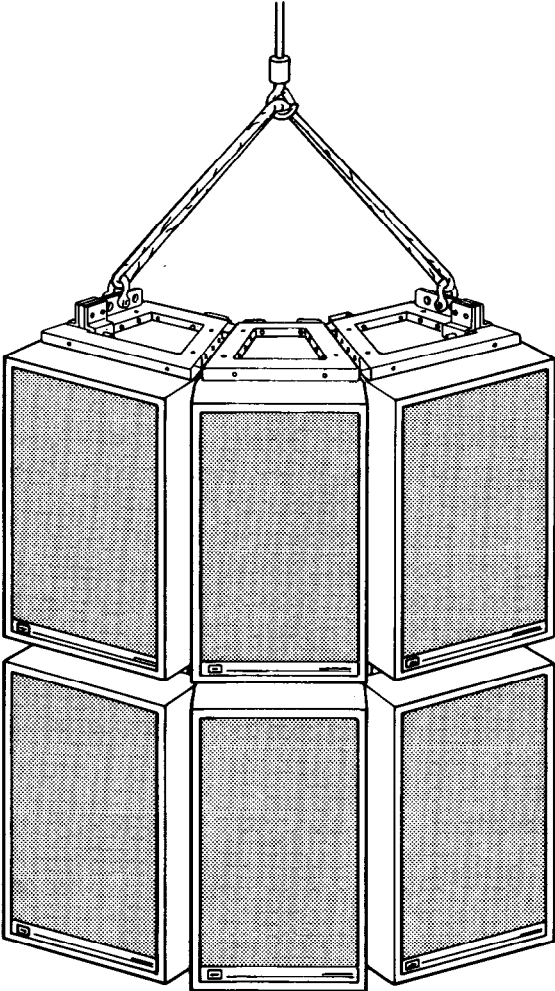




# ARRAY SERIES S.A.F.E. GUIDE



## Introduction

This guide provides instruction on what S.A.F.E. components are required, and how to connect them, to create several example arrays. The suspension points, hardware, and methods that are used to hang the array must meet professional rigging standards. JBL Technical Note Volume 1, Number 14 explains basic principles for suspending loudspeaker systems and provides further references.

## Safety Factors and Load Ratings

S.A.F.E. hardware is designed, engineered, and certified with a 6:1 safety ratio (i.e. if the array weighs 300 lbs the support structure must be capable of at least 1800 lbs). Correct use of this hardware is required for secure array construction. Model 4892 loudspeakers with truss module have been pull tested and rated at 5200 pounds break strength, with a 6:1 safety factor each 75 pound enclosure can support a working load of 866 pounds (a vertical array of 10). The working load ratings of other components are: connecting bar - 1387; shackle mount - 496 lbs; stacking bracket 427 lbs; quick release pin - 1783 lbs. As an example of how to use these numbers, we can calculate how many 4892 enclosures can be suspended from one pair (two) shackle mounts. The working load rating for each shackle mount is 496 lbs; each 4892 weighs 75 lbs with two truss modules; if each shackle mount supports one half the array, the maximum number of enclosures that can be supported is:  $(2 \times 496 \text{ lbs}) / 75 \text{ lbs} = 13$ . Careful calculations should be performed to ensure that all components are used within their rated work load before the array is suspended. Remember: the weakest component determines the size and safety of the entire array! **CAUTION!** Before suspending any array always inspect all components of the array (enclosure, truss module, threaded fasteners, connecting hardware, and lifting hardware) for cracks, deformations, corrosion, missing or damaged parts that could reduce strength and safety of the array. Use only load rated hardware. Building structural supports and hoist motors require inspection prior to each use by knowledgeable professionals. Never exceed maximum recommended load ratings.

## Components and Array Construction

The S.A.F.E. series of modular flying hardware eliminates the cost and bulk of large custom designed fly bars. Five basic items- truss module, connecting bar, shackle mount, stacking bracket, and quick release pins- easily combine to assemble a rigid array. Truss modules attach to the loudspeaker top and or bottom (we recommend both) using its internal steel braces, the connecting bars then join the truss modules using quick release pins. Lifting points for the array are created by attaching shackle mounts to the truss modules with the release pins. Straight vertical arrays are formed by connecting one top truss to a bottom truss using a stacking bracket, curved vertical arrays are created using multiple shackle mounts as shown later. All assembly is made with quick release pins for positive, easy connections. ALL QUICK RELEASE PINS MUST BE FULLY INSERTED FOR POSITIVE LOCKING. Figure 1 shows a simple array of two 4892 loudspeakers with the S.A.F.E. hardware required to connect them for "flying". Note two connector bars are used top and bottom at rear of array. This is the preferred way to connect an array together.

