Presenting Technical Insights Amplifies Understanding

DISCLAIMER

All information in the Technical Info pages are derived from various sources. They are deemed to be correct at the time of printing. However, some errors may occur due to unforeseen circumstances. Amperes Electronics shall not be liable for any consequences due to the application of the information or data provided. Technical specifications or data are related to audio engineering and may be amended for errors or due to improvement of technology.

TECHNICAL INFO

Selecting which products to fit into your system may be confusing. It will be based on your needs, expectations and regulatory requirement. Regulatory requirement is to comply specifications of fire departments and local building bylaws. The needs and expectations is leaning towards achieving satisfactory sound performance and corporation's own specifications.

Amperes has multiple models which can be mixed and matched to fit either needs.

In order to assist the designers to select appropriate products, Amperes has laid out simple guidelines which are divided into 5 categories, i.e. from simple / basic system to more complex IP setups. Each group can be further divided into different applications based on size and optional items.

We had provided sample drawings for easy reference. Log into the Technical Page in our website by scanning the QR code below.

We are also available for further technical assistance in designing your system.

Category of systems :

1 BASIC

Small application for paging and BGM with zones less than 6. Low cost and not required to comply to Fire Codes.

Examples :
Shops or showrooms, meeting rooms, workshops, surau (mosulla), small warehouse, counter calling, etc

2 CONVENTIONAL SMALL ANALOGUE

Small application for paging and BGM with zones up to 12. Low cost and required to comply to Fire Codes.

Examples :
Office buildings, factories, hypermarkets, mosques, boutique hotels, schools

3 CONVENTIONAL DIGITAL

Medium to large system of up to 250 zone, single or multiple connected buildings and need to comply to Fire Codes.

Examples :
Office / mixed development complexes, universities and colleges, hotels etc.

4 ETHERNET IP

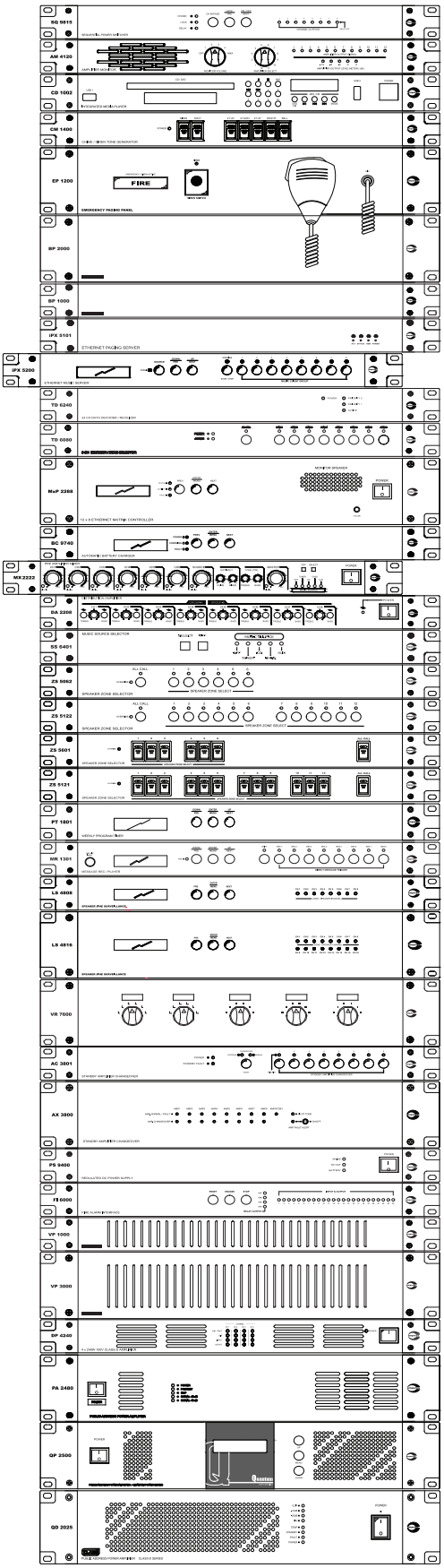
Medium to large decentralised systems of up to 250 zone. The cabling works for long distance may be an issue as well as using wireless connectivity for paging and BGM broadcast.

