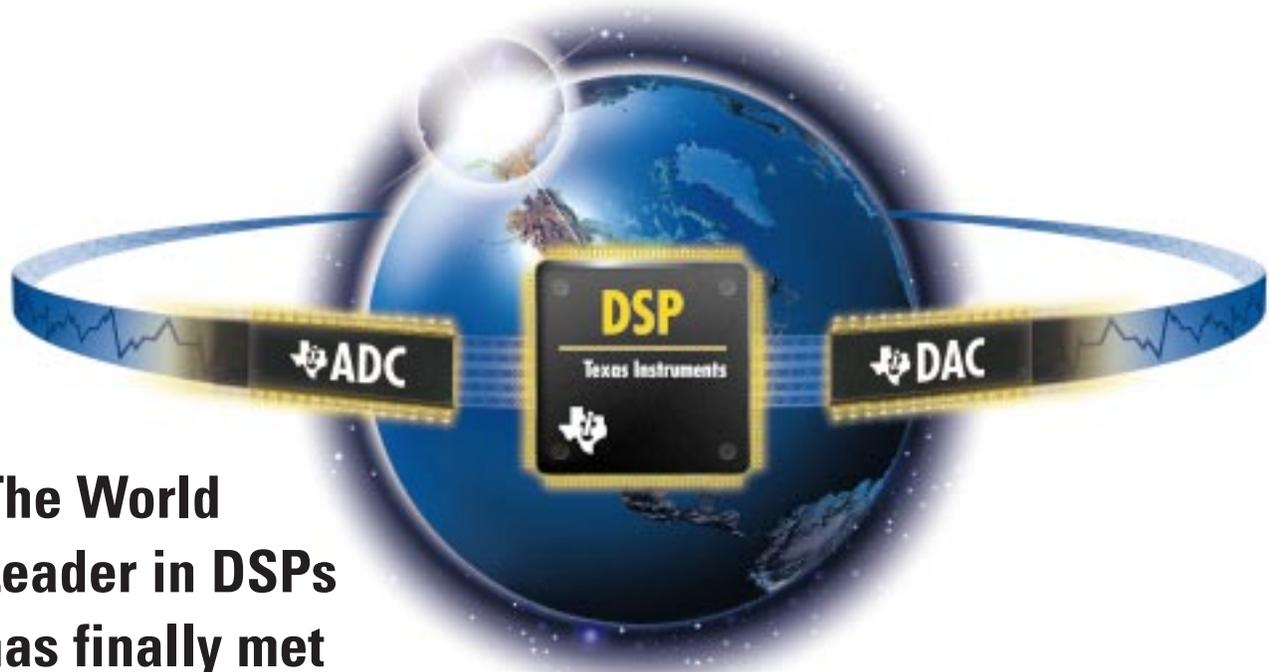


NOVEMBER ■ 1998
VOLUME 29

Showcase



**The World
Leader in DSPs
has finally met
its match.**

**World Class Data Converters
pages 6 – 10**

Inside

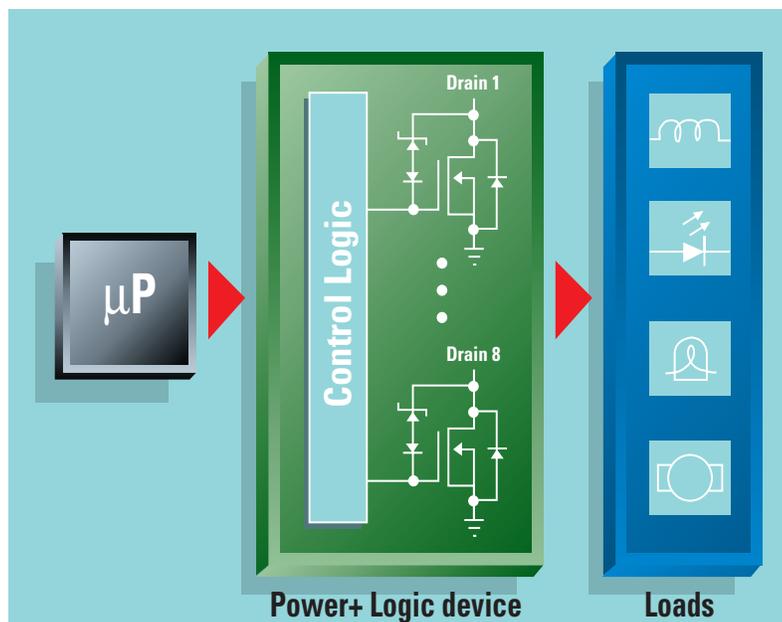
- Integrated shift register and 8-channel peripheral driver. **Page 2**
- Intelligent quad high-side driver. **Page 3**
- Class-D audio amplifier sets new standards in efficiency. **Pages 4-5**
- Programmable D/A allows for speed/power optimization. **Page 6-7**
- Industry's first programmable resolution A/D. **Page 8**
- High-speed 10-bit A/D with glueless DSP interface. **Page 9**
- 16-bit A/D D/A analog front-end. **Page 10**
- UART provides quad-channel integration and 64-byte FIFO. **Page 11**
- Fully compliant 4-port USB hub. **Page 12**
- USB power distribution features independent switches. **Page 13**
- Dual low dropout regulator with integrated processor resets. **Page 14**
- Programmable-synchronous buck regulator addresses advanced microprocessor power needs. **Page 15**
- High performance DSP power controller. **Page 16**
- Low-voltage audio power amps designed for stereo headphone applications. **Page 17**
- SOT-23 50-mA low-dropout regulator. **Page 18**
- 3-channel power supply supervisors. **Page 18**
- Evaluation module offerings. **Page 19**

POWER + CONTROL

Product features

- Eight 100 mA DMOS outputs
- Outputs current limited, 250 mA, (typ)
- ESD protection of 2.5 KV
- Low power operation
- Cascadable serial interface
- Characterized for operation between -40°C to 125°C

Cost-effective integrated LED driver



The TPIC6C595, a recent addition to the Power+ Logic family, is an 8-bit shift register with 100 mA DMOS outputs. The TPIC6C595 is a low-cost, monolithic IC designed specifically for low-current, medium-voltage loads such as LEDs.