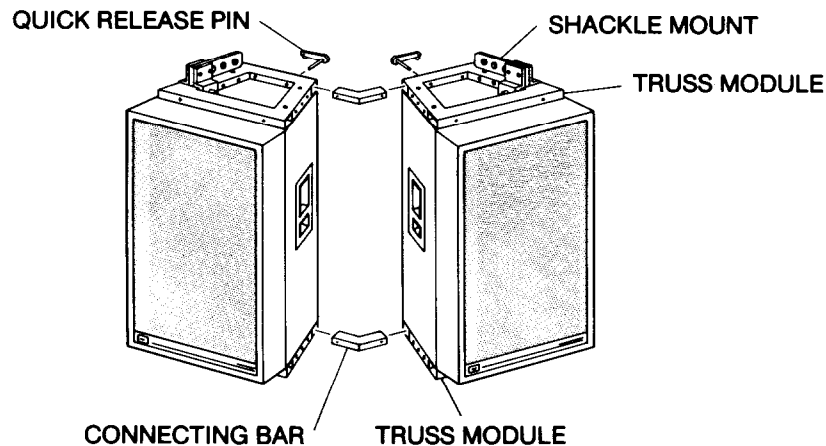


Figure 1

Figures 2a and 2b show two methods of coupling for vertical arrays. Table 1 indicates the number of each component required for listed array types.

