

A new angle on steered sound

QFlex



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

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
- Fully PAVA compliant
- AES Connectivity
- IP54 Certified (optional)



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.

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...





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
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”

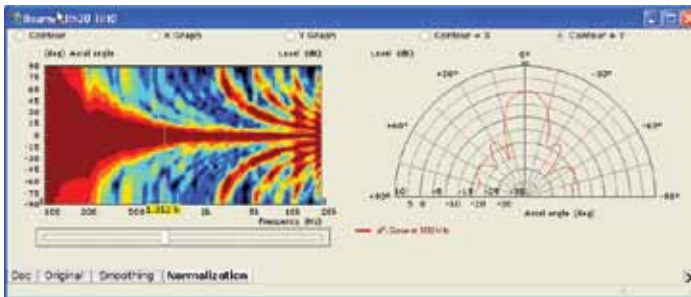
Why are you not using Dual Concentric or Coax Drivers?

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.

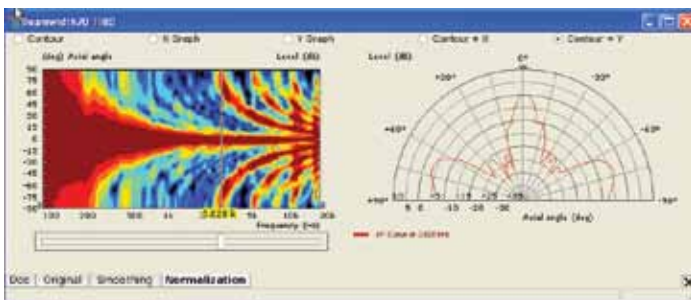
- Out of beam frequency response will be very irregular
- At high frequencies where tweeter spacing violates spatial sampling theorem ($\text{Dist} < \text{wavelength}/2$), we get strong side lobes (spacial aliasing)
- With extreme steering these lobes may even be significantly stronger than main beam

The effects of aliasing

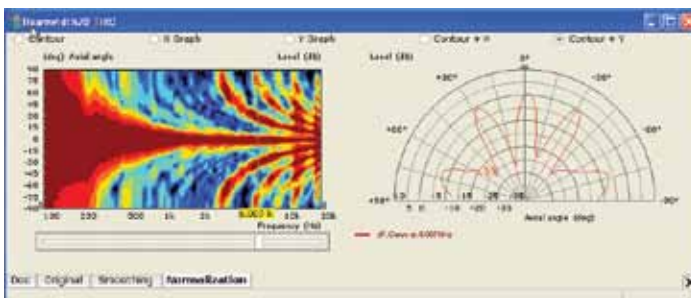
The measurements below show an 8 element device with the high frequency elements spaced at 100 mm (4") apart



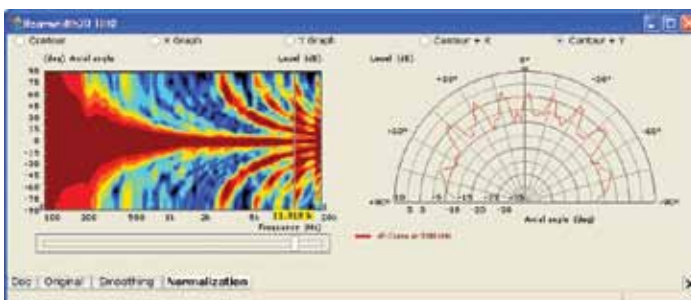
At 1 kHz the beam is well defined.



At 3 kHz 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.

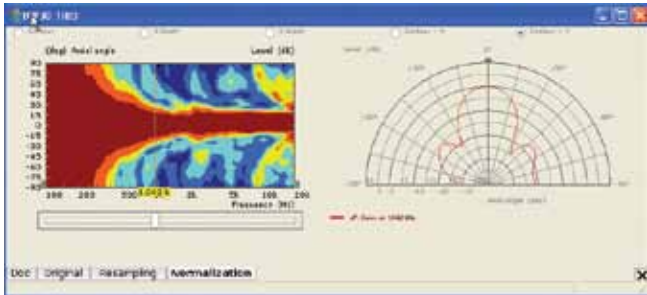


As low as 6 kHz multiple side lobes appear, effective beam control has now collapsed.