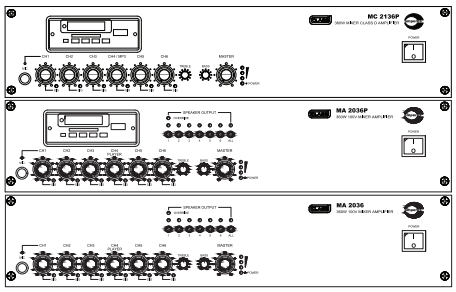
Examples :
Office / mixed development complexes, universities and colleges, hotels and resorts, parks, security and safety alarm broadcastings, etc.

5 MATRIX

Small to medium system which require flexibility of configuring different audio to different zones with uninterrupted paging. It can be full matrix (designated audio to zone) or semi matrix (groups with same audio-zones).

Examples :
Mixed developments, clubhouses, high end residential, hotels





Product outline drawings can be downloaded from our website

www.ampereselectronics.com
Precision Design, Absolute Confidence

VOICE ALARM SYSTEM; CODE OF PRACTICE

The following standards are applicable in the design of PA system for commercial applications;

BS 5839 Part 8 : 2013 : Code of practice for the design, installation, commissioning and maintenance of voice alarm system
EN 54 Part 16 : Design of Voice Alarm Control and Indicating Equipment
EN 54 Part 24 : Requirements for the design and construction of loudspeakers
SS 546: 2009 : Emergency voice communication system in building (Singapore Standards)

The use of the above documents : "As a Code of Practice, this standard takes the form of guidance and recommendations. It should not be quoted as if it is a specification. However, particular care should taken to ensure that claims of compliance are not misleading"

CE Markings : Most of Amperes products are CE certified by third party certification labs, under the standard IEC62368-1 (formerly 60950-1 and IEC60065 for Audio Visual products)

NEED FOR A VAS It is proven that most people react in a timely manner to voice messages as compared to bells / sounders and text information. A voice message reduces the wastage of precious time during distress in advising occupants to react to an emergency.

The followings are extracts from BS5839 Part 8:2013, summarized into points and applicable products from Amperes that shall be able to comply with the clause stated. This guide does not attempt to cover all the details of the standards and the reading of the requirements is through the publication itself.

Scope	Brief	Compatibility
Types of VAS	Category of systems as : Type V1 : Auto evacuation Type V2 : Live emergency messages Type V3 : Zonal live emergency messages Type V4 : Manual controls Type V5 : Engineered systems (tailored solutions)	Various components / equipment are available to mix and match which are compatible for each other to cater for the different categories of VAS applications.
Design of System	System type shall based on requirement such as : - Max size of coverage area - Min sound pressure level - Min intelligibility - Min duration of standby power supplies - Parameters of cables	Consult our technical team for optimum delivery and cost effectiveness of the required system
Fire alarm and VAS Interface	The necessary link between FAS and PA, the triggering method and the communication path between them	Amperes FI6000, MR1301, EP1200 Initiation from Fire Alarm panel to these devices shall perform the necessary alarm or messages, including manual bypass.
Fault monitoring	Faults shall be indicated within 100s from the occurrence for components and transmission path	Compatible components for fault reporting includes : Amperes LS4808 / 4816 speaker line monitoring unit Amperes AX3800 amplifier changeover Amperes BC9740 battery charger iPX modules are monitored via iPX5101 Network controller
Loudspeaker zones	Co-relations between emergency speaker zones and fire detection zones	Speaker zones can be divided into zones conveniently using Amperes ZS Series of speaker zone selectors
Loudspeaker and intelligible coverage	Selection of type, number, location and orientation of speaker according to acoustic and climatic environment, ambient noise level, area of coverage, characteristics of speakers etc.	Various types of speaker are available from ceiling to horn to suit the purpose such as emergency / BGM, environment and quality of sound reproduction.