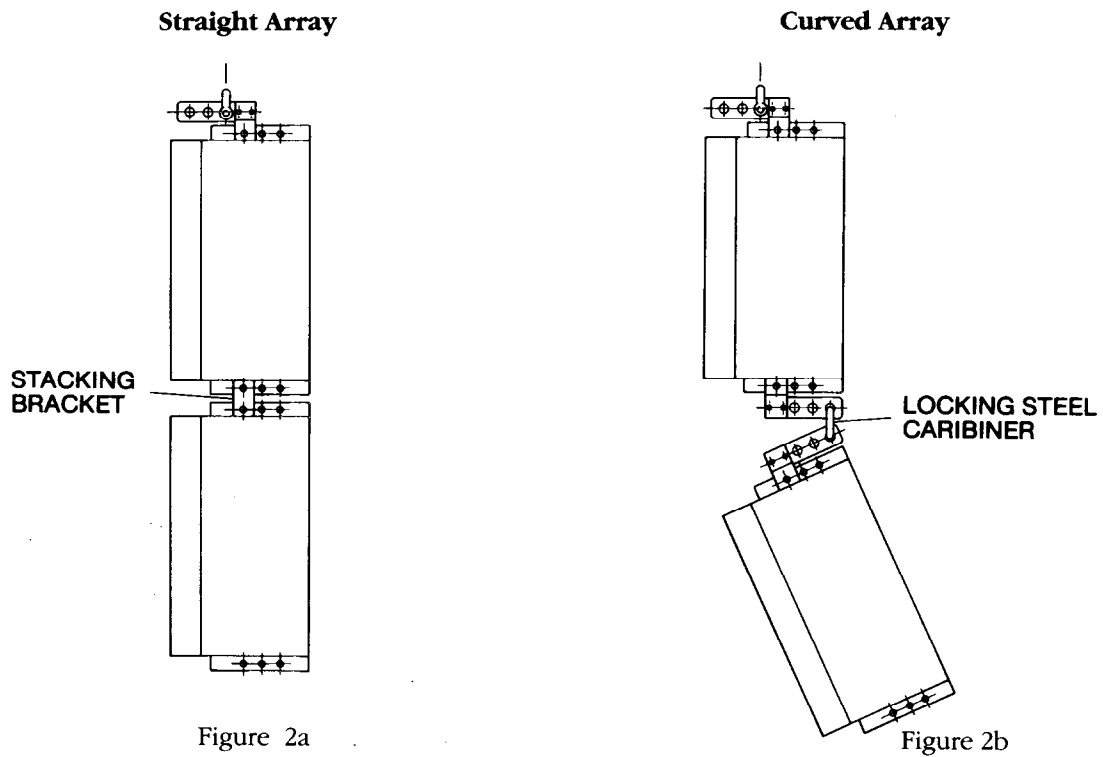


Figure 2a

Figure 2b

Hardware Type	Array Configurations						
	1 x 2	1 x 3	1 x 4	2 x 2	2 x 3	2 x 4	3 x 3
ASF-TM12 Truss Module	4	6	8	8	12	16	18
ASF-SM12 Shackle Mount	2	2	2	2 or 6*	2 or 6*	2 or 6*	2 or 10*
ASF-CB12 45° Connecting Bar	2	0	6	4	0	12	12
ASF-CB12 /30 30° Connecting Bar	0	4	0	0	8	0	12
ASF-SB12 Stacking Bracket	0	0	0	2 or 0*	2 or 0*	2 or 0*	4 or 0*
ASF-QRP Quick Release Pin	6	10	14	14	22	30	32
ASF-LSC Locking Steel Caribiner				0 or 2*	0 or 2*	0 or 2*	0 or 2*
* if Array is curved							

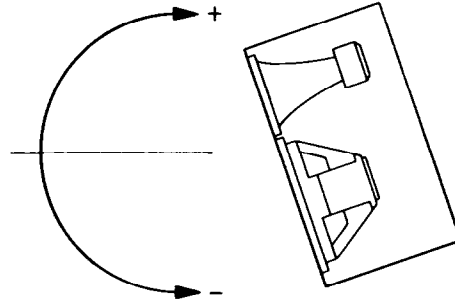
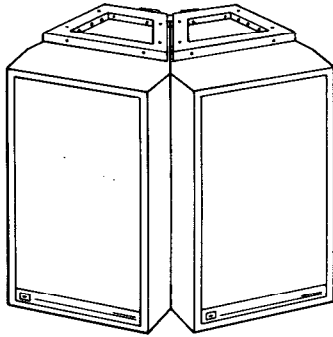
Table 1

## Array Design and Applications

This section contains “tilt” guides showing the amounts of vertical “splay” angle available for different arrays by selecting various combinations shackle mount and lift point locations. Since the arrays shown in these examples are suspended by a single point, guy lines will be required to stabilize the array from rotating.

### Tilt Guide for 1 x 2 Array

Table 1 shows range of possible angles with shackle mount extending toward front of cabinet, Table 2 with shackle mount extending toward rear of cabinet. A +5° to -28° range of aim angles are available from a single hang point.



Tilt angles for selected holes

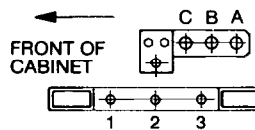
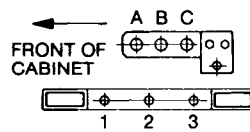
	1	2	3
A	+5°	0°	-5°
B	0°	-3°	-8°
C	-5°	-8°	-12°

Table 1

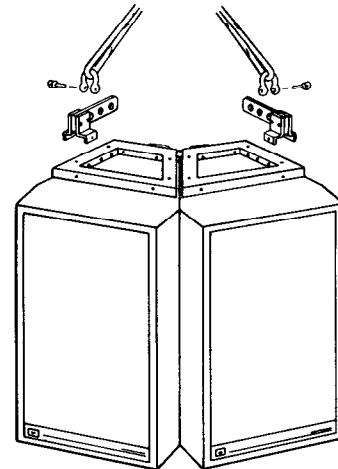
	1	2	3
A	-19°	-23°	-28°
B	-15°	-20°	-25°
C	-12°	-16°	-21°

Table 2

Direction of Shackle Mount on Truss

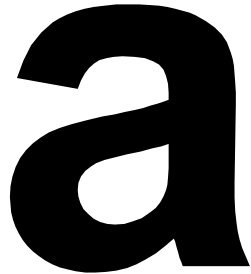
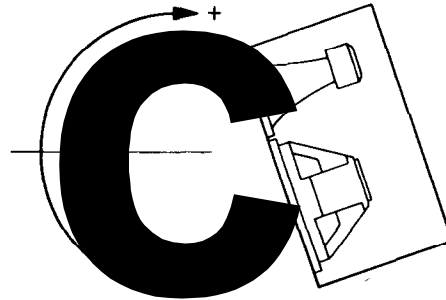
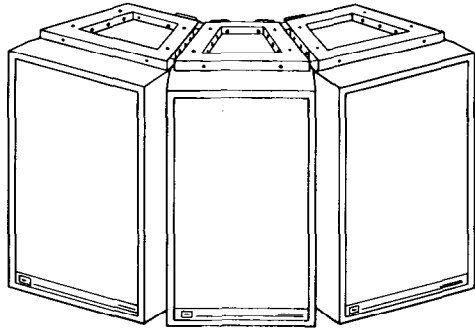


