ACTIVE SPEAKER SYSTEMS

Design and Installation Guide
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1. Products and Technology

This guide has been created to help in the specification and installation of Genelec Active Speaker Systems for Custom Install. Many questions arise from customers' perspectives and installers' experiences, and it is hoped that this guide will give a better sense of direction and an improved Genelec Home Theater experience.

1.1 Some Genelec History

Genelec has a world-wide reputation of designing and manufacturing the finest active monitors for the professional audio market. Since its founding in 1978, Genelec has supplied the most discriminating broadcast and recording organizations around the world with active audio monitors capable of meeting their highest requirements. Meeting those expectations has not been easy. The tremendous amount of research and development activity that is the key of Genelec's success in professional audio also benefits the Active Speaker Systems for Custom Install products. The goal remains the same – to design a tightly integrated audio system to provide accurate performance and superior reliability.

1.2 Active Loudspeaker Technology

The concept of an active loudspeaker is simple:

- Remove the passive crossover components from the traditional loudspeaker design, which are placed after the single amplifier on each channel.
- Design a custom electronic crossover, which is placed before the integrated amplifiers.
- Use as many amplifiers as there are drivers.

See Figure 1 for a block diagram of passive vs. active three-way loudspeaker design. Active design ensures that each driver (woofer, midrange and tweeter) has its own band-passed amplifier to which it is directly coupled and matched. This concept greatly reduces distortion, improves dynamic headroom and frequency linearity and increases the system total sound pressure level.

![Figure 1. - Active crossover BEFORE amplifier vs. Passive crossover AFTER amplifier](diagram)
It also allows the manufacturer to implement elaborated circuitry that protects the system from misuse and therefore increases reliability:

- Input Protection ensures that no signals above the acceptable input range enter and damage the active electronics.
- Driver Protection allows for the maximum power output from the system while ensuring that the drivers cannot be damaged by over driving the system.
- Thermal Protection shuts down the amplifiers if the acceptable operating temperature for the electronics is exceeded. When the temperature drops sufficiently the system resets itself.

Genelec active loudspeakers also feature proprietary Room Response Controls (see Section 4) which help optimise the loudspeaker’s tonal characteristics once they are installed in a home theater. Note that the amplifier can be located away from the enclosure but the loudspeaker/amplifier system is still an active system because everything is designed to work together.

1.3 Directivity Control Waveguide™

In 1983 Genelec designed a loudspeaker system that was radically unique in shape and acoustical properties. The entirely smooth and curved enclosure provided no sound coloration of the drivers and excellent control of the sound dispersion into the room. This was the birth of the revolutionary Directivity Control Waveguide™ (DCW™) technology. Today the DCW™ is a waveguide in which is mounted the high frequency (in three-way loudspeakers, midrange and high frequency) driver that controls the angle of dispersion.

The aim of the DCW™ is to match the frequency response and directivity of the drivers in the loudspeaker leading to a significant improvement in the performance of a direct radiating multi-way loudspeaker. The result is an excellent match of the overall frequency response on and off axis. This control of the directivity reduces incoming reflected sound at the listening position, thereby minimizing room coloration and improving the entire sound stage imaging. The DCW™ technology allows for extremely high audio consistency between very different Home Theater installations.

The DCW™ technology also improves the drive unit sensitivity up to +6 dB, and therefore increases the maximum sound pressure level as well as decreases driver distortion.

2 Planning The Installation of Genelec Products

The room size and the listening/viewing distance are the two criteria that drive any successful surround sound environment. Because Genelec designs and manufacturers many different sized models, there is a loudspeaker available to fit into any sized environment.

2.1 Terms used in this Guide

There are two terms used in this guide that should be defined before reading any further:

- **Loudspeaker** - The physical device that makes the sound in the listening room (in this case, amplifier, crossover, enclosure and drivers).

- **Channel** - The signal fed into the loudspeaker as decoded by the surround sound processor.

In 5.1 discrete surround sound systems there are five full bandwidth main channels (Left, Center, Right, Rear Left and Rear Right) and a band limited channel (LFE). There is an important distinction here; for example, the center channel is the signal that represents the sound that should be reproduced by the center loudspeaker. Another more complicated example is that the LFE channel is often called the ‘subwoofer channel’. This is only true in the movie industry where a subwoofer is connected directly to a LFE channel and bass management is not used. In Home Theater, the subwoofer is used to reproduce
some, or all, of the LFE channel and, if bass management is used, also some of the main channels. The signal that feeds the subwoofer is then often called the ‘subwoofer channel’. Other surround sound systems have more channels, which are explained later.

2.2 Room Size Specification

Probably the first known factor when designing a new Home Theater is the space where the Home Theater will be. Product selection is based upon the cubic volume of the listening environment. If it is an irregular shaped room, it is best to use the larger set of dimensions to be on the safe side.

See Section 2.10 Selecting the Right Model for a chart to select the correct loudspeaker model for a given room volume.

2.3 Listening Distance

The first things to consider are the size of the screen and the distance from the screen to the center of the seating area. This will affect which Genelec models are selected. All Genelec models (except subwoofers) feature the DCWTM (Directivity Control Waveguide™) technology. The DCWTM is used to control the dispersion pattern of the tweeter driver (and the midrange driver in three-way systems) in both the horizontal and vertical axis. Moving to larger models in the Genelec product line increases the possible distance from the loudspeaker to the listening area as the dispersion characteristics are optimized for longer listening distances.

See Section 2.10 Selecting the Right Model for a chart to select the correct loudspeaker model for a given listening distance.

2.4 Front Loudspeakers - A Model for Every Requirement

The Genelec Active Home Theater range is a little different than the offering of conventional hi-fi loudspeaker manufacturers. The Genelec range is application specific. In other words, if your room is a certain size, the listening distance is a certain length or a particular SPL is required, then there is a model in the product line to satisfy most needs. The Genelec range has a consistent design philosophy from the 6010A all the way up to the 1036A. This is clear from the outside but is also true of the parts that cannot be seen. Modern design methods give modularity benefits that enable efficient manufacturing techniques to be used in production. This ensures that all the products have consistent performance straight out of the box and are reliable in use.

2.5 Center Channel Loudspeakers

There are three main factors to consider when choosing and using center loudspeakers:

2.5.1 Center Loudspeaker Design

Conventional two-way ‘center’ loudspeaker designs are inherently compromised in the power response (the total radiated energy into the room). The driver spacing leads to horizontal off-axis cancellations around the high-pass crossover in the horizontal direction. In addition, the use of three drivers positioned in a line narrows the directivity in the plane of the drivers, i.e. horizontally. This severely compromises the sound quality for people sitting to the left and right of the center of the room, i.e. off-axis.

Given these two-way center loudspeaker design compromises and the recommendations from Dolby, DTS and others that, in an ideal surround sound system, the front loudspeakers are all the same for good timbre matching, the best choice for a center loudspeaker is another loudspeaker that it is the same as that used for the left and right loudspeakers. For example, the best match for an HT208B is another HT208B.
In three-way designs, the bass/midrange driver crossover frequency is much lower so the above acoustical problems are far less significant as the DCW™ can be rotated so that the horizontal directivity is maintained in the midrange/treble driver crossover region.

### 2.5.2 Center Loudspeaker Enclosure Location

Ideally, the center loudspeaker enclosure should be mounted at the same height as the picture so that the sound comes from the same place as the picture, although this is not always possible as demonstrated in the following two cases:

- **Perforated projection screens**
  The loudspeaker enclosure can be mounted in the center of the picture but there is a compromise to the frequency response - see Graph 1 in Section 3.7 Acoustically Transparent Screens. Some perforated projection screens are acoustically more transparent than others, but this should be weighed against corresponding compromises in the picture quality.

- **Large CRT’s, rear projecting displays and unperforated projection screens**
  The loudspeaker enclosure should be placed ABOVE the screen. This will reduce the effects of the floor reflection as the reflection distance and angle are both increased. Doing this will cause the ceiling reflection to become significant but this can be easily treated by adding some thin (5 cm / 2” rock wool) damping material to the ceiling - see Figure 2. The loudspeaker enclosure should never be placed behind an unperforated projection screen - See Section 3.7 Acoustically Transparent Screens.

### 2.5.3 Center Loudspeaker Enclosure Orientation

In the case of Genelec's larger three-way center channel systems, the bass/mid crossover frequency is much lower so the horizontal off-axis cancellations do not occur here. There will however be a cancellation at the mid/treble driver crossover but this can be overcome by orienting the DCW™ vertically so that the crossover cancellation is then in the vertical direction, i.e. not audible due to the fixed listening height.

Two-way systems should normally be positioned vertically to avoid audible off-axis cancellations at the crossover frequency. When positioned in this way, the crossover cancellation will be in the vertical direction (not a problem as the listening height is fixed) and the horizontal listening window will be wide and clean of abnormalities. However, if there is limited space, for example, when large flat panel displays or unperforated projection screens are used, then the loudspeaker enclosure can be placed horizontally but with this known compromise. See Section 2.10 Selecting the Right Model for a table on which center loudspeaker to select for a given room volume and listening distance.

![Figure 2. - Mounting the center loudspeaker above an unperforated projection screen](image-url)
2.6 Surround Loudspeakers - Dipoles vs. Direct Radiators

When Dolby Surround and Dolby Pro Logic were the sole surround formats, the idea of using dipole loudspeakers in the rear was to create a diffuse sound field in the listening environment for the ambient information. Today, however, there are three good reasons NOT to use this type of loudspeaker design for the rear channels:

- Dipole loudspeakers have a limited low frequency bandwidth, which is fine for use in matrix surround sound formats, such as Dolby Surround where the surround channel bandwidth is also limited (100 Hz to 7 kHz). However, in discrete surround sound formats, such as Dolby Digital and DTS, the rear channels have extended bandwidth from 20 Hz to 20 kHz. In addition, in the production stages, direct radiating loudspeakers are used that typically extend down to 40 or 50 Hz. Most dipoles used for surround applications do not extend much below 100 Hz so real impact in the bass is absent. However, there is envelopment in the mid bass and higher frequencies.

