TANNOY®

straight to the point

QFlex

Main goal: Software-controlled directivity for
optimal venue coverage and direct/reverberant ratio for
improved clarity and speech intelligibility

Tannoy is proud to present QFlex, a range of self powered, digitally steerable loudspeaker arrays.

With state of the art algorithms and dense physical spacing of transducers, QFlex is the first product of its kind to realize full range beam steering capabilities, producing class leading performance for both vocal and music applications.

Features

Extremely intelligible speech and music reinforcement.

Class leading steering control (+/- 70 degrees).

Densely spaced transducers to defeat the effects of aliasing.

Intuitive GUI.

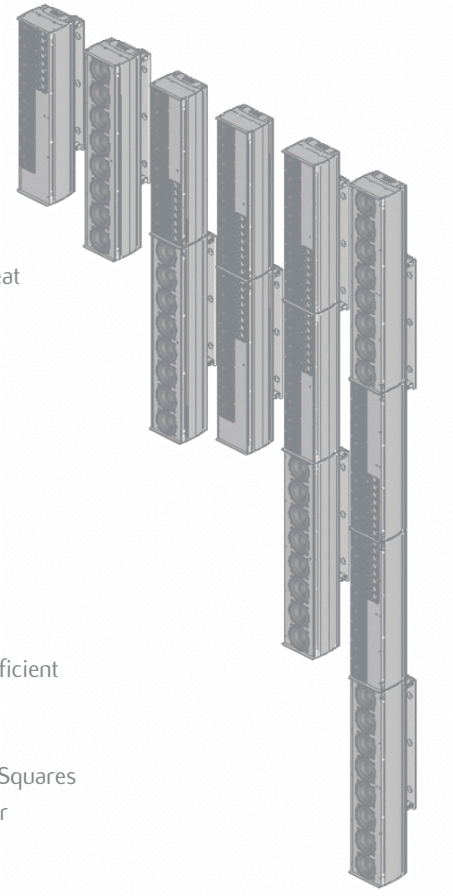
Integrated cutting edge DSP, network control and amplification.

Networkable with other Tannoy VNET products.

Unique digital filter structure for efficient implementation and low latency.

Uses a powerful Regularized Least-Squares Multichannel Inversion algorithm for state-of-the-art beam control.

Architecturally pleasing.



Let's begin with the basics. The architect designs a fantastic looking venue, both inside and out. The audience has assembled and is dazzled by the well designed combination of lighting, glass, surfaces, array of colours and textures on show. But what is the real reason they have gathered in this stunning auditorium? This may be a place to hear (and see) a lecture, performance or sermon. A stunning looking venue may well be appreciated for its aesthetics; but equally a performance venue is remembered by how it sounds.

Sound originates at the source (the loudspeaker). Generally the loudspeaker is a distance from the audience. The greater the audience, the further from the speaker they have to sit, unless a distributed system with a large number of loudspeakers is employed. This option is invariably unacceptable from an aesthetic point of view.

The sound wave which is emitted by a conventional loudspeaker expands as a sphere. By the time the sound has reached its intended participant it has expanded by a massive amount. Only a tiny fraction of the sound which comes from the loudspeaker (direct sound) actually reaches the listeners ear, typically 1% in a large auditorium. The remaining 99% of the sound is called the indirect sound. It's the indirect sound which contributes to unintelligible sound if it is neglected. Treating a venue with absorptive or diffuse surfaces can be prohibitively expensive.

However there is another solution...

QFlex is able to focus the acoustical output in the target directions where it is needed, delivering significant improvements to speech intelligibility and musical clarity in reverberant spaces, i.e. increase the “Hall Radius” beyond which reverberant sound becomes dominant.

Where to use QFlex?

Any reverberant space where speech intelligibility is difficult to achieve with standard and conventional methods.

Where architectural constraints limit the preferred positioning of conventional loudspeakers.

Houses of worship
Transportation Hubs –
Airports, Train stations
Museums and other public spaces
Theatres and Auditoria
Shopping malls
Conference Facilities
Video Signage
Corporate AV

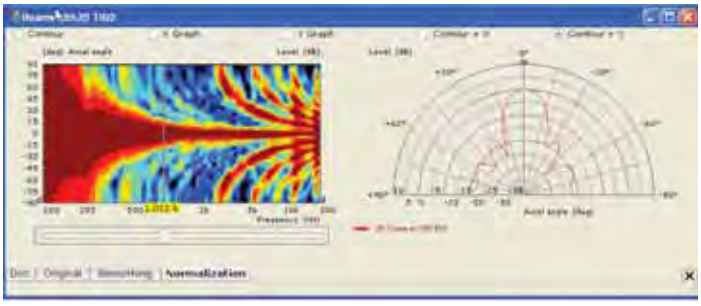
“You are Tannoy, the inventors of the Dual Concentric”

Why are you not using Dual Concentric or Coax Drivers?

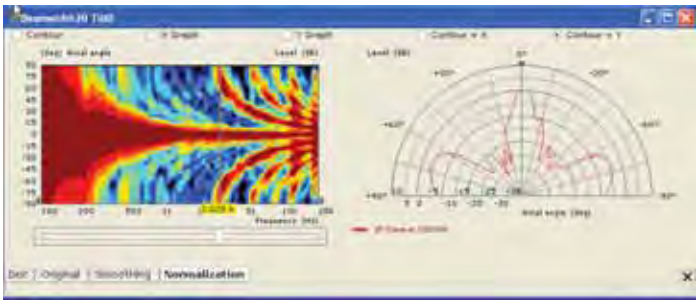
Effective steering and beam control requires densely spaced transducers. Tannoy’s hallmark Dual Concentric™ drivers are not suitable for use as array elements, because they prohibit tweeter spacing wider than a woofer diameter. This is not surprising since they are in themselves passive, axis-symmetric “arrays”. The utilization of coax drivers or vertically arrayed ‘full range’ drivers is therefore unsuitable for effective full range beam steering applications. It’s a simple rule of physics which no amount of corrective DSP can compensate for.

- Out of beam frequency response will be very irregular
- At high frequencies where tweeter spacing violates spatial sampling theorem (Dist < wavelength/2), we get strong side lobes (spacial aliasing)
- With extreme steering these lobes may even be significantly stronger than main beam

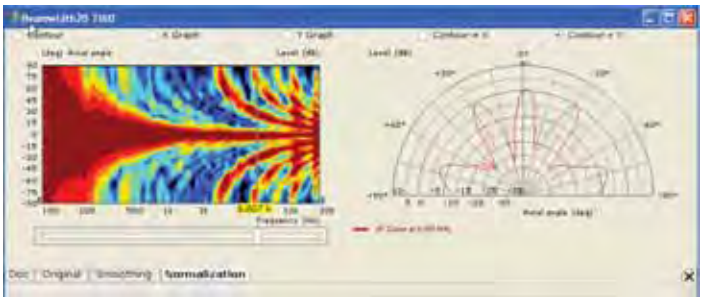
To show the effects of aliasing, the measurements below show an 8 element device with the high frequency elements spaced at 100mm (4") apart



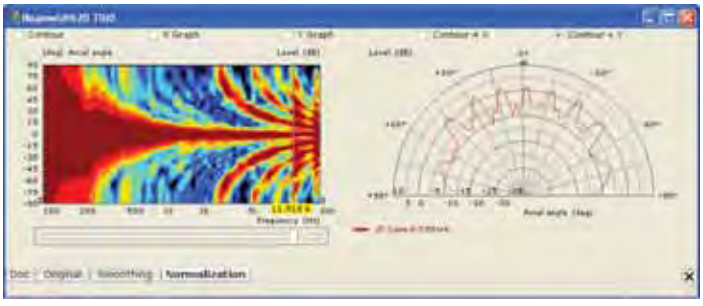
At 1kHz the beam is well defined.