Location of Shackle Mount on Array



**Tilt Guide for 1 x 3 Array (Note this configuration requires ASF-CB12 / 30)**

Tables 1 and 2 show tilt with lift points facing front and rear, located on outside truss rails providing a range of aim angles from +12° to +25°. All locations are behind the center of gravity resulting in down firing arrays. Tables 3 and 4 show tilt with lift points located on inside truss rails closer to the center of gravity resulting in a wider range of aim angles (+15° to -20°). Generally this would be a better choice. Position 1 does not allow clearance for shackle mount and is noted no connection (NC). Using the inside location also increases the load angle efficiency, reducing sling tension. (See page 8, JBL Technical Notes Vol. 1, Number 14)



Tilt angles for selected holes

	1	2	3
A	-12°	-13°	-15°
B	-13°	-15°	-17°
C	-15°	-17°	-20°

Table 1

	1	2	3
A	-22°	-23°	-25°
B	-21°	-22°	-24°
C	-20°	-21°	-22°

Table 2

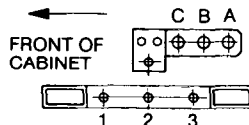
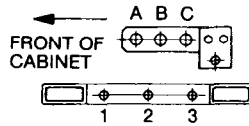
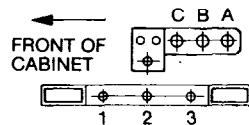
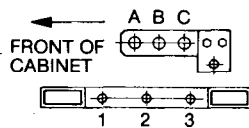
	1	2	3
A	NC	+15°	+10°
B	NC	+10°	+5°
C	NC	+5°	0°

Table 3

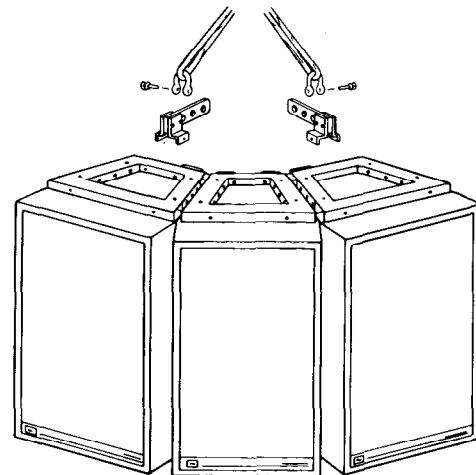
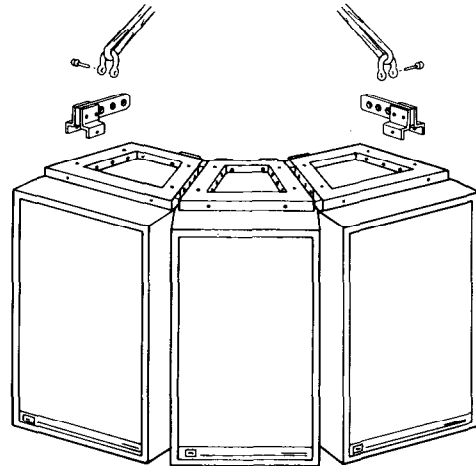
	1	2	3
A	NC	-15°	-20°
B	NC	-10°	-16°
C	NC	-6°	-12°