- Often the listening environment is absorbent in the mid range so the effectiveness of dipole radiation is lost. In fact, the effect of dipole loudspeakers is entirely dependent on the acoustics of the room that often vary considerably from one room to the next.

- The advent of multi-channel music formats, such as SACD and DVD-Audio, depends on greater usage of direct radiators as sides and rears in order to get the intended performance. These music mixes are monitored in studios with direct radiating loudspeakers, so playback through them in the home will create the result the engineer, producer and artists intended.

A Genelec direct radiator, whose off-axis response is smooth and natural sounding, will provide a good solution for the new extended bandwidth surround sound formats (SACD and DVD-Audio) and still work in any sonic environment. In addition, 7.1 and other such formats have changed room design techniques and so dipoles are no longer as suitable as they once were. The use of direct radiators will yield better front to back effects panning and more detailed playback of soundtrack events.

See Section 2.10 Selecting the Right Model for a table to select surround models for a given room volume and listening distance.

2.7 Subwoofers - Loud and Low

The primary function of a subwoofer is to move lots of air. Ideally, it should have a low cut-off frequency (<20 Hz for movie material, <35 Hz for music material), no distortion and play extremely loud. To play loud is easy - use big amplifiers. To play low is easy - use big drivers and large enclosure. To play loud AND low is hard, especially when low distortion is also desired. Do not be fooled by statements such as, “It has a 1200 W amplifier so it must be loud!” as this is only part of the story. Poor efficiency in the acoustics can make such a system quieter than a 12 watt system.

<table>
<thead>
<tr>
<th>Number of subwoofers</th>
<th>SPL for 5050A and multiples</th>
<th>SPL for 5041A and multiples</th>
<th>SPL for HTS3B and multiples</th>
<th>SPL for HTS4B and multiples</th>
<th>SPL for HTS6 and multiples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>104</td>
<td>110</td>
<td>113</td>
<td>117</td>
<td>129</td>
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<td>113.5</td>
<td>119.5</td>
<td>122.5</td>
<td>126.5</td>
<td>138.5</td>
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<td>4</td>
<td>116</td>
<td>122</td>
<td>125</td>
<td>129</td>
<td>141</td>
</tr>
</tbody>
</table>

Table 1. - Adding Subwoofers Increases the Maximum Peak SPL Output
See Section 2.10 Selecting the Right Model for a table to select subwoofer models for a given room volume and listening distance.
Genelec has worked very hard to have an efficient system that has appropriately specified amplifiers AND has very low distortion. For even lower distortion, just add more subwoofers to the system. For example, adding a second subwoofer to a system allows the input sensitivity to be decreased by 6 dB so each subwoofer plays 6 dB quieter but the overall level in the room is the same. This will reduce the distortion by more than 6 dB for the same replay level, as distortion is non-linear with respect to SPL. Using two smaller subwoofers instead of one large unit may also be preferable for space reasons. See Table 1 for details about multiple subwoofers.

2.8 System Building - How to Mix and Match

Now is a good point to discuss selection of an entire system. If one adheres to some of the basic guidelines set by Dolby Laboratories, DTS and other standardization organizations, then the best possible configuration is 5 identical loudspeakers all around for 100% timbre matching. Of course, this is not always practical but as 5.1 music has become more available, this aspect of system design becomes more important and therefore common practice.

In Section 2.10, Selecting the Right Model, there is a table which can be used to find which loudspeaker model is appropriate for a given room volume and listening distance. Some suggested side and rear loudspeaker solutions are given but the final choice will also be based on the listening preferences of the customer (what program material they prefer and how loud they play it), the space available in which to place the loudspeaker enclosure and budget. The AIW25 and AIW26 In-Wall loudspeakers have many applications even together with quite large Genelec models, however they will need to be used in multiples to fill large rooms.

7.1 systems are becoming more common in Home Theater, so sides as well as rear channels are almost the norm. Multiple loudspeakers are suitable in very large 7.1 systems too, so a set of 7 x AIW26 could be used in a very large system.

2.9 How Room Acoustics Can Affect Model Selection

Room acoustics is an area of Home Theater that is often overlooked. It is important and challenging but with some consideration, good sound can be the result. There is insufficient space in this document to explain all the issues associated with good room acoustics so two extremes are presented below that may influence the selection of one model over another:

- If the room is heavily damped (thick carpeting, heavy curtains and lots of upholstered furniture) there will be a loss of energy in the midrange frequencies. On the positive side, it should be remembered that an absorptive room usually results in more accurate imaging. If there is any doubt in the choice between two models based on the listening distance or room volume then select the larger model that offers higher maximum SPL output.

- Conversely, if the room is minimally furnished and has many hard surfaces with little absorption (although that would be a rarity in a dedicated home theater), then it may be possible to step down a model in the range. Such a room will tend to be highly reflective and support the loudspeakers' output, so some adjustment of the Room Response Controls will be necessary - see Section 4.2.2 Using the Room Response Controls. Unlike the well-damped room, the imaging will be rather diffuse.

There is more on room acoustics in Section 5 Room Construction and Acoustics.
2.10 Selecting the Right Model

Use the following chart as a guide for product selection and follow these three simple steps:

- Calculate the room volume and find the highest row in the table where the value of “Maximum Room Volume” is not smaller than the actual room volume.
- Measure the listening distance to the center of the listening area and find the highest row in the table where the value of “Maximum Listening Distance” is not shorter than the actual listening distance.
- If there are two different rows selected in the previous two steps, select the loudspeakers from the row that is lowest in the table, i.e. the larger of the two if there are two different lines recommended.

Note: these recommendations are for the SMALLEST system that can be expected to give a good theatrical experience. Larger systems offer more impact and headroom, so do not be afraid to select larger models in the range than those indicated. The main thing to be concerned about when upgrading the system is to keep the whole system in balance, so do not select a 1036A for the front wall and have 6020A’s for sides and rears!

Loudspeaker Selection Examples:

- If the room is 5 m / 16½’ wide, 9 m / 29½’ long and 3 m / 10’ high, then the room volume is 135 m³ / 4900 ft³. This limits the loudspeaker selection to HT210B or larger. If the listening distance is then measured to be say 5 m / 16’ 5” then the selected front loudspeakers are confirmed as being HT210B or larger.

- If the room is 6 m / 19½’ wide, 14 m / 46’ long and 2.5 m / 8’ high, then the room volume is 210 m³ / 7200 ft³. This limits the loudspeaker selection to HT315A or larger. If the listening distance is then measured to be say 8 m / 26’3” then the selected front loudspeakers should be HT324A or larger as the HT315A should only be used up to 7.6 m / 25’.

If there are any doubts about product selection for a particular room then please contact Genelec for advice. It is better to specify the correct system the first time so there are no problems after the room is finished as unnecessary fixes affect the reputation of the installer and Genelec.

<table>
<thead>
<tr>
<th>Maximum Room Volume m³ / ft³</th>
<th>Maximum Listening Distance m / ft</th>
<th>Typical Listening Distance m / ft</th>
<th>Front Loudspeakers</th>
<th>Side and Rear Loudspeakers (per channel)</th>
<th>Subwoofer</th>
</tr>
</thead>
<tbody>
<tr>
<td>65 / 2,300</td>
<td>2.4 / 8</td>
<td>1.8 / 6</td>
<td>6020A</td>
<td>6020A</td>
<td>5050A</td>
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<tr>
<td>75 / 2,600</td>
<td>3.0 / 10</td>
<td>2.2 / 7</td>
<td>AiW25</td>
<td>AiW25</td>
<td>HTS3B</td>
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<td>85 / 3,000</td>
<td>3.7 / 12</td>
<td>2.8 / 9.2</td>
<td>HT206B / AiW25</td>
<td>HT206B / AiW25</td>
<td>HTS3B / 5041A</td>
</tr>
<tr>
<td>115 / 4,000</td>
<td>4.9 / 16</td>
<td>3.5 / 11.5</td>
<td>HT206B / AiW26</td>
<td>HT206B / HT208B / AiW26 / AiW25</td>
<td>HTS4B</td>
</tr>
<tr>
<td>140 / 5,000</td>
<td>5.5 / 18</td>
<td>4.5 / 15</td>
<td>HT210B</td>
<td>HT208B / HT210B / AiW26 / 2x AiW25</td>
<td>2x HTS4B*</td>
</tr>
<tr>
<td>175 / 6,200</td>
<td>6.5 / 21</td>
<td>5 / 16.4</td>
<td>HT312A / AOW312</td>
<td>HT208B / HT210B / AiW26</td>
<td>2x HTS4B*</td>
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<tr>
<td>250 / 8,800</td>
<td>7.6 / 25</td>
<td>6.2 / 20.4</td>
<td>HT315A / HT320AC</td>
<td>HT210B / 2x AiW26</td>
<td>HTS6</td>
</tr>
<tr>
<td>370 / 13,000</td>
<td>8.5 / 28</td>
<td>7 / 23</td>
<td>HT324A / HT324AC</td>
<td>HT312A / AOW312 / 3x AiW26</td>
<td>2x HTS6**</td>
</tr>
<tr>
<td>500 / 17,600</td>
<td>10.0 / 33</td>
<td>8 / 26.3</td>
<td>HT330A</td>
<td>HT315A / 2x AOW312 / 4x AiW26</td>
<td>2x HTS6**</td>
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<tr>
<td>850 / 30,000</td>
<td>15.5 / 50</td>
<td>11 / 36</td>
<td>1035B / 1036A</td>
<td>HT315A / 2x AOW312 / 4x AiW26</td>
<td>3x HTS6**</td>
</tr>
</tbody>
</table>

Table 2. Active Home Theater System Selection Table

* Using multiple smaller subwoofers instead of one larger one may be preferable for space reasons.
** Such recommendations assume that the system is bass managed at 40 Hz. More subwoofers may be required for a higher crossover frequency. Consult Genelec for detailed subwoofer solutions for this sized installation.
2.11 Electronics Panel Controls - Features and Functions

Each Genelec Home Theater loudspeaker has an extensive set of controls located on the enclosure’s electronics panel. Each model features a combination of the following controls (see specific product data sheet for detailed specifications).

