Delta 20, DNA20

100V/70V Systems

Introduction

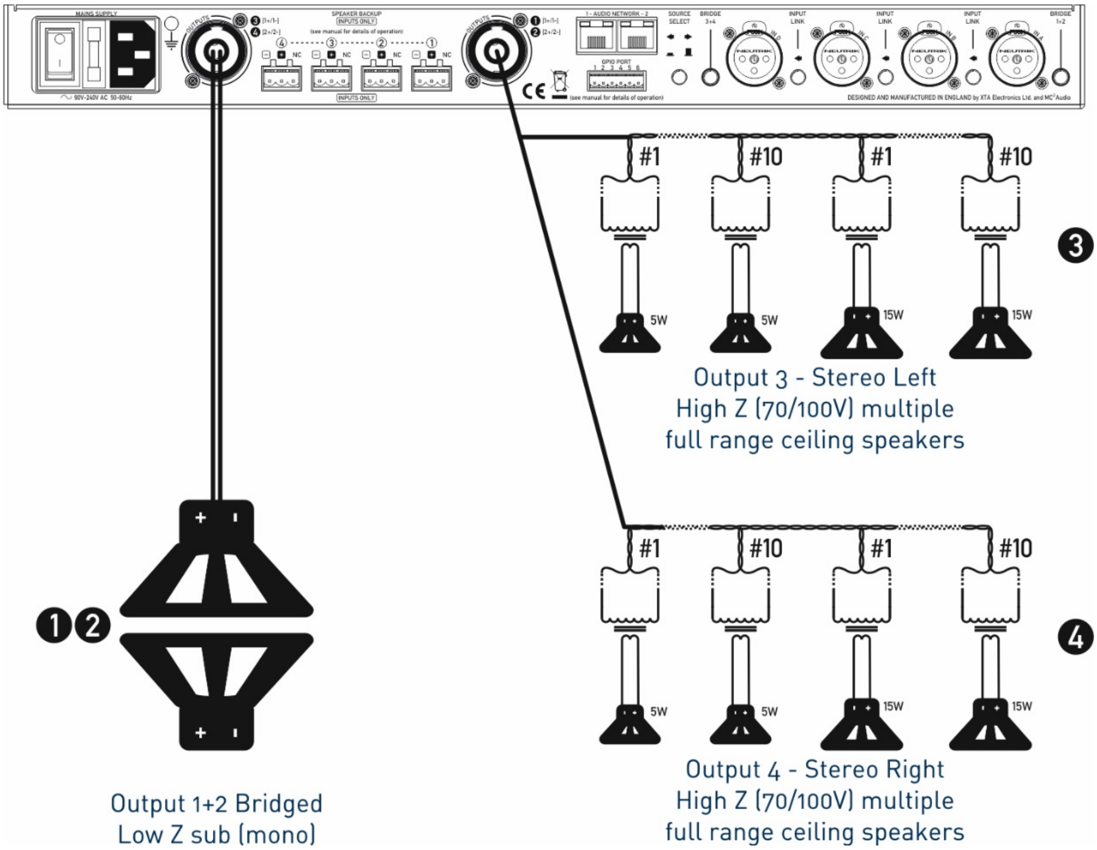
Despite the MC2 Delta 20 and XTA DNA20 being designed to with the highest audio performance in mind, they also lend themselves to applications for simple-to-deploy distributed audio applications – and that's from an input point of view with a Dante Network input option, and from an output point of view with step-up transformer options.

Individual channels can be fitted with either 100V or 70V step-up transformers, and this includes a high pass filter to prevent TX saturation and reduced performance. Having this flexibility to select any or all channels to run at "Hi Z" means systems using Delta 20/DNA20 amplifiers can combine the "best of both worlds" – quality multi-drop speaker systems with localised "Lo Z" for bass applications or bigger full range speakers.

Here are a couple of examples where this combination wins over traditional set-ups, providing better performance, and lower cost alternatives.

System #1 – fill a bar with background music but give it some hi-fi weight…

We've bridged the first two channels of the amplifier to give you about 650-700W into 4 R – enough to drive a 2 x 12" sub to a good level, and the other two channels are fitted with 100V transformers to operate as a stereo system and drive multiple pairs of speakers throughout the bar.