Table 4

Direction of Shackle Mount on Truss

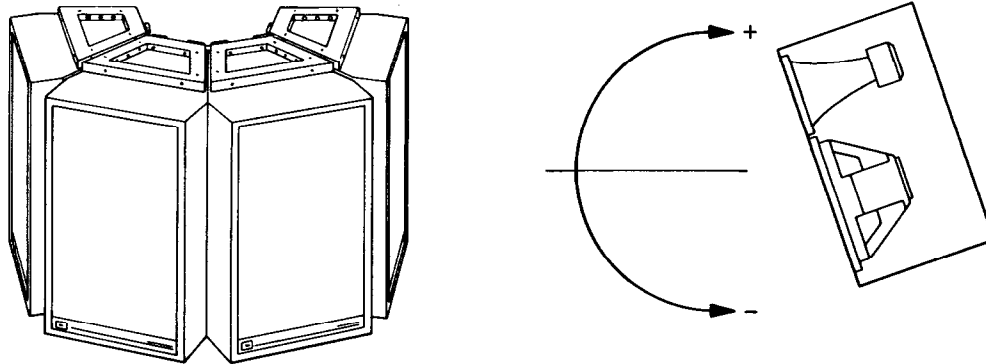


Location of Shackle Mount on Array



## Tilt Guide for 1 x 4 Array

Tables 1 and 2 show tilt with lift points facing front and rear, located on outside truss rails. Four cabinets create a 180° array that results in all locations on a common line behind the center of gravity. Tables 3 and 4 show tilt with lift points located on inside truss rails closer to the center of gravity resulting in a wider range of options. This is a better choice. Position 1 does not allow clearance for shackle mount and is noted no connection (NC). Aim angle options range from +10° to -12°



### Tilt angles for selected holes

	1	2	3
A	-25°	-25°	-25°
B	-25°	-25°	-25°
C	-25°	-25°	-25°

Table 1

	1	2	3
A	-25°	-25°	-25°
B	-25°	-25°	-25°
C	-25°	-25°	-25°

Table 2

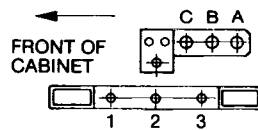
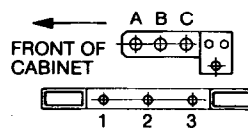
	1	2	3
A	NC	+14°	+10°
B	NC	+10°	+6°
C	NC	+7°	+2°

Table 3

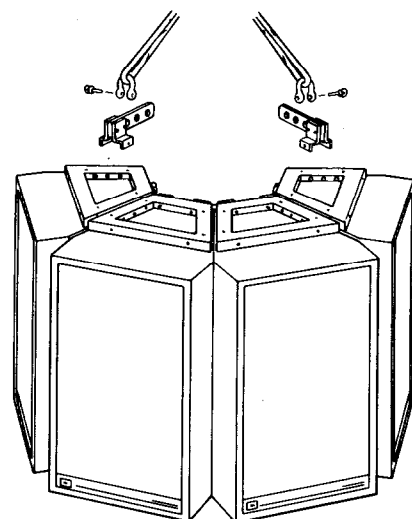
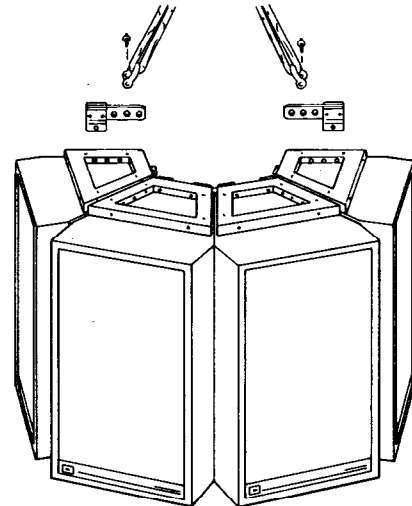
	1	2	3
A	NC	-9°	-12°
B	NC	-6°	-9°
C	NC	-3°	-6°

Table 4

### Direction of Shackle Mount on Truss



### Location of Shackle Mount on Array

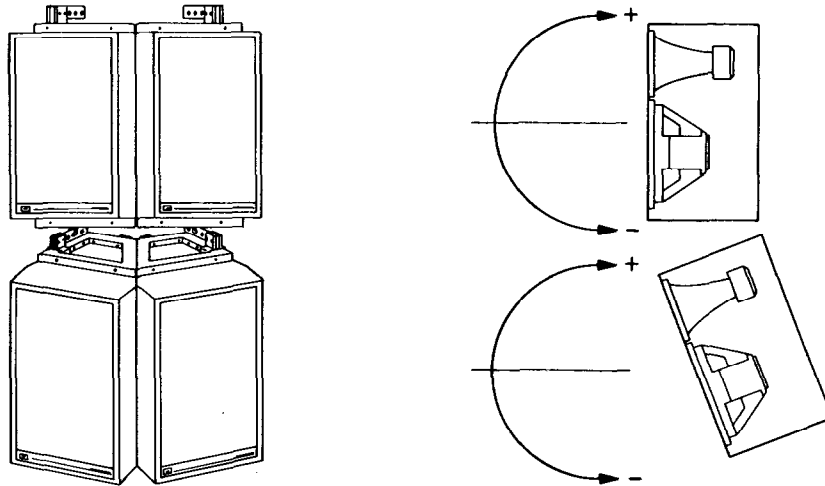


## Tilt Guides for multi-tiered Arrays

Four examples of curved arrays are shown, each with a different suspension location, noted by heavy black dots. Application notes are included. To calculate vertical coverage add  $18^\circ$  to the positive tilt angle and  $18^\circ$  to the negative tilt angle (disregard the "-" sign). If both aim angles are negative, add  $36^\circ$  to the difference.