At 3kHz a very strong side lobes are evident though the main beam is still well defined, this can present many practical problems, not least when working in reverberant spaces.

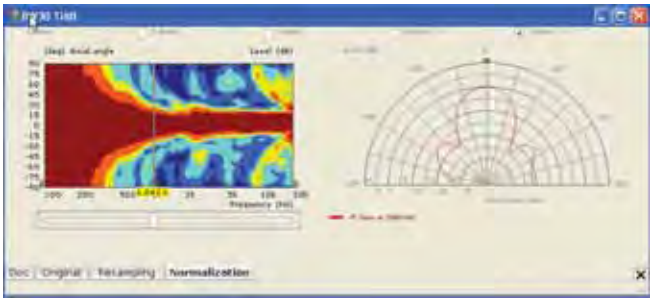


As low as 6kHz multiple side lobes appear, effective beam control has now collapsed.

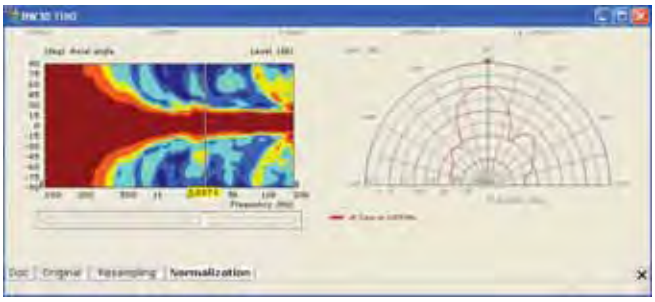


At 12kHz the directivity characteristics are actually wider than that of a conventional loudspeaker.

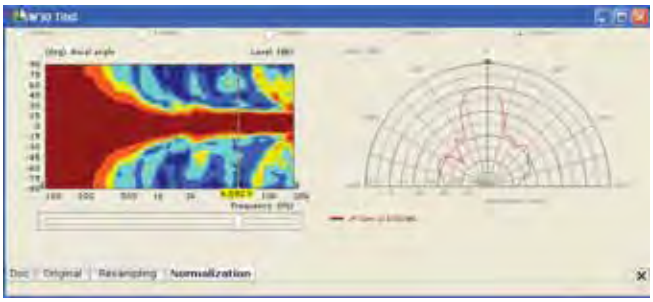
Example of a QFlex 16's beam control characteristics



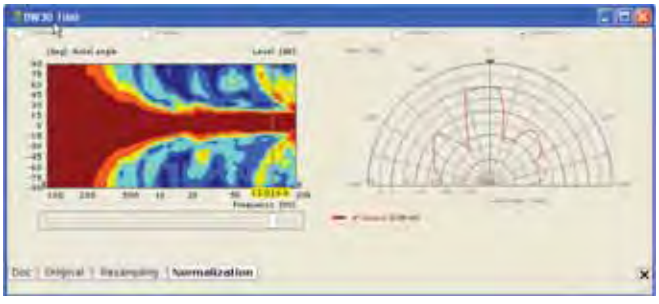
At 1kHz the beam is well defined.



At 3kHz the beam continues to be well defined with no evidence of aliasing.



At 6kHz there is still a well defined beam with no evidence of aliasing being maintained through a much wider range of frequencies than the coax configuration can achieve



Even at 12kHz the slight effects of aliasing (which are ultimately and eventually unavoidable) are still 10dB lower than the main beam.

Components attributed to quality beam steering characteristics

Low Frequency

The low and high frequency components have been specially designed with the intended application in mind.

It's important that the low frequency elements are densely spaced like the high frequency drivers for effective operation over their pass-band. To produce low frequencies the diaphragm area has to be proportionally large, but unfortunately, if the effective sources are too far apart we will experience unwanted aliasing. The 3" and 4" low frequency drivers in QFlex have been optimized with a combination of FEA (finite element analysis), Klippel™ Analysis, and laser inferometery.

With a highly efficient neodymium magnet structure and under-hung voice coil, we are able to achieve large linear excursions while maintaining distortion free performance. The large excursions produced by these tightly packed drivers allow for effective air movement within a very small radiating area. This affords us the desired low frequency performance while maintaining our dense spacing.

High Frequency

The choice of high frequency drivers at the early design stage in QFlex was pivotal in the performance outcome. Having acknowledged that Dual Concentric drivers were unsuitable for beam steering applications, we were faced with two basic dilemmas:-

a. If the spacing of our HF array was too large we were still faced with the prospect of aliasing at a lower than desirable frequency. Even "off the shelf" 1-inch domes wouldn't allow us the dense spacing required to avoid lobes at 8kHz due to the magnet geometries involved.

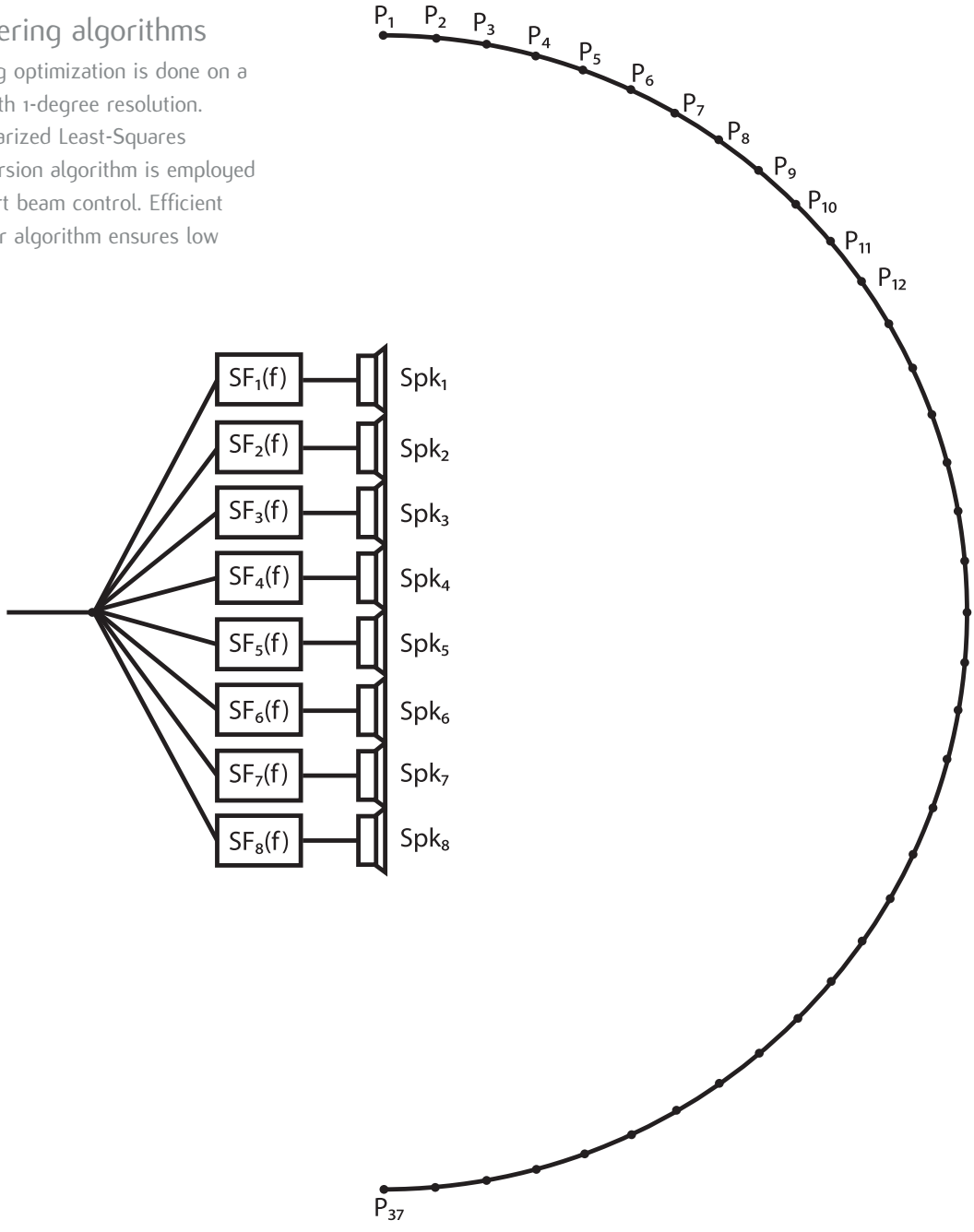
b. As voice coil diameter is a direct function of power handling capacity, anything less than 1" voice coils would not be acceptable for the demands of professional use. Due to the distances involved in the use of QFlex, air absorption and the effects of humidity need to be compensated for, so high frequency elements must be robust.

