

Audio Power Amplifiers

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Outline

- How much power do I need?
- How does loudspeaker cable affect performance?
- Audio Power Amplifier Classes
 - **A**
 - **B**
 - **AB**
 - **G**
 - **H**
 - **D**
 - **I**

How Much Power Do I Need?

- When SPL goal at a given listening distance known, also need:
 - Sensitivity rating of loudspeaker (typically spec as **1m** on-axis with input of **1 electrical watt**)
 - Acoustic level change/attenuation between loudspeaker and farthest listening position
- Example: **90 dB** program level at listening distance of **32 m outdoors**
 - Loudspeaker sensitivity measured as **110 dB**
 - **Acoustic level change = $20 \log(32) \cong 30$ dB**
 - Add **10 dB** for peak (program level) headroom
 - SPL required at source is $90 + 30 + 10 = 130$ dB
 - Need **20 dB** above 1 watt, or $10^{(20/10)} = 100$ W



Amplifier Power Required

<http://www.crownaudio.com>

[\[Back to Design Tools\]](#)

Listener Distance from source 32 M	Desired Level at Listener distance 90 dB SPL
Loudspeaker Sensitivity Rating (1W/1M) 110 dB	Amplifier Headroom 10 dB
<input type="button" value="Calculate"/>	Required Amplifier Power 102 watts
<input type="button" value="Reset"/>	

Equations used to calculate the data:

$$dBW = Lreq - Lsens + 20 * \text{Log} (D2/Dref) + HR$$

$$W = 10 \text{ to the power of } (dBW / 10)$$

Where:

Lreq = required SPL at listener

Lsens = loudspeaker sensitivity (1W/1M)

D2 = loudspeaker-to-listener distance

Dref = reference distance

HR = desired amplifier headroom

dBW = ratio of power referenced to 1 watt

W = power required

This calculator provides the required electrical power (power output from the amplifier) to produce a desired Sound Pressure Level (SPL) at a given distance, along with an amount of headroom to keep the amplifier(s) out of clip.

Example: You are designing a system where the farthest listening position from the loudspeaker is 100 meters, and the desired Sound Pressure Level is 85 dB SPL. The loudspeaker chosen for the job has a sensitivity rating of 95 dB. With the minimum recommended amplifier headroom of 3 dB, then you need to choose an amplifier that can supply at least 1,995 watts to the loudspeaker.

How Does Loudspeaker Cable Affect Performance?

- Damping is a measure of a power amplifier's ability to control the back EMF motion of the loudspeaker cone after the signal disappears
- The **damping factor** of a system is the ratio of the loudspeaker's nominal impedance to the total impedance driving it
- Example: Amplifier with damping factor of 300 (bigger is better) driving an 8Ω load means that the output impedance is 0.027Ω (lower is better)
- Impedance of speaker cable used can significantly reduce the damping factor (larger gauge wire has lower impedance)



Line Loss

[\[Back to Design Tools\]](#)

Power Driven on Line <input type="text" value="100"/> watts	Length of Line <input type="text" value="200"/> ft.
Voltage level <input type="text" value="15"/> volts	Wire Gauge #18 AWG ▾
<input type="button" value="Reset"/>	Line Loss: <input type="text" value="-3.3"/> dB
<input type="button" value="Calculate"/>	

This calculator provides line loss with 2-conductor cable on a constant voltage line.

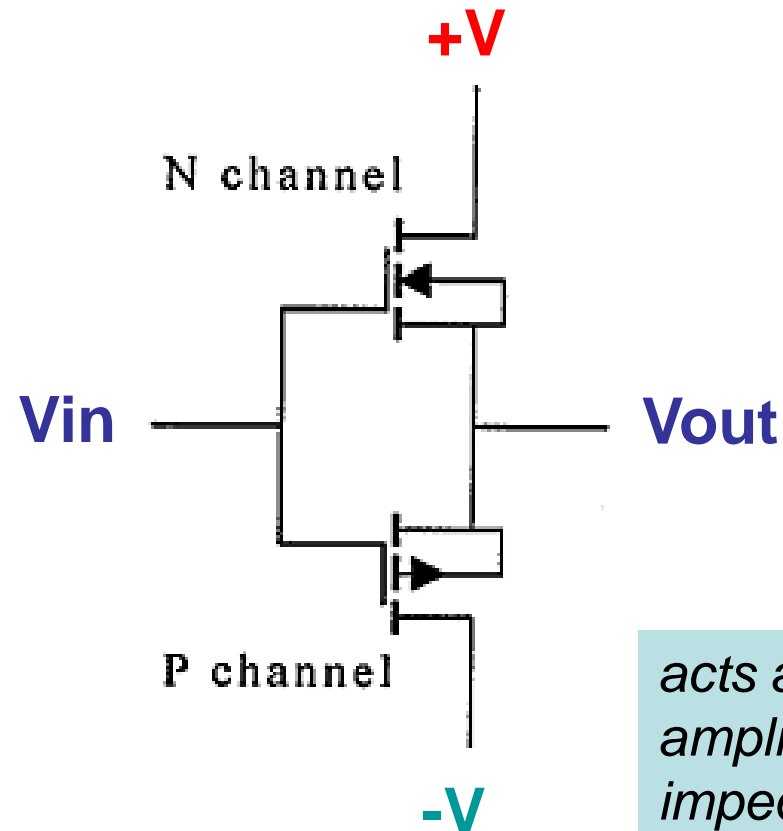
Equation used to calculate the data:

$$P_{loss} = 10 * \text{Log} [1 - ((2 * RL) / (2 * RL + (V_{line} \text{ squared} / Prated)))]$$

Audio Power Amplifier Classes

- Audio power amplifiers were originally classified according to the relationship between the output voltage swing and the input voltage swing
- Classification was based on the amount of time the output devices operate during one complete cycle of a signal swing
- Classes were also defined in terms of output bias current (the amount of current flowing in the output devices with no applied signal)
- For discussion purposes (with the exception of class A), assume a simple output stage consisting of **two complementary devices** (one positive polarity and one negative polarity) using any type of transistor

Basic Power Amplifier Output Stage (Voltage-Follower MOSFET Configuration)



acts as a current amplifier with high input impedance and very low output impedance

Power Amplifier Classes – “A”

- Class “A”
 - key ingredient of class A operation is that output device is **always on**
 - single-ended design with only one type polarity output device
 - the most inefficient of all power amplifier designs, averaging only around 20% (large, heavy, and run very hot)
 - are inherently the most linear, with the least amount of distortion
 - impractical for professional audio applications due to inefficiency

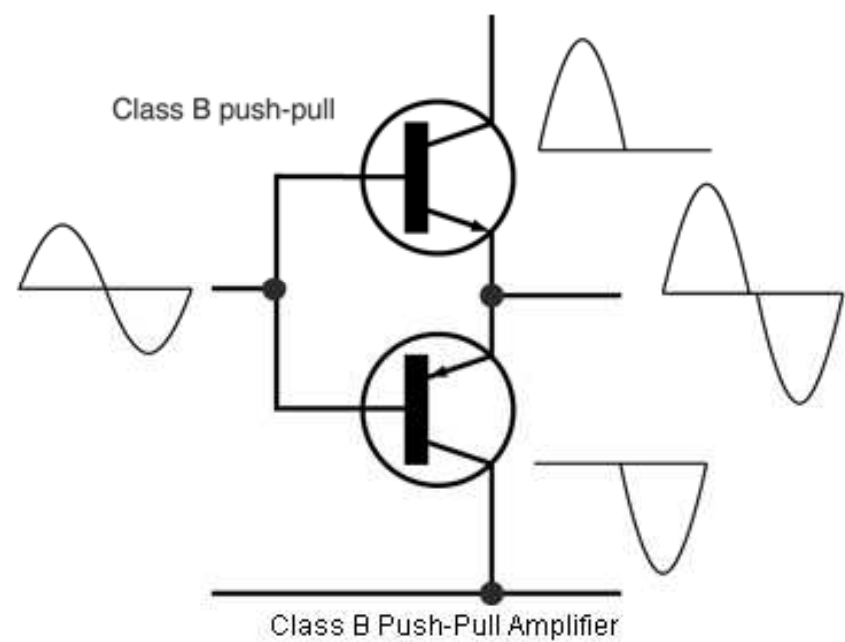
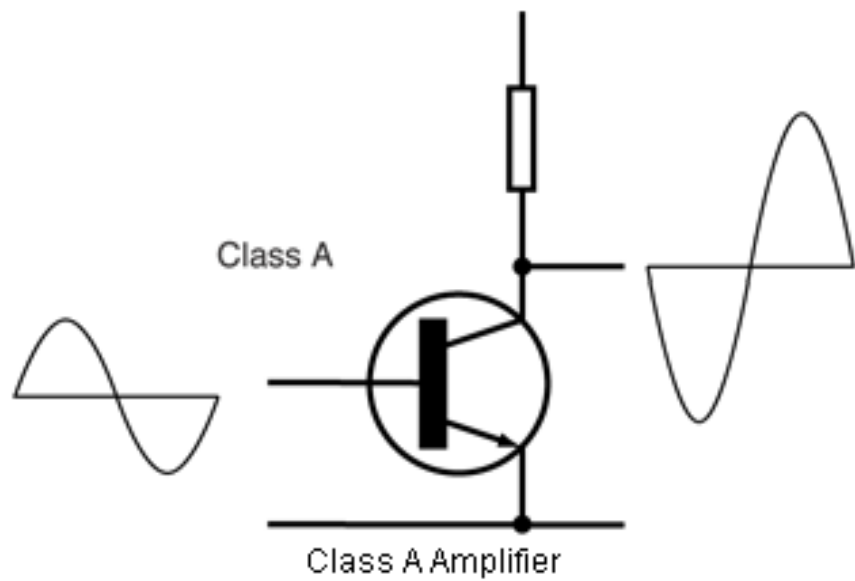
Example: Hawk A18 (2x10W)



