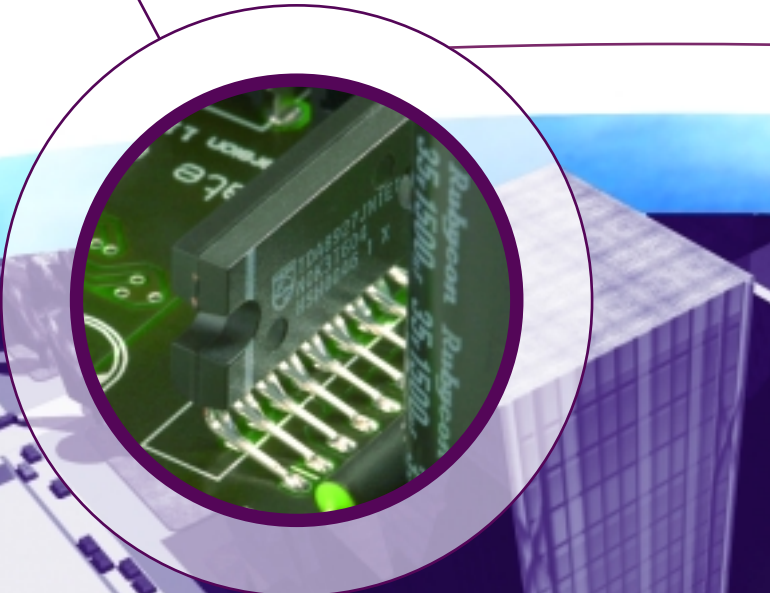
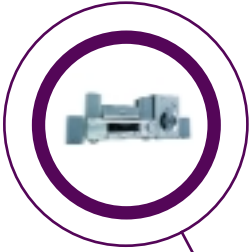


**PHILIPS SEMICONDUCTORS
CLASS D AMPLIFIER SOLUTIONS**

The class act in digital audio amplification



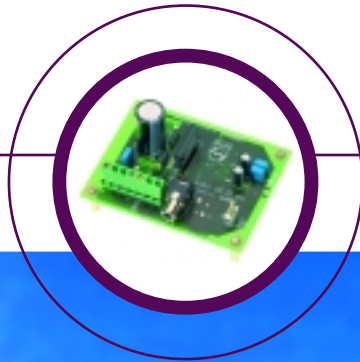
Let's make things better.



PHILIPS

HIGH PERFORMANCE CLASS D AUDIO AMPLIFIERS: **A CLASS APART**

Philips Semiconductors' state-of-the-art Class D amplifiers deliver the power, performance and sound quality you need in today's exciting digital audio market. Enabling smaller end products and easier mobility, our highly efficient and highly integrated Class D products are ideal for all your medium- to high-power music applications – from multi-channel DVD and TVs, through mini-systems and hi-fi separates, to portable devices and in-car audio.



As users demand even greater audio performance and quality, the answer lies in fully digital solutions which extend the digital horizon from source through to loudspeakers. Our current Class D amplifiers already achieve exceptional performance levels and constant innovation will continue to push the digital boundary, providing the next step in audio amplification – and a true digital audio experience.

Delivering up to 150 W, Philips' leading-edge Class D families complement our range of lower power analog devices, to deliver plenty of high quality music power for virtually all your applications,

at an affordable price. And with ever more entertainment systems incorporating multi-channel surround sound, our Class D amplifiers' small size, low power consumption and low heat dissipation make them the perfect solution; simplifying design-in, saving space and cutting costs.

These advanced audio ICs set new standards in digital amplifier performance, utilizing Philips' key process technologies and unique design expertise to maximize the benefits of Class D, and ensure your applications stay ahead of the field. They are manufactured using our SOI (Silicon On Insulator) process, enabling digital,

analog *and* high power components to be integrated together, providing inherent reliability, efficiency and low distortion.

Philips Semiconductors is fully committed to Class D technology, investing heavily in developing further product ranges with more sophisticated functionality. Already offering you a selection of high power two-chip devices, we are introducing several one-chip Class D products, with future generations bringing you even greater power and pushing performance levels to new heights.

The emergence of Class D

The trend toward more compact and mobile equipment, together with environmental concerns, is increasing the need for lower power consumption audio devices. And in parallel, the world is moving away from analog to the superior performance of digital solutions. In this market Class D amplifiers are the ideal

answer, with their many design and performance benefits surpassing linear Class A/B amplifiers in most general consumer audio applications.

