

**TI 385 (4.2 EN)**

**d&b Line array design, ArrayCalc V7.x**

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## 1. Introduction

This Technical Information paper will explain the procedure for designing and tuning d&b J, V, Q, T and xA-Series line arrays, point source systems from the E, Q, T and xS Series as well as column speakers from the xC Series in a given venue using the d&b Array Calculator (ArrayCalc) from version V7.x.x.

**Before setting up a system read the respective manuals and safety instructions.**

## 2. The J-Series line array

The J-Series consists of four different loudspeakers: the J8 and J12 loudspeakers and the J-SUB and J-INFRA subwoofers. The J8 and J12 are mechanically and acoustically compatible loudspeakers providing two different horizontal coverage angles of 80° and 120°. The dispersion of both systems is symmetrical and well controlled to frequencies down to 250 Hz, their bandwidth reaching from 48 Hz to 17 kHz.

In the vertical plane J8 and J12 produce a flat wavefront allowing splay angle settings between 0° and 7° (1° increments). An array should consist of a minimum of six cabinets - either J8, J12 or a combination of both.

The J8 with its 80° horizontal dispersion and high output capability can cover any distance range up to 150 m (330 ft) depending on the vertical configuration of the array and the climatic conditions.

The J12 offers a wider horizontal coverage which is particularly useful for short and medium throw applications. Using a combination of J8 and J12 cabinets enables the user to create a venue specific dispersion and energy pattern.

The J-SUB cardioid subwoofer extends the system bandwidth down to 32 Hz while providing exceptional dispersion control either flown or ground stacked in arrays, or set up individually.

The J-INFRA cardioid subwoofer is an optional extension to a J8/J12/J-SUB system. It is used in ground stacked configurations and extends the system bandwidth down to 27 Hz while adding impressive low frequency headroom.

### 2.1 Number of cabinets required

The number of J-Series loudspeakers to be used in an application depends on the desired level, the distances and the directivity requirements in the particular venue. Using the d&b ArrayCalc calculator will define whether the system is able to fulfill the requirements.

Depending on the program material and the desired level, additional J-SUBs will be necessary to extend the system bandwidth and headroom. In most applications a J-SUB to J8/J12 ratio of 1:2 is sufficient. Distributed SUB arrays may require a higher number of subwoofers, such as a J-SUB to J8/J12 ratio of 2:3.

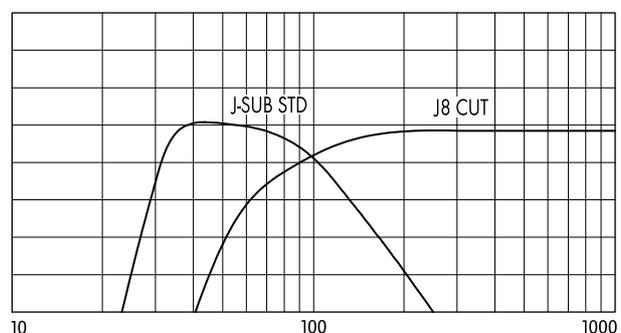
When additional J-INFRA systems are used, one cabinet provides the very low frequency extension for two J-SUB subwoofers, thus generally reducing the total number of J-SUBs required.

### 2.2 J-SUB subwoofer setup

J-SUB cabinets can be used ground stacked, as a horizontal SUB array or integrated into the flown array, either on top of a J8/J12 array or flown as a separate column.

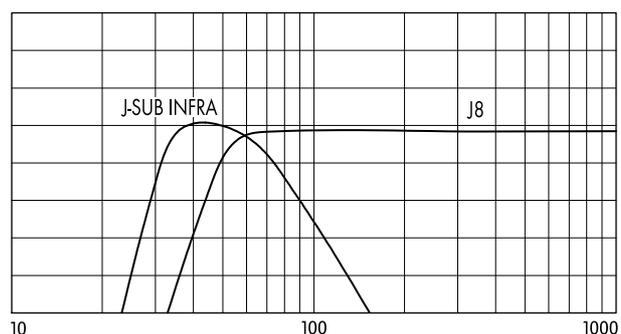
Depending on the application the dispersion pattern of the J-SUB cabinet can be modified electronically to achieve the best sound rejection where it is most effective. In cardioid mode, the standard setting of the D12 J-SUB setup, the maximum rejection occurs behind the cabinet (180°) while hypercardioid mode (HCD selected) provides a maximum rejection at 135° and 225°. The HCD mode should also be used when J-SUB cabinets are operated in front of walls.

When used with additional subwoofers, the J8/J12 system should be operated in CUT mode to gain maximum headroom at low frequencies.



**J8 / J-SUB crossover setup**

When maximum low end headroom is not an issue, the J8/J12 system can also be operated in standard mode (full range, i.e. CUT not selected) and additional J-SUB cabinets in INFRA mode can be used to extend the system bandwidth down to 32 Hz.



**J8 / J-SUB crossover setup, full range**

### 2.2.1 J-SUB ground stacks

Using J-SUB cabinets in L/R ground stacks provides maximum system efficiency due to the ground coupling of the cabinets.

### 2.2.2 J-SUBs flown on top of a J8/J12 array

Flown J-SUBs create a more even level distribution over distance. Compared to a ground stacked setup the area at the very front below the arrays has much less low frequency level because of the longer distance to the subwoofers. However, when a high level of low frequency energy at the front is desired, e.g. to compensate for a loud stage level, additional ground stacked subwoofers may be necessary.

### 2.2.3 Flown J-SUB columns

When complete columns of J-SUBs are flown the increased vertical directivity adds to the distance effect described above and thus creates a longer throw of low frequencies.

Clever positioning of flown subwoofer columns behind the main and outfill arrays of TOP loudspeakers can greatly enhance both visual appearance and acoustic performance of the complete system through increased overall coherence between the different parts of the system.

### 2.2.4 J-SUB horizontal SUB array

Arranging J-SUBs in a horizontal array (SUB array) provides the most even horizontal coverage eliminating the cancellation zones to the left and right of the center of a typical L/R setup. Refer to section 9.10 on page 28.

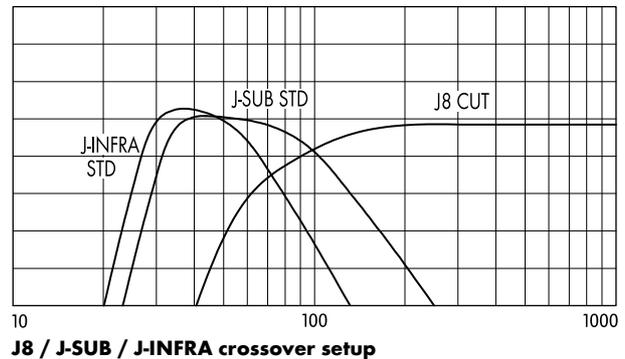
## 2.3 J-SUB/J-INFRA subwoofer setup

When used with J-INFRA cabinets J-SUB subwoofers are always operated in standard mode (i.e. INFRA not selected).

Depending on the application and the space requirements a combination of J-SUB and J-INFRA cabinets can be set up in several different ways.

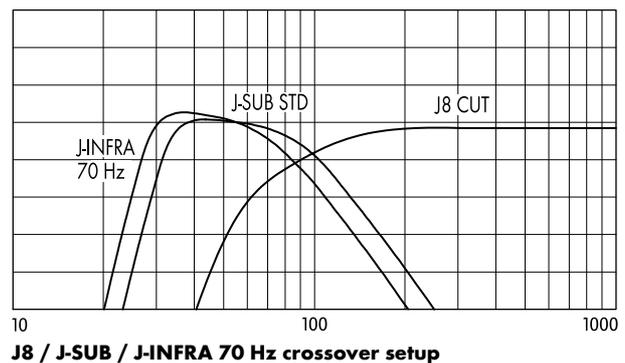
### 2.3.1 Combined J-INFRA/J-SUB ground stacks

Maximum coupling and coherence of the systems are achieved when J-INFRA and J-SUB systems are stacked close to each other. However, make sure to keep a minimum distance of 60 cm (2 ft) between adjacent stacks. J-INFRA cabinets should be operated in standard mode.



### 2.3.2 Flown J-SUB, J-INFRA ground stacks

Flown columns of J-SUBs provide a higher vertical directivity and thus a longer throw. Coupling with ground stacked J-INFRA will be less coherent and therefore requires the 70 Hz setting on the J-INFRA controllers.



### 2.3.3 Flown J-SUB columns, J-INFRA SUB array

As an option J-INFRA cabinets can be set up in a horizontal SUB array in front of the stage. Also in this case the 70 Hz setting on the J-INFRA controllers is advantageous. The correct alignment of the array dispersion and delay settings is performed using ArrayCalc. Refer to section 9.10 on page 28.

### 3. The V-Series line array

The V-Series consists of three different loudspeakers: the V8 and V12 loudspeakers and the V-SUB subwoofer. The V8 and V12 are mechanically and acoustically compatible loudspeakers providing two different horizontal coverage angles of 80° and 120°. The dispersion of both systems is symmetrical and well controlled to frequencies down to 250 Hz, their bandwidth reaching from 65 Hz to 18 kHz.

In the vertical plane the V8 and V12 loudspeakers produce a wavefront that allows splay angle settings ranging from 0° to 14° (1° increments). An array should consist of a minimum of four cabinets - either V8, V12 or a combination of both.

The V8 with its 80° horizontal dispersion and high output capability can cover any distance range up to 100 m (330 ft) depending on the vertical configuration of the array and the climatic conditions.

The V12 offers a wider horizontal coverage which is particularly useful for short and medium throw applications. Using a combination of V8 and V12 cabinets enables the user to create a venue specific dispersion and energy pattern.

The V-SUB cardioid subwoofer extends the system bandwidth down to 37 Hz while providing exceptional dispersion control either in flown or ground stacked arrays or set up individually.

The J-INFRA cardioid subwoofer is an optional extension to a V8/V12/V-SUB system. It is used in ground stacked configurations and extends the system bandwidth down to 27 Hz while adding impressive low frequency headroom.

### 3.1 Number of cabinets required

The number of V-Series loudspeakers to be used in an application depends on the desired level, the distances and the directivity requirements in the particular venue. Using the d&b ArrayCalc calculator will define whether the system is able to fulfill the requirements.

Depending on the program material and the desired level, additional V-SUBs will be necessary to extend the system bandwidth and headroom. In most applications a V-SUB to V8/V12 ratio of 1:2 is sufficient. Distributed SUB arrays may require a higher number of subwoofers, such as a V-SUB to V8/V12 ratio of 2:3.

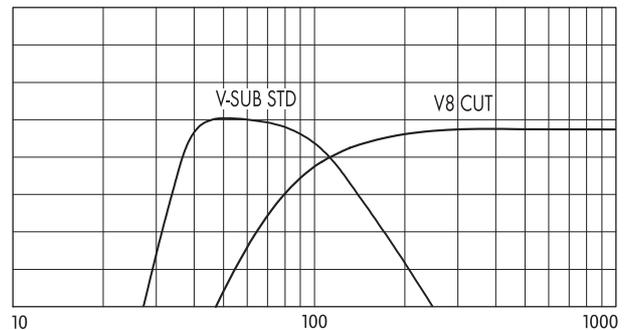
When additional J-INFRA systems are used, one cabinet provides the very low frequency extension for two V-SUB subwoofers, thus generally reducing the total number of V-SUBs required.

### 3.2 V-SUB subwoofer setup

V-SUB cabinets can be used ground stacked, as a horizontal SUB array or integrated into the flown array, either on top of a V8/V12 array or flown as a separate column.

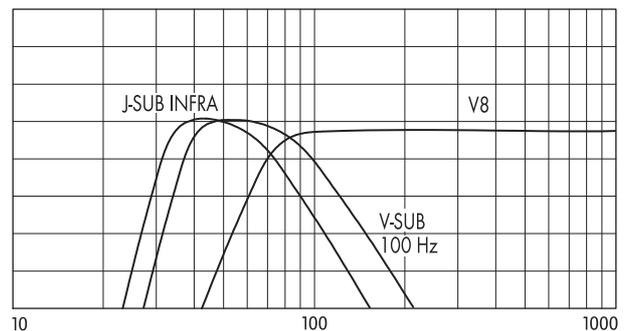
The V-SUB cabinet offers a cardioid dispersion pattern throughout its entire operating bandwidth.

When used with additional subwoofers, the V8/V12 system should be operated in CUT mode to gain maximum headroom at low frequencies.



#### V8 / V-SUB crossover setup

When maximum low end headroom is not an issue, the V8/V12 system can also be operated in standard mode (full range, i.e. CUT not selected) and additional V-SUB cabinets in 100 Hz mode or J-SUB cabinets in INFRA mode can be used to extend the system bandwidth down to 38 Hz/32 Hz.



#### V8 / V-SUB / J-SUB crossover setup, full range

### 3.2.1 V-SUB ground stacks

Using V-SUB cabinets in L/R ground stacks provides maximum system efficiency due to the ground coupling of the cabinets.

### 3.2.2 V-SUBs flown on top of a V8/V12 array

Flown V-SUBs create a more even level distribution over distance. Compared to a ground stacked setup the area at the very front below the arrays has much less low frequency level because of the longer distance to the subwoofers. However, when a high level of low frequency energy at the front is desired, e.g. to compensate for a loud stage level, additional ground stacked subwoofers may be necessary.

### 3.2.3 Flown V-SUB columns

When complete columns of V-SUBs are flown the increased vertical directivity adds to the distance effect described above and thus creates a longer throw of low frequencies.

Clever positioning of flown subwoofer columns behind the main and outfill arrays of TOP loudspeakers can greatly enhance both visual appearance and acoustic performance of the complete system through increased overall coherence between the different parts of the system. Refer to V-Series setup example 6a on page 50.

### 3.2.4 V-SUB horizontal SUB array

Arranging V-SUBs in a horizontal array (SUB array) provides the most even horizontal coverage eliminating the cancellation zones to the left and right of the center of a typical L/R setup. Refer to section 9.10 on page 28.

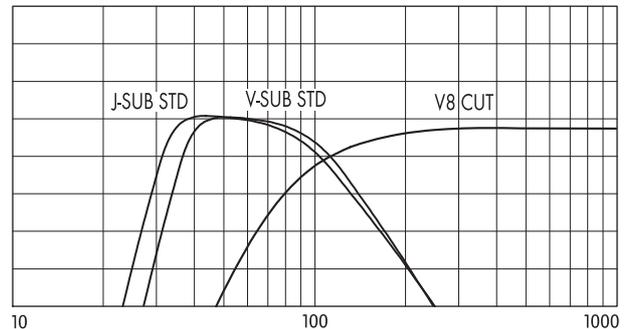
## 3.3 V-, J-SUB/J-INFRA subwoofer setup

When used with J-SUB and J-INFRA cabinets V-SUB subwoofers are always operated in standard mode (i.e. 100 Hz not selected).

Depending on the application and the space requirements a combination of V-SUB and J-SUB / J-INFRA cabinets can be set up in several different ways.

### 3.3.1 Combined J-, V-SUB ground stacks

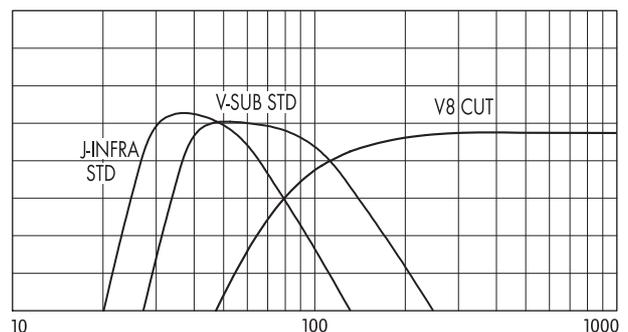
Maximum coupling and coherence of the systems are achieved when J-SUB and V-SUB systems are stacked close to each other. However, make sure to keep a minimum distance of 60 cm (2 ft) between adjacent stacks. J-SUB cabinets should be operated in standard mode.



V8 / V-SUB / J-SUB crossover setup

### 3.3.2 Flown V-, J-SUB or J-INFRA ground stacks

Flown columns of V-SUBs provide a higher vertical directivity and thus a longer throw. Ground stacked J-SUBs or J-INFRA can be operated in either crossover mode depending on the ratio of flown to ground stacked subwoofers.



V8 / V-SUB / J-INFRA crossover setup

### 3.3.3 Flown V-SUB columns, J-INFRA SUB array

As an option J-INFRA cabinets can be set up in a horizontal SUB array in front of the stage. In this case the 70 Hz setting on the J-INFRA controllers is advantageous. The correct alignment of the array dispersion and delay settings is performed using ArrayCalc. Refer to section 9.10 on page 28.

#### 4. The Q-Series line array

The Q1 is a compact and lightweight line array cabinet providing a 75° constant directivity coverage in the horizontal plane down to 400 Hz. The system can be used from very small configurations of two cabinets per array up to a maximum of twenty cabinets per array for larger venues.

Q1 cabinets have a very low height of only 30 cm (1 ft) and when combined in arrays its accurate wavefront covers up to 14° vertically per cabinet, and couples coherently up to 12 kHz when configured in a straight (0° splay) long throw section. The Q1 covers the frequency range from 60 Hz to 17 kHz.

The Q7 and Q10 cabinets are mechanically and acoustically compatible loudspeakers with 75° x 40° and 110° x 40° spherical dispersion patterns which can be used as a downfill (Q7) or nearfill extension with Q1 arrays.

Smaller configurations of Q1 cabinets can also be used ground stacked, supported by Q-SUB cabinets. The most even energy distribution in the audience area will however be achieved with a flown array.

The TI assumes that all Q-Series cabinets are driven by d&b D6 or D12 amplifiers. E-PAC amplifiers do not provide HFC and CSA settings.

#### 4.1 Number of cabinets required

The number of Q1 cabinets to be used in an application depends on the desired level, the distances and the directivity requirements in the particular venue. Using the d&b ArrayCalc calculator will prove whether the system is able to fulfill the requirements.

Depending on the program material and the desired level additional Q-SUB subwoofer systems will be necessary to extend the system bandwidth and headroom. The number of Q-SUBs needed per Q1 cabinet for serious full-range program will decrease with the size of the system. For small setups a 1:1 ratio is recommended, for example four Q-SUBs to four Q1s, while larger systems will work with a 2:3 ratio, for example eight Q-SUBs to twelve Q1s. Please note that CSA setups require a multiple of three Q-SUB cabinets.

As an option Q1 systems can also be used with J-SUB or J-INFRA subwoofers.

#### 4.2 Subwoofer setup

Subwoofers are operated most efficiently when stacked on the ground. For cleanest sound and coverage we recommend arranging subwoofers in a CSA configuration as described in d&b TI 330 Cardioid SUB array which is available for download from the d&b audiotechnik website at [www.dbaudio.com](http://www.dbaudio.com).

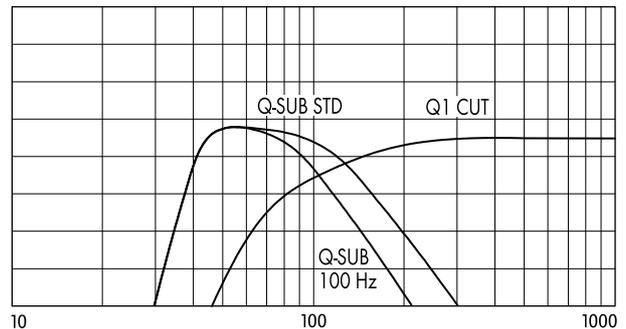
When used with subwoofers, the Q1 systems should be operated in CUT mode to gain maximum headroom at low frequencies.

#### Q-SUB (40 – 100/130 Hz)

Q-SUB cabinets can be used ground stacked or integrated into the flown array, either on top of a Q1 array or flown as a separate column.

Flown Q-SUBs create a different level distribution in the audience area than ground stacked ones. In particular the area at the very front below the arrays has much less low frequency energy when subwoofers are included in the array. This can be very useful in applications that do not require high levels of low frequency energy at the front, however for an event with high stage level additional ground stacked subwoofers may be necessary.

For Q1 arrays consisting of three or more cabinets we recommend the use of the 100 Hz setting for the Q-SUB systems. Smaller Q1 arrays providing less coupling at low frequencies may benefit from the higher crossover frequency of the standard mode of the Q-SUBs (130 Hz).



Q1/Q-SUB crossover setup

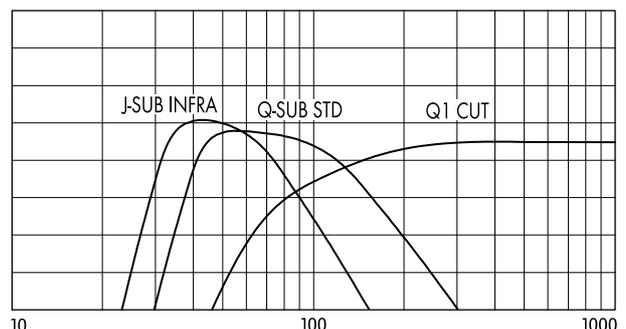
Compared to a standard Q-SUB configuration a CSA setup produces slightly less level above 70 Hz, so it may be advantageous to use the standard (130 Hz) amplifier setting.

#### J-SUB (32 – 70/100 Hz)

J-SUB cabinets can be used to supplement a Q1 system in different ways.

If the system is equipped with a sufficient number of Q-SUB cabinets, J-SUBs can be used to extend its bandwidth to below 32 Hz. Driven by D12 amplifiers set to INFRA mode one J-SUB will supplement up to four Q-SUB cabinets.

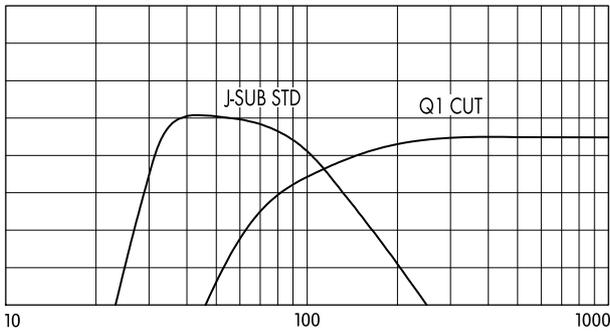
This combination will achieve its maximum headroom when the Q-SUBs are operated in the 130 Hz mode. If for audio reasons the lower crossover frequency to the Q1s is desired you may also reduce the gain of the Q-SUB amplifiers. Decreasing the gain by 2.5 dB will create the same downward shift to the upper slope as switching to the 100 Hz setting, but with less low frequency boost.



Q1/Q-SUB/J-SUB crossover setup

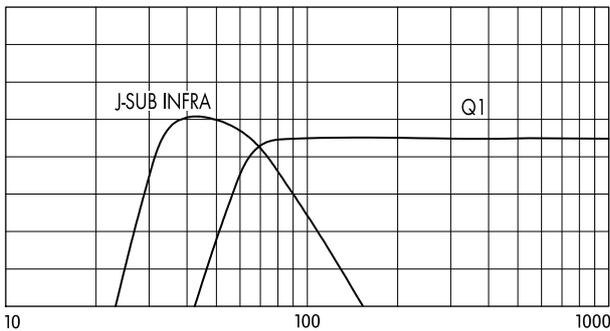
Please note that a combined ground stack consisting of Q-SUB and J-SUB cabinets will only provide a consistent directivity when Q-SUBs are used in CSA setups. Also make sure to keep the required distance of 60 cm (2 ft) between the stacks in order to not adversely affect the cardioid directivity of the systems.

J-SUB subwoofers can also be used as an alternative to ground stacked Q-SUBs. In this case J-SUB cabinets are operated in standard mode with a crossover frequency of 100 Hz. One J-SUB will replace three Q-SUB cabinets in a CSA setup and extends the system bandwidth down to 32 Hz.



**Q1/J-SUB crossover setup**

J-SUB cabinets in INFRA mode can be used to extend the bandwidth of a Q1 line array operated in full-range mode, without Q-SUBs. As this application does not expand the headroom of the Q1 array it is only useful when medium levels but very low frequencies are required, for example for special effects.

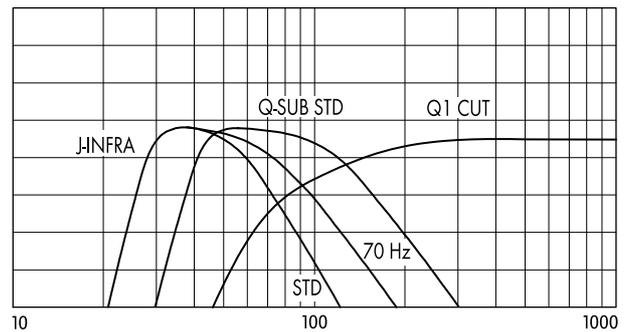


**Q1/J-SUB crossover setup, full range**

### J-INFRA (27 – 60/70 Hz)

To achieve the ultimate low frequency extension for a Q system consisting of Q1 and Q-SUB cabinets, additional J-INFRA subwoofers can be used. They provide a standard (60 Hz) and a 70 Hz mode. The selection of the mode depends on the coupling between J-INFRA and Q-SUB cabinets in the actual setup. When combined in a ground stack the standard (60 Hz) mode provides more headroom at very low frequencies.

Please note that a combined ground stack consisting of Q-SUB and J-INFRA cabinets will only provide a consistent directivity when Q-SUBs are used in CSA setups. Also make sure to keep the required distance of 60 cm (2 ft) between the stacks in order not to adversely affect the cardioid directivity of the systems.



**Q1/Q-SUB/J-INFRA crossover setup**

## 5. The T-Series line array

The T10 is a very compact loudspeaker system which can be used both as a line array and as a high directivity point source speaker. For these applications the T10 cabinet provides two different dispersion characteristics which can be swapped over without any tools.

In line array mode the T10 provides a 105° constant directivity coverage in the horizontal plane allowing for vertical splay angles of up to 15° per cabinet. The system can be used from very small configurations of three cabinets per array up to a maximum of 20 cabinets per array for larger venues. The T10 covers the frequency range from 68 Hz to 18 kHz.

The T-SUB subwoofer extends the system bandwidth down to 47 Hz either flown or ground stacked.

Smaller configurations of T10 cabinets can also be used ground stacked supported by T-SUB cabinets or mounted on a high stand. The most even energy distribution in the audience area will however be achieved with a flown array.

### 5.1 Number of cabinets required

The number of T10 cabinets to be used in an application depends on the desired level, the distances and the directivity requirements in the particular venue. Using the d&b ArrayCalc calculator will prove whether the system is able to fulfill the requirements.

Depending on the program material and the desired level additional T-SUB subwoofer systems will be necessary to extend the system bandwidth and headroom. The number of T-SUBs needed per T10 cabinet for serious full-range program will decrease with the size of the system. For small setups a 1:3 ratio is recommended, for example one T-SUB to three T10s.

### 5.2 Subwoofer setup

When used with subwoofers, the T10 systems should be operated in CUT mode to gain maximum headroom at low frequencies.

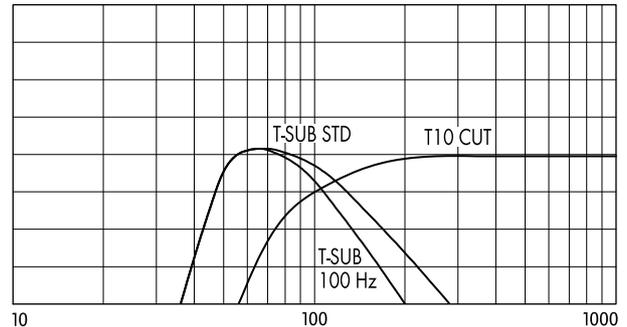
#### T-SUB (47 – 100/140 Hz)

T-SUB cabinets can be used to supplement the LF headroom of the T10 loudspeakers in various combinations. They can be used ground stacked or integrated into the flown array, either on top of a T10 array or flown as a separate column.

Flown T-SUBs create a different level distribution in the audience area than ground stacked ones. In particular the area at the very front below the arrays has much less low frequency energy when subwoofers are included in the array.

This can be very useful in applications that do not require high levels of low frequency energy at the front, however for an event requiring a loud stage level additional ground stacked subwoofers may be necessary.

For T10 arrays consisting of three or more cabinets we recommend the use of the 100 Hz setting for the T-SUB systems. Smaller T10 arrays providing less coupling at low frequencies may benefit from the higher crossover frequency of the standard mode of the T-SUB (140 Hz).



T10 / T-SUB crossover setup

#### B4-SUB (40 – 100/150 Hz)

#### Q-SUB (40 – 100/130 Hz)

#### E15X-SUB (37 – 100/140 Hz)

As an option T10 systems can also be used with B4-SUB, Q-SUB or E15X-SUB subwoofers. These cabinets cannot be integrated into a flown T-Series rig. However, they allow the deployment of T10 cabinets on their M20 flanges using either the T-Series Base Plate or the T-Series Cluster Bracket.

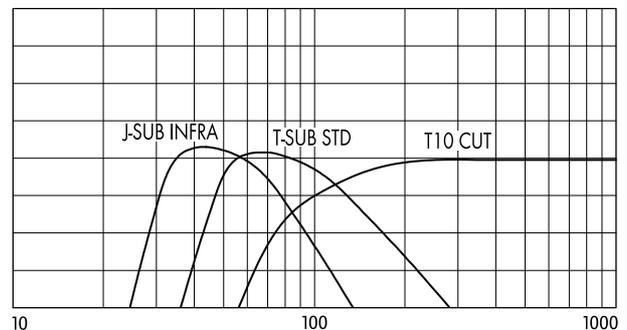
The T-Series Base Plate connects directly to the M20 flange and supports an array of up to 6 x T10 cabinets while the T-Series Cluster Bracket is pole mounted on the M20 flange and supports up to three T10 cabinets.