Power Amplifier Classes – “B”

- Class “B”
 - opposite of class A: both output devices are never allowed to be on at the same time
 - each output device is on for exactly one half of a complete sinusoidal signal cycle
 - class B designs show high efficiency but poor linearity around the crossover region (due to the time it takes to turn one device off and the other device on, which translates into extreme crossover distortion)
 - class B designs restricted to low power applications, e.g., battery operated equipment, such as communications audio

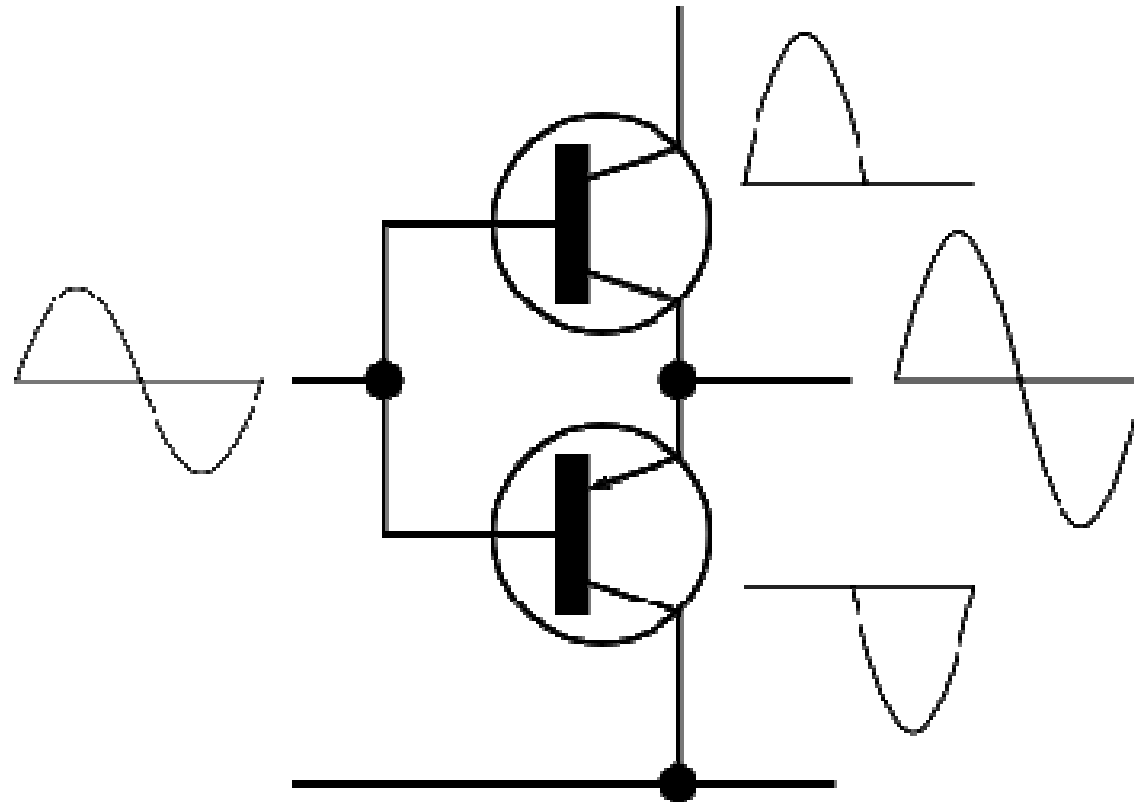
Class A vs. Class B



Power Amplifier Classes – “AB”

- Class “AB”
 - intermediate case: both devices are allowed to be on at the same time, *but just barely*
 - output bias is set so that current flows in a specific output device appreciably more than a half cycle but less than the entire cycle (enough to keep each device operating so *they respond instantly* to input voltage demands)
 - the inherent non-linearity of class B designs is eliminated, without the gross inefficiencies of the class A design
 - combination of good efficiency (around 50%) with excellent linearity that makes class AB the most popular consumer audio amplifier design

Class AB



Example: Class AB



Macro-Tech Series



The Crown Macro-Tech Series. No compromises, no gimmicks. Just brilliant engineering backed by superior manufacturing, support, and an unsurpassed commitment to quality. Like all Crown amps, the defining characteristic of the Macro-Tech Series is sonic accuracy. A tight, rock-solid low end, with smooth, detailed highs and a well-defined midrange. In short, the most accurate reproduction of an audio signal you've ever heard. And because we put the quality of sound above all else, a Crown is the most coveted amplifier in the business.

- **Ultra-Low Distortion:** Crown's patented Grounded Bridge™ circuitry generates incredible voltage swings with ultra-low distortion and superior reliability.
- **ODEP(R) Protection:** Patented Output Device Emulation Protection (ODEP) protects the amplifier and keeps the show going under adverse conditions that cause lesser amplifiers to fail. Front panel indicators show each channel's ODEP status. Several PIPTM modules also provide powerful ODEP-driven features.
- **Distortion Indicator:** Advanced Input/Output Comparator (IOC(R)) alerts you if the amplifier causes any distortion of 0.05% or more.
- **PIP compatibility:** Accommodates Programmable Input Processor (PIP) accessories that are used to customize the amplifier for specific applications. MA 02-Series amps are PIP2 compatible.
- **Selectable Mono Modes:** Bridge-Mono mode provides double output voltage and Parallel-Mono mode provides double output current from a single channel.
- **Selectable Sensitivities:** Choose from three input sensitivities: 0.775 volts or 1.4 volts for full rated power into 8 ohms, or a voltage gain of 26 dB.
- **Detented Level Controls:** Detented level controls make it easy to set and reset precise levels.
- **VZ Power Supply Technology:** The Macro-Tech 3600VZ and 5002VZ use patented power-supply technology which provides enormous power density and an optimum power match with a wide range of loads.
- **Current Indicator:** (Macro-Tech 5002VZ only) Cutting edge current flow/current limit (LOAD/LIMIT) indicators tell you if current is flowing to the loads, and if the loads demand more current than the amplifier can deliver.
- **On-Board Compressors:** (Macro-Tech 5002VZ only) Each channel has a custom compressor that reduces peak signal levels during input overload and output clipping. The compressors can be set for fast or slow operation, or turned off for output clipping.
- **Loudspeaker Offset Integration (LOI):** (Macro-Tech 5002VZ only) Each channel has a high-performance loudspeaker protection circuit that compensates for DC offset to protect woofers, and filters ultrasonic frequencies to protect tweeters.

[Front and Back Panel Views](#)
(Opens a new window)

[MA-2402 Specs](#)
[MA-3600VZ Specs](#)
[MA-5002VZ Specs](#)

[MA-2402 Datasheet](#)
[MA-3600VZ/5002VZ Datasheet](#)
[MA-2402 Manual](#)
[MA-3600VZ Manual](#)
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[Power/Current Draw and Thermal Dissipation Info](#)

[MA-2402 A & E Spec Sheet](#)
[MA3600VZ A & E Spec Sheet](#)
[MA-5002VZ A & E Spec Sheet](#)

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[Crown System Design Tools](#)
(Javascript Calculators)



Macro-Tech Series

MA-5002VZ Specifications

The following applies to 120-VAC, 60-Hz units in Stereo mode with 8-ohm loads and an input sensitivity of 26-dB gain unless otherwise specified. Specifications for units supplied outside the U.S.A. may vary slightly at different AC voltages and frequencies.

MA-5002VZ	*1 kHz Power	**20 Hz-20 kHz Power
2-ohm Dual (per ch.)	2,500W	2,155W
4-ohm Dual (per ch.)	2,000W	1,775W
8-ohm Dual (per ch.)	1,300W	1,090W
4-ohm Bridge-Mono	5,000W	
8-ohm Bridge-Mono	4,000W	3,670W

*1 kHz Power: refers to maximum average power in watts at 1 kHz with 0.1% THD.
**20 Hz-20 kHz Power: refers to maximum average power in watts from 20 Hz to 20 kHz with 0.1% THD.

Power

Load Impedance: Safe with all types of loads. Rated for 2 to 8 ohms in Stereo, 4 to 16 ohms in Bridge-Mono and 1 to 4 ohms in Parallel-mono mode.

Voltage Gain to 1-kHz, 8-ohm rated output:

- 132:1 6% or 42 dB 1 dB gain at 0.775-volt sensitivity.
- 71:1 12% or 37 dB 1 dB gain at 1.4-volt sensitivity.
- 20:1 3% or 26 dB 0.25 dB gain at the 26-dB gain setting.

Required AC Mains: 50 or 60 Hz; 100-, 120-, 200-, 208-, 230-, 240-VAC (10%).

AC Line Current, Current, voltage and frequency requirements are provided on the units back panel.

At Idle: All units draw 90 watts or less.

AC Line Connector: 10 AWG cordset with NEMA TT30P plug is provided on 120 VAC, 60 Hz North American units.