To prevent the outputs from over-current damage, the TPIC6C595 has current-limit capability that decreases as the junction temperature increases for additional device protection. The outputs also provide snubber circuitry to protect the device from inductive flyback. Each input has transient protection for increased robustness making the device suited for ESD sensitive applications. Implementing any of the previously mentioned features in a bipolar peripheral solution — as in the 74HC595 and ULN2003 — would require significant external circuitry and passive components, resulting in increased cost and printed board-space.

The TPIC6C595 offers a cost-effective integrated solution, as well as high reliability for switching LEDs or low-current incandescent bulbs. The device is available in dual-in-line (N) and surface-mounted (D) packaging.

Applications

Automotive:

- Instrumentation
- Heads-up displays
- Tell-tale lights

Industrial:

- Moving signs
- Instrumentation
- Electronic games

■ **Check box 01** to request a datasheet.

Power+ Logic family at a glance

The family offers a portfolio of similar devices such as the TPIC6C595 with various control logic and current options to drive solenoids, incandescent bulbs, LEDs, fractional horsepower motors, relays, and valves in many automotive or industrial applications.

	TPIC6259	TPIC6A259	TPIC6B259	—
'259: Addressable latch	TPIC6259	TPIC6A259	TPIC6B259	—
'273: D-type latch	TPIC6273	—	TPIC6B273	—
'595: Shift register	TPIC6595	TPIC6A595	TPIC6B595	TPIC6C595
$r_{DS(on)}$, typ	1.3 Ω	1 Ω	5 Ω	7 Ω
V_{DS} , max	45 V	50 V	50 V	33 V
E_{AS}	75 mJ	75 mJ	30 mJ	30 mJ
No. outputs	8	8	8	8
I_D^*	250 mA	350 mA	150 mA	100 mA
I_P^*	1.5 A	1.1 A**	500 mA***	250 mA***
I_{CC} , typ	15 μA	500 μA	20 μA	20 μA
ESD protection	3 KV	2.5 KV	2.5 KV	2.5 KV
Packaging	20-pin DIP 20-pin SO	20-pin DIP 24-pin SO	20-pin DIP 20-pin SO	16-pin DIP 16-pin SO