From Development To Reality

With these design dilemmas in mind, we set about developing a very unique high frequency array solution. The result is an 8 element array with a specially designed neodymium magnet structure allowing for very dense spacing of the sources. The dome centers are only 30mm apart, banishing aliasing to frequencies beyond 12kHz. Thermal power handling is further augmented by the inclusion of a common heatsink on the rear of the high frequency array.

Powerful steering algorithms

The beam steering optimization is done on a direction scale with 1-degree resolution. A powerful Regularized Least-Squares Multichannel Inversion algorithm is employed for state-of-the-art beam control. Efficient deployment of our algorithm ensures low latency levels.



Hardware

- Agile, powerful amplifiers for exceptional transient performance
- Universal mains power supply for operation anywhere in the world
- Ultra-efficient switching amplifier and power supply technologies for a small, cool package which is environmentally friendly
- Integrated inter-module connectivity for minimal cable visibility
- 96kHz signal processing and minimum signal path design for sonic transparency
- Fully synchronous design and professional quality signal converters for low noise
- Sophisticated driver management maximizes SPL while protecting drivers
- Comprehensive supervision and protection systems keep the product working reliably
- Fault detection and reporting system for peace of mind
- Two distinct operating modes selectable via hardware control lines
- Two audio inputs which may be mixed or switched between on change of operating mode
- Integrates fully with existing V-Net systems
- Abuse monitoring and logging allows the installer to detect abuse of the product
- Digital audio input (Available May 2009)

Amplifiers

Each QFlex module incorporates 8 or 16 channels of high performance amplification. The choices available to the design team were traditional class AB, integrated class D 'chip amps' or build a bespoke professional performance class D multichannel amplifier from the ground up. Class AB was deemed impractical primarily for physical and thermal reasons; it wouldn't fit and if it did it would roast! Class D chip amplifiers obviously solve the physical issue but do not provide the performance required. Typically these packages are specified at 10% THD which we wouldn't entertain, and they offer less efficiency, possibly 85%. A good figure until you compare with QFlex, which achieves 97 – 98%.

QFlex amplifier technology is proven in the most demanding sectors of the industry.

Cable Management

Further evidence of the attention to detail our engineers have lavished on QFlex is revealed in the cable management. Although this aspect of the product would typically have been left to last, the Tannoy approach of total system integration is in evidence again. Installation is swift, aesthetically pleasing and error free by design. Two flying cables interface power and data between column elements. The Cat5 data cable carries control signals, network communications messaging and audio, and an IEC cable for the mains power, both carried internally within the column. The simplistic solution of passing analog audio from master to slave elements would almost certainly result in significant crosstalk between data and audio, and would degrade the signal due to an additional D/A, A/D process. Our elegant solution satisfies all functional requirements while maintaining optimal signal quality.

DSP

A new member of the 3rd generation of Sharc Digital Signal Processors is used to perform the sophisticated processing for all sixteen channels in the QFlex product. This device has enough processing power to run the entire product at a brisk 96kHz sampling rate without the need to compromise the efficacy of the processing, and still has enough spare power to run the protocol engine, the monitoring and protection systems.

The audio processing algorithms we run in the DSP use a mixture of fixed-point and floating-point processing, and various bit-widths at various stages of the processing, depending on the particular needs of the algorithm, but always with a view to maximizing sonic performance rather than just to 'squeeze more processing in'.

Protection and Monitoring

The last thing any of us want is for a QFlex loudspeaker to fail. To achieve longevity of operation in harsh or abusive situations requires an intelligent monitoring and protection system which prevents any of the system components from becoming stressed. The protection systems in QFlex:

- Make sure that the output current of the amplifiers is within safe limits so that the power supply and power amplifiers are not stressed
- Make sure that the temperature of the product does not become elevated above that which is safe for reliable operation of all the components
- Make sure that the mains supply voltage is within a range which will allow normal operation, and suspend such operation if the mains voltage should fall outside this range, restoring normal operation when the voltage returns to normal
- Make sure that the voltage delivered to the drivers is within a range which the drivers can handle

- Limit the power applied to the drivers such that the temperature of the drivers is within safe limits, whilst maximising the SPL which QFlex will normally permit

All this is done is such as way that the product will continue to operate in as normal a way as possible, and will intelligently reduce stress progressively, or temporarily shut down parts of the system, returning to normal operation automatically wherever this is possible. Only as a last resort will the product enter any kind of permanent shut-down mode which will require intervention. Even then, QFlex will alert staff (via a flashing indicator and a relay contact connected to optional external monitoring systems) to the presence of a problem which requires attention.