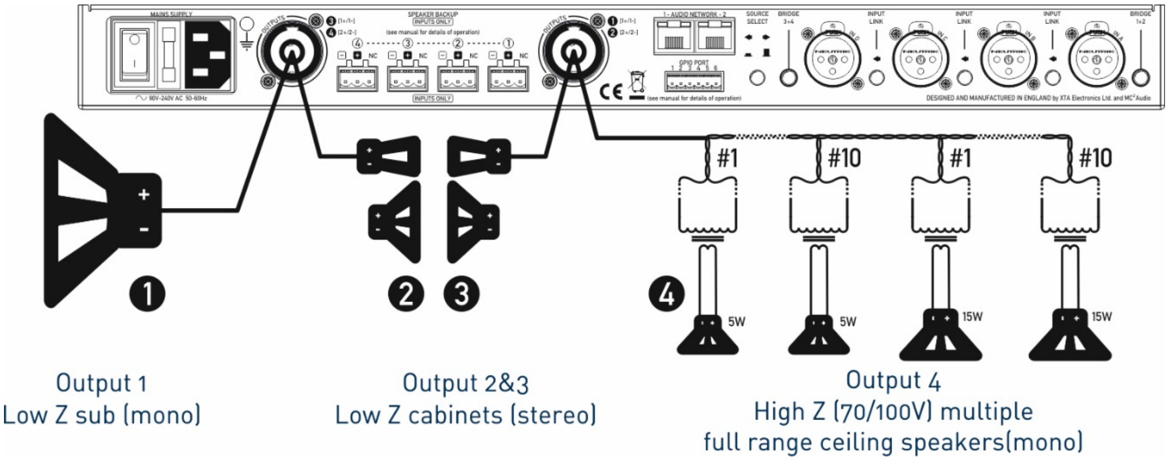


Driving 10 to 15 pairs of full range speakers and ceiling speakers would cover a fairly large venue. This will provide good levels of localised high quality audio without anyone having to be deafened by overly loud boxes, turned up too much to try and reach all corners!

This system would also work well in a mixed use venue such as an assembly room or civic hall where the majority of the time, the 100V part of the system is run in mono for speech, with occasional use in stereo for music or presentations.

System #2 – restaurant and cocktail bar – zoned with capable delivery…

To get the maximum flexibility from the system, this uses a single channel for a smaller (probably reflex) sub, running in tandem with a high quality pair of top boxes that can run to a sufficiently low frequency that the sub's outputs need not be as big. Together this forms the basis of a main system at the bar. Throughout the restaurant area, a single 100V channel can provide highly localised background music, which may or may not be the same as the bigger part of the system.



Remember that the Delta 20 and DNA20 is a quad channel amplifier and so there's no reason why the audio for the ceiling speakers in the restaurant has to be the same as that for the bar.

The sub will still probably require some low pass filtering, but the amplifier can also be fitted with an EQ/Crossover card (per channel) and that's a much more cost effective way of tuning the system than an external processor.

100V Line Theory – Don't be put off…

It's not the "black art" it can appear to be – using transformers to step up and step down the signals to run lots of horns has been around since the 1920s and it's easy to work with if you follow a few simple rules.

Distributed audio, particularly for speech applications, will often require many speakers to be positioned around a venue, to provide even coverage at acceptable levels in all locations. These speakers may be spread over a considerable area and involve long cable runs to achieve this. Using low impedance "traditional" methods would introduce unacceptable losses due to the actual resistance vs. the speaker impedance – it is easy to envisage a situation where the length of the cable could cause 50% loss in available power.

Using heavier gauge cabling can go some way to reducing the losses, but this often is costly and entirely impractical where many speakers are involved. Borrowing the method used to distribute mains electricity across long distances, where mains supplies are stepped up (using transformers) to higher voltages and stepped down for local consumption also works for distributed audio.

This method helps because, as the voltage is increased, to achieve the same power delivery there is a corresponding decrease in the current that must travel along the conductors. Lower current requirements means thinner gauge cabling and lower losses due to the square law of power delivery. Thinner gauge cabling therefore also means reduced costs, and lower amplifier power requirements than if each speaker (or at best a few speakers) required an individual amplifier channel.

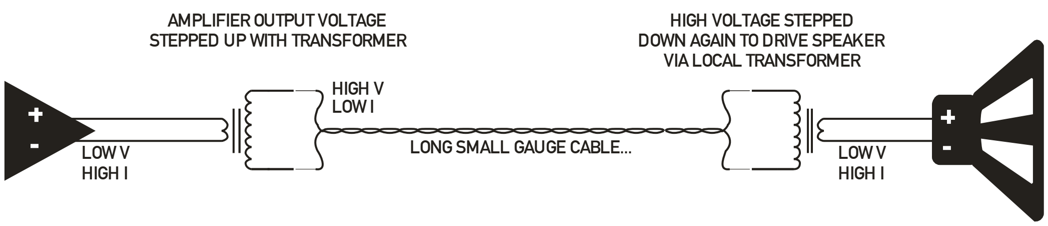
How It Works

Firstly, a few misconceptions around the name of this method should be clarified. It is true that the low voltage/higher current output of a standard audio amplifier is fed into a step-up transformer to produce a higher voltage/lower current output that can travel longer distances using thinner cables. This incurs fewer losses than a direct connection of a low impedance speaker directly over the same distance.

