Martin Audio

F2 User's Guide

F2 USER'S GUIDE

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F2 SYSTEM USER'S GUIDE

The Martin F2 has been designed to apply the advantages of coupled "separate component" loudspeakers to a standardised two-box system for use in high-level sound reinforcement applications

The bass section consists of a 2 x 15" hyperbolic horn with a programme power rating of 1 kW. This bass cabinet,which is fitted with flying points, is stack-compatible with the earlier Martin 115, 215 Mk1, 215 Mk3, and RS1200 systems.

The matching mid/high cabinet may be fitted with various combinations of mid, high, and super-high frequency units. These may be easily reconfigured to suit the user's requirements, the concept being similar to that of an amplifier rack.

For a hire company this versatility ensures high stock utilisation, because the same equipment can be supplied to customers in various forms to suit different applications.

The user may choose whether to work with multi-band cabinets for smaller venues, near-fill stacks and sidefills; or with separate long-throw cabinets for each frequency band, for large arenas and outdoor productions.

The F2 is designed to permit close-coupling of modules and cabinets when required, and provides an engineer with the ability to array a system for optimum coverage of each venue.

A correctly arrayed F2 system is capable of providing extremely even coverage, especially in difficult venues, ensuring that all of the audience receive the same sound. This achieves several benefits:

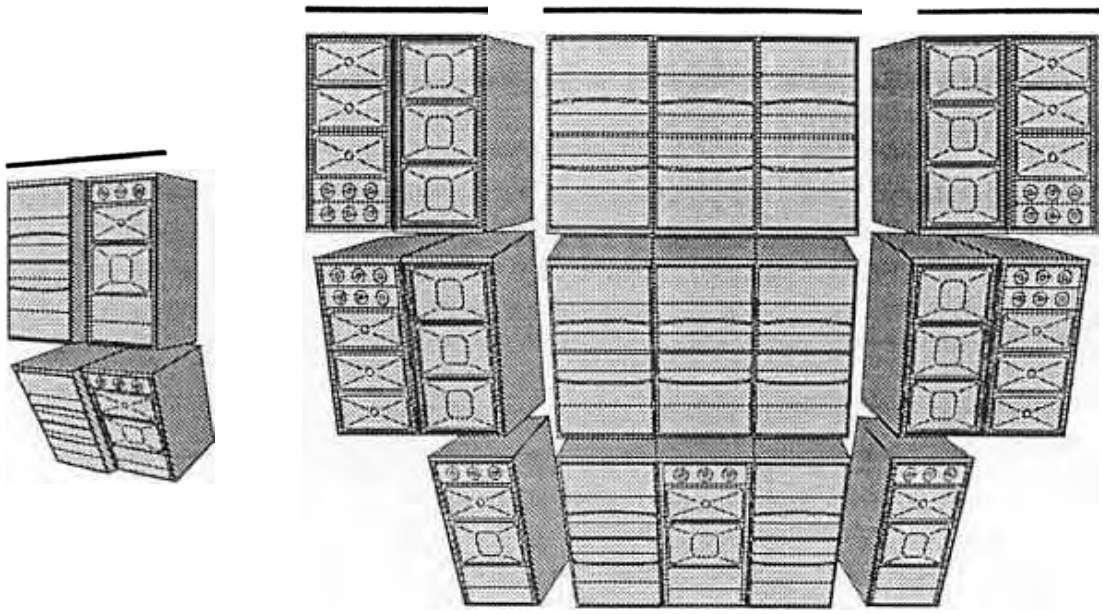
> The engineer can be confident that his or her mix is heard not only by those in the vicinity of the control desk, but by the entire audience.
>
> The performers and their management can be confident that their production will not be compromised by a poor sound for some sections of their audience.
>
> The promoters and venue management will indirectly benefit by their confidence in obtaining a high level of audience satisfaction.

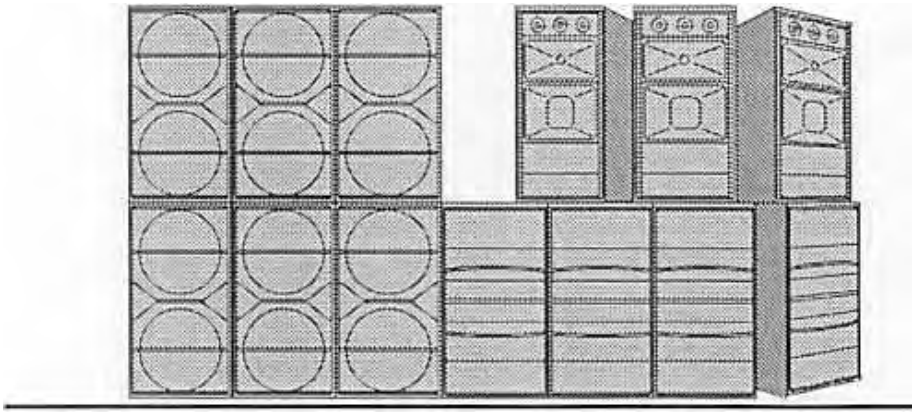
The system supplier can optimise the system with the minimum amount of equipment.

All F2 components use horn loading and well-proven high quality drive units. This results in high acoustic efficiency, which translates into fewer cabinets and lower power being required in a given application when compared with typical competitive systems. Carefully chosen cabinet dimensions allow full utilisation of truck space.

These factors can result in significant savings on transport costs.

The large number of F2 systems in use forms a worldwide network of fully compatible equipment which may be easily combined when the need arises.





F2 System for Typical Arena Venue, 5 10000 capacity
(Stage Right Shown)

F2 COMPONENTS

F2B

The F2 Bass cabinet is fitted with a pair of 15" 8Ω drivers with 4" voice coils. Maximum programme power is 1kW and the sensitivity is 107 dB @ 1W (2.0V) @ 1m in a stack (both drivers, measured in half-space). Dispersion is dependent on stack size and shape. It weighs 107 kg (235 lbs).

F2R

The F2 Rack consists of a rack-mount cabinet with grille and fittings. Height and width are the same as the F2B. The F2R may be fitted with various combinations of horn modules as required. Unused spaces may be filled with blanking modules. Several identical horn modules may be arrayed within a rack for long throw (reduced vertical dispersion) applications. Each module is mechanically and electrically self-contained, and plugs into an XLR panel inside the rack. Four separate circuits are available in the rack, and several identical modules may be parallel linked on the same circuit if desired. A write-on plate is fitted adjacent to the cabinet connector panel to allow clear identification of the wiring. The cabinet weight excluding modules is 61kg (122 lbs).

All modules are designed to provide the same 60° horizontal dispersion, with constant beamwidth over their working range. The reduced vertical dispersion required for "long throw" applications can be achieved by arraying several identical horns in the rack.

F2M

The F2M mid module is a compression loaded, high power, 12" driver with a 3" voice coil. Impedance is 10Ω (minimum 8.2Ω) and sensitivity is 108 dB @ 1W (3.16V) @ 1m. Module weight is 19.3 kg (42 lbs).

F2H

The F2H module is fitted with a 4" voice coil, 2" exit, titanium diaphragmed compression driver connected via a protection and matching network. Impedance is 12 Ω, and sensitivity is 108 dB @ 1W (3.46V) @ 1m. Module weight is 18.2 kg (40 lbs).

F2T

The F2T VHF module consists of an array of three 1.75" voice coil, aluminium alloy diaphragmed ring radiators connected via a protection and matching network. Impedance is 20Ω (minimum 16.2Ω) and sensitivity is 110 dB @ 1W (4.47V) @ 1m. Module weight is 9.8 kg (21½ lbs).

F2V

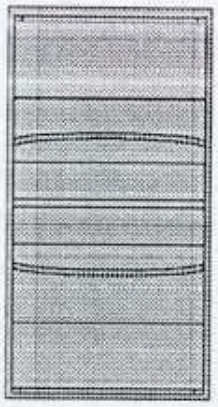
The F2V module is designed specifically for use in long throw arrays, and is fitted with a 1.75" voice coil, 1" exit, titanium diaphragm driver connected via a protection and matching network. Impedance is 16Ω (minimum 12.2Ω) and sensitivity is 104 dB @ 1W (4.0V) @ 1m.
Module weight is 8.6 kg (19 lbs).

F2-3UB, F2-4UB

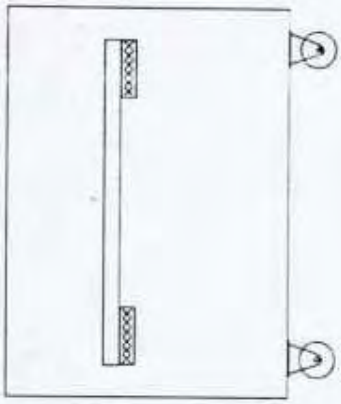
These are the two sizes of blank module available for filling up unused spaces within racks. They use the same fixing method and material as the horn modules and are visually compatible.

MX4

Unlike many loudspeaker systems, the F2 does not require specialised "processors" to function properly. Martin Audio manufacture, and suggest the use of, MX4-F2 system controllers which are supplied with all crossover and alignment functions optimised for the F2 system.

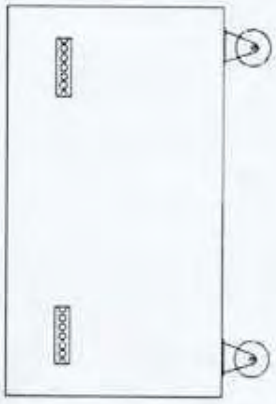


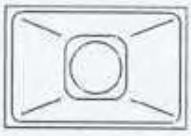
F2B



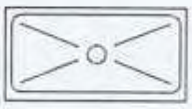
24 Units

F2R





F2M 8 Units

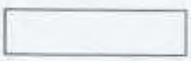


F2H 6 Units

F2T 3 Units

F2V 4 Units

F2-4UB 4 Units



F2-3UB 3 Units

1 Unit = 41mm

CONFIGURATION

Racks:

In practice, virtually all operational requirements can be met with a few standard F2 Rack configurations.

These are:

F2R-MHT "Combination" or short throw rack, fitted with:

1 x F2M 12" midrange horn
1 x F2H 2" HF horn
1 x F2T VHF array
1 x F2-4UB blanking module
1 x F2-3UB blanking module

Weight: 234 lbs (106kg)

F2R-3M "Mid" Long Throw mid rack, fitted with

3 x F2M 12" midrange horns

Weight: 250 lbs (114kg)

F2R-3H2T "Top" Long Throw HF rack, fitted with

3 x F2H 2" HF horns
2 x F2T VHF arrays

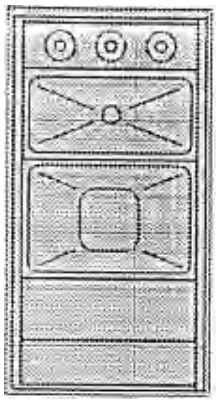
Weight: 285 lbs (129kg)

F2R-2H3V "High" Extra Long Throw HF Rack, fitted with:

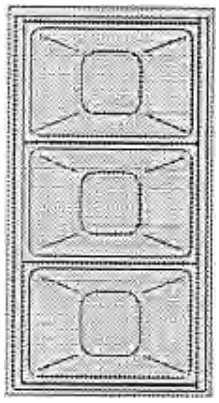
2 x F2H 2" HF horns
3 x F2V 1" VHF horns

Weight: 259 lbs (118kg)

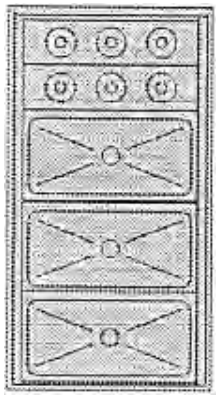
F2R-MHT
"Combination"



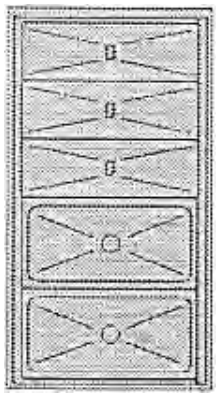
F2R-3M
"Mid"



F2R-3H2T
"Top"



F2R-2H3V
"High"



Stacks:

a. The minimum complete stack comprises:

1 x F2 bass cabinet

1 x F2 Combination MHT rack.

This has a dispersion of 60° Horizontal x 40° Vertical.

Doubling up this stack for wider horizontal dispersion is simple. The optimum 40° angle between the MHT cabinets translates into a 16" gap between the cabinet fronts, with the back corners in contact.

For narrower vertical dispersion, a "medium-throw" stack can be used, in which the upper MHT cabinet is inverted. This provides some coupling between modules, with the highest frequency components being the closest together.

b. The minimum complete "Long Throw" stack consists of:

2 x F2 Bass

x F2 Mid 3M rack

1 x F2 Top 3H2T rack

In this configuration, the close vertical coupling of similar horns gives a reduced vertical dispersion of around 20°, hence its suitability for "long throw" applications.

c. An "Extra Long Throw" stack consists of:

4 x F2 Bass

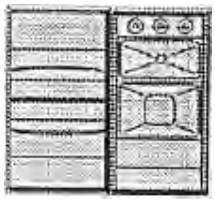
2 x F2 Mid 3M racks

2 x F2 High 2H3V racks

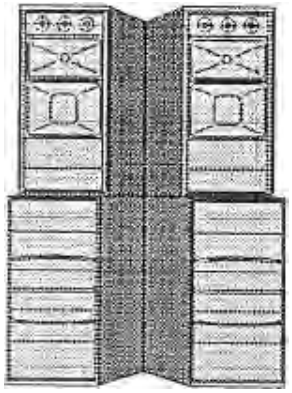
This configuration is capable of providing excellent results at distances of 200 feet (60 metres) and more. It is particularly useful for outdoor festivals and for covering tiered seating at the rear of large arenas.

It should be noted that High (2H3V) racks are always used in pairs, vertically stacked with the lower cabinet inverted so as to couple four F2H 2" modules together. They should not ideally be used individually as substitutes for Top (3H2T) racks.

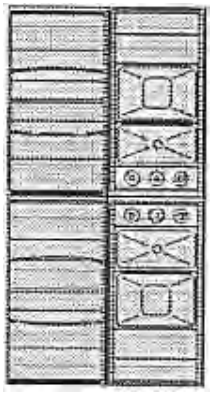
The basic configurations described above may be used as "building blocks" in the construction of large arrays.



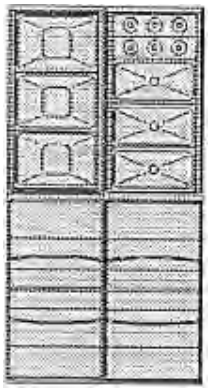
a. Minimum F2 Stack

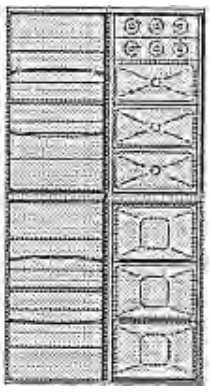


Double F2 Stack

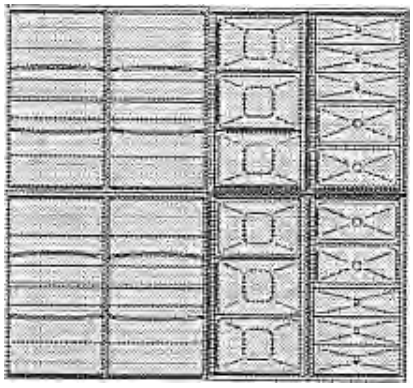


Medium throw coupled stack





b. Long throw stacks



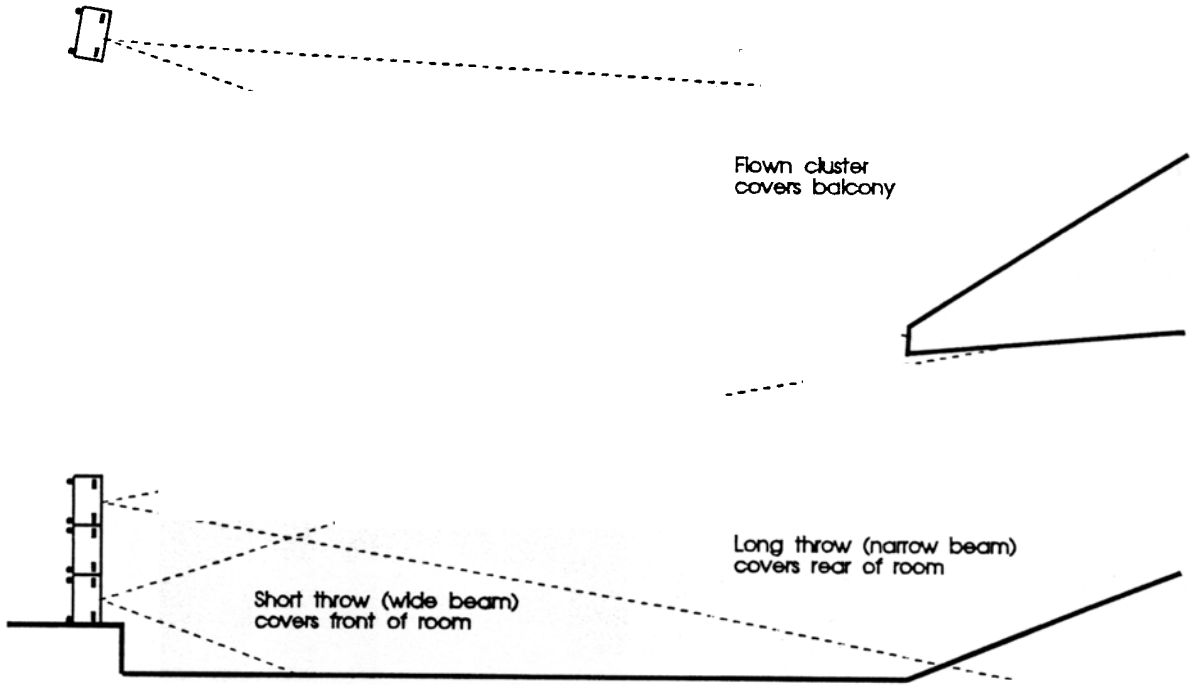
c. Extra long throw stack

COVERAGE

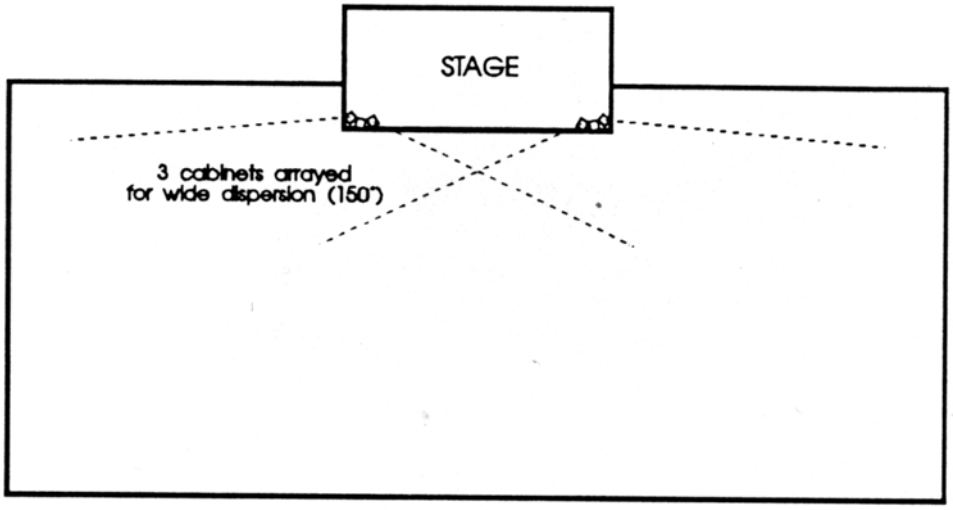
It is helpful to visualise the speakers' dispersion in similar terms to a lantern beam. If this is done, the system can easily be stacked to realise considerable benefits over "one-box" rigs. With care and experience it is possible to achieve very even and consistent sound coverage of all of the audience, even in difficult venues.

Every system will require some short throw or Combination cabinets to cover the audience close to the speakers. For ranges of 80 feet (25m) or more, long throw cabinets should be added. These should be stacked or flown sufficiently high that their beams miss the nearer areas of the audience already covered by the short throw speakers, and carefully aimed to provide the coverage required by the situation.

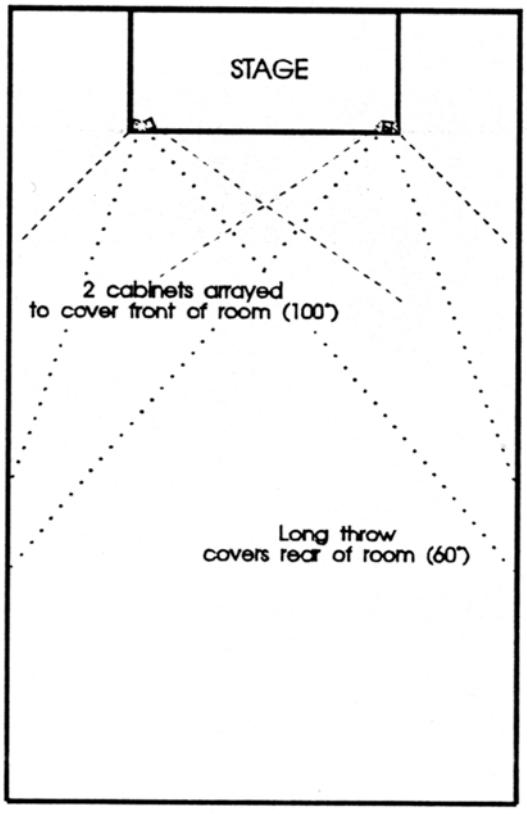
The speaker stack should be designed for optimum results in a given situation. "Typical" stack plans issued as a guide to the principles involved can be easily modified to suit the needs of particular venues. Regular users build up a dossier of venue-specific stack plans for their future reference.



System coverage principles



Wide venue



Long narrow venue

System coverage principles

STACKING AND ARRAYING THE F2

Ground Stacks

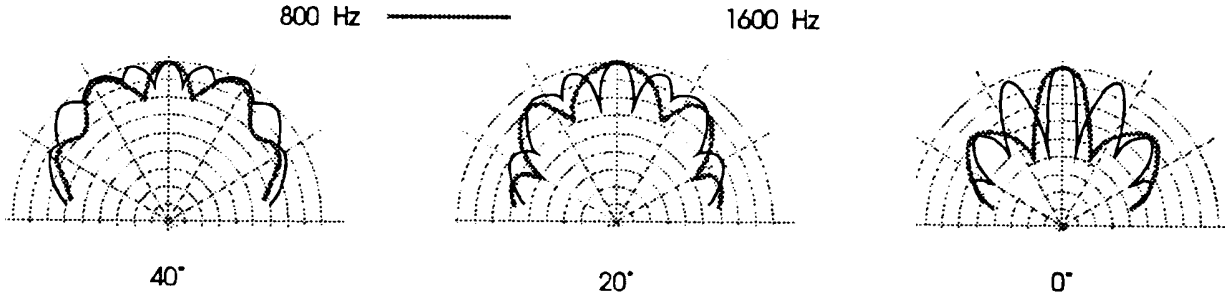
Unlike a "one-box" rig, the F2 makes it possible to apply the simple rules of stacking which will be familiar to those with experience of "separate component" speaker systems.

Bass speakers should be stacked together in a block, which improves their efficiency; and preferably high rather than wide. This is because dispersion is decreased in the direction of the largest dimension and the required coverage is normally wider in the horizontal plane than in the vertical.

Reducing the vertical coverage will normally reduce bass reverberation in the venue. However, it is more important to correctly position the mid and high frequency components than the bass cabinets, so the user should be prepared to compromise the shape of the bass stack in favour of using it as a stand for the F2 Racks.

Mid, high and VHF units will not be heard if they are masked by the audience, and therefore require positions above head height, at least 6 feet off the floor in "standing" venues.

Similar mid and high cabinets must not be stacked parallel side-by-side. They must be angled apart or stacked vertically. The optimum horizontal inter-cabinet angle for the F2 Rack is 40°, or a 16" gap between cabinet fronts with the rear sides touching. Reducing this horizontal angle results in more level on axis but disrupts the dispersion pattern, whilst a wider angle results in a loss of level on axis. Angles of less than 20° or more than 50° should generally be avoided.