* Each output, all outputs on
 ** Current-limiting circuitry and short-circuit protection
 *** Current-limiting capability

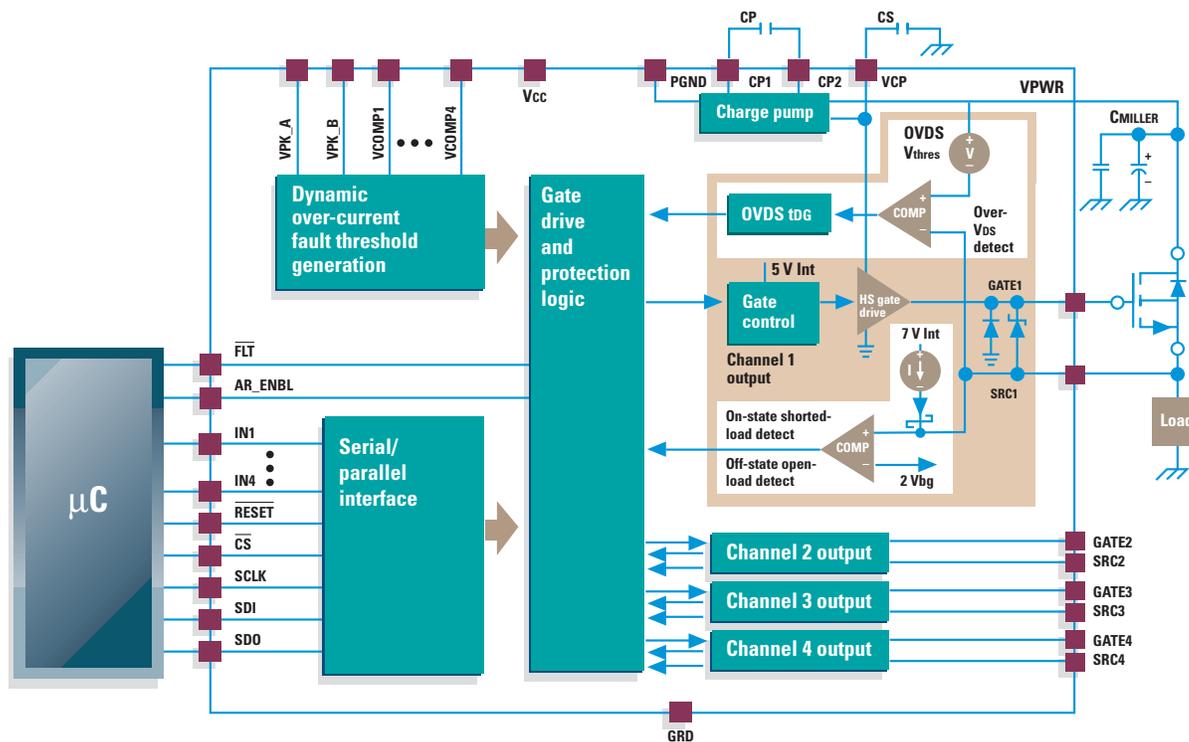
Suggested resale price

Quoted per device in quantities of 1,000

TPIC6259DW:	\$1.60
TPIC6273DW:	\$1.60
TPIC6595DW:	\$1.60
TPIC6A259NE:	\$1.89
TPIC6A595DW:	\$2.03
TPIC6B259DW:	\$0.78
TPIC6B273DW:	\$0.78
TPIC6B595DW:	\$0.78

For technical support, call (972) 644-5580.
 To order documentation, call 1-800-477-8924, ext. 3237

POWER + CONTROL



Product features

- Serial or parallel control interface
- Independent fault detection/protection
- Sleep state mode
- Serial interface feedback
- Auto re-try mode
- Cascadable serial interface

First intelligent pre-FET driver with dynamic fault threshold

The TPIC44H01, a four-channel high-side pre-FET driver, is a new addition to the Power+ Control family to compliment the existing line of low-side pre-FET drivers. The device is the first pre-driver to provide serial or parallel input interface to control four external NMOS power FETs. It is designed for low frequency switching of resistive or inductive loads including incandescent bulbs and solenoids.