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Scope	Brief	Compatibility
Power amplifiers	Requirement of reliable amplifiers with - Frequency response of at least 200 Hz to 8 kHz - Availability for standby changeover for faulty unit	Amperes series of amplifiers surpass the requirement with - QP / QD / PA / DP Series of amplifiers - Amperes AX3800 amplifier changeover
Ambient noise sensing (ANS)	Application of ambient noise detection and compensation (ANS) to adjust volume accordingly to improve intelligibility. (optional item)	Auto volume controller detects noise and adjust accordingly at specific area or zone, installed along with the 100V line circuit. Amperes AV7200 auto volume controller
Emergency microphones	States the requirement of easily accessed console at FCC and its characteristics such as : - Frequency response of 200 Hz to 5 kHz, min distortions - Priority override of all other audio sources - Single emergency mic active at any one time	Emergency paging panel with highest priority available for both conventional and IP systems. Both with built in siren tone generator, message inputs and visual indications. Amperes EP / iEP1200
Emergency message generator	Specifies the requirement of prerecorded emergency message player with minimum requirement such as frequency response, SN ratio and THD, storage media with non mechanical parts.	The EVAC player has memory bank of over 500 hours and easily adaptable to most installation Sample messages are available in several languages. Amperes MR1301 MK II
Priorities of messages	Classifications of priority level of messages or announcements to be as : - Emergency microphones - Prerecorded message from life threatening to warnings - Other prerecorded emergency messages - Non emergency messages	Amperes system has been designed with priority level, Emergency Paging panel being the highest. Upon activation from FAS to system, user shall have the control to assign the priority level of all other messages. Related products. Amperes FI6000 MK II, MR1301 MK II, EP1200 Amperes PT1801 MK II for scheduler messages
Networked large systems	Applicable for networked systems with separate VACIE or individual systems and linked to central. It stressed the importance of link communications and the ability to operate independently if any fault occurs at either one of the systems or the communication line.	Amperes iPX Ethernet IP PA is able to operate independently even when the main communication line to sub rack fails
Power supplies	Specifies the criteria of Mains power supply, back up power in case of mains failure, the duration of standby and operation for different types of installations. This includes Mains and back up indicators and labeling. Minimum back up capacity shall be 24 hours for standby and at least 30 minutes of operation	Technical info on battery calculations is available. The battery charger has indicator for charging status and some protections to prolong battery life, such as low battery warning and disconnection. Amperes BC9740 battery charger

Other parts of the standards include the followings :

- Placement and accessibility of VACIE
- Cabling of speaker circuit and its safety requirement
- Electrical safety precautions to VAS equipment
- Responsibility of installer, practices and workmanship
- Inspection and testing of wiring
- Commissioning and handover procedures including documentation and certification
- Acceptance and verification of installed system
- Maintenance of the system including user responsibility

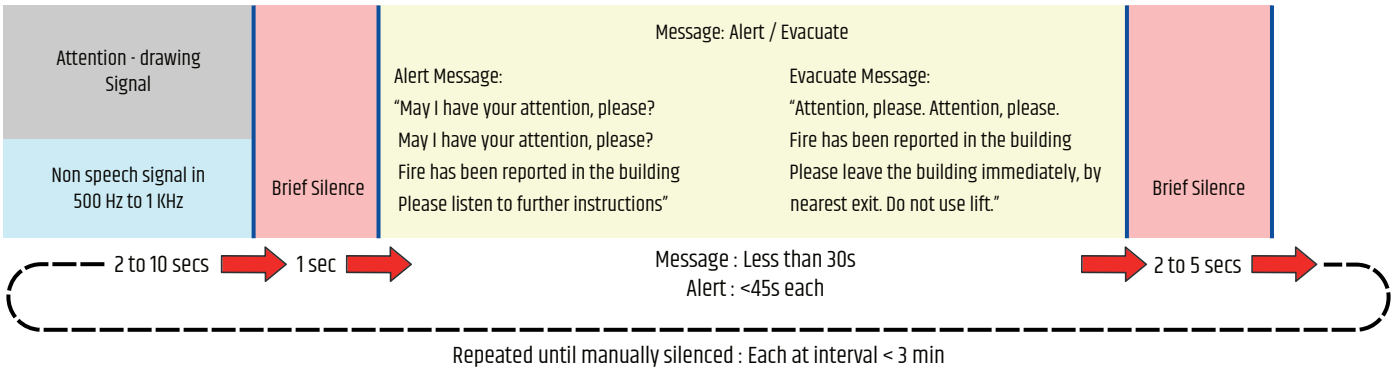
Abbreviations :