To achieve the best acoustic results in critical venues, we recommend to use the B4-SUB. It is a compact and effective solution providing a cardioid dispersion from a single amplifier channel.

Like the T-SUB these systems provide a 100 Hz circuit on their controller which can be set accordingly.

#### J-SUB (32 – 70/100 Hz)

J-SUB cabinets in INFRA mode can be used to extend the frequency range of a T-Series system. To gain maximum headroom T-SUBs should be operated in standard mode (i.e. 100 Hz not selected).



T10 / T-SUB / J-SUB crossover setup

## 6. The xA-Series line array

The 10AL and 10AL-D line array modules of the xA-Series have been specifically designed for fixed installations with visually unobtrusive integrated rigging systems.

For these applications, the cabinets are available with two different constant directivity dispersion characteristics in the horizontal plane:

The 10AL provides a 75° coverage while the 10AL-D version provides 105° of coverage. In the coupling plane, both allow for vertical splay angles of up to 15° per cabinet. Both versions may be combined in one array, for example with 10AL cabinets at the top for longer distances and one or two 10AL-D to cover the areas near the stage.

Both systems can be used from small configurations of three cabinets per array up to a maximum of 9 cabinets per array.

The 10AL (-D) covers the frequency range from 60 Hz to 18 kHz. 18A-SUB or 27A-SUB subwoofers extend the system bandwidth down to 37 Hz or 40 Hz, respectively. They can be flown in a separate column, integrated at the top or within an array or used as ground stacked applications. When they are flown together with line array modules, the maximum number of total cabinets is reduced due to the additional weight.

Configurations of up to six 10AL / 10AL-D cabinets can also be used ground stacked, supported by 18S-SUB or 27S-SUB cabinets. The most even energy distribution in the audience area will however be achieved with a flown array.

### 6.1 Number of cabinets required

The number of 10AL or 10AL-D cabinets to be used in one application depends on the desired level, the distances to be covered and the directivity requirements of the particular venue. Using the d&b ArrayCalc calculator will prove whether the system is able to fulfill the requirements.

Depending on the program material and the desired level additional 18A-SUB or 27A-SUB subwoofer systems may be necessary to extend the system bandwidth and headroom. The number of subwoofers required per 10AL (-D) cabinet to provide a serious full-range program decreases with the size of the system. For small to medium size setups, a 1:3 ratio is recommended, for example one 27A-SUB to three 10ALs.

## 6.2 Subwoofer setup

When used with subwoofers, the 10AL(-D) systems should be operated in CUT mode to gain maximum headroom at low frequencies.

### 27A-SUB/27S-SUB (40 – 100/140 Hz)

Subwoofers can be used to supplement the LF headroom of the 10AL loudspeakers in various combinations.

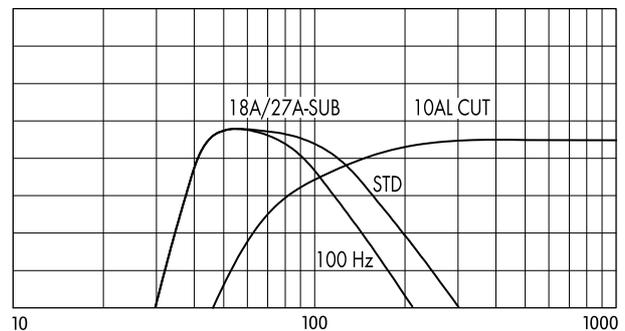
To achieve the best acoustic result in critical venues, we recommend the use of 27A-SUB or 27S-SUB subwoofers. They offer a compact and effective solution by providing cardioid dispersion from a single amplifier channel.

They can be used ground stacked (27S-SUB and 27A-SUB) or integrated into the flown array (27A-SUB), either at the top or within a 10AL array, or flown as a separate column.

Flown subwoofers create a different level distribution in the audience area than ground stacked ones. Particularly the area directly at the front below the arrays provides less low frequency energy when subwoofers are included in the array.

This can be very useful in applications that do not require high levels of low frequency energy at the front, however for an event requiring a loud stage level, additional ground stacked subwoofers may be necessary.

For 10AL arrays consisting of three or more cabinets, we recommend the use of the 100 Hz setting for the subwoofers. Smaller 10AL arrays providing less coupling at low frequencies may benefit from the higher crossover frequency of the standard mode (140 Hz).



10AL / 18A/27A-SUB crossover setup

### 18A-SUB/18S-SUB (37 – 100/140 Hz)

18A-SUB or 18S-SUB cabinets can be used in the same way as 27A-SUB or 27S-SUB cabinets but without the benefit of cardioid dispersion.

For these systems, just like for the 27S/A-SUBs, a 100 Hz circuit is available on the controller, which can be set accordingly.

## 7. The d&b point sources

From Version V7x.x, a range of d&b point source loudspeakers is available for integration into a project. This option mainly allows you to use all top cabinets of the White Range xS-Series both in stand-alone projects and in combination with 10AL arrays, for example. In addition, a range of point source loudspeakers of the d&b Black Range can be selected, for example all current top cabinets of the E-Series, Q(i)7, Q(i)1 and T(i)10PS. Apart from that, a T(i)10L loudspeaker that is deployed horizontally may also be used as a single nearfill with the T10PS setup although its polar dispersion does not reflect a "point source".

For cabinets that are equipped with rotatable HF horns, both horn orientations can be selected separately. Each selectable orientation for a specific loudspeaker type uses its own measured polar data set. This is defined by the chosen nominal horizontal and vertical dispersion angles and follows the convention [SystemName] [horizontal dispersion] x [vertical dispersion] while the cabinet itself remains in its typical mechanical orientation, i.e. in an upright position (e.g. 10S 75x50; E6 55x100; Q7 40x75 etc).

If a system is used lying on its side, the standard dataset must be used and the cabinet rotation must be set to either 90° (on its left side, seen from a listener's position) or 270° (on its right side, seen from a listener's position). The cabinet can be rotated in steps of 90° degrees. Each individual cabinet can be freely positioned within the room with horizontal or vertical aiming.

Selecting a loudspeaker optionally displays a balloon polar plot or its vertical aiming into the room.

More specific loudspeaker data can be found in the relevant documentation of d&b White and Black Range products.

### 7.1 Number of cabinets required

The number of point source cabinets is primarily defined by their specific application, for example as nearfill or delay systems or as the main system. Of course, the number of cabinets also depends on the desired level, the distances to be covered and the directivity requirements in the particular venue or project. Using the d&b ArrayCalc calculator will prove whether the system is able to fulfill the specific requirements.

Depending on the program material and the desired level, additional d&b subwoofer systems may be necessary to extend the bandwidth and headroom

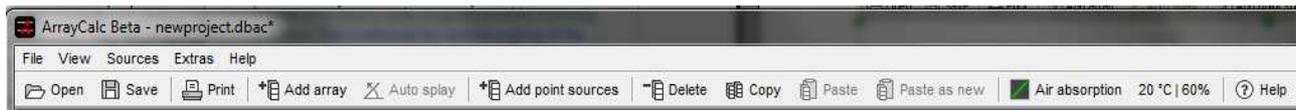
When used with subwoofers, the point sources should be operated in CUT mode to gain maximum headroom at low frequencies.

## 8. Column loudspeakers

The xC-Series column loudspeakers are passive 2-way designs with a passive bandpass system providing a cardioid dispersion control with an 18 dB average broadband attenuation to the rear of the loudspeakers. The 24C provides approximately 5° down tilt to the dispersion of low and mid frequencies. When the 24C-E Cardioid column extender is attached, vertical dispersion control is extended towards low frequencies by another full octave.

The HF horn array offers a specially shaped dispersion of about 20° to produce even level distribution over a typical audience area from a wide range of possible mounting positions. This is achieved by adjusting the vertical angle of the complete HF array between 0° and -14°. In the horizontal plane, the HF array provides a nominal dispersion of 90°.

## 9. ArrayCalc



For both acoustic and safety reasons all d&b line arrays must be designed using the d&b ArrayCalc simulation tool.

ArrayCalc also provides functionality to integrate individual d&b point source loudspeakers into a simulation project. ArrayCalc is available for PC and MAC.

ArrayCalc uses a sophisticated mathematical model synthesizing each line-array cabinet's wavefront with an array of narrowly spaced point sources combined with measured high-resolution dispersion data. Sound pressure level is calculated in 3D using complex data (vector summation).

Point sources are modelled using complex measured high-resolution 3D polar data.

### ArrayCalc provides the following features:

- Editing of three-dimensional listening planes to create audience areas in a given venue and shape.
- Help function to obtain venue dimensions using laser distance finders and inclinometers.
- Level distribution on up to five different audience areas displayed in 3D format for selectable frequency bands from 32 Hz to 12.5 kHz.
- Calculation of absolute sound pressure levels in audience areas including system headroom supervision for different input signals.
- Combination of up to 14 different array pairs distributed across the venue plus ground stacked subwoofers in L/R combinations or arranged as SUB array.
- Flown subwoofers integrated into the line arrays or flown as separate columns.
- Additional integration of up to six groups of d&b point source loudspeakers.
- Additional integration of xC column loudspeakers.
- Auto tuning algorithms for vertical aiming and splay angles of arrays as well as SUB array settings.
- Tuning of all relevant amplifier settings like level, array coupling, crossover and cardioid modes.
- Simulation of air absorption effects depending on environmental conditions, tuning of the respective amplifier settings.
- System time alignment between different sources and subwoofers using impulse and phase response data.
- Calculation of load and space requirements for rigging points.
- Calculation and supervision of electronic and physical load conditions as well as mechanical forces within arrays.
- Design and calculation printouts, printable parts lists for inventory control and loading as well as DXF and EASE export functions.
- Project file export into the d&b R1 Remote control software.

### System requirements

- PC with Intel/AMD (1 GHz or more); Windows 7 or higher.
- or Macintosh (Intel); Mac OS 10.6 or higher.
- 512 MB RAM, 2 GB recommended.
- 25 MB of available hard disk capacity.
- Mouse, preferably with wheel.
- Minimum screen resolution 1280 x 1024; on smaller screens viewport has to be scrolled.

### 9.1 ArrayCalc installation

#### Windows systems:

To install ArrayCalc, start ArrayCalcSetup.exe or ArrayCalcSetup.msi and follow the instructions in the setup dialog.

The default installation path is:

C:\Program files\dbaudio\ArrayCalc

A default project directory will be created:

#### Windows Version 7 or higher:

C:\Users\'username'\My Documents\dbaudio

To remove ArrayCalc from your system, go to Start – Settings – Control Panel – Add or remove programs in the Control Panel folder.

Select the ArrayCalc entry from the list and click the Remove button. The uninstall routine starts and the software is removed including all related components.

#### Macintosh systems:

Double-click ArrayCalc.dmg and drag ArrayCalc to your applications folder.

To remove ArrayCalc from your system, move ArrayCalc into the trash bin.

### 9.2 Starting ArrayCalc

#### Windows:

ArrayCalc can either be started via the Windows Start Menu, where it will appear in Programs – dbaudio – ArrayCalc – ArrayCalc or by double-clicking the ArrayCalc desktop icon.

Windows automatically links ArrayCalc project files (\*.dbac) to ArrayCalc. Alternatively, the program can therefore be started by double-clicking on any ArrayCalc project file.

#### Macintosh:

Click ArrayCalc or any ArrayCalc project file.

## 9.3 ArrayCalc menu options and Toolbar

The drop-down menus "File", "View", "Sources", "Extras" and "Help" on top of the page provide access to additional functions of ArrayCalc. Several menu items can also be accessed directly by clicking the respective button in the toolbar underneath.

### 9.3.1 File menu

- **New:** Creates a new project by loading the default setup. Modifying a simple existing setup is usually much faster than starting without any data.

- **Open / Save / Save as:** Loads or saves the project data including room data, arrays, SUB array design and alignment settings from/to a file. (file format: \*.dbac).

It is possible to open setup files created with ArrayCalc version 5.x, however additional data has to be provided manually. Opening setups from earlier Microsoft Excel based versions of ArrayCalc is not possible.

- **Open recent project:** Provides direct access to the last six projects saved.

- **Open example project:** Provides direct access to the example project files included in the installation package.

- **Export DXF:** Exports all / the currently selected array or the SUB array to a \*.dxf graphics file. The units used in the dxf-file are millimeters. However for compatibility reasons the unit formatting in the dxf-file is omitted, hence several CAD systems import the data as "unitless".

- **Export EASE:** Exports the selected array to a \*.txt file which can be imported by the d&b LineArray dll for EASE 4.x.

- **Export PNG:** Only available from the 3D plot page; exports the 3D plot, the color scale and the underlying signal selection to a \*.png file.

- **Print:** Print options for several pages of ArrayCalc.

- **Print preview:** Provides access to a print preview with several options (depending on the printer selected).

- **New instance:** Opens another instance of ArrayCalc.

- **Exit:** Closes ArrayCalc.

### 9.3.2 View menu

- **Toolbar:** Allows the toolbar to be switched on/off.

- **Status bar:** Allows the status bar to be switched on/off.

### 9.3.3 Sources menu

When working on the Sources page, the Sources menu provides the following functions:

- **Add array:** Adds a new empty array to the project. The maximum number of arrays is fourteen.

- **Auto splay:** Provides starting values for the splay angles of the selected array.

- **Add point sources:** Adds a new empty point sources dialog to the project. The maximum number of point

source groups is six. Each group may consist of up to 14 single point sources. You can also select column loudspeakers from this dialog by choosing xC-Series from the system selection.

- **Rename:** Highlights the name of the selected source for editing.

- **Copy:** Creates a copy of the selected source settings in the internal clipboard.

- **Paste:** Pastes all source settings copied to the internal clipboard into the selected source.

- **Paste as new:** Creates a new source containing all settings from the internal clipboard.

- **Delete:** Deletes the selected source from the project after confirmation.

- **Export source:** Exports the settings of the selected source to an ArrayCalc description file (\*.dhea for arrays, \*.dbep for groups of point sources).

- **Import source:** Imports the settings of a source from an ArrayCalc description file (\*.dhea for arrays, \*.dbep for groups of point sources) to the selected source.

### 9.3.4 Extras / Options menu

- **Units:** Provides access to the selection of:

the measurement units: metric (m/kg) or imperial (ft/lbs).

the temperature units: degrees centigrade (° C) or Fahrenheit (° F).

- **Web search:** Provides access to automatic update options.

- **Graphics:** Provides optional color palette for bright environment.

- **R1 export:** Defines the start mode of the generated R1 file.

- **Air absorption:** Provides access to the environmental settings (temperature and humidity) which are primarily relevant to calculate excessive absorption of high frequencies in air (see also 9.6.10). For quick access to the global Air absorption settings, an on-off switch is available in the toolbar at any time. A shortcut to the Extras/Options/Air absorption settings is provided there as well to define temperature and humidity values.

### 9.3.5 Help menu

- **F1 Help:** Provides access to this document.

- **Web search:** Searches the web for updates.

- **System info:** Provides information on the computer system.

- **About:** Provides information on the version of ArrayCalc you are using.

## 9.4 ArrayCalc workspace

The workspace is sub-divided into seven pages giving access to the various data input tables and calculation results:

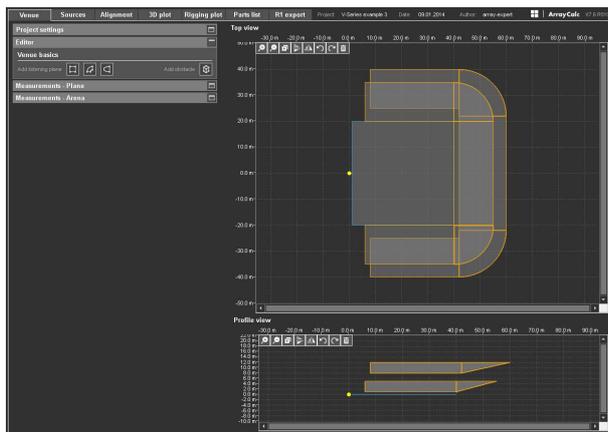
The usual procedure is first to enter the project description which can be accessed from the first four pages "Venue", "Sources", "Alignment" and "3D plot". Then room data is provided in the Venue editor which is accessible on the Venue page (see following section).

On the Sources page, you can add line arrays to the project, design its profile and location depending on the vertical dispersion requirements for each position. In addition, or alternatively, you can define and enter a group of d&b point sources or column loudspeakers. Furthermore an optional SUB array can be defined and tuned here (see also section 9.10 SUB arrays on page 28).

If you use more than one source, the Alignment page (see section 9.11 Alignment page on page 34) helps you to correctly time align the sources in a next step. This also includes the SUB array alignment.

In a third step, the 3D plot page enables you to tune and verify the detailed settings of the horizontal aiming and relative leveling of the arrays in order to achieve the desired level distribution.

## 9.5 Venue page



### 9.5.1 General data input

Cells with a gray background accept direct data input.

Position x: 0.0 m

A single click places the cursor in the cell to edit data.

A double-click additionally highlights the value left of the decimal point for editing and replacement while a triple click highlights the entire cell contents for editing and replacement.

To switch between metric and imperial units, refer to section 9.3 ArrayCalc menu options on page 13.

Cells with a drop-down icon attached offer a predefined selection of data input available from the drop-down list.

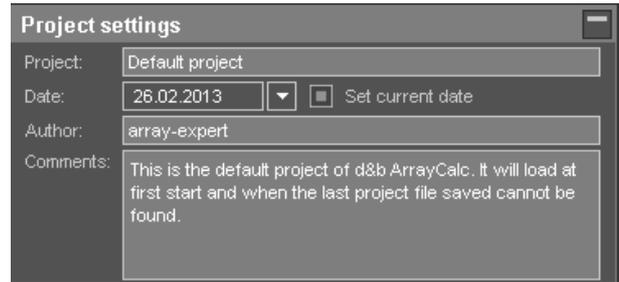
1°

Place the mouse pointer onto these cells and turn the mouse wheel to scroll through the possible selections for the

respective cell.

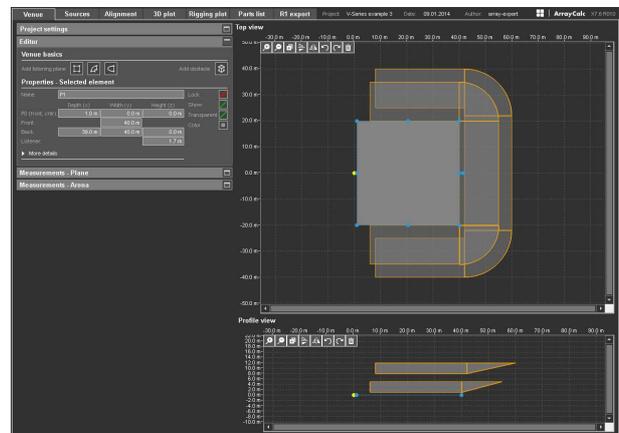
This is a fast tool to manually set splay angles.

### 9.5.2 Project settings



Enter information about the project you are planning. This data will be displayed in the headline or in the dedicated Comments sections as well as in the printouts.

### 9.5.3 Venue editor



### General editing

A listening plane is added to the project by clicking one of the basic geometric shapes, the quadrangle, the arc segment or the superelliptic plane.



A quadrangle starts as a square which can be moved, rotated and modified to any possible shape of a quadrangle. This is done by either modifying its coordinates numerically or by grabbing and moving the shape with the mouse as a whole, or dragging one of its corner points or its rotation point in one of the diagrams.

An arc segment starts as a symmetrical section of two concentric circle segments. It can be moved, rotated and modified to any possible shape of an arc segment by grabbing and dragging one of its corner points, one of its center points or its rotation point.

In the Venue editor, an arc segment is displayed in full, while for level calculations and mappings (3D plot) each arc is segmented into a suitable number of quadrangles.

An superelliptic listening plane starts with a span of 360° and can be moved, rotated and modified to any possible shape of an ellipse by dragging its start/end points or by entering data into the input fields in the Venue editor dialog.

When modifying plane coordinates, the standard shape is

symmetrical around its (front) center point. Only by using ALT+mouse movement is the symmetry abandoned and points can be modified individually.

Pressing the ALT key while dragging a plane activates the Snap to element option. When this option is active, the corner points of the plane being dragged snap to any other corner points of the other plane to which it is dragged. Please note that the height (z) of the snapping corner points will be adjusted to the height (z) of the corner points of the plane to which they are snapped.

### Listening plane properties



A listening plane is selected for viewing and editing its properties by clicking the plane in one of the diagrams:

**Name:** Each plane can be named individually.

**Plane coordinates:** In the upper section, a simplified plane definition based on symmetry of the plane itself is possible.

**Listener height:** Enter the typical height of the listener's ear.

In the More details section below, the three-dimensional coordinates of each corner point can be accessed individually. Place the cursor in one of the data input cells (x,y,z) of a specific point to highlight the respective point in both the Top view and the Side view diagrams.

**Lock:** This function protects all dimensional parameters of a listening plane against editing. Only the name and color of the listening plane can still be edited when the plane has been locked.

**Show:** If a plane is switched off here, its borders are displayed in dashed lines in the Venue editor. On all other pages, the plane or its sections are not visible. It is also excluded from all calculations.

#### Transparent option:

When a sound from a source hits a plane, it gets absorbed by the plane. This is indicated by the fact that the main beams of the relevant cabinets end as soon as they hit the plane. Listening points on other planes without a direct line of sight to a source or points which are in the shadow of a particular plane do not receive any sound from the source. This feature can be specifically helpful when simulating the level of under balcony listening positions.

When a plane's Transparent switch is enabled, the plane will not absorb the sound. In this case, the beams will go

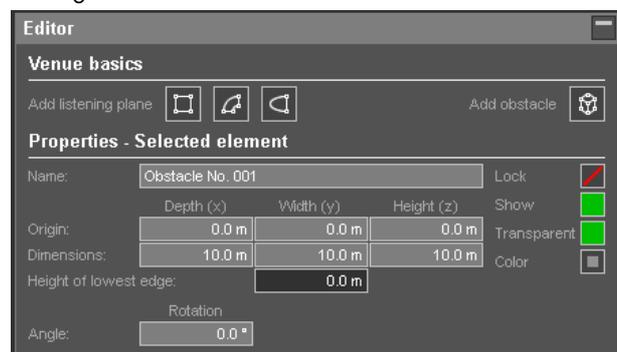
"through" the plane onto any other planes that are located in its shadow.

When the planes are set to absorbent, the system checks every single listening point for an acoustic "sightline", something which requires a considerable amount of computing time. As a result, to speed up calculation, listening planes should be switched to Transparent unless the planes need to be absorbent to check the levels under balconies, etc. For this reason, in every new plane the "Transparent" option is enabled as default.

**Color:** The color of each listening plane with its associated data such as calculated levels can be defined individually.

### Obstacles

A virtually unlimited number of obstacles (screens, displays, etc.) can be defined. An obstacle is added to the project by clicking the Obstacle button.



**Name:** Each obstacle can be named individually

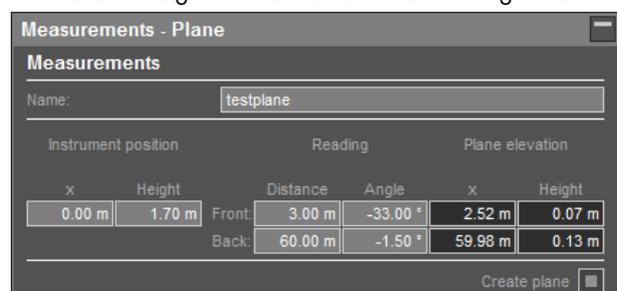
**Coordinates:** The reference point for all coordinate inputs is always the geometric center of its base edge (P4-P1; the one opposite to the grab point). The center of the obstacle's base edge P4-P1 is defined in the row "Origin". Its extension in x/y/z is defined in the row "Dimensions". An obstacle can only be symmetrical. x, y and z have to be positive values, so it always extends upwards from its base plane.

**Lock/Show/Transparent/Color:** Obstacles show the same behavior as described above for the listening planes.

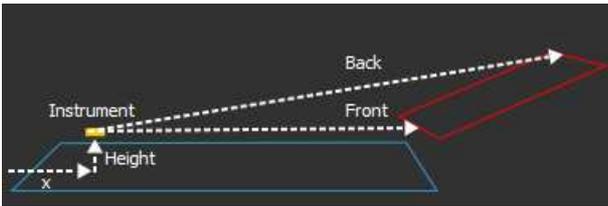
Obstacles are shown in the Venue editor, the Top view diagram and in the 3D plot.

### Measurements - Plane

An additional dialog which supports the input of plane coordinates using a laser inclinometer and a range finder.



This is a particularly useful method when the elevation of balconies or stands has to be determined.



For each plane profile to be determined, enter the distance and the viewing angle to the closest point (Front) and the farthest point (Back) of the plane.

From this, the x positions and heights are calculated.

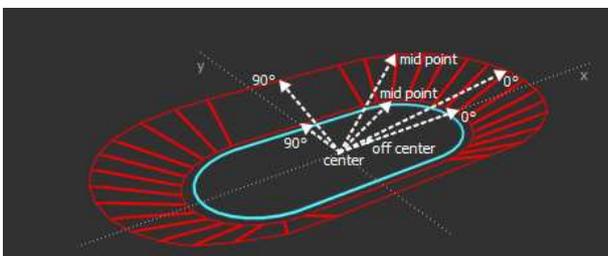
Create plane: After entering all measurements, click Create plane to add a new listening plane.

**Note:** If, with very small angles (low elevation), the measurement accuracy is not satisfactory, move the instrument closer to the object to increase the viewing angle. The sheet allows to input the instrument x-position and height for each plane.

### Measurements - Arena

An additional dialog which supports the input of measuring data of general superelliptic venues, such as arenas or stadiums using a laser inclinometer and a range finder.

When you click into an entry field, the interactive 'How' diagram shows to which parameter this particular field refers.



When measuring a venue with two or more tiers, enter the data for each tier separately by measuring its lower and upper edges. After that, click Create planes. Then repeat the procedure for the next tier.

**Name:** Each listening plane in ArrayCalc requires a unique name.

**Position center:** This is where you start to measure the venue. Specify the height (z) of your measuring instrument above ground.

**Lower edge:** Measure the angle and distance to the lower edge of the tier you want to capture at 0°, up to mid point and at 90°.

**Upper edge:** Measure the angle and distance to the upper edge of the tier you want to capture at 0°, up to mid point and at 90°.

**Position off center:** Now move your measuring instrument to a position off center on the x-axis in direction of 0°. Specify the coordinates of your instrument including height (z) above ground.

Measure up to the specified mid points on the lower and upper edges of the tier you want to capture.

**Segments / Create planes:** After entering all measurements, specify the number of segments into which the resulting superelliptic listening plane should be split and click Create planes.

When you click Create planes, up to 4 new listening planes will be added to the Venue editor depending on the desired number of segments you specified. You can edit each segment separately after selecting it.

### Top view and Profile view diagrams



The Top view diagram displays the venue and the listening planes added to the project. The planes can be modified in the diagram in x (depth) and y (width) directions using the mouse.

The Profile view diagram also displays the listening planes added to the project. Here the planes can be modified in z direction (height) using the mouse.

In both diagrams, a number of tool buttons are provided to modify the venue:

**Zoom in/out** (🔍):

Zooms into or out of the venue. Please note that double-clicking the diagram always sets the zoom factor to such a value that all listening planes and obstacles are displayed.

### Duplicate (📄):

Creates a new listening plane or obstacle as a duplicate of the one currently selected.

### Mirroring (📄):

Creates a new listening plane or obstacle as a duplicate of the one currently selected and mirrors its position either at the xz or at the yz plane.

### Undo / redo (↶↷):

Undoes or redoes the last action. The Venue editor in ArrayCalc V7.x.x supports 7 undo / redo steps.

### Delete (🗑️):

Deletes the currently selected listening plane or obstacle from the venue.

## 9.6 Sources page

### 9.6.1 Adding and deleting sources

+📄 Add array | ⏸ Auto splay | +📄 Add point sources

You can create up to 14 individual arrays or symmetrical pairs of arrays and in addition six groups of point sources by clicking the "Add array" or the "Add point sources" button in the toolbar or by selecting the "Add array"/"Add point sources" item from the Sources menu. For each line array or point source group in the project, a separate settings dialog is created and available for use.

You can delete the sources open for editing by clicking the "Delete" button in the toolbar or by selecting the "Delete" item from the Sources menu. This action has to be confirmed and can be canceled again before final execution.

## 9.7 Line Arrays

### 9.7.1 Array settings

The following description and examples refer to a line array dialog in ArrayCalc with V-Series cabinets selected. J, Q and T-Series system design is performed in the same way. Differing procedures for xA-Series arrays are described when applicable.

	GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
1	● V8	▼	0.0	Line	▼	-2.0 °	0.0 °
2	● V8	▼	0.0	Line	▼	-3.0 °	1.0 °
3	● V8	▼	0.0	Line	▼	-5.0 °	2.0 °
4	● V8	▼	0.0	Line	▼	-6.0 °	1.0 °
5	● V8	▼	0.0	Arc	▼	-8.0 °	2.0 °
6	● V8	▼	0.0	Arc	▼	-10.0 °	2.0 °
7	● V8	▼	0.0	Arc	▼	-12.0 °	2.0 °
8	● V8	▼	0.0	Arc	▼	-15.0 °	3.0 °
9	● V8	▼	0.0	Arc	▼	-20.0 °	5.0 °
10	● V8	▼	0.0	Arc	▼	-27.0 °	7.0 °
11	● V8	▼	0.0	Arc	▼	-37.0 °	10.0 °
12	● V8	▼	0.0	Arc	▼	-49.0 °	12.0 °

## Renaming arrays

In each headline of the array settings dialogs, the name of the respective array can be edited directly by clicking on the text at the left.