Sample Rate

Using a 96kHz sample rate rather than a perfectly usable 48kHz has several benefits, even though twice as much processing has to be done, making heavy demands on the signal processing solution:

- More 'open' sound because the audio bandwidth is nearer 40kHz than 20kHz
- Lower latency - the delay introduced by A/D and D/A conversion is halved
- Audio performance when driving very high levels is improved because non-linearities in protection systems will not cause alias components to be reflected in to the audio bandwidth

QFlex model line up

From an electronics pack point of view, there are four basic versions:

- 8 channel master unit (contains audio, power, and network inputs)
- 8 channel slave unit
- 16 channel master unit (contains audio, power, and network inputs)
- 16 channel slave unit

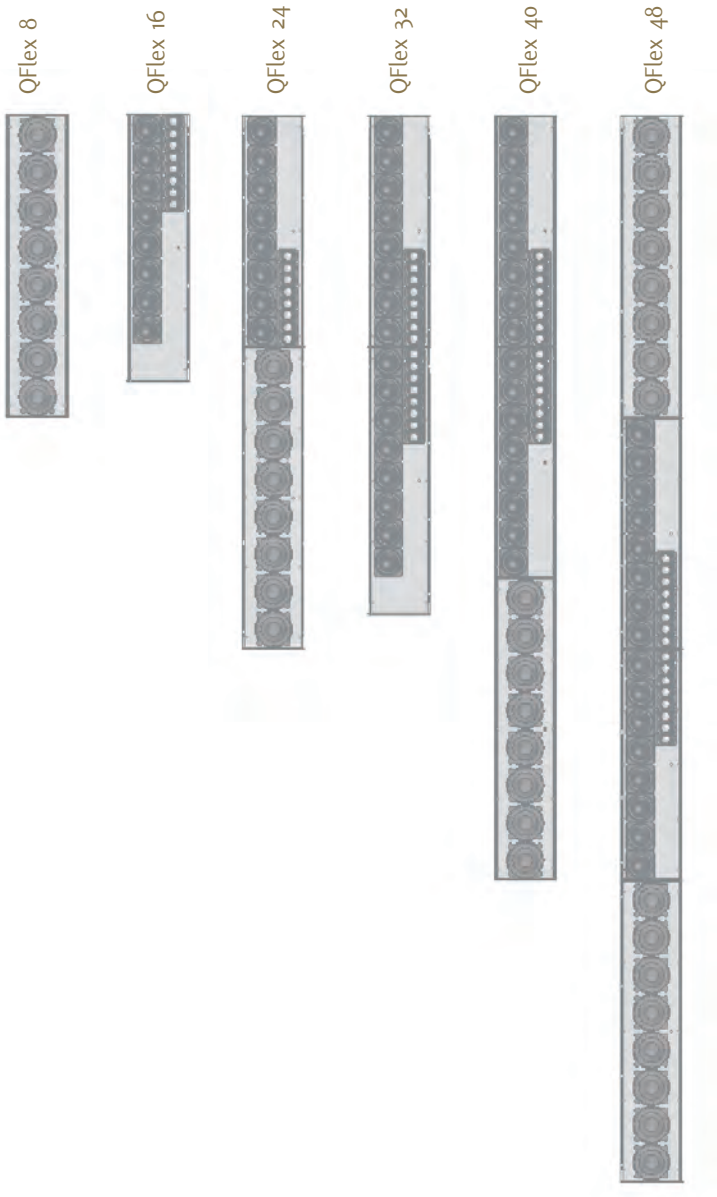
8 channel unit
(QFlex 8)

16 channel unit
(QFlex 16)

To avoid shipping very long products it will be possible to assemble the components of a larger column on site. The master unit will always be positioned at the bottom of any speaker column and will be slightly longer to accommodate the connectors and power indicator.

The top of the master unit will allow a slave unit to be mechanically fixed to it. The bottom of a slave unit will be designed to be mechanically fixed to the top of a master or slave unit.

The top of a slave unit will be the same as the top of the master unit to allow another slave unit to be mechanically fixed to it.



Which model do I Choose ?

Which QFlex system you specify depends on a number of criteria:-

Distance

Farther areas you wish to reach will require a larger QFlex column.
Typically, as a rule of thumb a QFlex16 will be used to distances of 20m(66ft), and a QFlex 48 in excess of 80m (260ft)

Low Frequency Control

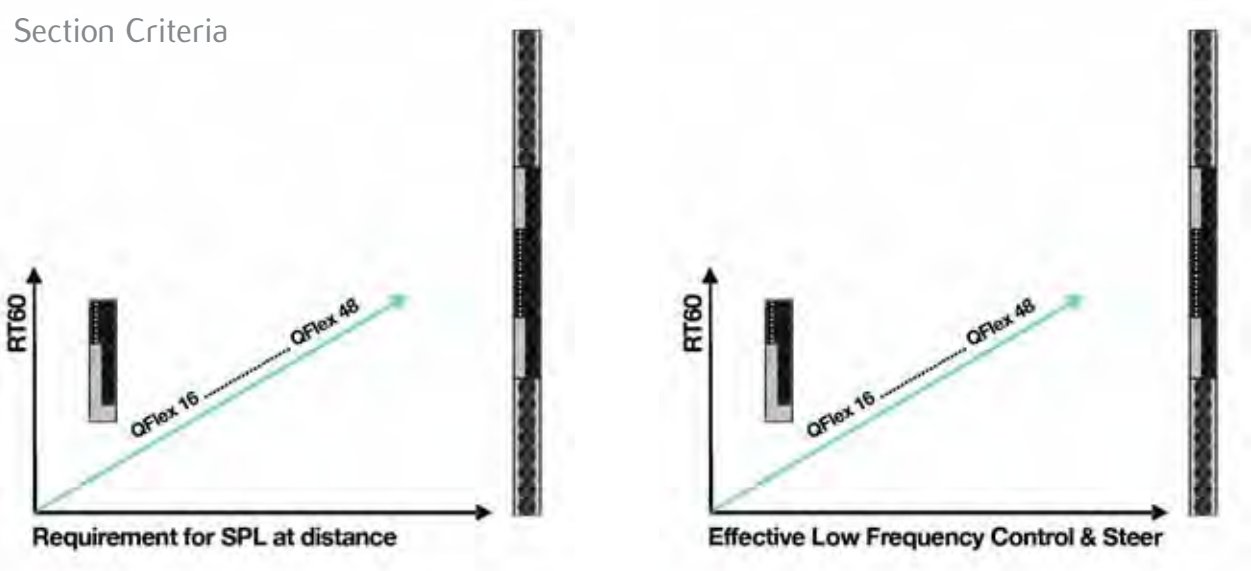
The larger the QFlex column, the more effective control at lower frequencies can be achieved. This also goes for effective steering control at lower frequencies.

QFlex16 (700Hz) ›››› QFlex48 (200Hz)

SPL Requirements

The larger QFlex arrays will have the ability to produce higher SPL levels. This is the case with all loudspeakers. as there are more drivers and amplifier channels in use. QFlex has the ability to generate quite incredible SPL levels at distance.

Section Criteria



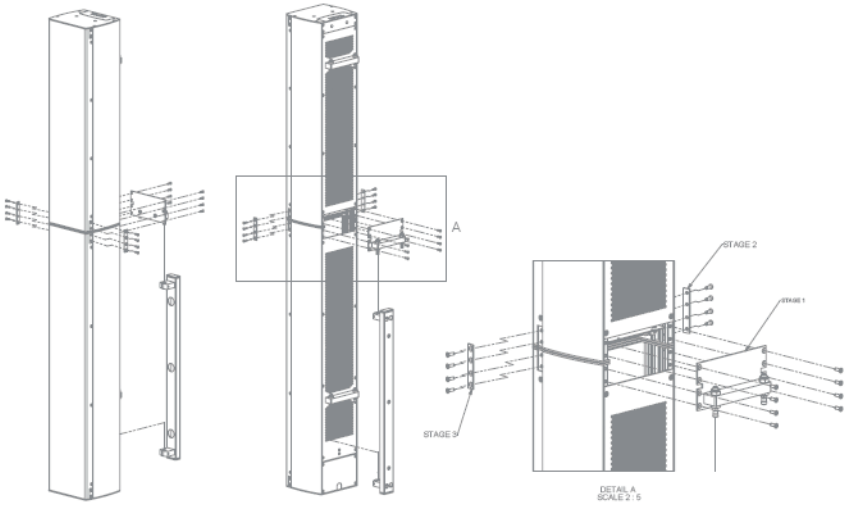
Using the BeamEngine software is a simple and effective way of choosing the correct model.