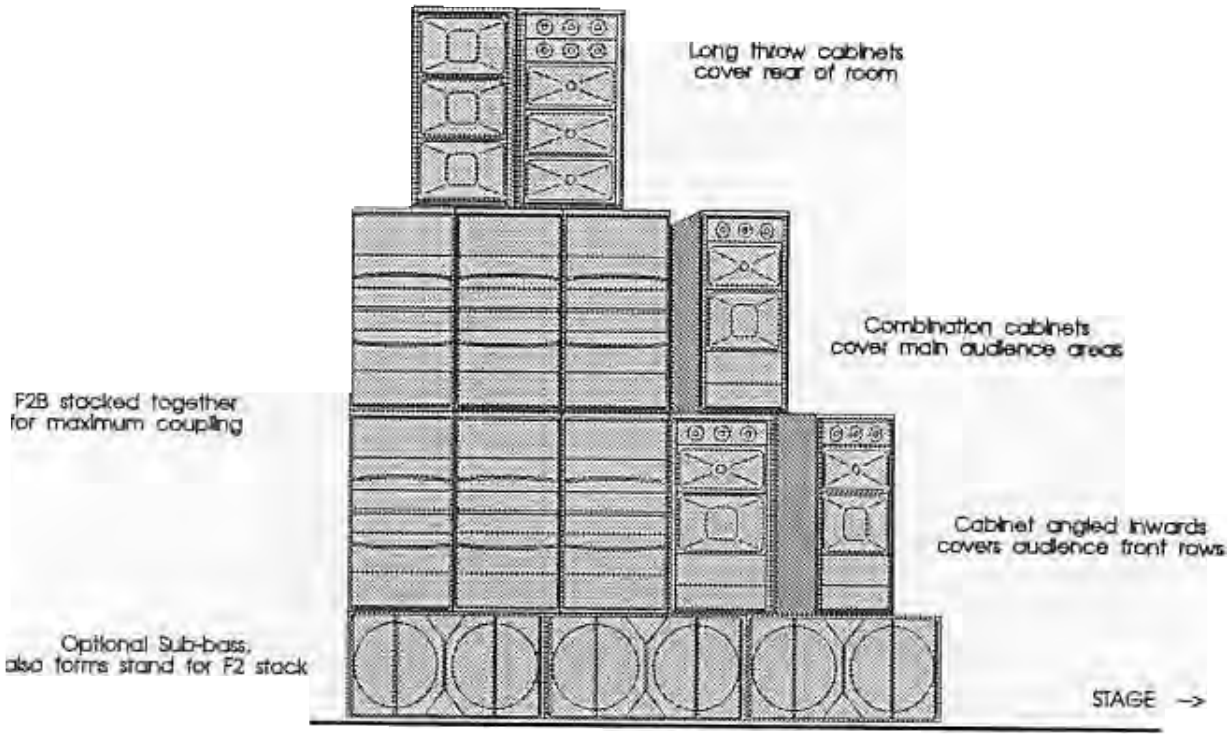


Typical horizontal polar diagrams for arrayed cabinets, showing interference

Vertical stacking will reduce vertical dispersion and effectively increase the throw. When Combination (MHT) or Top (3H2T) cabinets are vertically stacked in pairs, the upper one should normally be inverted. This places the higher frequency modules closer together and is also physically easier due to the weight distribution within the cabinet.

Long throw cabinets are always used in pairs, so that every Mid has a Top cabinet stacked with it and pointed in the same direction.

Speakers should only cover the audience. Pointing them at bare walls or into the roof will only result in increased room reflections and reduced clarity. The intention should be to use the directional properties of the array to maximise the direct-to-reverberant ratio of the system within the venue. The uppermost cabinets in a high stack can be angled downwards to cover the audience and reduce acoustic reflections from the walls of the venue, or upwards for balcony coverage. These vertical angles between cabinets can be easily set as required using, for example, 4" x 2" blocks.



Typical F2 stack for medium sized venue
showing stacking and arraying principles

FLOWN CLUSTERS

Flown clusters adopt the same criteria as ground stacks. Ensuring the vertical cabinet angles are accurately set will allow the full potential of the system to be realised.

As standard the F2 System is supplied with Aeroquip compatible and custom hinge flying points. The F2 can be supplied with alternative or additional flying methods such as the MAN System. For touring systems or temporary installations, suitable flying frames will be required.

As will be seen from the diagrams, most practical arrays are formed from columns which are two cabinets wide. Consequently, 2-way frames are the most versatile arrangement. They can be fitted with extra hanging points to allow a single width column as an alternative to a pair. 3-way and 4-way frames have also been used successfully in large arena systems.

Frames must be sufficiently deep to allow for a vertical pull-up strap at the maximum anticipated cluster size; this depends on the maximum column height and the downward angles required. A frame depth of 4 ½ feet is required for a standard arena system. For balcony coverage where only one or two rows of cabinets are used, the frame may be quite small. For unusual venues where extreme vertical coverage is necessary, frames may require a depth of up to 6 feet.

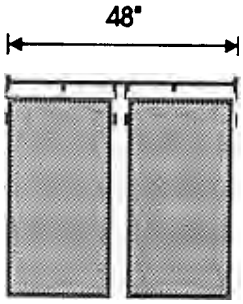
Frames must be sufficiently wide to allow for the intercabinet spacing which results from columns being curved. It is important to realise that if the corners of the bottom row of cabinets are in contact, the cluster will widen towards the top and the uppermost cabinets will be some distance apart. For this reason, two-way frames will generally be found more versatile than 3 or 4-way frames, as they may be suspended separately with the appropriate horizontal spacing.

Martin Audio can supply a BASIC computer program to calculate cluster and frame sizes and correct pull up strap positions. This will be found especially useful when planning permanent installations.

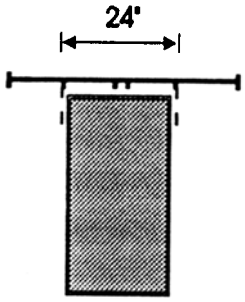
To maintain correct vertical alignment when the system is flown, F2 Cabinets are linked at the rear with hinges. With the Aeroquip system, the vertical angles are set with adjustable links between cabinets. With the optional MAN flying system, rear pull-up straps are used at appropriate points to set the vertical angles.

The upper F2 cabinet in a flown column is suspended from the flying frame with two Aeroquip fittings attached to hooks or chains, plus a special rear hinge fitted with a Unilock. Cabinets are then connected together with Aeroquip chain links and custom rear hinges. Integral metalwork links the attachment points within the cabinets.

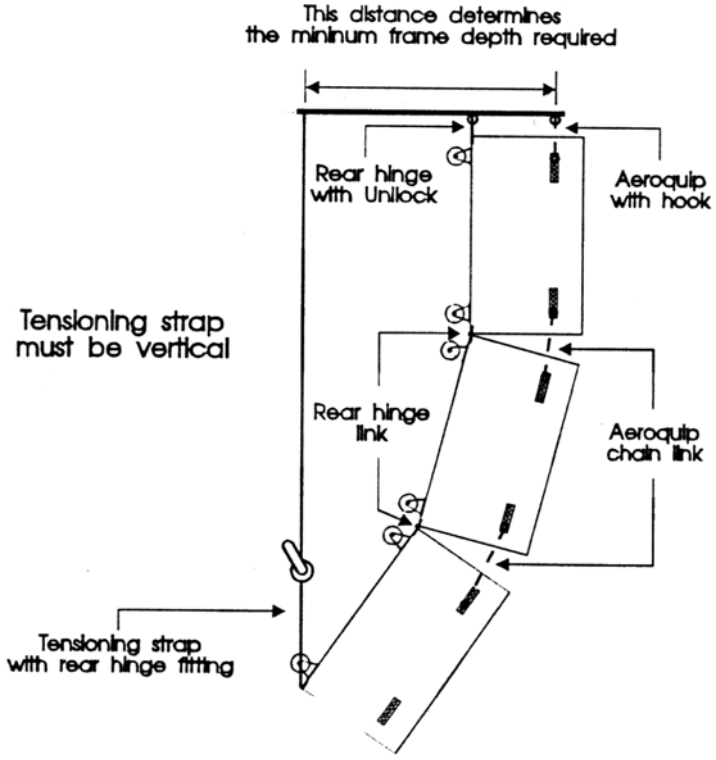
Finally a ratchet strap fitted between the frame and the bottom cabinet is tensioned to set the cabinet angles. When the strap is fully tightened, the load is shared between the Aeroquip side fixing points and the strap, whilst the rear hinges retain the cabinets in alignment. For correct weight distribution the strap must be approximately vertical.



2-wide frame
with two cabinets



2-wide frame
with single cabinet



F2 flying system

Setting Intercabinet Angles

Experience has shown that virtually all practical requirements can be met with only three different settings and that absolute accuracy is not required for acceptable results. However, extra care taken in setting these angles will be well repaid by the results obtained.

The optimum vertical angle between two similar "Top" or "Mid" racks will be between 10° and 18°, depending on the required throw. This corresponds to 4" to 8" gap between cabinet front edges.

The optimum vertical angle between a Long throw "Mid" or "Top" rack and a "Combination" rack will be between 18° and 22°. This corresponds to 7½" to 9" gap between cabinet front edges.

The optimum vertical angle between two "Combination" racks will be between 25° and 35°, depending on the required throw. This corresponds to 11" to 14" gap between cabinet front edges.

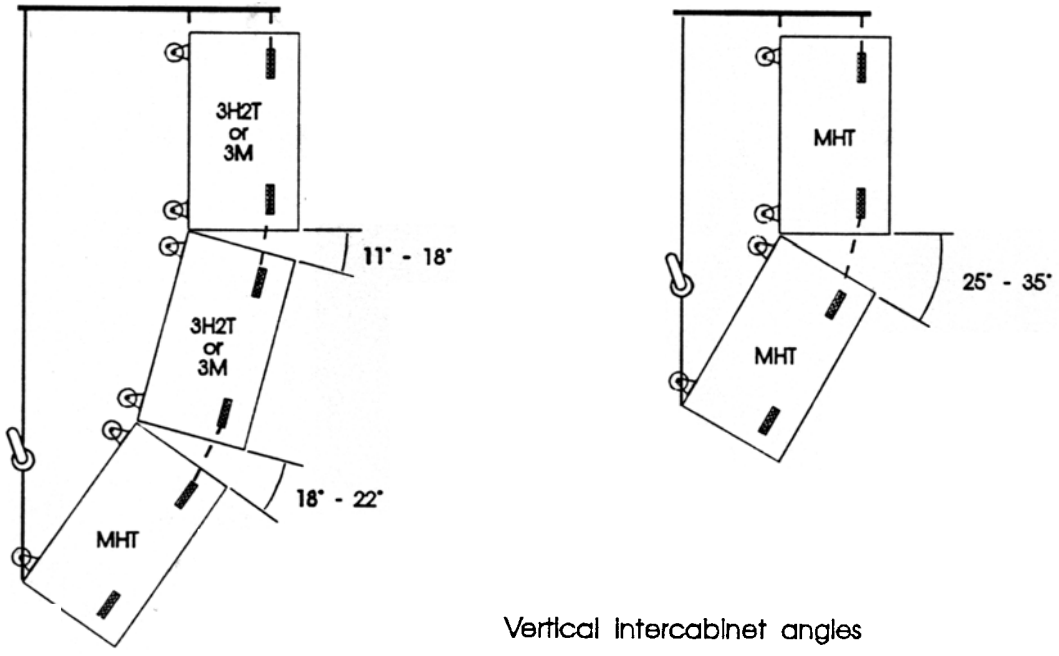
When Extra Long Throw "High" cabinets are used they must be coupled in pairs with no vertical angle between them. The "Mid" cabinets paired with them should be coupled in the same way.

Flying systems must only be assembled by trained and experienced crew, working in association with professional riggers.

All flying frames and fittings must be manufactured and tested to approved standards.

Only safety approved, load rated hardware may be used.

Flying hardware must be checked regularly and any suspect items discarded. The integrity of flying equipment is essential for public safety, and compromises in this area are not acceptable.



Vertical Intercabinet angles

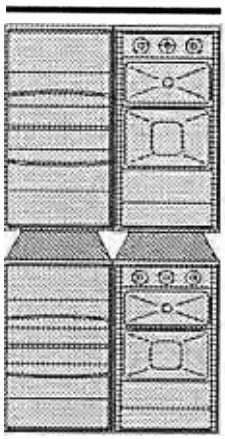
Small Flown Systems (Theatres, cinemas and balconies)

For Balcony coverage in small venues either a central cluster on a 3 or 4-way frame (or 2 x 2-way frames) or a stereo pair on 2-way frames can be used according to the coverage required and the engineer's preferences.

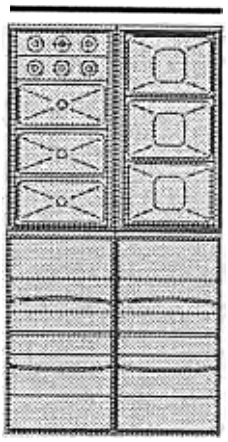
In many venues it will be helpful to fly some bass cabinets in addition to mid and high frequency components. Experience has shown that this achieves better low frequency coverage of balcony areas, compared with the use of ground stacked bass alone.

If the desired horizontal coverage is 60° or less, only one column of cabinets is required in each cluster. If it is between 60° and 100° then splayed pairs of cabinets will be required.

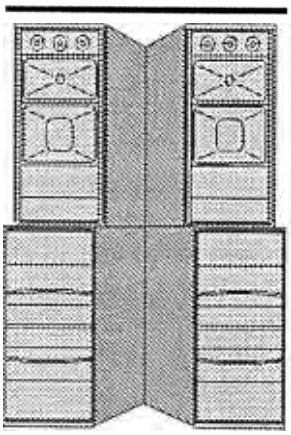
If the desired vertical coverage is 20° or less, or if the throw is more than 25 metres (80 feet), then long throw cabinets should be used.

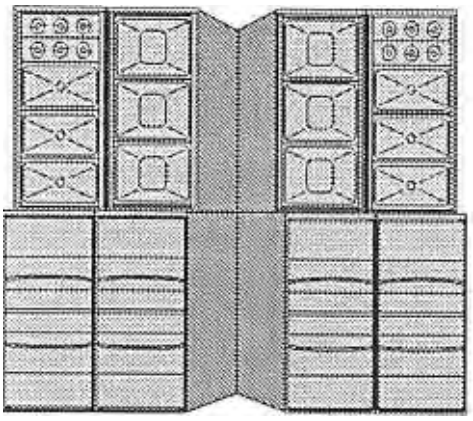


Flown cluster
for balcony coverage



Long throw flown cluster
with narrow vertical coverage





Wide dispersion centre clusters

Large flown systems (Arena Venues)

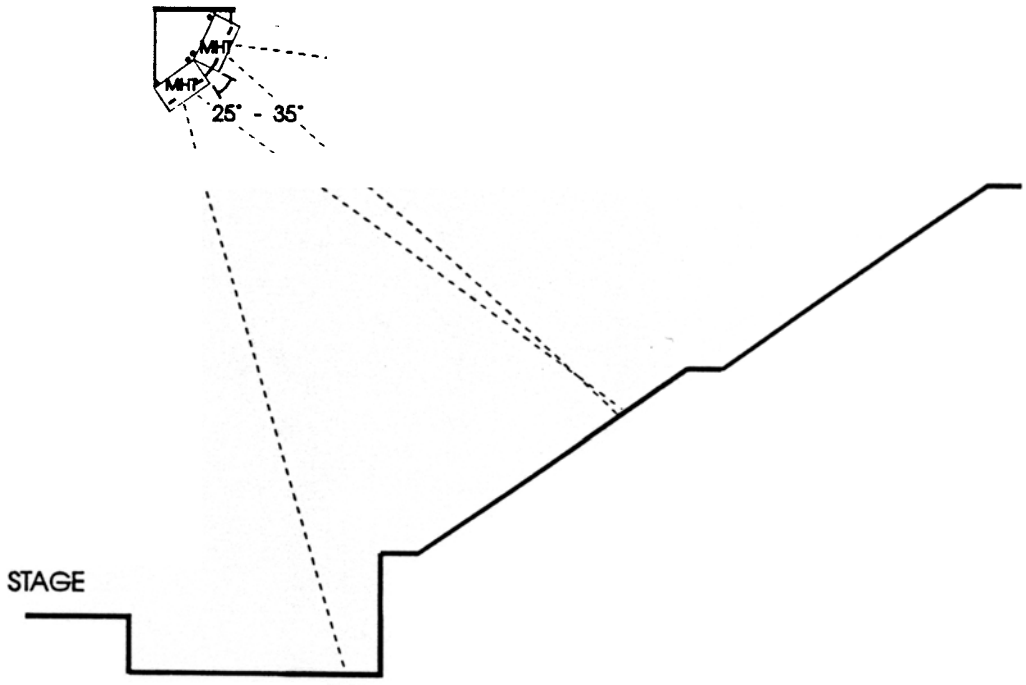
For most large venues a pair of standard clusters, each consisting of a central block of bass cabinets with a mid/high array on each side, can be used. If the cluster includes two or three "Combination" boxes angled downwards on the bottom row, only a minimum ground stack will be required for the front rows of the audience.

In most cases it is not necessary to vertically arc the block of bass cabinets, but the bottom row should always be angled well downwards. In reverberant venues a small (5-20°) downward angle on the main block of bass cabinets can reduce LF spill into the roof areas thereby improving sound clarity.

The horizontal angle between each Mid/High array and the central bass stack should be 20°, giving 40° in total. The entire cluster should be aimed to optimise coverage of the audience areas. Where several flying frames are used, they should be tied together with suitable linking bars or (black) sash cord to prevent them from moving out of alignment after they have been hoisted out.

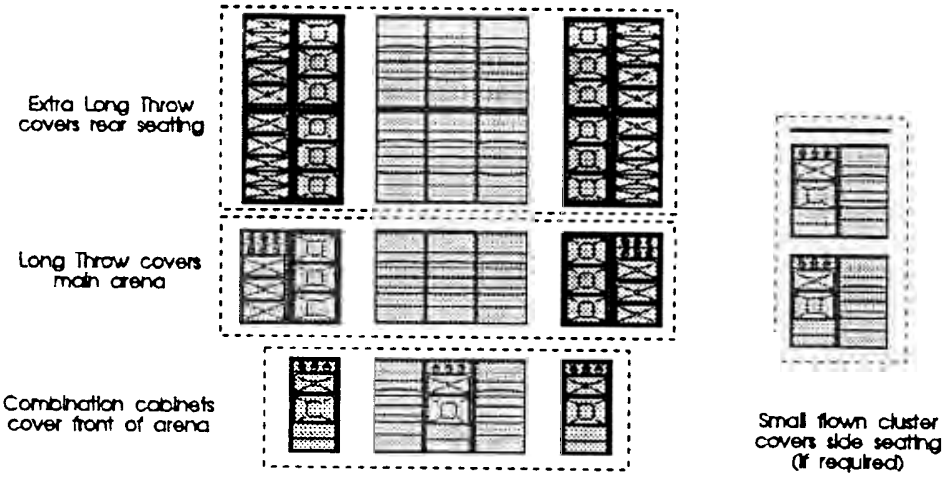
Many large venues require additional coverage of seating areas to the sides of the stage. Whilst these can sometimes be adequately covered by small ground stacks angled upwards with wood blocks, it is preferable to add a pair of small flown clusters, each comprising two or three "Combination" plus bass cabinets on a 2-way frame. The horizontal angle is adjusted in situ using (black) sash cord brail lines attached to the frame before it is hoisted out.

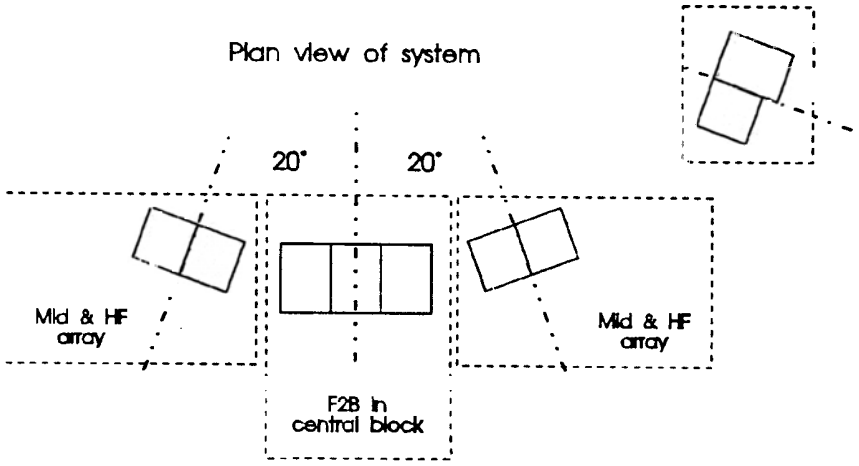
Provided the advice concerning cabinet angles is followed, the "standard" cluster can be easily modified to suit the requirements of different venues.

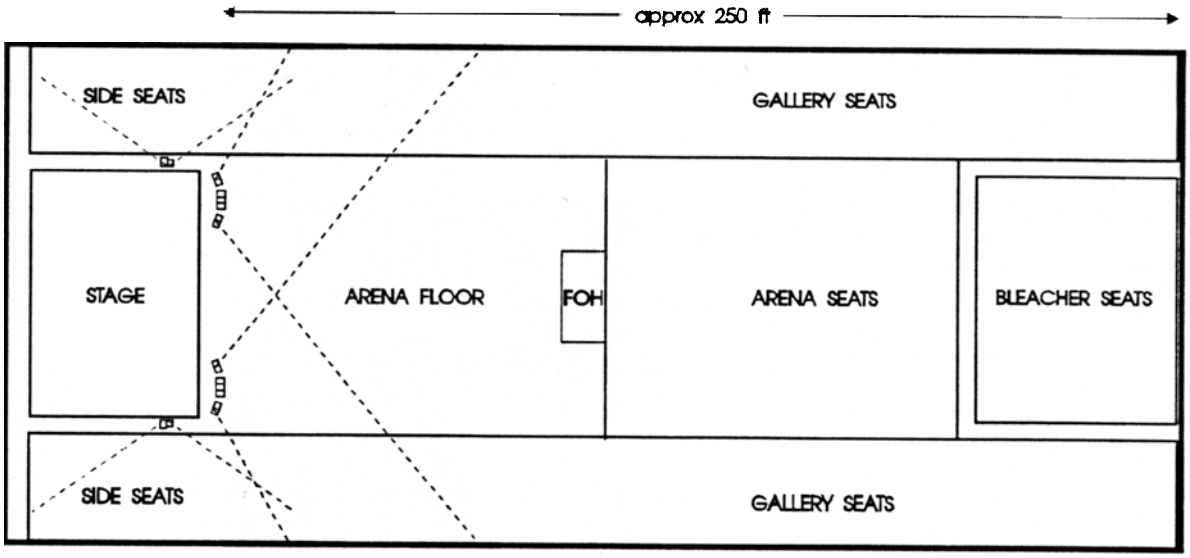


Coverage of side seats in arena with small flown cluster

Flown system for large arena venue

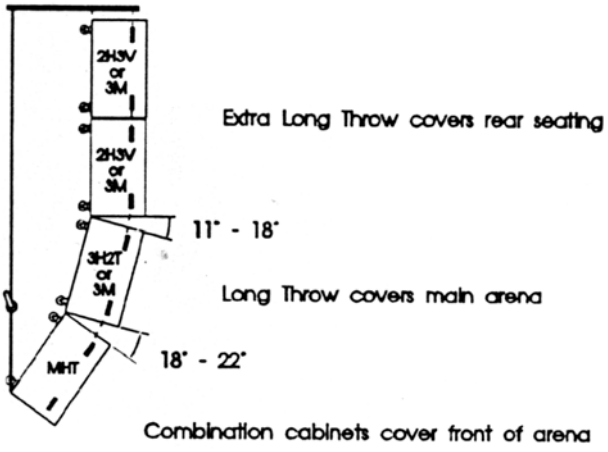


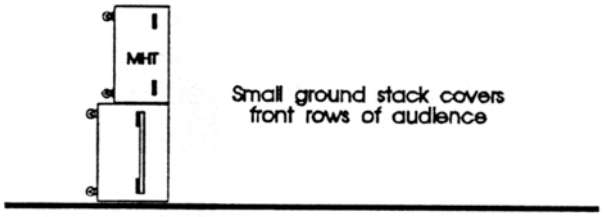


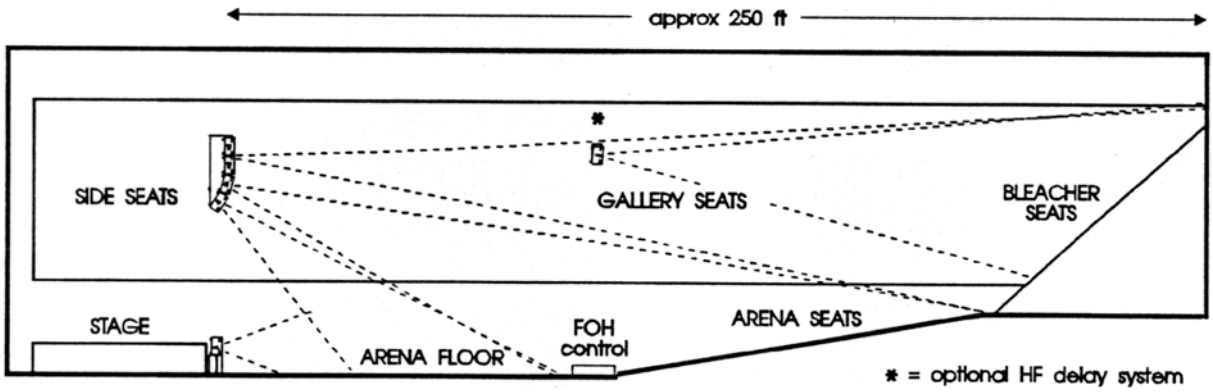


Plan view of typical arena venue

Large Arena System







Side view of typical arena venue

DELAY SYSTEMS

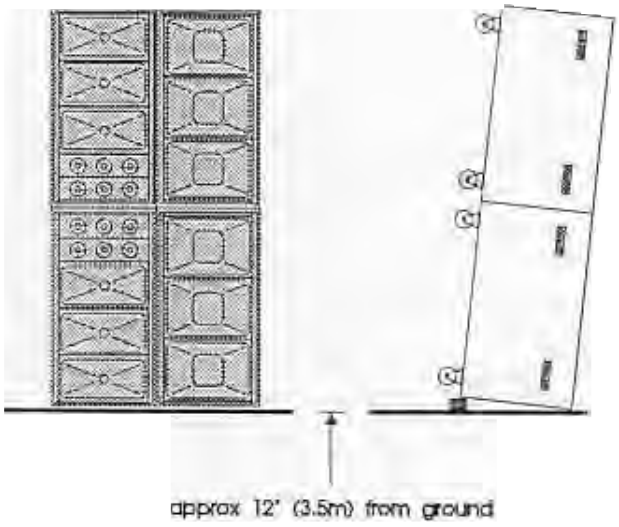
One major feature of the F2 is its ability to cover very large venues with an absolute minimum of additional delayed loudspeaker arrays, and in many cases with none at all. This provides maximum coherence and clarity of sound, and allows all of the audience to retain the impression of sound coming from the stage.