Signal/IOC: A green front-panel LED for each channel that flashes to show amplifier output. If a channel's output waveform differs from its input by 0.05% or more, the indicator flashes brightly to show distortion.

ODEP: An amber front panel LED for each channel that shows thermal-dynamic energy reserve. Normally, each ODEP indicator is lit to show available reserve energy. In the rare event that a channel has no reserve, its indicator will dim in proportion to ODEP limiting.

Load/Limit: A two-color (green/red) LED for each channel that shows load current and limit current. They glow green to indicate load current flowing out the amplifier, and they turn red when maximum current is being delivered to the load.

Input/Output

Input Connectors: Balanced three-pin XLR and balanced 1/2-inch (6.35-mm) TRS connectors are provided on the factory-installed PIP2-FXQ.

Input Impedance: Greater than 10 kohms, balanced. Greater than 5 kohms, unbalanced.

Input Sensitivity: Settings include 0.775 volts or 1.4 volts for standard 1 kHz power, or a 26 dB voltage gain.

Output Connectors: A multifunction, high-current output block is provided. Crown output blocks include three pairs of connectors for each channel (a total of 12 connectors). This allows multiple loudspeakers to be easily connected to each channel. High current screw terminals and banana jacks are provided which accept spade lugs, banana plugs or bare wire.

Output Impedance: Less than 10 milliohms in series with less than 2.5 microhenries.

[Front and Back Panel Views](#)
(Opens a new window)

[MA-2402 Specs](#)
[MA-3600VZ Specs](#)
[MA-5002VZ Specs](#)

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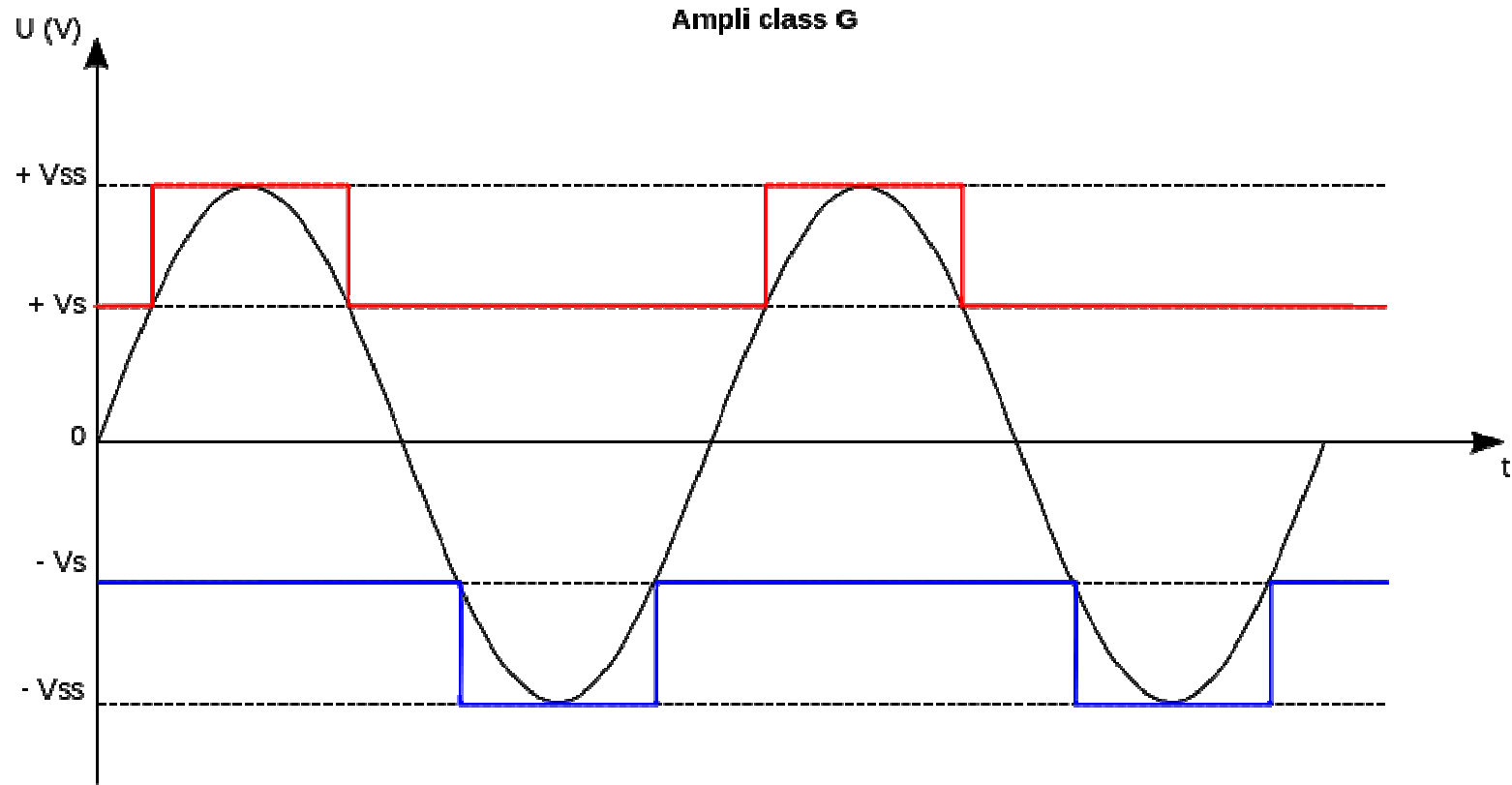
[Crown System Design Tools](#)
(Javascript Calculators)



Power Amplifier Classes – “G”

- Class “G”
 - operation involves changing the power supply voltage from a lower level to a higher level when larger output swings are required
 - common for pro audio designs
 - several ways to do this:
 - simplest involves a single class AB output stage that is connected to two power supply rails by a diode or transistor
 - for most musical program material, the output stage is connected to the lower supply voltage
 - automatically switches to the higher rails for large signal peaks (thus the nickname *rail-switcher*)
 - Another approach uses two class AB output stages, each connected to a different power supply voltage
 - the magnitude of the input signal determines the signal path
 - use of two power supplies improves efficiency enough to allow significantly more power for a given size/weight

Class G



Example: Class G

ENGLISH + 简体中文 + 日本語 + 한국어

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MAX9730

2.4W, Single-Supply Class G Power Amplifier

Highest Output Power Speaker Amplifier From a Battery

QuickView | Technical Documents | Ordering Info | More Information | User Comments (0) | All

Description

The MAX9730 features a mono Class G power amplifier with an integrated inverting charge-pump power supply. The charge pump can supply up to 500mA of peak output current over a 2.7VDC to 5.5VDC supply voltage range, guaranteeing up to 2.4W output power into an 8Ω load. The 2.4W output power allows for transient audio content to remain unclipped as the battery rail collapses over time.

FULL DATA SHEET (PDF, 200kB)
[Download](#) [E-Mail](#)

The MAX9730 maximizes battery life by offering high-performance efficiency. Maxim's proprietary output stage provides efficiency levels greater than Class AB devices without the EMI penalties commonly associated with Class D amplifiers. High efficiency allows the MAX9730 to be packaged in a WLP package without derating the output power handling capability.

The device utilizes fully differential inputs and outputs, comprehensive click-and-pop suppression, shutdown control, and soft-start circuitry. The MAX9730 is fully specified over the -40°C to +85°C extended temperature range and is available in ultra-small, lead-free, 20-bump WLP (2mm x 2.5mm) and 28-pin TQFN (4mm x 4mm) packages.

Key Features

- 2.7V to 5.5V Operation
- Integrated Charge-Pump Power Supply
- 63% Efficiency ($V_{CC} = 5V$, $P_{OUT} = 1W$)
- 2.4W Output Power into 8Ω at $V_{CC} = 5V$
- Up to 2.4W Instantaneous Output Power into 8Ω
- Clickless/Popless Operation
- Small Thermally Efficient Packages
 - 2mm x 2.5mm 20-Bump WLP
 - 4mm x 4mm 28-Pin TQFN

Applications/Uses

- Cellular Phones
- Handheld Gaming Consoles
- MP3 Players
- Notebook Computers
- Personal Media Players
- Smartphones

Key Specifications: Speaker Amplifiers

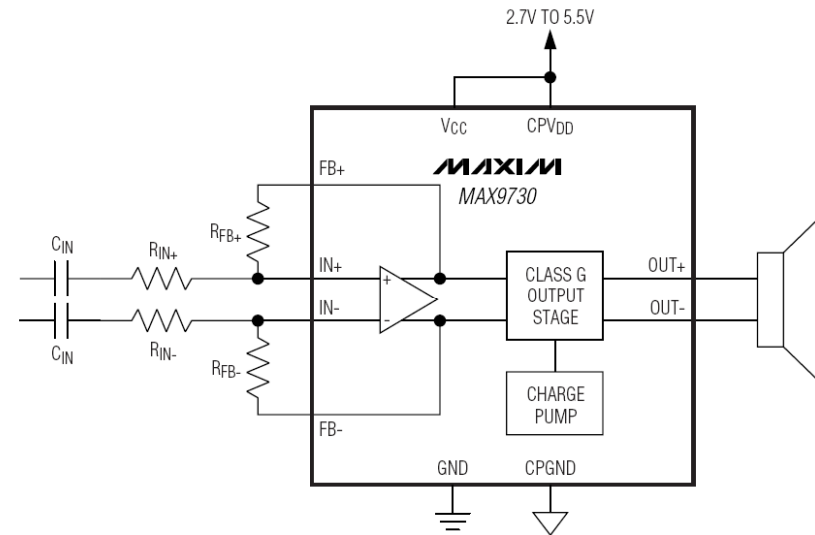
Part Number	Class	Speaker Amp. V_{CC} (min) (V)	Speaker Amp. V_{CC} (max) (V)	Speaker Amp. I_{CC} (typ) (mA)	P_{OUT} into 8Ω @ 1% THD+II (W)	P_{OUT} into 8Ω @ 10% THD+II (W)	Output Voltage Swing (Vp-p)	Speaker Amp. Half Pwr. THD+II (%)	SIRR, A-weighted (dB)	PSRR (dB)	Speaker Amp. External Gain	Speaker Amp. Fixed Gain (min) (V/V)	Speaker Amp. Fixed Gain (max) (V/V)	Number of Channels	RoHS Available	Package	Price**
MAX9730	Boosted/G	2.7	5.5	8	2.4	2.8	20	0.07	95	77	No	4	4	1	Yes	THIN GFN28 VLP10	\$0.80 @ 1k

[See All Speaker Amplifiers \(29\)](#)

Notes:
 **This pricing is BUDGETARY, for comparing similar parts. Prices are in U.S. dollars and subject to change. Quantity pricing may vary substantially and international prices may differ due to local duties, taxes, fees, and exchange rates. For volume-specific prices and delivery, please see the [price and availability page](#) or contact an authorized distributor.