VAS - Voice Alarm System
VACIE - Voice Alarm Control and Indicating Equipment
FAS - Fire Alarm System

The above extractions are only partial and relevant informations of which components from Amperes shall be able to offer or comply. Please refer to full text of the Standards.

RECOMMENDED MESSAGE SEQUENCE

Broadcast of alert or evacuation message should follow the sequence as shown below. The type of messages can be customized to suit local environment such as language differences. In some cases, it can be coded which is to alert staffs on possible emergency cases to avoid panic to the public.



The period of silence may depend on Reverberation Time (RTs) of the area.

SOURCE : BSI PUBLICATION

CHOOSE THE RIGHT INSTALLER

It is important that competent and well trained personnel are consulted and engaged in the design process, installation, testing and commissioning of the system to avoid design errors resulting in less than expected system worthiness.

Amperes are always ready to engage actively from the design stage towards end of installations. We are also available to provide installation support through our certified installers and maintenance works.

Please consult us for details.

CALCULATING BACK UP BATTERY CAPACITY

For most commercial installations, it is a requirement by local authority that the PA system must be able to operate during power failure. The means for back up supply to the system can be from building's standby generator or via standalone back up power supply bank i.e. Batteries.

The standby batteries' capacity should meet the requirement for either these conditions :

Building with back up generator :

- the minimum capacity to maintain the system operation for at least 6 hours, after which it is able to operate evacuation broadcast in all zones for at least 30 minutes.

Building without back up generator :

- the minimum capacity to maintain system operation for at least 24 hours. after which it is able to operate evacuation broadcast for at least 30 minutes

Calculation of minimum battery capacity :

C min = 1.25 ((T1 x I1) + D (I2 x T2) Ah

C min - min capacity of battery when new at 20 hr discharge rate at 20C in AH.
1.25 - Ageing factor allowing 5% per year for 4 years
T1 - Battery standby period in hours
T2 - Alarm time in hours (as 0.5 or 30 minutes)
I1 - Battery standby load in amperes
I2 - Battery alarm load in amperes
D - Battery de-rating factor (usually 1.75 for inefficiency of battery under load)

Example :

A system with full load of 50 amps and standby current at 2 amps would require minimum battery capacity of :

Cmin = 1.25 ((24 x 2) + 1.75 (50 x 0.5))
= 114.7 Ah

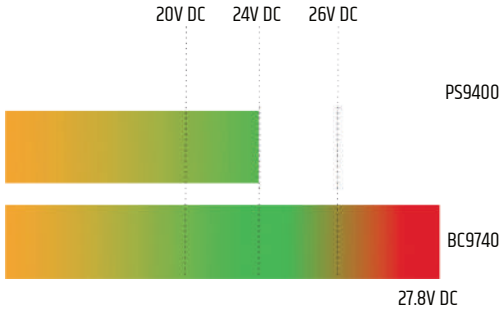
Select the closest battery capacity which is 100 Ah or 150 Ah.

Source of Info : BS5839-1 : 2013 ; annex D

CORRECT WAY OF POWERING EQUIPMENT WITH 24V DC POWER SOURCE

It is a misinformed idea to save some equipment cost in powering up equipment with 24V DC by using voltage output from battery charger instead of a 24V DC power supply unit or adaptor. It may damage the equipment concerned as normally they can operate in the range of 10% voltage tolerance and anything above that shall stress the power regulating circuitries. Not only would it shorten the life span but it would also generate excessive heat.