**Room Response Controls**

The Bass Roll-off and Bass Tilt controls allow the low frequency response of the loudspeaker to be reduced to compensate for LF loading when the loudspeaker is placed in a corner or against a wall respectively. The two-way systems’ Treble Tilt allows the treble to be controlled to compensate for the high frequency acoustic conditions in the room. Even more control is available in the 1035B and 1036A.

The level controls of the larger three-way loudspeakers include Bass Level, Midrange Level and Treble level. These controls allow the driver output levels to be controlled so that the loudspeaker can be tuned to the room.

The ‘Phase’ control featured on all subwoofers enables the alignment of the main loudspeaker/subwoofer combination in the time domain. The phase can be adjusted between 0, 90, 180 and 270 degrees.

**Input Section**

All loudspeaker models have an input sensitivity trimmer. The two-way loudspeakers and subwoofers feature an unbalanced non-inverting RCA input as well as a balanced line XLR input. Large three-way loudspeakers only have an XLR input whereas the subwoofers have an additional XLR link out connection.

<table>
<thead>
<tr>
<th>Models</th>
<th>'Autostart' Function</th>
<th>Power/standby LED On/Off</th>
<th>12 V Trigger Remote</th>
<th>Relay Switch Remote</th>
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</thead>
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</tr>
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</tr>
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<td>HT208B</td>
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<td>Yes</td>
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<td>AIW25 / AIC25</td>
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<td>HT312B / AOW312B</td>
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<td>Yes</td>
<td>Yes</td>
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<td>HT315B / HT320BC</td>
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<td>HT324A / HT324AC</td>
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<td>N/A</td>
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<td>N/A</td>
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<td>N/A</td>
</tr>
<tr>
<td>HTS3B</td>
<td>Yes</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HTS4B</td>
<td>Yes</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>HTS6</td>
<td>Yes</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 3. - Power Management Features vs. Models
Power Section
The mains power section comprises a voltage selector (country dependent voltage selection), an IEC mains input socket and an On/Off switch.

Remote Control Section
Genelec Home Theater products have a power management section that allows the installer to enable or disable the ‘Autostart’ function as well as the ‘Power’ and ‘Standby’ indicator LED’s on the front of the loudspeaker enclosure. Two types of remote switching terminals are also included: a 12V trigger function and a contact closure function operated via an external switch or relay as is often found on home theater automation systems. For details of the features provided in each model, see Table 3.

2.12 Audio Cables and Wiring

2.12.1 Electrical Requirements

The nature of the active technology in the product design means that the electrical power requirements are generally much lower than a passive system and amplifier with an equivalent SPL output. Idle currents are kept low and long-term full power output is limited by driver protection. However, some care should be taken to ensure that the start-up current is kept under control. In some cases a staged turn on may be necessary for large systems without soft start, for example, 7x HT312B and 2x HTS4B. Table 4 lists the individual channel requirements for both idle and full power output and the current requirements for start-up and full power output.

The start-up current peak is generally higher than the full power output current but because it is very short, only a rough value can be given. The slow blow fuses commonly used in residential properties do not notice short start-up peaks, for example, approximately twenty 6020A's can be connected to a 10 A fuse and a single power switch without the start-up current blowing the fuse.

<table>
<thead>
<tr>
<th>Models</th>
<th>Power Consumption, W</th>
<th>Current Requirements, A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Idle</td>
<td>Full Output</td>
</tr>
<tr>
<td>6020A</td>
<td>5</td>
<td>50</td>
</tr>
<tr>
<td>HT206B</td>
<td>20</td>
<td>100</td>
</tr>
<tr>
<td>HT208B</td>
<td>30</td>
<td>160</td>
</tr>
<tr>
<td>HT210B</td>
<td>50</td>
<td>200</td>
</tr>
<tr>
<td>AIW25 / AIC25</td>
<td>10</td>
<td>80</td>
</tr>
<tr>
<td>AIW26</td>
<td>30</td>
<td>160</td>
</tr>
<tr>
<td>HT312B / AOW312B</td>
<td>50</td>
<td>300</td>
</tr>
<tr>
<td>HT315B / HT320BC</td>
<td>60</td>
<td>500</td>
</tr>
<tr>
<td>HT324A / HT324AC/HT330A</td>
<td>70</td>
<td>1000</td>
</tr>
<tr>
<td>1035B / 1036A</td>
<td>150</td>
<td>3500</td>
</tr>
<tr>
<td>5050A</td>
<td>11</td>
<td>120</td>
</tr>
<tr>
<td>5041A</td>
<td>11</td>
<td>150</td>
</tr>
<tr>
<td>HT53B</td>
<td>16</td>
<td>200</td>
</tr>
<tr>
<td>HTS4B</td>
<td>16</td>
<td>250</td>
</tr>
<tr>
<td>HTS6</td>
<td>60</td>
<td>1000</td>
</tr>
</tbody>
</table>

Table 4. - Electrical Power Requirements
2.12.2 Cable Requirements

Genelec respects the dealer’s right to sell customers any good quality cable with good quality terminations that they feel is suitable for the installation. However, a few observations are detailed below:

Loudspeaker cables are not required in Genelec systems (except for the AIW26 and AIW25 In-Walls, AIC25 In-Ceiling and 5041A In-Wall Subwoofer) since in smaller systems the amplifier is built into the loudspeaker enclosure. In larger systems where the amplifier is separated from the enclosure, special Genelec cables are required for each loudspeaker system. Custom-made cable lengths are available but, in general, the cable length should be minimized.

Electrically the main requirements of line level cable are that it has a low capacitance (to avoid a high frequency roll-off on long cable runs), that it is not microphonic (makes an audible noise through the loudspeaker when it is moved).

2.12.3 Signal Cable Lengths

Most processors have plenty of output level to drive the signal up to 10 m / 30 ft without difficulty. The problem is that they often have unbalanced outputs so that the signal is susceptible to electrical interference along the entire cable length. In some cases, this may not be a problem if careful consideration has been paid to the physical placement of the cabling away from electrical sources of noise. In the case of the 6020A, HT206B, HT208B, HT210B loudspeakers, AIW25 and AIW26 In-Walls, AIC25 In-Ceiling and 5041A, 5050A, HTS3B, HTS4B & HTS6 subwoofers, unbalanced non-inverting RCA input connectors are provided together with the XLR input connectors. These are ‘either/or’ connections so never use both at the same time.

All the larger models (HT312B, AOW312B, HT315B, HT320BC, HT324A, HT324AC, HT330A, 1035B and 1036A) have XLR balanced line inputs only.

It is always preferable, where there is a choice, to use XLR balanced line cabling due to increased noise immunity on long cable runs around the room, even in electrically clean environments. Generally higher priced surround sound processors have balanced outputs and, in some cases, only some of the outputs are balanced, so a method must be used to convert the unbalanced RCA to a true balanced line signal. Therefore, Genelec has created the DI8A Active Balancer to solve these cabling problems and to make installations simpler. Genelec recommends that this unit is specified whenever possible in Genelec installations. In addition to eliminating RF problems, it should also prevent ground loop hums.

2.12.4 Remote Control Cables

Any standard 2 core cable can be connected to the remote control inputs. There are 4 pins on the loudspeaker remote control inputs that work in two groups (The RAM2/3 amplifiers for AIW25/AIC25 and 5041A have only two pins for the 12 V trigger type control). Do not attempt to use both remote control function at the same time. Note also that the remote control function will override the ‘Autostart’ dip switch function on the electronics panel when the ‘Remote Control’ switch is selected.

12V DC Remote
Pin 1 and 2 can be connected to a 12V DC Remote switch. If Pin 1 is set to +12 V the loudspeaker is “ON”. Setting Pin 1 to 0 V forces the loudspeaker into “Standby” mode. Pin 2 is the ground connection.

External Switch or Relay
Pin 3 and 4 can be connected to an external switch or relay. If the switch/relay contact is closed, then the loudspeaker is ‘On’ and when open it is then in ‘Standby’ mode.
2.12.5 Wiring the Cables

The input stages of all Genelec loudspeakers are designed to the highest standards, as used by broadcasters and music studios all over the world. They have electronically balanced inputs. In other words, transformers are not used so this means that the system is capable of electrically interfacing to either balanced or unbalanced sources. There are five possible ways to connect surround sound processors to Genelec loudspeakers:

**XLR output - RCA input**
This is not recommended as it is much better to use an XLR - XLR connection - see below.

**XLR output - XLR input**
This method is preferred over all the others mentioned in this section. As most surround sound processors do not offer XLR outputs, a DI8A Active balancer can be used to convert the RCA output of the processor to an XLR balanced line output.

![Diagram of RCA output to XLR input using 2-core + screen microphone cable](image1)

![Diagram of RCA output to XLR input using 1-core + screen microphone cable](image2)

![Diagram of Amplifier speaker output (max 50W) to XLR input using 2-core + screen microphone cable](image3)

![Diagram of Amplifier speaker output (max 50W) to XLR input using 1-core + screen microphone cable](image4)

Figure 4. RCA unbalanced line to XLR balanced line wiring diagram

Figure 5. High level amplifier output to XLR balanced line input wiring diagram

**NOTE:** For 100 W amplifiers, double the resistor wattage values shown in the diagram
RCA output - RCA input
This is the conventional method used in consumer electronics for connecting equipment. It is a satisfactory method for short cable lengths, for example, between the DVD and processor or for the front loudspeakers where the equipment is also located at the front of the room. It is susceptible to electrical interference and is not recommended for longer cable lengths over 10 m (30 ft).