Didn't Find What You Need?

- Next Day Product Selection Assistance from Applications Engineers
- Parametric Search
- Applications Help

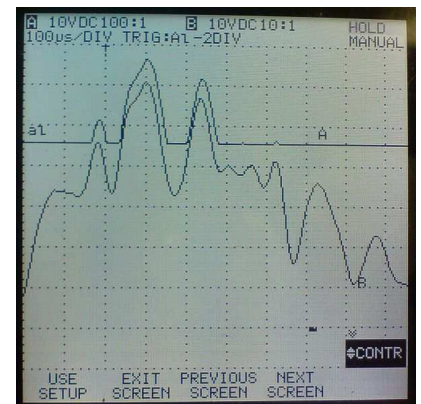
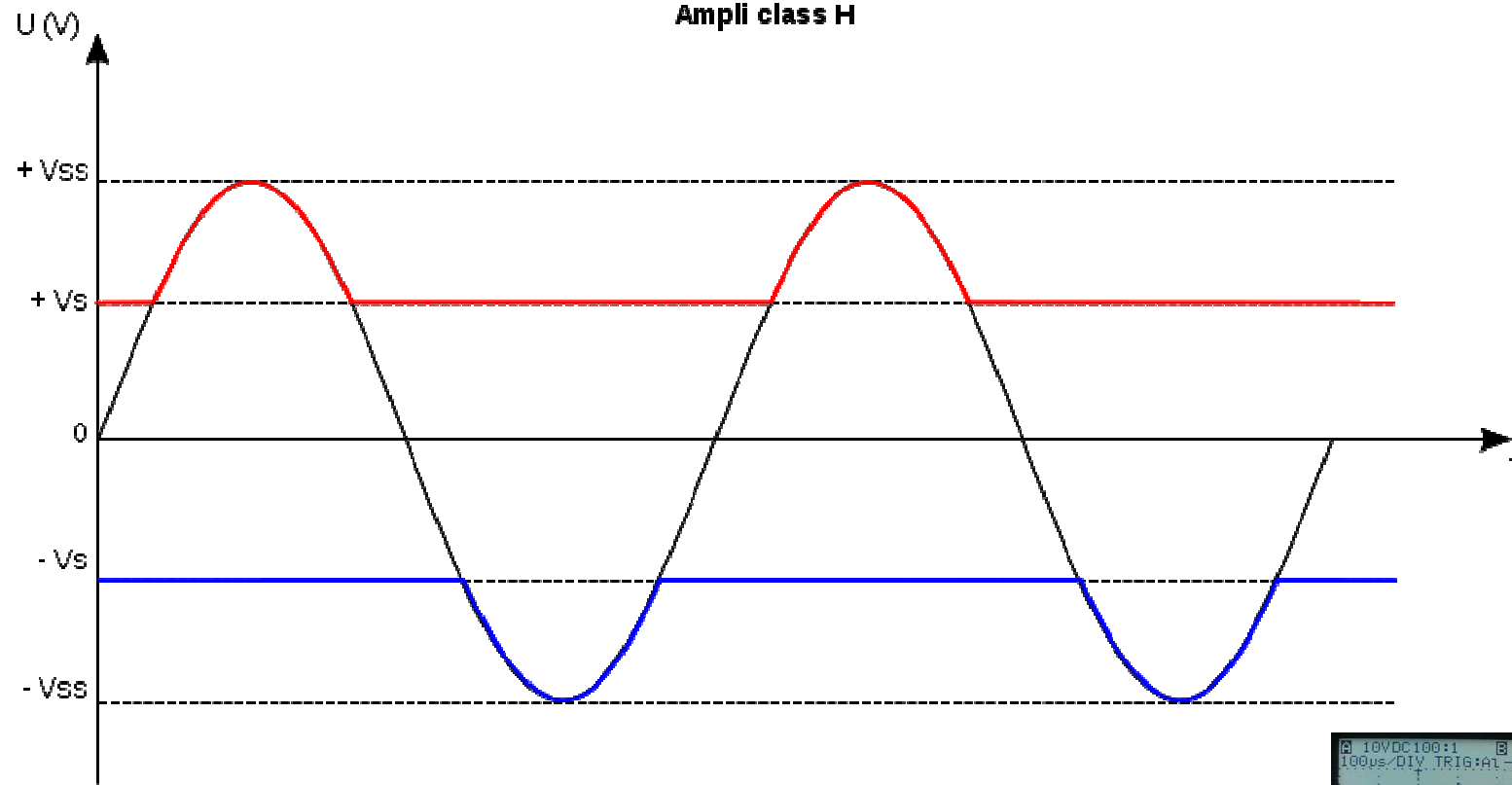


Power Amplifier Classes – “H”

- Class “H”
 - takes the class G design one step further and actually modulates the higher power supply voltage by the input signal
 - allows the power supply to track the audio input and provide just enough voltage for optimum operation of the output devices (thus the nickname *rail-tracker* or *tracking power amplifier*)
 - the efficiency of class H is comparable to class G designs

Class H

Ampli class H




Example: Class H

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The PLX Series

Español



A line of amplifiers that defines high impact. Up to 3,400 watts in a 2 rack-unit chassis that's only 13" deep and 21 lbs. We included our exclusive PowerLight® Technology used in our award-winning PowerLight Series for chest-pounding bass and crystal-clear highs. It also features hum-free noise floor and ultra-low distortion of 0.03% THD. To keep PLX running under the most demanding conditions, we've even added our Advanced Thermal Management System. PLXs offer the reliability of a company that's been building professional amplifiers for over 30 years.

PLX Series amplifiers are no longer being manufactured, please see the [PLX2 Series Amplifiers](#) for equivalent replacements.

FEATURES

- Exclusive PowerLight power supply for superior bass and lighter weight
- Ultra-low distortion (0.03% THD at 8 ohms) & studio-quality noise floor (-107 dB)
- LED indicators include bridge mono and parallel input modes
- Compact 2 RU, 21 lbs. and 13" deep chassis fits into any rack
- Class H output reduces AC power draw and heat by 40% (2402, 3002, & 3402)
- Selectable clip limiters and subsonic filters reduce distortion and protect speakers
- Variable-speed fan for low noise and solid 2 ohm performance
- Both 1/4" TRS & XLR inputs, Speakon® and shock-proof binding post outputs
- 3-year warranty plus optional 3-year extension available

PLX SERIES AMPLIFIERS

- ▶ [PLX1202](#)
- ▶ [PLX1602](#)
- ▶ [PLX2402](#)
- ▶ [PLX3002](#)
- ▶ [PLX3402](#)

DOCUMENTS

- ▶ [PLX Users Manual \(PDF 1.2Mb\)](#)
- ▶ [PLX Specifications \(PDF 248K\)](#)

HI-RES IMAGES

- ▶ [Front](#)
- ▶ [Rear](#)
- ▶ [Series](#)

RELATED PRODUCTS

▶ [PLX2 Series Amplifiers \(1104, 1804, 1802, 2502, 3102, 3602\)](#)

ACCESSORIES

Analog Signal Processing
 Crossover: [UF-2*](#) | [UF-3*](#)
 Equalizer: [SEQ-1*](#) | [SEQ-2*](#)

Transformers:
 70-Volt Output: [QT-300a](#) | [QT600](#)
 Input: [XF-1*](#)