Voltage from battery charger is normally around 27 to 28V DC whereas from power supply unit i.e. Amperes PS9400 is regulated at 24V DC. Thereby it is highly recommended to use suitable regulated power supply unit for operation.



The chart shows typical voltage output from a 24V DC regulated power supply against 24V DC battery charger. Most equipment can operate in the voltage range indicated by green colour. Apparently, it is not advisable to use battery charger's output as operating power source.

IP RATINGS

First Digit (Protection fr. Solid Object)		Second Digit (Protection from liquid)	
0	No Protection	**0**	No Protection
1	Solid object of up to 50 mm and above	**1**	Vertically falling water drops
2	Solid object of up to 12 mm and above	**2**	Water spray with 15° vertical angle
3	Solid object of up to 2.5 mm and above	**3**	Water spray with 60° vertical angle
4	Solid object of up to 1 mm and above	**4**	Water spray with full all direction with allowance
5	Dust with no harmful deposits	**5**	Low pressure water jet from all direction
6	Full protection from dust	**6**	High pressure water jet from all direction
		7	Temporary immersion in water
		8	Long immersion in water

Ingress Protection up is a classification to indicate the degree of protection of enclosures (such as speakers) against penetration of solid particles and moisture.

It is usually stated in two digits, IP54, which the first digit refers to protection against solid object and the second digit for protection from moisture.

Ref Standards : IEC 60529

GENERAL TERMS USED IN PA SYSTEMS

ROOT MEANS SQUARE (RMS) :

Average value of ac voltage, it is 0.707 time of the peak voltage of a constant sine wave.

IMPEDANCE (Ohm with symbol Z) :

A measurement of total resistance to current in a circuit with inductance and capacitance, such as speakers and microphones. The value differs for different frequencies, and thereby would normally be rated at Ohm @ 1 KHz.

Impedance of speaker circuit is measured with impedance meter and not the common multimeter.

SENSITIVITY :

The minimum signal required to produce a fixed output level and is specified in various terms. In microphones (mV/Pa), it is the amount of mV produced by a Pascal of sound pressure (94 dB) in axis with the transducer. In Speaker (dB, 1W @ 1m), it is the sound output in dB produced by 1W of power and is measured in axis of 1 m away. In professional amplifiers (dBu or V), it is the input signal required for the amplifier to reach its rated output.

SIGNAL TO NOISE RATIO (S/N Ratio) :

Measured in dB, is the ratio of signal to noise at same point of signal. It is measured at 1 kHz with 1V input signal. Higher S/N ratio is always preferred.

DECIBELS (dB) :

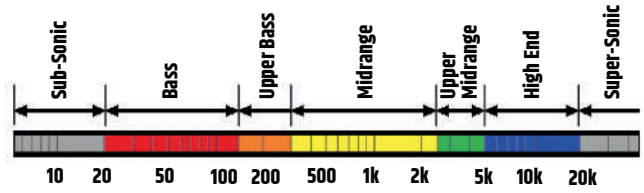
To express the ratio between two signals, like Voltage, Power, Current, etc. It's expressed in dB SPL for Sound Pressure Level, dBV for relativity to 1V and etc.

TOTAL HARMONIC DISTORTIONS (THD) :

Expressed in %, it's the ratio of fundamental frequency to the level of all harmonic frequencies produced by equipment. Lower percentage is better.

FREQUENCY RESPONSE :

Is used to indicate how well an equipment or speaker response to the audio input signal, usually 20 to 20 KHz. It is usually measured at 1KHz reference, 1V input level with +/- 3 dB.



BALANCED SIGNAL :

It refers to the cable carrying audio signal with 3 conductors, i.e. Hot, Cold and Ground or Shield. It offers better immunity against external interference and is the preferred choice for long distance cabling.