RCA output - XLR input
This connection method offers some improvement over the RCA-RCA method as the noise immunity is improved. It is not a truly balanced connection so some cable manufacturers refer to it as ‘semi-balanced’. The 2-core method shown below is preferred over the 1-core method as it gives increased noise immunity and less signal distortion. It is important that all of the connections are made otherwise there could be a loss of input signal level (e.g. XLR pin 3 left floating will result in a thin and weak sound) or induced hum (e.g. chassis ground and audio ground connected together) due to ground loops. Note: do not connect the XLR chassis to XLR pin 1, as this will compromise the RF immunity of the loudspeaker’s electronics. It is preferable to make the pin 3 to pin 1 connection at the RCA end so that noise immunity is maximized. Use the wiring conventions shown in Figure 4.

It is possible to find pre-made RCA-XLR cables but be sure to identify if the tip of the RCA end is connected to pin 2 at the XLR end and that pin 3 is connected to pin 1. Some cables are wired differently: the RCA tip is connected to XLR pin 3. Although both types work, mixing them in an installation will cause some loudspeakers to be out of phase compared to others. The logical choice is to select the type where the RCA tip is connected to XLR pin 2 as this wiring configuration does not invert the phase. This is then compatible with conventional XLR-XLR connections. Also, the XLR chassis to XLR pin 1 connection should be checked to see that it has not been made.

Loudspeaker level output - XLR input
This method can be used when preamplifier outputs are not available on the surround sound processor (a common situation on many receivers). Do not connect the loudspeakers directly to an amplifier output, as the loudspeaker’s input stage will be damaged. Use the simple attenuator design shown in Figure 5. Be sure to make all of the connections shown to minimize noise interference. The 2-core method is preferred over the 1-core method as it gives increased noise immunity and less signal distortion. It is important that all of the connections are made or there could be a loss of input signal level (e.g. XLR pin 3 left floating) or induced hum (e.g. chassis ground and audio ground connected together) due to ground loops. Note: do not connect the XLR chassis to XLR pin 1, as this will compromise the RF immunity of the loudspeaker’s electronics. Do not use this method on bridged amplifier designs as the amplifier may be damaged. Loudspeaker wire should be used between the amplifier and the attenuator. Screened wire should be used from the attenuator to the loudspeaker input. The attenuator box can be metal or plastic and one attenuator is required per loudspeaker channel.

2.13 Operating Voltage and Power Requirements
Each Genelec Active Speaker System is delivered with a mains power cable. The active electronic and power amplifiers are meant to be connected to a grounded mains connection (3-core mains).

Make sure that the correct supply voltage corresponding to your country is clearly indicated on the product before switching the power ON. Because of possible supply voltage variation in certain areas, it is advisable to make sure that this voltage swing does not go beyond the tolerances mentioned below:

Active Speaker Systems for Custom Install operating voltage range:
Standard model (USA - Europe): 115/230 V +/- 10 %
Japanese model: 100/200 V +/- 10 %

If it is expected that the supply voltage will vary outside the 10 % tolerance, it is recommended that a good quality power supply regulator is used.
2.14 Protection Circuits

Genelec active loudspeakers have custom designed protection circuits that are optimized for each model. The purpose is to protect the drivers from severe abuse that would otherwise decrease the system's reliability. The characteristic sound of activated driver protection is a short loss of high (or low) frequency or the whole signal completely for short, but audible periods. This is not signal compression. If the customer is often experiencing this phenomenon, the system is under specified for the required maximum sound pressure level in this particular room. In this case, the loudspeakers should be replaced with larger models that can deliver the desired SPL without overloading.

2.15 Troubleshooting

Genelec has a reputation for making high quality and reliable products but occasionally issues arise that require troubleshooting. If there appears to be a problem with the loudspeaker, it is often possible to isolate problems between the amplifiers or the drivers since the system is integrated.

If the loudspeaker is plugged in and turned on but there is no sound, the chances are that it is the amplifier. If the lights are on, then it could still be the amplifier but it could also be the driver(s). When in doubt, the amplifier of a known good system can be quickly swapped over to the problem system to see if the drivers are working. If they are then the problem is in the amplifier.

It cannot be stressed enough that the vast majority of loudspeaker problems turn out to be acoustical or cabling problems. PLEASE CHECK THESE FIRST, then contact the local Genelec distributor for advice.

3 Practical Installation Considerations

3.1 Main Loudspeaker Positioning

Ideal loudspeaker placement is often compromised when working within the client's wishes and room design restrictions. Often sound quality is third on the list after the room aesthetics and video requirements. However, with some attention to detail, it can be close rather than a distant third.

DVD's are normally mixed in studios that conform to the ITU standard ITU-R BS.775-1 "Multichannel stereophonic sound systems with and without picture" (Geneva, 1992-94). The closer a Home Theater can get to this standard the better the audio result will be. A few of the more important recommendations found in this international standard are presented and discussed below:

3.1.1 Angles

**ITU Recommendation:**
Left and right are positioned 30° from the center and the rears are positioned 110° ± 10° from the center. The loudspeakers should then be angled so that they point towards the optimum listening position - see Figure 6.

**In Practice:**
These angles are generally not respected in Home Theaters. The center loudspeaker is usually in the correct place but the left and right loudspeakers are positioned according to the size of the screen (a practice inherited from the movie theater 'standards'). Multiple loudspeakers are used for the rear channels to increase coverage in the listening area and are positioned wherever is most convenient on the side and/or rear walls.
3.1.2 Distance

**ITU Recommendation:**
All loudspeakers should be equidistant from the “sweet spot.”

**In Practice:**
In Figure 6, it can be seen that it is difficult to place the left, center and right loudspeakers equidistant front the “sweet spot” as the loudspeaker enclosures are normally positioned in the same plane, i.e. against a wall or in some cabinetry. The resulting timing differences are then electronically compensated for, using the processor. Unfortunately, this results in a compromise that is rarely referred to in most literature. The polar pattern of the loudspeaker is different at different listening distances and this cannot be compensated for in a simple digital delay.

3.1.3 Height

**ITU Recommendation:**
The front loudspeakers should ideally be placed at a height approximately equal to that of the listener’s ears (1.2 m / 4 ft from the floor). If the loudspeakers are to be placed higher or lower than the listeners’ ears, the loudspeakers should be angled vertically to point towards the listening position.

**In Practice:**
Genelec recommends that its loudspeakers be positioned at least 1.2 m / 4 ft off the floor so the floor reflection does not dominate the frequency response. If the loudspeaker is placed close to the floor, for example, below a screen, two things happen: a deep and wide notch occurs in the bass (typically around 100-200 Hz) and the loudspeaker is loaded which increases the entire bass output. Subjectively, the result is a muddy but thin sounding bass and midrange masking which makes speech less intelligible. For additional advice on loudspeaker placement, see Section 2.5.2 Center Loudspeaker Enclosure Location. Conversely, be careful that the ceiling reflection does not start to dominate instead.

The front loudspeakers can be placed such that the center loudspeaker is a maximum of 7° higher or lower than the left and right loudspeakers. This will not be audibly disturbing to the listeners as the human ear is not good at localizing in the vertical direction (zenith plane). The rear loudspeakers can be positioned at a maximum of 15° higher (lower is not practical!) than the front loudspeakers as humans are less good at localizing sounds to the rear.

![Figure 6. ITU-R BS.775-1 Recommended Loudspeaker Positioning in Recording Studios](image)
3.2 Subwoofer Positioning

Below are some recommendations for subwoofer positioning:

- Close enough to the front wall and slightly offset from the middle of the room, 30 cm / 1 ft, to avoid the first pressure minima position.
- In a corner, close to both front and side walls. This position will maximize the system efficiency due to the corner loading. A second subwoofer in the opposite corner may be required to avoid localizing a single subwoofer. Alternatively, use a lower bass management crossover frequency such as 60 or 40 Hz (be careful that the main loudspeakers can handle the remaining upper bandwidth - see Section 3.3 Bass Management.

These locations are contrary to the common belief that the best position for the subwoofer is in the front, on the floor and in the middle of the room, equidistant from the side walls. This location can be a serious compromise since the subwoofer sits in the pressure minimum of the lateral standing wave. Also, it has to be remembered that:

- Adjustment of the gain (Input Sensitivity) and frequency response (Bass Roll-off) of the subwoofer is necessary to balance the subwoofer to the main loudspeakers.
- The subwoofer can also be flush mounted into the front wall or some cabinetry but the discussion of the position of the source relative to the room remains valid.
- The phase adjustment on the subwoofer at the crossover frequency is important to achieve a flat frequency response in the crossover region.

3.3 Bass Management

The bass response of a Home Theater can even be more important than the visual image right from the first note. Client satisfaction depends upon the quality and quantity of bass energy, therefore careful attention is required for the lower frequencies. Unfortunately, simply putting many big subwoofers into the room will probably not ensure the client's happiness. Overblown and distorted bass can sound impressive at first but can quickly become tiring.

The most important aspect to consider for good bass response is the room shape and dimensions. Low frequency absorption will help reduce the effect of standing waves but this is usually difficult to fully accomplish due to the large depth required to absorb long wavelengths at low frequencies - see Section 5.1 Treating the Room for Good Acoustical Performance. If a room is reverberant at longer wavelengths, less energy will be required for low frequency reproduction. However, this has to be balanced against the listening position, as many times a standing wave in either the length, height or width dimension will have a negative effect, especially if the listener is in the middle of the room.

It is generally the case that if a room is small, say less than 125 m³ / 4400 ft³, a single subwoofer will work well. In addition, it is also a good idea to band pass all five main loudspeakers so that the lowest two octaves (20-80 Hz) are reproduced by the subwoofer. The logic behind this is that when the room dimensions are small and the room becomes resonant at specific frequencies, it is advantageous to be able to physically locate the source of the low frequencies to optimize the room mode excitation for a smooth bass response.

The bass management crossover frequency should be carefully selected to optimize the performance of the individual system. This is a trade-off between sharing the bandwidth between the subwoofer and the main loudspeakers and the possibility to localize the subwoofer. If the crossover is too high (>80 Hz), the subwoofer will be localized more easily. If the crossover is too low, the benefit of adding it will not be seen in the SPL output performance of the whole system. See Table 5 for the recommended crossover frequencies for different models. These frequencies are good starting values and may be adjusted to suit different rooms and set-ups.