Class D is also suited to portable equipment, such as cell phones, PDAs, MP3 players and other handheld, battery-operated devices.

And they are also a perfect choice for specific 'demanding' applications: for example automotive audio systems, which need wide temperature and voltage tolerances, together with immunity to external noise – properties more easily met by Class D in booster amps.



IN A CLASS OF **THEIR OWN**

Whether your applications require mature analog or advanced digital devices, Philips Semiconductors' comprehensive portfolio of audio amplifiers covers the whole spectrum of audio applications – and whatever you choose, our innovative process technologies deliver the highest quality, and most efficient and cost-effective solutions.

As the audio market moves progressively towards digital solutions, Philips constantly invests in the core technologies needed to ensure your audio products exploit commodity and consumer trends to the full. And in developing our leading-edge Class D amplifiers, we also draw on Philips' world-renowned expertise in wider areas, such as RF and shielding.

Our Class D amplifiers use unique technological design and application 'tricks' to lower EMI at high power, as well as reducing power consumption and improving sound quality – all at a low price. And with innovative packaging solutions and careful attention to the smallest of design details, such as pin layout optimization, our design know-how finally makes Class D viable for a vast range of portable products.

Ideal for automotive applications, such as car radio, these amplifiers are tolerant of fault conditions and the voltage spikes generated by the starter motor or dynamo (which can be as high as 50V) – offering easy reverse-polarity protection and loss of ground tolerance, **without** the need for external components.

Philips Semiconductors can also call on its broad knowledge base to help you design your Class D application: even extending to PCB layout to optimize EMC performance. Indeed, as part of a comprehensive support package which covers all your application needs, we offer detailed technical design-in capability to ensure you obtain the best end results with our Class D amplifiers.



Philips Semiconductors has a long history of research and design achievements in audio amplification. It was the first company to enter high volume production of thin-film SOI smart power technology and the first to introduce highly integrated, high power Class D amplifiers. We are continually developing future generations and, combined with the production capacity to meet all your supply requirements, our Class D solutions help keep you ahead in the fast-moving audio market with the most advanced devices.

A NEW CLASS OF PRODUCTS

Philips Semiconductors' latest series of Class D amplifiers offers you the high power and outstanding audio performance needed for today's music systems. Comprising the TDA8929 controller IC, and TDA8926 and TDA8927 power stages, these highly integrated two chip systems are rated from 20 W to 150 W – and deliver up to 300 W with application support.

They combine excellent THD (0.01%) and EMC performance with the benefits you'd expect from Philips' state-of-the-art Class D design, many thanks to its exceptionally high efficiency. By enabling significant power savings, smaller power supplies can be used; and the need for heatsinks is greatly reduced, increasing reliability and simplifying design. It also makes your applications smaller and lighter, as

well as extending battery life in portable products.

Operating from a symmetrical supply (from $\pm 15\text{ V}$ to $\pm 30\text{ V}$), the ICs feature an adjustable internal oscillator (200 – 600 kHz) with tracking option for external override. Supporting loads from $4\ \Omega$ to $8\ \Omega$, the output stages accept BTL or SE configurations and are protected against short circuit and overheating.

Key features of our TDA892x range include:

- power ranges from 20 W to 150 W
 - up to 300 W with application support
- up to 95% efficiency
- differential inputs
- application support
 - EMI, PCB, multi-channel and tuner compatibility
 - high power (300 W) demoboard.



Developed primarily for the consumer markets (and automotive markets), these advanced digital audio amplifiers are also ideal for a wide variety of applications, such as:

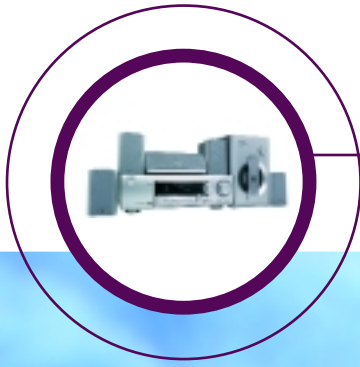
- DVD-audio and high-end TVs
- mini- and micro-sized audio systems
- car audio (application support)
- audio separates
- multi-channel speaker sets
- PA systems
- booster for (sub)woofers.