However, the concept of this system operating at either a "constant voltage", or "100V", or "70V" is slightly wrong. The system does NOT have a constant voltage output of any sort, unless a constant level of audio is being fed into the amplifier (such as a sine wave), at which point the output will be at a constant level. This would hold true in the low impedance (standard) case too. There is no extra method of modulating a fixed voltage, or there being a permanent high voltage output on the speaker lines.

The use of the terms "100V line" or "70V line" comes from the description of the system running at full power output only. The transformer used to step up the voltage should be chosen so that, when the amplifier is running at full power, the voltage across the lines will then be 100V (or 70V or whatever has been deemed appropriate for the given application). The only thing that is "constant" with this type of system is rated voltage at the amplifier's rated power. So, whether it's a 30W amplifier for distributing speech to some horns by a racetrack, or a 300W amplifier distributing music and announcements throughout a warehouse, both the systems will produce 100V (or whatever) when the amplifier is running at maximum power.

The majority of the time, the voltages present on the lines will be an order of magnitude less than 100V, as the audio being delivered will be at a much lower level than full output (assuming the amplifier chosen is up to the job!).



Once the voltage has been "stepped up" to the higher level for long distance transmission, when it reaches the speaker, in common with mains power reaching its destination, there must be some form of "stepping down" again to restore it to a voltage/current suitable for driving the speaker. This is achieved by using a localised "step-down" transformer, normally attached directly to the speaker chassis itself, or in the enclosure with the driver.

From this point on, the process for working out how many speakers can be connected to an amplifier channel becomes relatively simple, but remember one thing – this doesn't change the laws of physics – just as there is a limit to how many speakers can be connected in parallel on a "normal" channel of an amplifier, there is still a limit for 100V or 70V systems too!

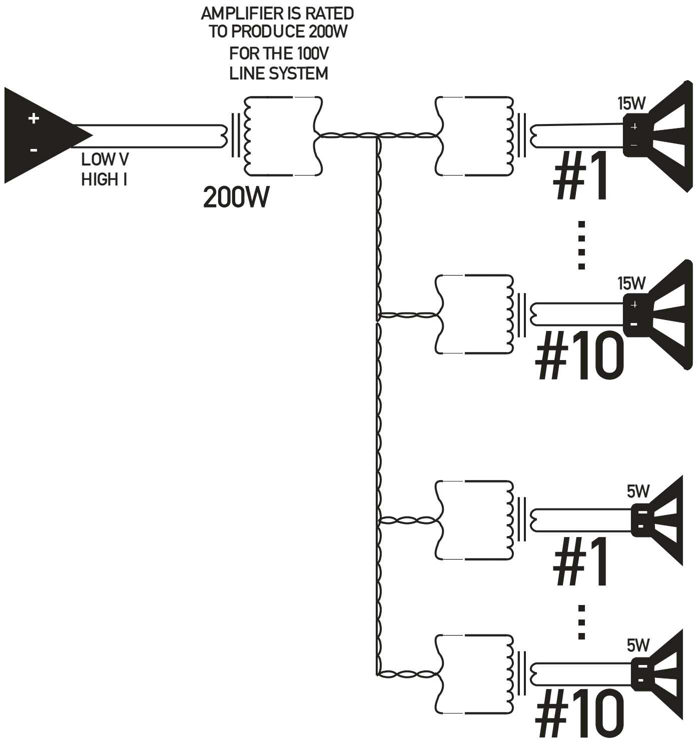
Example: How many speakers can I connect to an amp channel?

We'll start with an amplifier capable of supplying 200W to a 100V line system. This total "pool" of 200W can be split up any way we want to as many speakers as we want, providing their requirements don't exceed 200W in total.

The requirement of any particular 100V line configured speaker is quoted as a power rating for a given SPL output. Let's say we have decided upon two sizes of ceiling speaker for a given installation – one rated at 15W and one rated at 5W. Ignoring the SPL ratings for now, it's a reasonable assumption to make that the "15W" speaker will be generating a higher output level than the "5W" speaker (for any given voltage on the line).

Remember – this wattage value <u>isn't the power rating of the driver</u> – this is the power it will consume from the amplifier – the speaker's rating itself is not relevant (and is unlikely to be quoted as part of the speaker's spec. sheet).

