

SC28 Array Compensation EQ

This whitepaper gives an overview of line array frequency response and describes how compensation equalization (EQ) is implemented in the SC28. Spiral line arrays may give inconsistent results even with array compensation EQ, and care should be exercised when using this array shape.

Line Array Types and Nomenclature

Line arrays may be configured in one of many shapes. For use with the SC28, QSC recommends that a line array be configured as an *arcuate* or *spiral* array.¹

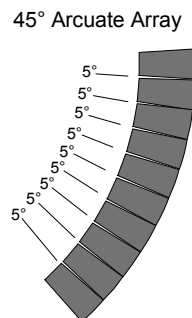
Total Splay Angle

The Total Splay Angle is the sum of all splay angles between the enclosures. For example, a 4-enclosure array with 5° splay angles between enclosures has a Total Splay Angle of

$$5^{\circ} + 5^{\circ} + 5^{\circ} = 15^{\circ}$$

Arcuate Arrays

Arcuate arrays (in the shape of an arc) have a constant splay angle between enclosures. For example, the following figure shows a 10-enclosure 45° arcuate array:



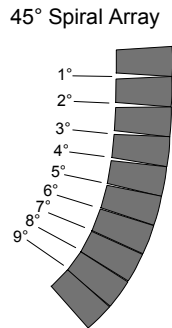
The Total Splay Angle is calculated as

$$5^{\circ} + 5^{\circ} + 5^{\circ} + 5^{\circ} + 5^{\circ} + 5^{\circ} + 5^{\circ} + 5^{\circ} + 5^{\circ} = 45^{\circ}$$

¹ Straight arrays have extremely narrow beamwidth at high frequencies. J-arrays are effectively replaced by spiral arrays, whose patterns are more regular.

Spiral Arrays

Spiral Arrays, sometimes called progressive arrays, have an increasing splay angle moving from the top of the array to the bottom. This type of array is defined by its *incremental angle*, which is the angle that is added to each splay angle as one moves down the array. For example, the following figure shows a 10-enclosure 45° spiral array with a 1° incremental angle:

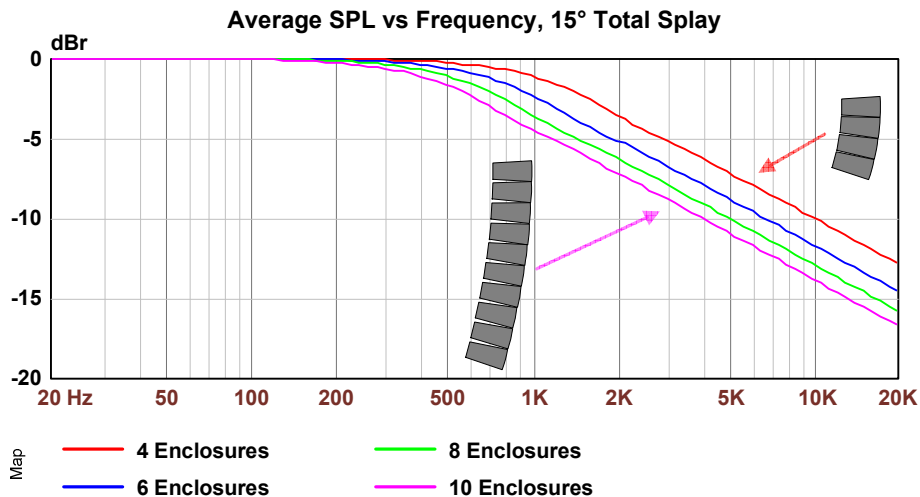


As can be seen in the figure, each splay angle in the array increases by 1°, which is the incremental angle. The Total Splay angle is calculated as

$$1^\circ + 2^\circ + 3^\circ + 4^\circ + 5^\circ + 6^\circ + 7^\circ + 8^\circ + 9^\circ = 45^\circ$$

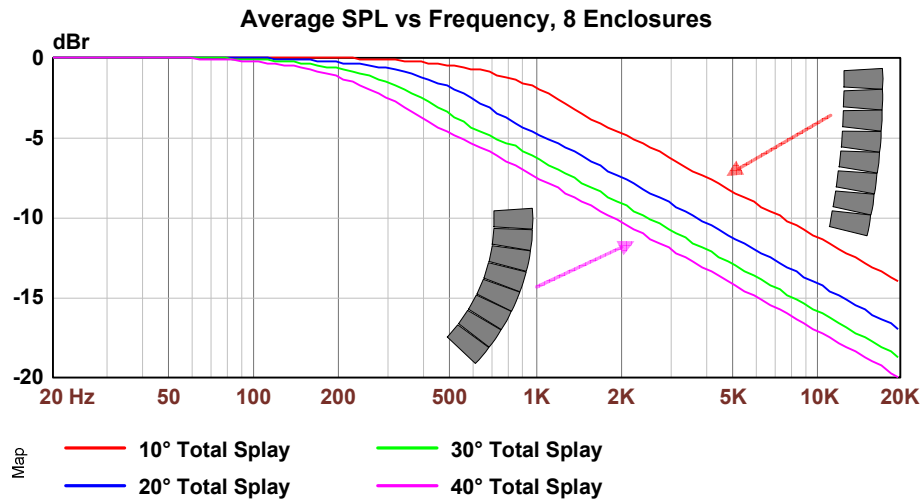
Array Frequency Response

The frequency response of a line array depends on its length (“Array Size”, or number of enclosures) and Total Splay Angle. Examples are shown in the following two figures.² The first figure shows an example of the change in frequency response vs. number of enclosures:



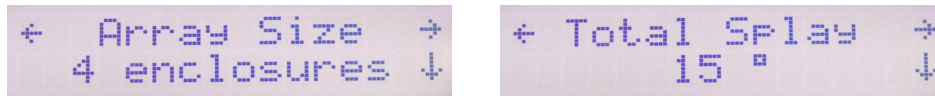
² The frequency responses shown are that of ideal arcuate line arrays averaged (RMS) over the total splay angle in the far field. The individual enclosure height is 300 mm (11.8”).

