBLY WILL SWING FORWARD.** If using a single point, raise the assembly taking the same precautions. Do **NOT** stand in front or behind the array, if you have two crew they should stand either side of the array and support it while it is flown, making sure they avoid trapped fingers when the motor takes the array off the ground and it swings forward.

If using two motors, now raise the front motor until the grid and cabinet are close to horizontal. Remove the wheelboard from the first cabinet. You are now ready for the second MLA.

Wheel the second cabinet up behind the array, remove the rear flying pin and flick out both rear flying bracket. Lower the grid and first cabinet until you can comfortably line the second cabinet rear bracket bar with the rear bracket on the first cabinet;-

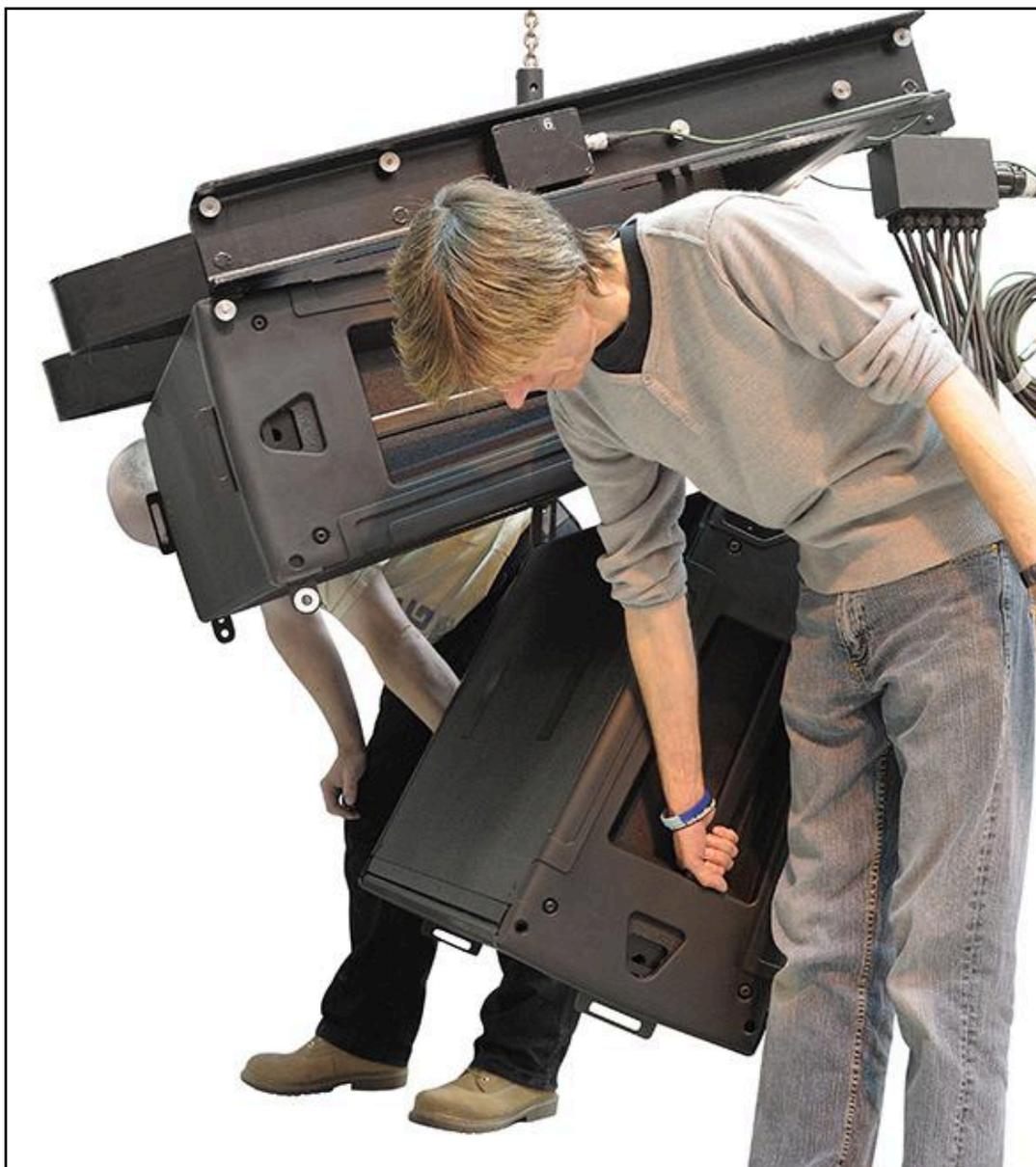


Check which hole needs to be connected from the optimisation that you did with Display 2.1 and connect the rear brackets with the flying pins;-



Next remove the flying pin from the front stowing position on the second MLA. Raise the grid until the second cabinet is just off the floor. As with the first cabinet and grid, the cabinet will swing forward suddenly when it leaves the floor so take care to avoid injury. The next stage is to swing the second cabinet up to link the front rigging brackets of both boxes. To make it a little lighter you can remove the wheelboard before you do this. With someone either side of the array, swing the cabinet up by its handle

and engage the front rigging bar on the first cabinet into the hole on the second cabinet and secure with the flying pin removed from the stowing hole;-







At this point you can connect power, network, audio and the inclinometer feed to the array. First connect the 12-way mains break-out loom to the distro hanger. This is secured using a flying pin through the large eye bolt on the top of the loom. If your array will be larger than 12 cabinets and you are going to be using a second 12-way breakout, attach the steel rope supplied with the flying system to the second hole in the distro hanger with another flying pin. This will hang halfway down the array and will support the second break-out loom using a small shackle to attach the eye bolt on the top of the connector box to the loop in the end of the steel rope.

Now the mains Tourmate, U-Net, Audio and Inclinometer cables can be connected. Most MLA and MLA Compact partners loom these cables together, see the chapter on cables for more details. The Tourmate connector mates with the chassis connector on the box at the top of the main break-out loom. You can then plug in the shortest 16A CeeForm connector labelled '1' to the top cabinet;-



Do NOT plug the second cabinet in yet as it will get in the way of rigging the next cabinet.

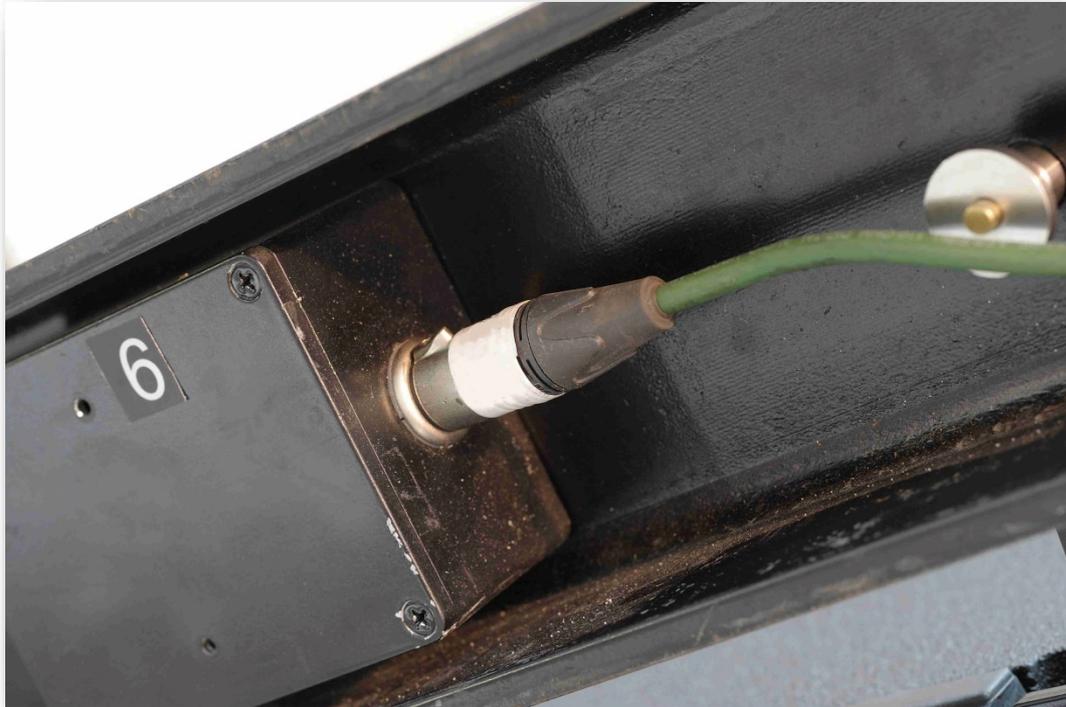
The first U-Net cable connects to the left hand U-net port on the first (top) MLA cabinet. Audio goes into the female XLR on the top MLA just above the U-Net port;-