To realise these benefits, it is essential that the main speaker clusters are arrayed and aimed correctly. This can readily be achieved with suitable combinations of short, long and extra long throw cabinets coupled at the recommended intercabinet angles as previously described. The cluster trim height must also be carefully set to define the far limit of coverage within the venue.

For distances of 200 feet or more, a small delayed system will be found useful, mainly to compensate for air absorption of high frequencies. This should consist of one or two "Top" (3H2T) cabinets plus one or two "Mid" (3M) cabinets, carefully aimed at the furthest sections of the audience and positioned such that the coverage is strictly defined to minimise timing errors. At outdoor venues such as football grounds, this delay system should be positioned on the control tower at least 12 feet above ground level, and angled downwards with wood blocks. The delay time should be set to approximately 15-20 ms (or 5 metres) more than that required for coincidence. This extra time will permit the delayed system to be driven at a surprisingly high level without moving the apparent source of sound away from the stage. A high pass filter or graphic equaliser should be used to roll off frequencies not required from the delayed system.

Flown delay cluster for Arena

Delay stack for rear of mix tower



SUB-BASS

The F2 is designed as a full range system and does not require sub-bass to work as such. As explained, low frequency performance is determined mainly by the size and shape of the loudspeaker stack or array. However, an additional sub-bass system is useful where high levels of energy are required below 40 Hz, for example for special effects.

For such use the Martin FSX is available. This is a ported cabinet fitted with two high powered 18" drivers with 4" voice coils and double-spider suspensions. The system impedance is 4 Ω and the sensitivity is 101dB @ 1 W @ 1m. It weighs 87kg (192lbs) and has the same dimensions as the F2B.

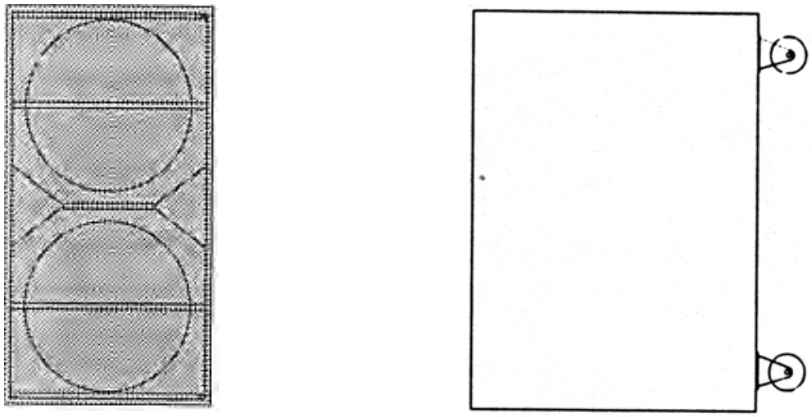
The FSX is designed to be ground stacked, preferably close coupled in a block. Eight per side are adequate for large arenas and medium-sized outdoor venues such as small football grounds, and blocks of 14 to 20 per side have been used with great success at large outdoor concerts. Measurements indicate that full output is maintained down to 28 Hz under these conditions.

Although in theory it is more effective to position the sub-bass centrally in a close coupled cluster under the stage, operational constraints normally dictate one stack each side, under the main bass speakers. A central position is only possible with a very high stage, and some performers find the resulting stage vibration objectionable. At an outdoor venue, sub-bass speakers should NOT be placed in a very wide, low line under the downstage edge. This common practice results in their being properly audible only down the centre-line of the venue due to the line source effect.

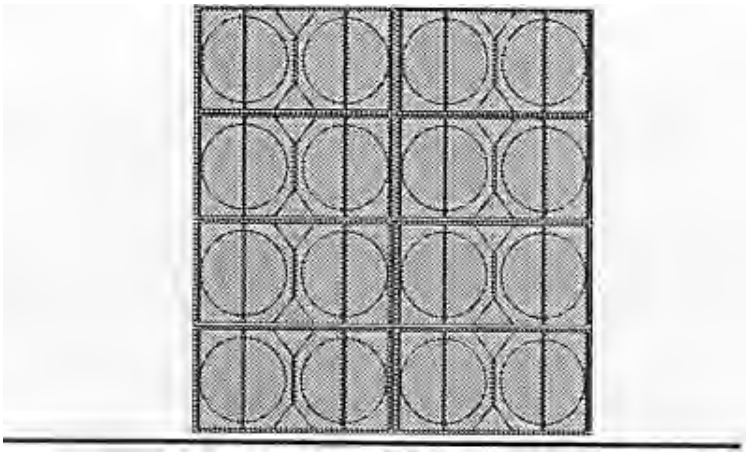
On large systems most engineers prefer to use sub-bass as a special effect, sent from one of the desk auxiliaries. The alternative is to use them as part of a five-way system, in which case a ratio of one FSX to every two F2B works well for quantities of between two and eight FSX per side. However it must be stressed that the F2 does not require sub-bass to perform as a full-range system.

Sub-Bass Crossovers

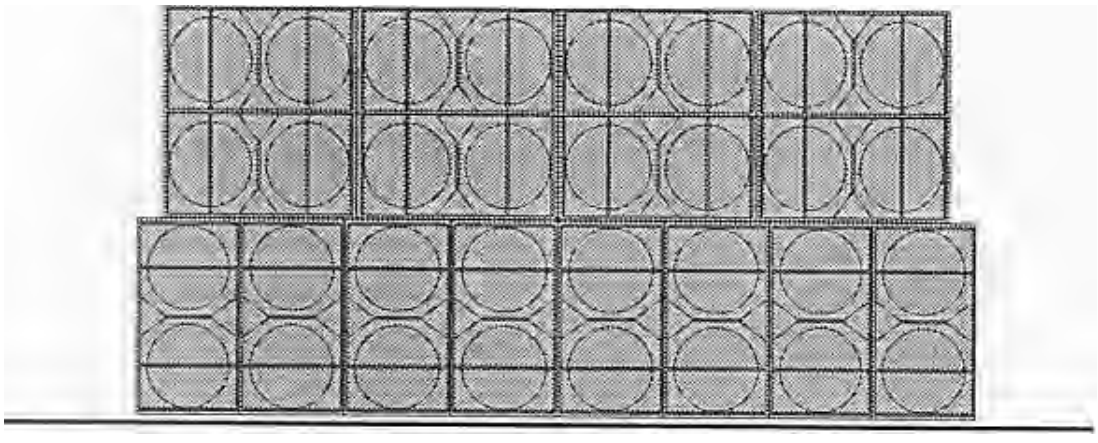
The correct band pass and delay alignments are provided by a Martin MX4 controller fitted with the appropriate plug-ins. This uses a 25 Hz high-pass and 80 Hz low-pass for the subs and, to maintain phase alignment with the main system to 80 Hz and beyond, the sub-bass amplifiers are driven via a chain of all-pass filters. The result is that with the cabinets stacked so that the fronts are physically aligned, the sub-bass drivers are effectively in the same acoustic plane as the horn loaded bass drivers.



FSX Sub-Bass



Typical FSX stack for Arena venue



Typical FSX stack for outdoor venue

CONNECTOR STANDARDS

All F2 systems are supplied with 3 pin XLR and EP8 multipin connectors to ensure worldwide system compatibility, although there is room on the input panels for additional connectors to suit individual requirements. Latest production also carries Neutrik NL8MPR 8- way Speakon connectors. Identical 8-way multicore cables may be used for all F2 cabinets,with signal selection performed at the amplifier racks. F2 Bass and FSX cabinets are wired such that if an 8-core cable is used, cores may be used in parallel pairs to reduce line resistance. Similar F2 cabinets can be linked together with XLR male-to-male loudspeaker cables.

The F2 Rack carries a write-on plate adjacent to the connector panel, to allow the operator to identify each circuit using a standard felt-tip pen. If the cabinet is reconfigured, this is simply rewritten after erasing the original marks with a solvent-damped rag. (isopropyl alcohol)

Full recommendations for speaker patching standards appear in the F2 Technical Manual.

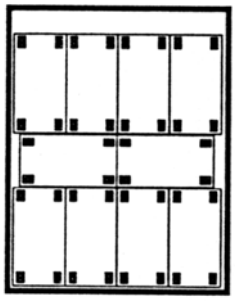
CROSSOVER POINTS

Unlike many other systems, the F2 does not require specialised "processors" for its proper function. Optimum F2 crossover points are 250 Hz, 1.5 kHz and 7 kHz, with 24 dB per octave filter slopes. The F2V module requires equalisation at the crossover to compensate for the power response of the driver. (For more detailed information see the F2 Technical Manual)

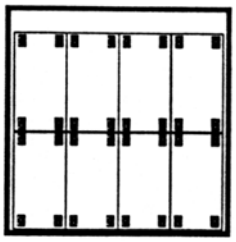
Although a standard Linkwitz-Riley crossover can be used, superior results will be achieved with Martin MX4-F2 controllers. These have non-standard filter alignments and band-edge phase adjustments optimised for the system. They also employ fast limiters which are used only to prevent the power amplifiers from clipping, thereby providing speaker protection whilst preserving full system headroom.

TRUCK PACKS

The F2 cabinet dimensions allow full utilisation of truck space. Ten cabinets per row can be stacked in a standard trailer, with eight per row on the dancefloor. One row of bass cabinets requires 36" depth, whilst a row of F2 racks requires only 30". A complete Arena system, including flying frames, motors and rigging, mains distribution and amplifiers, sub-bass and delay systems, plus FOH control, will fit in a single 45 foot trailer.

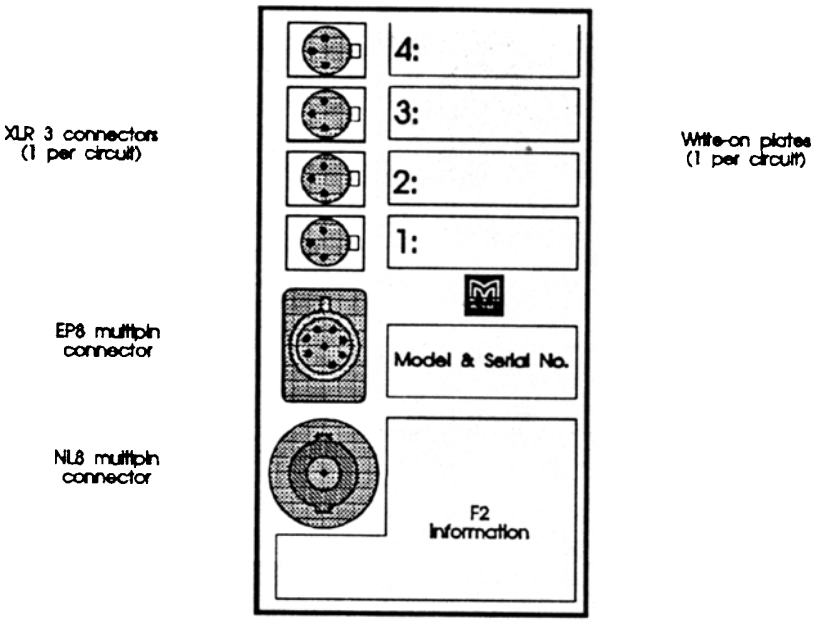


Trailer pack
10 x F2 per row

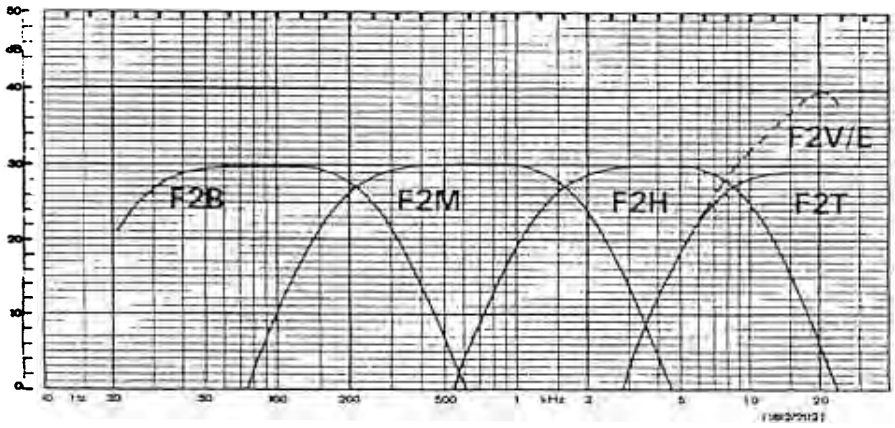


Trailer dance floor pack
8 x F2 per row

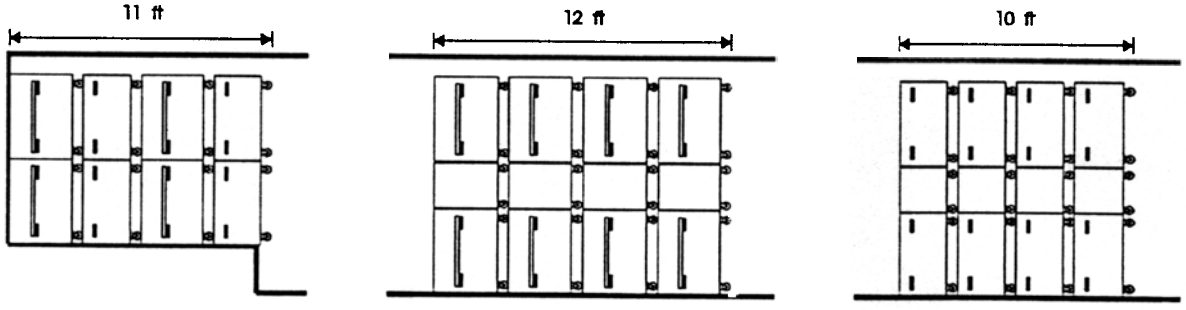
F2 Truck packing examples (rear views)



F2R Connector Panel



MX4-F2 Crossover Curves

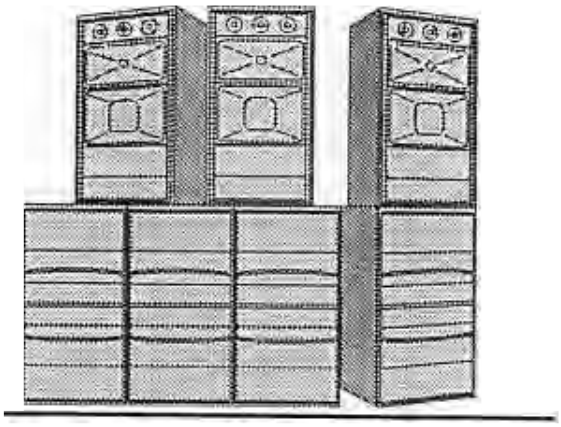


16 x F2B (or FSX) + 16 x F2R
typical trailer dance floor pack

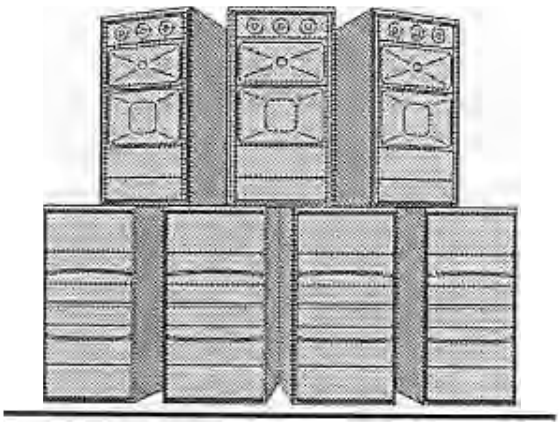
40 x F2B (or FSX)

40 x F2R

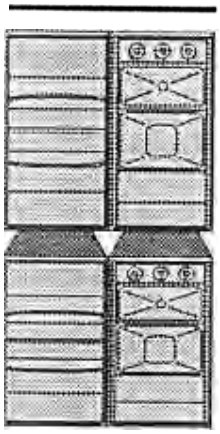
F2 Truck packing examples (side views)



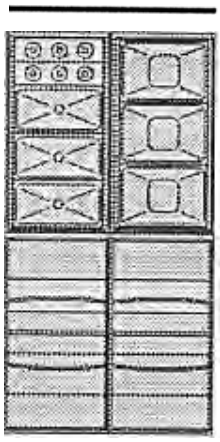
F2 system for typical college venue (approx. 1500 capacity)
Also suitable as arena ground stack



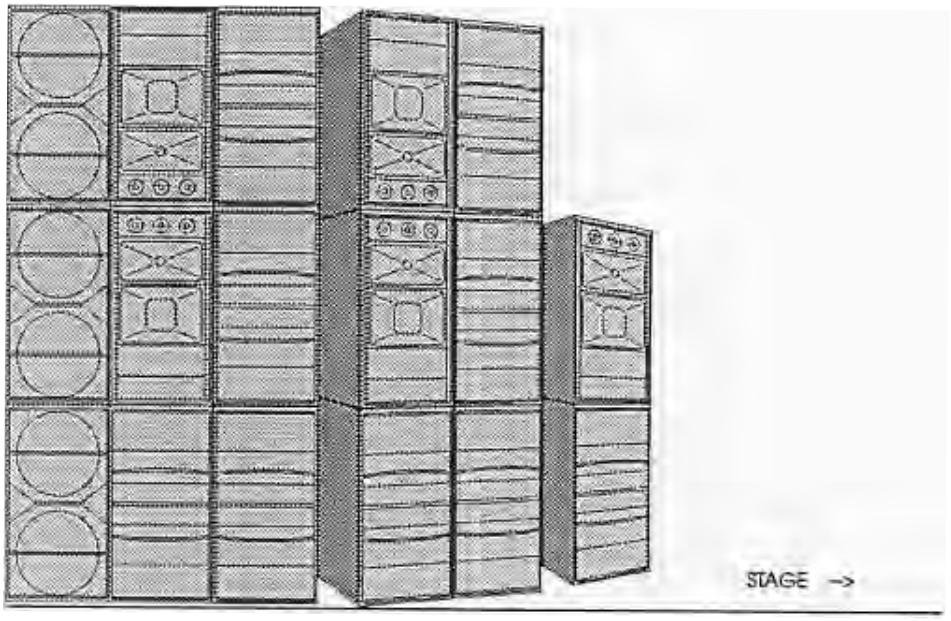
Alternative version with 150° dispersion
for nightclub or similar venue



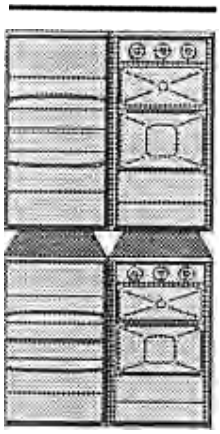
Flown cluster
for balcony coverage



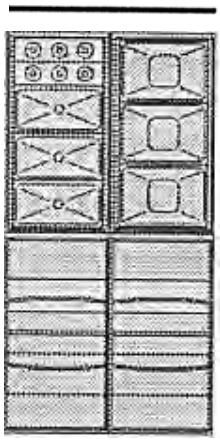
Alternative flown cluster
with narrow vertical coverage



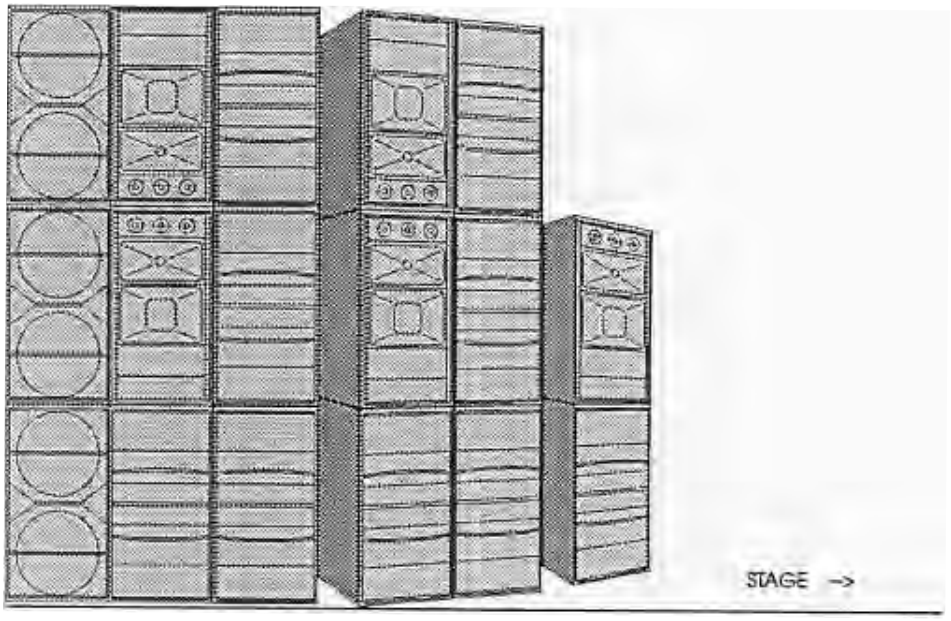
F2 system for typical theatre, ex-cinema, City Hall,
or similar venue of 2000 to 4000 capacity