The next figure shows an example of the change in frequency response vs. total splay angle:



Array Compensation EQ

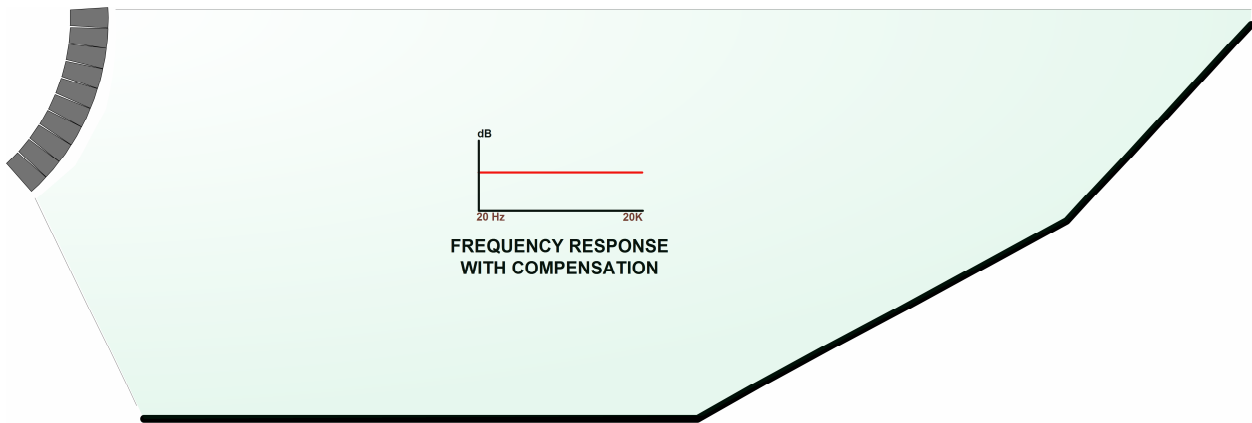
This change in frequency response requires compensation EQ. The SC28 automatically implements this compensation for a given number of enclosures and total splay angle. Simply make these selections in the Setup Menu for your line array configuration. For example:



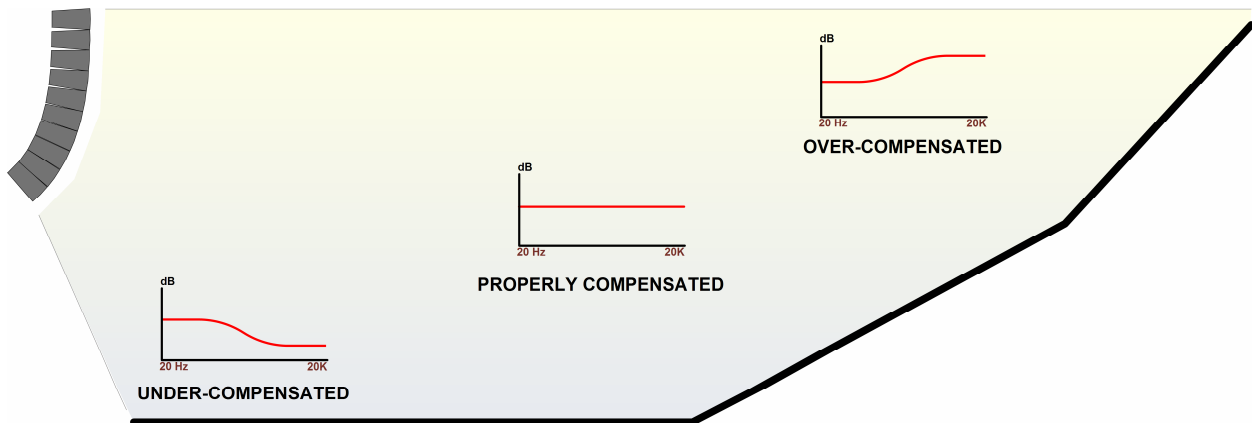
Spiral vs. Arcuate Compensation EQ

Arcuate arrays have a uniform average frequency response throughout their total splay angle, because the splay angles between the boxes are the same.³ This is illustrated in the following figure:

³ RMS frequency response of an ideal array averaged over the total splay angle.



Over the same total splay angle, the required compensation EQ for a spiral array is virtually the same as for an arcuate array.³ However, a spiral array does not have uniform frequency response vs. angle of declination (angle below horizontal). As a result, the top portion of the array is over-compensated, while the lower part of the array is under-compensated. This is illustrated in the following figure:



Typically, most of the audience is located in the properly and over-compensated area. The over-compensated area may be partially mitigated by the effects of high-frequency absorption of sound in air, since the distance to the audience is longer. The use of an external EQ or SC28's user EQ may be necessary to compensate for these effects.

Summary

The SC28 greatly simplifies the task of line array compensation EQ for various splay angles and number of enclosures. However, care must be exercised for spiral arrays, where ideal compensation EQ varies with declination angle.