High Impedance Installations (70/100V Lines) with HD Amplifiers

Introduction

High impedance installations, also known as 70V or 100V lines are commonly used in applications where the following requirements are met:

- There is a long distance between the amplifiers and the loudspeakers.
- Each loudspeaker does not need to handle a high amount of power.
- A high count of speakers are required, therefore each amplifier needs to drive typically more than 4 loudspeakers per channel.

In this kind of installations, a transformer is attached to the amplifier output so that the voltage output is up-converted either to 70 or 100V. On the loudspeakers side, another transformer will down-convert the 70 or 100V voltage to a voltage that can be held by the loudspeaker at low impedance.

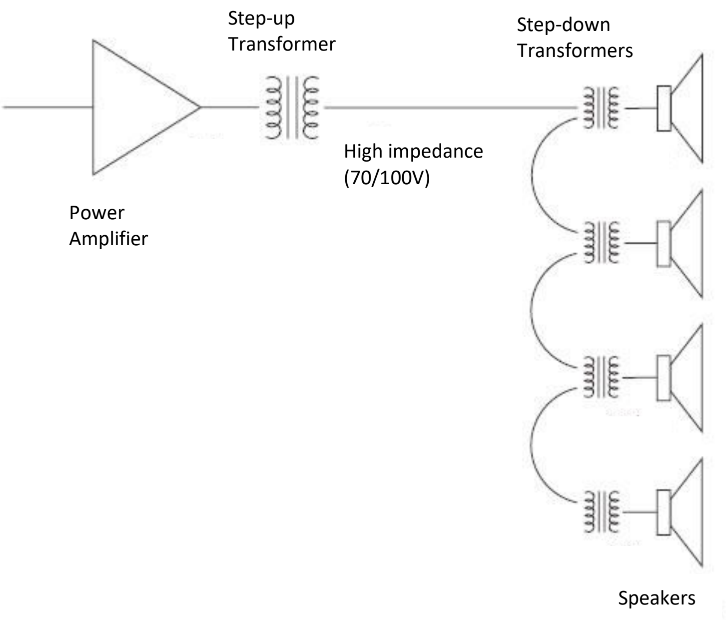

Fig. 1: Typical high impedance diagram with step-up and step-down transformers

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The transformers are passive components that have a high inductive behaviour, which influences the general frequency response of the system. The more power a transformer must be able to hold, the most difficult is to keep a flat frequency response in the audio spectrum.

Using amplifiers without step-up transformer

The step-up (or output) transformer can be avoided at the amplifier output, when the amplifier has an output voltage swing exactly in the range of 0 to 70V, or 0 to 100V. In that case, the signal will be received directly by the transformers at the loudspeakers' side. This brings a number of advantages to the installation, being the following the most relevant:

- Less cost (no need for a big output transformer)
- Better frequency response
- Lower complexity

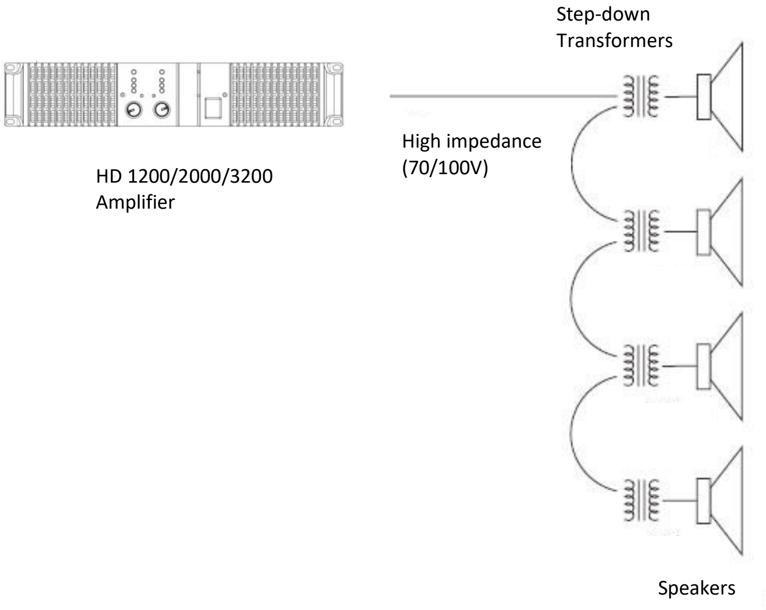

Fig. 2: High impedance diagram with HD Series (without step-up transformers)

Some of the Amate Audio HD Amplifiers comply with the requirements to be used in 70 and 100V lines without output transformer. The suitable models are:

Model	70V Line	100V Line
HD1200		✓ (Bridge Mode)
HD2000	✓ (Stereo Mode)	
HD3200		✓ (Stereo Mode) 100V @ -1dB

Table 1: Suitable HD Amplifiers for high impedance installations

Dimensioning the installation

In order to know the number of loudspeakers that can be used with each amplifier, either the input impedance or the rated power at high impedance of the loudspeaker with transformer must be known.