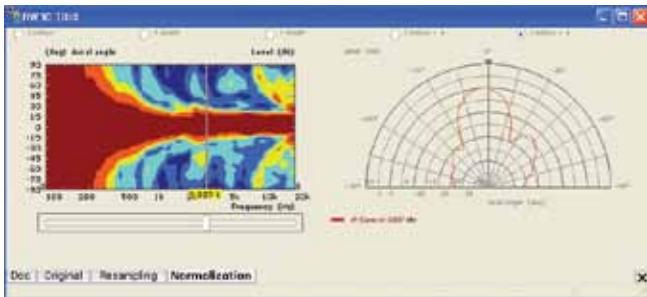


At 12 kHz the directivity characteristics are actually wider than that of a conventional loudspeaker.

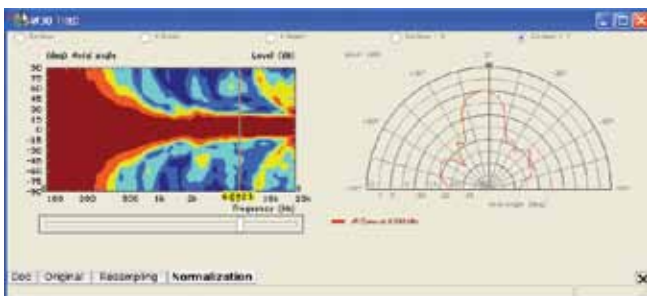
Example of a QFlex 16's beam control characteristics



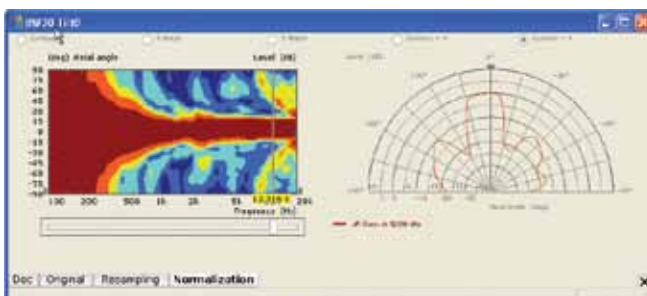
At 1 kHz the beam is well defined.



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



At 6 kHz 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 12 kHz the slight effects of aliasing (which are ultimately and eventually unavoidable) are still 10 dB lower than the main beam.

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)



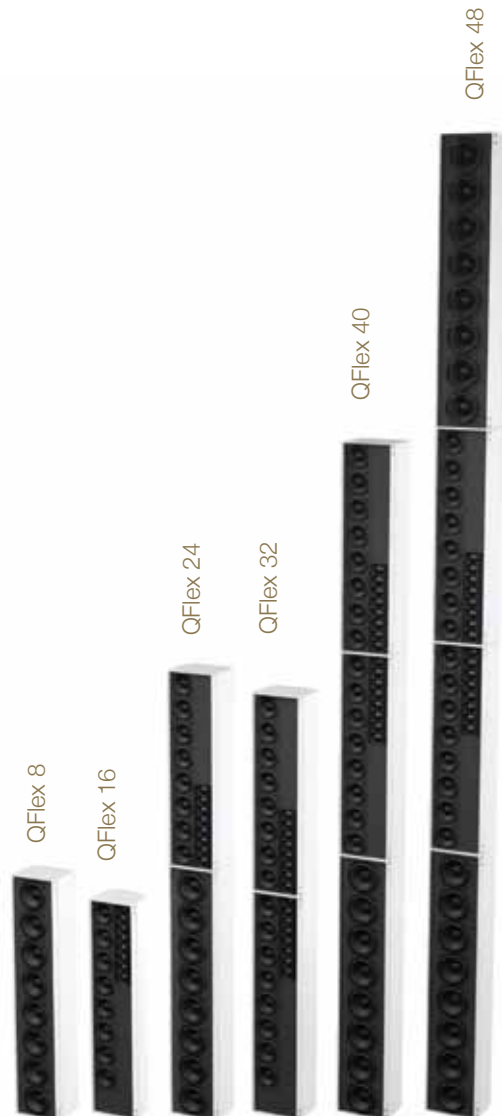
16 channel unit
(QFlex 16)