**Tilt Guide for 2 x 2 Array** - (Suspended from holes 1 - A, shackle mounts connecting top tier to lower one are towards front)

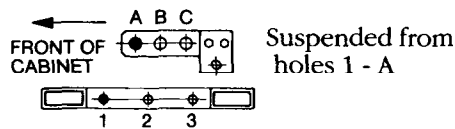
This configuration offers less difference in aim angles between the two tiers ( $+7^\circ$  to  $-12^\circ$ ). Any options chosen from Tables 1 and 2 will result in higher SPL, with more lobing.



Tilt angles for selected holes

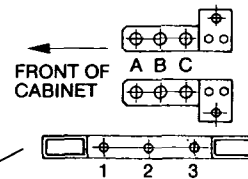
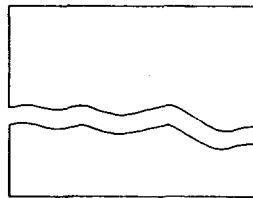
Direction of Shackle Mount on Truss

Location of Shackle Mount on top Array



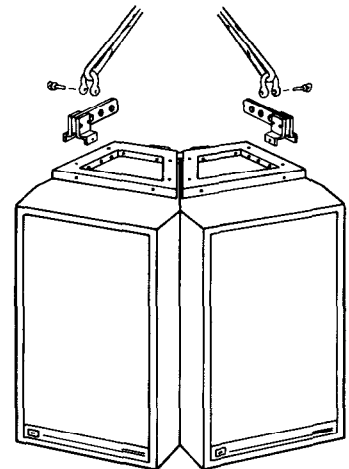
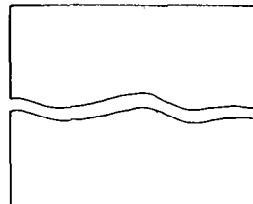
	1	2	3
A	$+1^\circ$	$+2^\circ$	$+3^\circ$
B	$+2^\circ$	$+3^\circ$	$+5^\circ$
C	$+3^\circ$	$+5^\circ$	$+7^\circ$

Table 1



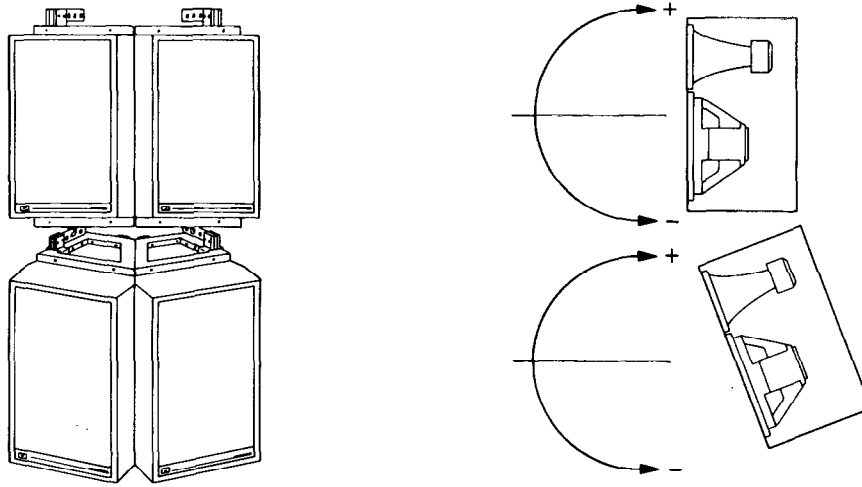
	1	2	3
A	$+7^\circ$	$+2^\circ$	$-4^\circ$
B	$+2^\circ$	$-3^\circ$	$-8^\circ$
C	$-3^\circ$	$-7^\circ$	$-12^\circ$

Table 2



**Tilt Guide for 2 x 2 Array** - (Suspended from holes 1 - A, shackle mounts connecting top tier to lower one are towards rear.)