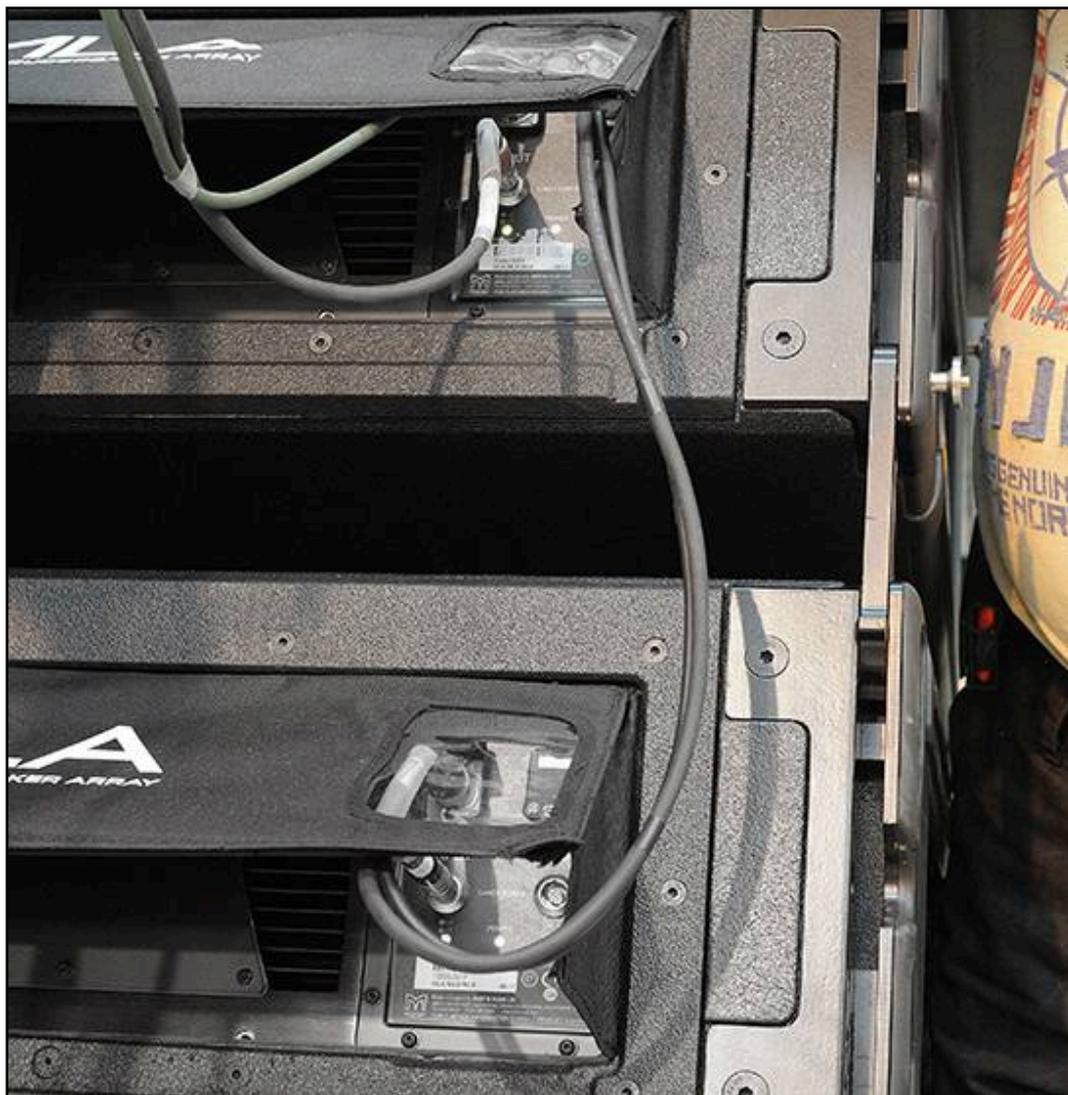
Assuming you have connected the U-Net cables to the Control rack and powered the rack you will see the cabinet power up. The amp module fans will briefly come on a full speed to clear and accumulated dust, the LED logo badge will illuminate for a few seconds and the power LED will light red. If your network connection is OK you will see the U-Net LED light green. If it is flashing or red or doesn't illuminate at all you have network issues which need to be resolved, see the troubleshooting guide for details.

The second U-Net cable in the loom will go to the second U-Net port in the final cabinet in the array to enable the close-loop topology. For now it can be left hanging loose.

Connect the inclinometer cable to the inclinometer sensor on the side of the grid;-



Connect one of the 800mm AES XLR cables and an 800mm U-Net cable (usually loomed together) from the audio out and U-Net port 2 on the top MLA cabinet down to the Audio input and U-Net port 1 on the second cabinet;-