Hardware and ordering information

The ordering process is simple simply choose the model you require.
All of the necessary hardware and bracketry is included.
Large QFlex modules are shipped in individual boxes for simple assemble on site.

See Left for a guide to the individual models used in each QFlex array.

Assembly is simple –



Bracket can be hinged on either side of the cabinet for ease of installation -

Design assistance is available for unusual mounting applications like soffit mounting.

Specifications

	QFlex 8	QFlex 16	QFlex 24
Configuration			
4" LF	8		8
3" LF		8	8
1" HF		8	8
No. of Amp Channels			
100W(RMS) @ 4 Ohms	8	16	24
Vertical Dispersion	Variable between 10 - 100 degrees (Asymmetric & multiple beams may also be generated)		
Frequency Range	110Hz - 4kHz	130Hz - 20kHz	110Hz - 20kHz
Horizontal Dispersion	120 degrees	120 degrees	120 degrees
Aiming Angle Limit	+/- 70 degrees	+/- 70 degrees	+/- 70 degrees
LF Beam Control Limit	700Hz	700Hz	400Hz
Maximum SPL @ 100ft (30m)*	92dB	94dB	96dB
Column Height	840mm (33")	744mm (29.3")	1483mm (58.4")
Column Width	171.5mm (6.7")	171.5mm (6.7")	171.5mm (6.7")
Column Depth	150mm (5.9")	150mm (5.9")	150mm (5.9")
Typical Application Distance**	20m (66ft.)	25m (82ft.)	40m (131ft.)
Sample Rate	96kHz	96kHz	96kHz
Audio Inputs	Analogue & AES/EBU	Analogue & AES/EBU	Analogue & AES/EBU
Weight inc hardware	15.25kg (33.6 lbs)	14.25kg (31.4 bs)	26.25kg (58.4 lbs)

* Average SPL (1kHz – 8kHz). Based on a mounting height of 10m (33ft) and a target area @ 30m (98.5ft) and 10m (33ft) wide. Maximum attainable SPL is dependant on the dimension of the target area(s). Exact figures can be derived in the BeamEngine™ programme.

** Based on the above venue criteria achieving 95dB SPL at the quoted distance.

QFlex 32	QFlex 40	QFlex 48
	8	16
16	16	16
16	16	16
32	40	48

Variable between 10 - 100 degrees (Asymmetric & multiple beams may also be generated)

130Hz - 20kHz	110Hz - 20kHz	110Hz - 20kHz
120 degrees	120 degrees	120 degrees
+/- 70 degrees	+/- 70 degrees	+/- 70 degrees
400Hz	250Hz	200Hz
100dB	100dB	101.5dB
1387mm (54.6")	2127mm (83.75")	2967mm (116.8")
171.5mm (6.7")	171.5mm (6.7")	171.5mm (6.7")
150mm (5.9")	150mm (5.9")	150mm (5.9")
50m (165ft.)	70m (231ft.)	80m (263ft.)
96kHz	96kHz	96kHz
Analogue & AES/EBU	Analogue & AES/EBU	Analogue & AES/EBU
25.25kg (55.7 lbs)	38.5kg (84.9 lbs)	51.5kg (113.6 lbs)

VNET™ network applications features

QFlex is a welcome and extremely versatile addition to the VNET family of products.

The modular approach of amplifiers, processing, monitoring and drivers designed into each loudspeaker enables acoustic optimization for the speaker to perform as a unified whole. The intuitive setup software, integrated processing, tuning control, performance diagnostics and protection produces an easy to install and exceptionally high performance networkable loudspeaker. VNET™ supports free network topology so that the loudspeakers can be arranged in a daisy chain, linked in a star configuration or in any combination of both.

Implementation of the network between nodes is via high quality rugged Neutrik Ethercon connectors, which are compatible with standard RJ45 plugs, and Cat 5 cable. Each speaker has a unique address for auto-location on the network.

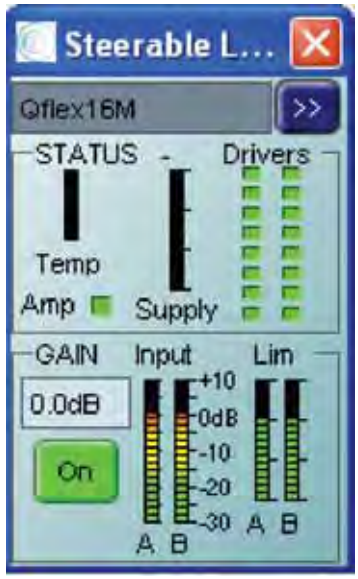
System commissioning and ongoing venue network control, incorporating real time diagnostics of electronics and drive unit, are all managed by the exclusive VNET™ software package.

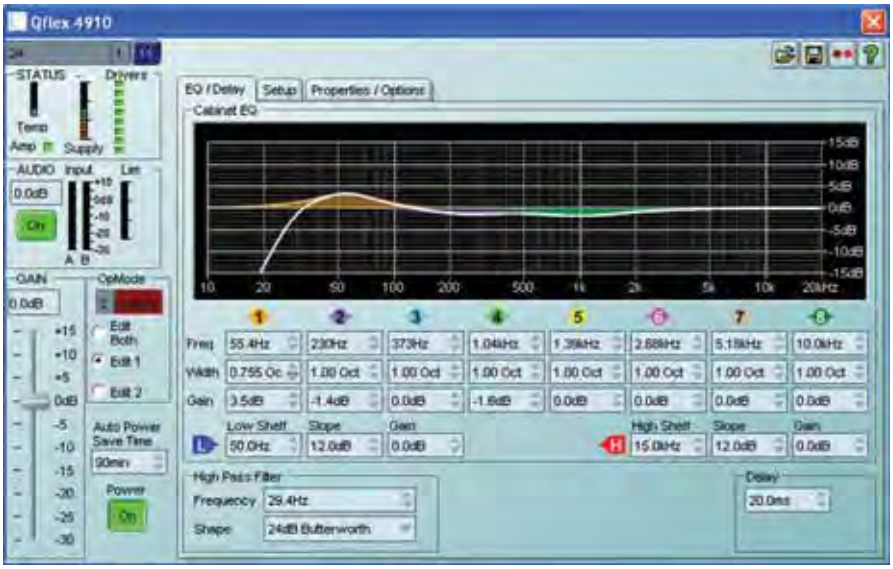
Supplied with each unit, this intuitive Windows tool controls the entire critical install, commissioning and performance monitoring functions. A standard wireless LAN-to-serial bridge can also be used to communicate with the network.