In some processors, the LFE channel information above the crossover frequency may not be reproduced,
so be careful when setting a crossover frequency lower than 80 Hz on these units. Well designed processors generally route the LFE information above the crossover to the left and right main channels and so these are good to use in larger systems where the crossover may be set below 80 Hz.

To overcome this potential LFE problem, sound engineers are advised by Dolby and DTS to check their mixes with the LFE channel band limited between 20-80 Hz so they can be sure it still sounds good on systems that have additional band limiting on the LFE channel.

### 3.4 Cabinet Mounting

#### 3.4.1 Main Loudspeakers

Genelec loudspeakers can be mounted into cabinetry. Experience has shown that the void to the sides and top of the loudspeaker should be filled as much as possible with insulation or dense open foam. This usually helps keep the cabinetry resonances under control and inaudible. Some setting of the Bass Tilt control may then be necessary to compensate for the additional loading on the bass driver - see Section 4.2.2 Using the Room Response Controls.

![Figure 7. Required free space around a 5050A, HTS3B or HTS4B subwoofer.](image-url)
3.4.2 Subwoofers

Mounting the subwoofers inside cabinetry often gives good results. With the 5050A, HTS3B and HTS4B all that is required is some additional space: the cavity should be at least 10 cm / 4” wider, deeper and taller than the outer dimensions of the subwoofer. This allows leaving 5 cm / 2” of space on either side of the subwoofer’s passive radiators and sufficient space behind and above the enclosure to allow cooling for the electronics (see Figure 7).

The HTS6 needs 20 cm / 8” of free space on the connector panel side where the reflex port is situated. Resonance in the void are normally in the 200-500 Hz region and so will not be excited by the subwoofer’s limited bandwidth, so no damping is required if the void is kept as small as possible.

3.5 Home Theater Front Wall

Home Theater front walls consist usually of a structural hard front wall construction with a combination of standard or custom made cabinetry mounted in front of that hard wall. All loudspeakers, subwoofers, electronics and cabling are mounted in that cabinetry. A thin structure (often cloth material over wood frames) covers the cabinetry to hide all equipment but the projection screen.

This construction method is not what is referred to as the ‘flush mounting’ technique. For loudspeakers to be acoustically flush mounted, they should be mounted into a solid and heavy wall structure which limits the space that bass can spread into. Low frequency sound can then only travel in that limited space. However, if the main loudspeakers are mounted so that their front baffles are 1.3 - 1.7 m / 4 - 5 feet away from the hard wall behind them, a back wall cancellation will occur (see 5.2 Wall Behind the Loudspeaker Cancellations) in the 50 - 70 Hz region, thereby seriously compromising the low frequency response of these loudspeakers. One solution is to choose cabinetry constructions that are not too deep, for example, the loudspeaker is placed as close to the wall as possible thereby avoiding the effects of the cancellation.

Also, when large front loudspeakers are positioned too close to the floor, their responses will have notches in the 80 to 120 Hz frequency region, causing deterioration of the bass reproduction. Loudspeakers should be placed at a reasonable height and if necessary slightly tilted down, which will minimise such floor reflections. Avoid positioning the loudspeakers too high, >20 degrees, as this may become disturbing to listeners.
3.6 Installing Remote Amplifiers

In many Home Theater installations one needs to install the amplifier unit away from the loudspeaker for ventilation and connection purposes. There are no cooling fans on these adapters so they can be mounted inside the listening room and hidden so that the loudspeaker cable can be kept short.

**Rack Adapter (1037-412)**

This model can be used for the HT210 / HT210B. The kit contains one 7U rack mount chassis with internal cable and connectors in place, one Speaker Cable Adapter and four 4 x 2 mm screws. Note that the Speakon 8- and 4- pole cables between the loudspeaker and the rack adapter are not included in this kit. They should be ordered as a separate item.

To install these rack adapters, the speaker cable adapter is fixed onto the rear of the loudspeaker and the internal speaker cable (with molex type connector) is connected to this cable adapter. The amplifier unit is mounted in the 19" rack adapter chassis. There should be at least 10 cm (4") or 1U of free space above AND below the 19" chassis to ensure sufficient air flow for cooling.

In larger active Home Theater systems, the amplifiers are always delivered as separate rack mountable boxes. Each amplifier should be well ventilated in the front and rear. These amplifier models have dual slow speed fans to provide proper cooling of the electronics. These fans might generate some noise when in operation, so proper planning of their location in the installation is recommended.

For the 1035B and 1036A systems, each amplifier unit is 48.3 cm / 19" wide and 75.5 cm / 29 3/4" or 17U high. These amplifier models have four slow speed fans that might also generate some noise when in operation, so it is recommended that they are installed outside the Home Theater room.

3.7 Acoustically ‘Transparent’ Screens

Genelec loudspeakers are ideal for use behind acoustically transparent video projection screens. The waveguide helps to focus the high frequencies through the material and so project the sound into the room. In addition, the room response controls can be used to compensate for the high frequency roll-off created by the screen. Finally, if only the center loudspeaker is being placed behind a perforated screen, the room response controls can be used to timbre match the L-C-R channels.

One note of caution is to be sure that the front baffle of the loudspeaker is placed far enough from the screen so that the screen does not flutter when the loudspeakers are played at a high SPL. Bass management can help to reduce this problem as the bass content of the front channels can be redirected to the subwoofer, which is typically placed away from the screen. However, care must still be taken as placing the loudspeaker too close to the screen can have a negative effect on the mid band frequencies. There should be at least 30 cm / 12” between the loudspeaker and the screen. Contact Genelec for recommendations on individual models.

A useful by-product of the DCW™ is that reflected sound from the screen is scattered due to the curved shape around the midrange and treble drivers, thus reducing the chance of standing waves. However, it is recommend that loudspeakers placed behind projection screens are angled so that the front panel is not parallel to the screen. This further prevents standing waves forming between the screen and the loudspeaker baffle.

Graph 1 shows the effect of typical screens. These responses are all 1/3rd octave smoothed in the frequency domain to simulate what is actually perceived in the room by the human ear. It is easy to see that placing loudspeakers behind unperforated screens is not a good idea! Both the perforated screen and the cloth screen show considerable improvement in the acoustic performance.
3.8 The In-Wall and In-Ceiling Loudspeaker Systems Installation

3.8.1 General installation

The Genelec AIC25 In-Ceiling loudspeaker, AIW25 and AIW26 In-Wall loudspeakers and 5041A In-Wall subwoofer share the same basic structure with a separate loudspeaker enclosure and its dedicated amplifier module. All the necessary hardware for mounting the loudspeaker enclosure into a wall structure is provided with the kit. Optional rack mount adapters for the amplifier modules and preconstruction brackets for the enclosures are available for straightforward installation work. The following gives a broad description of the installation procedure, but does not go to full detail of every stage. The complete Operating Manuals can be downloaded at www.genelec-ht.com.

Matching Loudspeakers and Amplifiers
Each AIC25, AIW25 and AIW26 loudspeaker has been factory calibrated for optimum performance with the individual amplifier it is shipped with. NEVER mix these matched amplifier-loudspeaker systems with others in the installation process. The matching units are marked with the same ID number.

Placement Considerations
If the loudspeakers are used in an application where their capability for precise sound imaging is needed, we recommend that the loudspeakers are placed as far away from corners and the ceiling as possible. If a diffuse sound field is preferred, for instance in a rear/side channel setup, you may actually benefit from the acoustical reflections from nearby boundaries. In this case, place the loudspeakers close to the ceiling or another wall, or have them face away from the reference listening position, so that the proportion of reflected sound increases. We generally do not recommend this as the loudspeakers perform best when they are facing towards the center of the listening area.

Installing the Loudspeaker Cables
The RAM1 and RAM2 amplifiers have separate power amplifiers for the tweeter and woofer. Be sure to maintain correct polarity when connecting the loudspeaker cables and be extra careful not to mix the tweeter and woofer cables. Use a good quality 4-conductor cable and make the cable runs as short as possible.

The RAM3 amplifier for the 5041A In-Wall subwoofer has a single power amplifier and requires a 2-conductor cable. Note that a loudspeaker cable introduces some resistance to the current flow and so longer cable runs will require thicker cables to overcome that issue. The connectors accept cables up to 9 gauge (6 mm²). Table 6. Recommended maximum lengths for speaker cables.

<table>
<thead>
<tr>
<th>Cable gauge</th>
<th>Max length</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.0 mm² / 14 AWG</td>
<td>30 m / 100 ft</td>
</tr>
<tr>
<td>3.3 mm² / 12 AWG</td>
<td>40 m / 131 ft</td>
</tr>
<tr>
<td>5.3 mm² / 10 AWG</td>
<td>60 m / 200 ft</td>
</tr>
</tbody>
</table>
Painting the Loudspeakers
The visible parts of the loudspeaker (grille and its surround) can be spray painted to match the wall colour and interior decorations.

Environmental Requirements for the RAM1, RAM2 and RAM3 Amplifier modules
Power amplifiers generate some heat when used at full power. To avoid overheating, ensure that there is good airflow around the amplifier and no other heat sources close to it. We recommend installing the amplifiers into a well ventilated equipment rack using their dedicated RM1 (for RAM2 and RAM3) and RM2 (for RAM1) rack mount kits. Sufficient cooling for the amplifier must be maintained at all times. As a general rule, the ambient temperature around the amplifier must not exceed 35°C / 95°F. See the Operating Manuals of these systems for more detailed information.

Connecting the Amplifier
The RAM1, RAM2 and RAM3 amplifiers are designed to be connected to a line level output of a preamplifier, surround sound processor or other low level source. The amplifiers have a balanced XLR input and an unbalanced RCA input. If cable connection lengths are greater than >10 m / >30 ft a balanced line connection is recommended as it offers better immunity to external interference. However, the more common RCA connection method is also available for short connection lengths in less electrically noisy environments. Do not use both RCA and XLR inputs at the same time.