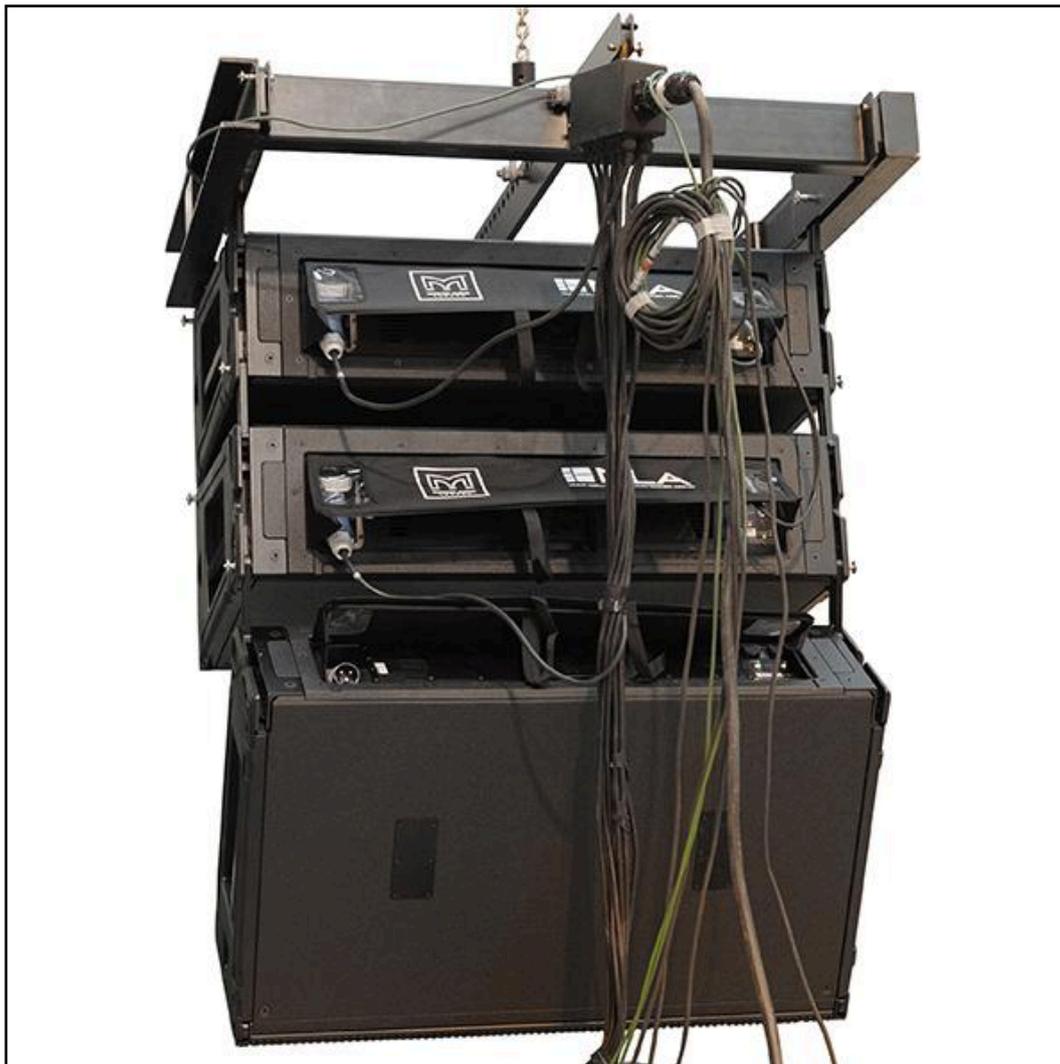


At this point the U-Net ports will not light on either cabinet as the second cabinet is not yet powered.

As you now have a couple of wheelboards you can start to neatly stack them, there are routed sections in the top of each wheelboard designed to act as a castor cup to ensure that the wheelboards stack neatly and safely to take up the minimum amount of space backstage;-

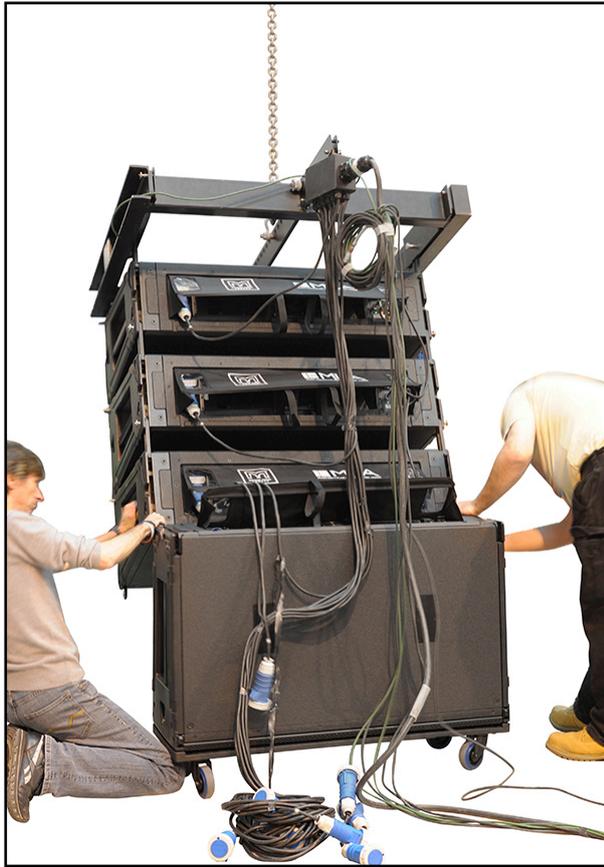


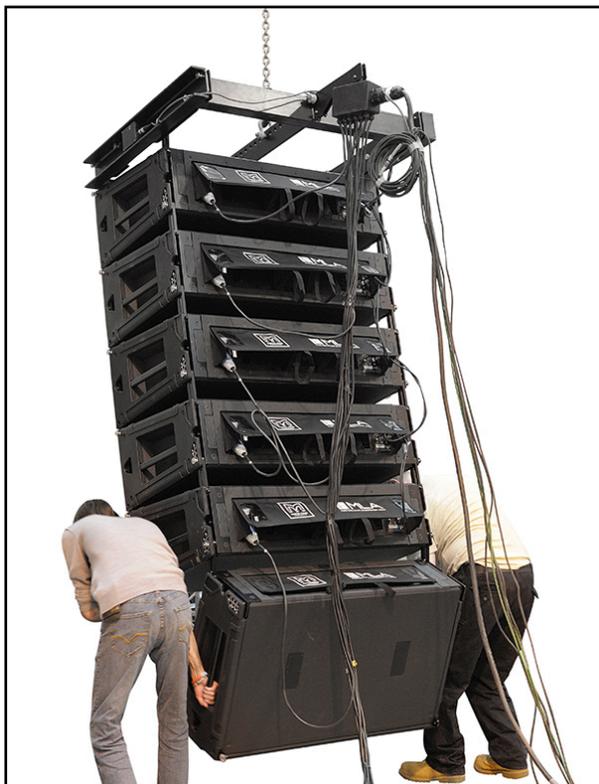
You can now add the third cabinet exactly as the second. Wheel it up behind the array; you will need to pull the cables clear to position the cabinet. Attach the rear rigging brackets to the holes indicated by your Display 2.1 project, remove the front rigging pins, lift the array until the third box is just off the floor, remove the wheelboard and swing the cabinet up so the bracket from the second cabinet engages in the hole in the top of the third and insert a rigging pin.

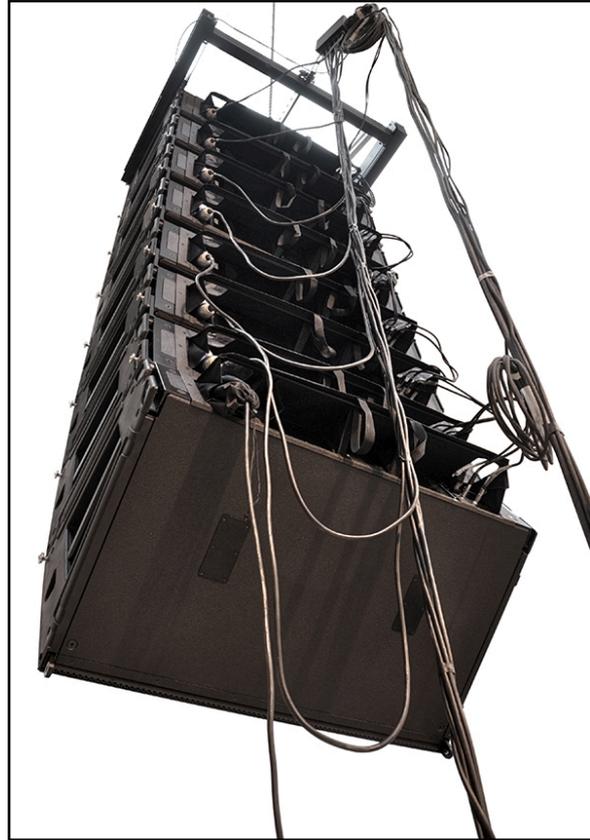


Connect power to the second cabinet (not the third) and check that you see the cabinet power up and U-Net LED's illuminate on both the first and second cabinets. Add another pair of link cables from the second and third cabinets.

Continue to build the array in the same way, always powering the cabinet before last and checking the previous network connections as you go;-







When you arrive at the final cabinet the only difference is that the trailing second U-Net cable is connected to the final U-Net 2 port on the last cabinet and the U-Net LED should be checked for good network connectivity between the final cabinet and U-Net port 2 on the Merlin back in the rack.

If the final cabinet is an MLD it is rigged in exactly the same way. It is a little heavier and the steeper angle makes it a fraction more difficult to locate the front rigging brackets but having rigged all of the previous cabinets you should have a good feel for how the rigging works so it shouldn't pose too much of a problem.