UNBALANCED SIGNAL :

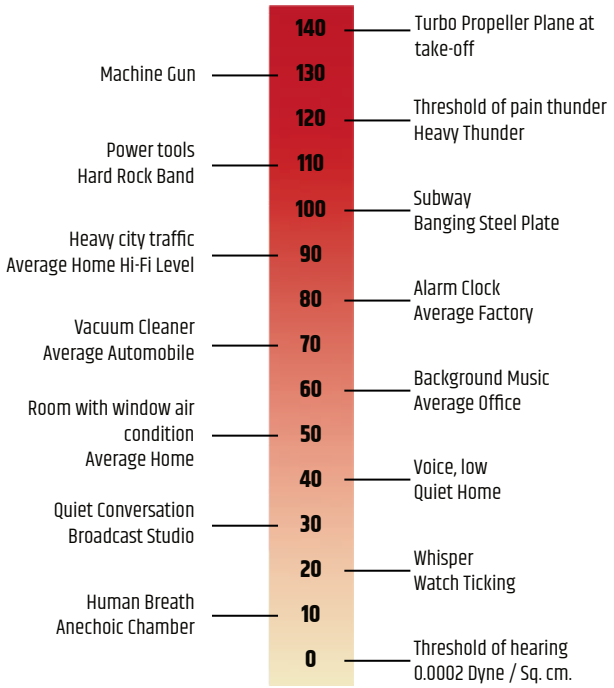
Refers to audio signal in cable with Hot and Ground (Shield) conductors. It is recommended for short distance cabling as it is subjected to interference.

SPEECH TRANSMISSION INDEX (STI) :

STI is used to measure speech intelligibility by injecting a test signal at source point and measurement is made at the listening plane. The measured value is within the range of 0 to 1.

SOUND PRESSURE LEVEL (SPL) :

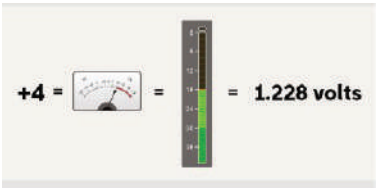
A measurement of loudness in relation to the threshold of human hearing at 20 uPa. It varies with frequencies and thereby in audio, it is expressed as RMS value in dB SPL. See also the SPL chart.



AUDIO LEVELS :

In professional audio, line level is referred to as +4 dBU which is a reference of how much it is above or below the reference level of 0.775V. 4 dBU = 1.25V rms. The value of consumer or semi-professional differs and is lower than this, eg. 0 dBV = 1 V rms. Consumer line level is typically -10dBV or 0.32V.

0.775V rms is used as reference as it is used to generate 1 mW (0 dBm) over the load of 600 Ohms. (P = V2 / R).



dBV	Voltage
+20 dBV	10 volts
0 dBV	1 volt
-20 dBV	0.1 volts
-40 dBV	0.01 volts
-60 dBV	0.001 volts
-80 dBV	0.0001 volts

TERMS RELATED TO SPEAKER POWER

AVERAGE POWER :

Often referred to as rms Power since rms value of voltage and current are used to calculate the power of speaker.

PROGRAM POWER :

Also known as Music Power and is normally twice the amount of Average Power. It is used to select suitable amplifier rating.

PEAK POWER :

Defines instantaneous power delivered to speaker at highest level of output.

SOUND PRESSURE LEVEL (SPL) OF SPEAKERS

From technical data sheet of speakers, it will normally indicate the SPL as example : 90@ 1 kHZ / 1W / m. Which means at 1 kHz, the SPL is 90 dB. Some datasheet may provide SPL at different frequencies, normally 4 kHz, 8 kHz, 12 kHz.

There is a co-relation between SPL shown at the datasheet against the distance from the point of speaker and the subsequent power pumped to the driver.

SPL (dB) TO DISTANCE

Sound Pressure Level ; SPL (dB) shall drop 6 dB whenever the distance from the source is doubled, calculated from :

SPL drop = 20 log D (D= distance in meter)

Distance (m)	2	4	8	10	15	20	30	40	50	60	80	100
dB Loss	6	12	18	20	23.5	26	29.5	32	34	35.6	38	40