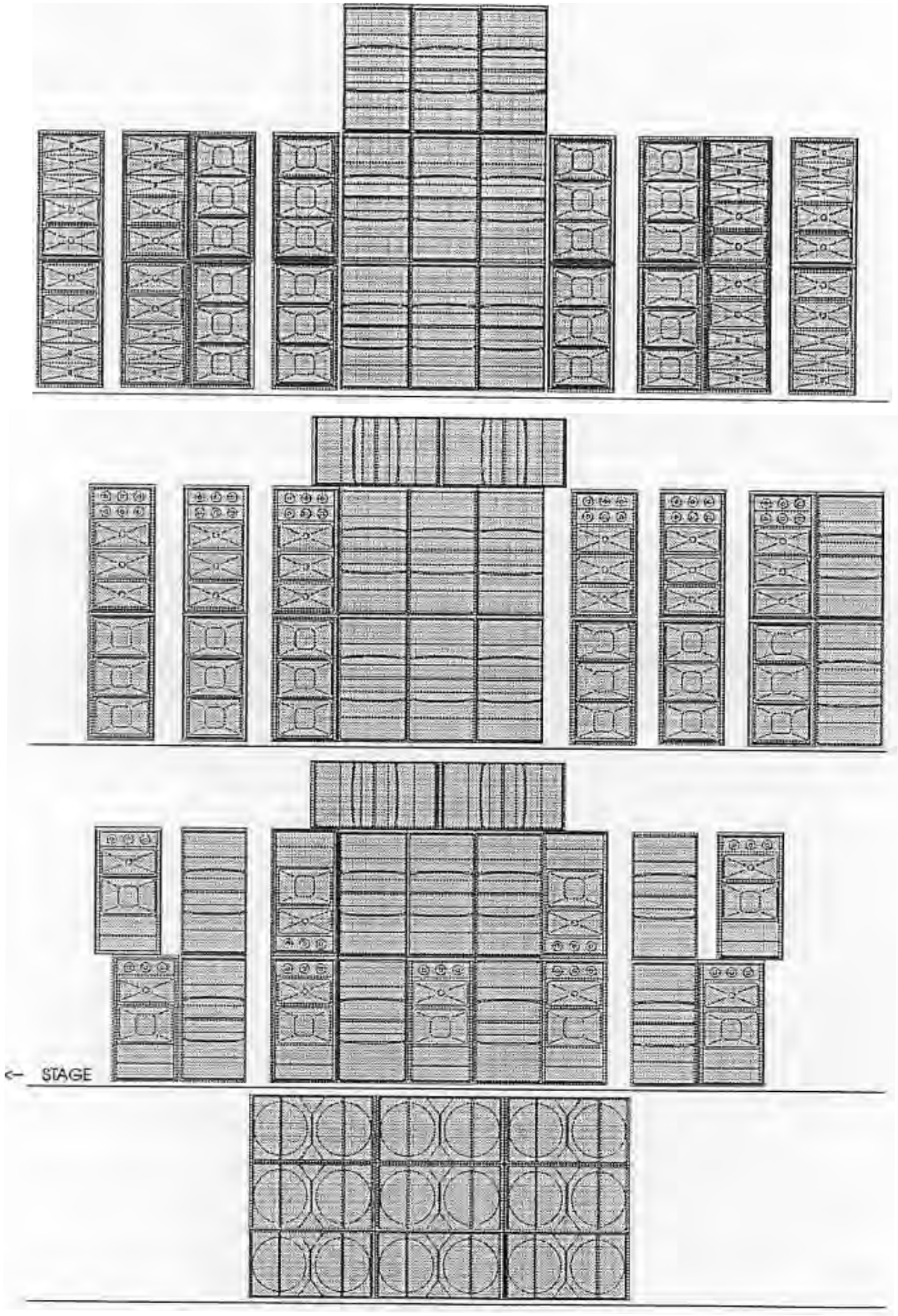
Flown cluster
for balcony coverage



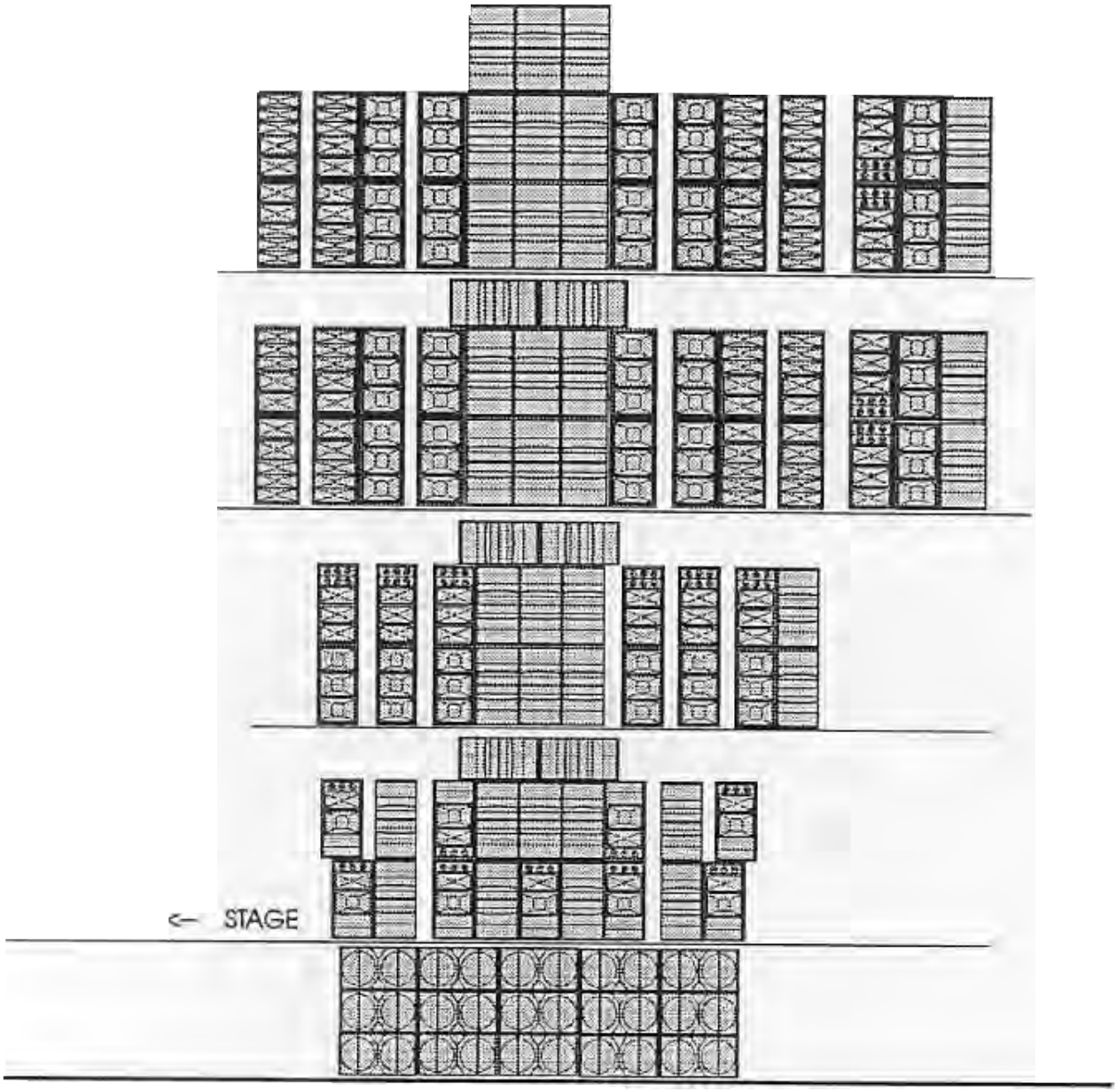
Alternative flown cluster
with narrow vertical coverage



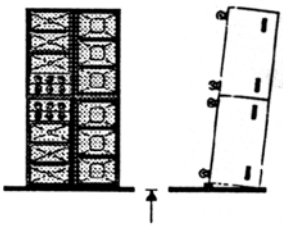
F2 system for typical theatre, ex-cinema, City Hall,
or similar venue of 2000 to 4000 capacity



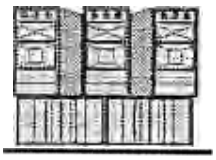
F2 Stack for small football stadium similar outdoor venue for 20 -50,000 people



Delay stack for rear of mix tower
(and field delay if required)

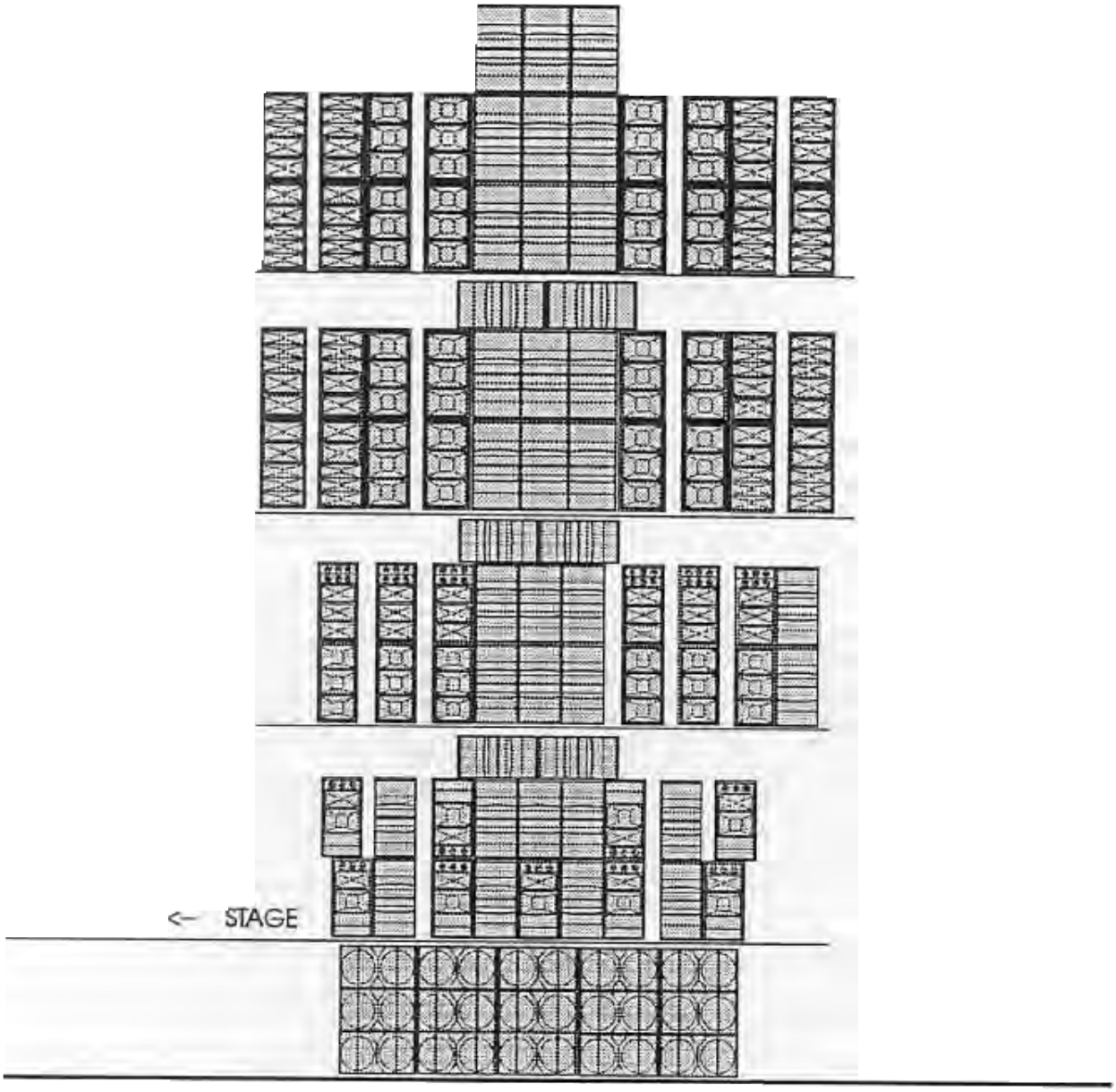


approx 12' (3.5m) from ground



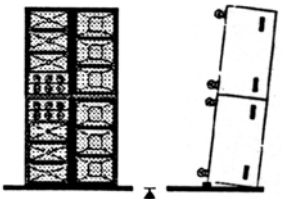
Centre fill (under stage)

F2 Stack for stadium with full size grandstands



Centre fill (under stage)

Delay stack for rear of mix tower
(and field delays if required)



approx 12' (3.5m) from ground

F2 Stack for large outdoor site

Martin Audio

F2 Technical Manual

F2 TECHNICAL MANUAL

Contents List

Typical example systems:

Multi-purpose "Conference" Venue

Arena Venues

Unusual Venues:

Royal Albert Hall, London

Arènes du Nîmes, France

Efes Amphitheatre, Turkey

F2 TECHNICAL MANUAL

This manual is supplementary to the F2 User's Guide and is offered as a source of more detailed technical information for advanced users, operations managers, and systems engineers.

CROSSOVERS

The F2 is a 4-way system, requiring suitable active crossovers. Extreme low frequencies can be augmented with a sub-bass to make the overall system 5 way.

Optimum F2 crossover points are 250 Hz, 1.5 kHz and 7 kHz, with 24 dB per octave filter slopes. The polarity of each output band must be set to conform with that of the speakers, (see "System and Component Polarity"). The F2V module requires equalisation at the crossover to compensate for the power response of the driver.

Provided that these specifications are met, it is quite possible to use the F2 with any industry-standard crossover designed for true professional use, however for optimum performance and for worldwide system compatibility we recommend the use of the Martin MX4 Controller.

For trouble-free installation, it is essential that crossover inputs and outputs utilise balanced circuitry, and careful attention should be given to our recommendations concerning limiter settings.

It should be understood that the use of inferior quality crossovers will compromise the performance of the entire system.

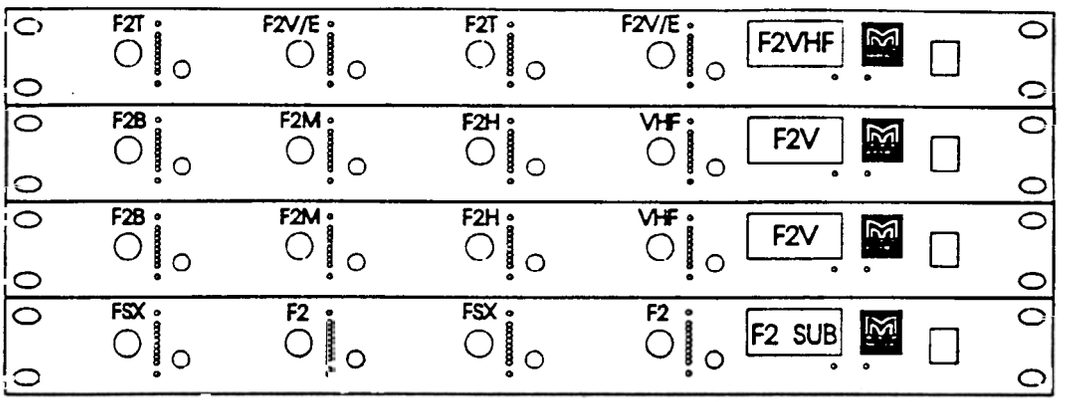
We strongly recommend the use of Martin MX4-F2 controllers, which provide fully optimised crossovers and band edge phase alignment for the F2 system. They should always be used if the full potential of the system is to be realised. The preset crossover points and phase alignment are the result of careful and extensive laboratory measurements using some of the most advanced test equipment currently available and the results are unlikely to be matched by "do it yourself" methods.

Crossover level settings

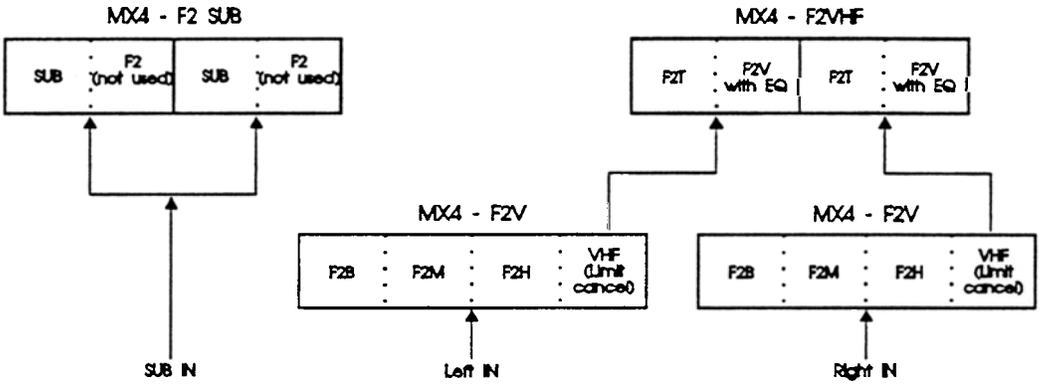
Most of the F2 modules are of similar sensitivity. For a system with a balanced quantity of components, the crossover output level controls will all be set around 0dB for a basic balanced sound. Some adjustment may be required to the low frequency level depending on the size and shape of the bass stack and the resulting coupling efficiency.

F2T/F2V split crossover

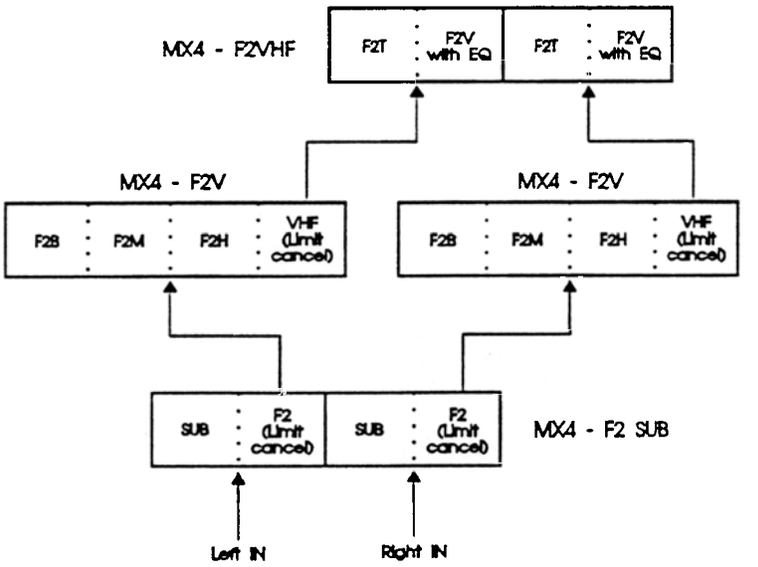
If a system is operated with a mixture of F2T and F2V modules, they should use the same crossover point (7 kHz), but the F2V amplifiers should be driven via a suitable equaliser to provide power response compensation. The simplest and most effective method is with MX4 controllers. Two are used in mono 4-way mode (fitted with F2V filter cards) to provide crossover functions in the normal way, and a third is used in stereo 2- way mode, fitted with an F2VHF EQ card and a "full-range" filter card. This provides independent limiter, EQ, level control, metering and line driver functions for the F2T and F2V channels (See diagrams).



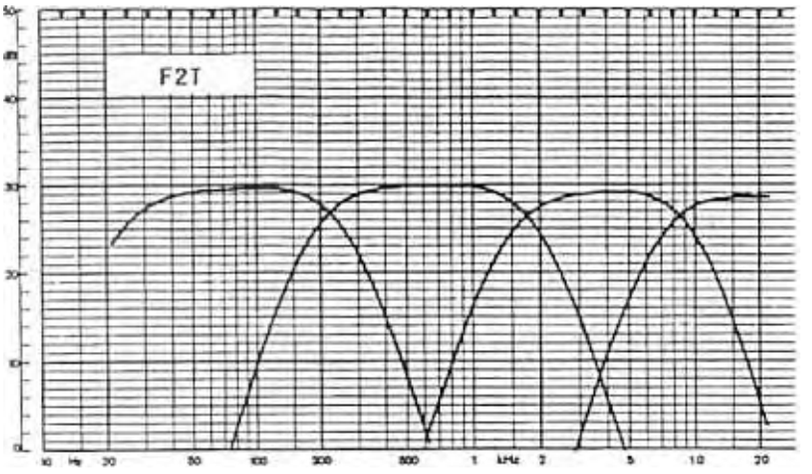
Stereo 4/5-way system using MX4 controllers,
including MX4-F2VHF for mixed F2V and F2T systems
(requires 4U rack space)

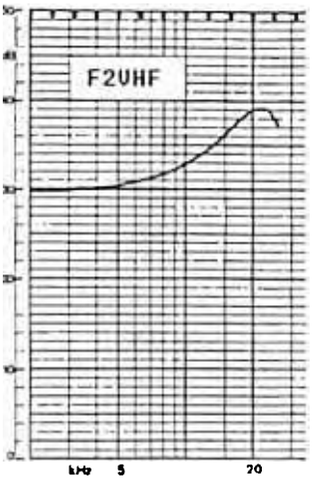


Normal configuration: 4-way with separate sub-bass



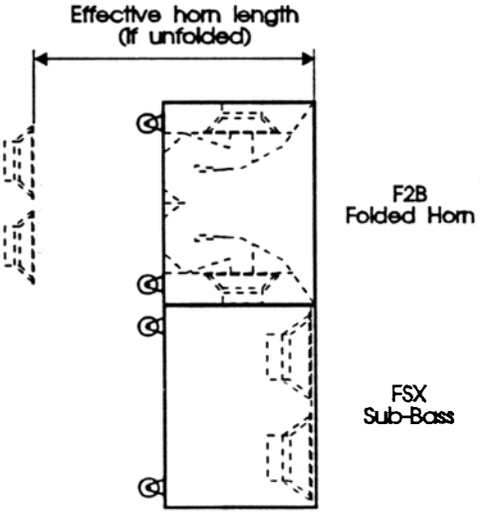
Alternative configuration: 5-way system



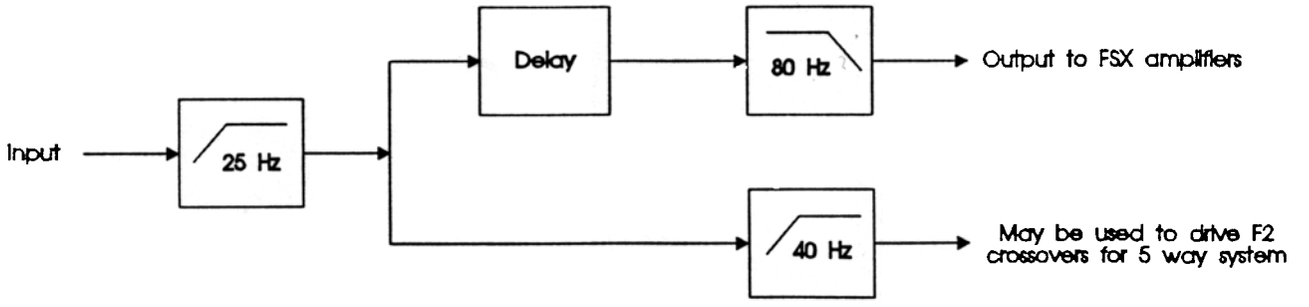


Sub-bass split crossover

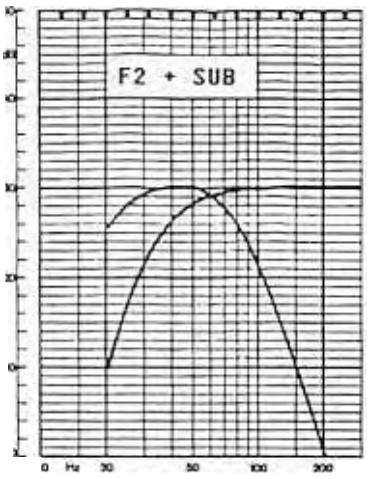
An additional MX4 controller may be used to drive a sub-bass system. It can be connected either as a crossover between the sub-bass and the F2 system (which effectively becomes 5-way), or as a bandpass filter for a sub-bass channel derived from an effects send. Limiter, level control, metering, and line driver functions are all provided. The MX4 also provides offset alignment which effectively places the sub-bass drive units in the same acoustic plane as those in the F2B horns when the cabinets are stacked together. The frequency ranges of the sub-bass and F2B are partially overlapped.