Power (W)	SE/BTL	Channel	TDA8926	TDA8927	TDA8929
20-50	SE 8 Ω	Stereo	•		•
50-80	SE 4 Ω	Stereo		•	•
50-100	BTL 8 Ω	Mono	•		•
80-150	BTL 8 Ω	Mono		•	•
150-200	BTL 4 Ω	Mono	• (2pcs)		•
200-300	BTL 4 Ω	Mono		• (2pcs)	•

Roadmap

Our initial offering of Class D amplifiers marks the beginning of an extensive product range addressing a broad spectrum of applications. The current families will be joined by a series of single-chip Class D audio amplifiers: the TDA8920, TDA8921, TDA8922 and TDA8923. Capable of delivering up to 150 W output power, they will offer you similar features as our two-chip amplifiers with superior performance, together with all the design-in advantages of a true one-chip solution.

	TDA8920	TDA8921	TDA8922	TDA8923
Stereo	2 x 50 - 80	2 x 25 - 50	2 x 15 - 25	2 x 5 - 15
Mono	150 W	100 W	50 W	30 W



UNIQUE SOI TECHNOLOGY FOR CLASS D

THE INHERENT AUDIO BENEFITS

Philips Semiconductors' advanced Silicon On Insulator (SOI) fabrication process sets our Class D products apart from the competition. Featuring high packing density, very high power output, minimal power dissipation and simplified design-in, SOI is a most attractive commercial option – reducing your total system costs. Manufactured using the SOI-based A-BCD1 process (see sidebar), our Class D audio amplifiers provide you with the ultimate solution for your digital sound system.

Due to the low on-resistance ($R_{DS(on)}$) of A-BCD1, our Class D devices generate very little heat, reducing the need for heat sinks – cutting the size of your application and keeping your costs down. The low $R_{DS(on)}$ also gives excellent power handling capabilities, allowing designers to choose between lower heat dissipation or higher current handling for

the same chip size, or a smaller chip with the same dissipation.

Intrinsically free from latch-up, SOI also makes our ICs inherently robust, increasing the reliability of your audio system, even when performing at maximum volume. Quicker and easier design-in, due to a significant reduction in parasitic capacitance, is another SOI benefit, resulting from excellent insulation (brought about by the isolation of components in the oxide layer). Eliminating latch-up and parasitics confers further advantages, including protection from voltage spikes and again, improved audio performance in real-world systems.

The packing density achieved by SOI is particularly beneficial for high voltage Class D amplifiers. Enabling size reductions up to 30%, this represents a

major improvement on bulk silicon: next generation A-BCDx (EZ-HV) devices improve on this still further, as well as offering even lower $R_{DS(on)}$, increasing SOI's many benefits.

Known as Advanced Bipolar-CMOS-DMOS (A-BCD1), Philips Semiconductors' SOI Smart Power process is a single poly, double metal technology, designed for applications from 12 V to 60 V. Fabrication consists of a 1.5 μm active silicon layer on top of a 1 μm layer of buried oxide: the latter providing complete isolation of all components formed on the chip.

With its ability to combine bipolar, JFET, CMOS and DMOS on a single-chip, SOI A-BCD1 is extremely versatile. It handles analog and digital power simultaneously, enabling optimized system solutions which combine high-voltage amplifiers and small-feature logic, together with D/A and A/D converters. ICs fabricated in A-BCD1 have the additional advantage of greater heat tolerance, operating up to 160 $^{\circ}\text{C}$ instead of the normal 125 $^{\circ}\text{C}$ for bulk silicon. This is because leakage currents are avoided due to the absence of reverse-biased junctions, normally needed to isolate components.

The numerous advantages for devices fabricated in the A-BCD process stem mainly from four inherent SOI characteristics:

- reduced resistance when the transistor is on ($R_{\text{DS(on)}}$)
- no latch-up (where the transistors effectively get 'stuck' in the on-state) – virtually eliminating adverse effects due to high external voltages, spurious interference or cross-talk via the substrate
- much greater packing densities
- significantly reduced parasitic capacitance.



A CLOSER LOOK AT **CLASS D**

How does Class D work?

Similar in principle to the switched-mode power supply, Class D uses pulse width modulation (PWM) techniques because of its superior performance compared to sigma-delta techniques. By switching the output power circuits completely off when there is no signal to amplify, conduction is stopped and energy losses are minimized. Up to 95% efficiency is attained for high power output and typically over 50% at lower power levels.