As the MLD is designed to have a steeper vertical dispersion and will always be on the bottom of a curved array, it is possible that the CeeForm connector will no longer be angled down and therefore when used outdoors there is a possibility of rain water running down the mains cable and into the connector. The connectors are rated to IP67 when mated however as an additional weatherproofing measure the MLD is fitted with a rain boot around the CeeForm into which the connector must be inserted to connect with the power inlet on the cabinet. This has a cord to seal the boot around the cable. Pull this tight, a friction grip holds the cord tight, it is released with a simple push button;-



The final step is to tidy the cables to keep the loom neat, particularly any spare Ceeform cables if your array is smaller than 12 boxes. Over-hanging cables should be neatly coiled and taped behind the array so they are invisible to the audience.

### Arrays greater than 12 enclosures

Rigging arrays up to 24 enclosures is exactly the same mechanically as smaller arrays. The same technique is used adding each additional MLA, connecting the cabinets as they are added to check that they power up and show good network connectivity. Network and audio connections link between adjacent cabinets all the way to the bottom of the array, the only issue is powering cabinets when you exceed the 12 enclosures that are catered for by the 12-way mains break-out loom.

It has been discovered in practice that the power consumption of MLA is very small indeed, well below the 16A rating of the Ceeform inlet connector or RCD breakers in the mains distro, particularly for the cabinets at the bottom of an array which as you might expect are not driven as hard as those at the top which are required to reach greater distances. For that reason it is perfectly acceptable to use Ceeform 'Y' splits to double the number of cabinets on a single Ceeform cable feed. You can comfortably do this for arrays of up to around 16 enclosures. For up to 24 you will need to add a second Tourmate feed and 12-way breakout loom.

The distro hanger has a second flying pin and hole which is provided as a means to support a second 12-way break-out. If the upper section of the array is fed by a 12-way loom connected to the middle hole in the distro hanger, the end hole is used to pin a length of steel rope with a loop at each end which is supplied with the MLA flying frame assembly. The rope is the right length to attach the second distro hanger behind cabinet 13 so it can be used in the same way as the distro at the top of the array with

the gradually lengthening mains cables feeding the cabinets from number 13 down all the way to number 24. A second Tourmate cable will need to be run up from the mains distro to the mid-point in the array to connect to the break-out loom.

## Rear position on grid

For some deployments, particularly those with a steep upwards angle, it may be necessary to attach the MLA to the rear position on the flying grid. The only significant difference is attaching the first enclosure to the flying grid, after that the rigging procedure is identical.

The first cabinet should be wheeled into position behind the flying grid. Obviously that rigging brackets will not line up directly with the flying grid while it is vertical so you will need to carefully lower it until it is at an angle sufficient to attach the rear bracket;-



Connect the rear bracket to the holes at the back of the flying grid. As the cabinet is at the back of the grid it is impossible to line up the front rigging positions with the cabinet and grid vertical, it is also difficult to swing up the cabinet to the grid as the grid has little stability with no cabinets attached so it will move around making it awkward to fir the pins. The easiest option is to fly

the grid and cabinet out so the cabinet is just off the floor, swing the cabinet forward and then land the whole array so the cabinet is on the ground with the grid on top as shown, if you have something solid enough it is helpful to land the cabinet onto an object so there is clearance with side for the rigging brackets to drop down when the pins are removed from the stowing position;-



In this position it is relatively easy to connect the front rigging pins to the grid. The array can then be flown and the rest of the array rigged in exactly the same way as before;-





### Flying MLX

The rigging of the MLX subs is very similar to the MLA and the same grid is used. There is provision for flying the subs rear-facing for building flown cardioid arrays.

The first stage is exactly the same as MLA, starting with the flying grid in the vertical position, wheel the first MLX up to the grid and attach the front and back rigging brackets;-



The grid and sub can then be flown lifting vertically and then lifting the front point to bring the cabinet to the horizontal. The wheelboard should be removed. Note that as with the MLA, the MLX will swing forward as soon as it leaves the ground, you must take extreme care, it is very big and heavy and could easily cause injury if it hits anyone when this is happening. Never raise an MLX when there is someone standing in front or behind the sub, crew flying the subs should stand either side and carefully steady the sub as it is flown making sure they avoid getting fingers trapped when it is moving.

Next wheel the second MLX up behind the first, raising or lowering the flown sub until the rear lower corners are close to the second cabinet rear upper corners. Connect the two together using the pins in the flown cabinet to free the flying bracket from its stored position and linking into the second MLX;-



There are now two options for attaching the front rigging. It can be flown off the ground and the second MLX swung up and connected at the front in exactly the same way as MLA however this requires strong crew as the MLX weighs 160Kg.



An easier option is to fly the array until the second cabinet is just off the ground, swing it forward and immediately land the array with the second cabinet horizontal so the first cabinet sits on top of the second;-



Whichever method is employed, the front rigging is attached in exactly the same way as the rear, removing the flying pin from the upper cabinet, swinging the rigging bracket down and attaching to the lower cabinet.

At this point the cable connections should be made; this is done in exactly the same way as MLA, a 12-way, mains breakout loom should be connected to the distro hanger and the first two CeeForm connectors connected to the cabinets. A cable loom comprising the Tourmate mains cable, U-Net and audio cables should be attached to the flying grid and connections. Note that when flying subs there is usually no need to use an inclinometer connection, the array would normally be flown vertically. Links between cabinets are made with the 3 metre U-Net and Audio cables which can be loomed together in the same way as the 80mm MLA/MLD links.

The array can then be flown and the third cabinet attached in the same way as the second, connecting each cabinet and checking network connectivity as each cabinet is attached.

### Cardioid Flown Arrays

MLX cabinets have the facility to be flown in an array facing backwards for applications requiring a cardioid array to restrict rear sub frequency propagation.

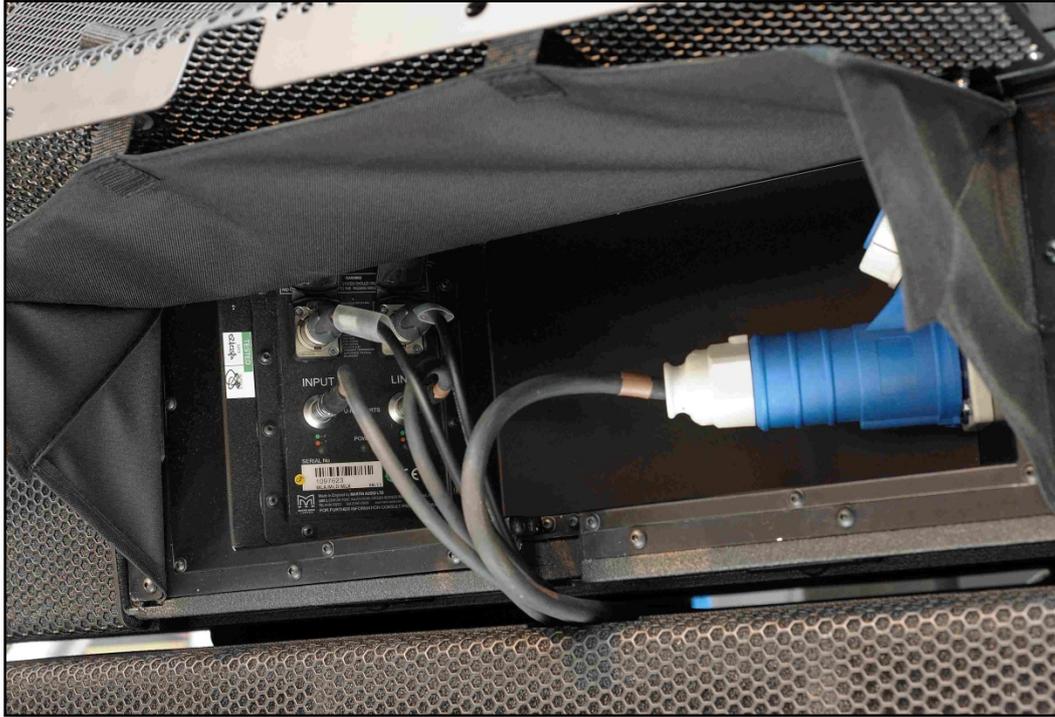
The first stage is to attach the rear facing sub to the existing array. In this example we have already flown two MLX facing forward. These should be flown well above head height to prevent injury to those working below. The sub to be rear facing should be positioned under the array and lowered flat so it is lined up directly with the existing MLX already flown but facing backwards;-