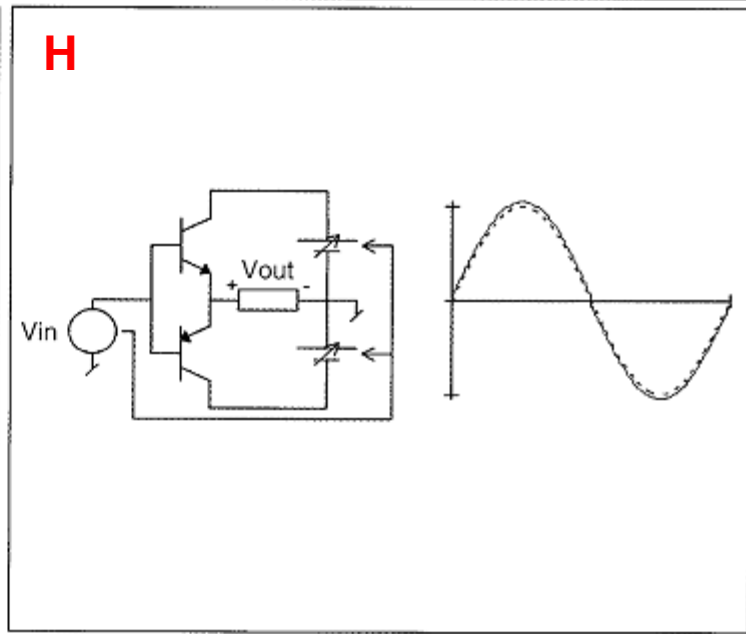
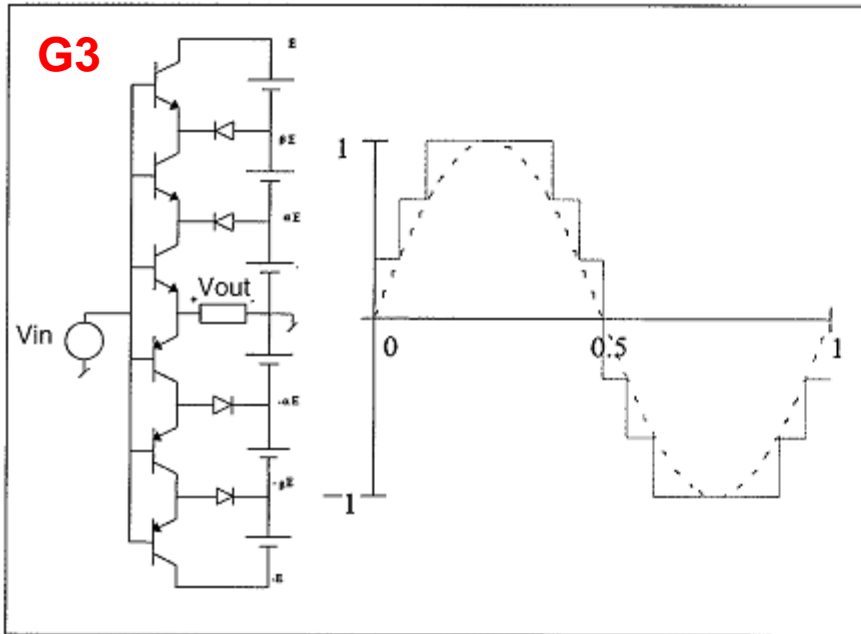
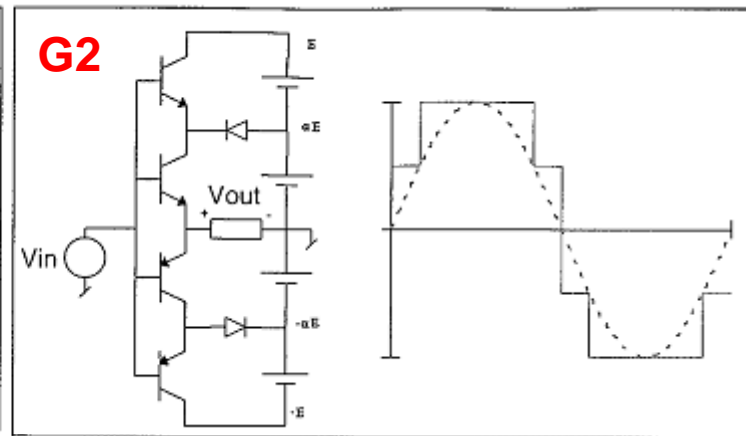
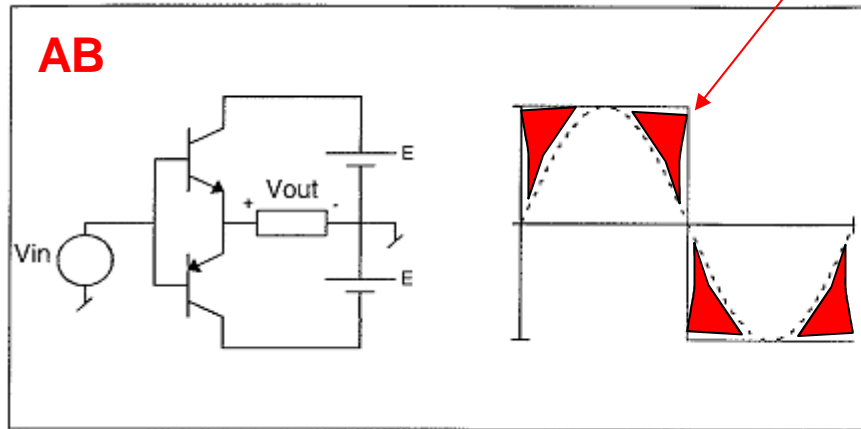
Limiters/Attenuators:
[SPL-1*](#)

*(Requires BSC-3 or BSC-5 BusCard)

SPECIFICATIONS	PLX1202	PLX1602	PLX2402	PLX3002	PLX3402
	<i>STEREO MODE, Both Channels Driven</i>				
8 ohms (20 Hz-20 kHz 0.03% THD)	200 W	300 W	425 W	550 W	700 W
4 ohms (20 Hz-20 kHz 0.05% THD)	325 W	500 W	700 W	900 W	1100 W
2 ohms (1 kHz 1% THD)	600 W	800 W	1200 W	1500 W	1700 W
	<i>BRIDGE MONO MODE</i>				
16 ohms (20 Hz-20 kHz 0.1% THD)	400 W	600 W	850 W	1100 W	1400 W
8 ohms (20 Hz-20 kHz 0.1% THD)	700 W	1100 W	1500 W	2000 W	2200 W
4 ohms (1 kHz 1% THD)	1200 W	1600 W	2400 W	3000 W	3400 W
Signal to Noise (20 Hz-20 kHz)	< -106 dB	< -107 dB	< -108 dB	< -107 dB	< -107 dB
Input Sensitivity @ 8 ohms	1.0 Vrms	1.2 Vrms	1.5 Vrms	1.7 Vrms	1.9 Vrms
Input Sensitivity @ 4 ohms	0.9 Vrms	1.1 Vrms	1.3 Vrms	1.5 Vrms	1.7 Vrms
Voltage Gain	40x (32 dB)	40x (32 dB)	40x (32 dB)	40x (32 dB)	40x (32 dB)
Output Circuitry	AB	AB	2-Step Class H	2-Step Class H	2-Step Class H
Power Requirements (1/8 Power Pink Noise @ 4 Ohm)	6A	10A	8A	10A	12A
	<i>ALL MODELS</i>				
Distortion (SMPTE-IM)	Less than 0.01%				
Distortion (Typical) 20 Hz-20 kHz: 10 dB below rated power 1.0 kHz and below: full rated power	Less than 0.01% THD Less than 0.01% THD				
Frequency Response	20 Hz-20 kHz, +/- 0.2 dB / 8 Hz-50 kHz, +0, -3 dB				
Damping Factor	Greater than 500				
Input Impedance	6k ohms unbalanced, 12 k ohms balanced				
Input Clipping	10 Vrms (+22 dB)				
Cooling	Variable-speed fan, rear-to-front air flow				
Connectors, each channel	Input: 3-pin XLR & 1/4" TRS balanced Output: Neutrik® Speakon® and touch-proof binding posts				
Amplifier Protection	Full short circuit, open circuit, thermal, ultrasonic, and RF protection Stable into reactive or mismatched loads				
Load Protection	On/off muting, DC-fault power supply shutdown				
Dimensions	19" (48.3 cm) rack mounting, 3.5" (8.9 cm) tall (2 rack spaces) 13.25" (33.7 cm) deep (from front mounting rails)				
Gain	40x (32 dB)				
Weight	21 lbs (9.5 kg) net, 27 lbs (12.3 kg) shipping				