At the first stage, Philips' current Class D design compares an analog input signal to a 360 kHz sampling frequency to generate a rectangular wave output, whose width modulation represents the input signal information. A triangular-shaped sampling signal is used, as this dramatically improves distortion over the more usual sawtooth waveform, and its extremely high frequency is several orders outside the audio band, ensuring the desired signal is uncorrupted by the process. The comparator's accurate signal conversion is ensured through a sophisticated regulator producing a very stable reference voltage, and the common-mode rejection property which ensures stable threshold triggering across the input's entire dynamic range.

The resulting digital signal is then fed to a switching power amplifier stage, designed and manufactured to very



precise specifications. Our TDA8927 IC is able to switch an incredible 7.5 A peak current at over 300 kHz, with negligible rise- and fall-times, ensuring a very clean reproduction of the original signal. Finally, a low pass filter stage removes the carrier frequency as well as current pulses caused by switching, limiting emissions that could cause EMC problems.

Combined with special protection and shielding circuitry, Philips Semiconductors' Class D amplifier ICs achieve impressive performance specifications, with a flat frequency response between 20 Hz – 20 kHz, and extremely low noise and distortion figures.

Bringing Class D into the real world

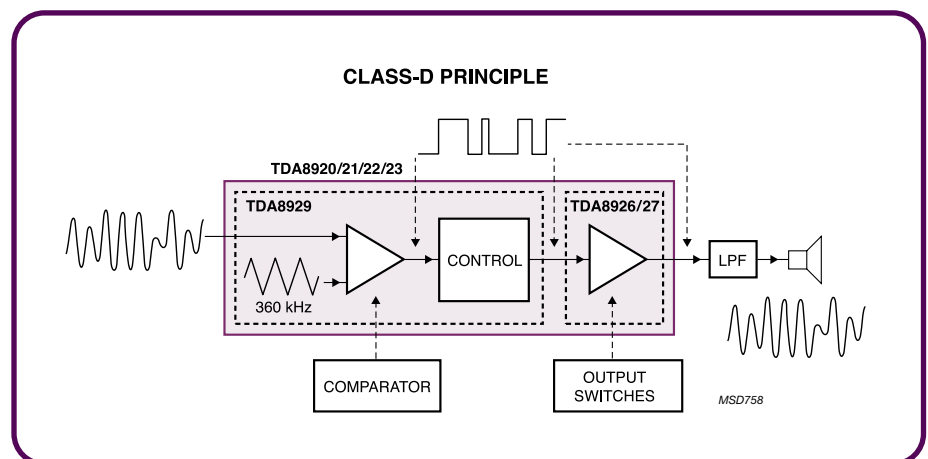
Through dedicated investment in amplifier research, Philips has smoothed away the rough edges of Class D technology. For instance, our advanced integration techniques reduce the number of external components usually associated with Class D, delivering overall system benefits with real price / performance advantages over linear

types. And next-generation devices will eliminate the need for such components altogether, simplifying your design work even further.

Our vast experience in RF design and shielding – including special pin layout and innovative packaging – has allowed us to overcome the previous limitation that higher powers increase EMI. This guarantees Class D's high quality audio performance even at high volumes, with extremely low distortion.

While low output amplifiers based on discretely can sometimes offer some cost advantages, the trend towards smaller digital systems and the need for

devices to consume less power make our Class D ICs today's essential solution. Class D designs are also much less complex than discrete solutions and, at higher powers, our Class D products achieve energy-saving and performance figures that discrete alternatives simply cannot match.



Philips Semiconductors

Philips Semiconductors is a worldwide company with over 100 sales offices in more than 50 countries. For a complete up-to-date list of our sales offices please e-mail sales.addresses@www.semiconductors.philips.com. A complete list will be sent to you automatically. You can also visit our website <http://www.semiconductors.philips.com/sales> or contact any of the following sales offices by phone or mail:

North America

Philips Semiconductors C.R.M. Center
2800 Wells Branch Parkway
Mailstop P-411
Austin, Texas 78728
United States
Tel. +1 800 234 7381
Fax +1 800 943 0087

Europe, Africa, Middle East and South America

Philips Semiconductors International
Fulfillment and Sales Support Center
P.O. Box 366
2700 AJ Zoetermeer
The Netherlands
Fax +31 79 3685126

Asia Pacific

Philips Semiconductors Asia Pacific
Market Response Management Center
P.O. Box 68115
Kowloon East Post Office
Hong Kong
Fax +852 2756 8271

Japan

Philips Semiconductors
Philips Building 13-37
Kohnan 2-chome
Minato-ku,
Tokyo 108-8507
Tel. +81 3 3740 5130
Fax +81 3 3740 5057

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