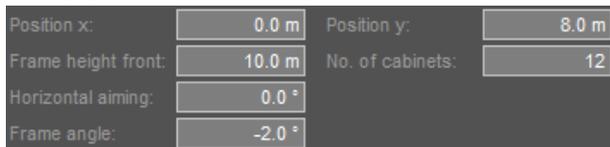
The headline also contains a Gain Reduction LED (GR LED) and individual Mute switches for the entire array(s). Their functions are described in detail in sections 9.7.3 Gain Reduction indicator GR on page 23 and section 9.7.9 Maximum SPL and headroom on page 23.

ArrayCalc supports different array setups including flown subwoofers or ground stacked configurations. The type of system and its mounting can be selected independently for each array / pair of arrays.



Selection of system and mounting

## Array positions, aiming and No. of cabinets



### Position x / Position y

Defines the coordinates of the top front of the array. When the Pair option is enabled, the y coordinate is always set to a positive value and the second array will be located at the negative y value.

### Frame height front

Height above ground of the top front edge of the Flying frame (trim height).

### Horizontal aiming

Horizontal aiming of the array. Positive angle: aimed towards positive y values. (For pairs of arrays it refers to the house left array, i.e. positive value: rotated inwards, negative value: outwards). To calculate SPL over distance, ArrayCalc uses the projection of the listening planes in the direction of each array's horizontal aiming.

### Frame angle

Sets the vertical aiming of the entire array. The vertical orientation of the uppermost cabinet is identical to the frame angle.

A line array produces a precisely shaped wavefront following the mechanical arrangement of the cabinets. The cut off at the upper and lower limits of the vertical dispersion of a column is very sharp, and therefore accurate aiming is absolutely essential to address the desired audience area.

The first parameter to set is the flying frame angle and height. For best results the top cabinet of the column should aim at the farthest point in the audience area. Aiming the Flying frame up to 2° above this point sometimes gives a smoother coverage and can help to stabilize the level distribution under changing climatic conditions outdoors.

Check the SPL plot for the effect but at the same time consider a possible increase of reflections from the rear walls.

## No. of cabinets

Total number of SUB and TOP cabinets used in the array. The final selection of the cabinet type for each individual position is made in the cabinets section.

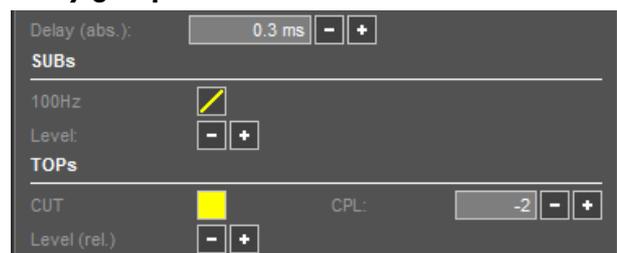
With Q1 arrays a Q7 loudspeaker can be inserted at the very bottom of the column (horizontally mounted with rotated horn). The maximum splay of 14° is used here. Compared to a Q1 used in the same position this setup gains about 10° more coverage to the front for high frequencies. The Q7 has to be driven by a separate amplifier channel in Q7 configuration.

## xA-Series: No. of cabinets / TOP cabinet orientation



The TOPs of the xA-Series have a biaxial design. Although they do not provide mechanical symmetry, their dispersion design is highly symmetrical within the nominal dispersion area, the level roll-off beyond that area is inevitably not perfectly symmetrical. To enable a symmetrical setup for stereo systems, the cabinet orientation may be reversed. In the default orientation, the HF waveguide is located to the left, viewed from the audience side.

## Array group controls



Depending on the selected array and the cabinet types used, group controls are available which define the main amplifier settings for the whole array or functional parts of it. The simulation result changes in accordance with the settings.

## General group controls

**Mute:** Located in the headline in order to be available even if the array is not opened for editing. Depending on the setting of the Mute switch, an array will be taken into account in the 3D mapping and be displayed, or not displayed, on the Alignment page.

The Level vs. distance result of the individual array is not affected by the Mute setting.

**Delay value for the array:** Acts as an absolute control, i.e. the value entered here will be set for each loudspeaker of the array.

### Loudspeaker specific amplifier controls

**Level control:** Independent level controls for SUBs and TOPs each working with relative values to maintain individual tunings.

**CUT:** Available for all line array TOP speakers. Reduces the low frequency level. To be selected depending on the subwoofer setup.

**CPL:** Available for all line array speakers. Reduces the low and mid frequency level. The setting depends on the array length and curvature.

**HFC:** Available for all line array speakers. Increases high frequency response to compensate for air absorption effects. HFC can only be set when the "air absorption" switch is activated.

**HCD:** Available for active cardioid J-SUB and J-INFRA subwoofers. Changes from cardioid to hypercardioid mode.

**INFRA, 100 Hz, 70 Hz:** Subwoofer crossover options for different models.

### Line array configuration settings, Levels and Splay angles

All cabinets							
GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay	
1	V-SUB	0.0	---	---	-2.0 °	0.0 °	
2	V-SUB	0.0	---	---	-2.0 °	0.0 °	
3	V8	0.0	Line	---	-4.0 °	2.0 °	
4	V8	0.0	Line	---	-5.0 °	1.0 °	
5	V8	0.0	Arc	---	-7.0 °	2.0 °	
6	V8	0.0	Arc	---	-9.0 °	2.0 °	
7	V8	0.0	Arc	---	-11.0 °	2.0 °	
8	V8	0.0	Arc	---	-14.0 °	3.0 °	
9	V8	0.0	Arc	---	-19.0 °	5.0 °	
10	V8	0.0	Arc	---	-26.0 °	7.0 °	
11	V8	0.0	Arc	---	-36.0 °	10.0 °	
12	V8	0.0	Arc	---	-48.0 °	12.0 °	

You can define the amplifier settings for each cabinet individually. However, if two or more cabinets are linked to the same amplifier or amplifier channels, identical settings have to be chosen for these cabinets.

The coverage and level distribution in the audience areas are mainly adjusted using the splay angles between the cabinets. The first entry in the column is the angle between the Flying frame and the first cabinet which is always set to 0°. Left to the splay column the absolute vertical aiming of each cabinet is indicated.

The J8/J12 wavefront characteristic allows a maximum splay angle between adjacent cabinets of 7° while still providing a gapless coverage at high frequencies (V8/V12: 14°; Q1: 14°; T10: 15°). Lower frequencies will disperse into a wider area creating an overlap of the coverage patterns between the single cabinets. Therefore directivity

and the level of lower frequencies increases with every cabinet added to the column.

Decreasing the splay angles will enforce the overlap of the coverage patterns at high frequencies resulting in increased directivity and high-frequency output.

Small splay angles are used when covering remote audience areas where additional high-frequency energy is needed to maintain intelligibility in a reverberant venue, and to compensate for the HF absorption of air which increases with distance.

Usually the distances to the audience that an array has to cover decrease from the top to the bottom of a column, consequently it is desirable to gradually increase the vertical splay angles between adjacent cabinets, resulting in a spiral -or "J"-shape.

If a desired level distribution cannot be achieved with a given number of cabinets and/or external restrictions in the placement of the array, the levels of individual cabinets can be modified. This should always be the last option, and generally be limited to a few dBs.

### Line / Arc selection

Depending on the array curvature in the respective section of the array, you can select an appropriate configuration. The Arc (Q1: standard) configuration is applied when the speakers are used in a curved array section while the Line configuration is used for groups of four or more speakers closely coupled with small splay angles to form a long throw array section. Refer to section 9.18 Arc and Line configurations on page 40 for further details.

### HFC settings

With the calculation for excessive absorption of high frequencies in air enabled, the selectors for the HFC compensation circuit will be available and its setting will be included in the calculation. When the air absorption calculation is globally switched off, the processing for "HFC off" will be taken into account. By globally switching the air absorption calculation on/off, a meaningful compensation of the individual amplifier channels can be verified. Refer to section for further details.

### 9.7.2 Auto Splay



For line array design you may use the "Auto splay" function located in the tool bar (or in the Sources menu) to get start values which should later be optimized manually to achieve the desired SPL distribution.

The algorithm's first criterion attempts to fully cover the activated listening planes. If more total splay is available than needed for coverage, a progressively splayed array with cabinet aiming points equally spaced along the listening planes is created. The Flying frame angle (= top cabinet) will be aimed at the farthest listening point.

If the Auto Splay function proposes a set of large splay angles, only slightly increasing from top to bottom, this is a good indication that more cabinets should be considered for the application.

### 9.7.3 Copy, Paste, Paste as new



- **Copy:** Creates a copy of the selected array or groups of sources with all settings in the internal clipboard.
- **Paste:** Pastes all source settings copied to the internal clipboard into the selected array or group of sources.
- **Paste as new:** Creates a new array or group of sources containing all settings from the internal clipboard.

### Gain Reduction indicator GR



Each cabinet has a yellow GR LED which indicates when a particular amplifier channel has reached its limit for the given signal level with one of the simulated input signals selected for the 2D and 3D SPL plots.

A possible Gain Reduction is not considered in the SPL calculations, i.e. will not limit a cabinet's calculated output and will therefore not modify the SPL distribution. Consequently, with (too) many GR LEDs on, the calculated and displayed level distribution might actually not be attainable.

Whenever a GR LED lights up for a cabinet within an array, the GR LED in the headline is activated even if the array is not opened for editing.

### 9.7.4 Mechanical load conditions for arrays



#### WARNING!

**Potential risk of personal injury and/or damage to materials.**

Never set up an array which exceeds the load limits.

- Reduce the number of cabinets or the total splay angle until the load conditions are within limits.

When a given array configuration exceeds the mechanical load limits, a warning is displayed in the array's headline:

Exceeding the BGV-C1 limits will bring up a yellow warning symbol:



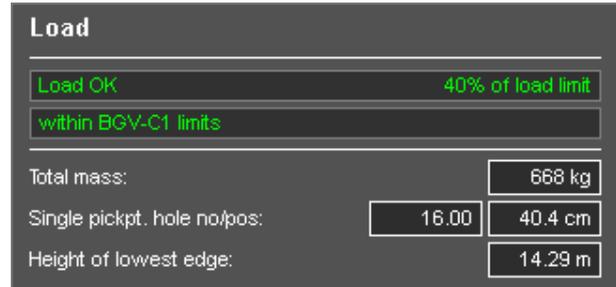
Exceeding the absolute load limits will bring up a red warning symbol:



### Array selection

You can select any array defined in the project for display and simulation by opening the respective array settings dialog.

### Load conditions for selected array



#### Load conditions and single pick point settings

This section provides general information on the mechanical load conditions of the array:

If the load conditions are within the load limits, the following message will be displayed:



For applications covered by the BGV C1 Rule for the Prevention of Accidents, "within BGV-C1 limits" is displayed as additional information if the designed array fulfills the load requirements.

If the load limits are exceeded, the following message will be displayed:



For applications covered by the BGV C1 Rule for the Prevention of Accidents, "out off BGV-C1 limits" is displayed as additional information if the designed array exceeds the load requirements.

### Load conditions for xA-Series arrays

Since xA-Series arrays are intended for fixed installation use only, the additional requirements of the BGV C1 rules do not apply. Consequently, no further details are provided here.

Some xA-Series configurations would exceed the rigging system load capacity if the fully assembled array was lifted from horizontal assembly position (i.e. when the array was assembled on the floor):



In this case, the array must be assembled vertically. Add only one cabinet to the suspended array at a time.

### Total mass

The calculated weight of the array including all rigging components.

### Single pickpt. hole no/pos

For single hoist operation, these values indicate where the Load adapter should be attached to the Flying frame to get the desired vertical aiming of the array.

The closest hole of the frame's hole grid, counted from the front of the frame, as well as the exact position as a distance from the front of the frame's center beam are displayed.

The J Load adapter supplied with the J Flying frame allows the pick point position to be set with a resolution of a 1/2 hole. The Q and T-Series Flying frames with Q/T Load adapter provide a resolution of 1/4 hole.

If the calculated pick point is beyond the frame, an error message will be displayed:



Single hoist operation might not be allowed for large arrays. In this case these cells show "-".

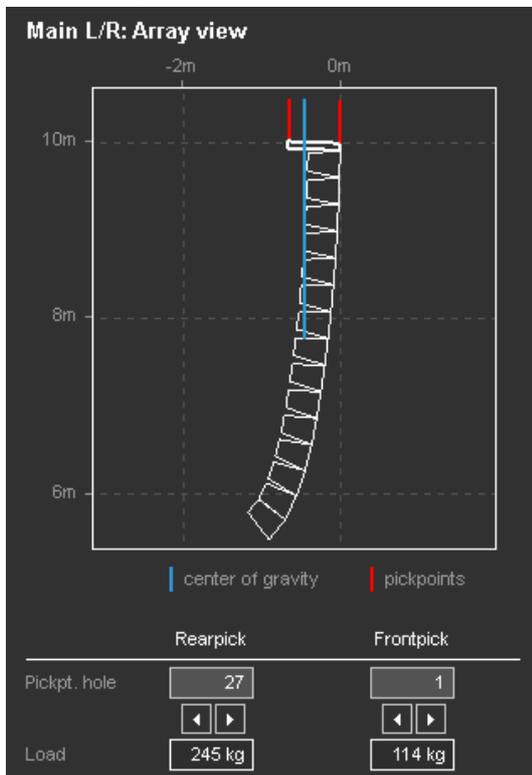
### Height of lowest edge

Height above the ground of the lowest edge of the array. Allows easy verification of trim height using a laser range finder or a tape measure.

### V and Q Flying adapter

If a small V or Q-Series array allows the optional use of the Z5385 V Flying adapter / Z5156 Q Flying adapter, the pickpoint information is displayed on the Rigging plot page provided the corresponding array is selected on this page. Refer to section 9.14 Rigging plot page on page 39.

### 9.7.5 Array view and load distribution



Array side view with load parameters and pick point settings

The array side view shows the mechanical setup of the cabinets including the center of gravity of the whole array (blue). A cabinet being edited in the array section is highlighted in yellow.

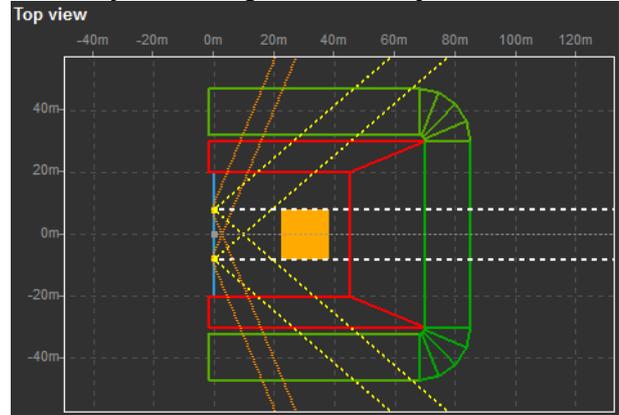
### Rearpick / Frontpick

The pick points for dual hoist support can be set to optimize load distribution. Depending on the exact hole position of the Load adapters on the Flying frame, the loads for each hoist are calculated. The load distribution can be modified by moving the pick points.

### xA-Series arrays

The orientation of the Z5415 Flying bar adapter xA changes according to the center of gravity of the array. If both orientations are possible, the rearward orientation is chosen.

### 9.7.6 Top view diagram for arrays

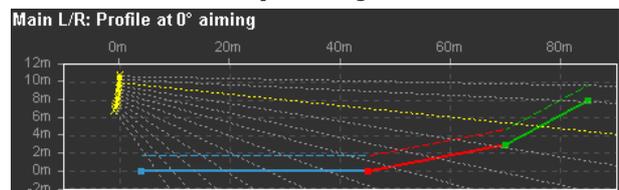


Top view of listening planes and arrays

The top view shows the active listening planes, the position of the arrays and their horizontal coverage area (nominal -6 dB isobars).

All arrays of a project are shown, the currently selected one is colored, all others are shown in gray. The dashed beams indicate the main axis of each array, the yellow (gray) dotted lines the coverage area of the uppermost cabinet and the orange (gray) dotted lines the lowest cabinet, in this case a J12. The coverage lines end when they hit a listening plane that is set to absorbent. (See section on page ).

### 9.7.7 Profile at array aiming

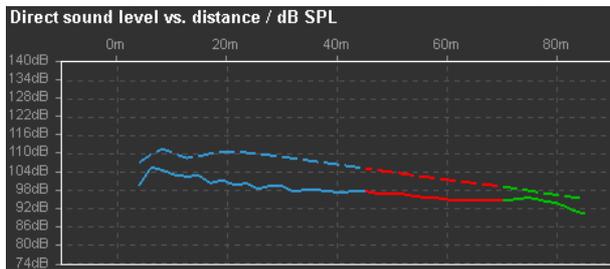


Profile view at horizontal aiming of selected array

The profile view shows a cross section through the active listening planes in the direction of the selected array's main axis with the listener ear height indicated. The x scaling is always relative to the array's position and therefore does not necessarily correspond to the absolute scaling of the top view diagram. Each dashed beam marks the main axis

of one cabinet. The beam of a cabinet being edited in the array section is highlighted in yellow.

### 9.7.8 SPL plot and signal selection for arrays



The SPL plot shows the direct sound level vs. distance for two frequency bands or alternatively for a broadband signal for all active listening planes in the direction of the selected array's horizontal aiming.

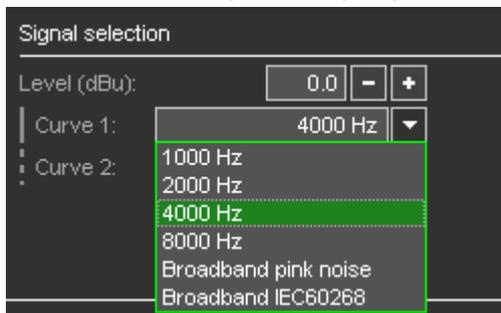
The reading is in dB SPL for the given input signal level taking all signal processing settings for the individual cabinets into account.

Curve 1 (continuous) can be selected to show the high/midrange level distribution, selectable in octave bands from 1000 Hz to 8000 Hz.

When one of the frequency bands is selected for curve 1, a second curve (dotted) appears representing the lower range selectable in octave bands from 63 Hz to 500 Hz, where the dispersion is defined by the overall array curving, not by the particular aiming of single cabinets.

The higher the frequency, the more the coverage is defined by the individual aiming of each single cabinet. Using 4 kHz for the high/mid curve is a good compromise, giving enough directivity information while not being affected too much by the HF absorption of air. Try to match as closely as possible the characteristics of the curves by modifying the splay angle settings and switching between the octave bands.

Increasing the splay between two cabinets will reduce the high/mid level in their target area, decreasing the splay will increase the level. As the plot only displays direct sound, keep in mind that reverberant sound changes the balance between low and high frequencies, typically towards the lower frequencies. Allow a relative increase (not an absolute increase) of higher frequencies towards larger distances to maintain good intelligibility.



As an alternative to the octave frequency bands also pink noise or IEC 60268 broadband signal can be selected for the SPL simulation. In this case only one curve is visible.

These signals are particularly interesting to predict the system headroom with typical music program.

The frequency weighting of the calculated broadband SPL can be selected between linear, A-weighting and C-weighting from the second list box.

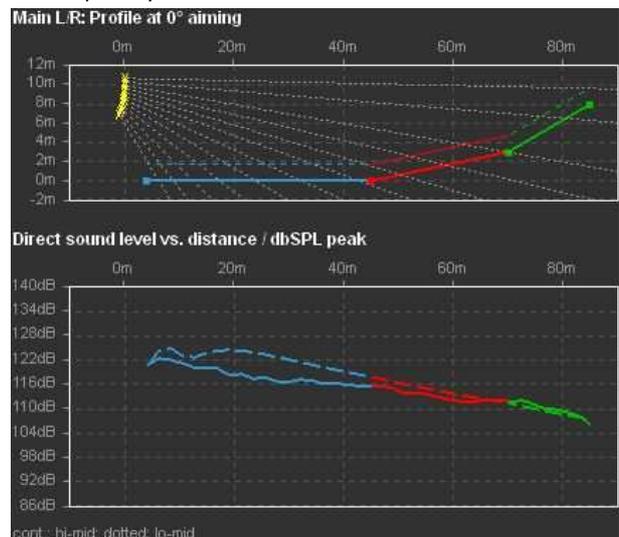
### Resolution



The spacial resolution of the SPL calculation can be changed from standard "std" to "high" when fine-tuning the array.

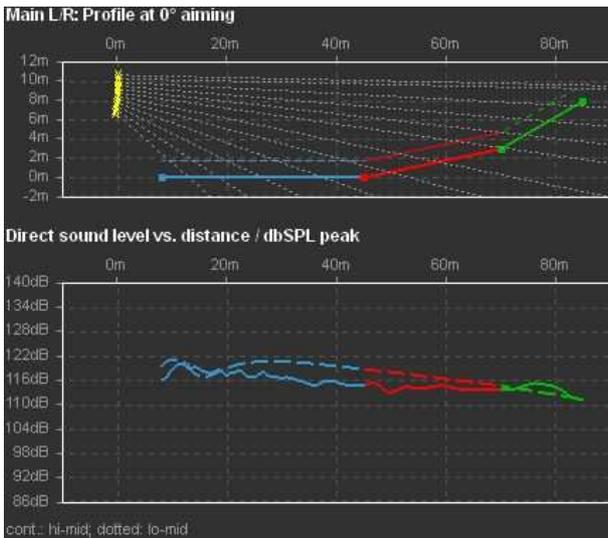
Please note that using "high" resolution calculation times will increase by a factor of 3.

The following two examples show different splay configurations and the effect on the SPL distribution for a 12-deep array in the same venue.



### 12-deep J8/J12 setup, medium directivity

In the first setup the plots for low/mid and high/mid SPL (4 kHz band) are very similar. The high/mid directivity of the system is not very high in order to match the level drop of the lower frequencies. As a consequence, the tonal balance of the system's direct sound will be very consistent over distance. This setup works in a room with low reverberation and for program material where the tonal balance is more important than optimum intelligibility and level distribution in the far field.



**12-deep J8/J12 setup, high directivity**

In the second example the system is tuned the opposite way in order to adapt it to a critical acoustic environment. More cabinets cover the far field to reduce the drop in level over distance at high and mid frequencies.

The higher direct sound level at the back of the room will compensate for the reverberant field and increase the speech intelligibility.

### 9.7.9 Maximum SPL and headroom

After the system parameters have been set and the desired level distribution has been achieved, check the maximum SPL of the system by increasing the input signal. If any of the systems reaches its gain reduction level, the respective GR LED lights up. If octave frequency bands are selected, the headroom simulation assumes that band limited pink noise signals of the selected frequency bands and the given level are present at each individual amplifier input.

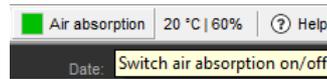
If a broadband signal is selected, the entered level represents the summed signal level. Therefore the system's headroom relative to the input signal level is of course higher when applying individual frequency bands than with a broadband signal.

To obtain a realistic system headroom estimation with typical Rock/Pop music program, we recommend that you use the IEC60268 signal spectrum.

**Note:** The calculated SPL is an RMS value. In ArrayCalc versions prior to V7.6.x, this value is a peak value. To compare the results for sine wave signals, 3dB have to be added to the RMS value to obtain a peak value. ArrayCalc constantly monitors the broadband amplifier headroom and whether the third octave band level of any cabinet exceeds the maximum possible level in the respective bands.

### 9.7.10 Air absorption

In addition to the overall loss of sound pressure with increasing distance, a certain amount of the acoustic energy is absorbed by air. This effect follows a quite complex function of mainly frequency, humidity and temperature.



When the Air Absorption switch is activated, ArrayCalc calculates this effect for selectable temperature and humidity values. The Air Absorption switch is located in the Extras-Options menu and directly accessible from the toolbar. To define the temperature units, click Extras-Options and choose between degrees Celsius and Fahrenheit under Units. The relative humidity can be specified in 4 steps: "dry-20 %", "low-40 %", "std-60 %" and "high-80 %".

Note that in reality there is not much point in specifying humidity values in more detail based on readings taken at one position within an audience area. In almost all cases, this only pretends to be a high accuracy since these conditions strongly vary with the height above an audience... and that's where the sound has to pass through.

### Compensating for air absorption - HFC function

When air absorption calculation is selected, you can set the HFC (high frequency compensation) selectors and their settings will be taken into account in the frequency response and headroom simulation of the respective cabinets. When you switch off the air absorption calculation, the settings for the cabinets will be kept and the HFC drop-down lists will be disabled. In this case, the HFC settings will not be taken into account.

That means, by switching the air absorption calculation on or off, you can verify a useful compensation for the individual amplifier channels.

The different settings of the HFC correction cover the following distances according to the individual systems used:

Series	HFC1	HFC2
J	40 m	80 m
V	30 m	60 m
Q	30 m	-
T	25 m	50 m
xA	25 m	50 m

#### Overview of HFC distance compensation

The values apply for a relative humidity of 40 %. The HFC2 compensation in the J8/J12 Line, V8/V12 Line and T10 Line setups includes a bandwidth limitation to approx. 10 kHz to keep the necessary boost within meaningful limits not wasting the system's headroom.

See also section 9.7.10 Air absorption on page 23 for further details.

### 9.7.11 Array EQ / CPL



Six J8/J12 cabinets arrayed vertically with up to 12° total splay angle produce a flat frequency response. Longer columns with more total splay will boost low and low/mid frequencies. The adjustable CPL function in the amplifier compensates for these effects. While setting the splay angles the Array EQ "Coupling" parameter (CPL, 0...-9 dB) can be set to a useful attenuation of lower frequencies to achieve a balanced sound. The setting of the CPL parameter affects the frequency response of the array, the curves of the SPL plot shifting accordingly.

The same principle applies to Q and T arrays. CPL should be used with arrays of four or more cabinets and a total splay of more than 15°.

Matching the 500 Hz curve (selectable for the Lo-mid curve) with the 1000 Hz curve (Hi-mid) usually provides a good start value for the CPL setting. The CPL parameter is available in the d&b amplifier configurations for J-, Q- and T-Series and should be set there correspondingly. All amplifier channels powering one array must be set to the same CPL value.

### 9.7.12 Level adjustment (Lev/dB)

After having set the splay angles, you may still find a significant increase in level very close to the array. It can be adjusted by decreasing the level of the lower cabinets of the array. When applying this to ArrayCalc, consider that usually several cabinets are linked to the same amplifier channel, so set the levels equally for all cabinets which will be connected in parallel.

If you want to change the level of the whole array to modify the coverage between different arrays of the setup, you can use the relative Level group control. Don't forget the level of the SUBs if there are any in the array.

**Note:** Keep in mind that for a lot of applications a certain increase in level towards the front is expected or even required, in particular with ground stacked subwoofers and high stage levels.

Please note that the effect of the level adjustment on the SPL distribution may decrease when the system is driven to its limits.

Setting the SPL distribution purely by splay angles provides a more consistent dynamic behavior.

### 9.7.13 Horizontal arrays of J8, V8, Q1 and T10 columns

The recommended horizontal angles between adjacent arrays are listed in the following table matrix:

Series	J	V	Q	T
J	50°- 70°	50°- 70°	45°- 65°	50°- 75°
V		50°- 70°	45°- 65°	50°- 75°
Q			40°- 60°	50°- 70°
T				60°- 80°

Smaller horizontal angles between the columns will give a smaller horizontal coverage area, but will produce higher sound pressure on the center axis and increased comb filter effects between the arrays. Larger horizontal angles with careful level tuning can help to seamlessly align outfill arrays while at the same time compensating for the reduced distances these arrays have to cover.

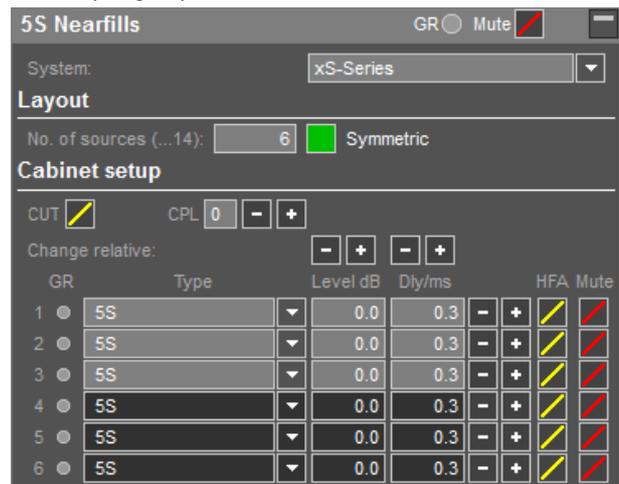
The array configurations should be thoroughly adapted to the actual room acoustics and requirements. In order to keep diffuse sound low, the total coverage angle should only be as wide as necessary to cover the audience area.

The smoothest coverage will be achieved if both columns of a horizontal array have identical vertical setups. Of course this is often not realistic. If the columns are considerably different in length or vertical aiming a distance of at least 3 m (10 ft) between their lifting points will reduce audible interference effects.

In general, an equal height of the bottom boxes of two adjacent columns gives the smoothest transition for close audience areas where interference effects are most audible.

## 9.8 Point sources

In the Point sources dialog you can define the system, number, type and orientation of the selected point source cabinet per group.



