



*Pioneer*

## Achieving THX Certification with Class D Amplifiers

### THX Case Study—Pioneer

#### Introduction

For more than 20 years THX has bridged the gap between the artistic community and the consumer electronics industry. Today, THX Certified home theater receivers, speakers and amplifiers are designed to present movie, music and video games with the same level of detail, clarity and impact as produced in the studio.

As the high definition media formats started to appear in 2001, consumer electronics companies approached THX to review a range of new Class D switching technology as a viable replacement to traditional class A/B amplification. At first, THX was skeptical that a Class D amplifier solution could meet the same benchmarks of its analog predecessors. Class D promised more efficient power consumption and slimmer designs. But, could it deliver THX Certified quality and performance the way the artist intended?

#### Reference Level: Listening Loud and Clear

One of the key attributes that THX adapted from the filmmaking community for home entertainment products was the Reference Level concept. Today, all movies are mixed in studios to an output level of 85dB SPL with 20dB of headroom. THX Certified receivers and preamplifiers recreate this same Reference Level and headroom when the volume dial is turned to the 0dB position. This allows the user to experience the exact volume level used by the filmmaker to mix the movie—with the same fidelity found in the studio.

Achieving THX Reference Level is no simple task. It requires a tremendous amount of power to drive an audio system effortlessly without clipping or distorting. To ensure the amplifier can reach this peak performance, THX developed a set of specifications as part of its THX Ultra2, THX Select2 and I/S Plus certifications.

Power output is key to THX certification. Depending on the amplifier design, when the volume is increased and an amplifier is stressed and overdriven, excessive current draw can sag the voltage rails. This introduces excessive harmonics rising in frequency as the output tries to increase more than the amplifier can deliver.

These harmonics can cause thermal damage to the tweeter. For this reason, THX requires CE manufacturers to build receivers with a healthy power supply reservoir. This helps deliver high, on-demand current bursts and presents effortless performance even when playing at the highest volume levels.

## THX Testing Process

The THX amplifier testing and certification focuses on three primary areas: 1) Engineering Competence, 2) Product Compatibility and 3) Reference Level Performance.

To achieve THX certification, an amplifier must pass more than 500 tests covering noise, distortion, current, voltage output and many others. Wattage numbers are not factored into THX certification because they often change depending on the impedance of the speaker and how much distortion is allowable in the measurement. Wattage numbers may also vary depending on the number of channels being driven at any given time. Instead, THX evaluates the actual voltage and current with different loads on single and multiple channels.

THX performs single and multiple channel testing with sine waves to evaluate the abilities of the amplifier's transformer and power supply current reserves. Because the goal of THX certification is to replicate the cinema listening experience in the home, THX created burst testing methods for all channel conditions. This type of testing mimics very aggressive program material, often found in action film soundtracks.

THX Amp Testing and Certification	
Reference Output Voltage	Continuous Single Channel Output Voltage Capability
Voltage Gain	Continuous Multiple Channel Output Voltage Capability
Frequency Response With Various Loads	Burst All Channel Output Voltage Capability
Noise Output Voltage	Short-Term Output Current Capability
Hum	Long-Term Output Current Capability
Crosstalk	Load Impedance Range
Harmonic Distortion and Noise	Transient Output Capability
Modulation Distortion	Transient Overload Recovery Time
Difference-Frequency Distortion	Asymmetrical Clipping
Overload Restoring Time	Propagation Delay
Polarity	Output Impedance
D.C. Offset at the Output	Input Impedance
Stability with Capacitive Load	Fan Control Operation
Mechanical Noise Level	Conducted Interference
Output Protection Stability	Radiated Interference

## Class D Amplifiers

When manufacturers first approached THX to inquire about a specification for switching amplifiers, THX engineering pointed them to the analog requirements. Why? THX was not willing to certify a new technology just because it was new.

Lowering the THX requirements for a new amplifier technology was not an option because the sole determiner of THX certification is audio performance. This type of thinking benefits amplifier and receiver manufacturers by providing them the freedom to be as creative as possible with their product designs. As long as the end result meets THX requirements, manufacturers are free to integrate a variety of existing and emerging technologies, including Class D switching amplification.

With its novel design and power efficiencies, Class D became a natural choice for manufacturers that were looking to create a unique approach to enhancing performance and leveraging more power, using

less energy in smaller chassis. However, early Class D solutions struggled to meet THX requirements for certification due to THX's stringent loading, noise, distortion and frequency response standards.

THX requires amplifiers to demonstrate flat frequency response to accurately reproduce music and cinematic content in the home. When movie or music source material goes into a THX Certified amplifier, it should not be altered in any way that could detract from the original vision of the filmmaker or recording engineer. This THX principle posed a direct challenge to Class D switching amplifiers due to the fact that Class D often incorporates output filters, which interact with the speaker load. Because of this, the THX engineering team was skeptical that a Class D solution would ever successfully achieve certification.

## **Pioneer Goes Class D**

In 2007, THX began working with Pioneer on its new initiative to evaluate a feasible Class D solution for A/V receivers. Pioneer viewed Class D as a means of improving performance for the emerging demands of high definition audio and video formats. This new technology could enable home enthusiasts transitioning to Blu-ray Disc to realize the full potential of uncompressed audio soundtracks. From a system design standpoint, Class D also allowed Pioneer to develop more compact chassis designs with higher power output, additional channel configurations and improved fidelity.

After initial testing, THX engineers uncovered several predictable areas of concern, including frequency response, noise performance, distortion and power output shortfalls. A close working relationship between the THX and Pioneer design engineering teams ensued to tackle the challenges posed by Class D integration.

Pioneer's expertise in grounding, noise reduction and chassis design in collaboration with ICEpower™ aimed to make sure the new Elite receivers could exploit the benefits of Class D while still retaining Pioneer's signature sound and performance. By using a feedback system to sense the speaker load and correct frequency response anomalies, Pioneer and ICEpower solved the conventional problems of Class D technology and rendered a flat frequency response that had previously prevented manufacturers from passing the demands of THX certification.

## **2008-2009 Pioneer Elite Receivers**

With its 2008-2009 Elite series of receivers, Pioneer became the first manufacturer to go to market with a THX Certified product featuring a Class D design. These integrated receivers deliver clean, low distortion power in a smaller, more compact chassis. They are also more energy efficient than previous models.

For Pioneer, the result of the extensive collaborative process with THX is a line of A/V receivers designed from the ground-up to present movie, music and games at THX Reference Level. When the volume is turned to "0" the listener will experience the raw impact of sound without hiss from the speakers, crosstalk between channels, hum from the mains or any other inherent distortion. No other receiver manufacturer has accomplished this using Class D.

Pioneer's commitment to delivering technically superior audio and video products remains at its core and is the constant driver that pushes their research and development to deliver THX Reference Level performance in the home theater. Being the first manufacturer to add a THX Certified Class D A/V receiver to its list of THX Certified products is a milestone, and this year's new line of Pioneer Elite receivers continues to prove the relevancy of Class D amplification by adding two additional models to this extensive list.

Whether Class D will become a widespread industry standard for A/V receiver products still remains to be seen. However, the advances shown by Pioneer with its latest Elite line of receivers demonstrates that Class D can be leveraged to deliver solid performance against the industry's toughest benchmarks.

For more information about THX certification, visit [www.thx.com](http://www.thx.com)