An RS485 interface is used for the serial data, with a twisted pair to send and receive information to a high number of nodes over very long distances. Operating a shared bus system, so that a single computer can control any node on that bus, also means that status information can be gathered from any of the devices.

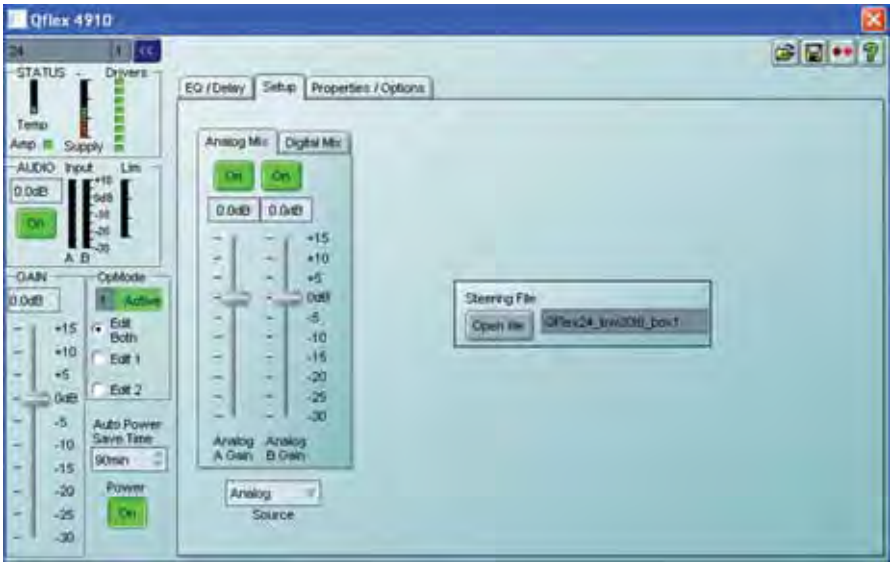
The RS-485 differential signal is very robust, while its noise immunity and long-distance capability ensure it is one of the most popular communications methods used in industry. Only data to control setup functions and ongoing system diagnostics is carried over the network. As each VNET™ loudspeaker controls its own DSP functions any unforeseen problem would be isolated to only that particular node and audio will still be delivered.

Speakers are automatically identified on the network software setup screen with factory default names. The name can be edited to reflect their actual location on the network, with physical location confirmation by selecting the 'Locate' function to activate an LED mounted on the front of the loudspeaker. The loudspeakers are fully calibrated at the factory, avoiding the need to input the correct speaker management settings or any dynamics at the point of install.

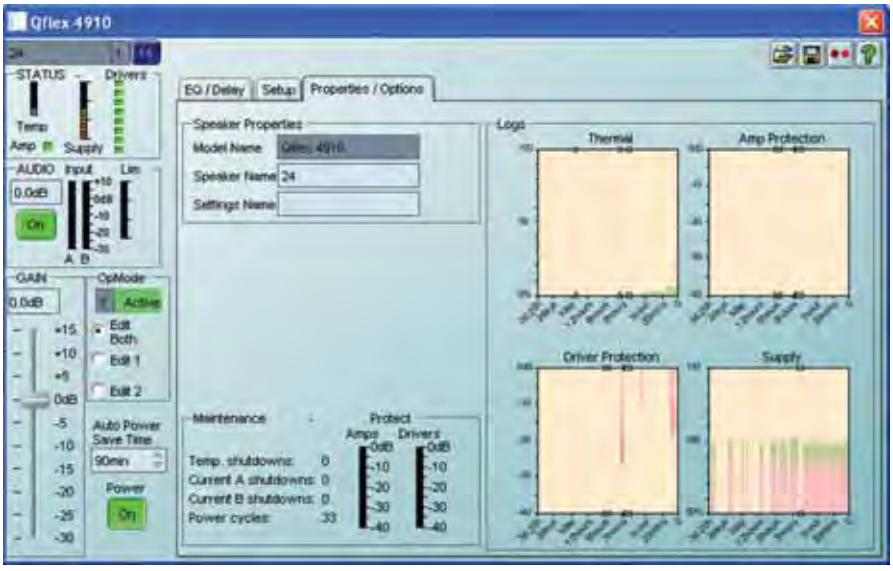




QFlex VNET EQ & delay Setup.



Setup Window



Control & Telemetry Window

QFlex
Beam Engine

QFlex Beam Engine

We have developed a highly intuitive GUI which doesn't require a degree in acoustics to operate, and will achieve accurate and predictable results. The beam engine is running a complex set of Matlab™ functions based on real measurement data.

This design tool allows for simple modelling of single QFlex arrays. It will graphically represent and generate steering algorithms for:-

- A sectional view (elevation) of the audience area.
- The mechanical aiming angle and mounting location of the QFlex array.

Contrary to what the others do, we apply a single shaped beam to the required coverage area. This beam can be asymmetric in shape; we can also specify quiet areas between a beam. This approach is more flexible and more powerful than any existing competitors' product.

From the defined listening area input by the user, they specify target SPL's over the coverage area. Multiple audience areas can be specified if required.

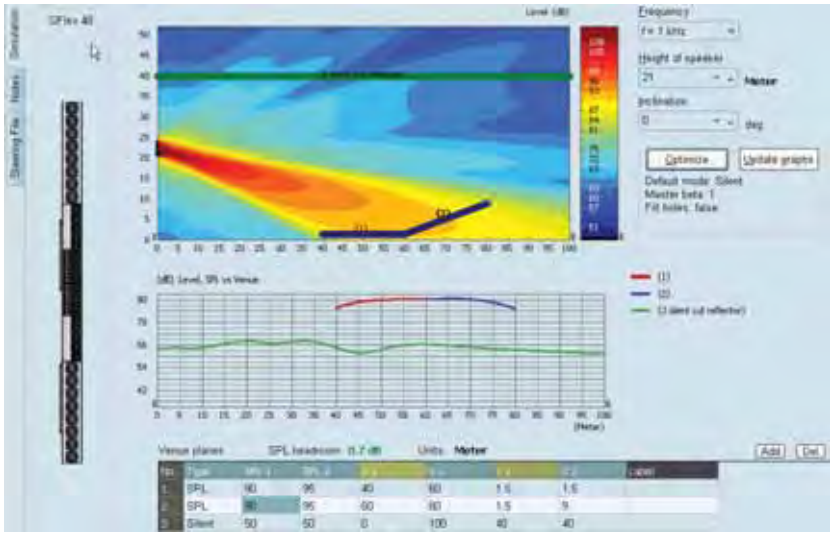
We use 3 different status sets for each zone specified:

Specified value, silent, or unspecified ("don't care").