SPL (dB) TO DISTANCE

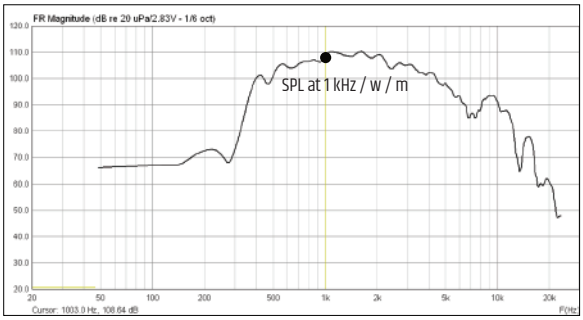
SPL (dB) shall increase by 3 dB when the power to the speaker is doubled, calculated from :

SPL = 10 log W (W= power input)

Power (W)	1	2	4	8	10	15	20	30	40	50	80	100
dB Increase	0	3	6	9	10	11.8	13	14.8	16	17	29	30

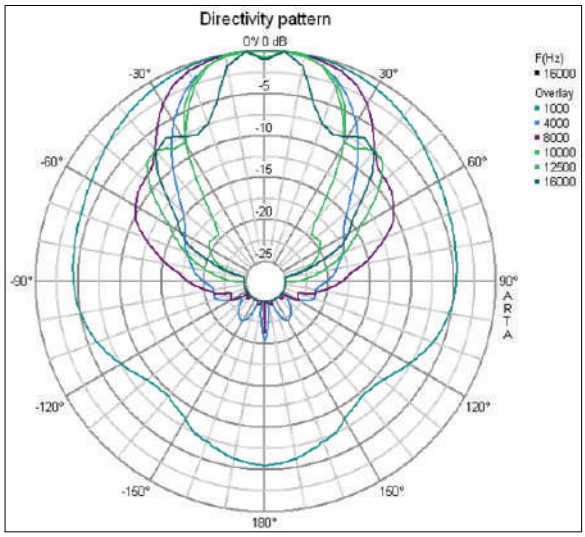
To determine SPL at a distance away :

SPL (d) = { SPL rated + 10 log W } - 20 log D
E.g. Speaker is rated 90dB W/m @1 kHz and powered at 10W at a distance 20m away, the SPL is :
SPL 20m = (90 + 10 log 10) - 20 log 20
= 100 - 26
= 74 dB



Frequency response chart

The above chart shows frequency response of a speaker from 20 - 20 kHz with 1W power applied to the driver and measured at 1 m away. From the chart, SPL with reference to 1 kHz can be determined. The frequency response of the speaker is then deduced by drawing a range of + / - 3 db at the 1 kHz point. Some manufacturer may state as +/- 6 dB.



Polar chart

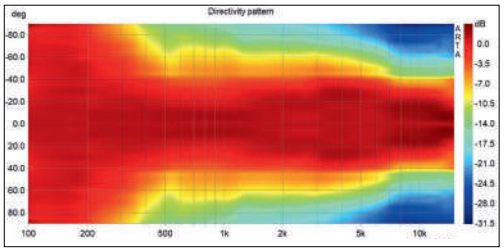
Polar chart of a speaker may be half of full polar.

A polar chart shows the dispersion angle of a speaker of different frequencies. This chart is generated at speaker test room or anechoic chamber by powering the speaker with 1W, measured by a well calibrated measurement microphone and taken at different angle of speaker orientation.

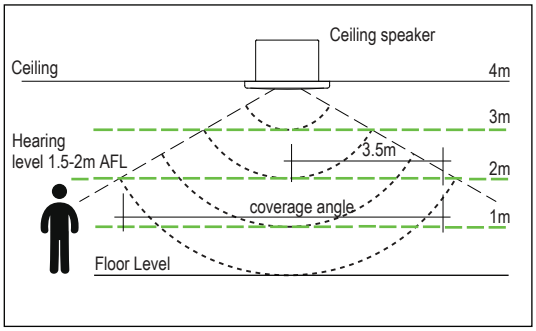
Polar chart would normally show horizontal reading and vertical dispersion angle is collected by following the above method.