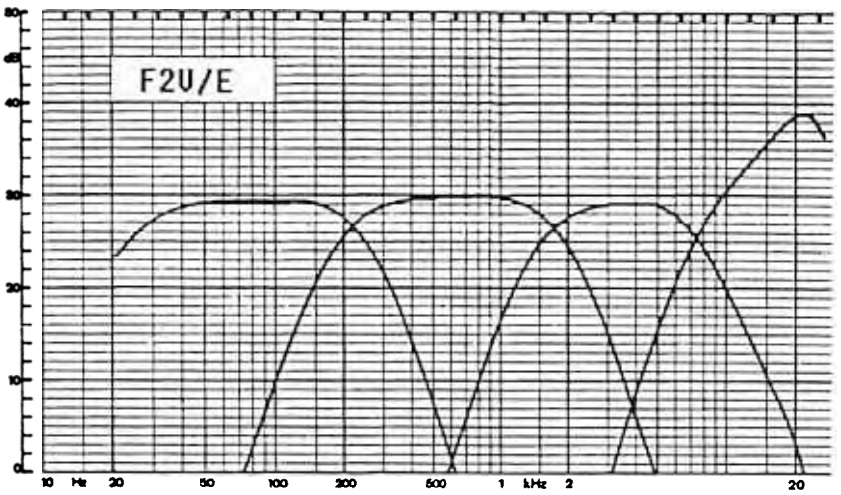


Acoustic path length difference between FSX and F2B



Block diagram of MX4 - F2+SUB (one channel shown)



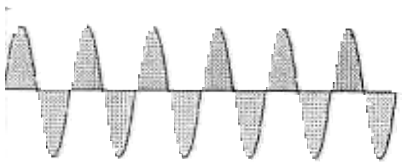


Crossover Limiter Settings

To provide speaker protection whilst preserving full system headroom, crossovers should include fast limiters which are set only to prevent the power amplifiers from clipping. With an MX4 controller, this simply requires that the limit threshold switches be set to match the amplifiers' full power sensitivity. A system operated in this way and used by experienced professional sound engineers should normally be immune from loudspeaker overdrive failures.

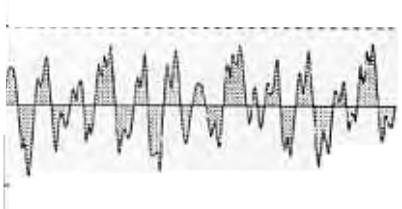
In discotheque installations, or where serious system abuse is anticipated, limiters should be set to ensure that the output of the amplifiers cannot exceed the long-term continuous power ratings of the loudspeakers. In this case, the limiter setting may be calculated from the amplifier's voltage gain or input sensitivity, but for more accurate results a signal generator, oscilloscope and dummy load can be used to set the limited amplifier output power.

It is important to understand that a low powered amplifier driven into clipping (overload) is more likely to damage a loudspeaker than a high powered amplifier used within its ratings. This is because music signals have a high peak-to-average ("crest") factor. When an amplifier is severely overdriven its output waveform is clipped (its peaks are squared off) reducing the crest factor. In extreme cases, the waveform can approach that of a square wave. An amplifier is normally capable of producing far more power under these conditions than its quoted "maximum power", which is specified for an undistorted signal.

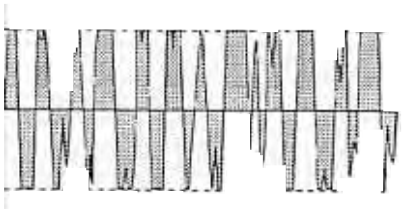


Sine wave signal

Square wave signal



Undistorted music signal



Same music signal clipped by overdriven amplifier

Amplifier clipping: shaded area indicates power

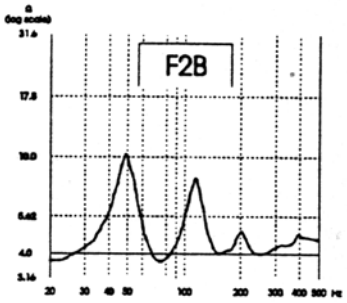
SYSTEM AND COMPONENT POLARITY

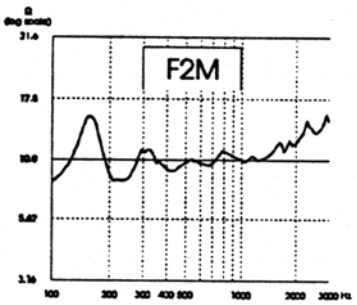
The acoustic polarity of each F2 system component has been selected to ensure compatibility with previous Martin equipment.

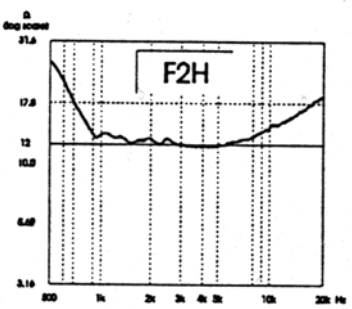
Using the normal XLR convention for loudspeaker circuits (pin -, pin 2 +), the component polarity, as indicated by a pulse-type phase checker, is as follows:

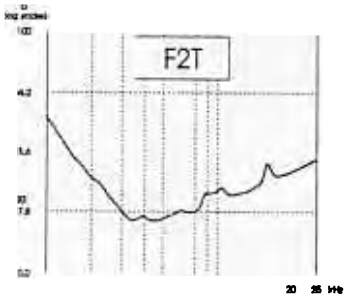
F2B and F2M: Positive
F2H, F2V and F2T: Negative
FSX: Positive

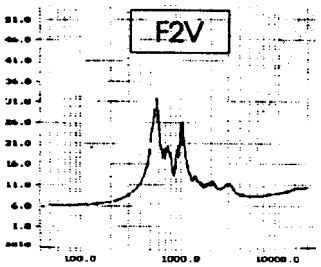
System alignment, including polarity reversal on the High and VHF bands, should be provided in the electronic crossover. Therefore when a complete system is phase checked, all elements will indicate "in-phase" if all connections are correct.

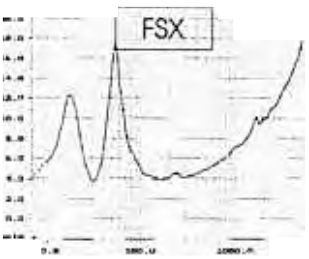












F2 Unit	Number in parallel					
	1	2	3	4	5	6
F2B both drivers	4 (3.7)	2 (1.9)	-	-	-	-
F2M	10 (8.2)	5 (4.1)	3.3 (2.7)	2.5 (2.0)	-	-
F2H	12 (11.6)	6 (5.8)	4 (3.9)	3 (2.9)	2.4 (2.3)	2 (2.0)
F2T	20 (16.4)	10 (8.2)	6.7 (5.4)	5 (4.1)	4 (3.3)	3.3 (2.7)
F2V	16 (12)	8 (6.0)	5.3 (4.0)	4 (3.0)	3.2 (2.4)	2.7 (2.0)

F2 Module average impedance (minimum in brackets)

AMPLIFIERS

All amplifiers in the system should be set up to have the same gain (not necessarily the same sensitivity). This should ensure similar output levels for a given input drive,and will avoid drastic settings of crossover (or distribution amplifier) level controls. If the amplifiers are not all identical then those with the highest output power should be used for the lower frequencies. All amplifiers must be of the same polarity; it should be noted that some manufacturers continue to use an obsolete standard in which XLR pin 3 was the non-inverting input.

In large or complex systems, some amplifiers may be driven at reduced level to balance the system coverage, particularly for ground stacks and side seating clusters. After adjustments have been optimised by ear, these amplifier settings should be marked or noted for future reference.

In general, the higher the amplifier power, the better the system will sound provided that it is not overdriven.This is due to increased headroom and a greater ability to handle transient signals. We recommend the use of amplifiers rated at a minimum of 300 watts into 8Ω (500 watts into 4Ω) for mid, high and super high frequencies. Amplifiers of higher power output are preferable for the bass frequencies (and sub-bass if used).

Amplifier Loading

The F2 module specifications and impedance curves may be used to determine how many modules may be driven in parallel by a given amplifier. In large touring systems where truck space is at a premium, high powered amplifiers specified to drive 2Ω loads may be preferred, especially for bass and midrange.

Distribution Amplifiers

In very large systems where more than 16 amplifier inputs are driven in parallel, their combined load may be substantially less than 600Ω. Under these circumstances it is desirable to use distribution amplifiers on stage to reduce the load on the front-of-house crossovers. For this purpose additional MX4 Controllers may be configured as distribution amplifiers by fitting them with "full-range" filter cards. This technique is also useful when it is necessary to adjust the drive to groups of amplifiers having differing gain or sensitivity specifications.

Electrical power requirements of large systems

Because of the high crest factor of normal music signals, combined with the very high efficiency of the loudspeakers, the average electrical power required by a large F2 system is surprisingly low. In normal practice 3-phase power is used, with one phase supplying each side of the PA and the third phase powering the stage and FOH control equipment. A major production with an extensive backline and monitor system will draw up to 50 Amps from the third (stage) phase, whilst a smaller production may draw only half this amount.

Using typical industry-standard amplifiers, the mains current drawn from a 240 Volt supply will be 40-45 Amps per side for the small (5 - 10,000 capacity) Arena system, or 50-60 Amps per side for the large (8 - 15,000 capacity) Arena system.

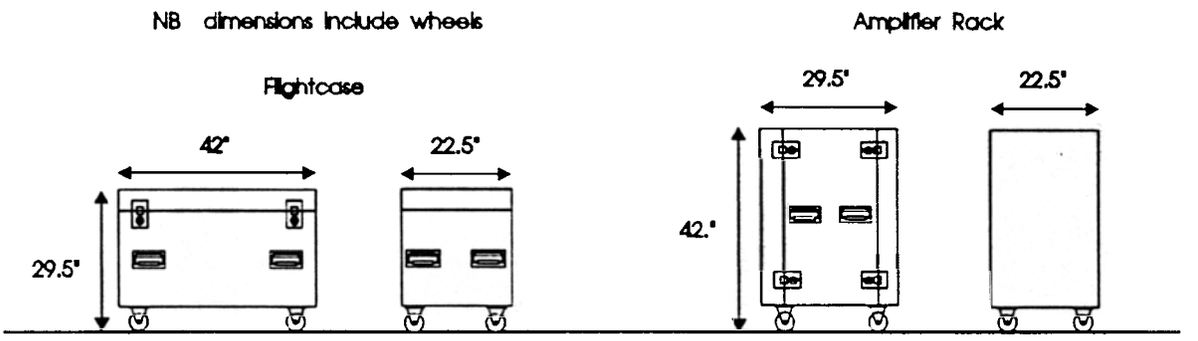
The system recommended for small football grounds and similar venues will draw 70-100 amps per side, whilst the large stadium or outdoor systems require 100-150 Amps per side.

COMMON STANDARDS

Martin Audio believes it is important that all F2 systems throughout the world should be compatible. This is ultimately beneficial to all F2 owners and users. It greatly facilitates sub-hiring, and the combining of systems for large-scale events. Effectively this results in a global "F2 hire network" offering identical systems worldwide. This facility is very attractive to, for example, a potential customer undertaking a world tour where time-scales and budgets may not allow for a system to be shipped between continents.

System Integration

For general convenience and ease of truck packing, it is advised that wherever possible, cable and hardware trunks and amplifier racks are made to the same dimensions as F2R cabinets.



F2 compatible cases

F2R Type	Circuit No.			
	1	2	3	4
MHT Combination	1 x F2M	n/c	1 x F2H	1 x F2T
3M Mid	2 x F2M	n/c	1 x F2M	n/c
3H2T Top	3 x F2H	n/c	2 x F2T	n/c
2H3V High	2 x F2H	n/c	3 x F2V	n/c

n/c = not connected (drives next cabinet)

Recommended F2R Wiring Standard

Recommended F2R Patching Standard

With this method, each 4-pair loudspeaker multicore drives up to two F2R Mid, Top, or High cabinets, or up to three Combination cabinets. Circuits 2 and 4 are used for the second cabinet, which is driven from the respective individual XLR sockets via male to male XLR speaker cables. To link to a third Combination cabinet, a fan-out cable (8pin male to 4 XLR male) is used.

Alternatively, a 4-pair cable may drive one or two F2B cabinets, which can similarly be linked with a pair of XLR male to male cables. In this case, cable pairs 1 & 2 are used in parallel to reduce line resistance, as are cicuits 3 & 4, and each amplifier channel powers one driver in each cabinet of the pair. A 2 Ohmn amplifier may be used to power all four drivers.

A small stack comprising of one F2B and one F2R-MHT is often required for stage side-fill monitors or to cover a specific audience area. This can be driven from a single 4-pair cable if Circuit 2 is used for the F2B. A short Y-lead is used to allow both XLR inputs on the F2B to be driven in parallel from the Circuit 2 XLR connector on the F2R.

To link F2M modules within the F2 Rack, Y-leads (XLR female to 2 XLR male) are used. These can be made up from suitable 1.5mm^2 cable, and should be about 6" long. All other F2 modules are fitted with XLR male outlets for parellel linking.

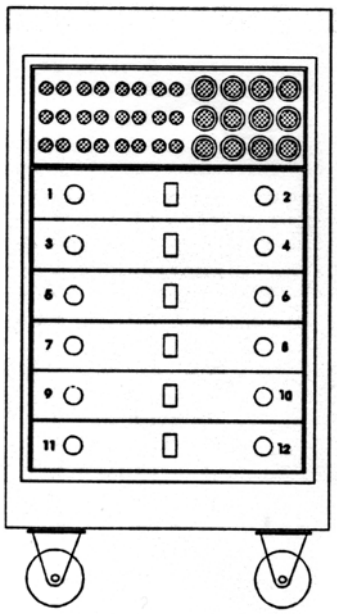
Suggested Amplifier Rack Configuration

This has been used successfully by a number of F2 hire companies. Each amplifier rack, which has external dimensions identical to the F2R, contains six 2U stereo amplifiers plus a 4U or 6U connector panel.

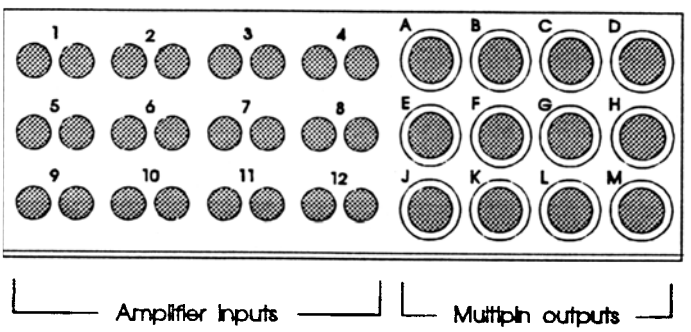
The connector panel carries XLR female and male connectors for each amplifier input to allow parallel patching, plus a number of 8-pin output connectors for loudspeaker multicores. This panel is hinged, and may be opened to reveal an internal patch panel which carries four paralleled sockets from each amplifier output. Each 8-pin connector carries four flying patch leads (one per circuit) which may be plugged into these sockets in any desired combination.

Therefore the amplifier rack may be quickly and easily configured to drive any combination of F2 cabinets. This is especially useful for one-off events and sub-hires, whilst for a tour it may be prepared and labelled at the warehouse and dedicated to drive the same section of the system at every show.

All 8-core loudspeaker cables should have a minimum of 2.5mm^2 cores for low line resistance, and preferably be black in colour for low visibility.



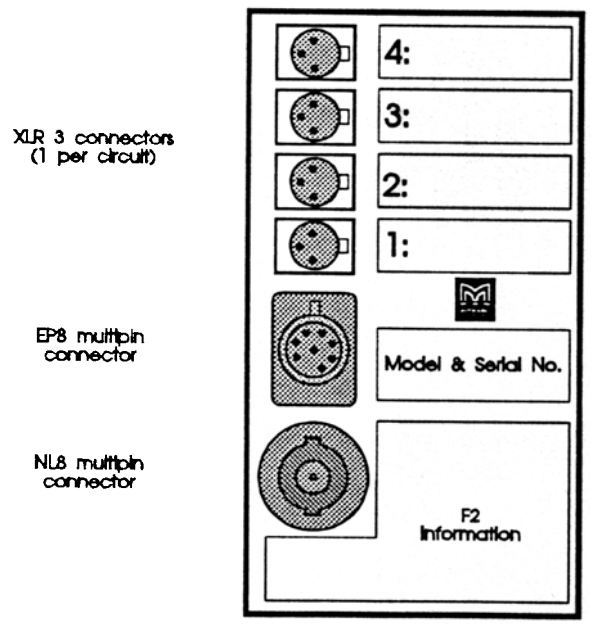
Amplifier rack



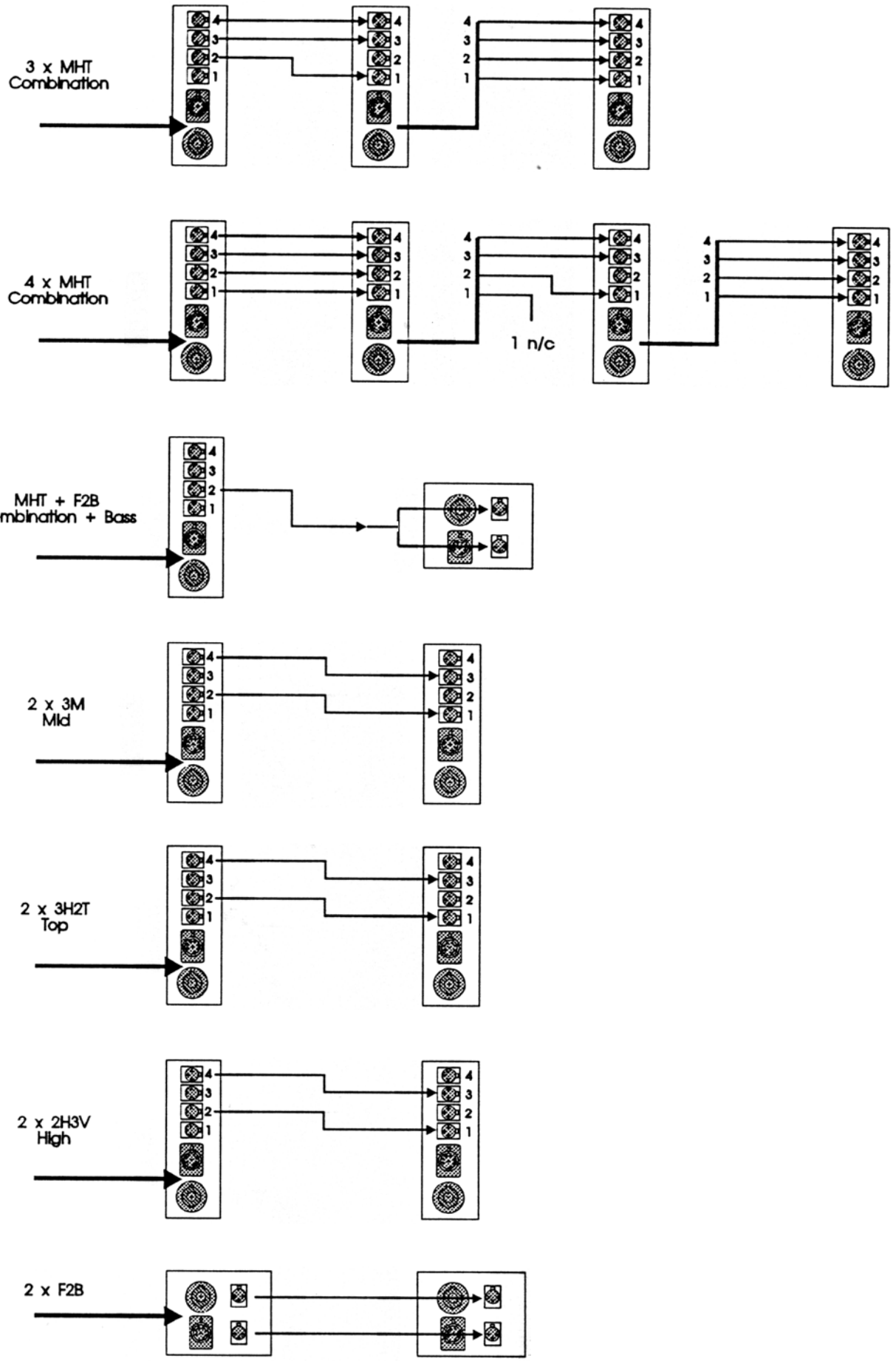
Connector Panel

To drive:	Circuit No.			
	1	2	3	4
up to 3 x MHT Combination	F2M	F2M	F2H	F2T
up to 4 x MHT Combination	F2M channel 1	F2M channel 2	F2H	F2T
MHT + F2B Combination plus Bass	F2M	F2B	F2H	F2T
2 x 3M Mid	F2M channel 1	F2M channel 2	F2M channel 1	F2M channel 2
2 x 3H2T Top	F2H channel 1	F2H channel 2	F2T	F2T
2 x 2H3V High	F2H	F2H	F2V channel 1	F2V channel 2
1 x F2B with minimum cable resistance	F2B	F2B	F2B	F2B
2 x F2B from separate 4_ amp. channels	F2B channel 1	F2B channel 1	F2B channel 2	F2B channel 2
2 x F2B from single 2_ amp. channel	F2B	F2B	F2B	F2B

Recommended Patching Standard for 8- pin connectors



F2R Connector Panel



F2 Cabinet Patching

FLYING THE F2

The F2 flown array techniques may be used for both indoor and outdoor applications, provided that the venue (or outdoor stage wing) roof is designed and certified to take the necessary loads. It is essential to employ the services of experienced professional riggers when installing motor points, and to comply with any local safety regulations.

To maintain correct vertical alignment when the system is flown, F2 cabinets are linked at the rear with hinges. With the Aeroquip system, vertical intercabinet angles are set with adjustable links between cabinets. With the optional MAN flying system, vertical angles are set by use of the appropriate steel cable links and rear pull-up straps.

AEROQUIP SYSTEM

The upper F2 cabinet in a flown column is suspended from the flying frame with two Aeroquip fittings attached to hooks or chains, plus a special rear hinge fitted with a Unilock. Cabinets are then connected together with Aeroquip chain links and custom rear hinges. Integral metalwork links the attachment points within the cabinets.

Finally a ratchet strap is fitted between the frame and the bottom cabinet is tensioned to set the cabinet angles. When the strap is fully tightened the load is shared between the Aeroquip side fixing points and the strap, whilst the rear hinges retain the cabinets in alignment. For correct weight distribution the strap must be approximately vertical.

Correct setting of pull-up straps

The weight distribution between cabinet flying points is determined by the position of, and the tension in, the pull-up straps. Therefore care must be taken to ensure that these straps are correctly set.

For optimum weight distribution and cabinet alignment the pull-up straps should be vertical, and flying frames must be sufficiently large to allow for this if a system is to be flown more than two cabinets deep.

To equalise the load on the cabinet side fittings the pull-up strap must be in line with the centre of the cabinet column.

The pull up strap must be correctly tensioned. It should be tightened until the back corners of the uppermost pair of cabinets come into contact and the weight is just taken off the top hinge fitting. Under these conditions the load is shared between the top fittings and the pull-up strap.

If both the top fittings are slack, this indicates that the pull-up strap is not sufficiently tensioned.

If only one top fitting is slack, this indicates that the pull-up strap is not correctly aligned with the centre-line of the column of cabinets.

These problems must be corrected before the cluster is flown out.