The flown subs are then lowered on top of the rear facing sub and connected front and rear in the usual way. The rigging brackets are identical front and back to make this possible. Now fly the array again keeping it well above head height. Now bring the next MLX over and again lower it flat under the array but facing forwards. Next you need to lay a 2.5m Ceeform extension cable (part number PWA00053), and two 3m link looms one facing in one direction and the second in the opposite direction, all in the central channel down the middle of the top of the cabinet;-



Now bring the flown cabinet in and land them carefully on top of the sub on the ground. Once in place make sure that the cables in the centre channel move freely, if they won't move they are probably trapped under the upper cabinets. Fly them out a short distance and re-position the cables before bringing the array back down and trying again. Once positioned, link the sub front and back in the usual way and then make the connections at the front of the array to the rear facing sub which of course has its rear panel at the front of the array. Raise the lower panel to make the connections;-



If there is any excess cable it can be pulled back through to the back of the array. Connect the Ceeform extension to the next Ceeform outlet on the breakout loom and connect the two link looms to the cabinets above and below the rear facing MLX, the link with the female XLR goes to the MLX above and the one with the male XLR to the one below. Check for power and network connectivity for the rear facing sub and the cover for the connection points can be lowered dressing the cables into the channel in the middle of the connection panel. The ventilation panel must be opened but the grilles on the rear of the cabinet make it look reasonably unobtrusive once the array is rigged. Any remaining cabinets can be connected in the usual way. The normal ratio for a cardioid array is two forward facing to every one rear facing.

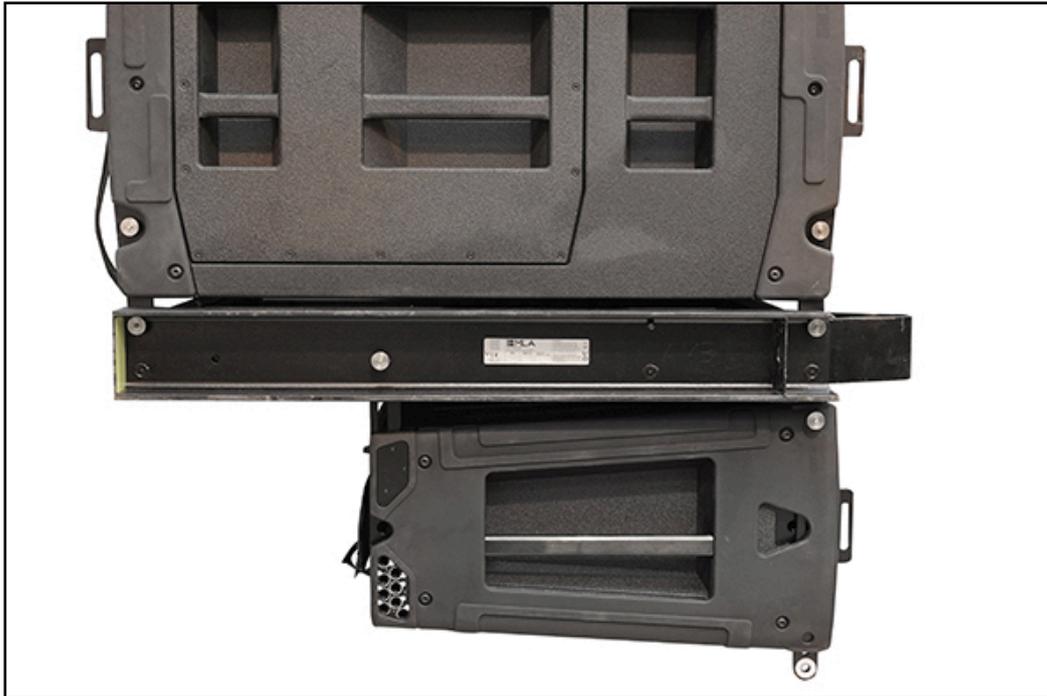
### MLA Flown under MLX

By using a second flying grid it is possible to assemble combination arrays with MLA flown under MLX. The maximum size for a combination array is six MLX with twelve MLA.

The first step is to fly the MLX exactly as described. When this is complete, position the second flying grid on the floor under the array. Lower the MLX until they have landed on top of the grid and pin them in position exactly as if you were connecting to another MLX. Fly the array out until the flying grid is just higher than the height of an MLA on its wheelboard. Wheel the first MLA under the grid and connect the rear flying bracket;-



The array can be flown so the MLA is just off the ground and swung up to connect at the front exactly as with a standard MLA array;-



You can now continue to build the array in exactly the same way as a normal MLA array.

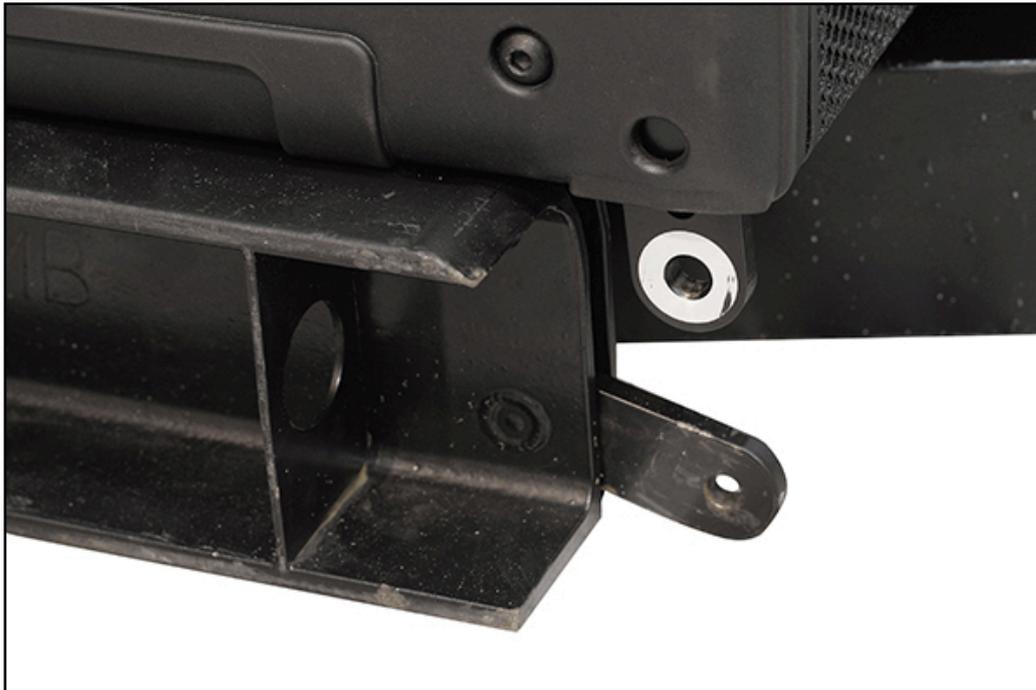
### Ground Stacked MLA arrays

MLA may be ground stacked with arrays of up to six cabinets. A ground stacked system uses the standard flying frame on the ground or on top of MLX. Start with the flying grid flat on the floor or on top of an MLX. It should be pinned to the MLX if used on top. Wheel the first MLA in front of the grid and lower it down flat on top of the grid so it comes to rest in the horizontal. Remove its wheelboard;-



Remove the pin from the front position on the flying grid, note that if you are ground stacking on top of MLX this pin will already have been removed to release the bracket that attaches to the front of the MLX. Remove the pins from the front stowage

positions of the MLA on both sides and the flying bracket will drop down. Carefully slide the MLA backwards guiding the tabs of the MLA flying bracket into the slot on the top of the flying grid;-



When the holes are aligned the cabinet can be pinned in place. It may help align the holes by lifting the rear of the MLA slightly.