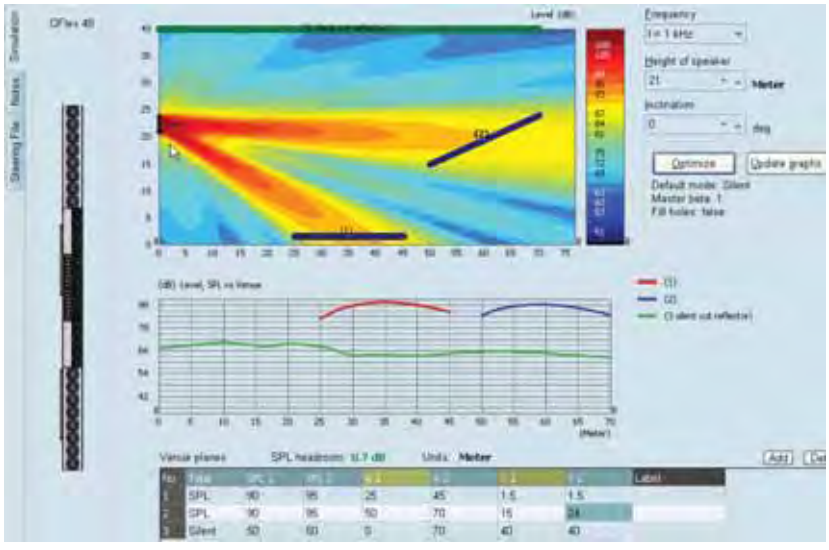
The silent directive could be applied to reverberant zones such as ceilings, etc...

The steering algorithm generated within the beam engine is then saved and loaded to the DSP via the VNET software. This sequence of steps can be carried out in a matter of seconds.

Select Your QFlex Model



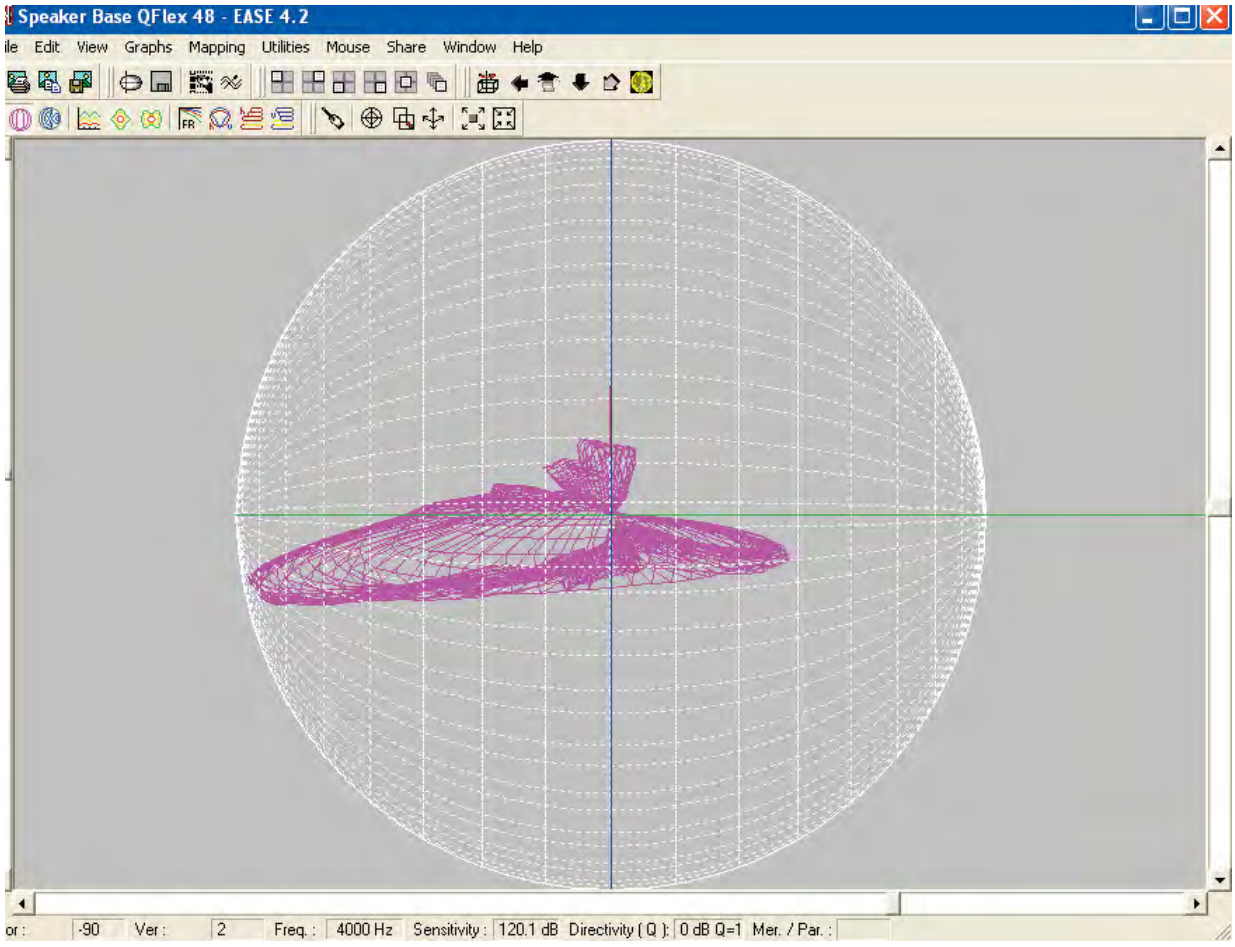
Optimize your space



EASE™ and CATT Acoustic™

Where more than one QFlex array is deployed in an installation it may be necessary or demanded to carry out a more resolute acoustical analysis of the room.

To properly evaluate QFlex coverage in 3D you can export a configuration file from BeamEngine which can be used in Ease™ and CATT Acoustic™



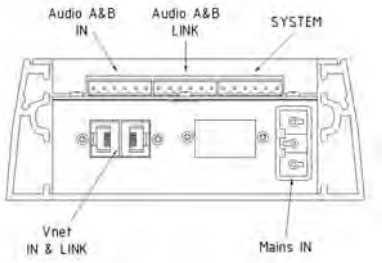
QFlex Hardware Specifications

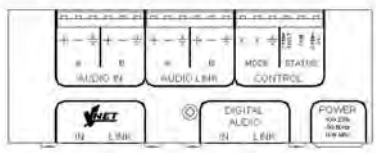
1.0 General

1. To avoid shipping very long products, it will be possible to assemble the components of a QFlex column on site.
2. The master unit will always be positioned at the bottom of any speaker column and will be slightly longer to accommodate the connectors and power indicator.
3. The top of the master unit will allow a slave unit to be mechanically seamlessly fixed to it.
4. The bottom of a slave unit is designed to be mechanically fixed to the top of a master or slave unit.
5. The top of a slave unit is the same as the top of the master unit to allow another slave unit to be mechanically fixed to it.
6. QFlex systems may be configured to enter a power saving standby mode either automatically or in response to a VNET command, returning to operating mode either upon the detection of audio or a 'power up' VNET command.
7. QFlex shall incorporate digital & analog audio inputs and use VNET protocol for monitoring and control.
8. The system will meet the safety requirements of UL60065 7th edition & EN60065 2002.
9. The system will meet the EMC requirements of Fcc15a and EN55103

2.0 System Connectivity

1. The master unit will incorporate all the external user connectivity.
2. The connectors will be towards the bottom of the master's rear panel and will be hidden and secure when installation is complete.
3. Connections will be accessed by the removal of an access plate(s) which will require the use of a tool.
4. There will be two balanced analog audio inputs labeled A and B.
5. Inputs A and B will be on a 6 way phoenix connector.
6. Link outputs A and B will be on a 6 way Phoenix™ (pluggable terminal block) connector.
7. The analog inputs present a bridging impedance of 10k Ohms.
8. The VNET input & output is on a standard RJ45 connector
9. Mains connection will be via a standard 16Amp pluggable connector.
10. Mains for slave units will come from before the master units' mains fuse. Slave units will each carry a mains fuse for their individual protection.
11. The top of the master unit will electrically connect to the bottom of a slave unit with cables that are completely concealed once the column is assembled.