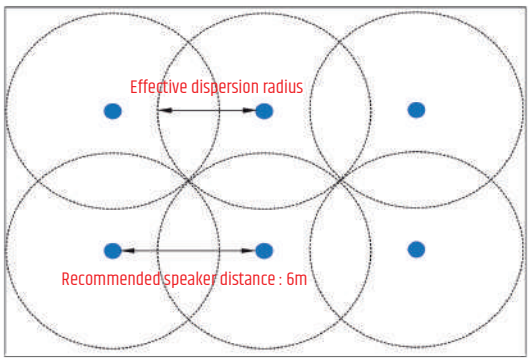
Data of dispersion angle of a speaker can be used to determine the quantity required for an area, with reference to the listening plane height, the power tap and the SPL to be achieved.

A more illustrative simulation showing colored map can also be generated showing the SPL intensity for different frequency against the dispersion angle.



POSITIONING OF SPEAKERS





The criteria to be considered in determining the number of speaker required in any installation shall include :-

1) The ceiling height
2) Acoustical factor of the environment
3) Type of speakers, e.g. Dispersion angle and SPL level.
4) Expected environment such as factory, office or shopping complex.

In order to hear properly, the sound source from speaker shall be around 6 to 10 dB above the background noise.

If the power input is 3W, the SPL (1 kHz) at 2m from speaker shall be approximately 93 dB. With music source, the average SPL shall be 3 dB below; thereby the hearing will be around 89 dB, which is a rather comfortable level in a shopping mall.

From this, the coverage area can be estimated ; i.e. Approximately 7m diameter or 38 sq m. Further to this, the distance of speaker can be ascertained by dividing the area of the mall to the area of coverage by each speaker.

Data sheets for speakers are available to be downloaded from our website. Refer to each individual speaker for more information.

SPEAKER CABLING IN 100V LINE SYSTEM

Cable used in PA installation is subjected to losses, which is similar to cabling in electrical installations. The factors affecting the percentage loss include the cable size, length, conductor material, input voltage, load and temperature. A typical loss chart with relation to cable size is shown below (copper conductors in single phase).

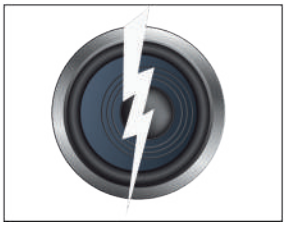
Refer to manufacturer's data sheet for more accurate information.

Cable Gauge AWG	Conductor Size (mm sq)	Impedance Ohm / 1000 ft	Length in Meter for 0.5 dB Power Drop (Appr 81% at Load)				
			500W Load 20 Ohm	300W Load 33 Ohm	200W Load 50 Ohm	100W Load 100 Ohm	50W Load 200 Ohm
10	5.26	1	190	320	490	990	1990
11	4.17	1.26	150	260	390	780	1580
12	3.31	1.59	120	200	310	620	1250
13	2.62	2	90	160	240	490	990
14	2.08	2.53	75	130	190	390	780
15	1.65	3.18	60	100	150	310	620
16	1.31	4.02	45	70	110	240	480
17	1.04	5.06	35	60	90	170	390
18	0.82	6.39	26	50	70	150	370

Cable Size	125W power		250 W		500W	
	1 dB loss	3 dB loss	1 dB loss	3 dB loss	1 dB loss	3 dB loss
10	1727	6045	862	3017	429	1502
12	1087	3805	542	1897	270	945
14	683	2391	341	1194	170	595
16	430	1505	215	753	107	375
18	269	942	134	469	67	235
Total Impedance	800 Ohm		400 Ohm		200 Ohm	

This table provides an approximate cable length permissible for specified loss of signal in 100V line speaker installations.

POSSIBLE CAUSE OF SPEAKER DAMAGE



Speakers may be damages while in operation and can be associated to excessive power delivery in certain frequencies or due to natural disaster such as lightning strike. To prevent or at least to prolong the lifespan of the speaker, the followings should be taken into consideration.

- Avoid excessive input power to speakers.
- Ensure audio signal delivered is within the frequency bandpass of the speaker (e.g. sub bass)
- Do not allow amplifier to clip, i.e. ensure power rating of amplifier is higher than the total load
- The amplifier with DC output protection, and preferably with high pass and low pass filters