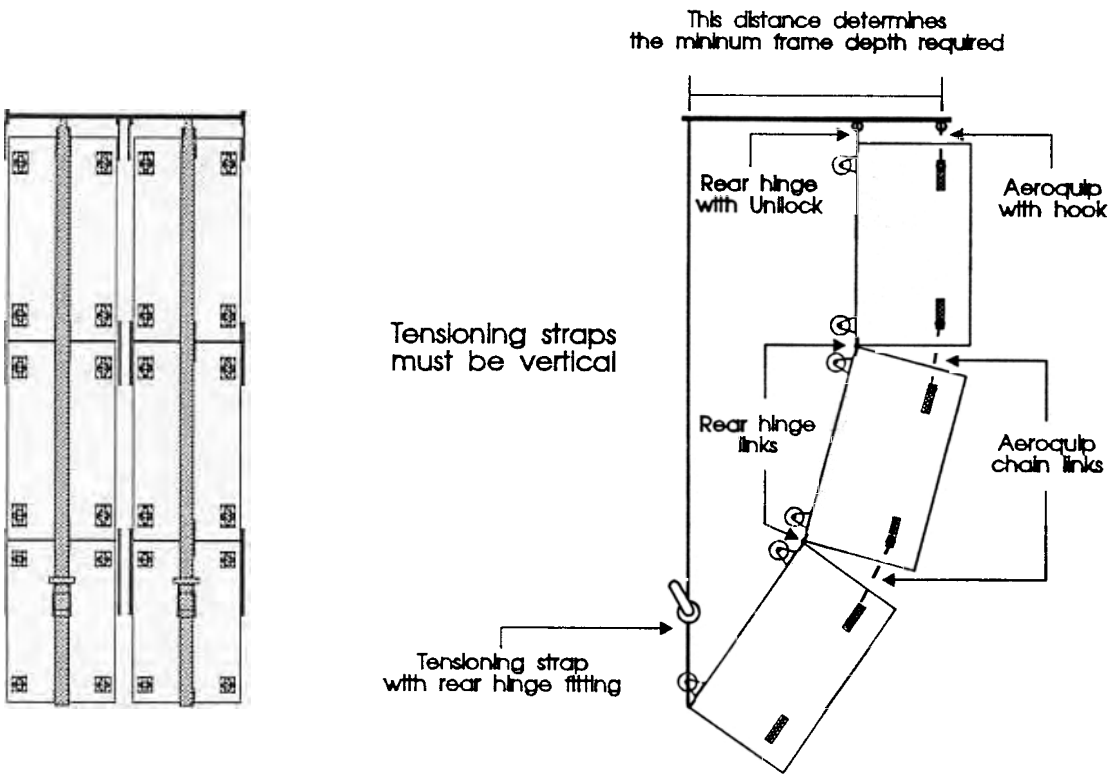
MAN SYSTEM

The upper F2 cabinet is suspended from the flying frame with a pair of steel cables. Each steel cable is fitted with a safety hook at one and a quick release suspension clip at the other, which mates with the MAN flying point in the side of the cabinet. The suspension clip is designed to take a hook to enable the next cabinet to be suspended from it with a further pair of steel cables, thereby allowing cabinets to be hung in vertical columns.

Several lengths of steel cable are available to suit the range of intercabinet angles required. A floating rear hinge allows for fine adjustment of these angles according to the tension in the rear pull-up straps.

As this is a two-point suspension system, the rear straps are used only to set the vertical cabinet angles and the downward tilt of the column. Intermediate straps may be used if appropriate to aid cabinet alignment.

Whilst not offering the precise, and accurately repeatable, vertical angles available with the Aeroquip chain system, the MAN flying system is very quick and simple to use. This is of considerable benefit in one-night touring applications, especially if the venues are sufficiently similar that each requires only minor variations on a standard rig.



F2 Flying System

CABINET ANGLES AND AEROQUIP CHAIN SETTINGS

(see accompanying diagram)

Although a wide range of vertical intercabinet angles may be obtained with alternative Aeroquip Link settings, virtually all operational requirements can be met with the use of only four different angles. Some variation is permissible to these "standard" settings where experienced or advanced users wish to fully optimise a system's coverage.

To fully couple two cabinets with nominally no vertical splay angle (it will actually be approximately 1½° due to the necessary mechanical tolerances), a SHORT chain set is used, per diagram Ref.0.

The vertical angle between two similar Top or Mid cabinets should be 11°- 18°, depending on the required coupling. This corresponds to Refs. 3 to 5 using SHORT Aeroquip chain sets. Diagram Usage "L" refers. This results in 4½" - 7½" gap between cabinet front edges, with a fully tensioned pull-up strap.

The vertical angle between a Long throw cabinet and a Combination cabinet should be 20° (± 2°). This corresponds to Ref.5 or Ref.6 using SHORT Aeroquip chain sets, or Ref.1 using LONG Aeroquip chain sets. Diagram Usage "X" refers. This results in 7½" - 9" gap between cabinet front edges, with a fully tensioned pull-up strap.

The vertical angle between two Combination cabinets should normally be 25° - 35° for "short throw" use. This corresponds to Refs.3 to 5 using LONG Aeroquip chain sets. Diagram Usage "C" refers. This results in 11" - 14" gap between cabinet front edges, with a fully tensioned pull-up strap. When tighter coupling is required for "medium throw"applications, alternative settings may be determined from the diagram.

The vertical angle between Bass cabinets will normally be set to correspond with the associated column of F2 Racks, but in reverberant venues it can be preferable to use tighter coupling, with only the bottom row angled well downwards to match the bottom row of F2 Racks.

It will be found that when setting large vertical angles, the cabinets will initially hang approximately 30° apart with the linking chains slack. This is perfectly safe during set-up and the angles will be correctly set when the pull-up strap is tensioned.

WARNING:

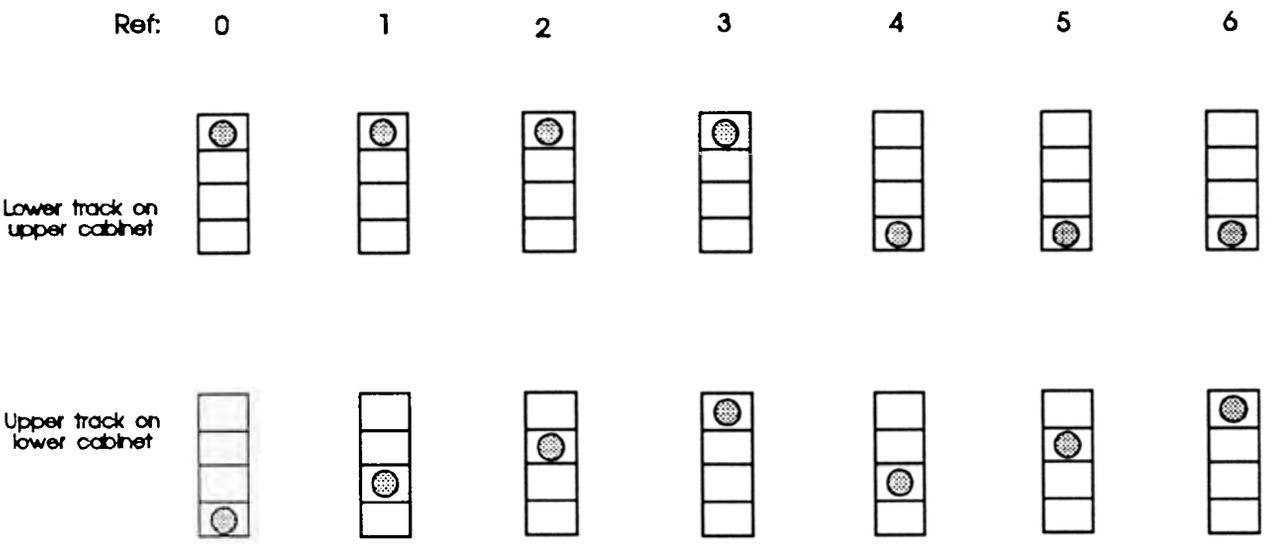
Flying systems must only be assembled by trained and experienced crew, working in association with professional riggers.

All flying frames and fittings must be manufactured and tested to approved standards.

Only safety-approved, load-rated hardware may be used.

Flying hardware must be checked regularly and any suspect items discarded. The integrity of flying equipment is essential for public safety, and compromises in this area are not acceptable.

F2 Rack Cabinet Aeroquip Settings



With SHORT chain: (7 links)

Angle:	1.8	5	8.4	11.4	14.7	18	21.6
Spacing:	.75"	2"	3.5"	4.75"	6"	7.5"	9"
Usage:	LX,C			L	L	LX	X

With LONG chain: (12 links)

Angle:	16.8	20.4	24	27	30.8	34	37.7
Spacing:	7"	8.5"	10"	11.25"	12.75"	14"	15.5"
Usage:	L	X	-	C	C	C	

"L" = between two Long throw cabinets

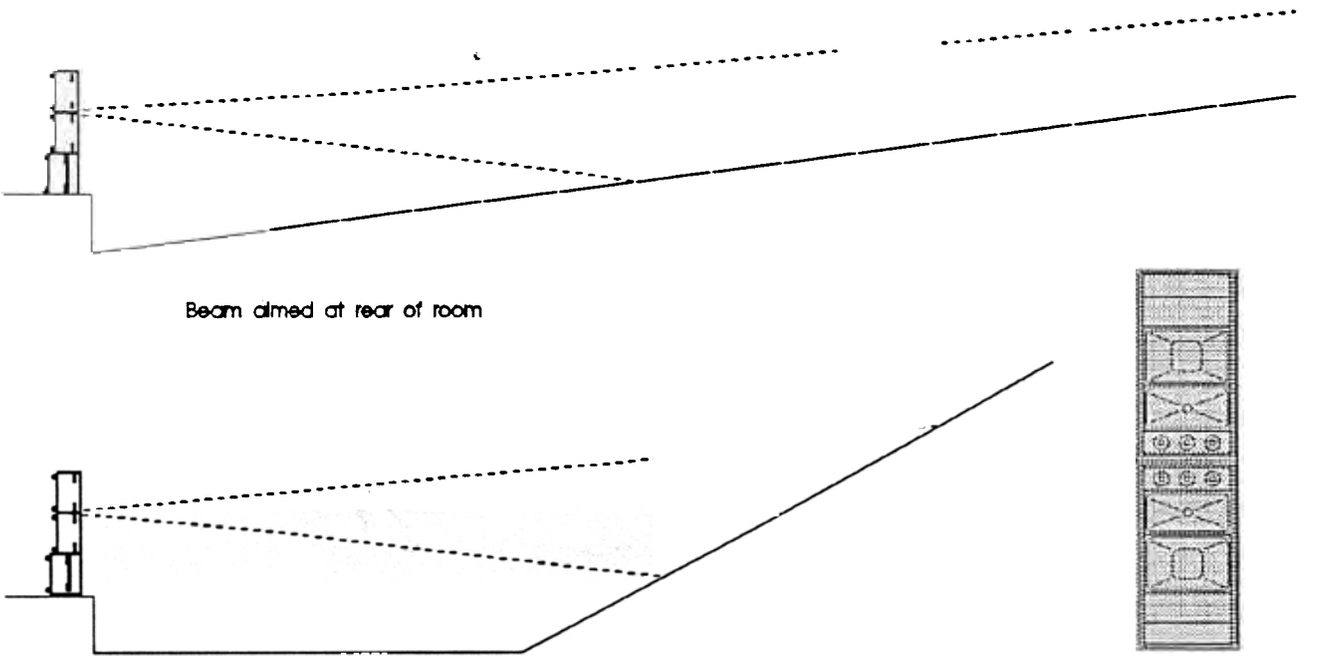
"X" = between Long throw and Combination cabinets

"C" = between two Combination cabinets

ADVANCED STACKING

Medium throw using coupled F2R-MHT

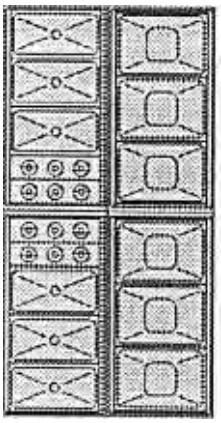
A coupled pair of "Combination" cabinets, with the upper cabinet inverted, will provide greater projection than a single cabinet due to narrower vertical dispersion. This can be considered as a "medium throw" system, and is a very useful technique for obtaining even dispersion from front to back of a medium-sized venue. However, users should beware that an unpleasant hot spot can result if they are aimed directly at a nearby audience which would be better served by a short throw system. Like long throw cabinets, they should be positioned sufficiently high, and carefully aimed so that the centre of the beam covers the most distant area. Experience will show when Combination cabinets should be inverted for extra projection and when they are best used singly.



"Medium throw" stacking

Extra-long throw using coupled F2R-3H2T instead of F2R-2H3V

The preferred method of obtaining extra-long throw coverage (more than 200 feet or 60 metres) at very high frequencies is with correctly coupled pairs of F2R-2H3V "High" cabinets. However, acceptable results may often be obtained by coupling pairs of F2R-3H2T "Top" racks with the upper cabinet inverted to place the F2T modules close together. The projection above 8kHz will not be as good as that provided by F2V modules which were specifically designed for such use, and this can be compensated for if desired with suitable delayed systems.



Alternative Extra Long-throw stack using F2T instead of F2V

Arena Systems

Several variations are possible to the Arena system described in the F2 Users' Guide, depending upon the size and shape of the venue and the style of music and consequent sound levels required. In many venues, single Top (3H2T) and Mid (3M) cabinets may be substituted for the Extra-long throw pairs in the offstage section of the main cluster, thereby allowing use of identical 2-wide flying frames throughout the system. Four successful versions of the Arena cluster are shown in the diagrams.

Centre fill, central delay, and side seating clusters.

When a production is being mixed in stereo then, where circumstances permit, these should receive a mono sum signal from the FOH desk matrix. This is obviously preferable for any audience areas which are only within range of a single loudspeaker cluster.

System testing

After plugging up a system it is normal practice to check all amplifiers and speakers with pink noise from the FOH desk. The usual method is to send noise on all bands as soon as the FOH desk and crossovers have been powered up. In a large system the flown clusters are rigged first, then hoisted clear to allow work to continue in the areas beneath them. This often occurs before the FOH control point is operational.

Due to the time and trouble involved in flying a cluster in to correct any wiring problems, users are strongly advised to check these BEFORE they are flown out, and a portable pink noise generator should be carried for this purpose.

OUTDOOR SYSTEMS

The successful implementation of a large outdoor sound system requires specialised experience and a good understanding of the behaviour of sound at festival sites and in large stadia.

The long-throw capabilities of the F2 allow remarkably even coverage of very large audiences whilst minimising any requirement for supplementary delayed systems. This can result in significant savings, especially when it is realised that each delay system normally requires a supporting structure, generator power supply and security personnel, in addition to the extra sound equipment involved.

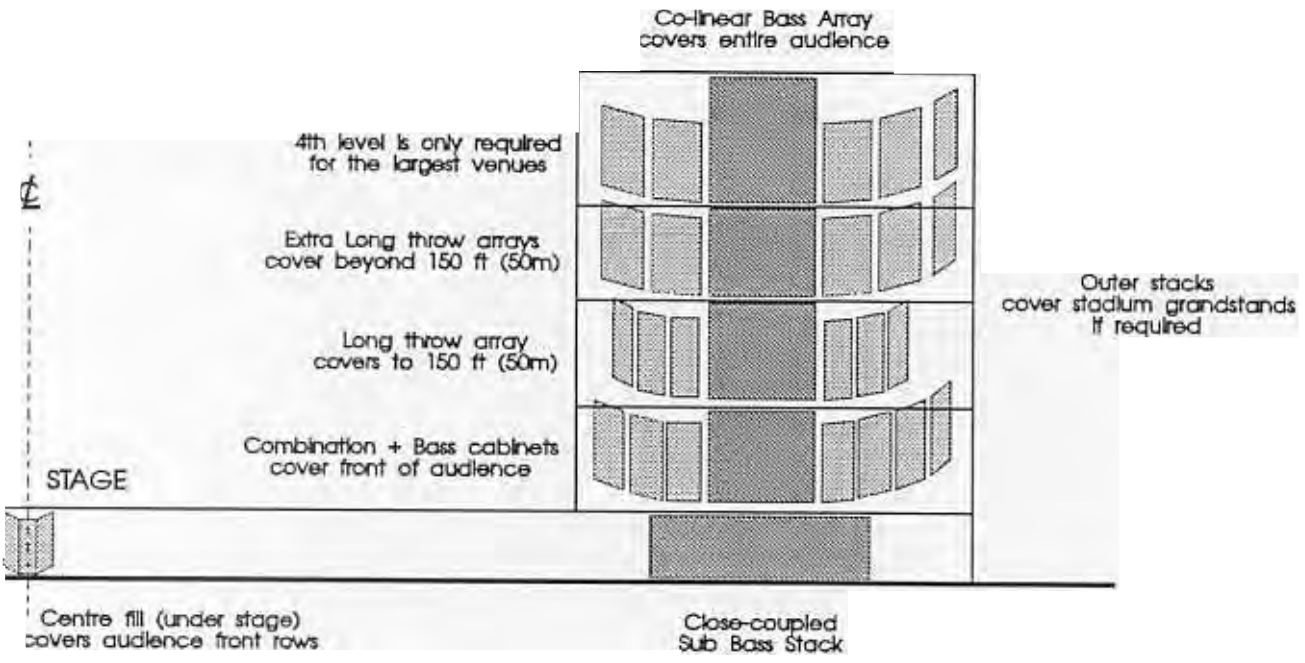
These benefits are achieved by stacking the main system on three or four levels of decking in the form of a high, narrow, coherent array.

The F2B cabinets effectively form a single vertical co-linear array (or "line source") which has wide horizontal dispersion and narrow vertical dispersion. The furthest sections of the audience receive the most intense coverage, which progressively lessens towards the front of the audience. This compensates for the reduction in sound level with increasing distance, and ensures that sound levels experienced close to the loudspeakers are not excessive.

The F2R cabinets are arranged to produce similar results, with Combination cabinets covering the front audience and progressively longer throw arrays providing more distant coverage from higher up the stack. In a large stadium, the offstage sections of the array are aimed for specific coverage of nearby grandstand areas.

All except the short throw cabinets must be angled downwards, 4"x 2" wood blocks normally being used for this purpose. This is necessary to compensate for the refraction of sound upwards by air temperature gradients (the acoustic mirage effect) and to confine the sound within the concert site.

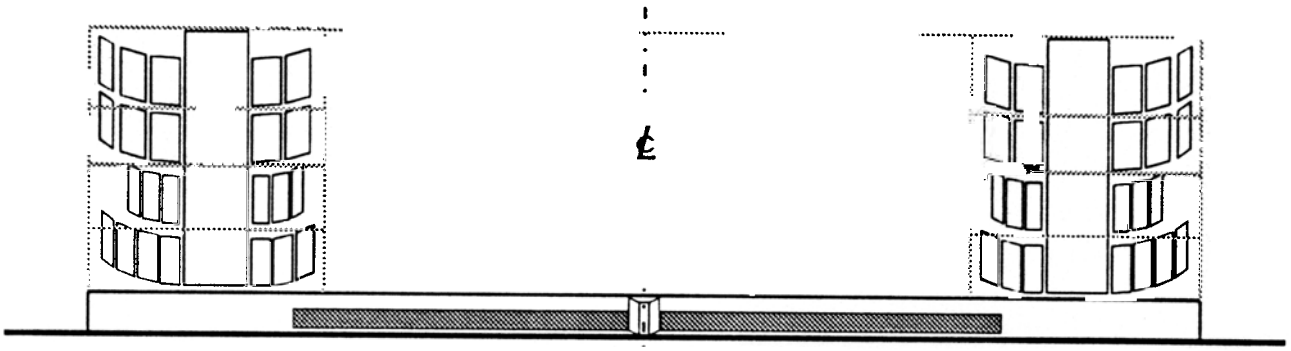
A small delayed system, as indicated in the F2 Users Guide, should be provided on the rear of the FOH control tower. Additional field delays will only be required for exceptionally large festival sites.



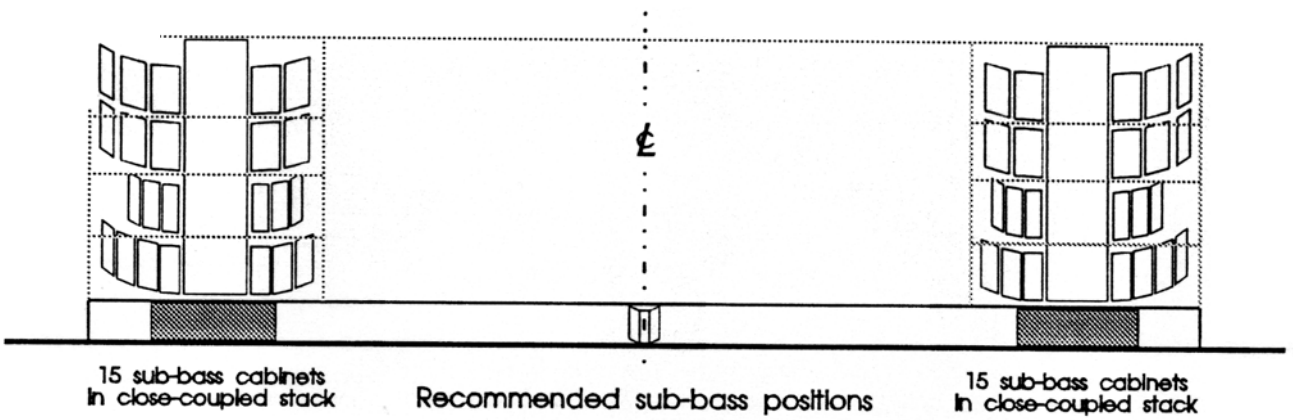
Large outdoor system principles

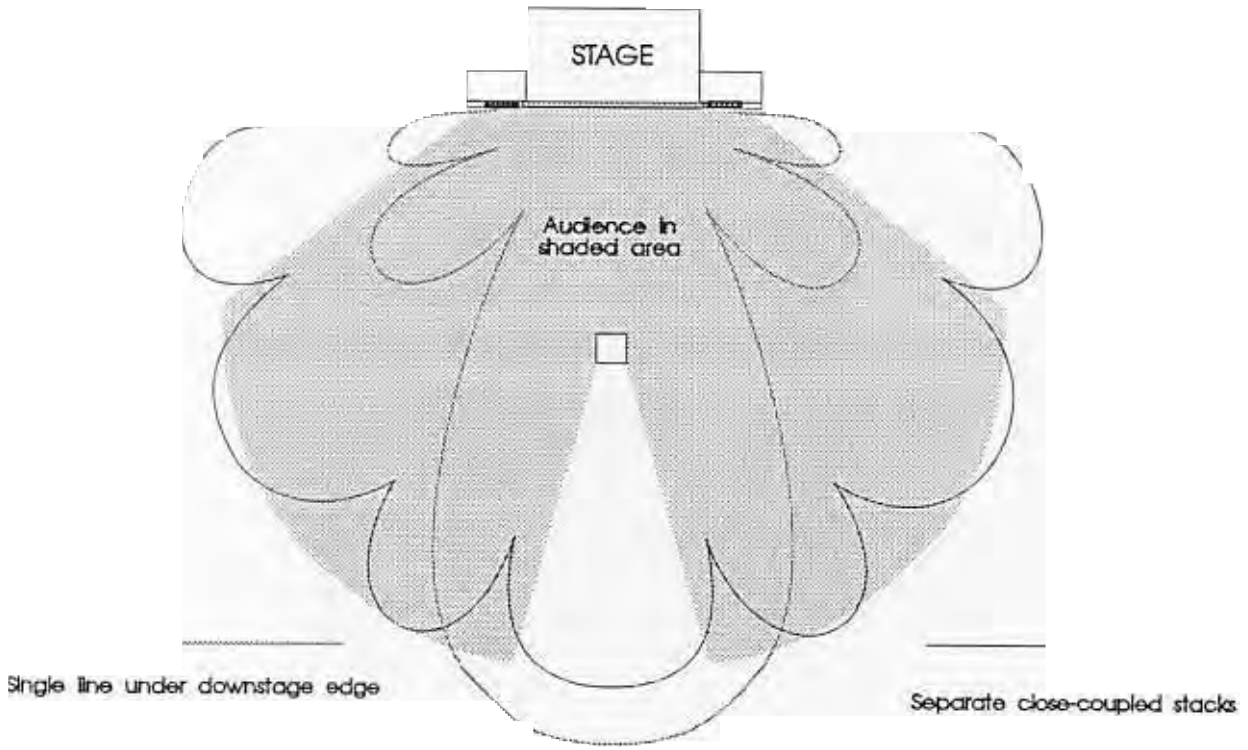
Sub-bass at outdoor venues

As explained in the F2 Users' guide, a very wide sub-bass stack should not be used. This would behave as a horizontal co-linear array, projecting sound down the centre of the site with little coverage towards the sides; the opposite effect to that created by the vertical array of bass speakers. Better results will be achieved with a smaller stack each side, filling the gap between the ground and the first level of decking for the main system.