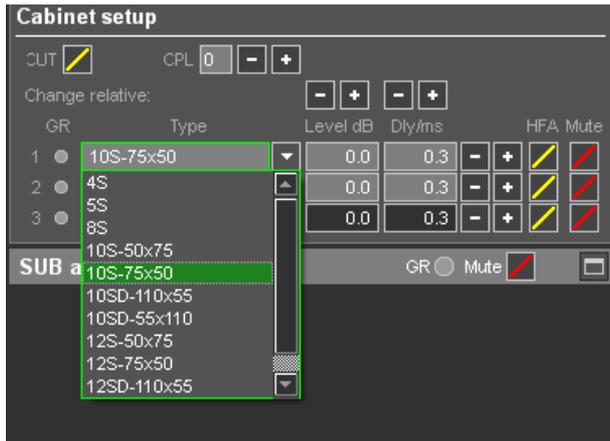
Point sources dialog

### System selection, No. of sources, Symmetric option



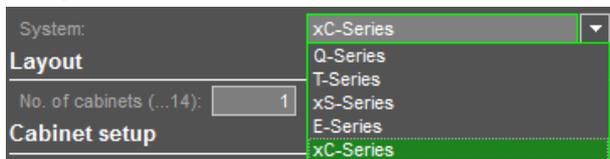
Defines the series from which the individual loudspeakers can be selected and the number of sources you want to use in the group. The symmetrical option simplifies data input for L/R symmetrical setups. When the Symmetric switch is activated, the data of each cabinet which is defined on one side is mirrored at the x/z plane resulting in corresponding data on the other side.

## Cabinet setup



## 9.9 Column loudspeakers

The column loudspeakers from the xC-Series can be selected from the system selection within the Point sources dialog.



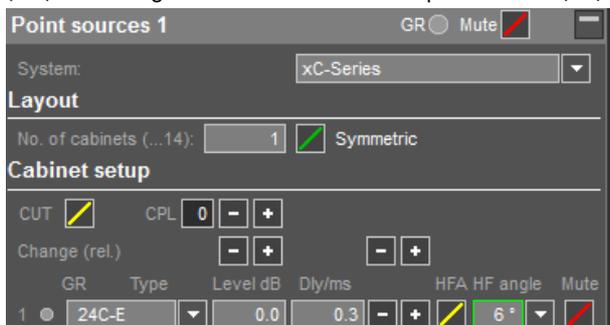
In each individual cabinet position in the Cabinet setup section, you can select either

"24C" for a single 24C column loudspeaker or

"24C-E" for a 24C column loudspeaker with a 24C-E column extender attached.

When 24C or 24C-E is selected, the splay setting on the right of the relevant row represents the internal angling of the HF array within the cabinet (HF angle).

The cabinet coordinates (x/y/z) represent the upper front corner of the respective loudspeaker or combination of loudspeakers. In addition, this point is the center of rotation when angling the systems either horizontally (hor), vertically (ver) or rotating them about their main dispersion axes (rot).



## General group controls

**Mute:** Located in the headline in order to be available even if the group of sources is not opened for editing. Depending on the setting of its individual Mute switch, a source will be taken into account in the mapping plots and be displayed, or not displayed, on the Alignment page. The Polar and Balloon diagrams of the individual sources are not affected by the Mute setting.

The Mute control located in the headline of a group of point sources can have three different states:



**Full red:** Indicates that all members of the group are muted.

**Full black with red diagonal line:** Indicates that all members of the group are unmuted.

**Half black / half red:** Indicates that the Mute switches of the individual group members have different settings. In this case, when moving the mouse pointer on the group control in the headline, a second Mute control button appears. One acts as a pushbutton to mute all individual group members, the other one acts as a pushbutton to unmute all individual group members.

## Group controls CUT and CPL

Controls for functions that must have the same settings for all group members (CUT and CPL) are provided as common controls for the group.

## Group controls for Level and Delay

Controls for functions that can be set individually for different group members (Level and Delay) are provided as relative controls incrementing /decrementing all respective values while maintaining relative settings.

The simulation results change in accordance with the settings.

## Cabinet specific controls



**Type:** Defines each individual cabinet and its HF horn orientation.

For cabinets that are equipped with rotatable HF horns, both horn orientations can be selected separately. Each selectable orientation for a specific loudspeaker type uses its own measured polar data set. This is defined by the chosen nominal horizontal and vertical dispersion angles and follows the convention [SystemName] [horizontal dispersion] x [vertical dispersion] while the cabinet itself remains in its typical mechanical orientation, i.e. in an upright position (e.g. 10S 75x50; E6 55x100; Q7 40x75 etc).

If a system is used lying on its side, the standard dataset must be used and the cabinet rotation must be set to either 90° (on its left side, seen from a listener's position) or 270° (on its right side, seen from a listener's position).

**Level control:** Independent level control to maintain the individual tuning of the particular loudspeaker.

**Delay control:** Independent delay control to maintain the individual tuning of the particular loudspeaker.

**HFA:** Available for all point source loudspeakers. Rolls off the HF response of the system providing a natural, balanced frequency response when a cabinet is placed close to listeners in near field or delay use.

## Cabinet layout, positioning and aiming

Cabinet layout						
	x	y	z	Horizontal	Vertical	Rotation
1	40.0 m	12.0 m	9.0 m	10 °	-8 °	0 °
2	40.0 m	4.0 m	9.0 m	0 °	-8 °	0 °
3	40.0 m	-4.0 m	9.0 m	0 °	-8 °	0 °
4	40.0 m	-12.0 m	9.0 m	-10 °	-8 °	0 °

You can define the individual position of each cabinet in the room by entering the desired x, y, and z coordinates. For point sources, the insertion point is the geometric center of the cabinet front. All three values can be modified for the whole group in a relative way at one go using the + / - buttons.

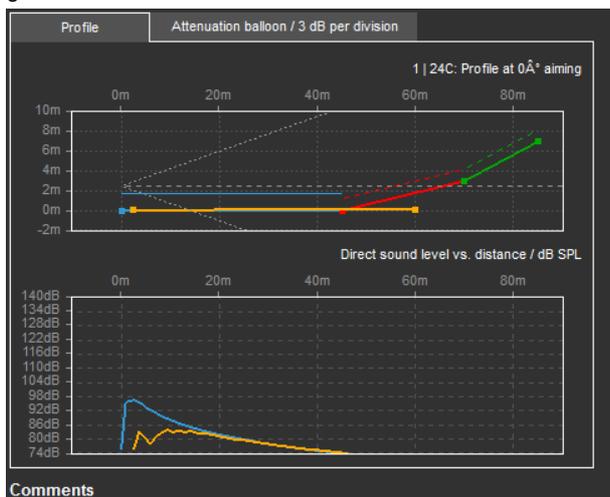
The coverage and level distribution in the audience areas are mainly adjusted by entering data in the entry fields for Vertical and Horizontal aiming. Horizontal aiming: a positive angle aims towards positive y values. (For pairs of cabinets it refers to the house left cabinet, i.e. positive value: rotated inwards, negative value: outwards).

The Rotation field allows you to adapt the cabinet's deployment to given visual or mounting restrictions relating to a specific loudspeaker position. The cabinet can be rotated in steps of 90° degrees.

To calculate SPL over distance, ArrayCalc uses the projection of the listening planes in the direction of each source's global aiming.

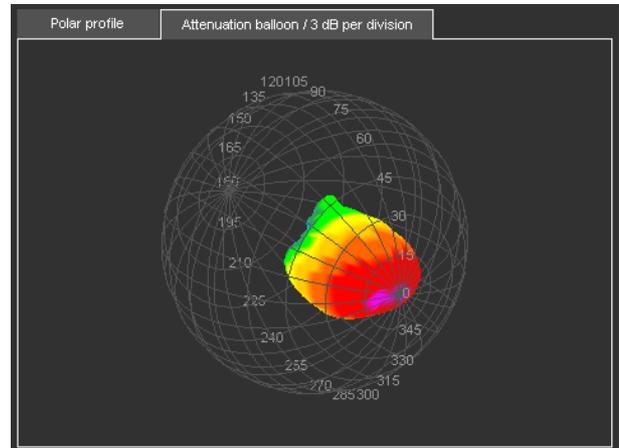
### Polar profile (vertical profile)

The diagram displays the vertical aiming of the selected cabinet reflecting the actual aiming into the room. At the top and bottom, the vertical -6 dB isobar lines are shown as a guideline.



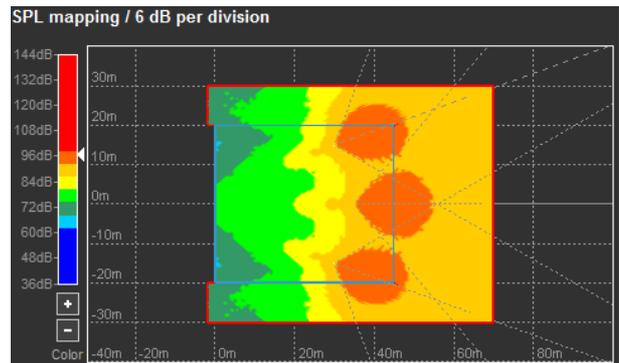
## Attenuation balloon

The diagram displays the 3D polar plot of the selected loudspeaker in the form of an attenuation balloon or alternatively the projection of the listening planes in the horizontal direction of the main axis, the main axis itself and the nominal -6 dB axes.



- Dragging with the mouse alters the viewing angle.
- Turning the mouse wheel zooms in and out.
- Double-clicking into the diagram always takes you back to the default side view.

### 9.9.1 Point source SPL mapping



#### Point source SPL mapping

The mapping plot shows the calculated level distribution on all active listening planes including the level contribution of all sources of the currently active point source group, the positions of the cabinets, their aiming and their nominal -6 dB coverage.

#### Spatial resolution of the SPL mapping

The spatial resolution of the mapping calculation is fixed to 1m with a minimum of 400 points per plane.

#### Signal selection and SPL summation method

SPL calculation	Signal selection	Air absorption
Highest SPL: 97.3 dB	Level (dBU): 0.0	On/Off <input checked="" type="checkbox"/>
Calculated: 100 %	Frequency: 2000 Hz	Temperature: 20 °C
Autocalculate <input checked="" type="checkbox"/>	Show dispersion <input checked="" type="checkbox"/>	Humidity: std - 60%
Recalculate <input checked="" type="checkbox"/>	Show interferences (f <= 163 Hz) <input checked="" type="checkbox"/>	

You can select the simulated frequency range in standard third octave bands.

For frequency bands of 163 Hz and below you can use complex SPL summation as an option thus showing interferences. Higher frequencies are always displayed as an energy sum. To display interferences correctly and totally, the spatial resolution of the mapping has to be in the range of half the wavelength of the simulated frequency. The 163 Hz band is able to fulfill this requirement for a minimum resolution of 1 m. A mapping with a higher resolution would dramatically increase calculation time while providing minimum additional information.

Here you can also set the signal level that is applied to all amplifier inputs. The selected frequency band is monitored for sufficient headroom (Refer to section 9.7.9 Maximum SPL and headroom on page 23).

### Air absorption

When the Air Absorption switch is activated, ArrayCalc calculates this effect for selectable temperature and humidity values. The Air Absorption switch and the environmental settings are located in the Extras-Options menu and are also directly available from the toolbar. To define the temperature units, click Extras-Options and choose between degrees Celsius and Fahrenheit under Units. The relative humidity can be specified in 4 steps: "dry-20 %", "low-40 %", "std-60 %" and "high-80 %".

The global Air absorption switch and the environmental settings affect all SPL calculations both on the Sources page as well as on the 3D plot page (refer to section 9.7.10 Air absorption on page 23).

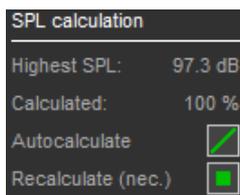
### Color scale



The color scale for the SPL mapping has a fixed 6 dB per division resolution. The color scale window displayed can be set according to the calculation results. This is done by either clicking the +/- buttons underneath the scale or using the mouse wheel while the mouse pointer is on the scale. The small arrow to the right of the scale indicates the highest SPL value calculated for the plot.

The color scale does not rescale automatically. This enables you to quickly notice the result of any change in the setup while optimizing the project. For a start, we recommend you to set the scale taking the displayed "highest SPL" value as a reference.

### Automatic calculation and status



When the Autocalculate switch is activated, the 3D mapping calculation immediately starts as soon as any relevant parameter in the project is changed.

The calculation starts using a very rough resolution, getting more and more detailed until the maximum resolution is reached. In this process the mapping plot is constantly updated.

This procedure allows you to modify setup parameters as soon as a certain result or behavior is perceptible without having to wait for the calculation to be completed. The progress of the calculation in relation to the target resolution is displayed in per cent.

**Note:** However, please note that constant recalculation will lead to a persistently high processor load and will quickly discharge your notebook batteries. For this reason, when working on notebook computers without AC supply, switch off the Autocalculate function. You can trigger a recalculation manually by clicking the Recalculate button. If a relevant parameter in the project has been modified since the last calculation, this is indicated by "Recalculate (required)".

### 9.9.2 Simulation limits

All the calculations performed in ArrayCalc assume perfect free field conditions. For this reason, it must be kept in mind that all the resulting predictions might not be describing the final result when working indoors. In a room with a distinct modal structure in the low frequency range ArrayCalc's predictions especially in the low frequency range might deviate significantly from reality.

## 9.10 SUB arrays

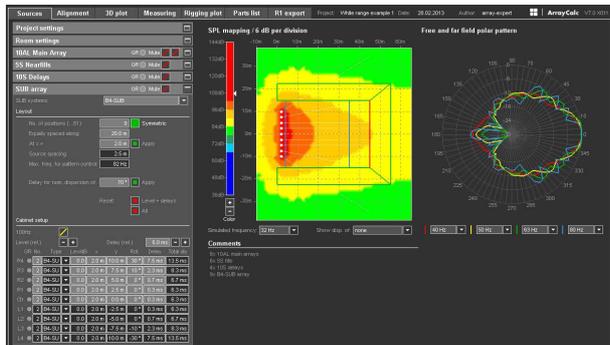
### 9.10.1 General considerations on stacked subwoofer placement

The intention of a SUB array is to distribute the available low frequency energy as evenly as possible.

ArrayCalc calculates the dispersion and coverage of horizontal SUB arrays for different LF bands. It provides the necessary individual delay settings of the subwoofers to achieve the desired array directivity.

ArrayCalc applies a complex summation (vector summation) of all sources of the SUB array for a fixed number of sample points distributed evenly across the displayed area. For all subwoofer types high resolution dispersion data is used containing both amplitude and phase information.

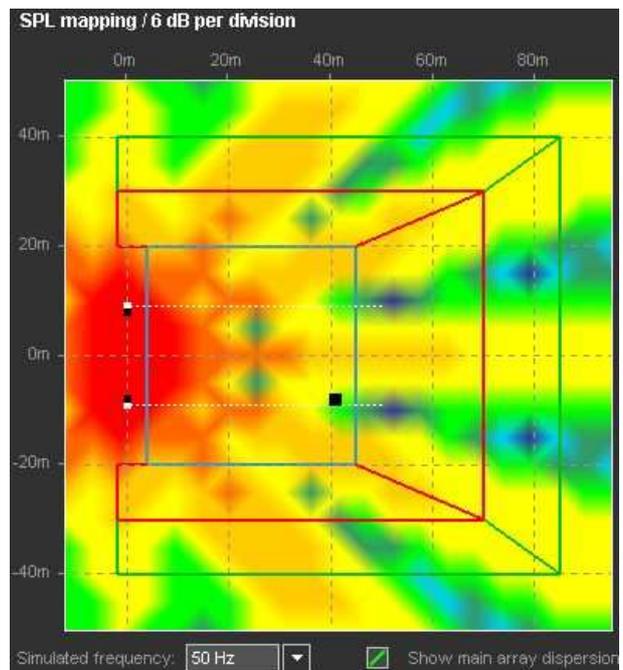
For SUB arrays as well as for a standard L/R setup, ArrayCalc allows to calculate the overall time alignment between ground stacked subwoofers and a selectable array in the project to provide a correct system impulse response. This procedure is performed on the Alignment page, which is described in detail in section 9.11.1 Time alignment of SUB arrays on page 34.



Sources page, SUB array selected

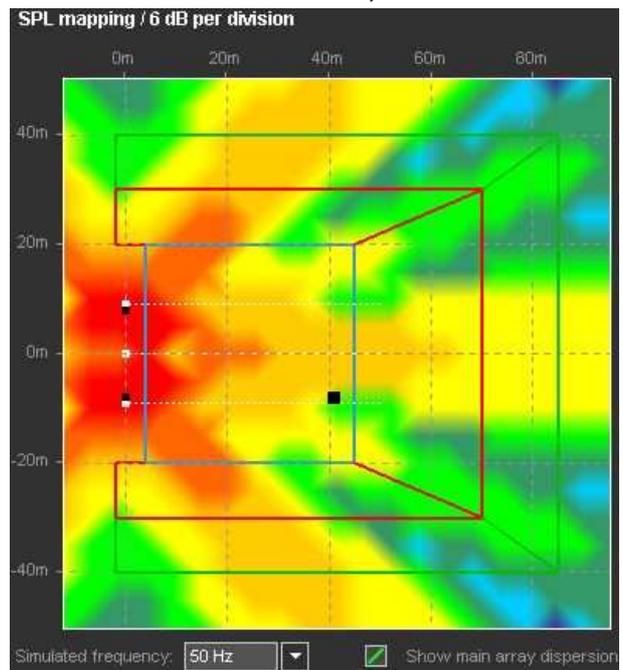
### 9.10.2 L/R ground stack

A conventional L/R subwoofer configuration provides the best coupling between the individual subwoofer cabinets, thus providing highest efficiency and best impulse response. However, this only applies to the setup center axis. A look at the SPL mapping at 50 Hz shows all the well-known side effects: The power alley in the center, the cancellation zones to the left and right of the center, repeated power zones, etc.



50 Hz mapping L/R subwoofer setup

A common approach to change this behavior is to add an additional center source. A look at the SPL mapping of a L/C/R subwoofer arrangement at 50 Hz shows: The zone in the center of the audience area is more even, but from the second cancellation zone, it isn't any better.



50 Hz mapping L/C/R subwoofer setup

### 9.10.3 Design criteria

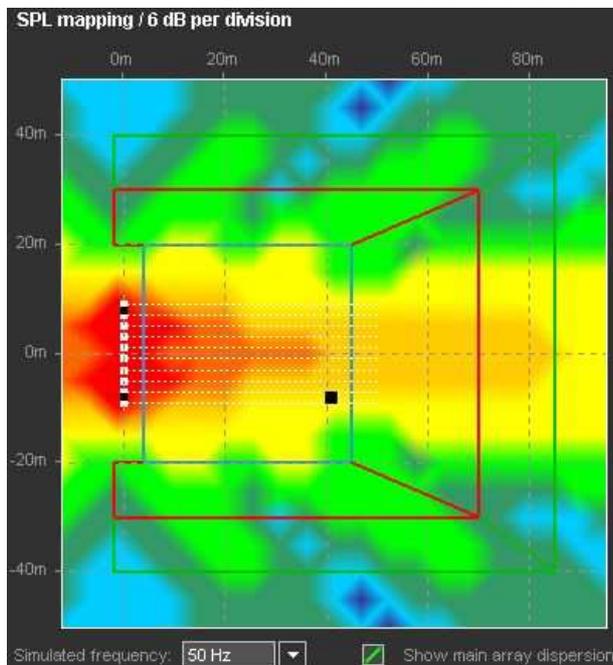
Two sources, which are spaced at a distance of half the wavelength of the frequency they reproduce, cancel each other out in the direction of their connecting line. For frequencies higher than this, the cancellation axis turns more and more towards the center axis while a second maximum appears and increases in level with rising frequency.

In the L/R example above, where the distance from left to right is 18 m (59 ft) (which is more than 2.5 times the wavelength at 50 Hz), the main lobe is in the center, there are 2 side lobes with cancellation zones in between and beyond, and the third side lobe is just about to appear clearly.

Consequently, to have full control over the array behavior within the entire operating bandwidth of the subwoofers, the source spacing must be close enough to fulfill the half-wavelength criteria mentioned above for the highest frequencies at which the subwoofers operate. In the actual application, the criteria can be undermined slightly: Firstly, because a subwoofer cabinet is not a theoretical point source, but has a certain extension, so the spacing between cabinet centers can be slightly wider than exactly half the wavelength; secondly, when directional (cardioid) subwoofers are used, they already have a certain rejection towards the sides, so the unwanted side lobes are suppressed to a certain degree.

### 9.10.4 Physical placement of cabinets

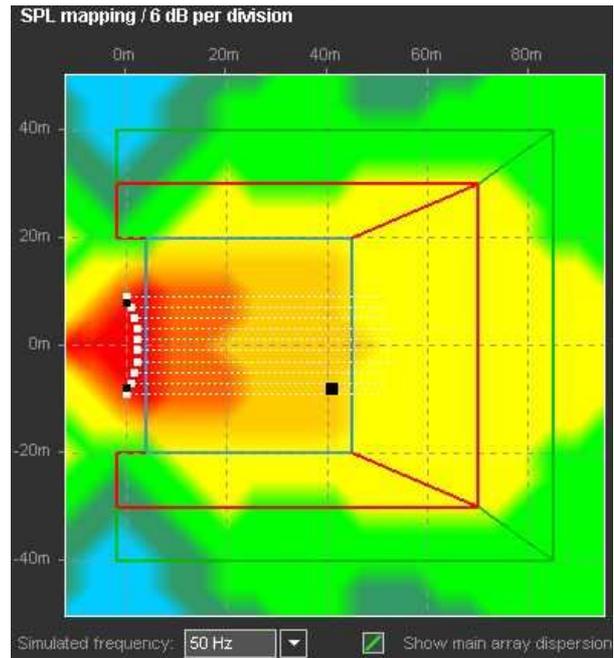
The first step is to array multiple omnidirectional subwoofers (e.g. Q-SUBs) in a line, close enough to avoid lobing. This is quite common practice. A look at the 50 Hz distribution of an array of 10 subwoofers, equally spaced along 18 m (59 ft), shows a strong center lobe that drops quickly by more than 12 dB towards the sides of the audience area.



**50 Hz mapping of a straight array of 10 subwoofers**

It is also clearly visible that the behavior is identical in the direction of the audience area as well as in the direction of the stage.

Curving the array physically widens the dispersion, thus providing a more useful coverage.



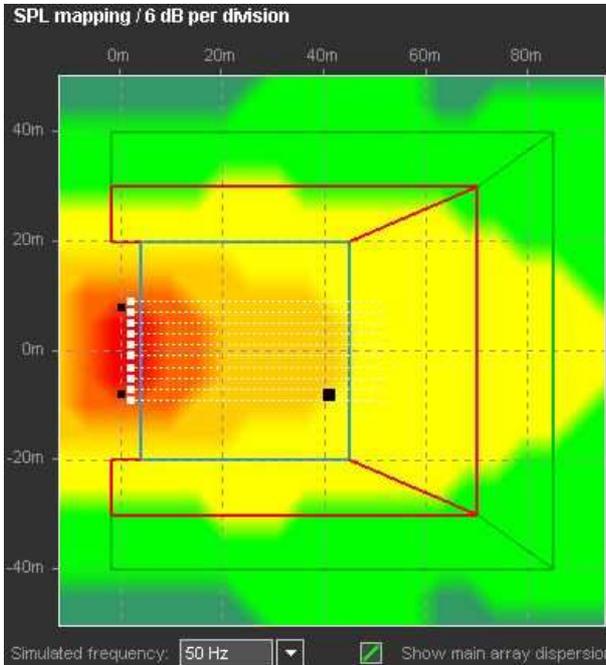
**50 Hz mapping of a physically curved 10-source SUB array**

This arrangement has two significant disadvantages. Firstly, it occupies positions hardly available for subwoofer placement in reality; secondly, it creates an energy focus on the stage center which is very difficult or even impossible to handle with many open microphones.

### 9.10.5 Shaping the wavefront using delays

The above examples show that our aim is to achieve the performance of a curved array towards the audience area, but without the increased stage levels and with a realistic space requirement.

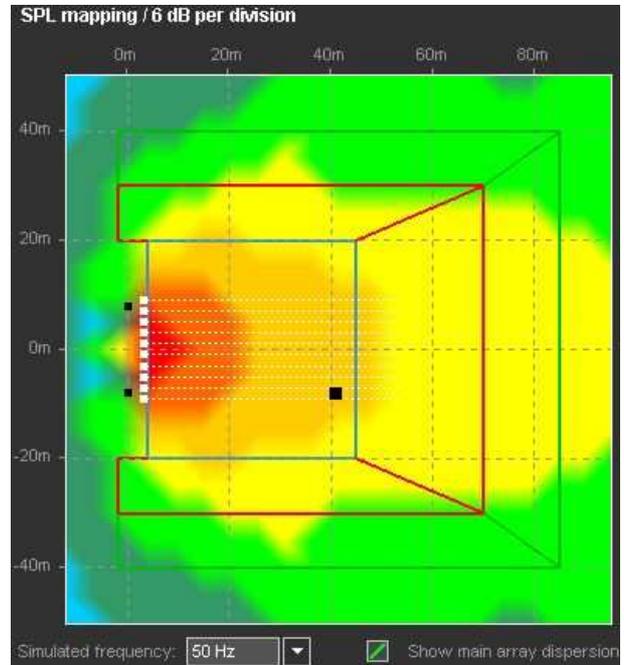
Transforming the physical arc into a delay pattern achieves the desired performance while avoiding the space problem and reducing the low frequency peak at the center of the stage by about 6 dB.



**50 Hz mapping of 10 delay-arc'd omnidirectional subwoofers**

### Array of directional (cardioid) subwoofers

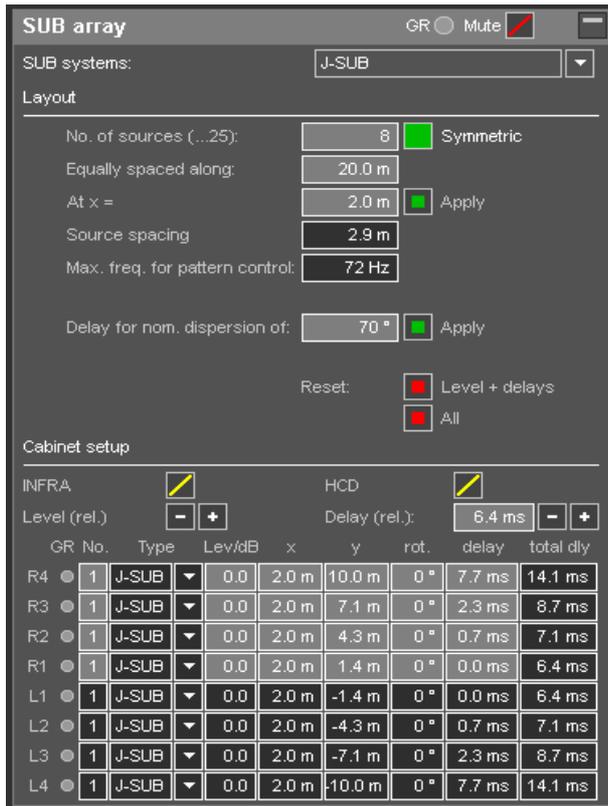
Distributed SUB arrays with their dispersion designed with a delayed arc, set up from directional subwoofers (cardioid or hypercardioid) offer exceptional control possibilities of the low frequency energy while keeping the on-stage low frequency level at a minimum. The following plot uses the identical delay pattern as the one above but the omnidirectional subwoofers are replaced by cardioid ones. Note the reduction of the on-stage level of 12 to 18 dB.



**50 Hz mapping of 10 cardioid delay-arc'd subwoofers**

Furthermore, directional subwoofers allow to manipulate the dispersion pattern by rotating the single cabinets about their vertical axes. If they are well arranged, this allows for very wide array dispersions while maintaining low on-stage levels.

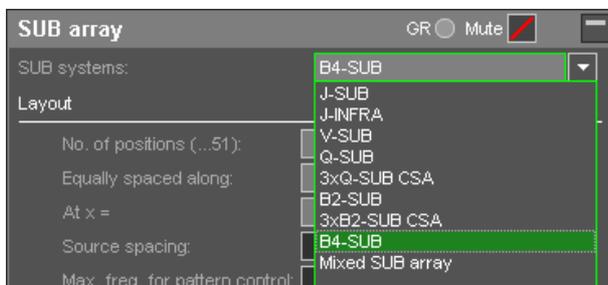
### 9.10.6 SUB array settings



SUB array dialog

### System selection

From the SUB systems drop-down list, choose the desired cabinet type.



SUB system selection

Define the number of sources you want to use.



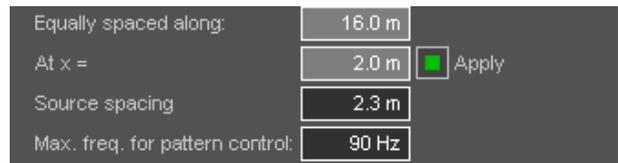
A "source" consists of one or more cabinets of identical subwoofers. The actual number of cabinets can be defined individually for each position. For CSA arrangements consisting of three Q-SUB or B2-SUB subwoofers it is automatically set to 3 and locked.

The special case of mixed SUB arrays consisting of stacks of J-SUBs and/or V-SUBs in some positions and stacks of J-INFRAs in others is described separately in section 9.10.7 Mixed arrays of J-, V-SUBs and J-INFRAs on page 32.

**The Symmetric switch:** Saves some work if the setup is symmetrical. When enabled, all editable data in the upper half of the data table is automatically mirrored into the lower half.