3.8.2 Installing the AiW26 Loudspeaker Enclosure
Use the cardboard wall cut-out template that also shows the loudspeaker drivers to find the best location for the AiW26. The loudspeaker enclosure requires a minimum of 88 mm / 3 27/32" of free depth behind the sheetrock. The mounting brackets need a clearance inside the wall of at least 125 mm / 5" above the top edge of the hole and 65 mm / 2 9/16" below the lower edge. Also note that the grille frame is wider and taller than the hole and requires about 30 mm / 1 3/16" of smooth wall surface around all sides of the hole.

Lift the AiW26 into the hole top end (cable binding posts) first and push the lower end of the loudspeaker onto the edge of the hole. Push both mounting brackets fully up and hold them there as you push the lower half of the loudspeaker into the wall. When the loudspeaker is in the correct position, pull the mounting brackets down. The grille cover holds onto the loudspeaker’s frame with magnets. All this takes about one minute per enclosure once the hole is cut in the wall.

3.8.3 Installing the AiW25 and AIC25 Loudspeaker Enclosures
Use the cardboard wall cut-out template that also shows the loudspeaker drivers to find the best location for the loudspeaker. Examine the wall or ceiling structure carefully to find an unobstructed location for the loudspeaker. The loudspeaker enclosure requires a minimum of 98 mm / 3 27/32" (AiW25) or 160 mm / 6 4/16" (AIC25) of free depth measured from the outer surface of the sheetrock. Also note that the enclosure flange is wider and taller than the hole and requires about 20 mm / 3/4" of smooth wall surface around all sides of the hole. When you have found a good location, check that the template is level and trace the hole onto the sheetrock with a pencil along the outline of the template and make the cut along the marked lines.
Lift the loudspeaker enclosure into the hole and turn the Phillips 2 screws on the front baffle clockwise so that the mounting tabs rotate outwards. Continue tightening the screws until the sheetrock is firmly clamped between the mounting tabs and the enclosure flange. If necessary, a secondary support line can be attached to the tab next to the loudspeaker cable connector.

3.8.4 Installing the 5041A In-Wall Subwoofer Enclosure

The 5041A subwoofer enclosure is mounted on four vibration-isolating mounting brackets that absorb enclosure vibrations occurring at high playback levels. Attach the lower brackets to the wall joists and position the subwoofer enclosure on them. Next attach the upper brackets that secure the subwoofer in place. As the mounting is flexible, it is very important to ensure that no part of the subwoofer enclosure comes to contact with drywall or any other part of the wall structure.

During the installation the bass divers and reflex port of the 5041A enclosure are covered with a protective cover that also provides a cut-out template for the drywall installers. Once the drywall is in place, the cover can be removed and replaced with the grille frame and grille insert.

4 The Room Response Controls

Because all loudspeakers have different responses depending on where they are placed within different rooms, flexible room response controls have been integrated into the design to help optimise the loudspeaker’s tonal characteristics once they are installed.

4.1 Boundary Loading Effect

The sound produced by a loudspeaker in a room is limited by the large reflecting surfaces of that room. For low frequencies this means the walls, the floor and the ceiling. Here, the room effects are the strongest. In the midrange, mainly the loudspeaker enclosure and objects near the loudspeaker limit the radiated sound. For high frequencies, the sound is limited entirely by the loudspeaker baffle and the driver itself.

Low frequency sound spreads out in all directions (omnidirectional) for all loudspeakers and subwoofers so cancellations, standing waves and the proximity of boundaries affect their performance. As an example, loudspeakers typically have a flat free field response (anechoic response in $4\pi$ space) so mounting it in a large wall corresponds to limiting the radiation space to half of the free field space in which the loudspeaker was designed. This gives a 6 dB increase at frequencies below 200 Hz, and applies to any flush mounted loudspeaker or loudspeakers placed with their back against a solid wall. Placing the same loudspeaker in a corner (intersection of two walls but not on the floor), results in a low frequency increase of 12 dB. An increase of 18 dB is seen for positioning in a three-walled corner. For subwoofers, which are usually located on the floor against a solid wall, a 12 dB increase is seen compared to free field acoustic conditions. Once placed in a corner the increase again will be 18 dB. This gain is beneficial for subwoofers, as it provides additional headroom and a consequently lower system distortion.

The boosts mentioned above are theoretical and for an ideally simple situation. Experience shows that
the actual low frequency emphasis when placing a loudspeaker next to a wall is generally about 4 dB. In all cases, this boost has to be compensated for, otherwise a natural sound balance will not be heard. This is achieved by using the unique Genelec Room Response Controls featured on all Home Theater loudspeaker models.

4.2 Tuning the Home Theater

4.2.1 Subwoofer Phase

Setting the phase of the subwoofer(s) is essential for a good sounding Home Theater. If the phase is not correctly set, then adding subwoofers can actually result in LESS bass in the listening area. There are four ways to achieve a good result. Use one subwoofer for these procedures and then set the other subwoofers to the same setting when the result is known:

Test Tone
Instructions for setting the subwoofer phase using a test tone are detailed in the 5050A, HTS3B and HTS4B operating manuals, so they have not been repeated here.

Measurement
Use an MLS, TDS or two channel FFT type measurement system to directly obtain the phase frequency response of the subwoofer and the center loudspeaker. In a correctly aligned system, the subwoofer should be 180° out of phase from the center loudspeaker at 120 Hz. This is because the bass management in the surround sound processor introduces 180° phase change at the selected crossover frequency.

Listening
Use a CD with deep and repetitive bass content. One person should sit in the center of the listening area and the other near the phase controls of the subwoofer. Make a rough attempt to get the subwoofer sounding right using the input sensitivity control, then systematically set each of the phase controls so that the worst-case setting is found, i.e. the setting with the least amount of bass (180° out of phase). This setting should be quite easy to find. Then reverse the 180° phase control setting so that the system is in phase and the bass sounds full. Adjust the input sensitivity to suit the new phase setting.

Calculation
If the listening distance from the subwoofer to the center of the listening area is the same as that from the center loudspeaker to the center of the listening area, then the phase should be set to 0°. A +90° phase change is required for every additional 72 cm / 24” that the subwoofer is away from the center of the listening area compared to the center loudspeaker. The phase change control on Genelec subwoofers is actually a phase delay (0°, -90°, -180° and -270°) at 120 Hz so some simple maths is required to find the correct setting. For example, if the subwoofer is an extra 2.1 m / 7’ away from the center of the listening area compared to the center loudspeaker then the phase should be set to +270°, which is the same as -90°.

4.2.2 Using the Room Response Controls

All Genelec loudspeakers have room response controls and the larger models have more than the smaller models to give a greater degree of control. These controls allow the installer to adjust the output level to each driver and to change the Bass Tilt, Bass Roll-off and Treble Tilt depending on the model. Using these controls will greatly enhance the sound of the Home Theater; unfortunately, in most cases they are never touched. This means that the end user does not get the best possible sound out of the system. This is a lost opportunity as the controls are very easy to use and with a little time and some listening an installation can be transformed from a decent sounding system into an awesome sounding Home Theater.
The main issue here is that the fear of taking away bass must be overcome. In Home Theater, it is often thought that “the more bass, the better.” This is not true, as a very bassy system will just result in listener fatigue and a loss of intelligibility in the midrange.

Bass Tilt and Bass Roll-off
This is the most critical area of tuning a Home Theater System. Too much bass masks the midrange, thereby making speech less intelligible and guitars & vocals in music less open sounding. Most loudspeakers are designed to perform best when placed on a stand away from the wall but as soon as ANY loudspeaker is placed next to (or in) a wall or inside cabinetry, the loudspeaker response becomes loaded, the bass response rises and midrange masking takes place. Therefore, Genelec provides a means to reduce the bass output using the room response control DIP-switches. Bass Tilt provides a gentle slope to compensate for boundary loading, and corner loading can be additionally compensated by using the Bass Roll-off control.

Treble Tilt (Treble Level)
The easiest control to adjust is the Treble Tilt on two-way systems (Treble Level on three-way systems). In most installations, it should be set to -2 dB. The reason for this is that most people do not actually want to hear a flat response up to 20 kHz (as is done in recording studios). By adjusting the treble down by 2 dB, the system may sound smoother or warmer to many listeners, so that listening becomes a pleasurable experience. Note that if the loudspeaker is placed behind a cloth or a perforated projection screen, then the Treble Tilt or Treble Level control can probably be set to 0 dB to compensate for the energy loss due to the sound absorption of the fabric in front of the treble driver.

Tables 7 and 8 can be used as a rough guide of how to set the dip switches. This is just a starting point and the optimum settings will vary between different rooms.

If acoustic analysis tools such as RTA, TDS or MLS systems are available then this tuning can be achieved quite quickly and effectively to give good loudspeaker sound quality and matching for each channel. If such specialized equipment is not available, it is possible, with a little practice, patience and objective listening, to do the tuning by ear. The tuning should not be done until the room is complete, as the addition of seating and other absorbing materials may change the tonal balance of the system.

Take a well recorded CD that contains a male vocal and a full band and/or orchestra (acoustic instruments are preferable). Listen to a passage that contains the vocal and as little instrumentation as possible. Then listen to a passage that has a substantial amount of bass. If the voice recedes or changes character, then there is too much bass output. The bass energy is masking the midrange so set the Bass Tilt control, one switch at a time, until the vocal heard in the loud passage sounds the same it does in the quiet passage.