Now connect the MLA ground stack bars to the appropriate holes in the grid just under the rear of the MLA. Raise the rear of the cabinet and pin the bar into the hole in the MLA as required to obtain the necessary angle;-



The stack is now ready for the next cabinet;-



The stack is built in the same way, positioning the next cabinet on top of the previous, the front should be lined up so that when the front bracket pins are removed from the stowing point the bracket drops down straight into the rigging bracket of the cabinet below and can be pinning in place at the front. The pins storing the rear bracket of the cabinet below should be removed, the upper cabinet raised at the back and the bracket pinned in the correct hole for the desired angle;-



Unlike a flown array you are advised not to wire the array as it is built, the cabling is likely to get in the way and as the system is ground stacked it is usually very easy to access the connection points when you have finished building the stack;-



## Rigging MLA Compact



MLA Compact shares many of the principals of its rigging with its bigger brother in the MLA family. The general approach of attaching cabinets to the flying grid then adding each subsequent cabinet by connecting the rear flying points and swinging the cabinet up to link at the front is the same however there are some significant differences.

Cabling and system connectivity is identical to MLA using the same Master and slave racks, cable trunks and cable systems which ideally would also be built into looms to make system connection more neat and efficient. MLA Compact itself is supplied in flightcases each holding a pair of Compact and they are semi rigged within the flightcase with flying pins connecting the cabinets at the front;-



The first step is to unbox all MLA Compact keeping them on the wheelboards. The flying grids are contained in their own flightcase along with the distro hangers, Inclinator reader, shackles and accessories. The flying grids are comparatively light so handling is not the issue that the MLA grids present. Remove one Flying grid and position it under the flying point or points. Attach a distro hanger to the back of the grid with one of the large shackles and use the same shackle to attach the hook from your hoist. Suspend the grid so it is held vertically, just touching the ground. Do this even if you are flying from a single point as it will prevent the grid from accidentally falling over while you are connecting it to the first Compact enclosure.

Wheel the first pair of Compact up to the grid. The front brackets are permanently exposed and as mentioned the two cabinets should be linked by their front brackets. Before connecting to the flying grid, check your Display 2.1 optimisation for the angle between the first two cabinets. If the wheelboard has been fitted up the right way (indicated by arrows routed into the bottom) only the second cabinet will be attached to it, the first cabinet can be pivoted upwards and the angle set between the two;-

Remove the flying pin securing the rear brackets on the first cabinet and swing them out of the way; for tight angles between cabinets it may be impossible to swing the bracket out on the first cabinet after you have set the angle between one and two so always swing the bracket out first. Check the angle on your Display optimisation, swing the rear brackets over and tip the first cabinet up to enable you to pin the brackets into the correct hole. Double check that the pins have been inserted correctly and the centre button has popped back out to lock it in place.



Now move the two Compact over to the vertical flying grid and line up the front flying brackets on the first cabinet with the corresponding holes on the flying grid;-



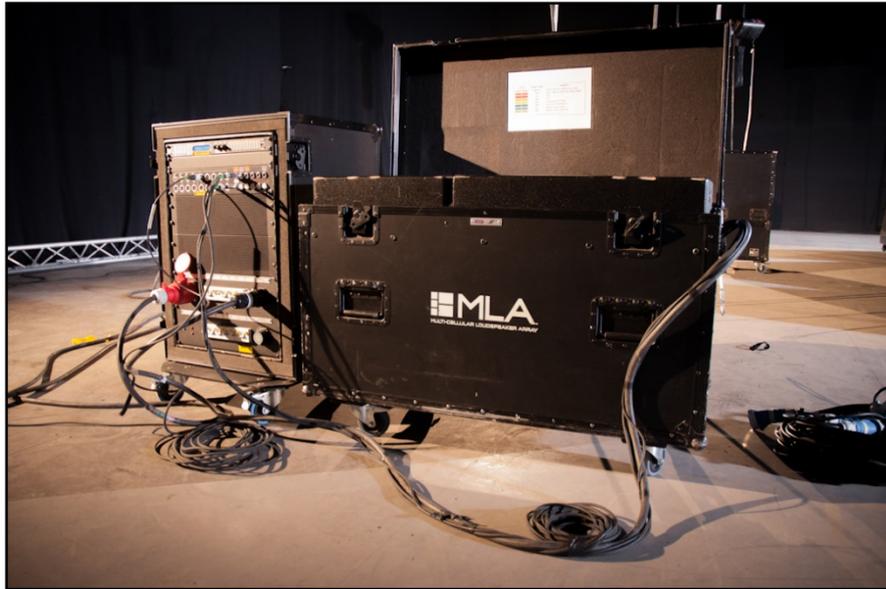
The Compact will have to be lined up completely square to the grid or it will be impossible to line up the holes in the grid and cabinet bracket. Connect the first cabinet to the flying frame, first with the front bracket;-



And then connect the rear bracket which you have already swung out.

If you are flying from a single point, move the hook from your hoist to the correct position on the centre spine of the flying grid as indicated on the Compact rigging spreadsheet using a second shackle. If you are using two hoists attach the second to the front most point on the flying frame with the second shackle. Fly the assembly first using just the rear hoist to raise it just off the ground, then take up the front hoist to raise the array to the horizontal. Be aware that the array will swing forward when it leaves the ground, take extreme care and ensure that nobody is standing immediately in front or behind the array when you lift it. Crew assisting with rigging the system should stand either side of the array and steady it carefully making sure they avoid getting fingers caught when it swings forward. Remove the wheelboard.

Connections can now be made to the array. If you have loomed your cables as described in the cables chapter you should place the cable trunk next to the Master or slave rack;



Connect the Tourmate mains cable to the mains distro, U-Net cables to U-Net ports 1 & 2 on the patch panel and the inclinometer cable to the reader which can be placed on top of the rack. If you are using the Merlin in the rack for audio distribution you can connect the array audio feed to the relevant audio output on the patch panel;-



Attach a 12-way Tourmate to Ceeform mains break-out loom to the distro hanger on the back of the flying grid, connect the Tourmate mains cable at the other end of the array loom to the break out loom;-



Connect the U-Net cable designated for the top cabinet to U-Net port 1 and the audio XLR cable to the XLR input on the first cabinet. Connect the Inclinometer cable to the sensor on the grid;-



Connect an 800mm link loom (U-Net & Audio) between cabinets 1 and 2 and connect the shortest Ceeform outlet from the mains break-out loom to cabinet 1. Do not connect the second cabinet at this stage as the Ceeform will get in the way as you connect the next pair of cabinets. Connect power to your rack and turn on all the breakers for both Tourmate outlets. Check that the Merlin powers up and you have a U-Net port 1 illuminated. Check that cabinet 1 has powered up correctly and you also have the U-Net port 1 LED illuminated.

Now prepare the next pair of Compact which will become 3<sup>rd</sup> and 4<sup>th</sup> in the array. As before, check the angle required between 4 & 4 from your Display 2.1 optimisation and set the angle using the rigging bracket on the 4<sup>th</sup> cabinet and lifting the 3<sup>rd</sup> to pin in the right hole. Wheel the pair of cabinet up behind the array and connect the rigging bracket on the 3<sup>rd</sup> cabinet to the correct hole on the 2<sup>nd</sup> compact referring to your Display 2.1 optimisation again for the relevant angle.