### Using the automatic placement

Define the width across which you want to distribute your cabinets ("...equally spaced along:"), and the x position where the line should be positioned.



The cell values "Source spacing" and "Max freq. for pattern control" already provide a quick overview of the distance between the subwoofer centers (i.e. will this fit into an existing stage grid?) and the upper frequency limit it provides. Above this frequency range, lobing will occur and make pattern control inaccurate. The given value does not exactly follow the half-wavelength criteria since the sources are not theoretical points but have a certain physical extension. As a guideline, for SUB arrays operated in INFRA mode, spacing should be close enough to give pattern control up to a minimum of 75 Hz.

Press the Apply button to distribute the selected number of subwoofers evenly across the given width. The x-y columns of the matrix are filled in automatically.

### Using the automatic delay proposal

Each source can be delayed individually to achieve the desired dispersion. To simplify this, ArrayCalc provides an automatic algorithm to create the delay arc based on the nominal far field dispersion of the array (-6 dB).



Keep in mind that a nominal dispersion of 50°-70° from a SUB array extending over the entire width of a stage usually equals the nominal dispersion of a standard left-right system.

Press the corresponding Apply button to fill in the suggested delay values in the "delay" column. The values are calculated using the current source positions including all manual changes to an automatically spaced setup. If desired, the delay values can be modified manually.

### SUB array group controls



Depending on the type of subwoofers selected, group controls are available which define the main amplifier settings for the array. The simulation result changes in accordance with the settings. Note that the level mapping diagram which is displayed when you select the SUB array option on the Arrays tab shows a relative level distribution only. As a result, it does not change if, for example, the overall input signal level is altered.

## Group controls are

**Mute:** Located in the headline in order to be available even if the array is not opened for editing.

**Relative delay value for the array:** The value is relative in order to align the SUB array to a selected array while keeping the arc-delays.

**Relative levels:** Increments/decrements the levels of all sources by 0.5 dB.

Loudspeaker specific amplifier controls such as:

**Switch 1:** Defines the upper frequency extension of the selected system, i.e. "INFRA", "70 Hz" or "100 Hz" modes.

**Switch 2:** When available, defines the dispersion characteristics of the selected subwoofer system, i.e. HCD (hypercardioid) mode.

## Cabinet setup

	GR No.	Type	Lev/dB	x	y	rot.	delay	total dly.
R5	1	J-SUB	0.0	2.0 m	10.0 m	0°	7.7 ms	13.6 ms
R4	1	J-SUB	0.0	2.0 m	7.8 m	0°	2.8 ms	8.7 ms
R3	1	J-SUB	0.0	2.0 m	5.6 m	0°	1.3 ms	7.2 ms
R2	1	J-SUB	0.0	2.0 m	3.3 m	0°	0.4 ms	6.3 ms
R1	1	J-SUB	0.0	2.0 m	1.1 m	0°	0.0 ms	5.9 ms
L1	1	J-SUB	0.0	2.0 m	-1.1 m	0°	0.0 ms	5.9 ms
L2	1	J-SUB	0.0	2.0 m	-3.3 m	0°	0.4 ms	6.3 ms
L3	1	J-SUB	0.0	2.0 m	-5.6 m	0°	1.3 ms	7.2 ms
L4	1	J-SUB	0.0	2.0 m	-7.8 m	0°	2.8 ms	8.7 ms
L5	1	J-SUB	0.0	2.0 m	-10.0 m	0°	7.7 ms	13.6 ms

**Cabinet setup matrix**

## GR indicators

Each source position has a yellow GR LED which indicates when a particular amplifier channel has reached its limit for the given signal level with one of the simulated input signals selected for the 2D and 3D SPL plots.

A possible Gain Reduction is not considered in the SPL calculations, i.e. will not limit a cabinet's calculated output and will therefore not modify the SPL distribution. Consequently, with (too) many GR LEDs on, the calculated and displayed level distribution might actually not be attainable.

Whenever a GR LED lights up for a cabinet within an array, the GR LED in the headline is activated even if the array is not opened for editing.

## No. of cabinets

Defines the number of cabinets for the respective source position. For CSA arrangements consisting of Q-SUB or B2-SUB subwoofers this number is set to 3 and locked.

## Cabinet type

Shows the type of the selected subwoofer system. In case of a mixed J-SUB / V-SUB / J-INFRA array you can select the specific cabinet type for each individual position.

## Level/dB

The gain to be set on the respective amplifiers / amplifier channels.

**Note:** Do not try to achieve the desired dispersion by using individual cabinet level settings. Use identical levels for all amplifiers, otherwise the array dispersion will change when the system is driven to its limits.

## x/y columns - manual positioning

Subwoofer x/y positions can also be defined manually. This may be necessary if SUB arrays have to be fitted into existing stage sets, or if single obstacles have to be taken into account.

After placement is modified manually, the displayed source spacing and the frequency limit for pattern control are not necessarily valid any more.

The mapping and the polar plots should be checked for increased lobing at the upper end of the frequency range.

## Rotation - rotation angle

Take advantage of directional subwoofers: For very wide dispersions, additional rotation of subwoofers can help to keep the energy distribution smooth and even. Progressive rotation towards the outermost subwoofers should then be applied. In many applications a rotation by 60° for the outermost SUBs and 30° for the ones next to them makes a great difference. Observe the mapping and polar plots while working on this. Avoid rotations by more than 90°.

When setting up the subwoofers physically, make sure you rotate them about their center axes. Do not move the center.

## Total delay

This column indicates the actual values to be set at the respective amplifier channels. It is the sum of all the individual delay values within the array plus the overall time alignment to the main system. Refer to section 9.11.1 Time alignment of SUB arrays on page 34.

## 9.10.7 Mixed arrays of J-, V-SUBs and J-INFRA

In general, a SUB array should always be set up using identical systems for all positions in order to obtain a predictable and frequency consistent total behavior. However, it is possible to build a SUB array consisting of source positions with J-SUBs, V-SUBs or J-INFRA. The dispersion characteristics of these subwoofer types have been closely matched across their entire frequency ranges and the full spheres to enable a combined operation.

In this case, a default ratio of 2 x V-SUBs to 1 x J-SUB is set in order to balance the SPL/headroom.

A setup consisting of alternating positions of 3 x J-SUBs and 2 x J-INFRA is most beneficial. The same applies to a setup consisting of alternating positions of 2 x V-SUBs and 1 x J-INFRA. In such a combination, the J-INFRA subwoofers can provide all the extended frequency range on the very low end with sufficient headroom. However, it is important to match the upper frequency extension.

If you have selected a mixed array of J/V-SUB and J-INFRA subwoofers in the SUB systems drop-down list, the cabinet types listed in the Cabinet setup section are displayed in a list box from which you can select the system for each position.

The bandwidth selection switches (Switch 1) of the two systems work in reverse, i.e the J-SUB has an "INFRA" (the V-SUB a 100 Hz) switch lowering the upper frequency extension when "on", while the J-INFRA has a "70 Hz" switch rising the upper frequency extension when "on". Consequently, they have to be combined and are mutually exclusive. When you activate one, the other one is disabled. Their proper use is controlled by the "hip/hop" selector.

### 9.10.8 Dispersion displays

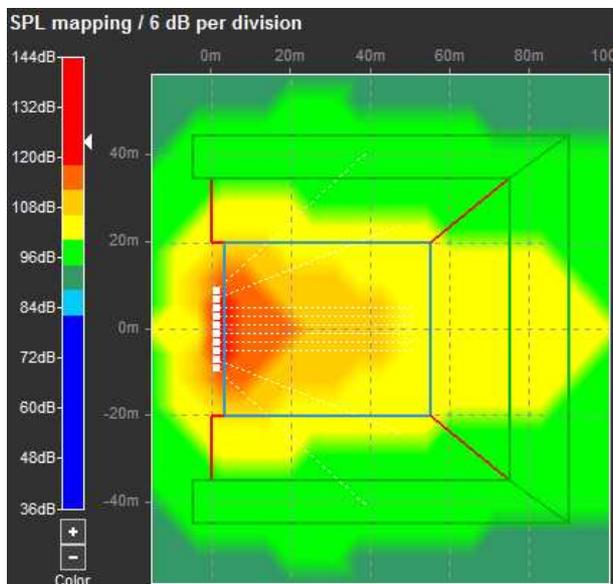
The following displays help to evaluate the performance of the array.

#### Mapping diagram

Select the simulation frequency.



Consider and compare all relevant frequencies within the system's operating bandwidth. Each colored isobar represents a drop in level by 6 dB. Place the mouse onto the drop-down list and use the wheel to quickly change between the frequencies.



Mapping diagram with color scale

#### Color scale

The color scale for the SPL mapping has a fixed 6 dB per division resolution. The color scale window displayed can be set according to the calculation results. This is done by either clicking the +/- buttons underneath the scale or using the mouse wheel while the mouse pointer is on the scale. The small arrow to the right of the scale indicates the highest SPL value calculated for the plot.

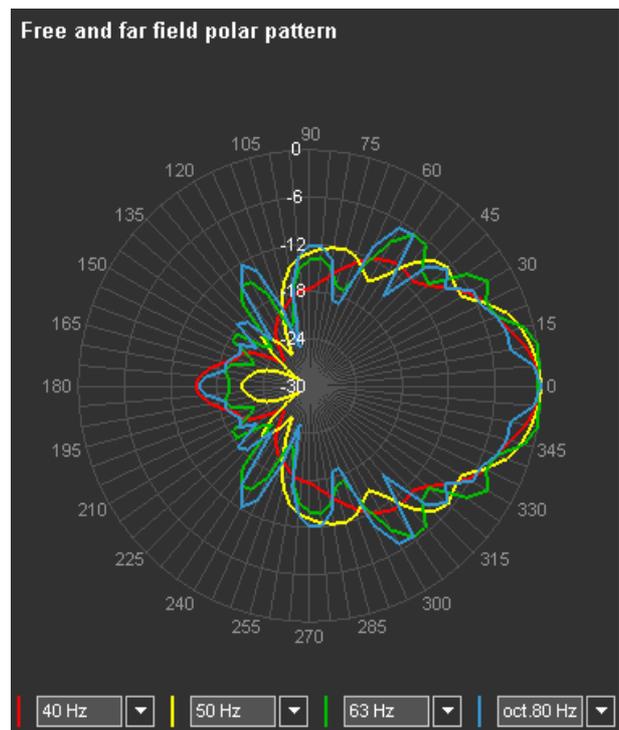
The color scale does not rescale automatically. This enables you to quickly notice the result of any change in the setup while optimizing the project.

#### Polar diagram

Polar diagrams visualize the far field behavior of the array, i.e. the dispersion pattern at a distance which is much larger than the array dimensions.

Although this distance might often extend beyond the actual audience area, the polar diagram provides helpful information about the consistency of the dispersion patterns for different frequency bands displayed in a single plot.

Third-octave frequency bands between 32 Hz and 100 Hz can be selected, as well as the octave average at 40 Hz and 80 Hz.

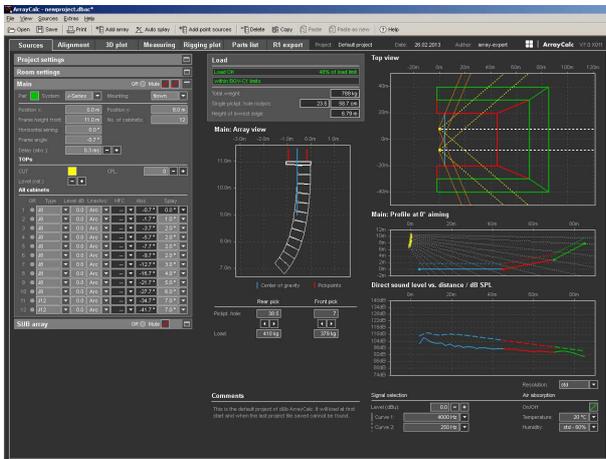


Polar diagram

Use the Alignment page to calculate the correct time alignment between the SUB array and a selectable flown array with the help of a phase matching procedure (refer to section 9.1.1.1 Time alignment of SUB arrays on page 34).

## 9.11 Alignment page

For a complex system consisting of multiple sources it is essential to time align the different parts in a useful way. ArrayCalc provides a dedicated Alignment page to help you find a useful alignment strategy and finally deduce starting values.



### Alignment

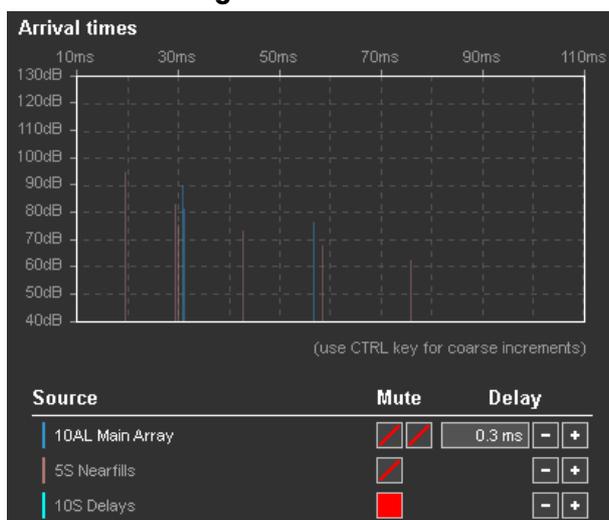
The left side of the page contains a fully operable copy of the project, room and source settings of the project.

### Selecting the test point for array alignment

Within a copy of the Top view diagram, a test point can be chosen either by clicking in the diagram and/or by moving around using the arrow buttons next to its x/y coordinates or by directly entering numerical values.

The z-coordinate is calculated based on the x/y position and on the presence of a listening plane at this position. When you move the point, the algorithm keeps it on the same plane as long as possible. If the end of a plane is reached, it jumps onto the next plane in the direction of moving. The Current plane field shows the name of the plane on which the test point is currently located.

### Arrival times diagram



Arrival times diagram including point sources

The arrival times diagram shows the first arrival of acoustic energy reaching the test point in milliseconds for all arrays or individual sources in the project provided they are unmuted. Underneath the diagram you can define mute and delay settings for each array. In case of an array, both functions are operable copies of the same functions in the array settings dialog of each array.

The Delay settings can be defined by entering data directly into the relevant field of each array or using the +/- buttons. Holding down the CTRL key (Apple key for Macintosh) while clicking the +/- buttons switches from fine to coarse increments.

In case of a point source group, the Mute switch here mutes or unmutes the entire group. If you want to mute/unmute the individual sources of the group, you have to go to the appropriate point source settings dialog. The delay buttons for a point source group increment/decrement the delay values for all sources of the group while keeping their settings relative to each other. As a result, a numeric data input field is not available here.



In the above example, the test point is located at a position to align the "Outfill" array to the "Main Array" array. The first arrival time from the left side of the paired "Outfill" array is around 110 ms, while the arrival time of the left side of the paired "Main L/R" array is around 114 ms. That means, approximately 4 ms of delay have to be added to the "Outfill" array to set a correct time arrival for this test point position.

In this example, the left sides (L) of the paired arrays were taken as a basis because they are closer to the test point than the right sides. The peaks at 148ms and 157 ms represent the arrival times from the right sides of the paired arrays. Note their relatively low levels and therefore negligible influence at the selected position. These peaks can be switched off by simply muting the right sides (R) of the paired arrays.

The alignment for point sources is performed in a similar way. Place the test point at a suitable position within the target area of each point source and set the delay accordingly. In case of distributed point sources, it may be necessary to perform this procedure for each individual source.

### 9.11.1 Time alignment of SUB arrays

It is vital to carry out a correct time alignment of ground stacked or arrayed subwoofers to the main system. ArrayCalc accurately calculates the settings necessary for an optimum alignment at a user-defined distance from the system, thus replacing a measurement system.

**Note:** Before evaluating the necessary time alignment, make sure all mechanical and acoustic parameters as well as the arc-shaping delay times of the SUB array are set correctly and correspond to the actual setup at the venue. Verify all actual distances, positions and trim heights. Wrong parameters will deliver an incorrect alignment. If in doubt, use an acoustic measurement system to set the delays (refer to section 9.22 Time alignment on page 42).

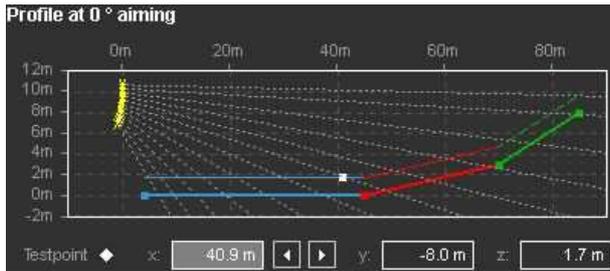
Make sure to use the final delay setting for the selected source to which the subwoofers are to be aligned. If the source delays are modified later, the subwoofer alignment has to be re-checked.

### Selecting the source for alignment

Phase-response against Main L/R

Select one of the sources in the project for phase alignment with the SUB array. Make sure to select a source with a target dispersion that is reasonably similar to the SUB array.

### Selecting the test point



You can select the distance (x value) at which the phase responses of the SUB array and the source are compared. This test point is always located at the y position of the left source selected. This provides a good alignment result for a wide area in the infield of an audience area, including the FoH position. Choose an x position at a sufficient distance from the sources. Usually a typical FoH position is a good choice.

### Calculating the phase response

The phase responses of both the selected source and the SUB array at the test point are calculated using a complex sum of all contributing sources including their angle-dependent phase and level response and delay settings. To obtain a useful phase plot, the distance of the closest source to the test point is compensated for in the diagram.

Set both delay values to minimum (0.3 ms) and check which system sound arrives earlier (selected source or SUBs).

It is the one with fewer "turns" in the phase response, since a steeper phase curve means more delay.



In the above example it is the white trace representing the summed response of the SUB array, indicating that the SUB array needs additional delay for phase matching.

Gradually increase the delay of the earlier signal until the two phase traces match each other within the relevant frequency range ~55 Hz and ~120 Hz (dark area) as well as possible.



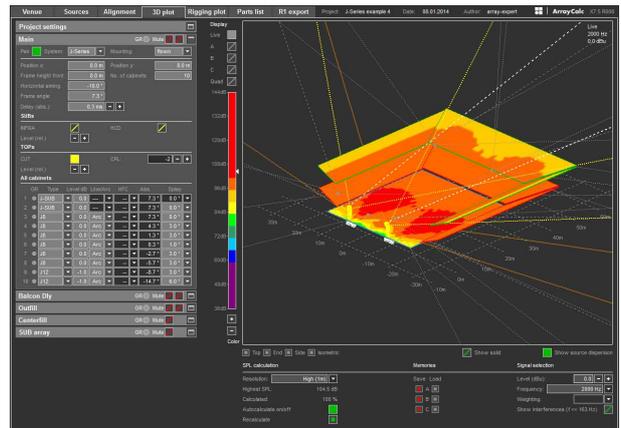
### Aligning a L/R subwoofer setup

The delay alignment tool can also be used to align L/R ground stacked subwoofers to any other source. Set the number of subwoofer sources to 1. Now only the center source is active. Enter the x and y coordinates of the left ground stack and proceed as before.

Source	x	y	Level/dB	rotation	delay	total delay
Centre	2.0 m	-8.0 m	0.0 dB	0.0 °	7.3 ms	13.7 ms

## 9.12 3D plot page

ArrayCalc offers the possibility to calculate an SPL mapping including all sources in the project on all defined listening planes for a selectable third octave frequency band.



The left side of the page contains a fully operable copy of the project, room and source settings of the project.

The calculation results are displayed in a zoomable, mouse controlled 3D diagram that is fully rotatable.

## Preset views



Directly underneath the diagram area, you can choose between different standard views: "Top" - view from above onto the x-y plane, "End" - view from the end onto the y-z plane, "Side" - view from the house left side onto the x-z plane and a standard 30°/30° "Isometric" view. The preset views always affect the diagram situated directly above them.

In addition, you can define any other view by clicking and holding down the left mouse button in the diagram when moving the mouse. An up/down movement rotates the viewport around the x-axis, a left/right movement rotates it around the y-axis.

Holding down the right mouse button while moving left/right rotates the viewport around the z-axis. The distance between the click position and the rotational axis defines the leverage of the movement.

Turning the mouse wheel zooms in and out.

You can also move the diagram by holding down the CTRL key (Apple key for Macintosh) while clicking in the diagram and holding down the left mouse button when moving the mouse.

If you are completely lost, simply click one of the preset views or double-click into the diagram. This will restore the last preset view selected.

## Show sources / show source dispersion

When the Show sources switch is enabled, 3D rendered drawings of all sources are displayed. As usual, the selected source is highlighted.

When the Show source dispersion switch is enabled, the main axis of the first TOP cabinet of each array as well as the nominal dispersion axes of the first and the last TOP cabinets of each array are displayed in the diagram. For point sources, the main axis of each cabinet is displayed.

## Spatial resolution of the SPL mapping



### Mapping resolution

The spatial resolution of the mapping calculation in the 3D plot can be selected underneath the diagram. Possible settings are High (1 m) / Mid (2 m) / Low (5 m). Between each of them, the time for a full calculation increases by a factor of 4. A resolution of 2 m is used as default setting.

Be aware that high resolution mapping calculations of large venues (arena or stadium) using many large arrays can easily exceed 15 minutes of calculation time and will require a lot of RAM memory!

For detailed calculations of particular areas only the relevant listening planes may be switched on in the Room settings menu. This improves calculation time and ensures a maximum sized display of the planes.

## Signal selection and SPL summation method



You can select the simulated frequency range in standard third octave bands.

For frequency bands of 163 Hz and below you can use complex SPL summation as an option thus showing interferences. (SPL calculation within each array is always based on complex summation). Higher frequencies are always displayed as an energy sum.

To display interferences correctly and totally, the spatial resolution of the mapping has to be in the range of half the wavelength of the simulated frequency. The 163 Hz band is able to fulfill this requirement for a minimum resolution of 1 m.

A mapping with a higher resolution would dramatically increase calculation time while providing minimum additional information.

Here you can also set the signal level that is applied to all amplifier inputs. The selected frequency band is monitored for sufficient headroom (Refer to section 9.7.9 Maximum SPL and headroom on page 23).

## Air absorption

Use the Air absorption switch to consider air absorption in the SPL calculations. The Air absorption switch is located in the Extras-Options menu and directly accessible from the toolbar. The related settings for temperature and relative humidity are also accessible there. (Refer to section 9.7.10 Air absorption on page 23).

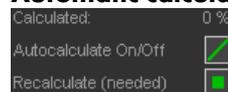
## Color scale



The color scale for the SPL mapping has a fixed 6 dB per division resolution. The color scale window displayed can be set according to the calculation results. This is done by either clicking the +/- buttons underneath the scale or using the mouse wheel while the mouse pointer is on the scale. The small arrow to the right of the scale indicates the highest SPL value calculated for the plot.

The color scale does not rescale automatically. This enables you to quickly notice the result of any change in the setup while optimizing the project. For a start, we recommend you to set the scale taking the displayed "highest SPL" value as a reference.

## Automatic calculation and status



When the "Autocalculate" switch is activated, the 3D mapping calculation immediately starts as soon as any relevant parameter in the project is changed, even if the 3D plot tab is currently not active.

The calculation starts using a very rough resolution, getting more and more detailed until the resolution set in the

options is reached. In the process, the 3D plot is constantly updated.

This procedure allows you to modify setup parameters as soon as a certain result or behavior is perceptible without having to wait for the calculation to be completed. The progress of the calculation in relation to the target resolution is displayed in per cent.

**Note:** However, please note that constant recalculation will lead to a persistently high processor load and will quickly discharge your notebook batteries. For this reason, when working on notebook computers without AC supply, switch off the "Autocalculate" function. You can trigger a recalculation manually by clicking the "Recalculate" button. If a relevant parameter in the project has been modified since the last calculation, this is indicated by "Recalculate (required)".

### Memories and display options

The 3D plot provides three memories to store calculated mapping results and various display options. This feature enables you to compare either different frequency bands for one source configuration or different source configurations for the entire venue.

In the "Memories" section underneath the diagram you can store a calculated mapping result with the current viewport settings including all related project data such as room and array configurations to a particular memory (A, B or C) by clicking one of the Save buttons. If you want to edit the data of a memory, click the respective "Load" button next to the "Save" button. This will load the stored mapping results including the complete room and source configurations to the live workspace. Please note that loading a stored memory will overwrite the current settings of your live workspace.



You can view a memory by selecting the respective display option on the left side of the diagram. You can choose individual views (Live, A, B or C) or a combined view of all results (Quad). If you want to change the default preset view for a memory, display the respective memory A, B or C individually and select the desired preset view. This view will then also be displayed in the Quad view.

Keep in mind that this option is intended for display purposes only. The related project settings are not loaded to your live workspace.

#### Notes:

1. ArrayCalc does not store any mapping results when you save a project file. Only the project, room and array settings of the live workspace are saved. Also the A, B and C memories are only temporarily stored during an ArrayCalc session. As soon as you exit ArrayCalc, this data is also lost. That means, if you want to keep the project configuration on which an SPL mapping is based and which you stored to one of the memories, you have to load the relevant memory to the live workspace and then save it as a project. When the project configuration has been saved, the mapping results can easily be recalculated by loading and recalculating the

respective project file.

2. Saving and loading high-resolution mapping data for large venues can take a lot of time and require massive amounts of RAM, easily reaching the gigabyte range!

### Print and Export

You can print out all possible display options of the mapping diagram(s) or you can export them in \*.png format for further use in documentation. To use the print or export functions, select "Print" or "Export" from the File menu.

### 9.13 R1 Export page

The ArrayCalc export function for R1 project files provides a fast and convenient way to transfer the whole system setup created in ArrayCalc to an R1 remote control user interface. In addition, the R1 Export function also includes an option for printing out a patch plan.

At the click of a button ArrayCalc creates an R1 V1 or an R1 V2 project file (.rop or .r1p) containing the amplifiers (devices) and all groups and control elements to operate the system simulated in ArrayCalc.

#### 9.13.1 Export R1 files

In addition to the R1 V2 project file, a Snapshot containing all settings for the devices and group controls is created. You can load this Snapshot in R1 V2 by clicking the appropriate button on the Overview page of the exported R1 V2 project.

To maintain integrity between an R1 V2 project file and the Snapshot, the Snapshot is saved within the exported project file.

#### Standard procedure

To make effective use of the R1 Export feature, proceed as follows:

1. Use the Link cabinets function at the top of the R1 Export page.  
If necessary, adapt the patch of individual devices manually. A detailed description is given in section 9.13.3 Patch dialog on page 38.
2. Use the Configure amplifiers function at the top of the R1 Export page.  
If necessary, adapt the configuration of individual devices manually. A detailed description is given in section 9.13.4 Cabinets section on page 38.
3. Click the Export R1 files button and save the R1 project file and the Control settings file.
4. Open the R1 project file in R1 V2.
5. Load the Snapshot using the appropriate button on the Overview page of the exported R1 project.

## Patch plan printout

ArrayCalc provides you with a detailed patch plan printout including the chosen input type and source. On the R1 Export page select 'Print' from the File menu or press Ctrl+P (CMD+P for Mac OS X systems).

### 9.13.2 Patches



The R1 Export page provides a patch dialog for each array in the project to allow individual assignment (patch) of the cabinets to the respective amplifier channels. Additionally the dialog allows you to configure several settings for remote control in R1.

#### Link all cabinets function



Clicking the Link all cabinets button at the top of the R1 Export page links the recommended number of cabinets to one amplifier channel. This function applies to all arrays in one project (including the additional devices), whether they are open or not.

**Note:** Please note that only adjacent cabinets with identical level and switch settings are linked. ArrayCalc does not share amplifier channels between different arrays automatically. For this reason, unused amplifier channels are not used on other arrays but are listed in the Unused channels section at the bottom of each array. Amplifiers can be shared between different arrays manually. Make sure that all entries of the respective amplifier have the same Output mode settings.

#### Configure all amplifiers function



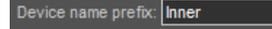
Clicking the Configure all amplifiers button at the top of the R1 Export page creates a default order of device IDs and channel settings for the entire project. Amplifier IDs start at 0.01 for the top left cabinet of the first array in the list. You can also specify a Start ID manually.

When you click the Configure all amplifiers button, ArrayCalc displays a dialog asking you whether the Start IDs you specified should be taken into account. If you select "Use Start IDs", the system will start counting from the specified IDs.

### 9.13.3 Patch dialog

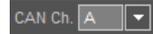
ArrayCalc provides separate patch dialogs for line arrays, point source groups and the SUB array. Such a patch dialog displays the name of the related source and is split into a header and a cabinets section.

## Device name prefix



The device name of each amplifier is automatically generated automatically by the system and consists of the first 10 characters of the name of the respective source plus the Remote-ID of the amplifier. The device name cannot be edited itself but it is possible to change its prefix by changing the name of the respective source in the source settings dialog of the Sources page.

## CAN channel (CAN ch.)



This option sets all devices of a patch dialog to the same R1 CAN interface channel. This option is no longer relevant when using R1 V2 and is deactivated automatically when using at least one D80 amplifier in the project.

**Note:** Please note that using this option will overwrite all CAN interface channels you manually set for individual devices in this dialog. The default setting is CAN interface channel A. For further information on CAN channels, please refer to the R1 manual.

## Total number of amplifier



ArrayCalc displays the total number of amplifiers used in the currently open patch dialog. To obtain the total number of all amplifiers in a project, please refer to the Parts list page.

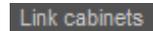
**Note:** Please note that the total number of all amplifiers on the Parts list page depends on your settings on the R1 export page.