Incorrect stacking technique - row of 30 sub-bass cabinets under stage





Sub-bass dispersion patterns at large festival site

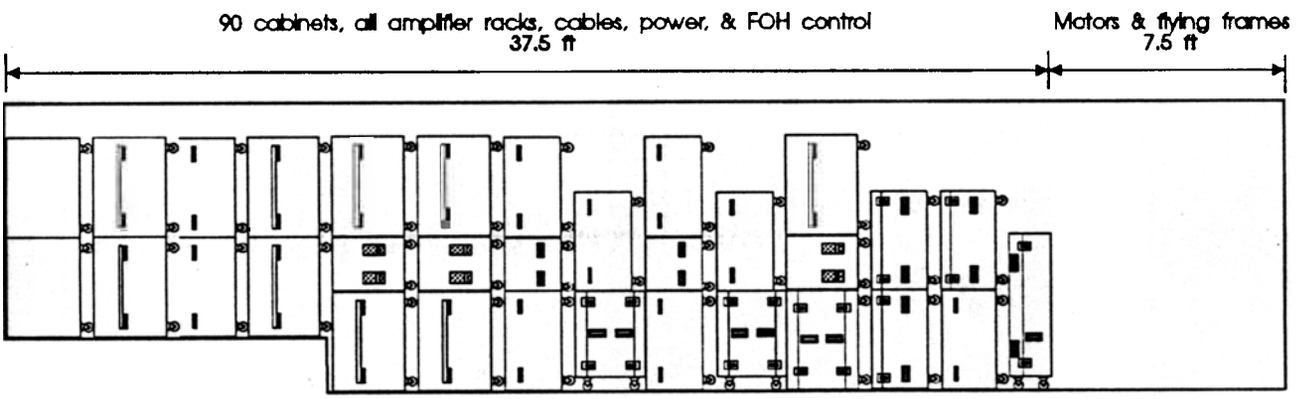
ERGONOMIC TRUCK PACKS

The following notes may help to maximise crew productivity and ease of handling when loading a trailer with F2.

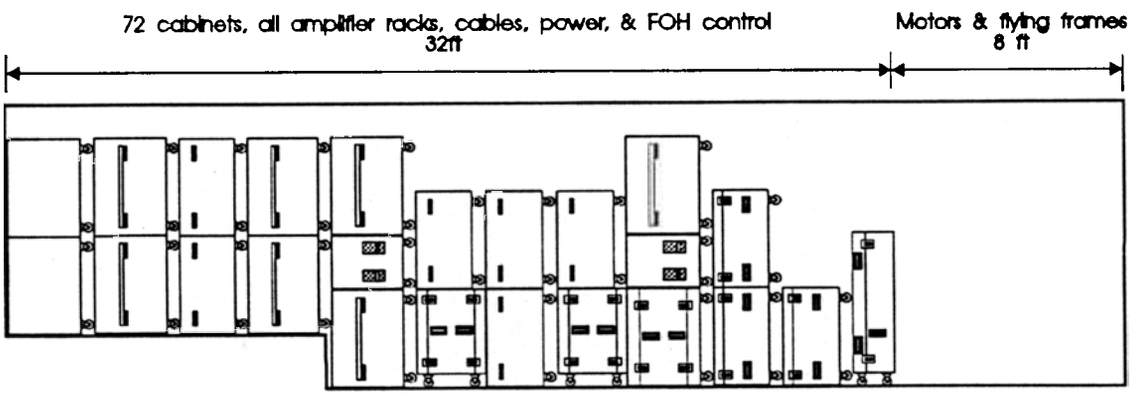
F2B/FSX cabinets: F2B cabinets should form the bottom rows whilst any FSX, which are lighter, should be reserved for the middle or top rows.

F2R cabinets: any Top (3H2T) cabinets, which are the heaviest, should be reserved for the bottom rows. Combination (MHT) cabinets, which are the lightest, are best selected for the top rows. They should always be inverted, to optimise the weight distribution for ease of handling.

Truck packing will be greatly simplified if the amplifier racks and cable trunks have been made to the dimensions recommended (see "System Integration"). Amplifier racks will normally be heavier than F2 cabinets and will remain on their wheels. Therefore they will be packed on the bottom rows, and positioned in the pack so that they cannot shift.



Large arena system packed in 45 ft trailer



Small arena system packed in 40 ft trailer

System Power, Sensitivity and Truck Pack Efficiency

The quoted power of a loudspeaker system is not, in itself, very meaningful. Because of its very high efficiency, an F2 System will outperform some competitive systems of several times its power. F2 users are therefore strongly advised to avoid an unqualifed statement of system power in a competitive quotation for a job.

Whilst small hire companies often quote on system power, reputable suppliers to major tours will normally base a quotation on the size of the venues to be covered. However, an unscrupulous bidder might be quoting on the basis of providing "more power" than a competitor, even though the higher powered system produces less sound. Similarly, an unscrupulous manufacturer may try to sell a system to hire companies on the basis of "more power per foot of truckspace" even though an equivalent from their competitors actually requires only half as many loudspeakers and amplifiers to do the same job.

The sensitivity figure quoted by a manufacturer is an indication of how much sound OUTPUT can be obtained from a given loudspeaker. When comparing competitive systems it is important to realise that 3dB more sensitivity means "half as much power to produce the same amount of sound", whilst 6dB more sensitivity means "produces the same sound level at twice the distance".

In general, horn loaded loudspeakers are more efficient than direct radiators, requiring less power from the amplifiers (or a smaller number of speakers) to generate the same acoustic output. Many loudspeaker systems use direct radiating drivers for the low and mid frequencies, which may be perfectly adequate for short throw applications. Furthermore, a system in which units may be arrayed for narrow beam projection will produce higher sound levels at a distance, compared with a "one box" loudspeaker or a fixed format "two box" system which cannot take advantage of directional gain.

The following comparison may be of interest:

Box "A" is a horn-loaded bass cabinet with a sensitivity of 107dB and a maximum programme power of 1000 Watts. Ten cabinets (10kW) stack in 3 feet of trailer space.

Box "B" is a short horn/bandpass bass cabinet with a sensitivity of 102dB and a maximum programme power rating of 1200 Watts. Twelve cabinets (14.4kW) stack in 3 feet of trailer space.

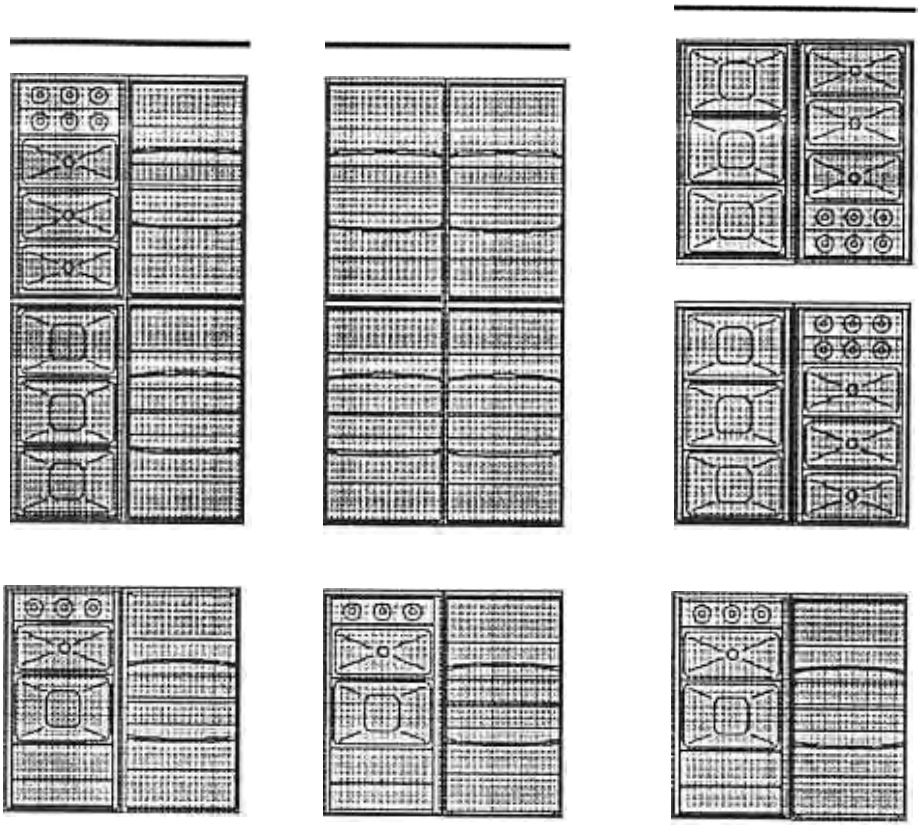
Box "C" is a ported bass cabinet with a sensitivity of 102dB and a programme power rating of 1600 Watts. Nine cabinets (14.4kW) stack in 3 feet of trailer space.

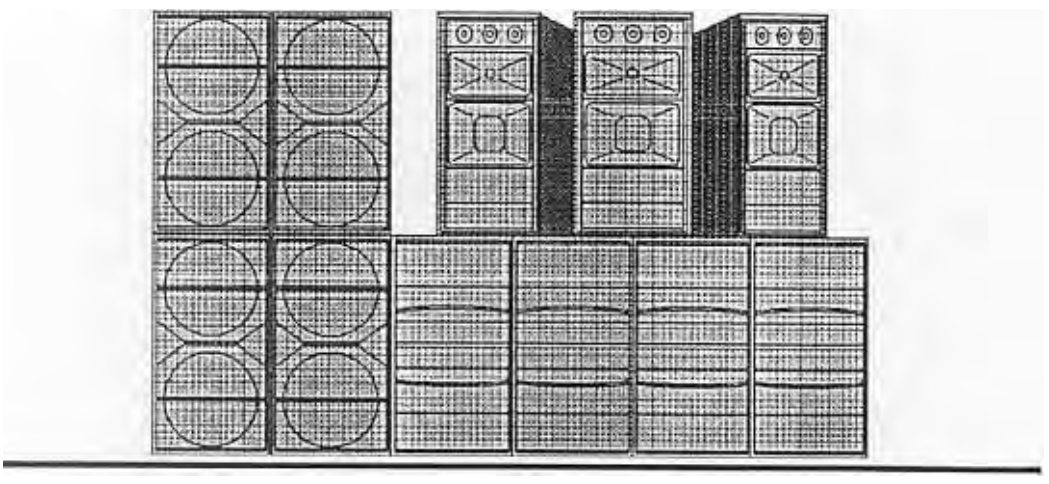
To produce the same acoustic OUTPUT as the 10kW of box "A" requires 31.6kW of box "B" or box "C". This means that 26 of box "B", or 20 of box "C", are required to do the same job as 10 of box "A".

Put in another way, TWO full trailers of box "B" or "C" are required to produce the same acoustic output as ONE trailer full of box "A".

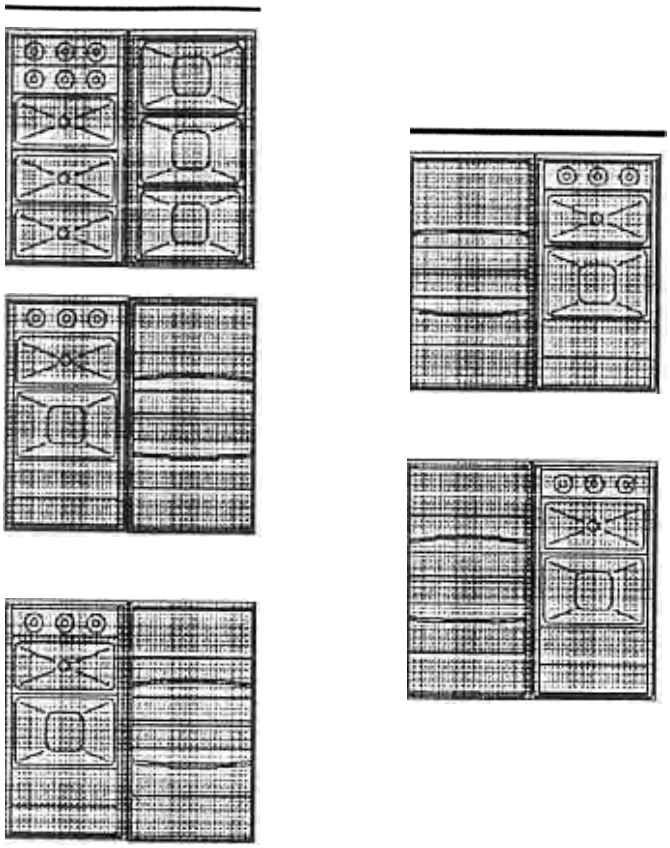
Despite this, a hire compacy with box "C" regularly quotes for work on the basis that they get three times as much power in the same truck space as their competitor with box "A". Their clients remain blissfully unaware that an equivalent using box "A" would require one third of the power, and only half the truck space.

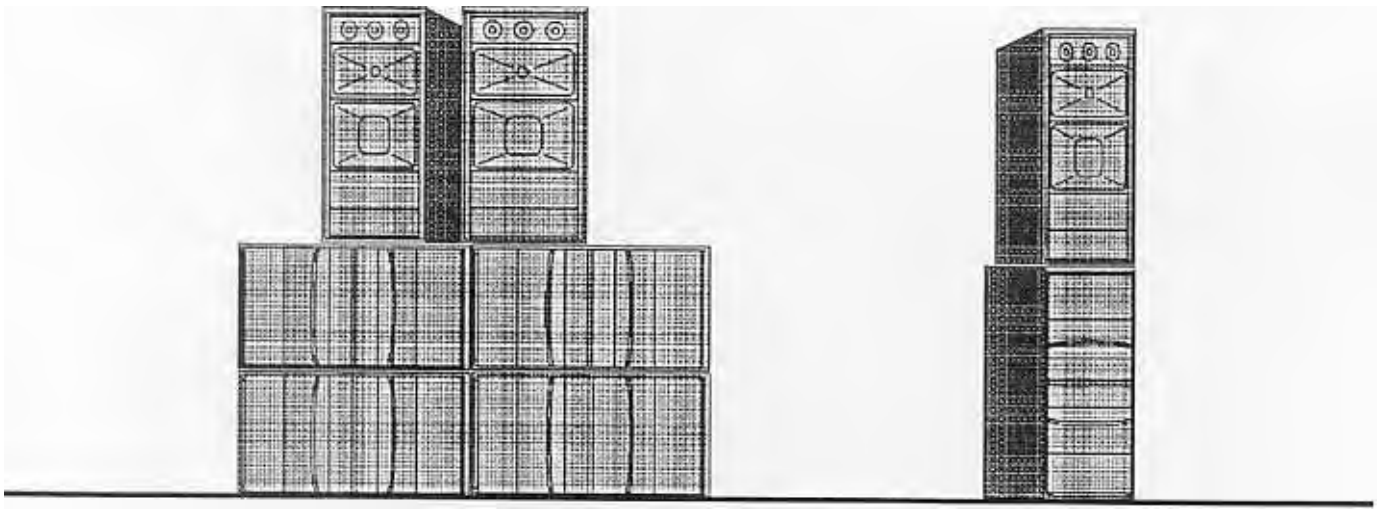
Box "A" above is the F2B. The other shall remain nameless.



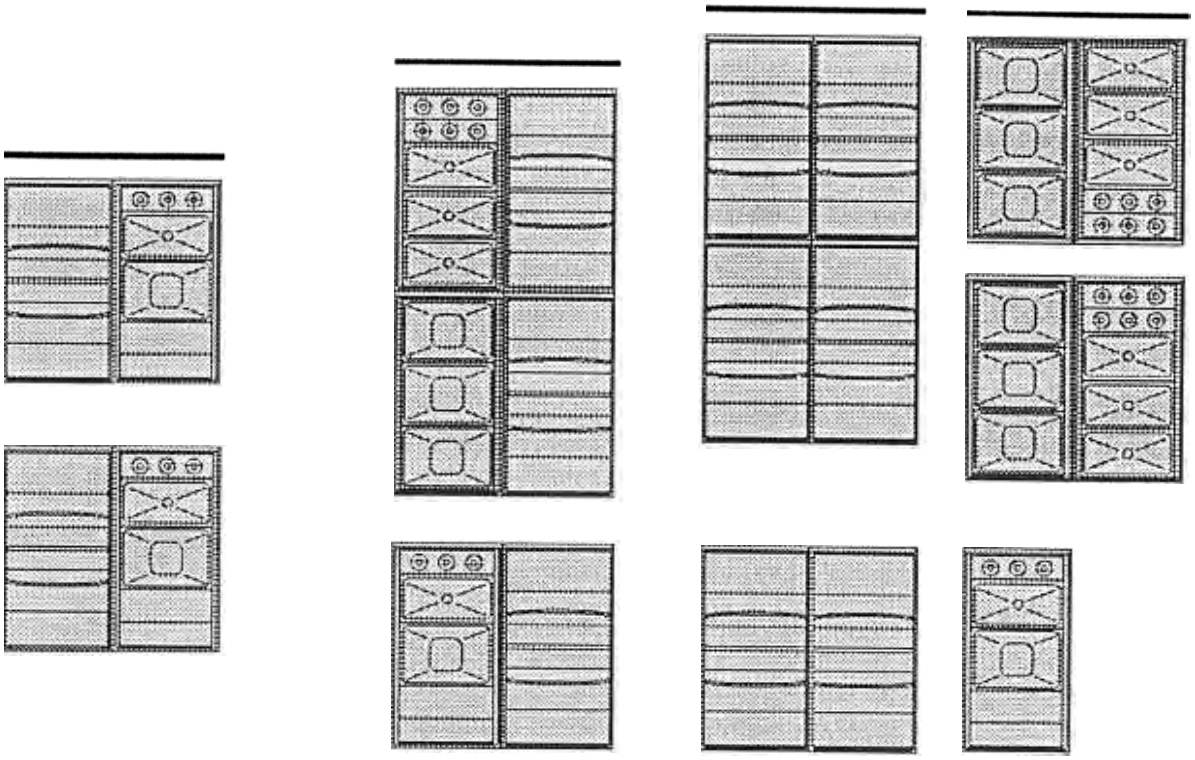


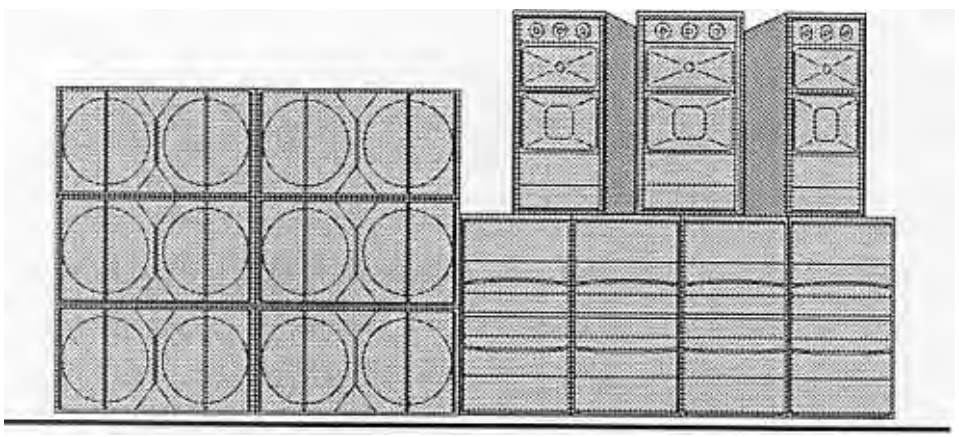
F2 System for Rock Show In large Conference Venue,3 - 5000 capacity
(Stage Right Shown)



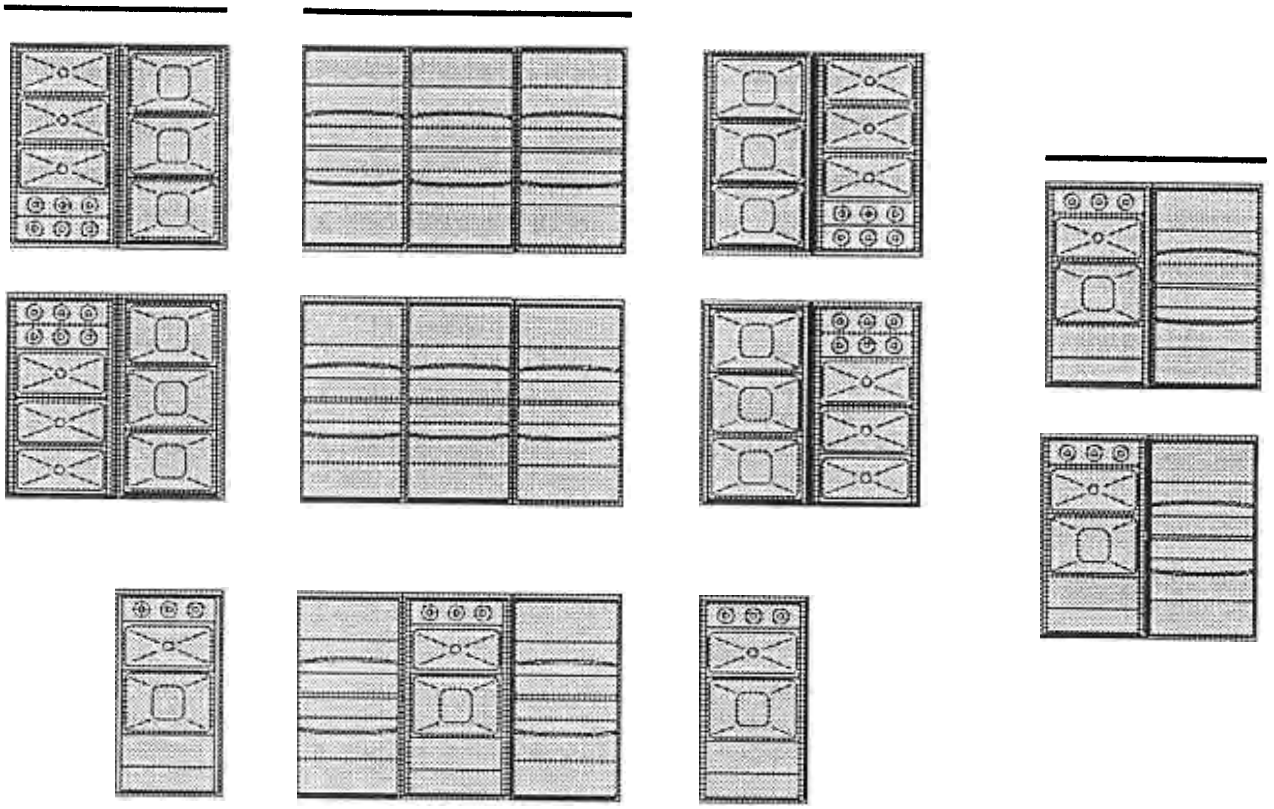


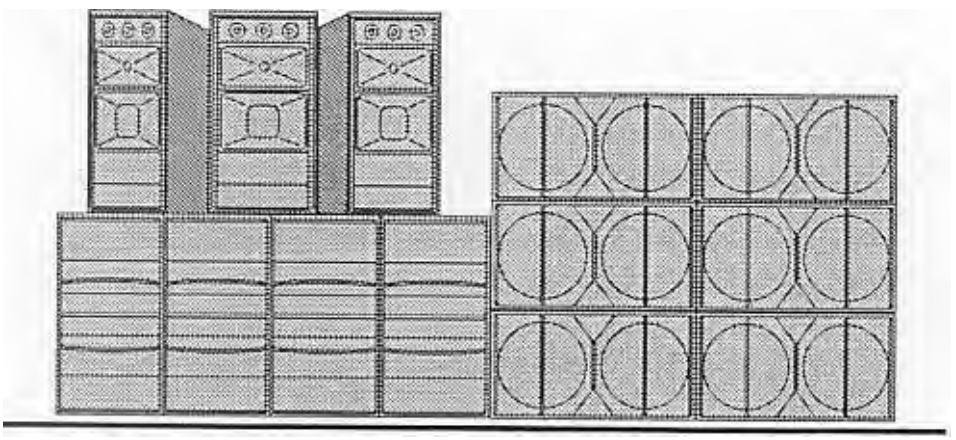
F2 System for Rock Show In small Conference Venue, 2 - 4000 capacity
(Stage Left Shown)