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 20 m (66 ft), and a QFlex 48 in excess of 80 m (260 ft)

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)

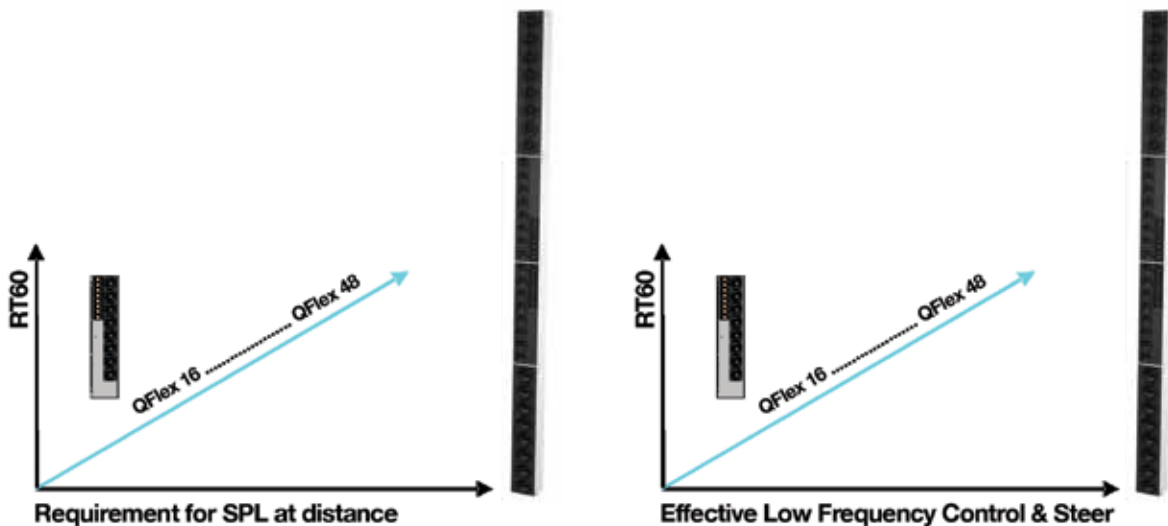
SPL Requirements

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.



Advanced Technology

The QFlex system offers many unique performance advantages over both traditional loudspeaker designs as well as other 'digitally steerable' products on the market. In addition to the core array products, Tannoy has also developed a number of additional optional components or enhancements to provide unrivalled flexibility and capability in even the most demanding installed sound applications.

Many of the new features that Tannoy has introduced on QFlex aim to deliver more resolute safety and monitoring facilities, making it fully compliant in any life safety or mass notification environment. In addition QFlex now benefits from multiple signal input capabilities and has also been weatherised for outdoor or harsh environments without compromising on the product's sleek aesthetic, making it even better suited for large scale transport hub applications such as within airport terminals and major train stations.

- 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
- 96 kHz 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 VNET systems
- Abuse monitoring and logging allows the installer to detect abuse of the product
- AES digital audio inputs as standard
- Optional Constant Voltage Interface available for easy integration with existing 70 V/100 V distributed systems
- For critical system wide monitoring and diagnostics in large-scale PAVA applications.
- New Dante Bridge device for integration with larger installed systems utilising the Dante digital audio protocol

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 96 kHz 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'.



Better connected

QFlex benefits from an extensive range of options where signal routing is concerned, with recent enhancements and optional interfaces greatly expanding on the standard analogue line-in. This ensures QFlex remains one of the most flexible and versatile digitally steerable systems on the market, easily integrated into any installed audio system design - both new or existing.

Constant voltage interface

For applications utilising existing front end 70 V / 100 V systems, a new Constant Voltage interface is available, allowing for integration into existing constant voltage systems by stepping down signal from 100V/70V to line level. The CV interface is an optional addition to any QFlex column, housed in a enclosure with identical profile to the QFlex column itself and fitting discretely to the base of the master unit (bottom of column).