More Efficient Linear Designs

wasted power



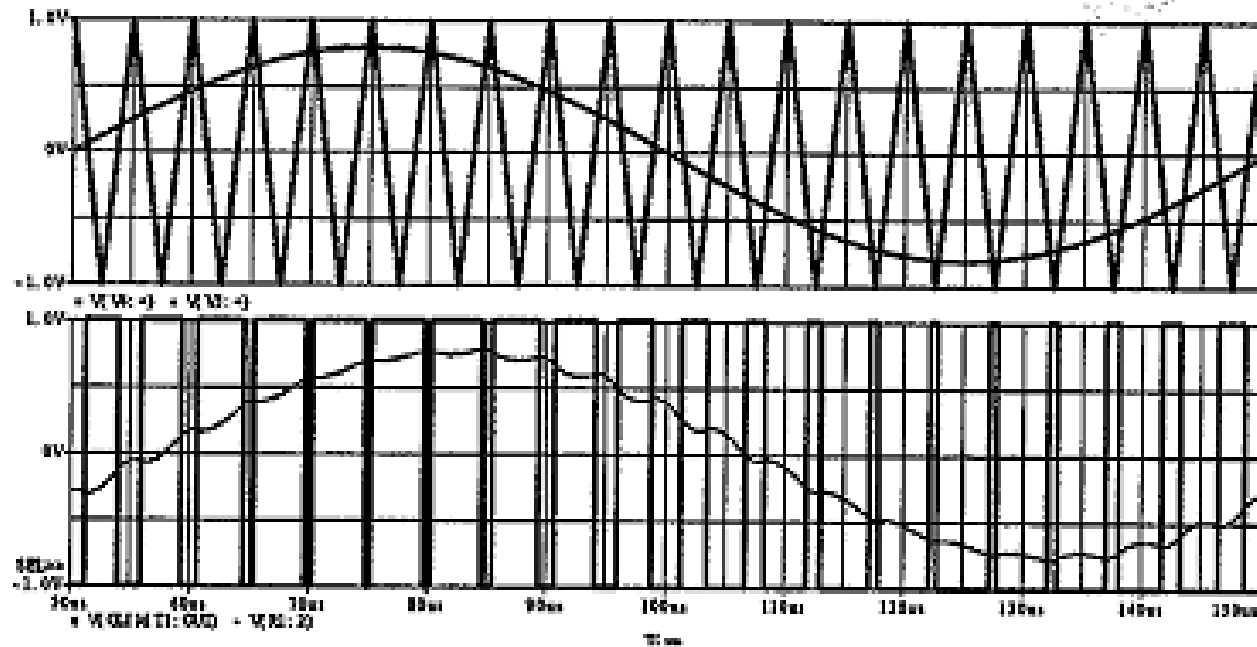
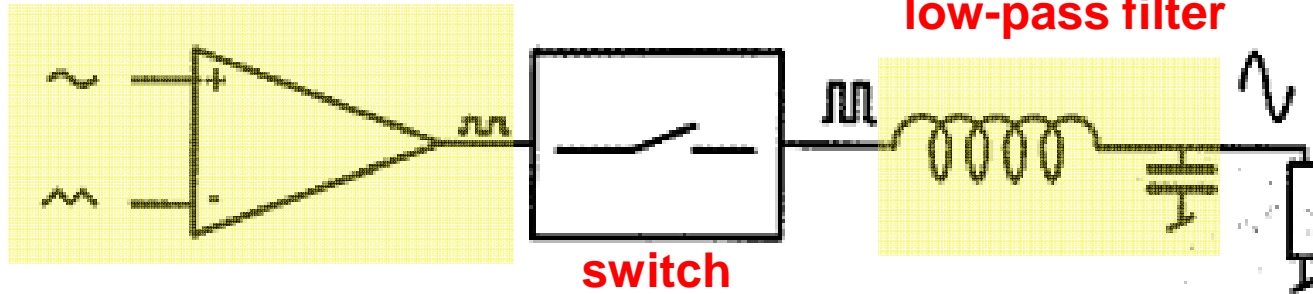
Power Amplifier Classes

- Class “D”
 - operation is switching, hence the term *switching power amplifier*
 - output devices are rapidly switched on and off at least twice for each cycle
 - the output devices are either completely on or completely off so theoretically they do not dissipate any power
 - class D operation is theoretically 100% efficient, but this requires zero on-impedance switches with infinitely fast switching times
 - practical designs do exist with true efficiencies approaching 90%
 - Class D is at least as old as 1954 (U.S. Patent 2,821,639: solid-state full-bridge servo amplifier)

Basic Class D Principle

natural sampling \rightarrow PWM

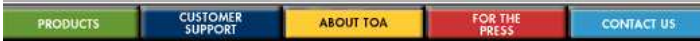
audio input
triangle waveform



Power Amplifier Classes – “D”

- Class “D” – Complications
 - need to operate at high switching speed (e.g., 250 KHz) for full audio bandwidth (20 KHz) reproduction with low distortion
 - traditional design requires “dead time” between positive and negative polarity phases (to avoid destruction of output switching devices) – introduces additional distortion
 - quality of switching devices (“on” resistance, switching speed) limit efficiency/performance

Example: Class D



DA Series Multi-channel Digital Amplifiers



Also see the new **9000 Series Digital Matrix Mixer/Amplifiers**.

The **DA Series** multi-channel digital power amplifiers are ideal for multi-zone distributed speaker systems and professional sound applications. Engineered with Class D technology, the new DA Series amplifiers operate at 85 percent efficiency and consume almost one-third less power than conventional analog amplifiers. The compact and lightweight single or dual rack-space design and ultra-low heat dissipation allow designers to rack-mount up to five units without open space between units.



The DA Series is comprised of high- and low-impedance four-channel models each equipped with an independent power supply for each channel to assure continuous operation and unmatched reliability and performance. Other features include recessed stepped attenuators for precise gain calibration, removable dust filters for easy maintenance, and optional isolation transformer.

Competitively priced, the new DA Series multi-channel power amplifiers are backed by TOA's five-year warranty.



*NEW MODELS!

Model	Power Output	Availability
DA-250D*	2x250W (4 ohms) 2x170W (8 ohms)	Now Shipping!
DA-250DH*	2x250W (70V) 1x500W bridged (140V)	
DA-250F	4x 250W (4 ohms) 4x 170W (8 ohms) 2x 500W bridged (8 ohms)	
DA-250FH	4x 250W (70V) 2x 500W bridged (140V)	
DA-500F-HL	4x 500W (70V) 2x 1000W bridged (140V) 4x 550W (8 ohms) 4x 100W (4 ohms) 2x 1100W (16 ohms)	Now Shipping!
DA-550F	4x 550W (4 ohms) 4x 350W (8 ohms) 2x 1100W bridged (8 ohms) 2x 700W bridged (16 ohm)	

Example: Class D

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Products / Amplifiers

PowerLight 3 Series

Professional Power Amplifiers

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PL325 | PL340 | PL380

The PowerLight™ 3 Series is designed for the most demanding live audio users, whether in touring rigs or fixed installations. The most requested features of the PowerLight 2 series have been upgraded to deliver "the ultimate analog amplifier", while the QSC Dataport ensures full compatibility with advanced digital processing and QSCControl.net™. Three models range in power from 1250 watts to 4000 watts per channel at two ohms, all in two-rack space chassis that are only 15.6" (40 cm) deep and 22 lbs (10 kg).

In addition to higher power, the PowerLight 3 Series offers higher input voltage, selectable sensitivity, and easily adjusted rear panel switches with color coded LED indicators. For those users who simply want a high performance amplifier to go with their existing processor or console, the PowerLight 3 Series is an ideal choice, offering high power, excellent value, and zero signal latency. When complete integration of amplifier control, monitoring and DSP is desired, the PowerLight 3 Series is fully compatible with the QSCControl.net BASIS™ networked audio platform, with its comprehensive drag and drop DSP functionality. Simpler DSP requirements can be met with the DSP-4 processing module.

The flagship of the PowerLight 3 Series is the new 8000 watt PL380. This highly refined, all-switchmode amplifier incorporates nearly 40 years of QSC engineering experience, resetting expectations for Class D audio quality. The PL380 combines a pair of 4000 watt Class D amplifier channels with the well proven PowerLight supply, to deliver more than twice as much audio power as previous 2 rack unit PowerLight amplifiers. Reactive "back EMF" from the speaker is recycled to the power supply, and unmatched "plug-to-plug" efficiency of 85% keeps AC power needs to a minimum, while delivering more energy to the speaker.

Years of patient development have resulted in outstanding 20 Hz - 20 kHz audio performance, plus complete protection from normal hazards of the trade. Even simple features such as dependably silent, surge-free on/off switching indicate the special care taken to keep things safely under control. The most pronounced "sonic signature" of the PL380 is one of immense headroom, sailing through even the most difficult loads with no signs of stress or change of tonality.

For lower power applications, the PL325 and PL340 offer the same feature set, matched to upgraded versions of QSC's most advanced linear amplifier platform. Recent advances in power supply capacitors further improve power and low impedance performance, while continuing to offer the best available audio performance. As a result, designers have the choice of running a single type of amplifier throughout their rig, or matching amplifier performance to specific transducer types.


POWERLIGHT3 SERIES

- ▶ **PL340**
- ▶ **PL325**
- ▶ **PL380**

DOCUMENTS

[PowerLight 3 Specifications \(PDF 217K\)](#)
[Especificaciones de PowerLight 3 \(PDF 266K\)](#)
[User Manual \(PDF 3.9MB\)](#)
[PL3 B-range Brochure \(PDF 1.2MB\)](#)
[Full Range Power Ratings for PL3 Series \(PDF 308K\)](#)
[White Paper - Design Considerations for High-Output Portable Amplifiers \(PDF 283K\)](#)
[PL380 in Jan 2008 Pro Audio Review \(PDF 462K\)](#)

[Learn More About PowerLight 3](#)



HI-RES IMAGES

[PL325 Front \(2928x820 600K\)](#)
[PL325 Side \(2772x940 700K\)](#)
[PL340 Front \(2928x820 691K\)](#)
[PL340 Side \(2772x940 623K\)](#)
[PL325/PL340 Rear \(2692x816 611K\)](#)
[PL380 Front \(2928x820 600K\)](#)
[PL380 Side \(2772x940 692K\)](#)
[PL380 Rear \(2688x892 671K\)](#)
[PL3 Series Stack \(2840x1748 1.3MB\)](#)
[Front Panel Controls \(3008x1796 2.2MB\)](#)
[Front Panel Security Plate \(3008x1796 2.2MB\)](#)

PL380 TOUR

Take a tour inside the PL380 highlighting some of the design features that make the PowerLight 3 Series "the ultimate analog amplifier"
[Click Here to begin the tour!](#)

CAD DRAWINGS

[PL325 & PL340 \(DXF, zipped 760K\)](#)
[PL380 \(DXF, zipped 534K\)](#)