3.0 System Integrity & Emergency Provision

1. The system will indicate that it is powered up and working correctly by pulling in a single pole two way relay.
2. If a fault is detected in either the master unit or any slave units the FAULT relay will be de-energized.
3. The relay contacts will be rated to carry 500mA at 50VDC.
4. All three relay contacts will be available on a Phoenix™ (pluggable terminal block) connector on the master unit.
5. The relay contacts will be 'volt free', i.e. there will be no electrical connection between any of the relay contacts and the QFlex electronics.
6. It will be possible to make the system change its operating mode in the event of an emergency. For example, switch to a different audio input with different EQ.
7. The operating mode change can be activated by either of two means :
a. An input line (line X) on the master unit being grounded or released (by an external switch, relay or open collector output etc.)
b. An input line (line Y) on the master unit detecting the presence or absence of an externally applied voltage greater than +4.5V.
The operating mode change connections will be on a Phoenix™ (pluggable terminal block) connector.

4.0 Amplifiers

1. Each amplifier is able to continuously deliver 100W of unmodulated 6dB crest factor pink noise in to a 4 Ohm load with either 115V 60Hz or 230V 50Hz mains.
2. Frequency response will be 20Hz to 20kHz +/-1dB when driving a 4 Ohm resistive load.
3. Distortion is below 0.07% at 1kHz, (3dB below clip)
4. Noise is better than 110dBA below full output.
5. The audio inputs are balanced.
6. Output current will be sensed and used for driver impedance calculation and over current protection.

5.0 DSP & Audio

1. Audio conversion will be made using 24bit A/D and D/A converters that will typically achieve a system dynamic range in excess of 110dBA.
2. Slave units have their own DSP system, working independently of the master unit, using a signal derived from the input signal on the master unit (after input processing).
3. To preserve quality, audio will be transported from the master unit to any slave units digitally.

6.0 Networking

1. Communication will use Tannoy's VNET protocol.
2. Physical layer networking will be standard VNET.
3. When using VNET as the physical layer, network address assignment will be automatic and not require user intervention.
4. Slave units will be able to automatically determine and report their vertical position in a column.
5. Slave units are full VNET members and can be controlled and monitored directly without the involvement of the master unit.
6. Users will identify master and slave units by their given name.
7. VNET software will load beam steering information into the individual speakers via the network.
8. It will be possible to perform firmware updates over the network.

QFlex software specifications

1.0 General

1. This specification details the software features of the QFlex product range, in terms of the signal processing and monitoring in the loudspeaker, and the PodWare control panel.
2. The QFlex product is part of the VNET family of products and operates like the present V Series products.
3. The Digital Signal Processing will be done at 96 kHz sample rate.

2.0 Signal Processing

1. Selection of the audio input is done on two levels. The selection between the primary input (analog or digital) is carried out manually in VNET software, and the selection between Primary Digital and Primary analog inputs is done automatically on the following basis: An input will be selected if the signal level on it exceeds -60dBFS, and there is less than -60dBFS on the other input. Once made, this selection will be kept ('remembered') until such time that this input has less than -60dBFS of signal and another input has more than this.
2. Input (User) Equalization may be applied to the column by means of eight parametric stages and two shelving stages.
3. Input (User) Delay allows the entire column to be delayed up to a maximum of one second (1000ms)
4. A 4th Order High-pass filter allows the LF response to be curtailed for example when used with an external sub.
5. An overall thermal limiter will 'dim' the loudspeaker if it is determined that any one driver is becoming too hot, as estimated by the RMS detectors on each output.
6. A comprehensive signal limiter in each path simultaneously prevents clipping in the amplifiers, and prevents overflowing the filters.
7. Extension units do not have any input processing. They are driven from a feed in the base unit from a point after the input HP filter. Input processing settings on the base unit are therefore also applied to all the extension units in a QFlex column.

3.0 Operating Modes

1. Two Operating Modes are available – Operating Mode 1 and Operating Mode 2. These allow differences in input processing and input selection to be programmed, and selected by means of the Operating Mode control inputs.
2. Since input selection (either Primary or Override) can be part of the Operating Mode programming, Operating Modes may be used for emergency evacuation (Voice Alarm) purposes for example. The Operating Mode thus triggered for VA will select the Override input and may have different equalization and gain to the normal Operating Mode.
3. Since there are two different ways of selecting the Operating Mode using the Operating Mode control inputs (see the Hardware specification), the particular Operating Mode used for VA could be either Operating Mode 1 or Operating Mode 2 depending on the way the system is used.
4. Although Operating Mode selection is only applied to Base units, the effect will be on all members of a column since input selection and input processing is for the entire column.

4.0 Monitoring and Protection

1. By monitoring the real-time current flow into each driver and the voltage delivered to each driver, the impedance of each driver can be checked for continuity. This is a very important feature; if one single driver fails in a QFlex column, beam steering performance is seriously compromised.
2. The current in each output is monitored and used to determine if a short-circuited driver is causing a dangerous flow of current. If this condition is detected, the output for that driver is muted, and the condition logged.
3. The temperature of the electronics module is monitored and logged.
4. The voltage fed to each amplifier is monitored and is used to illuminate the 'clip' indicator in VNET software when it is determined that the amplifier is being driven into clip.

5.0 VNET Panel

1. We follow the same principles as the V Series, VNET product.
2. There are four different panels, one for each model of hardware (8 and 16 drivers, master and slave).
3. In a column consisting of a master unit and one or more slave units, VNET Software will discover a 'device' for each of these, and populate the 'Tree' with a node for each. A separate panel for each may then be launched.

4. The user panel for the base model allows access to:

- Gain trims for each of the 3 input sources
- Overall Gain
- Mute
- Input Equalization
- Delay
- High-pass filter
- Input level metering
- Limiter metering
- Temperature indication and logging
- Driver health indication (one per driver)
- Amplifier clip indication (one)
- Amplifier protection and logging (one)
- Thermal limiter indication and logging (one)
- Auto Power-Save control
- Loudspeaker name
- Settings name
- Beam Engine file loading features (see below)
- Operating Mode edit selection and active Operating Mode indication

5. The User panel for the Slave model allows access to:

- Limiter metering
- Temperature indication and logging
- Driver health indication (one per driver)
- Amplifier clip indication (one)
- Amplifier protection and logging (one)
- Thermal limiter indication and logging (one)
- Auto Power-Save control
- Loudspeaker name
- Settings name
- Beam Engine file loading features (see below)

6.0 Beam Steering

1. The beam steering parameters (steering coefficients) are determined entirely by the file loaded from the QFlex BeamEngine application.
2. A BeamEngine file may be loaded into a loudspeaker by clicking a 'Load Beam File' button. This launches a file open dialog, allowing the appropriate BeamEngine file to be opened.
3. A BeamEngine file would be loaded into the PodWare panel of each individual loudspeaker in a multiple QFlex column.
4. The Beam Steering parameters remain in the device until changed by loading another BeamEngine file.

Notes

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