AES connectivity

System connectivity has also been greatly enhanced with QFlex now being capable of receiving and transporting digital audio via AES3 stream over long distances. A new VNET/AES break-in interface is available from Tannoy, allowing the VNET network and AES3 to be transported on the same CAT5 cable.

Digital networking via Dante bridge

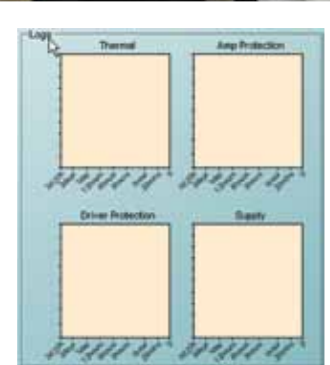
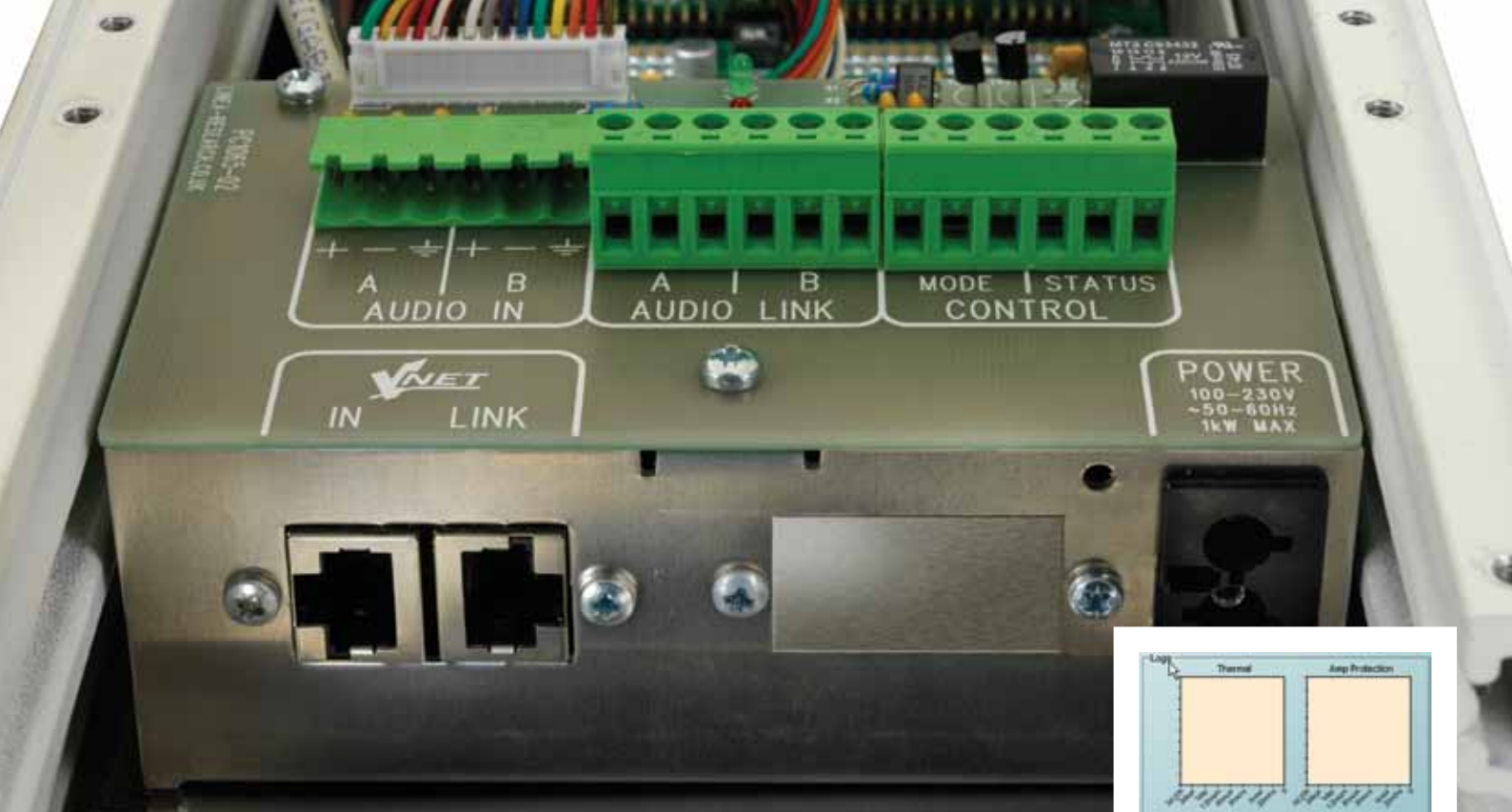
A fully networked solution is also available by way of a Dante network bridge. The advantage here is that we only need a single bridge per zone. This hybrid solution is very cost efficient and keeps node costs down.