This configuration has many useful applications. The upper tier can be rotated between +6° and +12°, while the lower tier has a -8° to -30° range of aim angles. Using locations 3- A from both Tables will provide a seamless vertical coverage angle of 78° with minimal lobing.

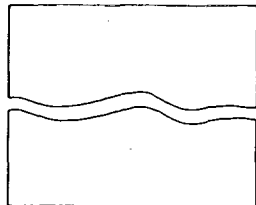
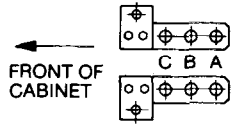
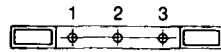
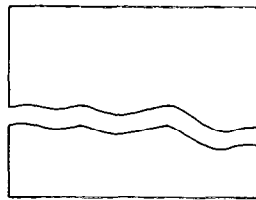
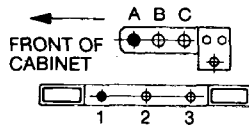


Tilt angles for selected holes

	1	2	3
A	+8°	+10°	+12°
B	+7°	+9°	+11°
C	+6°	+8°	+10°

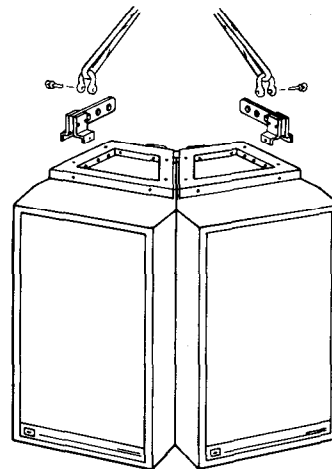
Table 1

Direction of Shackle Mount on Truss



Suspended from holes 1 - A

Location of Shackle Mount on top Array



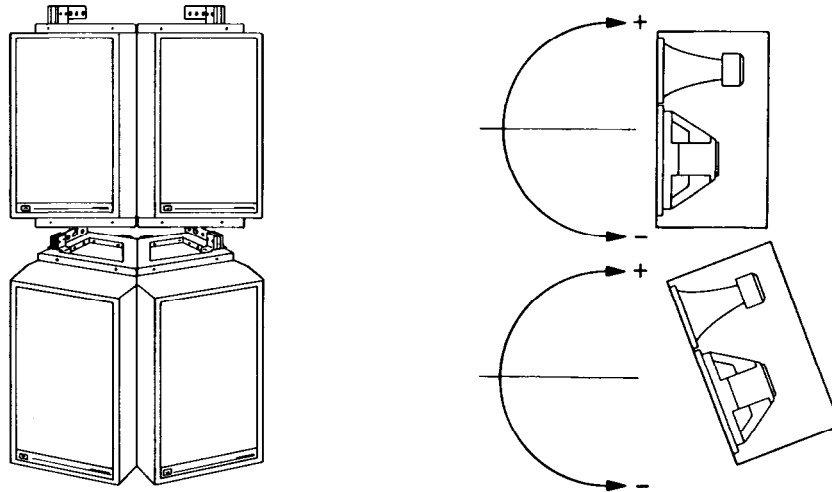
	1	2	3
A	-20°	-25°	-30°
B	-14°	-19°	-25°
C	-8°	-13°	-19°

Table 2



**Tilt Guide for 2 x 2 Array** - (Suspended from holes 3 -A, connecting shackle mounts towards rear)

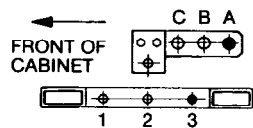
All connecting locations are behind each tier's center of gravity which allows only negative aiming angles. A vertical coverage angle of 56° is possible. This array would provide good high power front fill in many applications.



Tilt angles for selected holes

Direction of Shackle Mount on Truss

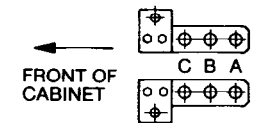
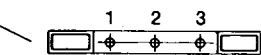
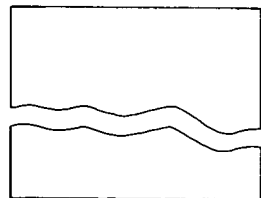
Location of Shackle Mount on top Array