<table>
<thead>
<tr>
<th>Loudspeaker position</th>
<th>Treble Tilt</th>
<th>Bass Tilt</th>
<th>Bass Roll-off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free standing - damped room</td>
<td>-2 dB</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Free standing - live room</td>
<td>-4 dB</td>
<td>-2 dB</td>
<td>-2 dB</td>
</tr>
<tr>
<td>In a corner</td>
<td>-2 dB</td>
<td>-4 dB</td>
<td>-4 dB</td>
</tr>
<tr>
<td>In a cabinet</td>
<td>-2 dB</td>
<td>-2 dB</td>
<td>-2 dB</td>
</tr>
</tbody>
</table>

Table 7. Recommended dip switch settings on bi-amplified models

<table>
<thead>
<tr>
<th>Loudspeaker position</th>
<th>Treble Level</th>
<th>Midrange Level</th>
<th>Bass Level</th>
<th>Bass Tilt</th>
<th>Bass Roll-off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free standing - damped room</td>
<td>-2 dB</td>
<td>None</td>
<td>None</td>
<td>-2 dB</td>
<td>None</td>
</tr>
<tr>
<td>Free standing - live room</td>
<td>-4 dB</td>
<td>-2 dB</td>
<td>None</td>
<td>-2 dB</td>
<td>-2 dB</td>
</tr>
<tr>
<td>In a corner</td>
<td>-2 dB</td>
<td>None</td>
<td>-2 dB</td>
<td>-2 dB</td>
<td>-2 dB</td>
</tr>
<tr>
<td>In a cabinet</td>
<td>-2 dB</td>
<td>None</td>
<td>-4 dB</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>

Table 8. Recommended dip switch settings on tri-amplified models
To set the Bass Roll-off control, listen to the very lowest notes of a bass guitar or piano. If they are reproduced substantially louder than the rest of the higher notes then progressively set the Bass Roll-off control until a balance is achieved. Note that the Bass Roll-off control only operates around the lowest frequencies of the loudspeaker enclosure so it will have little audible effect in a bass managed system.

Note: ONLY USE ONE DIP SWITCH AT A TIME in each group, as the switches are not cumulative (-2 dB + -4 dB does not equal -6 dB!). The exception to this rule is on the subwoofers' Bass Roll-off and Phase controls and on the 6020A controls where two switches can be set to give a cumulative net effect.

### 4.2.3 Balancing the System

Now that the subwoofer Phase control and the other Room Response Controls have been set correctly (see previous two sections), the next stage is to balance the system so that each channel is reproduced at the correct level. There is an important distinction here: this procedure involves balancing the LFE channel and main channels (electrical issue) and is not the same as balancing the subwoofer to the main channels (an acoustic issue). Up to now the system should be balanced acoustically so now it is time to balance the system electrically. This relatively simple process uses the pink noise generator in the surround sound processor and any cheap sound pressure level (SPL) meter.

Before starting this process, it is a good idea to check that input sensitivity of all of the loudspeakers is set to maximum (fully clockwise = -6 dBu) and that the subwoofer has been adjusted to a suitable input sensitivity as previously described. Set the SPL meter to 'C-weighting' and 'slow' and turn on the pink noise in the surround sound processor. Sitting in the center of the listening area and with the SPL meter at arm's length, slowly increase the processor output until the SPL meter reads 79 dB. Repeat this process until the reading for each of the main channels matches to within +/- 0.5 dB. For the LFE channel, the SPL meter should read 4 dB hotter than the main loudspeakers, i.e. 83 dB, due to the limited bandwidth it is expected to reproduce. This target level is the same irrespective of the bass management crossover frequency, as, in a good processor, the LFE channel should be reproduced in its entirety using careful routing to the appropriate loudspeakers.

Finally, listen carefully to some DVD's to subjectively fine tune the subwoofer sensitivity.

### 4.3 Other Processor/Decoder Settings

Usually the loudspeakers' bass management is implemented in the surround processor or decoder. For the Genelec Home Theater loudspeakers to perform in an optimum way, here are various basic recommendations on processor/decoder settings:

**Small or Large?**

When selecting the menu ‘Speaker Type’ there usually is a choice between ‘small’ or ‘large’ loudspeakers. If ‘small’ is selected the bass of the main loudspeakers is relocated to the subwoofer. Then the subwoofer replaying the LF content can be located in the best place in the room rather than where the main loudspeakers have to be put, i.e. L-C-R, etc... However, the subwoofer then has to work much harder than if it was only reproducing the LFE channel. This setting is recommended for two way systems with subwoofers. ‘Large’ might be selected in large Home Theaters that have three way systems which cover a larger spectrum.

**Delay Adjustment**

In the ‘Delay Adjustment’ menu, the precise distances between each loudspeaker and the reference listening point has to be entered. Setting these values properly will help in achieving a good sound stage imaging and proper rendering of surround effects.

**Internal Level Settings**

If the adjustment of the individual loudspeaker level is performed via the processor/decoder, it should only be done after the acoustic adjustment of the loudspeaker to the room. When the Room
Response Controls are activated, the overall level of the loudspeaker will be altered. so proper order in the adjustment method is recommended.

4.4 Genelec in-room Measurements and Calibration

It has already been mentioned earlier that once loudspeakers are placed in a room their performance and tonal characteristics change according to the quality of the room acoustics, construction geometry and loudspeaker location. To ensure that every major Home Theater installation is set up optimally, Genelec has a global goal to measure and calibrate each of these rooms. This systematic procedure has gained Genelec a very high reputation in the professional recording and broadcast studio world for quality and consistency of their monitoring loudspeaker systems. The same is becoming true in the Home Theater market.

The measurements and calibration of the loudspeaker/room system is done using MLS type signals, professional WinMLS measuring equipment and high grade measuring microphones. All Genelec loudspeaker have a design tolerance of +/-2.5 dB over their entire frequency response when measured in free field (anechoic) conditions. This very tight manufacturing tolerance allows the calibration engineer to match any Genelec loudspeaker with any quality Home Theater environment to achieve superior audio reproduction.

5 Room Construction and Acoustics

Low frequencies have long wavelengths that are omni-directional, so they bounce off all hard surfaces in the room. The more solidly the room is built, the more the low frequency energy remains in the space. Here are two basic cases:

- A solid room offers good sound isolation from the rest of the building; unfortunately, it means that the low frequency energy in the room should be absorbed to avoid standing waves, room modes and bass cancellations (different words for the same thing!). A bad example of the reverberation time in this type of room is shown in the red curve in the right hand graph of Section 5.1.2 Mid and High Frequency Treatment. Subjectively the bass sounds boomy in some parts of the room and there are other locations where there is little or no bass.

- A leaky room allows the low frequency energy to escape from the room and so is equivalent to improved room absorption. Unfortunately, this means that the low frequency energy travels to other parts of the building and the mid and high frequencies become relatively lively compared to the bass. A bad example of the reverberation time in this type of room is shown in the blue curve in the right hand graph of Section 5.1.2 Mid and High Frequency Treatment.

A solid, isolating structure should be constructed from heavy material such as concrete, bricks or stone. A single layer of 12 mm / ½ inch sheetrock screwed into wood studs is not a solid structure. However, rooms constructed with three layers of sheetrock on both sides of 4” studs followed by a 6” insulated air gap and another similar wall will be much more solid. To get the real benefit of such structures, they have to be constructed with extreme care and with proper supervision. Genelec recommends the use of a well-qualified room acoustician AND a contractor with experience designing Home Theaters or similar type rooms, such as music studios.

5.1 Treating the Room for Good Acoustical Performance

5.1.1 Low Frequency Treatment

Sometimes there are customer complaints that the loudspeakers sound bad, but after some investigation it usually turns out to be a lack of low frequency control in the room. Low frequencies are normally
considered to be below 200 Hz, as this is where the room size starts to dominate the sound quality. The formula which relates frequency to wavelength is:

\[ c = f\lambda \]

Where:  
- \( c \) is the speed of sound in air (344 m/s)  
- \( \lambda \) is the wavelength in meters  
- \( f \) is the frequency in Hz

Turning this formula around and applying some values to it gives:

\[ \lambda = \frac{344 \text{ m/s}}{200 \text{ Hz}} = 1.72 \text{ m (6'5")} \]

Extending this calculation down to 50 Hz gives a very long wavelength of 6.88 m / 25'8" and 20 Hz is a colossal 17.2 m / 56'5" in length.

How can these low frequencies be controlled? There is one traditional but effective way of controlling low frequency energy and that is to build what is called a “¼ wavelength bass trap.” This bass trap is built over an area greater than 66% of a reflecting surface (typically the hard back wall). The idea is to convert the acoustic air movement (velocity) into heat energy and hence absorb the sound. This process is most efficient when the absorbing material (typically rock-wool or mineral wool) is positioned where the air movement is largest; unfortunately, this is often in the middle of the room. However, placing the absorbing material on the wall allows the sound wave travelling towards the wall to be absorbed but ALSO the remaining sound that bounces off the hard wall travels back though the absorbing material before re-entering the room at a considerably lower (and hopefully insignificant) level. In a good case, more than 95% (>25 dB) of the sound should be absorbed.

Unfortunately, there is a trade-off. When the absorbing material is placed against the wall the depth of the material defines how low a frequency is trapped. To be effective at low frequencies the absorber material needs to be thick... very thick! For example, if the absorber needs to trap down to 50 Hz then the thickness should be ¼ of 6.88 m / 25'8", which is 1.72 m / 6'5". The bass trap’s effectiveness will be less at lower frequencies than this.

Clearly, this can be a problem in many large Home Theaters, as this is equivalent to about one row of seating. In smaller rooms, this loss of space is probably impossible to consider. Panel resonators can save space and still have attenuation properties down to quite low frequencies but they are more difficult to design and construct. Alternatively, corner traps can control a reasonable amount of low frequency energy and take up less useful internal room space. Further information on these acoustic treatment techniques is available in textbooks and good acoustic design firms should have little problem working out good solutions for problematic spaces.

### 5.1.2 Mid and High Frequency Treatment

Unlike low frequencies, the midrange and high frequencies are far easier to control because these wavelengths are so much shorter; 1 kHz is approximately 30 cm / 1’ and 10 kHz about 3 cm / 1”. It is very easy to add back into an over damped room some midrange and high frequency reflections required for natural sounding acoustics by using diffusers (even picture frames and decorative thin wood panels can be effective if used cleverly).

The reverberation time (RT) gives an indication of how well controlled the room is at various frequencies. A good sounding Home Theater should have a flat RT of about 0.3 s to 0.4 s, but it may drop away slightly at higher frequencies and rise up at lower frequencies. Below are examples of a good quality room and a bad quality rooms.