So, to work out how many speakers the amplifier can handle, it's as simple as adding up the number of 15W speakers we want to use and the number of 5W speakers, and making sure this total is no more than the 200W we have available.



Let's say we have worked out that we need 10 of the 15W speakers, for starters – that comes to 10 x 15W = 150W, leaving us with 50W "spare", which means we could connect another 10 of the the 5W speakers. That's 20 areas in total – not bad for just 200W!

This is in an ideal world of course…now for how it really works!

Calculating Real World Requirements

The choice of amplifier power, in an ideal world, would allow us to do this simple calculation and everything to operate perfectly with the power available exactly matching the power delivered to the speakers. However, this isn't an ideal world, and there are two main factors that impede (!) this from being true – losses in the cables themselves, and insertion losses in the step-up and step-down transformers.

Whilst it is theoretically possible to calculate these losses, there is a "Catch 22" situation in play here, which means that even measuring the real world losses through cables in a system becomes impossible. Getting hold of insertion loss information for transformers is difficult, and in order to measure the losses, you need to build the system, which you can't do until you specify your amp power, which you can't do until you measure the losses!

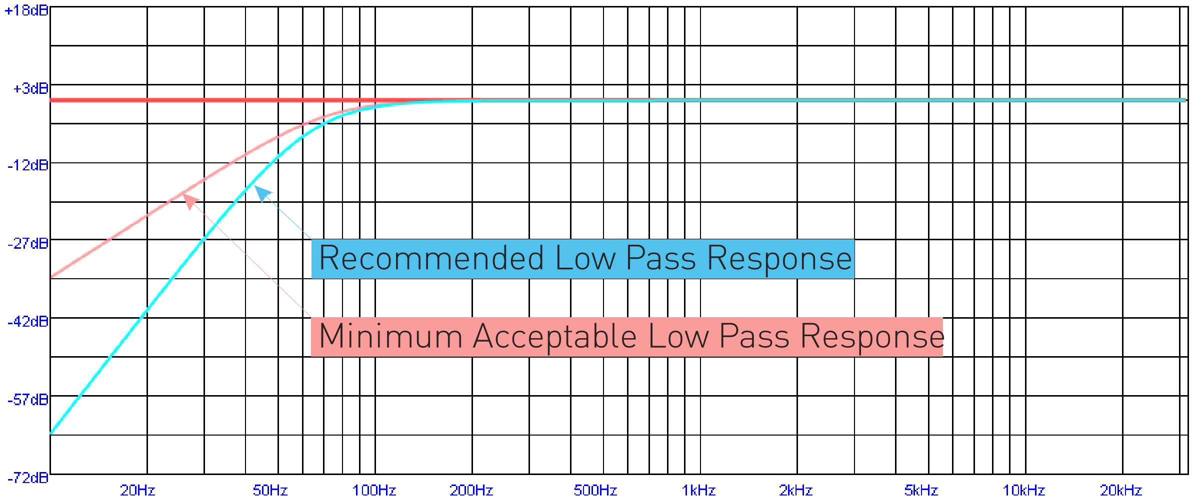
Thus, there is a reliable "rule of thumb" that states that amplifier power should be approximately 50% bigger than your speaker power requirements would suggest. So, if your speakers total power comes to 100W per channel, go for an amplifier nearer 150W per channel to account for all the losses and ensure you deliver the power and so SPL you require.

Getting The Best Performance

As 100V line systems are primarily intended for background music applications and foreground delivery of speech program only, the necessity for the highest fidelity audio has never been paramount. This does not mean that a carefully designed system can't perform to a high audio standard – it can, but there are certain constraints that need to be considered when evaluating performance.

Due to the fact that transformers are in use throughout a 100V line systems, being careful not to saturate the cores of these transformers with excessive energy is paramount to the system not just working well, but not damaging the amplifier. Low frequency power tends to be the main culprit for this condition, and a saturated transformer core appears as a very low impedance across the amplifier's output terminals, close to a direct short, resulting in early amplifier overheating, protection circuits muting the audio unnecessarily and generally bad behaviour! It manifests itself, in audio terms, as a distorted rasping sound - similar to a misaligned voice coil might sound.

This can be easily avoided by ensuring that high pass filters are fitted to all channels to limit the low frequency content of the system. We recommend fitting crossover cards to our amplifiers, or inserting suitable filtering using an external speaker management system, such as the XTA DP4 and 5 Series. Our recommendation is a 63Hz HPF with a roll-off of 24dB/Octave. The minimum response requirement is -3dB @ 70Hz and 12dB/Octave roll off below this.



The DNA20 and Delta20 have this HPF built-in, and this is activated (on an individual channel basis) on channels with transformers fitted.