PA/VA applications

Today we are encountering many applications where emergency PA/VA and BGM is combined.

For PA/VA we must provide the the features required to meet worldwide legislative and safety standards. QFlex is designed for use in emergency sound systems, providing the most resolute intelligent monitoring and protection system of any digital beam-steering product. Very Clear and intelligible messages are critical; it is vitally important that the message is clearly understood the first time, for both instructional and emergency scenarios in public buildings and transportation hubs. Many large transportation hubs pose a real acoustical challenge to the designer with hard and reflective surfaces contributing to high reverberation times.

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, making it a perfect choice for high quality BGM applications. QFlex will deliver increased intelligibility in reverberant spaces and consistent SPL, whether you are close to the speaker or at distance. In many cases, a product such as QFlex is the only way of achieving the required levels of speech intelligibility in large reverberant spaces.



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 in such a 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.

Extensive Diagnostics

All elements of QFlex products are constantly monitored and logged. Fault conditions can be reported in various ways -

- Via the built in onboard failure relay
- Via the VNet network on software
- Sentinel SM1 System Monitor

Sentinel SM1 system monitor

The optional standalone Sentinel SM1 System Monitor provides complete system-wide fault monitoring and reporting for mission-critical applications. Built on a tried and trusted processing 'engine', Sentinel keeps a watchful eye on the audio system and, if required, any controlling PCs. Problems are reported via relay contacts to the main monitoring panel in your system as well as being shown on Sentinel's front panel display. Multiple Sentinels can even monitor each other and the same network simultaneously for systems that require dual redundant monitoring.

Ease of use

There are no complex menus or software applications to navigate with the SM1. In most cases, you simply connect the SM1 to your network of VNet devices, and it immediately starts to provide the monitoring your system requires.

If your system demands something slightly more elaborate, such as monitoring a PC, then a simple control panel in the PodWare application allows you to set such things up.

Reliability

Sentinel SM1 has been built on a hardware and software platform which has been field tested for several years and proven to be extremely reliable. But, just in case of any problems, a hardware Watchdog monitors the operation of the software, and will cause the processor to do a hard reset and restart if any problem is found.

PodWare application

The companion PodWare PC Windows application uses a small panel called a Monlcon to display all important status information at a glance. The full control panel is only one click away from the Monlcon, from which adjustments to all facets of Sentinel's operation may be made. In most cases no setup will be required.

Security

SM1's front panel controls may be disabled via the Secure button on the rear panel of the unit.