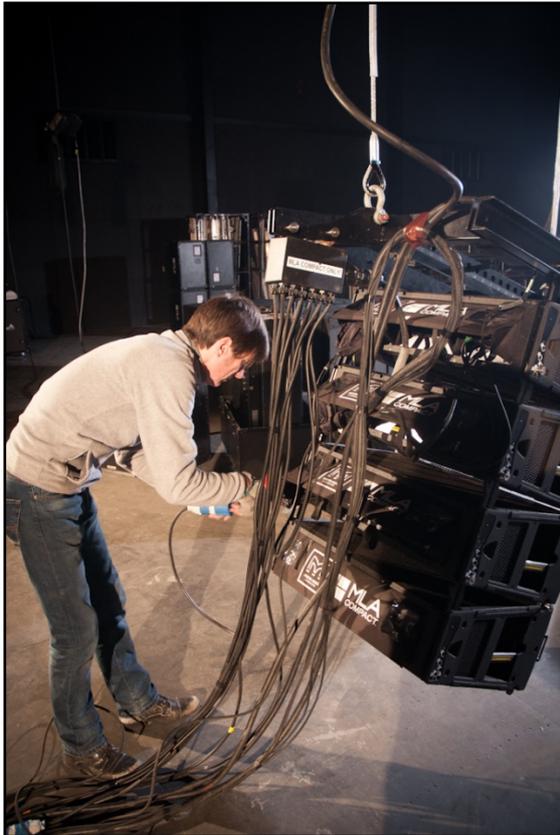


Raise the array just enough to get the Compact clear of the floor and swing the two cabinets up pinning the 3<sup>rd</sup> cabinet to the 2<sup>nd</sup> at the front on both sides;-



Remove the wheelboard then connect power to cabinets 2 and 3 but NOT 4, as we have mentioned, the Ceeform on the lower cabinet will make it difficult to rig the next pair of Compact. Connect link cables from cabinet 2 to 3 and 3 to 4, check that they power up correctly and that you get U-Net LEDs illuminating on all powered cabinets.

Continue to build the array in this way, preparing the next pair of cabinets, attaching to the rear bracket and swinging up the cabinets to link at the front. Continue to cable up as you go checking for power and green U-Net LEDs;-





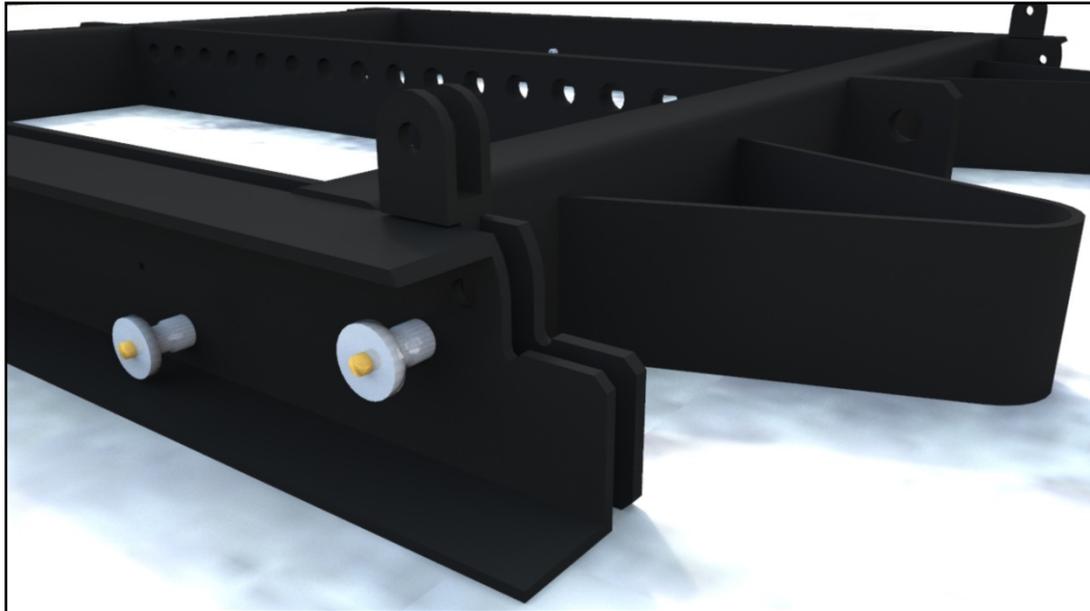
When you have connected the final Compact, connect the last Ceeform connectors to all remaining cabinets and the last link then the final U-Net cable that goes back up to the array loom checking for U-Net connectivity both on Port 2 of the final cabinet and on the Merlin.

The array is now ready to be flown to its final position but it is worth discovering the array using Vu-Net and running a system check as described in the U-Net chapter to ensure that every cell is working before flying the array to the correct trim.



### Ground Stacking MLA Compact

MLA Compact can be easily ground stacked using the standard flying grid in a similar way to its big brother MLA. The first step is to prepare the flying grid. At the front you will find the locating brackets which in normal flying use are in a stowed position facing forward. The flying pin securing them needs to be removed. The bracket is hinged on a slot so it can be pulled out, rotated 90° upwards and lowered until the shoulders of the brackets are resting on the top of the frame. It must then be pinned in place;-

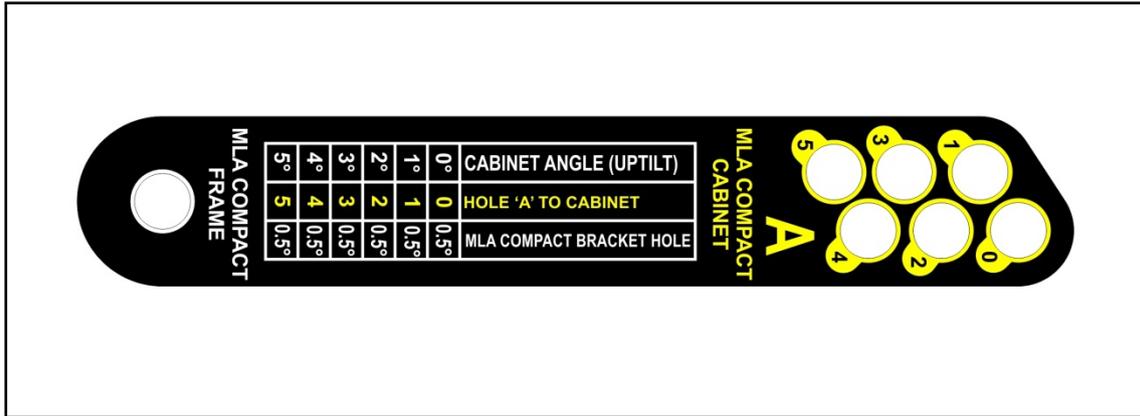


Now place the first cabinet flat on top of the grid being careful that the exposed bracket doesn't damage the bottom of the cabinet, always lift it into position rather than dragging it. Secure it into the bracket at the front of the grid with a flying pin;-