### 9.13.4 Cabinets section



Cab.	Line/Arc	LeveldB	RFC	Link cabinets	Channel name	Device	Output mode	Ch.	CAN Ch.	ID
1	Line	0.0	1	J8	Inner L1	D12	2-Way Active	A/B	A	0.01
2	Line	0.0	1	J8	Inner L2	D12	2-Way Active	A/B	A	0.02
3	Line	0.0	1	J8	Inner L3	D12	2-Way Active	A/B	A	0.03
4	Line	0.0	1	J8	Inner L4	D12	2-Way Active	A/B	A	0.04
5	Line	0.0	1	J8	Inner L5	D12	2-Way Active	A/B	A	0.05

#### Link cabinets



Clicking the Link cabinets button at the top of the Cabinets section of a particular array links the recommended number of cabinets to one amplifier channel for the whole of this array. Alternatively, clicking the link button that is located next to an individual cabinet assigns this cabinet to the amplifier channel above and no entry will be created for it in the R1 device list.

#### Channel name



By default, the system suggests a channel name determined by the name of the source of which the respective cabinet is a part and the specific position of the cabinet within the array or the group of point sources. This name can be edited.

## Device

### Device

The default device is the D80 amplifier. You can select the D12 or D6 amplifiers for the loudspeakers that are supported by the D12 or D6.

## Output mode

### Output mode

For a D80, the Output mode can be set for each of the two channel pairs (A/B and C/D). Make sure that the same Output mode is set for all the channels of a single D80. The same applies to D12/D6 amplifiers and their two channels.

## Channel (Ch.)

Select amplifier channel A, B, C or D of a D80/D12/D6 or a pair of them when the Output mode is 2-Way Active.

## CAN channel (CAN Ch.)

Select the R1 CAN interface channel (i.e. the actual physical interface) to which the device will be connected. The default setting is CAN interface channel A. This option is no longer relevant when using R1 V2 and is deactivated automatically when using at least one D80 amplifier in the project.

## Remote ID (ID)

Set the Remote-ID of the device. When editing an ID, make sure the ID is unique. For 2-way active cabinets, the D80 amplifier is configured automatically. For passive cabinets, select an appropriate Output mode. Depending on the cabinet and amplifier used, it is possible to use one channel for more than one cabinet even on different arrays.

If only a single channel of an amplifier is assigned, the remaining channels is set to LINEAR mode and added to the Unused channels section at the bottom of each array.

**Note:** When you press CTRL+ENTER (CMD+ENTER for Mac OS X systems) while the cursor is placed on an ID field, the system automatically moves the cursor to the next ID field in the row below and increments this particular ID based on the ID specified in the field above.

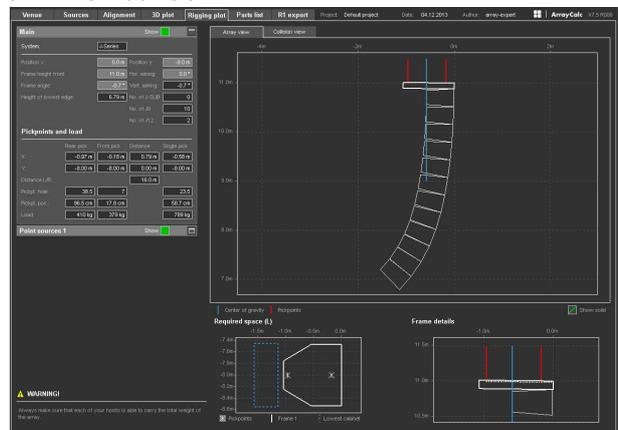
### 9.13.5 Additional devices for R1 export

Here you can add amplifiers for d&b loudspeakers that are not part of the particular ArrayCalc setup. Define the number of remote groups required and then add devices to each group. The name of a group may be edited by clicking in the appropriate edit field.

**Note:** Please note that changing the name of a group will reset all channel names to a default value based on the given new name of the group.

## 9.14 Rigging plot page

An additional page that displays all mechanical information such as weights, load conditions, rigging points and dimensions of line arrays. A rigging plot with this information for each array in the project should be made available beforehand for stage and rigging planning. Rigging plot



For arrays, the Array view shows the overall shape of the array, its required overall space and frame details.

The Collision view diagram gives an overview of all sources selected including the overall clearance needed for each source. A possible collision during setup can be seen here, as well as the absolute positioning of sources in the room.

The dialog of an array shows the exact x/y coordinates of the rigging points of each selected array, their relative distances in x and y directions, the position of possible single pickpoint support, and the individual pickpoint loads of each array.

The dialog of a point source group shows the x/y coordinates of each point source of that particular group.

## Print options

You can print out two different views of the rigging plot: either with detailed data of the selected array or as an overview plot including all coordinates of the rigging points, their relative distances and the loads of all arrays in the project. If the number of arrays/groups of point sources in the project exceeds 7, the printout extends over more than one page.

## V Flying adapter

A V array with no more than four V-TOP cabinets allows the optional use of the Z5385 V Flying adapter. If this is possible for a selected array, the closest pickpoint hole and the exact (theoretical) distance in cm/in is displayed in the array data section.

## Q Flying adapter

A Q array with no more than three Q-TOP cabinets allows the optional use of the Z5156 Q Flying adapter. If this is possible for a selected array, the closest pickpoint hole and the exact (theoretical) distance in cm/in is displayed in the array data section.

## 9.15 Parts list page

ArrayCalc generates a parts list including all cabinets and rigging components that are required for the specified single or symmetrical arrays defined in the project. Also included are the designed SUB array and the cabinets used for the groups of point sources or columns. The number of amplifiers is available once you have assigned the cabinets to the amplifier channels on the R1 export page.

## 9.16 Ground stacked setups



### WARNING!

**Potential risk of personal injury and/or damage to materials.**

Ground stacked arrays must be secured to avoid either possible movement or tipping over.

When a stacked configuration is selected, the array design will be reversed. Subwoofers will be placed as lowest cabinets. A maximum of 8 cabinets can be selected.

As the Flying frame has to be mounted horizontally, the aiming of the cabinets has to be performed with the help of splay angles only, starting with the lowest J/V/Q/T cabinet. There is no Auto splay algorithm available. The height of the system is defined by the stage height and the number of subwoofers.

GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
6	V8	0.0	Arc	---	3.0°	0.0°
5	V8	0.0	Arc	---	1.0°	2.0°
4	V8	0.0	Arc	---	-3.0°	4.0°
3	V8	0.0	Arc	---	-7.0°	4.0°
2	V-SUB	0.0	---	---	0.0°	0.0°
1	V-SUB	0.0	---	---	0.0°	0.0°

### Splay setting of the lowest cabinet

J and V-Series arrays are always mounted on their appropriate Flying frames. The angle options for the lowest cabinet are  $-3^{\circ}/0^{\circ}/+3^{\circ}$  for J-Series and  $-7^{\circ}/-3.5^{\circ}/0^{\circ}/+3.5^{\circ}/+7^{\circ}$  for V-Series and are set in the "Splay to frame/SUB" cell.

Array Calc assumes the use of a standard flying frame between SUBs and TOPs. If you use other accessories (e.g. Z5386 V Stack adapter), please consider the actual number of splay angles available. In this case, the difference in height must be compensated by modifying the "stage/riser height" accordingly.

With Q1 and T10 arrays the splay value below cabinet no.1 represents the setting according to the scale on the splay link / cabinet.

When Q Tops are stacked on the Q Flying frame, a value of  $8^{\circ}$  results in the cabinet aiming horizontally ("0 to frame"). However, when stacked on a Q-SUB cabinet the actual splay angle between these cabinets has an offset of  $6^{\circ}$ . The setup is best adjusted while watching the absolute angles of the Q1 cabinets.

When T10 arrays are stacked on a T-Series Flying frame, the splay angle of the lowest cabinet can only be set to  $-2^{\circ}$  or  $0^{\circ}$ .

When T10 arrays are stacked on a T-SUB cabinet, the splay angle of the lowest cabinet can be set to  $-2^{\circ}$ ,  $-1^{\circ}$ ,  $0^{\circ}$ ,  $+1^{\circ}$ ,  $+2^{\circ}$ ,  $+3^{\circ}$ ,  $+4^{\circ}$  or  $+6^{\circ}$ .

When T10 arrays are stacked on a T-Series base plate, the splay angle of the lowest cabinet can range from  $-8^{\circ}$  to  $+5^{\circ}$  ( $1^{\circ}$  increments).

With ground stacked systems the low/mid SPL curve generally shows an increase at the very front when approaching the stack. Creating a similar curve for the high/mid frequencies is not advised as to achieve this the cabinets would have to be placed at the level of the listeners' ears. This would create dangerous sound pressure levels at the front, and would not reach the audience at the rear.

## 9.17 System tuning

The most convenient way to finalize system tuning is to use the d&b Remote network with the R1 software.

## 9.18 Arc and Line configurations

For J-, V-, Q- and T-Series loudspeakers the d&b amplifiers provide two different configurations each and they are set depending on the mechanical design of the array. The Arc (Q1: standard) configuration is applied when the speakers are used in curved array sections while the Line configurations are used for groups of four or more loudspeakers when coupled to form a long throw array section.

Compared to the Arc (Q1: standard) configuration the Line setting uses different CPL attenuation functions reducing the upper midrange to compensate for the extended near field effect of the straight array section.

With more than two consecutive splay settings of 0° or 1° (V, Q1 and T10: 0°, 1° or 2°; 10AL(-D): 0°, 1°, 2° or 4°), the Line setting should be used for the respective cabinets. All the other cabinets should be operated using the Arc (Q1: standard) configuration.

The transition from Line to Arc/standard configuration within the array is made according to the splay progression but certain deviations may be permitted due to the grouped wiring of the cabinets.

You can select the configuration for each individual cabinet in the array settings dialog.

### 9.19 CUT circuit

Set to CUT, the low frequency level is reduced. The source is now configured for use with the system's dedicated subwoofers. The CUT circuit must be set consistently within a source.

You can activate the CUT function using the CUT group control in the array / point source settings dialog.

### 9.20 CPL circuit

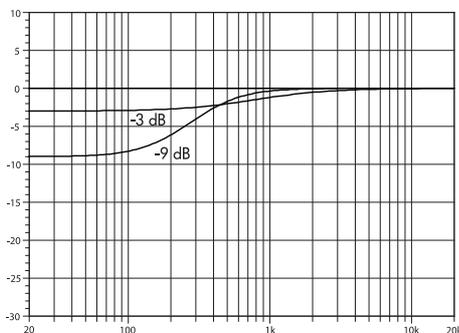
The CPL (Coupling) circuit compensates for coupling effects between the cabinets by reducing the low and mid frequency level.

You can activate the CPL function using the CPL group control in the array / point source settings dialog.

### J and V-Series

The CPL function should be applied when J or V-TOP cabinets are used in arrays of six (J) or four (V) or more cabinets. As coupling effects change with the length and curvature of the array, the CPL function differs between Arc and Line setup. Its design enables (and requires) a common setting of dB attenuation values between 0 and -9 dB to be applied to the entire array. CPL begins gradually below 2 kHz, with the maximum attenuation below 100 Hz. At higher attenuation values the corner frequency of the filter shifts towards lower values.

The principal function of the CPL circuit for J-Series cabinets is shown in the diagram below. Please note that all cabinets within a column must be operated at the same CPL setting.

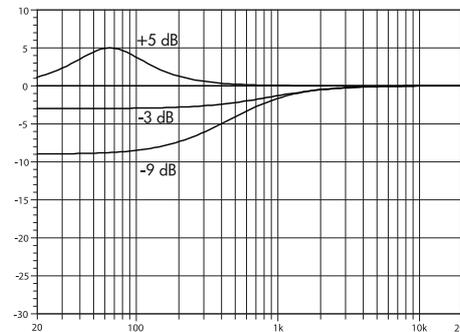


Frequency response correction of the J-Series CPL circuit

### Q, T and xA-Series

The Q, T and xA-Series CPL circuits work in a similar way, however the filter corner frequency shifts differently according to the attenuation to comply with the different system dimensions and curving possibilities. CPL can be set between +5 and -9 dB.

Positive CPL values (not supported by ArrayCalc) produce a low frequency boost. This is useful when small arrays without additional subwoofers are used for full-range coverage. Positive CPL will reduce system headroom.



Frequency response correction of the Q-Series CPL circuit

### CPL for point sources

For point sources, CPL compensates for coupling effects resulting from cabinets mounted close to acoustic boundaries, such as walls or rigid ceilings.

### 9.21 Air absorption and HFC circuit

In addition to the overall loss of sound pressure with increasing distance, a certain amount of the acoustic energy is absorbed by air. This effect follows a quite complex function of mainly frequency, humidity and temperature.

When the Air Absorption switch is activated, ArrayCalc calculates this effect for selectable temperature and humidity values. To define the temperature units, click Extras-Options and choose between degrees Celsius and Fahrenheit under Units. The relative humidity can be specified in 4 steps: "dry-20 %", "low-40 %", "std-60 %" and "high-80 %".

Note that in reality there is not much point in specifying humidity values in more detail based on readings taken at one position within an audience area. In almost all cases, this only pretends a high accuracy since these conditions strongly vary with height above an audience and that's where the sound has to pass through.

When air absorption calculation is selected, you can set the HFC (high frequency compensation) switches and their settings will be taken into account in the frequency response and headroom simulation of the respective cabinets. When you switch off the air absorption calculation, the settings for the cabinets will be kept and the HFC drop-down lists will be disabled. In this case, the HFC settings will not be taken into account. That means, by switching the air absorption calculation on or off, you can verify a useful compensation for the individual amplifier channels when observing the changes in the high frequency level calculations.

When wiring the cabinets in a column keep in mind that all cabinets linked to one amplifier will be operated at the same amplifier settings.

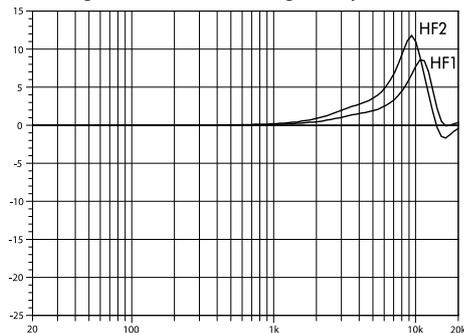
The HFC circuits of the J, T and xA-Series configurations have two settings (HF1, HF2) for the different zones that the cabinets have to cover. The settings should be used selectively depending on the particular requirements.

Series	HFC1	HFC2
J	40 m	80 m
V	30 m	60 m
Q	30 m	-
T	25 m	50 m
xA	25 m	50 m

#### Overview of HFC distance compensation

At lower humidity values absorption by air increases therefore the distances at which the respective HFC settings provide a correct equalization will be shorter.

The HFC2 compensation in the J8/J12, V8/V12, T10 and 10AL(-D) Line setups include a bandwidth limitation to approx. 10 kHz to keep the necessary boost within meaningful limits not wasting the system's headroom.



Example of frequency response correction of the HFC circuits

## 9.22 Time alignment

Within a line array column it is absolutely essential to maintain perfect time alignment, otherwise the whole principle of creating a coherent wavefront will fail. Therefore, all amplifiers used to drive one column must be fed from the same input signal. Should a delay for the complete line array be necessary, the delay function in the amplifier channels can be used. The setting must be identical for all amplifier channels used in the column.

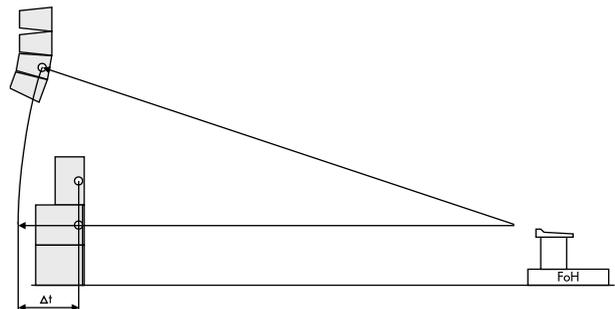
### 9.22.1 Subwoofers

A correct time alignment of subwoofers to the main line array is very important. If the required delay settings cannot be calculated using ArrayCalc (unknown geometry of the setup, unknown latency of devices in the signal chain), an acoustic measurement system should be used.

The signal arrival at the FoH position can be used as a reference for time alignment.

In the following example the subwoofer amplifiers have to be set to a delay time of  $\Delta t$ , equivalent to the physical offset  $\Delta x$  divided by the speed of sound (343 m/s or 1126 ft/s).

$$\Delta t = \frac{\Delta x}{v_{\text{sound}}}$$



#### Time alignment of ground stacked cabinets

**Note:** An automatic time alignment using impulse responses - sometimes called "delay finder" - cannot provide correct results when systems cover different frequency bands, as this is the case with line array cabinets and subwoofers.

Therefore use the response of the flown array and a full-range speaker placed on top of the subwoofer (e.g. nearfill) to determine the delay setting.

### 9.22.2 Nearfills

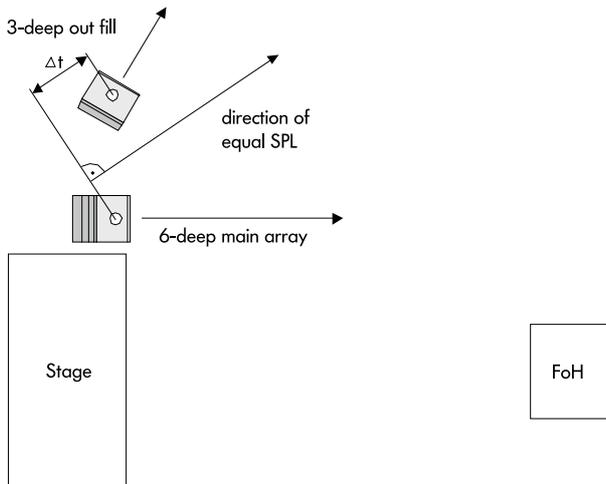
If nearfill loudspeakers are placed on top of subwoofer cabinets, the respective amplifier channels have to be set to the same delay value as the subwoofer.

When applying SUB arrays with extensive delay settings to form the wavefront, equal delay settings of nearfill speakers placed on top of the subwoofers may not allow for correct source imaging in some positions. In this case, the correct timing of the nearfill speaker is of greater importance and a possible local phase mismatch to the subwoofer is acceptable.

### 9.22.3 Horizontal array

If multiple J/V/Q/T-Series columns or any combination of them are used per side, the arrays should be time-aligned at a meaningful position around the direction where both produce equal level. Use ArrayCalc's Alignment page to perform the alignment (refer to section 9.11 Alignment page on page 34).

Should the procedure result in additional delay for the array selected for the subwoofer alignment, make sure this is compensated for in the delay settings for the SUB array. To measure the delay setting between subwoofers and main column on site turn off the outfill column.



**Time alignment of a horizontal array**

### 9.23 Equalization

If additional equalization of the system is required, use the d&b amplifier's 4-band fully parametric equalizer. It is important when applying the equalization that all channels are set identically within one column. Using the d&b Remote network and the R1 remote software the amplifier channels and their equalizers can be operated in user-defined functional groups, such as array, subwoofers, or outfill. Please refer to T1 391 "Effective use of R1" which is available for download from the d&b audiotechnik website at [www.dbaudio.com](http://www.dbaudio.com).

Using the amplifier's parametric equalizer for the system EQ provides the sound engineer with a flat FoH EQ for his personal sound design.

## 10. ArrayCalc setup examples

The following plots show a selection of J, V, Q, T and xS/xA-Series array setups for different array sizes and venues.

All these and additional project files can be accessed for further evaluation and modification. To open an example project, select 'Open example project' from the File menu.

## 10.1 T-Series setup examples

Project: T-Series example 1 Date: 09.01.2014 Author: array-expert ArrayCalc X7.5 R008

Venue Sources Alignment 3D plot Rigging plot Parts list R1 export

### Project settings

**Main**

System: T-Series Mounting: flown

Position x: 0.0 m Position y: 6.0 m

Frame height front: 4.0 m No. of cabinets: 3

Horizontal aiming: 10.0°

Frame angle: -4.7°

Delay (abs.): 0.3 ms

**TOPs**

CUT: CPL: 0

Level (rel):

**All cabinets**

GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
1	T10	0.0	Arc	-	-4.7°	0.0°
2	T10	0.0	Arc	-	-10.7°	6.0°
3	T10	0.0	Arc	-	-23.7°	13.0°

**SUB array**

### Load

Load OK 15% of load limit  
within BGV-C1 limits

Total weight: 45 kg

Single pickpt. hole no/pos: 13.5 19.9 cm

Height of lowest edge: 3.34 m

### Main: Array view

Center of gravity Pickpoints

Rear pick: 22 Front pick: 1

Pickpt. hole: Load: 26 kg 18 kg

### Comments

3xT10 flown or on T cluster bracket  
2xB4-SUB

### Top view

### Main: Profile at 10° aiming

### Direct sound level vs. distance / dB SPL

Resolution: std

Signal selection

Level (dBu): 0.0

Curve 1: 4000 Hz

Curve 2: 250 Hz

T-Series setup example 1, Arrays: 3 x T10 flown or on T cluster bracket, 2 x B4-SUB

Project: T-Series example 3 Date: 09.01.2014 Author: array-expert ArrayCalc X7.5 R008

Venue Sources Alignment 3D plot Rigging plot Parts list R1 export

### Project settings

**Main**

System: T-Series Mounting: flown

Position x: 0.0 m Position y: 8.0 m

Frame height front: 8.0 m No. of cabinets: 8

Horizontal aiming: 0.0°

Frame angle: -7.0°

Delay (abs.): 2.5 ms

**TOPs**

CUT: CPL: -2

Level (rel):

**All cabinets**

GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
1	T10	0.0	Arc	-	-7.0°	0.0°
2	T10	0.0	Arc	-	-9.0°	2.0°
3	T10	0.0	Arc	-	-12.0°	3.0°
4	T10	0.0	Arc	-	-16.0°	4.0°
5	T10	-2.0	Arc	-	-22.0°	6.0°
6	T10	-2.0	Arc	-	-29.0°	7.0°
7	T10	-2.0	Arc	-	-39.0°	10.0°
8	T10	-2.0	Arc	-	-51.0°	12.0°

**SUB array**

### Load

Load OK 40% of load limit  
within BGV-C1 limits

Total weight: 101 kg

Single pickpt. hole no/pos: 22.25 32.4 cm

Height of lowest edge: 6.50 m

### Main: Array view

Center of gravity Pickpoints

Rear pick: 33 Front pick: 1

Pickpt. hole: Load: 67 kg 33 kg

### Comments

8xT10 flown, flat field  
8xB4 Sub Array

### Top view

### Main: Profile at 0° aiming

### Direct sound level vs. distance / dB SPL

Resolution: std

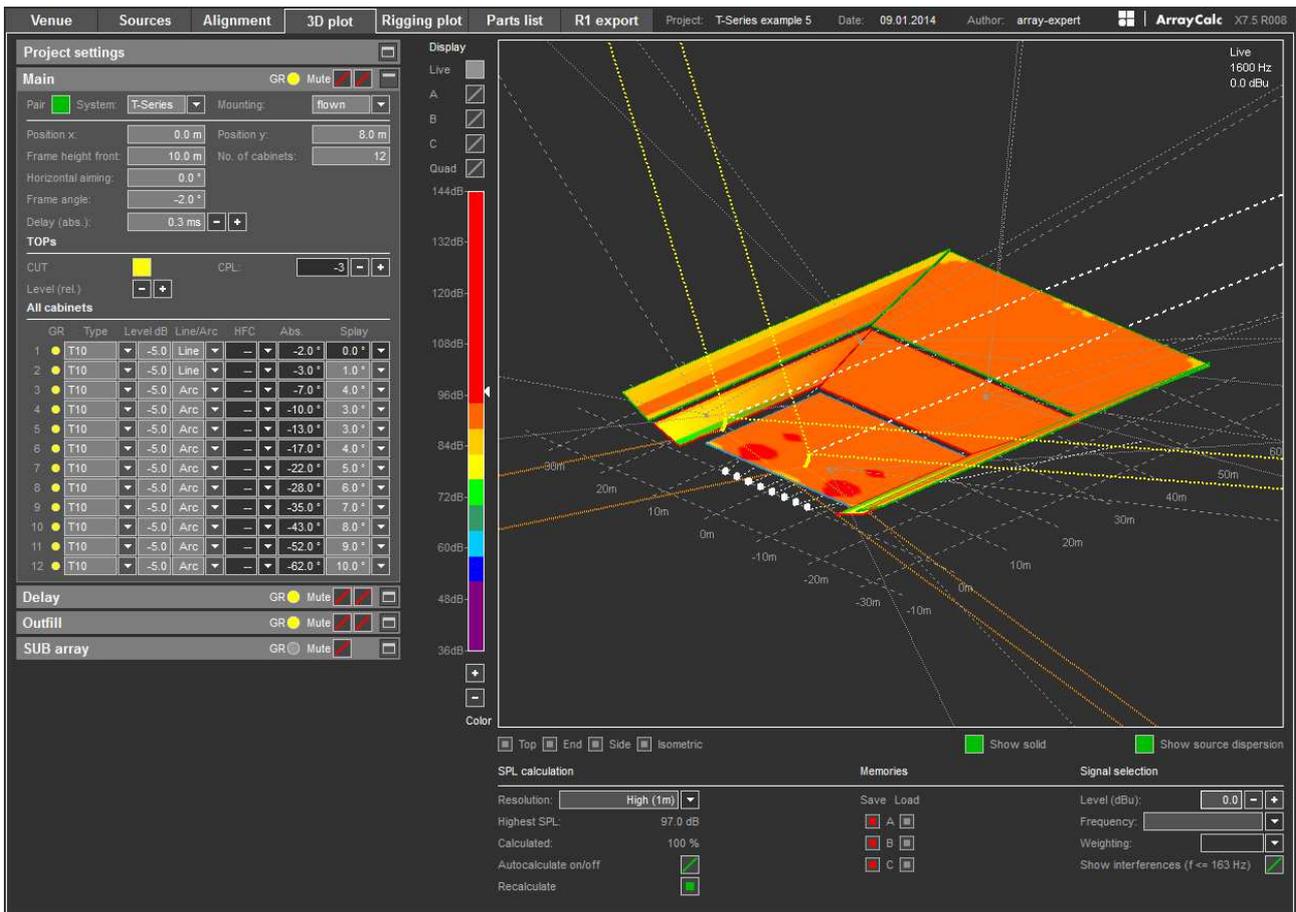
Signal selection

Level (dBu): 0.0

Curve 1: 4000 Hz

Curve 2: 250 Hz

T-Series setup example 3, Arrays: 8 x T10 flown, flat field, 8 x B4 SUB array



**T-Series setup example 5, 3D plot: 12 x T10 flown, Arena type venue, 4 x T10 Delay, 3 x T10 Outfill, 8 x B4-SUB array**

## 10.2 Q-Series setup examples

Project: Q-Series example 3 Date: 09.01.2014 Author: array-expert ArrayCalc X7.5 R008

**Project settings**

**Main**

System: Q-Series Mounting: frown

Position x: 0.0 m Position y: 10.0 m

Frame height front: 11.0 m No. of cabinets: 7

Horizontal aiming: -5.0°

Frame angle: 3.2°

Delay (abs.): 0.3 ms

**TOPs**

CUT: CPL: -2

Level (rel.): +

**All cabinets**

GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
1	Q1	0.0	Arc	-	3.2°	0.0°
2	Q1	0.0	Arc	-	-0.8°	4.0°
3	Q1	0.0	Arc	-	-6.8°	6.0°
4	Q1	0.0	Arc	-	-12.8°	6.0°
5	Q1	-1.0	Arc	-	-21.8°	9.0°
6	Q1	-1.0	Arc	-	-33.8°	12.0°
7	Q7	-2.0	-	-	-47.8°	14.0°

**SUB array**

GR Mute

**Load**

Load OK 34% of load limit  
within BGV-C1 limits

Total weight: 175 kg

Single pickpt. hole no/pos: 13.75 33.0 cm

Height of lowest edge: 8.95 m

**Main: Array view**

Center of gravity Pickpoints

Rear pick: 27 Front pick: 1

Load: 85 kg 89 kg

**Top view**

**Main: Profile at -5° aiming**

**Direct sound level vs. distance / dB SPL**

Resolution: std

**Comments**

6xQ1 1xQ7 theatre with balcony  
8 x B4-SUB array

**Signal selection**

Level (dBu): 0.0

Curve 1: 1000 Hz

Curve 2: 500 Hz

Q-Series setup example 3, Arrays: 6 x Q1, 1 x Q7 Theater with balcony, 8 x B4-SUB array

Project: Q-Series example 3 Date: 09.01.2014 Author: array-expert ArrayCalc X7.5 R008

**Project settings**

**SUB array**

SUB-systems: B4-SUB

**Layout**

No. of positions (...51): 8 Symmetric

Equally spaced along: 18.0 m

At x = 1.0 m Apply

Source spacing: 2.6 m

Max. freq. for pattern control: 80 Hz

Delay for nom. dispersion of: 80° Apply

Reset: Level + delays All

**Cabinet setup**

100Hz

Level (rel.): + Delay (rel.): 1.2 ms

GR No.	Type	Lev/dB	x	y	Rot.	Delay	Total dly
R4	1 B4-SU	0.0	1.0 m	9.0 m	20°	7.9 ms	9.1 ms
R3	1 B4-SU	0.0	1.0 m	6.4 m	10°	2.5 ms	3.7 ms
R2	1 B4-SU	0.0	1.0 m	3.9 m	0°	1.0 ms	2.2 ms
R1	1 B4-SU	0.0	1.0 m	1.3 m	0°	0.3 ms	1.5 ms
L1	1 B4-SU	0.0	1.0 m	-1.3 m	0°	0.3 ms	1.5 ms
L2	1 B4-SU	0.0	1.0 m	-3.9 m	0°	1.0 ms	2.2 ms
L3	1 B4-SU	0.0	1.0 m	-6.4 m	-10°	2.5 ms	3.7 ms
L4	1 B4-SU	0.0	1.0 m	-9.0 m	-20°	7.9 ms	9.1 ms

**SPL mapping / 6 dB per division**

Simulated frequency: 50 Hz Show disp. of: none

**Free and far field polar pattern**

40 Hz 50 Hz 63 Hz 80 Hz

**Comments**

6xQ1 1xQ7 theatre with balcony  
8 x B4-SUB array

Q-Series setup example 3, SUB array: 6 x Q1, 1 x Q7 Theater with balcony, 8 x B4-SUB array

Venue Sources Alignment 3D plot Rigging plot Parts list R1 export Project: Q-Series example 5 Date: 09.01.2014 Author: array-expert **ArrayCalc** X7.5 R008

### Project settings

**Main** GR Mute

**Outfill** GR Mute

**Center Q7** GR Mute

**SUB array** GR Mute

SUB systems: J-SUB

Layout

No. of positions (...): 8  Symmetric

Equally spaced along: 16.0 m

At x = 2.0 m  Apply

Source spacing: 2.3 m

Max. freq. for pattern control: 90 Hz

Delay for nom. dispersion of: 70°  Apply

Reset:  Level + delays  All

**Cabinet setup**

INFRA  HCD

Level (rel.)  Delay (rel.): 4.7 ms

GR No.	Type	Levl dB	x	y	Rot.	Delay	Total dly
R4	1 J-SUB	0.0	2.0 m	8.0 m	25°	6.2 ms	10.9 ms
R5	1 J-SUB	0.0	2.0 m	5.7 m	15°	2.3 ms	7.0 ms
R2	1 J-SUB	0.0	2.0 m	3.4 m	0°	1.0 ms	5.7 ms
R1	1 J-SUB	0.0	2.0 m	1.1 m	0°	0.3 ms	5.0 ms
L1	1 J-SUB	0.0	2.0 m	-1.1 m	0°	0.3 ms	5.0 ms
L2	1 J-SUB	0.0	2.0 m	-3.4 m	0°	1.0 ms	5.7 ms
L3	1 J-SUB	0.0	2.0 m	-5.7 m	-15°	2.3 ms	7.0 ms
L4	1 J-SUB	0.0	2.0 m	-8.0 m	-25°	6.2 ms	10.9 ms

### Top view

Test point ■ x: 18.7 m y: -18.5 m z: 1.7 m

Current plane: \_\_\_\_\_

### Arrival times

(use CTRL key for coarse increments)

Source	Mute	Delay
Main	<input checked="" type="checkbox"/>	0.3 ms
Outfill	<input checked="" type="checkbox"/>	1.1 ms
Center Q7	<input checked="" type="checkbox"/>	7.8 ms

All sources to SUB array (rel.)