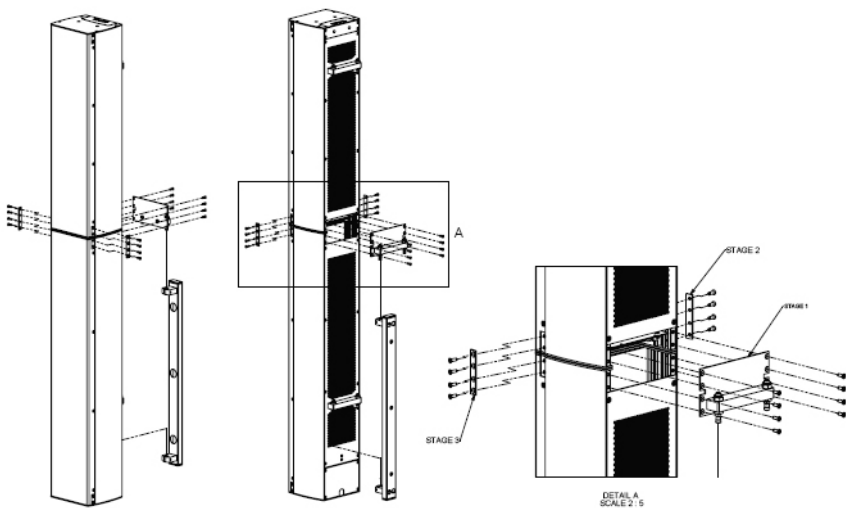




Hardware and ordering information

The ordering process is simple simply choose the model you require. All of the necessary hardware and brackety is included. Large QFlex modules are shipped in individual boxes for simple assemble on site. Design assistance is available for unusual mounting applications like soffit mounting.

Assembly is simple –



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



All QFlex models are available with optional specification for custom paint colour finish as well as in weatherised 'WP' variant for operation in challenging environmental conditions.

Custom colour finish

Tannoy offer custom paint finish on all QFlex models, in any standard RAL colour as well as advanced custom texture mapping.

This advanced technique allows for QFlex columns to be perfectly matched with building material textures such as marble, sandstone or wood - making the loudspeaker completely discrete and architecturally neutral, a critical benefit where strict design aesthetics are an issue such as in traditional house of worship spaces or modern designed art galleries and museums. Custom finishing requires additional lead-time on delivery and must be specified at order.

Weather proof

Weather proofed (WP) versions of QFlex are available which provide protection against water and dust ingress to IP54 standard. These enhanced QFlex models benefit from gasket sealed enclosures, solid aluminium rear panels, grade 304 stainless steel mounting hardware and sealed cable gland on the input and power connector. This specification is available with additional lead-time on delivery and makes QFlex capable of operating in more challenging environments where limited moisture and dust/airborne contaminants are an issue, such as railway stations.



Specifications

	QFlex 8	QFlex 16	QFlex 24
Configuration			
4" LF	8		8
3" LF		8	8
1" HF		8	8
No. of Amp Channels			
100 W (RMS) @ 4 ohms	8	16	24
Vertical dispersion	Variable between 10 - 100 degrees (Asymmetric & multiple beams may also be generated)		
Frequency range	110 Hz - 4 kHz	130 Hz - 20 kHz	110 Hz - 20 kHz
Horizontal dispersion	120 degrees	120 degrees	120 degrees
Aiming angle limit	+/- 70 degrees	+/- 70 degrees	+/- 70 degrees
LF Beam control limit	700 Hz	700 Hz	400 Hz
Maximum SPL @ 100 ft (30 m)*	92 dB	94 dB	96 dB
Column height	840 mm (33")	744 mm (29.3")	1483 mm (58.4")
Column width	171.5 mm (6.7")	171.5 mm (6.7")	171.5 mm (6.7")
Column depth	150 mm (5.9")	150 mm (5.9")	150 mm (5.9")
Typical application distance**	20 m (66 ft.)	25 m (82 ft.)	40 m (131 ft.)
Sample rate	96 kHz	96 kHz	96 kHz
Audio inputs	Analogue & AES/EBU	Analogue & AES/EBU	Analogue & AES/EBU
Weight inc hardware	15.25 kg (33.6 lbs)	14.25 kg (31.4 bs)	26.25 kg (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)

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



Select Your QFlex Model

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.