Suspended from holes 3 - A

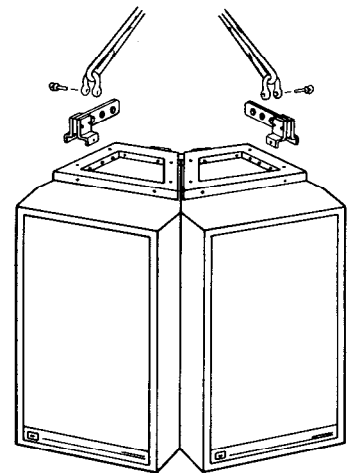
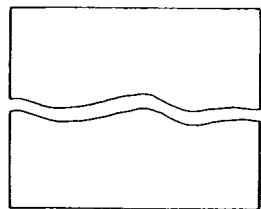
	1	2	3
A	-11°	-10°	-8°
B	-12°	-11°	-9°
C	-14°	-12°	-10°

Table 1



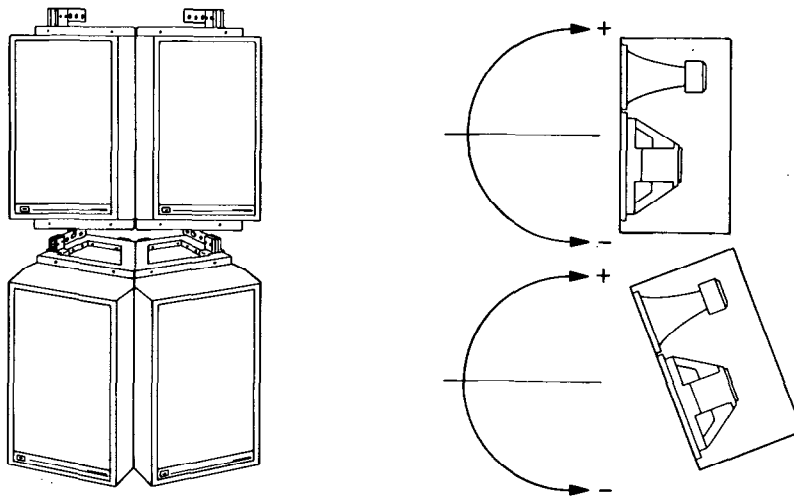
	1	2	3
A	-20°	-24°	-28°
B	-15°	-20°	-24°
C	-10°	-15°	-20°

Table 2



**Tilt Guide for 2 x 2 Array** - (Suspended from holes 3 - C, connecting shackle mounts towards rear)

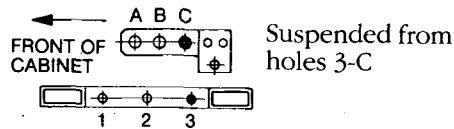
The top tier of this array can be aimed directly horizontal, while the lower tier can have an aim angle of  $-28^\circ$  for a vertical coverage angle of  $64^\circ$ . This array could be very useful for applications requiring balcony coverage and down fill.



Tilt angles for selected holes

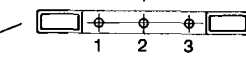
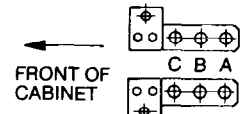
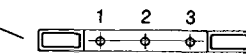
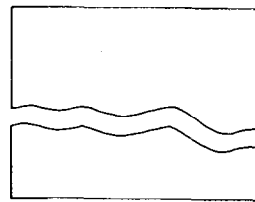
Direction of Shackle Mount on Truss

Location of Shackle Mount on top Array



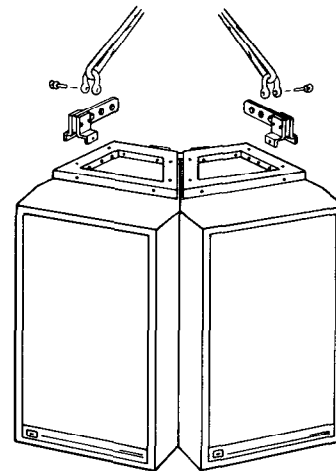
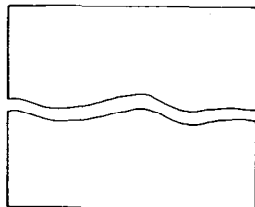
	1	2	3
A	$-2^\circ$	$-1^\circ$	$0^\circ$
B	$-3^\circ$	$-2^\circ$	$0^\circ$
C	$-5^\circ$	$-3^\circ$	$0^\circ$

Table 1



	1	2	3
A	$-16^\circ$	$-22^\circ$	$-28^\circ$
B	$-14^\circ$	$-19^\circ$	$-24^\circ$
C	$-12^\circ$	$-17^\circ$	$-22^\circ$

Table 2





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A Harman International Company

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6/92 2500  
P1119