ARCHITECT'S & ENGINEER'S SPECIFICATIONS

[PL325](#)
[PL340](#)
[PL380](#)

ACCESSORIES

Handle: [2RU](#)

PowerLight 3 Power Amplifiers			
Watts at Clipping			
Model	Watts per channel		
	8 ohms	4 ohms	2 ohms
PL325	500	850	1250
PL340	800	1250	2000
PL380	1500	2500	4000*

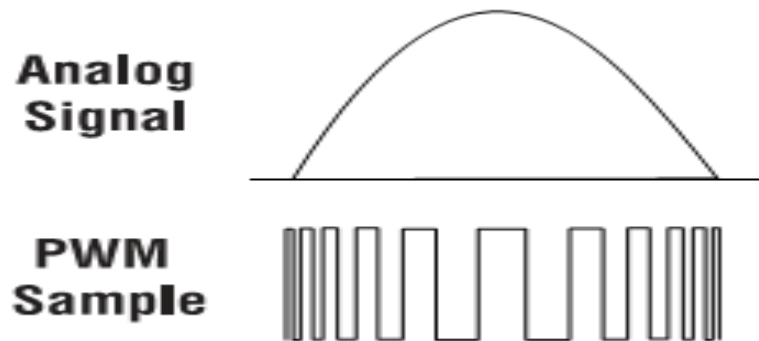
EIA 1 kHz 1% THD
 * Burst mode testing required due to AC service current limitations

Comprehensive full range power ratings with explanations can be found in the following paper: [Full Range Power Ratings for PL3 Series \(PDF 308K\)](#)

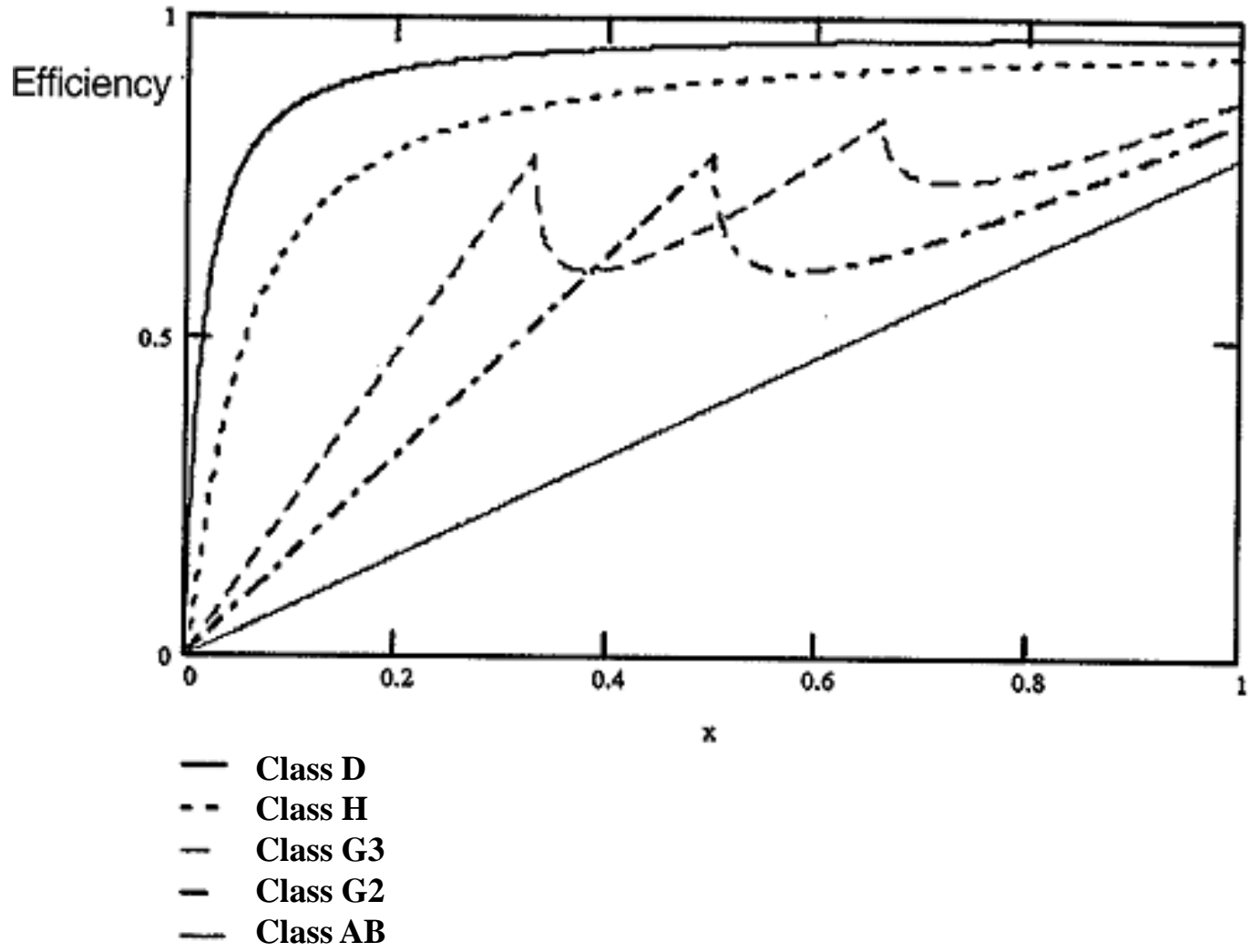
SPECIFICATIONS	PL325	PL340	PL380
	<i>STEREO MODE, Both Channels Driven</i>		
8 ohms EIA 1 kHz 1% THD	500 W	800 W	1500 W
4 ohms EIA 1 kHz 1% THD	850 W	1250 W	2500 W
2 ohms EIA 1 kHz 1% THD	1250 W	2000 W	4000 W*
	<i>BRIDGE MONO MODE</i>		
8 ohms EIA 1 kHz 1% THD	1700 W	2600 W	5000 W
4 ohms EIA 1 kHz 1% THD	2500 W	4000 W	8000 W*
Typical Distortion (20 Hz -3 kHz, 3dB below clip, or 20 Hz - 5 kHz, 10dB below clip, or 20 Hz - 20 kHz, 20dB below clip)	0.002-0.01%	0.002-0.01%	0.01-0.03%
8 ohms	0.005-0.01%	0.005-0.01%	0.03-0.06%
4 ohms	0.02%	0.02%	0.1%
2 ohms			
Maximum Distortion (20 Hz - 20 kHz, 1 dB below rated power) 4 to 8 ohms	0.05%	0.05%	0.2%
Frequency Response (8 ohms)	20 Hz - 20 kHz, +/-0.2 dB	20 Hz - 20 kHz, +/-0.2 dB	20 Hz - 20 kHz, +/-0.2 dB
Noise (20 Hz - 20 kHz, 32 dB Gain)	-106 dB	-105 dB	-104 dB
Dynamic Headroom (4 ohms)	2 dB	2 dB	2 dB
Damping Factor (8 ohms)	500	500	200
Output Circuitry	Class H (2-tier)	Class H (2-tier)	Class D
Input Sensitivity 26 dB Setting 32 dB Setting	3.28V 1.60V	3.92V 1.96V	5.27V 2.67V
Input Gain (1.2V setting)	34.5 dB	36.4 dB	39.1 dB
Maximum Input Level 1.2V setting 32 dB setting 26 dB setting	11V (+23 dB) 14.6V (+25.5 dB) 25V (+30 dB)	11V (+23 dB) 14.6V (+25.5 dB) 25V (+30 dB)	10V (+22 dB) 22V (+29 dB) 25V (+30 dB)
AC Power Requirements ** 120V 50/60 Hz 230V 50 Hz	8.5A 7.5A	12A 7A	18A 11A
Cordset 120V 50/60 Hz 230V 50 Hz	NEMA-15 CEE 7/7 16A	NEMA-15 CEE 7/7 16A	NEMA L5-30P CEE 7/7 16A
Chassis Power Connector All Voltages	20A PowerCon	20A PowerCon	32A PowerCon
	<i>ALL MODELS</i>		
Input Impedance	> 10k ohms balanced, or unbalanced		
Cooling	Variable-speed fan, rear-to-front air flow		
Connectors (each channel)	Input: XLR Male, XLR Female and 3-pin detachable terminal blocks (1 each per channel) Output: Neutrik Speakon® (ch 1 wired to both channels) and 5-way binding posts DataPort: HD-15, input signal in parallel with XLR input connectors		
Front Controls	AC Power Switch Gain Controls, 21 detents, 1 dB steps (each channel)		
Front indicators (LED color)	Power (Blue) Bridged (Yellow) Parallel (Orange) Clip/Prot (Red x 2) Level -10 (Orange x 2) Level -20 (Green x 2) Signal -35 (Green x 2)		
Rear Controls (with LED indicators)	Input Mode: Bridge (Yellow), Stereo (Green), or Parallel (Orange) Gain / Sensitivity: 26dB (Orange), 32dB (Green), or 1.2V (Yellow) High Pass (each channel): 3 Hz (Off), 30 Hz (Yellow), or 50 Hz (Orange) Clip Limiter (each channel): Off, On (Yellow)		
Amplifier and Load Protection	Short circuit, open circuit, thermal, RF protection. On/off muting, DC fault shutdown,		

Power Amplifier Classes – “S”