- The room with the RT shown in Graph 2 has a very tight and punchy bass but the mid and high frequencies also sound natural and spacious. This was entirely due to efforts to control
the low frequency reverberation time using panel absorbers on the ceiling and 1.4 m / 5’5” of damping material at the rear of the room!

- In the room with the red curve in Graph 3 the sound was very boomy even though the frequency response of the loudspeakers was very flat. This case is hard to solve, as thick damping material needs to be added to control the low frequencies.

- In the room with the blue curve in Graph 3 the sound was very bright and so the treble tilt control had to be turned down considerably to compensate. This case is easy to solve by adding some absorbing material, such as heavy curtains, around the room to control the high frequency reflections.

## 5.2 Room Modes, Reflections and Wall Behind the Loudspeaker Cancellations

**Room Modes**

Every room (with the exception of a perfect anechoic chamber) has a set of resonant frequencies. These frequencies and their relative strength in the sound field are defined by room geometry and surface materials. Frequencies below 300 Hz are most critical due to their long wavelengths and so these frequencies will excite room modes quite easily. The fewer the number of modes the more audible they will be. Basically the number of existing modes depends on the room dimensions and the frequency band in question. Large rooms have more modes than small rooms. So, in general, this favours using large rooms instead of small, up to a point. As the room size increases, so does the reverberation time. At the same time the distance between walls increases and reflections start to sound like echoes, especially if the walls are not acoustically treated.

Most Home Theaters have parallel walls which leads to strong rooms modes. The incident sound and its reflections off these walls may constantly reinforce each other, creating a resonance. In such
a case the pressure minimum and maximum are found on specific, permanent locations in the room. The distance between the two walls determines the set of resonant frequencies in that space. When a loudspeaker is driven in such a space, room modes are excited. To avoid this, loudspeakers should not be placed in a pressure maximum. For example, if the room height is \( H \), positioning the loudspeaker precisely at height \( H/2 \) coincides with a pressure minima in the vertical plane. Placing the loudspeaker at \( 2/5 \ldots 2/6 \) room height minimizes problems from hard ceiling and hard floor surfaces.

This could help problems with the lowest modes, which are most difficult to absorb. In general, the number of room modes depends on the proportions of the room, and so the Home Theater designer should avoid planning room proportions with precise integer ratios.

**Reflections**

Practically all rooms suffer somehow from interference between the direct and reflected sound. The first floor reflection is usually present, especially for the center loudspeaker when mounted below the screen. Attempts to absorb the reflected sound are usually not very successful, especially for the floor reflection. One should note that even with an absorption coefficient of 0.9 the reflected wave is only 10 dB below the direct sound. To get 90 \% absorption at 80 Hz about 1 m of porous absorbent is needed. To properly deal with boundary reflections, reflective surfaces should be minimised and some absorption should be placed near the loudspeakers. Also, by using Genelec controlled directivity loudspeakers, the ratio of direct versus reflected sound is significantly increased.

**Wall Behind the Loudspeaker Cancellations**

Another boundary interference to consider is the so called ‘rear wall’ cancellation effect, generated by the single reflection from the wall behind the loudspeaker. When two identical signals are in anti-phase, they cancel each other. If the loudspeaker is a quarter wavelength away from a rear reflective wall, the reflected wave will come back to the loudspeaker with half a cycle phase difference and thus cancel the original signal at that frequency. The importance of the cancellation depends on the distance and the reflection coefficient of the wall, but it is usually very audible. For a bass-managed Home Theater set-up using an 80 Hz crossover between main loudspeaker and subwoofer here is a set of practical placement solutions.

First, the distance between the radiating subwoofer driver and the wall behind the subwoofer providing part of the low frequency loading must not exceed a conservative 90 cm (35”). If the subwoofer is placed further than that, cancellation notches will degrade the subwoofer response.

Secondly, there are three practical alternatives for the main loudspeakers (reproducing frequencies above 80 Hz in our example):

- First, the loudspeakers could be flush mounted in a hard wall (or ‘infinite baffle’) eliminating the rear wall reflection problem.
- Second best is placing the loudspeaker very close to the wall, which raises the cancellation frequency to a value where the loudspeaker is more directional and so the cancellation becomes inaudible. In most cases a distance around 20 cm / 8” between the front baffle and the wall behind can be considered as appropriate.
- The third logical cure is to move the loudspeaker away from the wall, and in our example this means a minimum of 1.1 m / 3’7”. In doing so, the cancellation frequency drops down below the 80 Hz cut-off of each main loudspeaker.

### 5.3 Home Theater Performance - The Right Combination of Products

The final performance of a quality Home Theater is intrinsically linked to the equipment selection, the room construction, the entire system integration and the project planning and management. The aim of this chapter is to provide brief guidelines concerning the basic concept behind audio equipment selection so that the best possible result is achieved.
First, the best audio equipment will only reach its optimum performance if properly installed in a quality room. This means that the first consideration when building or installing a Home Theater is the room acoustics. This is the foundation, but often the most neglected part of the project. Then, in the audio equipment chain, cabling and source equipment will certainly play an important role in the final sound quality, but the most noticeable changes will come from the loudspeaker performance. Of course, the product selection should fit each room. If the audio is undersized then the whole Home Theater experience will be compromised. Surprisingly, a screen that is slightly too small combined with a fantastic audio system will feel much more comfortable and impressive than vice-versa.

6. Production and Quality Standards

6.1 Genelec Manufacturing Process

Quality assurance is highly emphasized in the production process at Genelec Oy. In the spirit of Quality Policy, everybody in the organisation is committed to quality. Continuous improvement and zero-defect principles are part of the daily work. Quality assurance process in manufacturing is based on comprehensive incoming inspection, electrical testing of all amplifiers, acoustical test of all products and finally checking visually all products before packing.

6.2 Safety Considerations

All Genelec active loudspeakers have been designed in accordance with international safety standards, to ensure safe operation and to maintain the instrument under safe operating conditions, the following warnings and cautions must be observed:

- Servicing and adjustment must only be performed by qualified service personnel. The amplifier must not be opened.
- Do not use the loudspeaker with an unearthed mains power cable as this may lead to personal injury.
- To prevent fire or electric shock, do not expose the loudspeaker or amplifier unit to water or moisture. Do not place any objects filled with liquid, such as vases on or near the loudspeaker or amplifier.
- Note that the amplifier is not completely disconnected from the AC mains service unless the mains power cable is removed from the amplifier or the mains outlet.

6.3 Guarantee and Maintenance

Genelec Home Theater loudspeakers are supplied with a guarantee against manufacturing faults or defects that might alter their performance. The guarantee term is two years. Refer to supplier for full sales and guarantee terms. Any maintenance or repair of the product should be undertaken only by qualified service personnel.

6.4 ISO 9001 Standards

Genelec Oy have developed a quality system to meet all requirements of the international quality standard ISO 9001 (rev 2000). Genelec's Quality System is customer focused. Standard practises cover all the main processes and activities. The system also covers environmental aspects (ISO 14001, Environmental Management System). The documented quality system is certified by SGS Fimko.
6.5 Product Awards

Since 1978 Genelec has been designing high quality active monitors for broadcast and professional recording applications. Genelec has now also turned its attention to the Custom Install market and is prominent in high end theater installations.

Over the years, Genelec has been presented with numerous industry awards for its innovative designs and technical excellence. These include the 2003 Electronic House - Product of The Year Award (CEDIA Indianapolis, USA) for the HTS6 subwoofer, the 2004 Home Cinema Choice Magazine Award (UK), ‘Oscar’ for Best High-End Home Theater speaker system for the HT208 and HTS4 models and the 2006 Electronic House - Product of The Year Award (CEDIA Indianapolis, USA) for the innovative Play 6020 System.

Other awards for the professional active monitor products include:

2008 - TEC Award for the SE DSP Monitoring System
2008 - Musik Messe International Press Award (MIPA) for the 8240A DSP Monitoring System
2007 - TEC Award for the 8200/7200 DSP Series Monitoring Systems
2007 - Keys Magazine Readers Award for 8240A
2007 - Best Audio Innovation Award for the 8200/7200 DSP Monitoring Systems - Digital Studio Magazine (UAE)
2006 - PAR Excellence Award for the 8200 DSP Series Monitoring System
2006 - Mix Certified Hit Top Ten Technology Award Musikmesse - Genelec 8200 DSP Series
2006 - PAR Excellence Award for the 7050B LSE Active Subwoofer
2006 - Musik Messe International Press Award for the 8050A Monitoring System
2005 - TEC Award for the 8050A Monitoring System
2005 - Remix Technology Award - 8130A
2003 - TEC Award for the 7070A Active Subwoofer
2003 - EQ Blue Ribbon Award for the 7073A Active Subwoofer
2002 - EQ Blue Ribbon Award for the LSE Active Subwoofer Series
2001 - EQ Exceptional Quality Award for 1029.LSE PowerPak 5.1 Monitoring System
2001 - PAR Excellence Award for the 1029.LSE PowerPak 5.1 Monitoring System
2001 - Musik Messe International Press Award for the 1031A Monitoring System
2000 - Musik Messe International Press Award for the 1031A Monitoring System
2000 - TEC Award for the 1036A Main Control Room Monitoring System
2000 - PAR Excellence Award for the 1093A Active Subwoofer
1999 - PAR Excellence Award for the 1036A Main Control Room Monitoring System
1997 - TEC Award for the 1029A/1091A Monitoring System
1997 - BE Radio NAB Pick Hit Award for the 1029A/1091A Monitoring System
1997 - Musician Magazine Editor’s Pick Award for the 1029A/1091A Monitoring System
1996 - PAR Excellence Award for the 1029A/1091A Monitoring System
1996 - EQ Blue Ribbon Award for the 1029A/1091A Monitoring System
1995 - TEC Award for the model 1030A
1995 - Professional’s Choice Award for the model 1031A - Producer Version
1993 - TEC (Technical Excellence & Creativity) Award for the model 1038A

6.6 Further Advice and Information

Further product information and installation advice can be found on the Genelec Home Theater web site (www.genelec-ht.com). Also, look out for Genelec dealer and installer training seminars organized by distributors.
www.genelec-HT.com

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