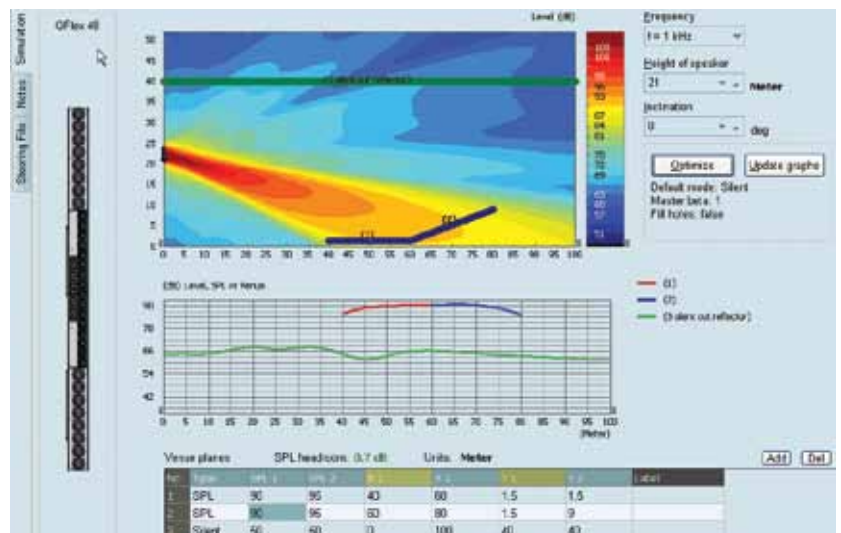
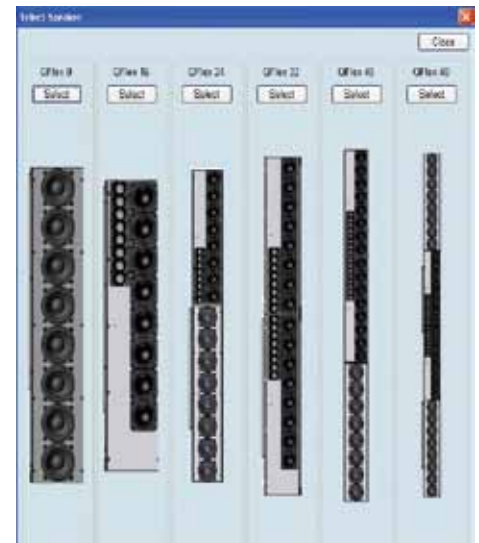
From the defined listening area input by the user, they specify target SPL's over the coverage area. Multiple audience areas can be specified if required.

We use 3 different status sets for each zone specified:

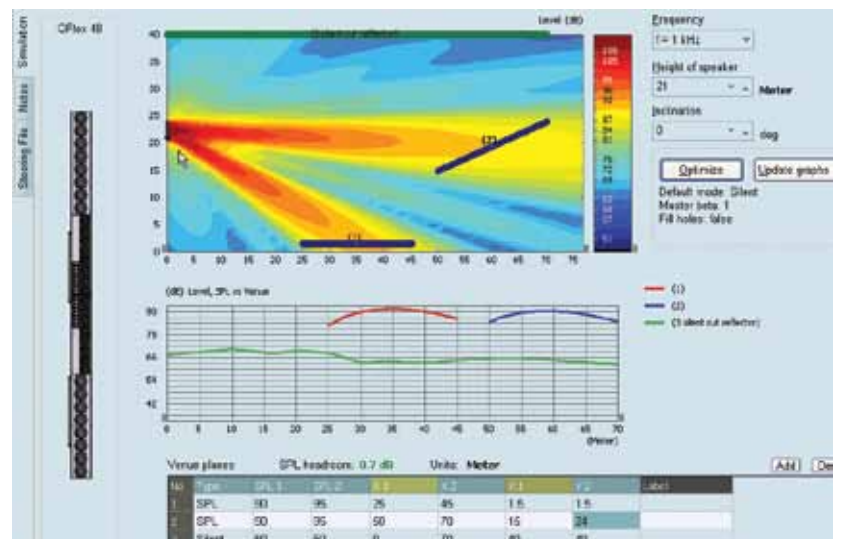
Specified value, silent, or unspecified ("don't care").

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.