Delay SUB array: (rel.) 4.7 ms

### Alignment SUB array

Main: Profile at 0° aiming

Test point ● x: 32.4 m y: -8.0 m z: 1.7 m

### Phase response against (L)

Main  SUB array  (distance-compensated)

**Q-Series setup example 5, Alignment: 15 x Q1, Arena, 6 x Q1 Outfill, 1 x Q7 Center, 8 x J-SUB SUB array**

### 10.3 V-Series setup examples

Venue Sources Alignment 3D plot Rigging plot Parts list R1 export Project: V-Series example 3 Date: 09.01.2014 Author: array-expert ArrayCalc X7.5 R008

#### Project settings

**Main**

Pair:  System: V-Series Mounting: frown

Position x: 0.0 m Position y: 10.0 m

Frame height front: 11.0 m No. of cabinets: 8

Horizontal aiming: -5.0°

Frame angle: 3.2°

Delay (abs.): 0.3 ms

**TOPs**

CUT:  CPL: -2

Level (rel.):

**All cabinets**

GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
1	V8	0.0	Arc	-	3.2°	0.0°
2	V8	0.0	Arc	-	-0.8°	4.0°
3	V8	0.0	Arc	-	-6.8°	6.0°
4	V8	0.0	Arc	-	-12.8°	6.0°
5	V8	0.0	Arc	-	-19.8°	7.0°
6	V8	0.0	Arc	-	-30.8°	11.0°
7	V12	0.0	Arc	-	-42.8°	12.0°
8	V12	0.0	Arc	-	-56.8°	14.0°

**SUB array**

#### Load

Load OK 31% of load limit  
within BGV-C1 limits

Total weight: 296 kg

Single pickpt. hole no/pos: 21 38.0 cm

Height of lowest edge: 8.73 m

**Main: Array view**

Center of gravity Pickpoints

Rear pick: 40 Front pick: 1

Pickpt. hole: 152 kg 145 kg

**Comments**

6xV8 2xV12 theatre with balcony  
8 x V-SUB Array

#### Top view

**Main: Profile at -5° aiming**

**Direct sound level vs. distance / dB SPL**

Resolution: std

Level (dBu): 0.0

Curve 1: 4000 Hz

Curve 2: 500 Hz

V-Series setup example 3, Arrays: 6 x V8, 2xV12 Theater with balcony, 8 x V-SUB array

Venue Sources Alignment 3D plot Rigging plot Parts list R1 export Project: V-Series example 3 Date: 09.01.2014 Author: array-expert ArrayCalc X7.5 R008

#### Project settings

**Main**

**SUB array**

SUB systems: V-SUB

**Layout**

No. of positions (...51): 8  Symmetric

Equally spaced along: 18.0 m

At x = 1.0 m  Apply

Source spacing: 2.6 m

Max. freq. for pattern control: 80 Hz

Delay for nom. dispersion of: 80°  Apply

Reset:  Level + delays  All

**Cabinet setup**

100Hz

Level (rel.):  Delay (rel.): 1.3 ms

GR No.	Type	Lev/dB	x	y	Rot.	Delay	Total dly
R4	1 V-SUB	0.0	1.0 m	9.0 m	20°	7.9 ms	9.2 ms
R3	1 V-SUB	0.0	1.0 m	6.4 m	10°	2.5 ms	3.8 ms
R2	1 V-SUB	0.0	1.0 m	3.9 m	0°	1.0 ms	2.3 ms
R1	1 V-SUB	0.0	1.0 m	1.3 m	0°	0.3 ms	1.6 ms
L1	1 V-SUB	0.0	1.0 m	-1.3 m	0°	0.3 ms	1.6 ms
L2	1 V-SUB	0.0	1.0 m	-3.9 m	0°	1.0 ms	2.3 ms
L3	1 V-SUB	0.0	1.0 m	-6.4 m	-10°	2.5 ms	3.8 ms
L4	1 V-SUB	0.0	1.0 m	-9.0 m	-20°	7.9 ms	9.2 ms

#### SPL mapping / 6 dB per division

Simulated frequency: 50 Hz Show disp. of: none

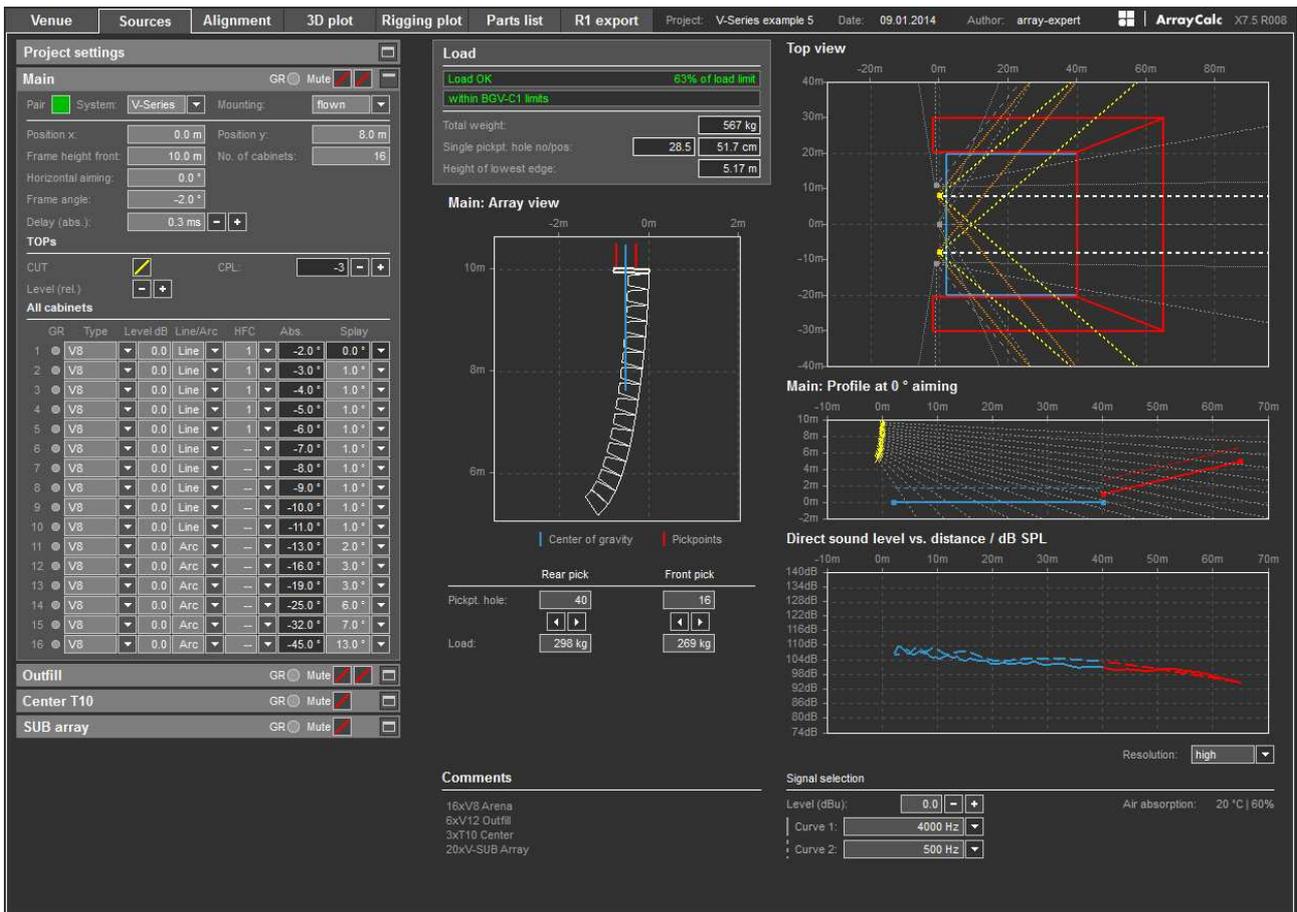
**Comments**

6xV8 2xV12 theatre with balcony  
8 x V-SUB Array

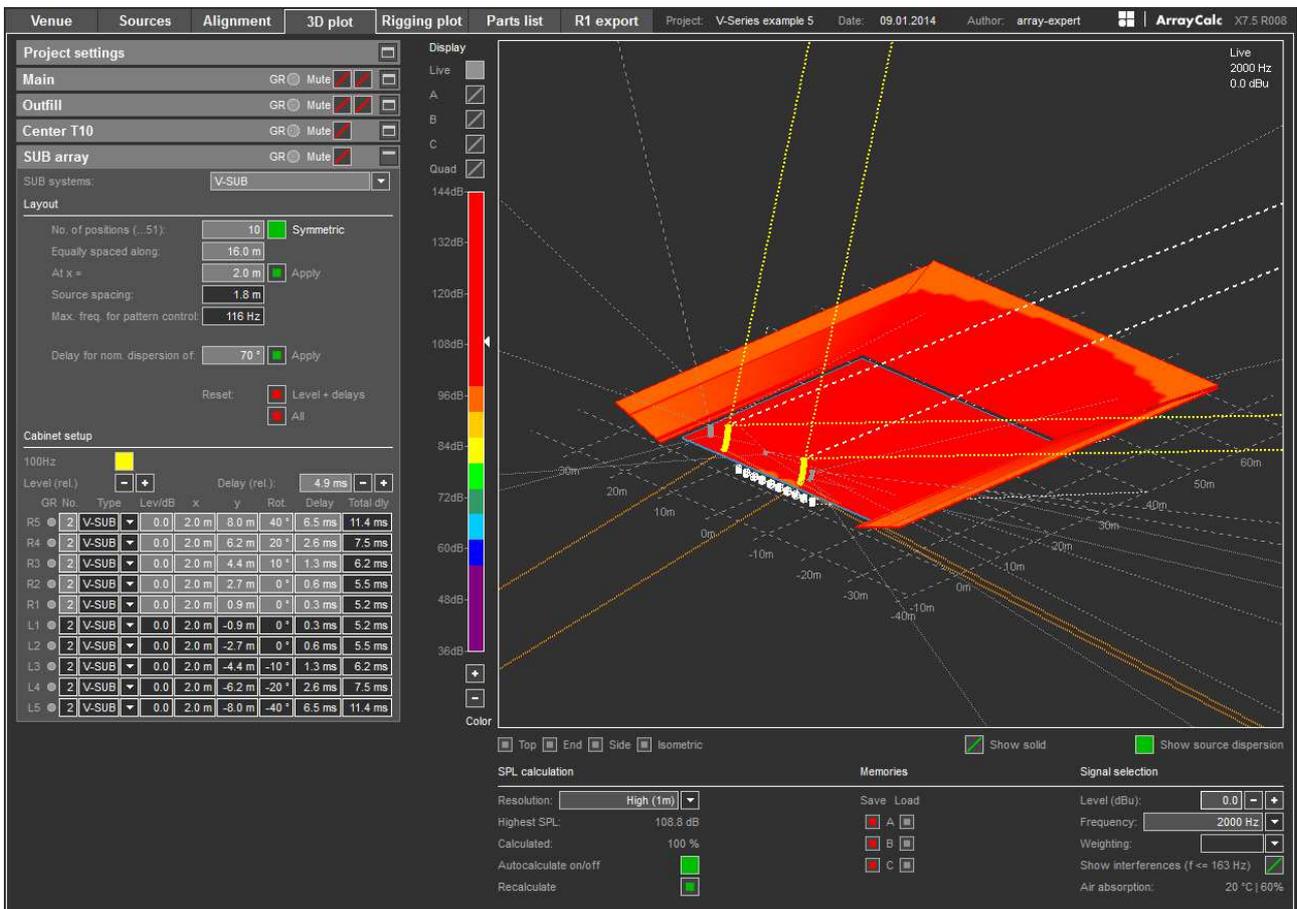
#### Free and far field polar pattern

40 Hz 50 Hz 63 Hz 80 Hz

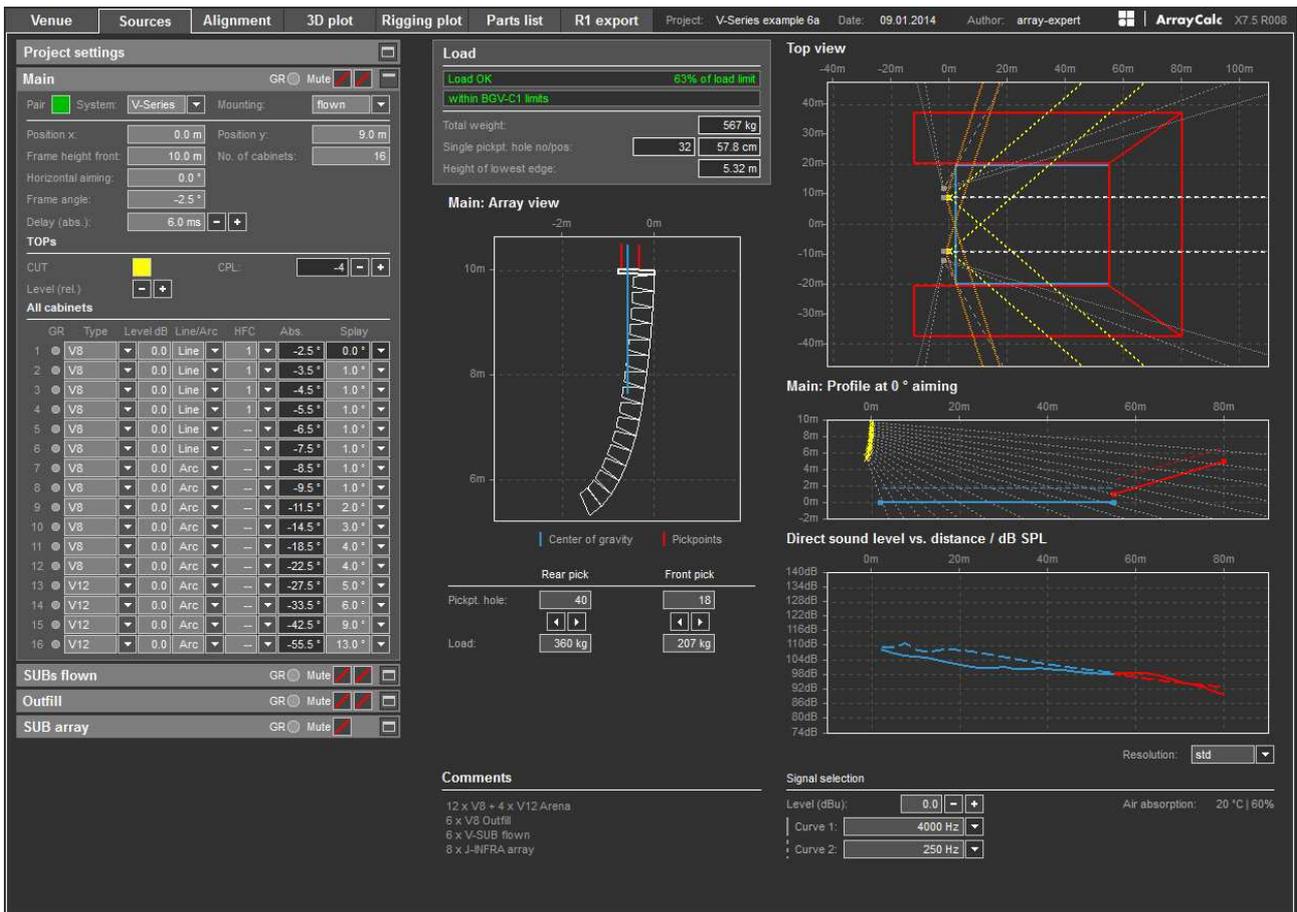
V-Series setup example 3, SUB array: 6 x V8, 2 x V12 Theater with balcony, 8 x V-SUB array



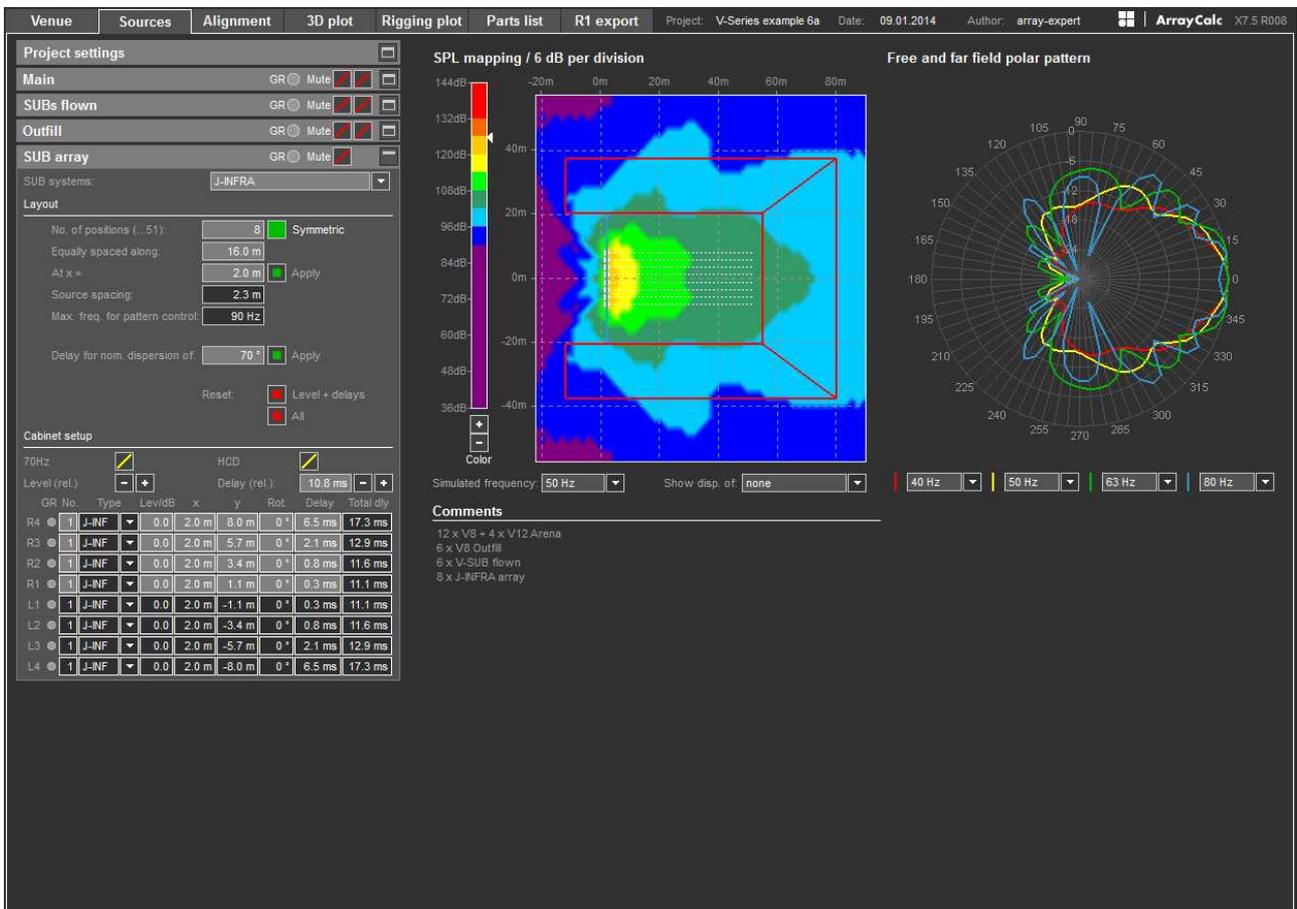
**V-Series setup example 5, array: 16 x V8, 6 x V12 outfill, 3 x T10 center, 8 x V-SUB array**



**V-Series setup example 5, 3D plot: 16 x V8, 6 x V12 outfill, 3 x T10 center, 8 x V-SUB array**

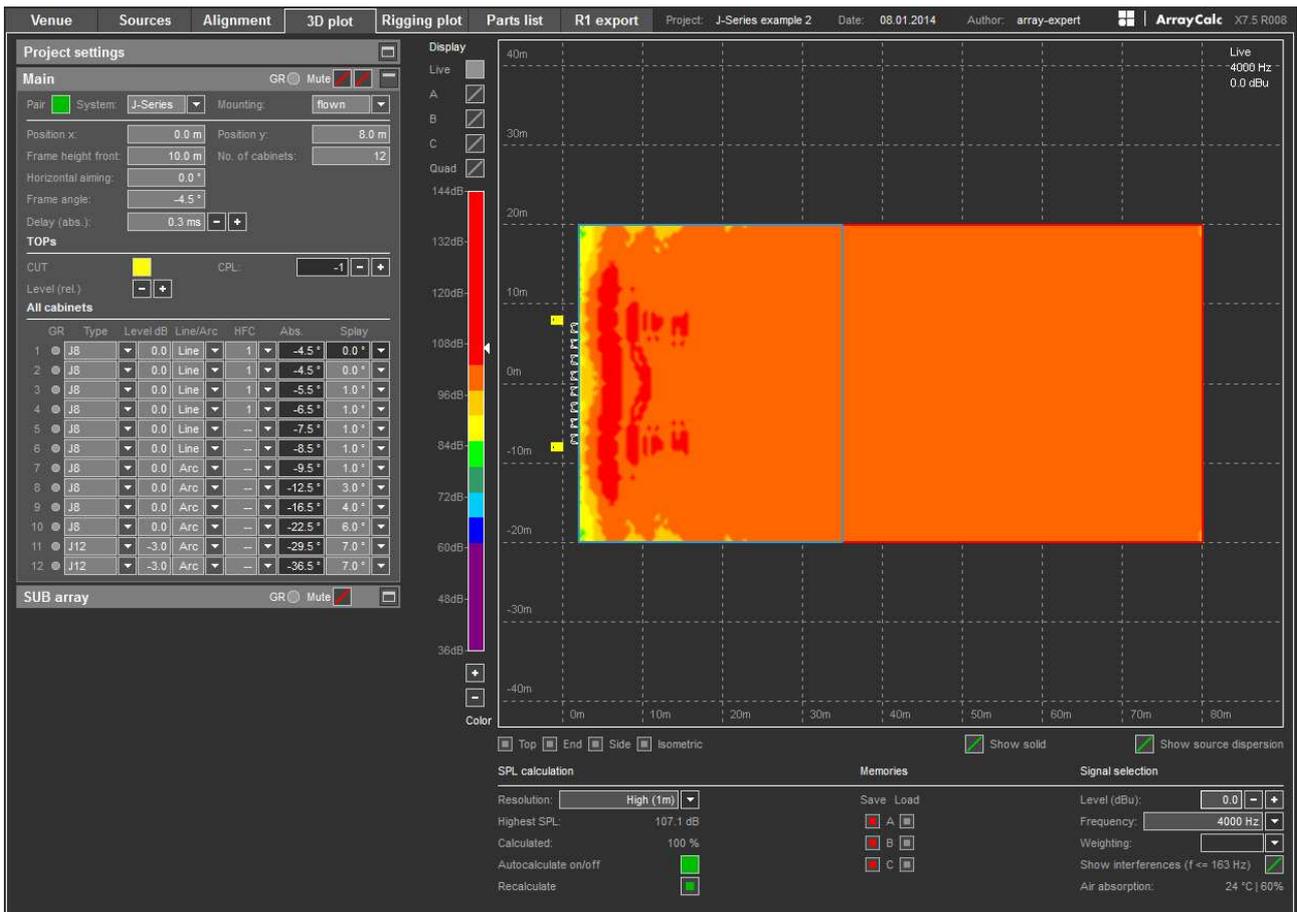


V-Series setup example 6a, array: 12 x V8 + 4 x V12 arena, 6 x V8 outfill, 6 x V-SUB flown, 8 x J-INFRA array