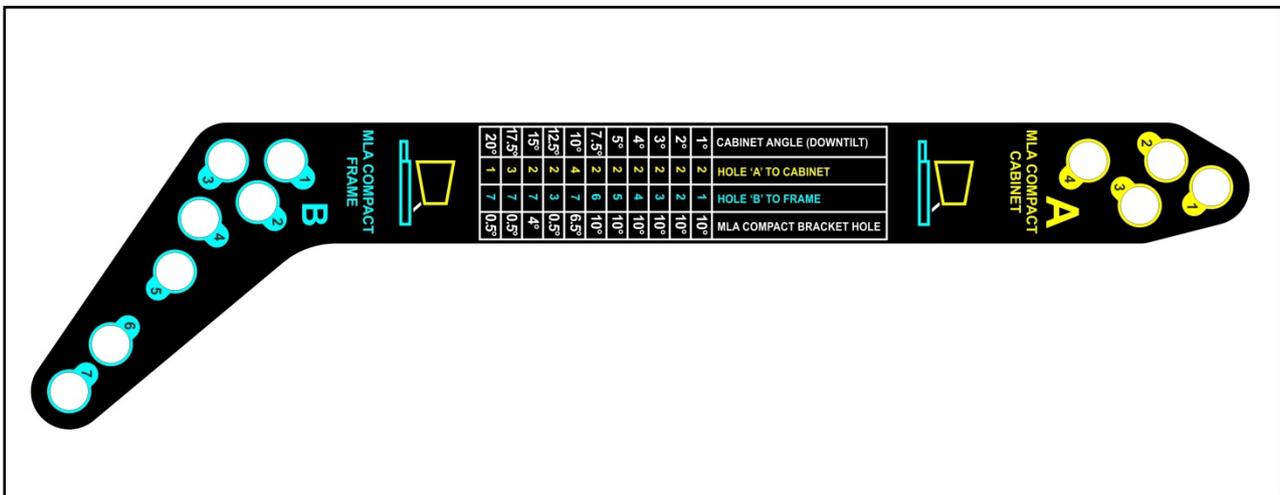
You are now ready to set the angle at the rear using one of the two ground stack bars. There is a long and a short bar the use of which is determined by your Display 2.1 design. If the bottom cabinet has an upward tilt the short bar is used, if it has a downward tilt the long bar is used.

The first step is to calculate the angle of the bottom cabinet which is done from the MLA Compact Pick Loads spreadsheet which has a tab for ground stacking. You enter the calculated angles from the project design in the yellow section and the angle for each cabinet with respect to the horizontal is shown in the blue panel. The key figure is the angle for the bottom cabinet. If it is tilting upward the short ground stack bar can provide angle of 0, 1, 2, 3, 4 & 5°. The Long bar takes care of down tilts or negative angles. The following angles are provided for;- -1, -2, -3, -4, -5, -7.5, -10, -12.5, -15, -17.5 & -20°. Both bars have a number of holes; the combination to use to achieve the desired angle is shown on a table printed on the side of each bar. For the short bar;-



Read the required angle from the first column, connect the bottom hole to the frame and use the corresponding hole from 0 to 5 connected to the 0.5° hole in the bottom MLA Compact to achieve the required angle.

The long ground stack bar is a little more complex;-



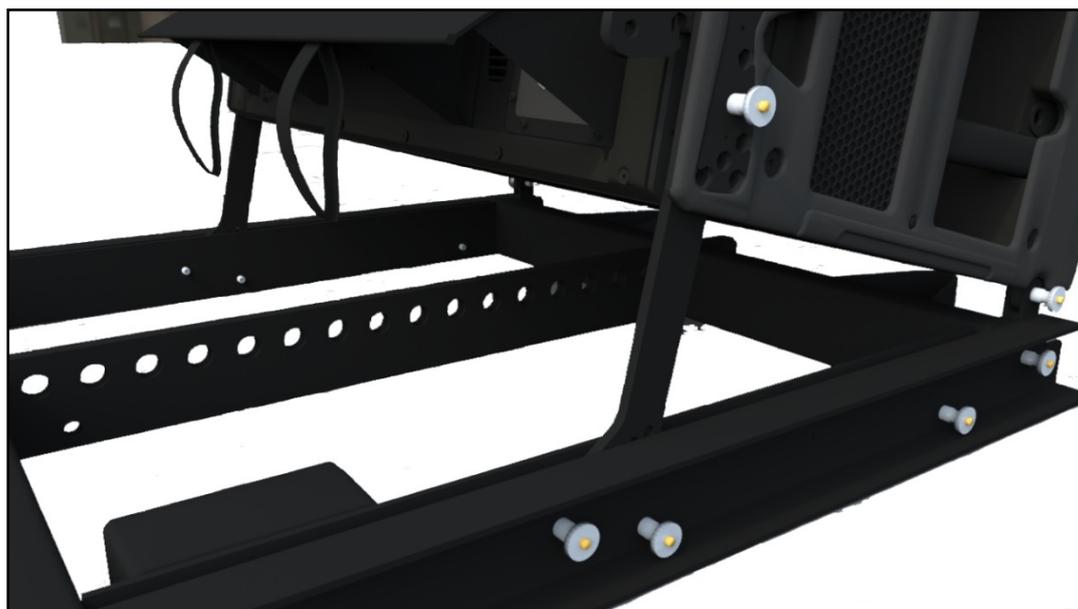
There are a number of options that are used to obtain the correct angle; the angle is shown in the first column, having selected your angle you then look across to the next three column which show you which of the cabinet connection holes "A"(yellow) from 1 to 4 to use and which of the Frame connection holes "B"(Blue) from 1 to 7 and finally which bracket hole in the bottom cabinet to use.

For example, if we require a down-tilt of 10° we use yellow hole 3, to connect to the 6.5° hole in the cabinet and blue hole 7 right at the end of the "dog leg" to connect to the flying frame.

Next connect the bar in place. It is instinctive to connect to the frame first however when using the short bar, if you connect to the frame and let go of the bars they drop down inside the gap between the plates of the flying frame and it is difficult to recover them. Connect to the cabinet first, note that you will probably have to remove the rear bracket flying pin from both sides to get the rear bracket swing arm out of the way before attaching the ground stack bar;-



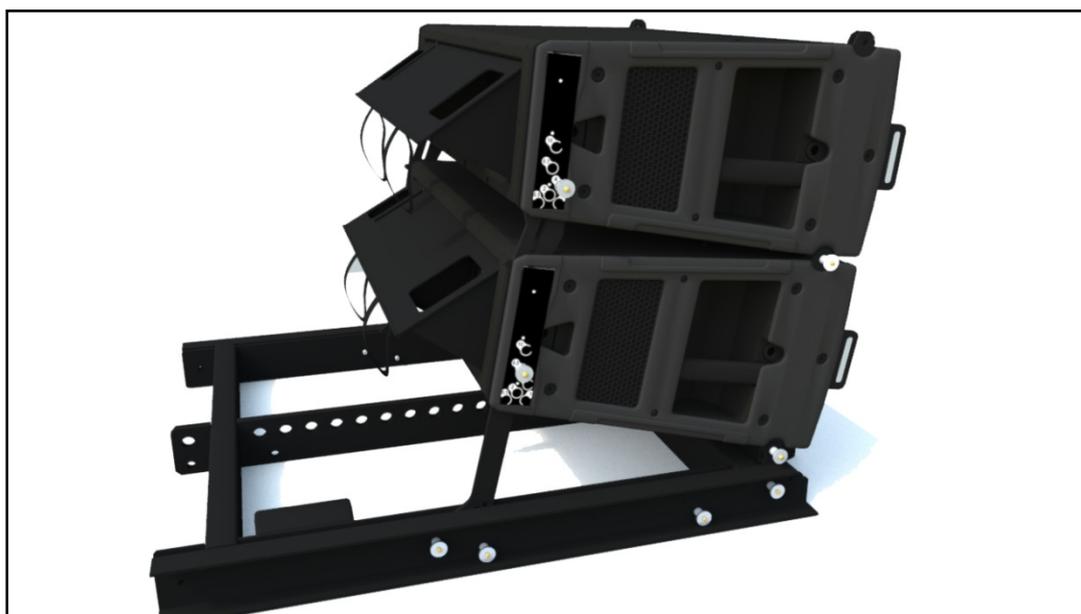
raise the rear of the cabinet and pin the bottom hole in the ground stack bar to the flying frame;-



Now place the next cabinet on top of the first and pin it at the front;-



Raise the back of the cabinet and link the cabinets at the angle shown in your Display project;-



Continue adding cabinets, always connecting the front brackets first and then setting the angle and pinning at the rear;-





The finished 6-box ground stack system;-



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