- Class “S”
 - first invented in 1932
 - used for both amplification and amplitude modulation
 - similar to Class D except the rectangular PWM voltage waveform is applied to a low-pass filter that allows only the slowly varying DC or average voltage component to appear across the load
 - essentially this is what is called “Class D” today



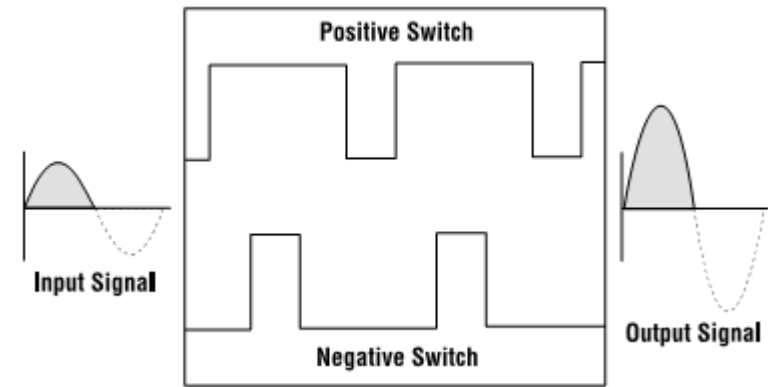
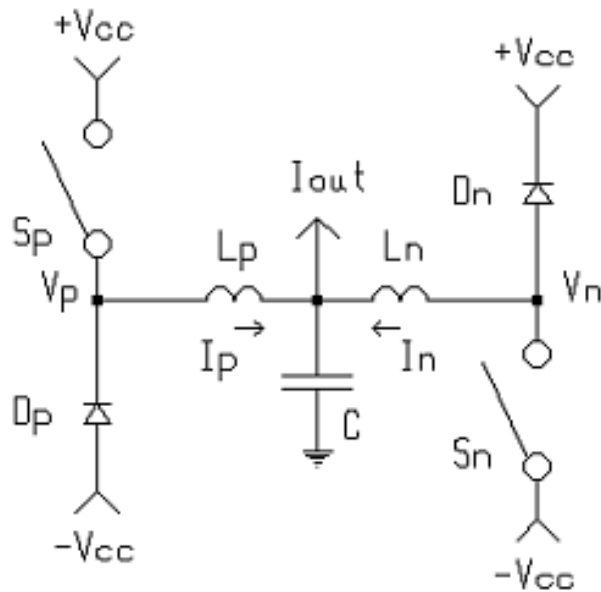
Relative Efficiency



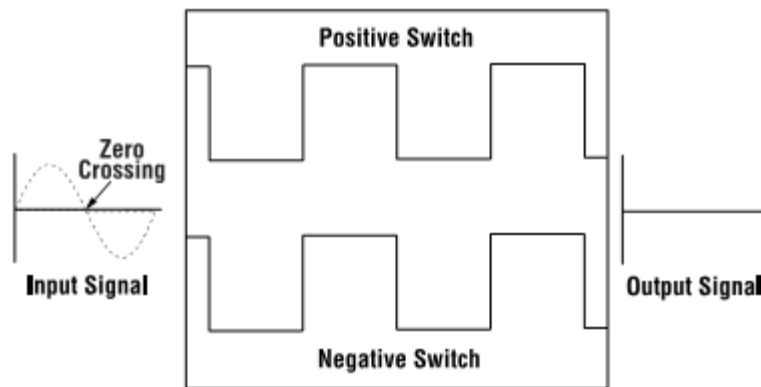
Power Amplifier Classes – “I”

- Class “I”
 - based on patent U.S. 5,657,219 covering opposed current converters
 - “I” is short for “interleave” as this is the only four-quadrant converter known that uses two switches yet that has an interleave number of 2
 - when used with fixed-frequency naturally sampled two-sided PWM it forms a theoretically optimum converter having the least unnecessary/undesirable PWM spectra
 - also called a “balanced current amplifier”

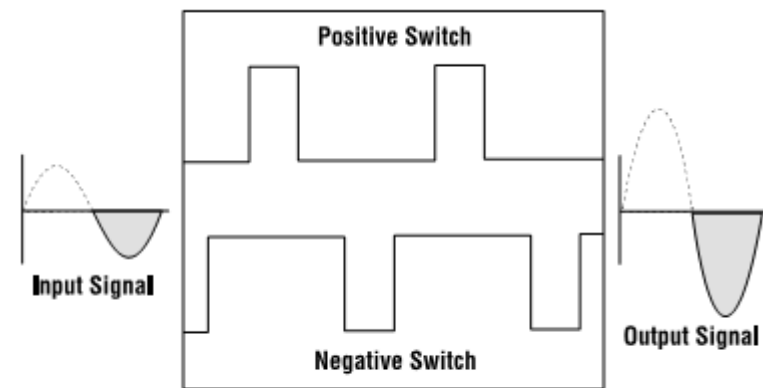
Balanced Current Switching Amplifier



Class-I Switches, Positive Signal




Class-I Switches, Signal at Zero Amplitude




Class-I Switches, Negative Signal

Example: Class I


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I-Tech Series



New! I-Tech Drop Test Video

	Power Output						
	Dual				Bridge		
	2 Ohm		4 Ohm	8 Ohm	4 Ohm	8 Ohm	
	20 msec BURST	1 kHz	20 Hz - 20 kHz	20 Hz - 20 kHz	20 Hz - 20 kHz	20 Hz - 20 kHz	20 Hz - 20 kHz
I-T4000	2,565	1,800	1,800	2,000	1,250	3,600	4,000
I-T6000	4,570	2,500	2,500	3,000	1,500	5,000	6,000
I-T8000	5,900	3,500	3,500	4,000	2,100	7,000	8,000

Guaranteed minimum power in watts with 0.35% THD

[Front and Back Panel Views](#)
(Opens a new window)

[Specifications](#)

[Datasheet](#)

[Operation Manual](#)

[2-page brochure](#)

[6-page brochure](#)

[Application Guide](#)

[Quick Start Guide](#)

[I-Tech FAQs](#)

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[I-T4000 AC & Thermal Info](#)

[I-T6000 AC & Thermal Info](#)

[I-T8000 AC & Thermal Info](#)

[I-T4000 A&E Specs](#)

[I-T6000 A&E Specs](#)

[I-T8000 A&E Specs](#)

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Touring sound. Earth-shattering performance. I-Tech's patented class-I technology is the number one choice of touring professionals worldwide.

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- Front panel lockout – ensures that tunings and presets are safely stored and protected from curious users
- Remote monitoring and control for complete system control anywhere in the venue

For product availability and pricing please contact your local dealer.

Performance	I-T4000	I-T6000	I-T8000
Input Sensitivity (volts RMS) for rated output	Adjustable in 0.1V steps from 1.4V to 7.75V		
Voltage Gain for full rated power at 8 ohms	37.1 dB to 22.2 dB	37.9 dB to 23.0 dB	39.3 dB to 24.5 dB
Frequency Response (at 1 watt, 20Hz - 20 kHz)	± 0.25 dB		
Signal to Noise Ratio below rated full-bandwidth power, A-weighted	> 105 dB		
Total Harmonic Distortion (THD) at full rated power	< 0.35%		
Intermodulation Distortion (IMD) 60 Hz and 7 kHz at 4:1, from full rated output to -35 dB	< 0.35%		
Maximum Input Level	+15 dBu or +21 dBu, depending on setting of maximum input level		
Latency (analog, digital inputs)	Analog: 1.13 mS. Digital: See Sample Rate / Latency Table below.		
A/D, D/A Converters	24-bit 96 kHz Cirrus Logic		
Digital Input	AES/EBU, 24-bit, 32-96 kHz. Onboard sample rate converter.		
Network	Onboard HiQnet and TCP/IP, compatible with standard 100Mb Ethernet hardware		
DSP	24-bit conversion with 32-bit, floating-point DSP processing		
Attenuators	Speed-sensitive rotary encoders, 0.5 dB steps, range 0 to -100 dB.		
Damping Factor (8 ohms): 20 Hz to 100 Hz	> 5000		
Crosstalk (below rated power, 20 Hz to 1 kHz)	> 80 dB		
Common Mode Rejection (CMR) (20 Hz to 1 kHz)	> 50 dB		
DC Output Offset (Shorted input)	< ± 3 mV		
Input Impedance (nominal)	20 kilohms balanced, 10 kilohms unbalanced		
Load Impedance (Note: Safe with all types of loads)	Stereo 1-2-4-8-16 ohms Bridge Mono 2-4-8 ohms		
Required AC Mains	Universal AC input, 100-240VAC (±15%), 50/60 Hz. Max. AC mains voltage 277VAC.		
AC Line Connector	USA, UK, European, Australia, India		
Construction	All Models		
Ventilation	Flow-through ventilation from front to back		
Cooling	Dual-zone, microprocessor controlled, continuously variable speed fans		
Dimensions	EIA Standard 19-inch rack mount width (EIA RS-310B), 3.5-inch (8.9-cm) height, 16.2-inch (41.1-cm) depth behind front mounting surface		
Weight	Net Shipping		
	28 pounds (12.7 kg) 36 pounds (16.3 kg)		

Industry Trends

- Analog amplifier (“Class AB”) market share \$2-3B in 2003 (Class D market share was only 2-3%)
- By 2006, digital amplifier (“Class D”) market share rose to 15% and by 2008 to 30%
- By 2011, Class D market share predicted to be 67%
- Conclusion: Class D is here to stay!