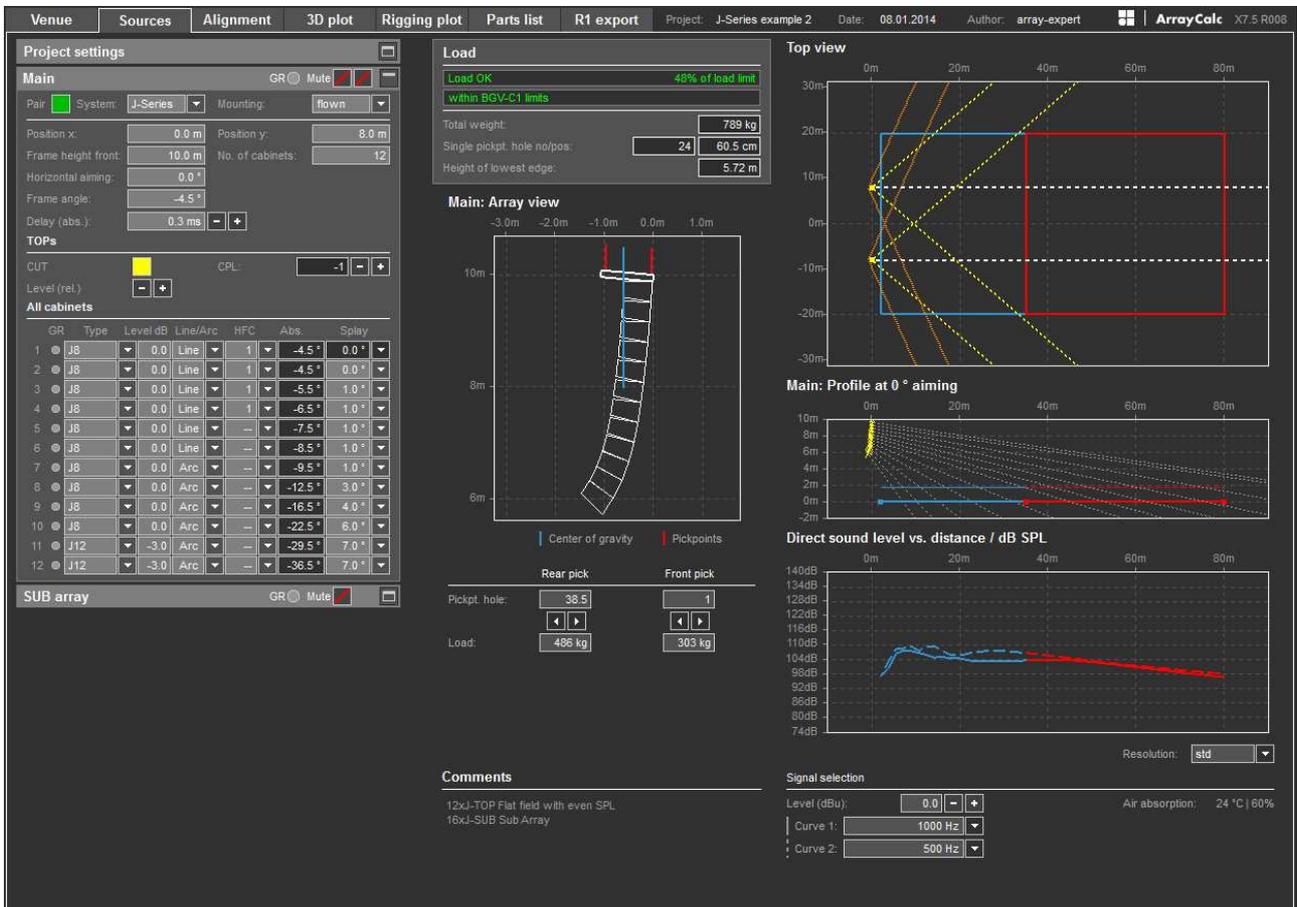


V-Series setup example 6a, SUB array: 8 x J-INFRA array

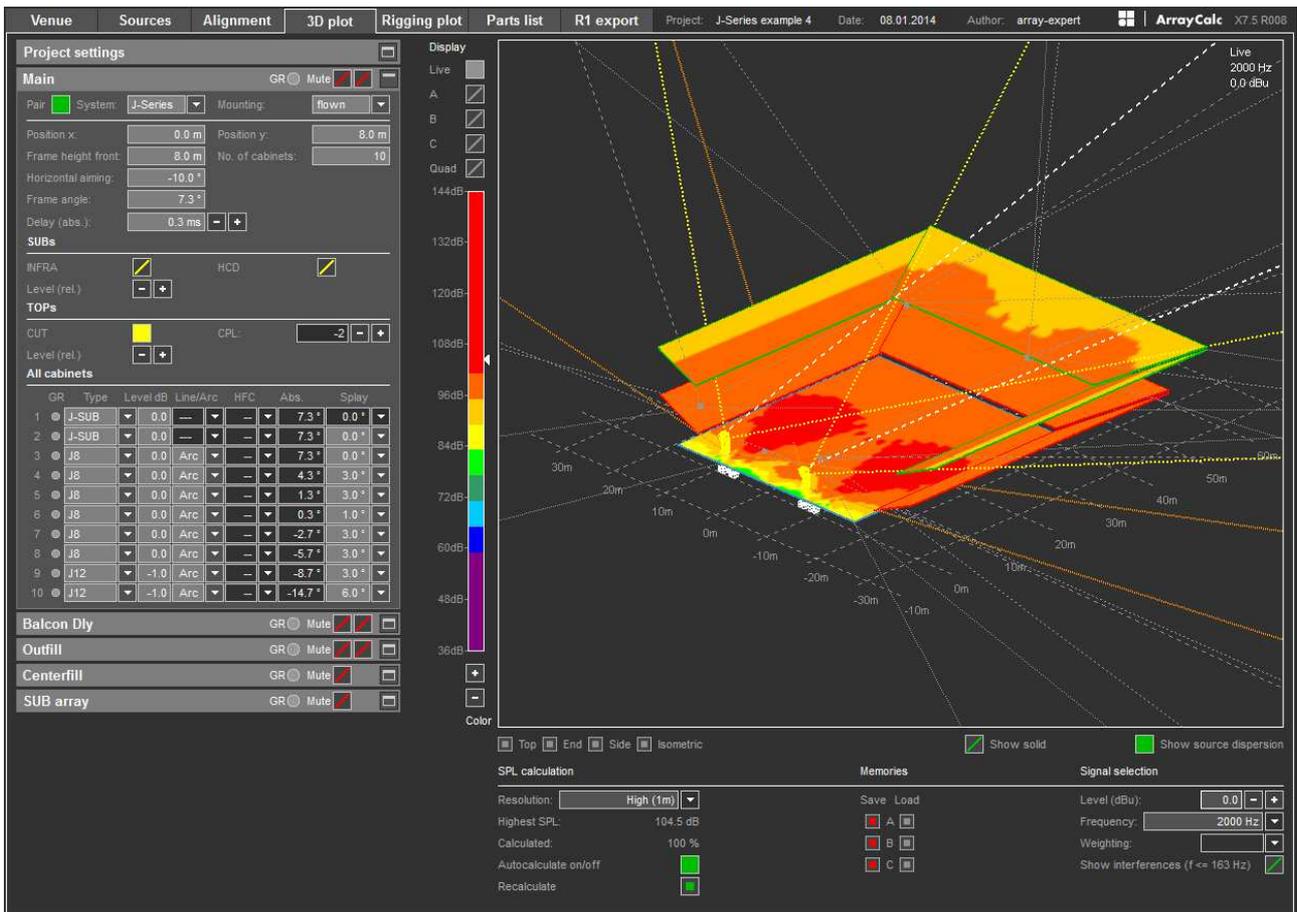
## 10.4 J-Series setup examples



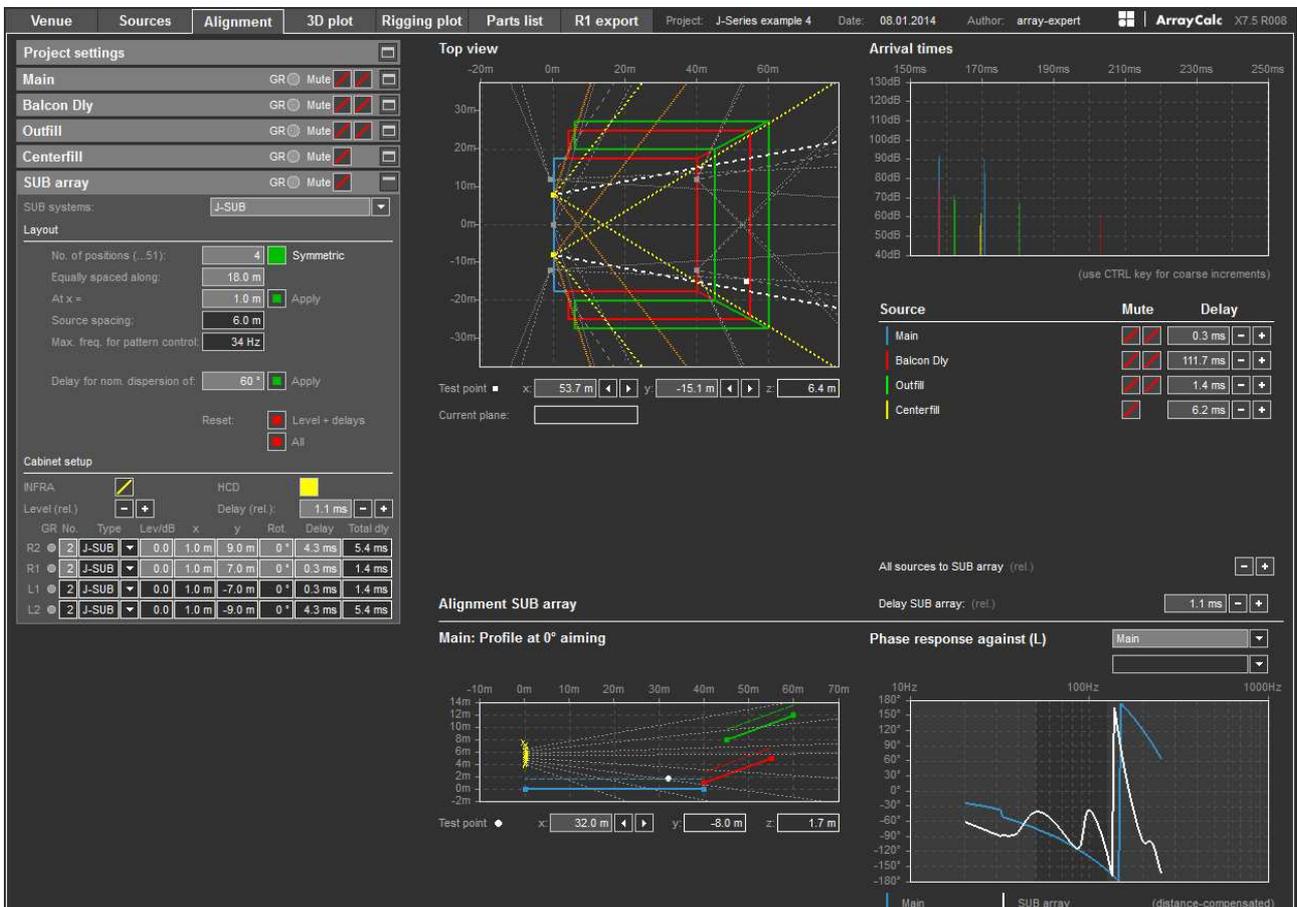
J-Series setup example 2, 3D plot: Medium flat field with very even SPL, 12 x J-TOP, 16 x J-SUB array



J-Series setup example 2, Arrays: Medium flat field with very even SPL, 12 x J-TOP, 16 x J-SUB array



**J-Series setup example 4, 3D plot: Large theater 2 x J-SUB, 6 x J8, 2 x J12 ; T-Series balcony delay, Outfill and Centerfill; J-SUB L/R rotated**



**J-Series setup example 4, Alignment: Large theater 2 x J-SUB, 6xJ8, 2 x J12 ; T-Series balcony delay, Outfill and Centerfill; J-SUB L/R rotated**

Project: J-Series example 4 Date: 08.01.2014 Author: array-expert ArrayCalc X7.5 R008

**Project settings**

**Main** GR Mute

Pair  System: J-Series Mounting: frown

Position x: 0.0 m Position y: 8.0 m

Frame height front: 8.0 m No. of cabinets: 10

Horizontal aiming: -10.0°

Frame angle: 7.3°

Delay (abs.): 0.3 ms

**SUBs**

INFRA  HCD

Level (rel.)  +

**TOPs**

CUT  CPL: -2

Level (rel.)  +

**All cabinets**

GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
1	J-SUB	0.0	---	---	7.3°	0.0°
2	J-SUB	0.0	---	---	7.3°	0.0°
3	J8	0.0	Arc	---	7.3°	0.0°
4	J8	0.0	Arc	---	4.3°	3.0°
5	J8	0.0	Arc	---	1.3°	3.0°
6	J8	0.0	Arc	---	0.3°	1.0°
7	J8	0.0	Arc	---	-2.7°	3.0°
8	J8	0.0	Arc	---	-5.7°	3.0°
9	J12	-1.0	Arc	---	-8.7°	3.0°
10	J12	-1.0	Arc	---	-14.7°	6.0°

**Balcon Dly** GR Mute

**Outfill** GR Mute

**Centerfill** GR Mute

**SUB array** GR Mute

**Load**

Load OK 51% of load limit

within BGV-C1 limits

Total weight: 826 kg

Single pickpt. hole no/pos: 8.5 / 22.0 cm

Height of lowest edge: 3.80 m

**Main: Array view**

Center of gravity | Pickpoints

Rear pick: 38.5 | Front pick: 1

Pickpt. hole: 169 kg | Load: 657 kg

**Top view**

**Main: Profile at -10° aiming**

**Direct sound level vs. distance / dB SPL**

Level (dBu): 0.0

Curve 1: 4000 Hz

Curve 2: 250 Hz

Resolution: std

**Comments**

2xJ-SUB, 6xJ8, 2xJ12 Large theatre  
T-Series balcony delay, Out- und Centerfill  
J-SUB L/R rotated

**J-Series setup example 4, Arrays: Large theater 2 x J-SUB, 6 x J8, 2 x J12 ; T-Series balcony delay, Outfill and Centerfill; J-SUB L/R rotated**

Project: J-Series example 6 Date: 09.01.2014 Author: array expert ArrayCalc X7.5 R008

**Project settings**

**Main** GR Mute

Pair  System: J-Series Mounting: frown

Position x: -1.0 m Position y: 15.0 m

Frame height front: 18.0 m No. of cabinets: 22

Horizontal aiming: -4.0°

Frame angle: 0.5°

Delay (abs.): 0.3 ms

**TOPs**

CUT  CPL: -1

Level (rel.)  +

**All cabinets**

GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
1	J8	0.0	Line	---	0.5°	0.0°
2	J8	0.0	Line	---	-0.5°	1.0°
3	J8	0.0	Line	---	-1.5°	1.0°
4	J8	0.0	Line	---	-2.5°	1.0°
5	J8	0.0	Line	---	-3.5°	1.0°
6	J8	0.0	Line	---	-4.5°	1.0°
7	J8	0.0	Line	2	-5.5°	1.0°
8	J8	0.0	Line	2	-6.5°	1.0°
9	J8	0.0	Line	2	-7.5°	1.0°
10	J8	0.0	Line	2	-8.5°	1.0°
11	J8	0.0	Line	1	-8.5°	0.0°
12	J8	0.0	Line	1	-9.5°	1.0°
13	J8	0.0	Line	1	-10.5°	1.0°
14	J8	0.0	Line	1	-11.5°	1.0°
15	J8	0.0	Line	---	-12.5°	1.0°
16	J8	0.0	Line	---	-13.5°	1.0°
17	J8	0.0	Arc	---	-15.5°	2.0°
18	J8	0.0	Arc	---	-18.5°	3.0°
19	J12	0.0	Arc	---	-22.5°	4.0°
20	J12	0.0	Arc	---	-27.5°	5.0°
21	J12	0.0	Arc	---	-33.5°	6.0°
22	J12	0.0	Arc	---	-40.5°	7.0°

**Side Hang** GR Mute

**Main Sub** GR Mute

**Side Sub** GR Mute

**Delay** GR Mute

**Dly Center** GR Mute

**Top view**

Test point: x: 25.6 m y: -47.4 m z: 0.0 m

Current plane: -

**Arrival times**

Source Mute Delay

Source	Mute	Delay
Main	<input type="checkbox"/>	0.3 ms
Side Hang	<input type="checkbox"/>	2.5 ms
Main Sub	<input type="checkbox"/>	2.2 ms
Side Sub	<input type="checkbox"/>	3.0 ms
Delay	<input type="checkbox"/>	237.2 ms
Dly Center	<input type="checkbox"/>	266.8 ms
Center	<input type="checkbox"/>	0.3 ms

All sources to SUB array (rel.)  +

Delay SUB array: (rel.) 11.7 ms  +

**Alignment SUB array**

**Main: Profile at 0° aiming**

Test point: x: 50.0 m y: -15.0 m z: 1.7 m

**Phase response against (L)**

Main | SUB array (distance-compensated)

**J-Series setup example 6, Alignment: Stadium setup**

Project settings

**Main**

System: J-Series | Mounting: flown

Position x: -1.0 m | Position y: 15.0 m

Frame height front: 18.0 m | No. of cabinets: 22

Horizontal aiming: -4.0° | Frame angle: 0.5°

Delay (abs.): 0.3 ms

**TOPs**

CUT: [ ] | CPL: -1

Level (rel): [ ]

**All cabinets**

GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
1	J8	0.0	Line	--	0.5°	0.0°
2	J8	0.0	Line	--	-0.5°	1.0°
3	J8	0.0	Line	--	-1.5°	1.0°
4	J8	0.0	Line	--	-2.5°	1.0°
5	J8	0.0	Line	--	-3.5°	1.0°
6	J8	0.0	Line	--	-4.5°	1.0°
7	J8	0.0	Line	2	-5.5°	1.0°
8	J8	0.0	Line	2	-6.5°	1.0°
9	J8	0.0	Line	2	-7.5°	1.0°
10	J8	0.0	Line	2	-8.5°	1.0°
11	J8	0.0	Line	1	-8.5°	0.0°
12	J8	0.0	Line	1	-9.5°	1.0°
13	J8	0.0	Line	1	-10.5°	1.0°
14	J8	0.0	Line	1	-11.5°	1.0°
15	J8	0.0	Line	--	-12.5°	1.0°
16	J8	0.0	Line	--	-13.5°	1.0°
17	J8	0.0	Arc	--	-15.5°	2.0°
18	J8	0.0	Arc	--	-18.5°	3.0°
19	J12	0.0	Arc	--	-22.5°	4.0°
20	J12	0.0	Arc	--	-27.5°	5.0°
21	J12	0.0	Arc	--	-33.5°	6.0°
22	J12	0.0	Arc	--	-40.5°	7.0°

**Side Hang** | **Main Sub** | **Side Sub** | **Delay** | **Dly Center**

**Load**

Load OK | 92% of load limit | within BGV-C1 limits

Total weight: 1391 kg

Single pickpt. hole no/pos: --

Height of lowest edge: 10.22 m

**Main: Array view**

Center of gravity | Pickpoints

Rear pick: 38.5 | Front pick: 1

Pickpt. hole: 38.5 | Load: 1039 kg | 352 kg

**Comments**

Stadium J-System example with V-Series Delays and Centerfill

**Top view**

**Main: Profile at -4° aiming**

**Direct sound level vs. distance / dB SPL**

Resolution: std

Signal selection

Level (dBu): 0.0

Air absorption: 20 °C | 60%

Curve 1: 2000 Hz

Curve 2: 250 Hz

J-Series setup example 6, Sources: Stadium setup

Project settings

**Main**

System: J-Series

Position x: -1.0 m | Position y: -15.0 m

Frame height front: 18.0 m | Hor. aiming: -4.0°

Frame angle: 0.5° | Vert. aiming: 0.5°

Height of lowest edge: 10.22 m | No. of J-SUB: 0

No. of J8: 18 | No. of J12: 4

**Pickpoints and load**

X:	Y:	Distance L/R:	Pickpt. hole:	Pickpt. pos.:	Load:
-1.96 m	-14.93 m	30.0 m	38.5	96.5 cm	1039 kg
-1.03 m	-15.00 m	0.07 m	1	2.8 cm	352 kg

**Side Hang** | **Main Sub** | **Side Sub** | **Delay** | **Dly Center** | **Center**

**Array view** | **Collision view**

Center of gravity | Pickpoints

**Required space (L)**

Pickpoints | Frame 1 | Lowest cabinet

**Frame details**

**WARNING!**

Always make sure that each of your hoists is able to carry the total weight of the array.

J-Series setup example 6, Rigging plot: Stadium setup

## 10.5 xS/xA-Series setup examples

Project: White range example 1 Date: 09.01.2014 Author: array-expert ArrayCalc X7.5 R008

**Project settings**

10AL Main Array GR Mute

Pair  System: xA-Series Mounting: flown

Position x: 0.0 m Position y: 8.0 m  
 Frame height front: 11.0 m No. of cabinets: 8  
 Horizontal aiming: 0.0° TOPs left: HF left  
 Frame angle: -1.2° TOPs right: HF right  
 Delay (abs.): 0.3 ms

**TOPs**

CUT  CPL: -2

Level (rel.)

**All cabinets**

GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
1	10AL	0.0	Arc	--	-1.2°	0.0°
2	10AL	0.0	Arc	--	-3.2°	2.0°
3	10AL	0.0	Arc	--	-7.2°	4.0°
4	10AL	0.0	Arc	--	-11.2°	4.0°
5	10AL	0.0	Arc	--	-15.2°	4.0°
6	10AL	0.0	Arc	--	-21.2°	6.0°
7	10AL	-2.0	Arc	--	-30.2°	9.0°
8	10AL	-2.0	Arc	--	-42.2°	12.0°

5S Nearfills GR Mute    
 10S Delays GR Mute    
 SUB array GR Mute

**Load**

Load OK 47% of load limit

Total weight: 121 kg  
 Single pickpt. hole no/pos: 7 32.8 cm  
 Height of lowest edge: 8.84 m

**10AL Main Array: Array view**

Center of gravity Pickpoints

Rear pick: 12 Front pick: 1  
 Load: 69 kg 52 kg

**Top view**

**10AL Main Array: Profile at 0° aiming**

**Direct sound level vs. distance / dB SPL**

Resolution: std

Level (dBu): 0.0 Air absorption: 20 °C | 60%  
 Curve 1: 4000 Hz  
 Curve 2: 500 Hz

**Comments**

- 8x 10AL main arrays
- 6x 5S fills
- 4x 10S delays
- 9x B4-SUB array

xS/xA-Series setup example, Sources: 8 x 10AL line array

Project: White range example 1 Date: 09.01.2014 Author: array-expert ArrayCalc X7.5 R008

**Project settings**

10AL Main Array GR Mute

Pair  System: xA-Series Mounting: flown

Position x: 0.0 m Position y: 8.0 m  
 Frame height front: 11.0 m No. of cabinets: 8  
 Horizontal aiming: 0.0° TOPs left: HF left  
 Frame angle: -1.2° TOPs right: HF right  
 Delay (abs.): 0.3 ms

**TOPs**

CUT  CPL: -2

Level (rel.)

**All cabinets**

GR	Type	Level dB	Line/Arc	HFC	Abs.	Splay
1	10AL	0.0	Arc	--	-1.2°	0.0°
2	10AL	0.0	Arc	--	-3.2°	2.0°
3	10AL	0.0	Arc	--	-7.2°	4.0°
4	10AL	0.0	Arc	--	-11.2°	4.0°
5	10AL	0.0	Arc	--	-15.2°	4.0°
6	10AL	0.0	Arc	--	-21.2°	6.0°
7	10AL	-2.0	Arc	--	-30.2°	9.0°
8	10AL	-2.0	Arc	--	-42.2°	12.0°

5S Nearfills GR Mute    
 10S Delays GR Mute    
 SUB array GR Mute

**Load**

Load OK 47% of load limit

Total weight: 121 kg  
 Single pickpt. hole no/pos: 7 32.8 cm  
 Height of lowest edge: 8.84 m

**10AL Main Array: Array view**

Center of gravity Pickpoints

Rear pick: 12 Front pick: 1  
 Load: 69 kg 52 kg

**Top view**

**10AL Main Array: Profile at 0° aiming**

**Direct sound level vs. distance / dB SPL**

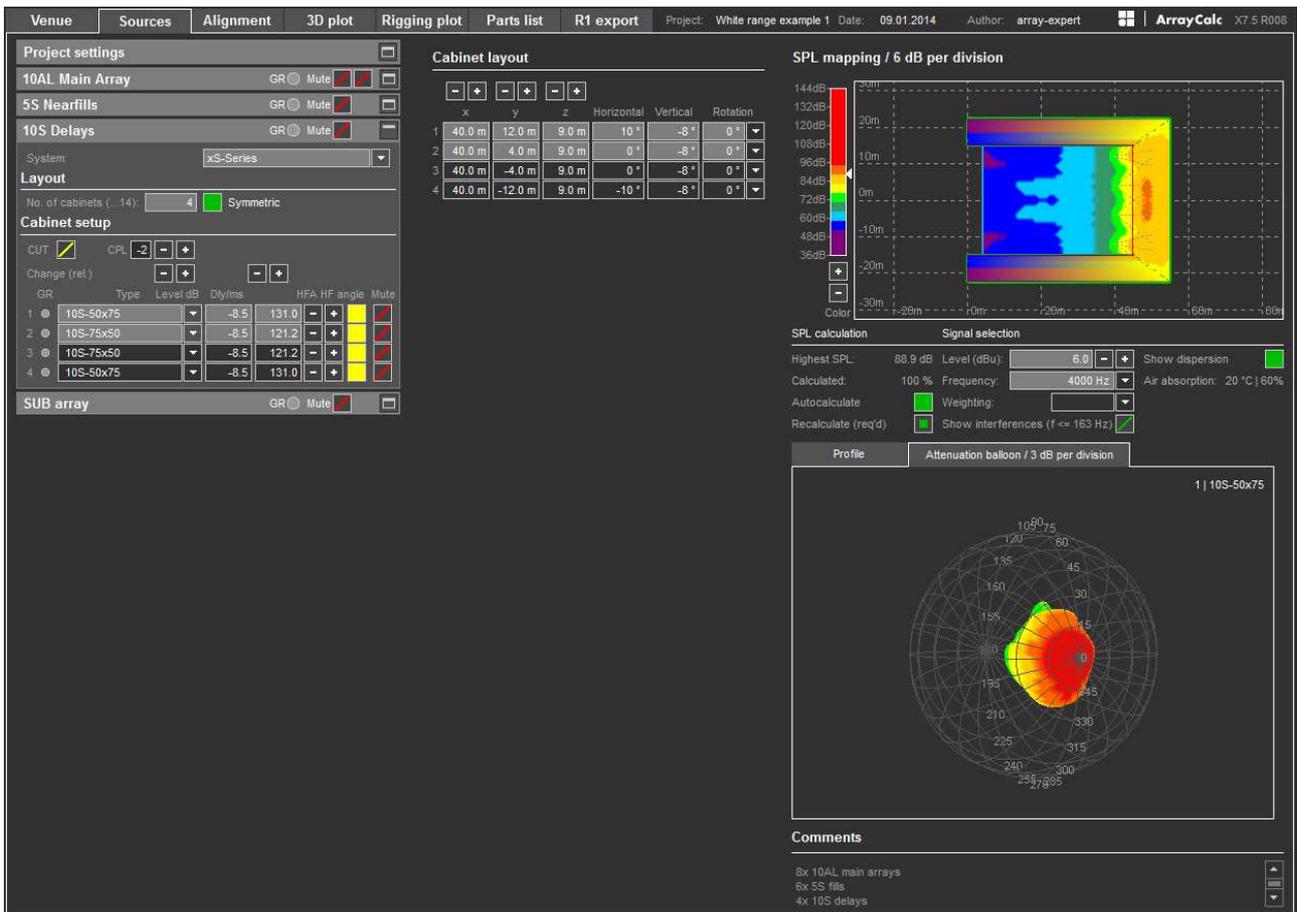
Resolution: std

Level (dBu): 0.0 Air absorption: 20 °C | 60%  
 Curve 1: 4000 Hz  
 Curve 2: 500 Hz

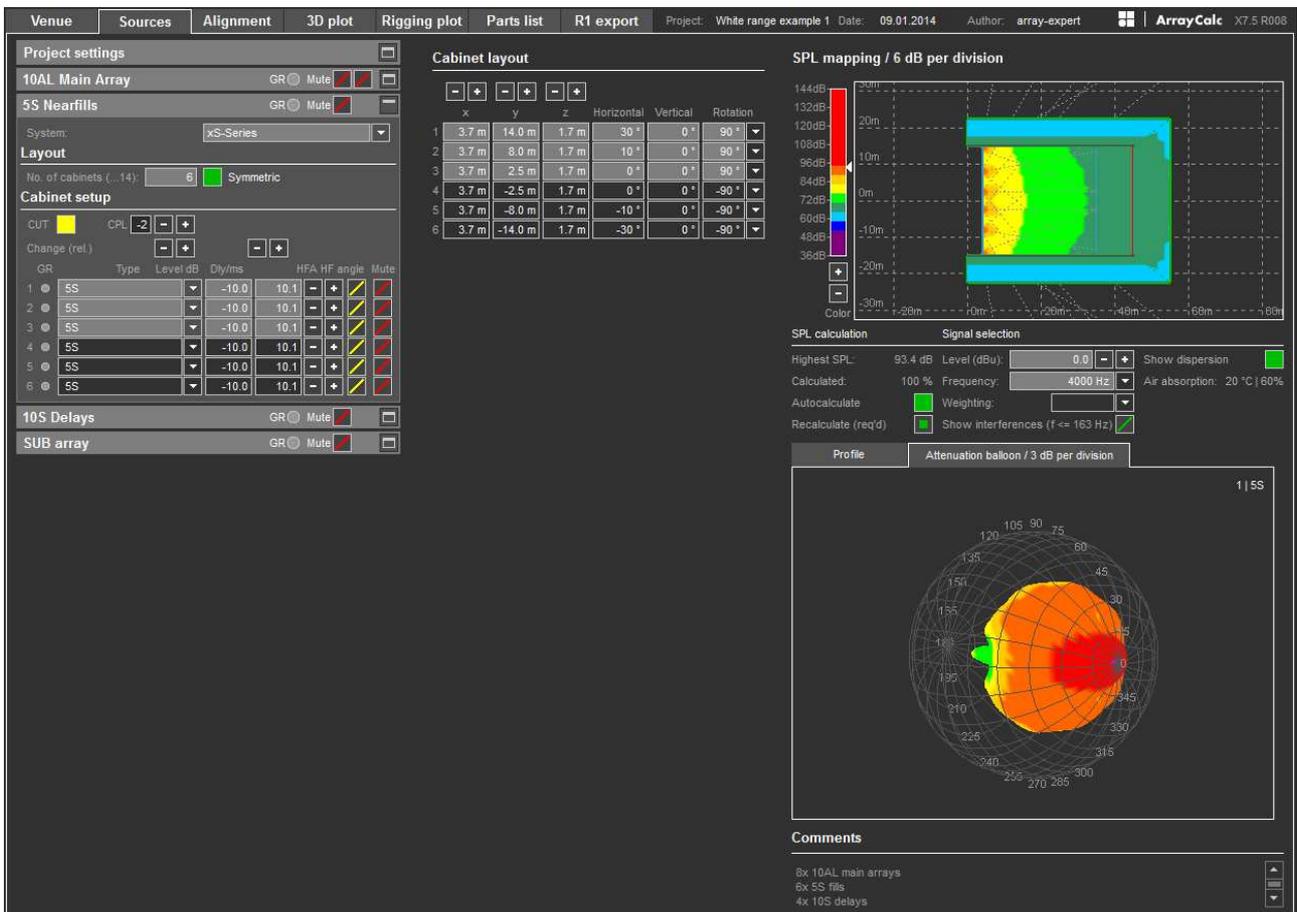
**Comments**

- 8x 10AL main arrays
- 6x 5S fills
- 4x 10S delays
- 9x B4-SUB array

xS/xA-Series setup example, Sources: 4 x 10S point source as delay with SPL mapping and Polar profile



**xS/xA-Series setup example, Sources: 4 x 10S point source as delay with SPL mapping and Polar balloon**



**xS/xA-Series setup example, Sources: 6 x 5S point source as near fill with SPL mapping and Polar balloon**