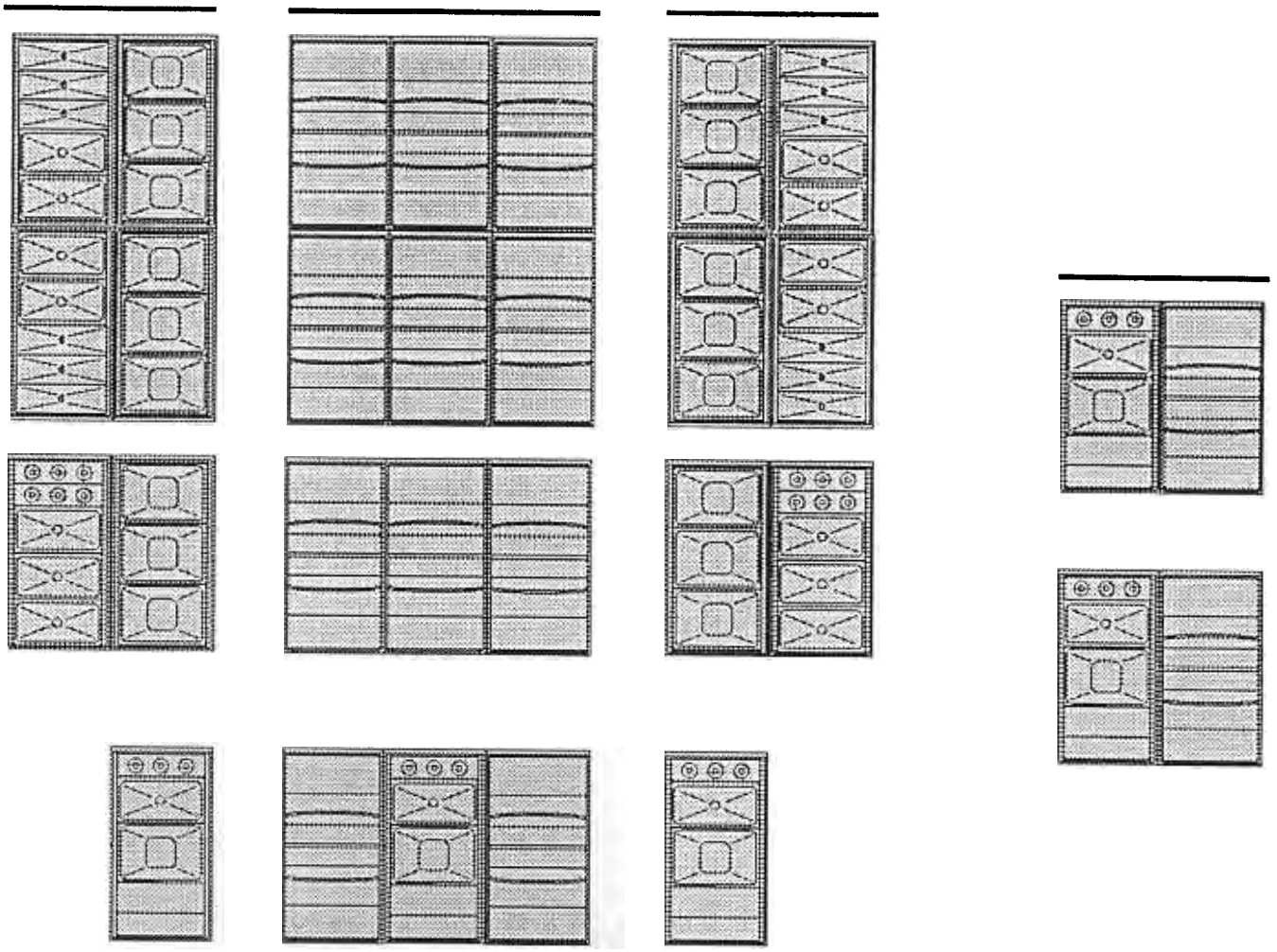


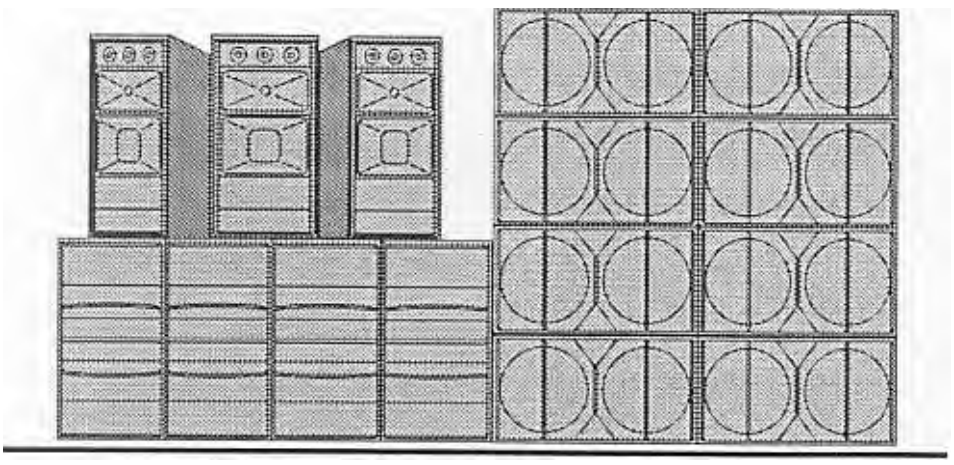
System for Typical Arena Venue, 5 10000 capacity
(Stage Right Shown)



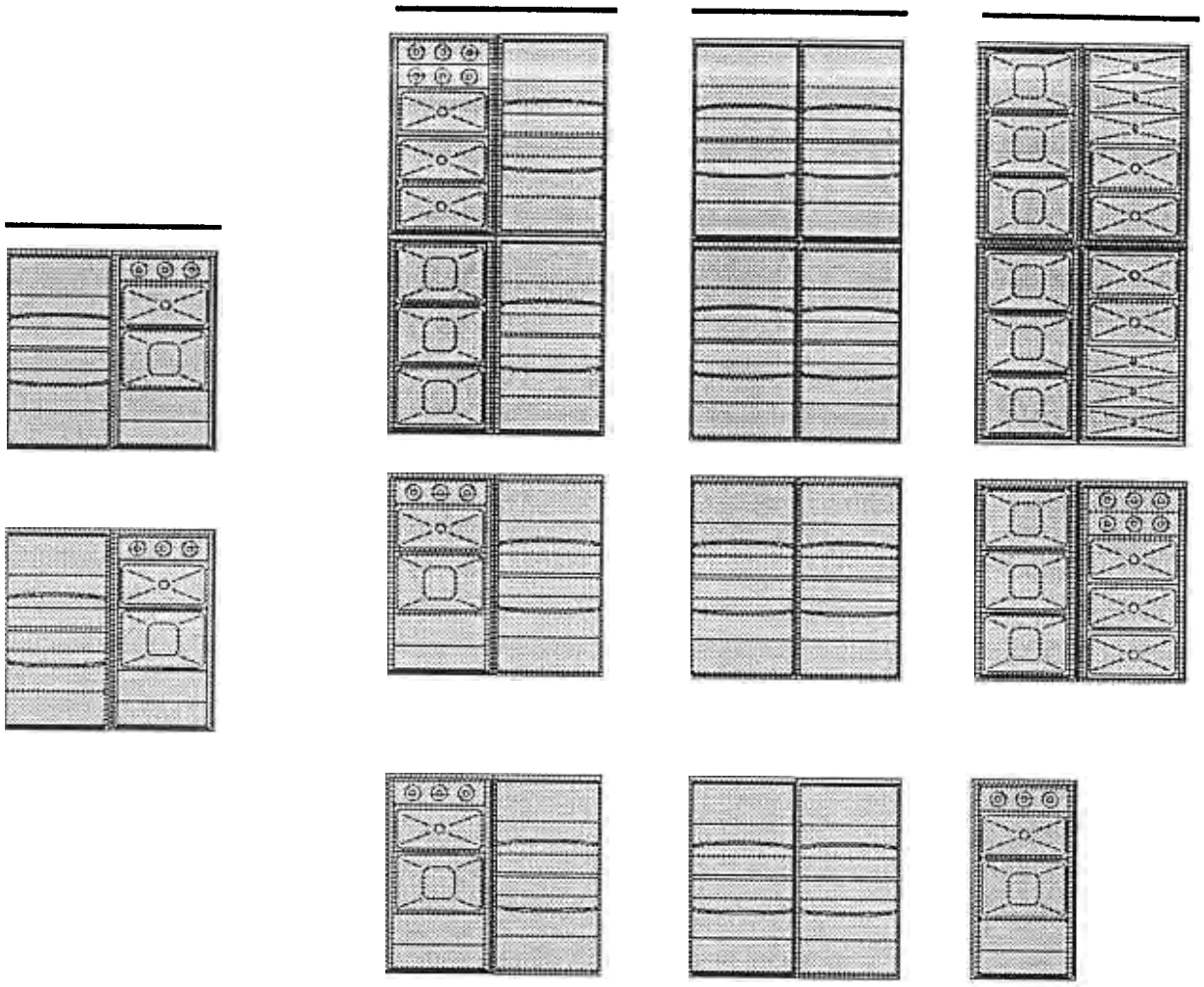


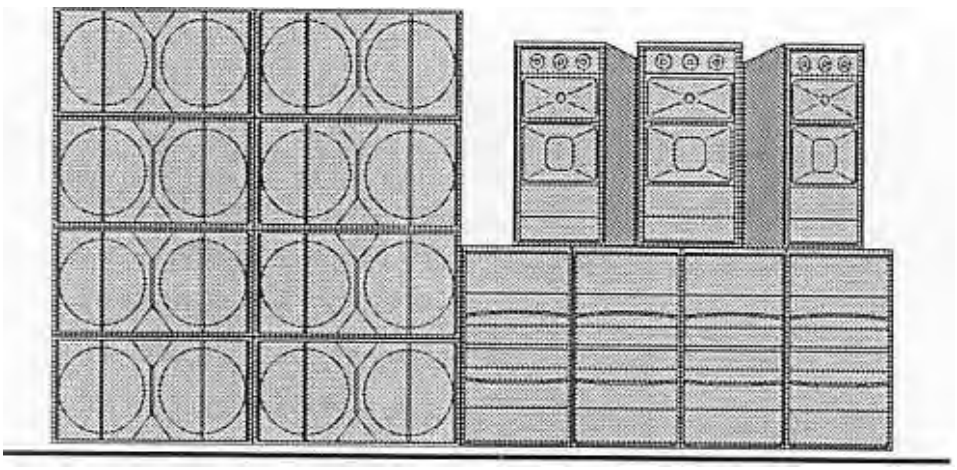
F2 System for Typical Arena Venue, 5 - 8000 capacity
(Stage Left Shown)



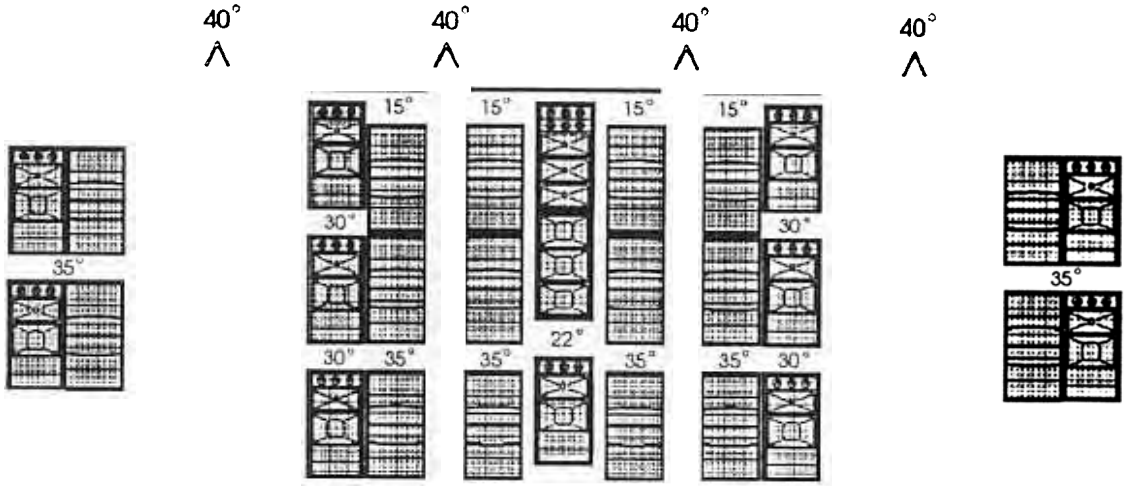


F2 System for Typical Arena Venue, 8 - 15000 capacity
(Stage Left Shown)



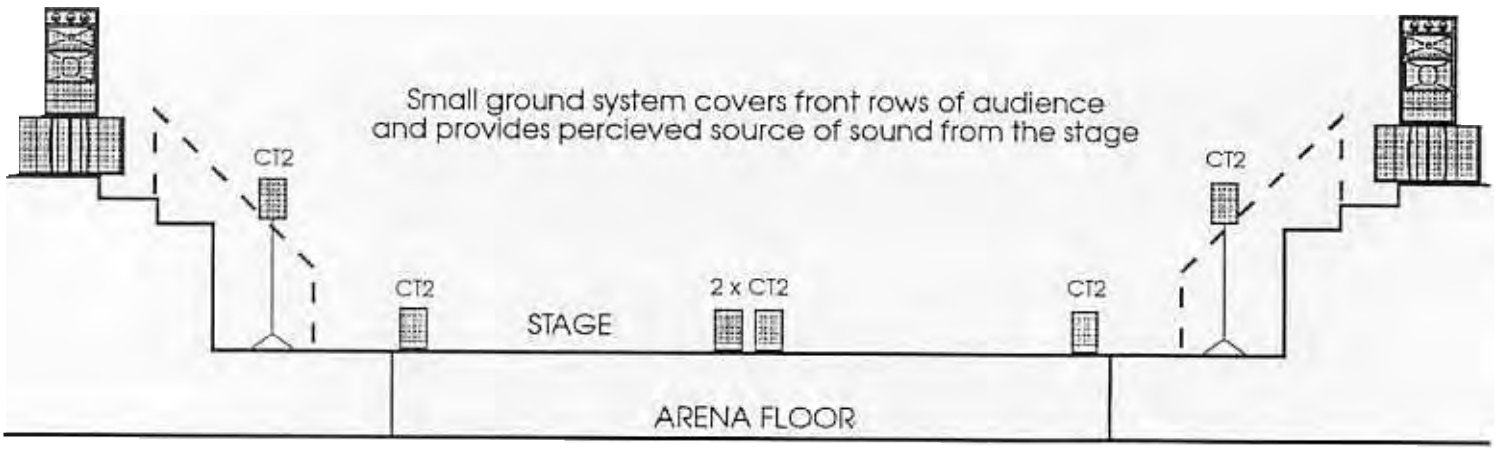


F2 System for Typical Arena Venue, 8 - 15000 capacity
(Stage Right Shown)

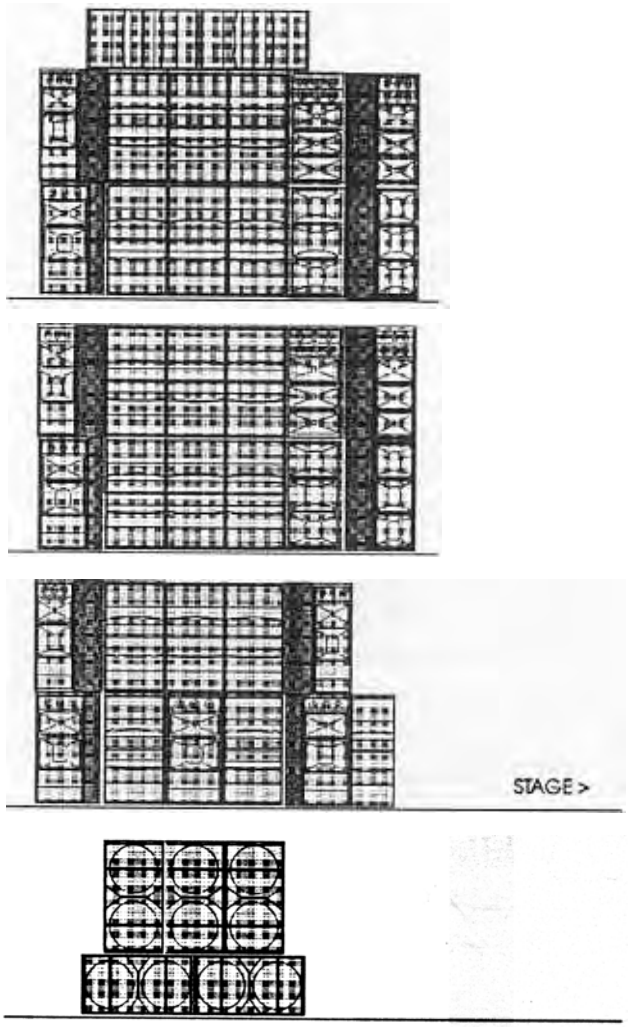


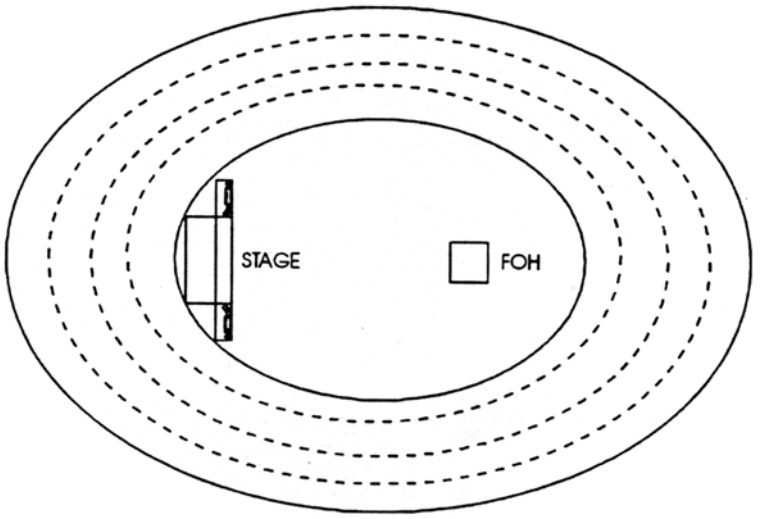
Centre cluster
provides even coverage
of most of audience

Side clusters
ensure complete coverage
to end of balcony

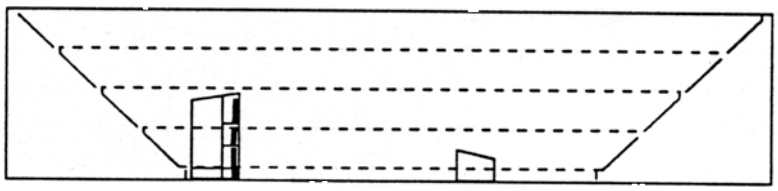


F2 System for Royal Albert Hall



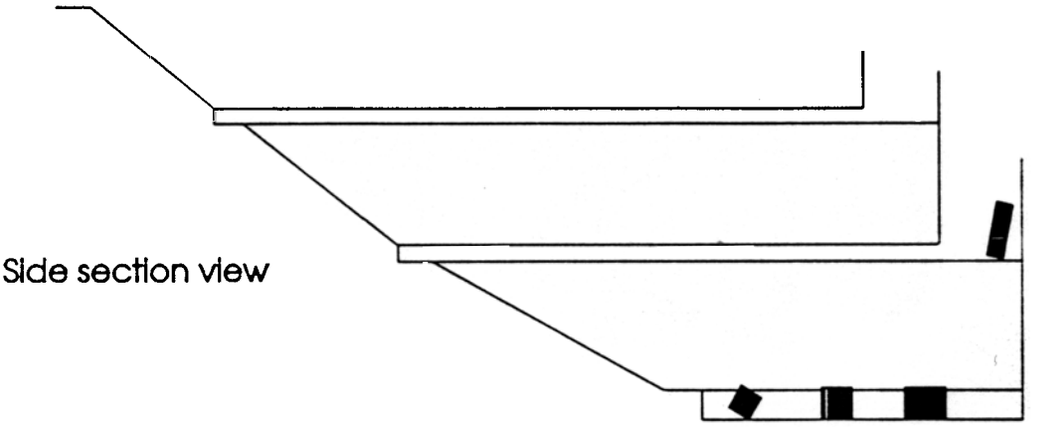


Plan view

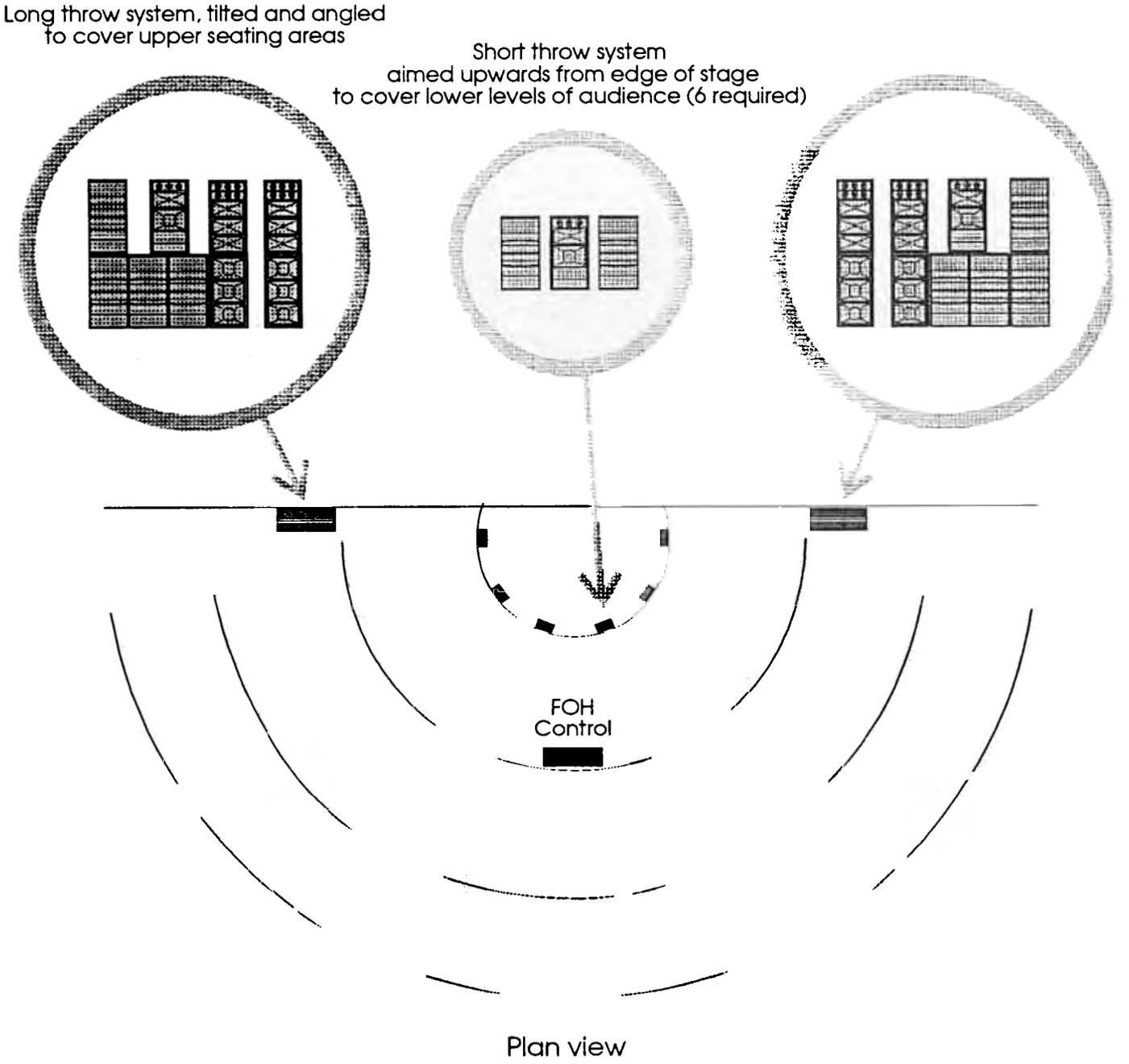


Sectional view

F2 system in Arènes de Nîmes
(Stage Right shown)



Side section view



Plan view

F2 System used for MOR act at Efes Amphitheatre, Turkey