In Amate Audio's range of Public Address Speakers, there are two items available with integrated transformer: B5/T and B6/T. B8 and CS6FR can be also installed in high impedance lines, using the TF-100 transformer (sold separately).

In all these models, the transformer can be used in different positions to limit the output power of the loudspeaker. This is used because the lower power is required at each transducer, the higher number of loudspeakers can be attached to the same amplifier channel.

In B5/T and B6/T, the power selection is accomplished by a selector knob located at the rear. In the TF-100, the power is selected by connecting the cables in the proper socket:

Fig. 3: TF-100 (left) and selector in B5/T and B6/T (right)

Max. Power @100V Selector position(*)	Max. Power @70V	Load Impedance
40W	20W	250 Ohm
20W	10W	500 Ohm
10W	5W	1000 Ohm
5W	2,5W	2000 Ohm

Table 2: Relationship between load impedance and power in 70V and 100V lines

(*) Selector position is the position used in the selector in B5/T or B6/T, or the cable socket in TF-100.

With the data in Table 2 it is possible to know how many loudspeakers can be connected to one amplifier. Two methods can be used: impedance or power, depending of which data of the loudspeaker is available.

Method 1: Impedance

The best practices recommend installing all the loudspeakers in parallel, so the resulting load impedance that the amplifier will drive can be calculated as following:

$$\frac{1}{R} = \frac{1}{R1} + \frac{1}{R2} + \frac{1}{R3} + \cdots$$

which can be simplified when all the impedances R1, R2, R3 are equal:

$$\mathrm{R} = \frac{RL}{n}$$

Where:
R is the resulting impedance of the loudspeaker line
RL is the input impedance of each transformer
n is the number of loudspeakers

The resulting impedance R must be always higher than the rated impedance of the amplifier for high impedance installations (see Table 3 for HD amplifiers).

Method 2: Power

A more straightforward way is just to add the rated power of each loudspeaker. The power summation must be below the rated amplifier power (see Table 3 for HD amplifiers)

$$\mathrm{P} = P1 + P2 + P3 \ldots$$

which can be simplified when the rated power of the loudspeakers are equal:

$$P = n \cdot PL$$

Where:
P is the total power of the loudspeaker line
PL is the rated power of each loudspeaker
n is the number of loudspeakers

It should be taken into account that the rated power is different if the loudspeaker is used in a 100V or in a 70V line. If the loudspeaker is rated at 40W in a 100V line, the rating for 70V will be half of the power, i.e. 20W.

Model	Configuration	Minimum Impedance	Maximum power	Max. loudspeakers (250 Ohm)
HD1200	Bridge	6.5 Ohm	1500W	38 @ 40W (100V)
HD2000	Stereo	4 Ohm	1000 + 1000 W	50 + 50 @ 20W (70V)
HD3200	Stereo	4 Ohm	1800 + 1800 W	45 + 45 @ 40W (100V)

Table 3: Impedance and power of HD amplifiers in high impedance installations

Application examples

Example 1: 100V line with HD1200 (bridge mode)
20 loudspeakers with transformer: n = 20
Selector position: 20W.

$$P = 20 * 20W = 400W$$

The result is below the rated power of 1500W specified in Table 3, so the amplifier is perfectly capable.

Example 2: 70V line with HD2000 (for one channel)
12 loudspeakers with transformer: n= 12
Selector position: 40W (will be equivalent to 20W at 70Volt).

$$P = 12 * 20W = 240W$$

This is also below than the maximum rated power of one amplifier channel, 1000W (shown in Table 3).
The type of loudspeakers can be mixed, so for example, one channel may be used to drive 12xB5/T and the other channel can be used for 12xCS6FR with TF-100.

Example 3: 100V line with HD3200 (for one channel)
50 loudspeakers with transformer: n = 50
Selector position: 40W.

$$P = 50 * 40W = 2000W$$

This is above the maximum power supported by the amplifier (1800W, shown in Table 3). In this case, there are two options possible: either reduce the loudspeaker count or change the selector position to 20W:

With selector at 20W:

$$P = 50 * 20W = 1000W$$

With 40 loudspeakers:

$$P = 40 * 40W = 1600W$$

In both cases now the amplifier is capable of driving the loudspeakers.

Final notes

Although high impedance installations bring many advantages when a high count of loudspeakers may be deployed, it is highly recommended to assess first if a low impedance installation can be made instead. Transformers add complexity, power losses and drastic quality losses to the installation, so they should be avoided whenever possible.

Amate Audio manufactures a number of loudspeakers with 16 Ohm impedance to help avoiding the use of 100V lines in some cases. B6, B8 and CS6FR are available as low impedance units (16 Ohm), so one amplifier can drive up to 8 units of each without transformer.

If a high impedance installation is needed anyway, using amplifiers without output transformer (such as the HD amplifiers explained in this guide) reduce the cost and increase the quality of the installation.

More information:

www.amateaudio.com/project-assessment/
www.amateaudio.com/hd-series/
www.amateaudio.com/public-address/