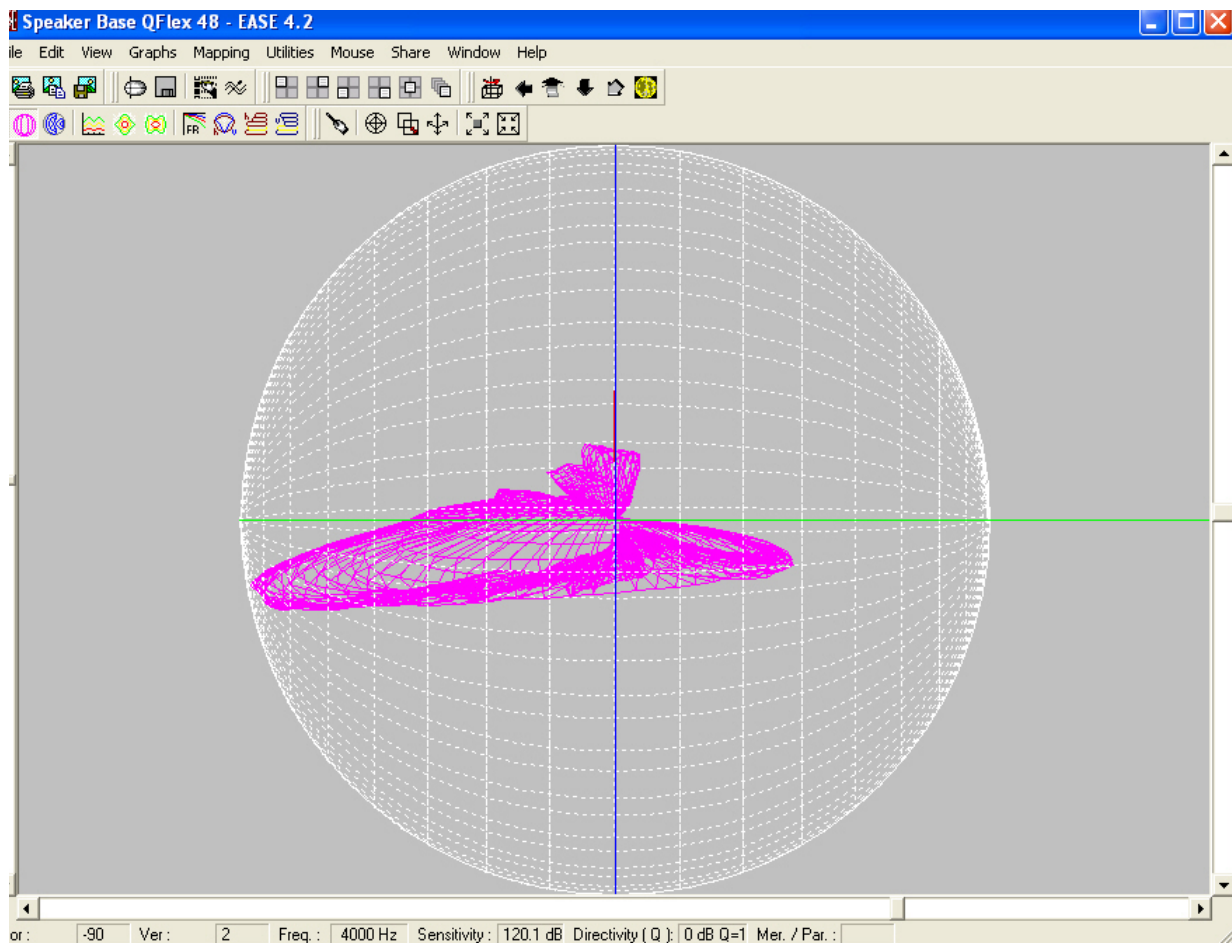
Optimize your space



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





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.

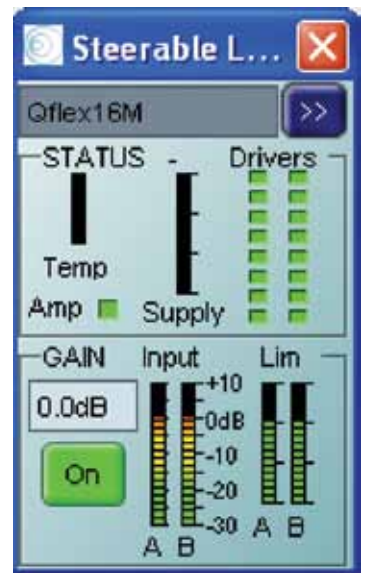
System commissioning and ongoing venue network control, incorporating real time diagnostics of electronics and drive unit, are all managed by the exclusive VNET software package.

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.



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