The TPIC44H01 is also the first high-side pre-FET driver

Typical applications

Automotive:

- Headlamps
- Turn signals
- Daytime lights
- Interior lights
- Transmission
- Engine controls
- Anti-lock brakes
- Active suspension
- Fuel injectors
- Door locks

Industrial:

- Process control systems
- Robotics
- Electronic data processing

PCs:

- Battery switching/management

with diagnostics, that is compliant to federally mandated OBD II, allowing for decreased costs and reduced downtimes in automotive applications. Each channel has independent open-load detection (2.4 V) and over-current and

short-to-ground (2.35 V) detection/protection with fault status reporting via the serial interface. For increased protection and reliability, the device has dynamic over-current threshold ideal for incandescent bulb applications with long inrush current. Over-voltage lockout (30 V) circuitry provides additional protection for the device and the external FETs.

In addition, the TPIC44H01 has a low-current sleep state (45 μ A) that is suitable for low power applications. Multiple TPIC44H01s may be cascaded via the serial interface to reduce I/O lines from the host controller. The device is available in surface-mounted (TSSOP) packaging.

- Check box 02 for a datasheet.

Suggested resale price

Quoted per device in quantities of 1,000

TPIC44H01DA: \$1.56

Read Showcase online and download datasheets at:

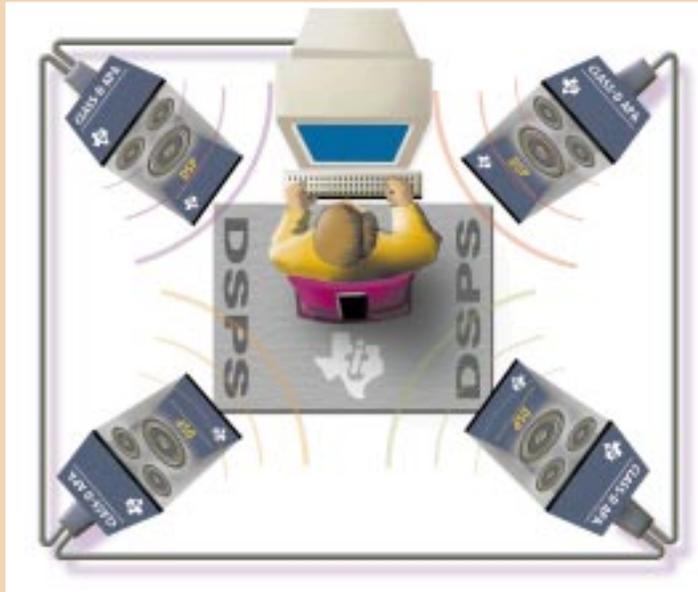
www.ti.com/sc/showcase

A U D I O P O W E R A M P L I F I E R S

Product features

- Extremely efficient Class-D operation
- Shutdown control
- 2- W_{RMS} stereo output
- Low THD+N... 0.5 percent (20 Hz to 20 kHz)
- Characterized -40°C to 85°C
- Plug-n-Play EVM available now

Industry's first stereo Class-D



The TPA005D02 delivers a full 2- W_{RMS} to each speaker with a 5-W peak capability to reduce clipping and keep THD+N below 0.5 percent across the entire audible frequency band.



Plug-n-Play EVM

TPA005D02, first fully integrated stereo Class-D audio amplifier, sets new standards in efficiency. When compared to linear or Class-AB amplifiers, the TPA005D02 consumes one third of their average supply current. Integrated shutdown control extends battery life further by minimizing supply current to 400 μA . This extremely efficient mode of operation makes the device ideal for portable applications including:

- Notebook computers
- PDAs
- Hand-held PCs
- USB Speakers
- Battery operated equipment

The TPA005D02 delivers a full 2 W_{RMS} to each speaker with a 5-W peak capability to reduce clipping and keep THD+N below 0.5 percent across the entire audible frequency band.

Class-D amplifiers process analog signals using pulse-width modulation (PWM) techniques, the key behind Class-D amplifiers' increased efficiency. The PWM signals are applied to power DMOS H-bridges providing high output current capability. High-frequency square waves of constant amplitude, but varying width, are output from the IC. These pulses of varying widths contain the audio information. The output signal must be low-pass filtered to isolate the audio information

Suggested resale price

Quoted per device
in quantities of
1,000

TPA005D02DCA:
\$3.48

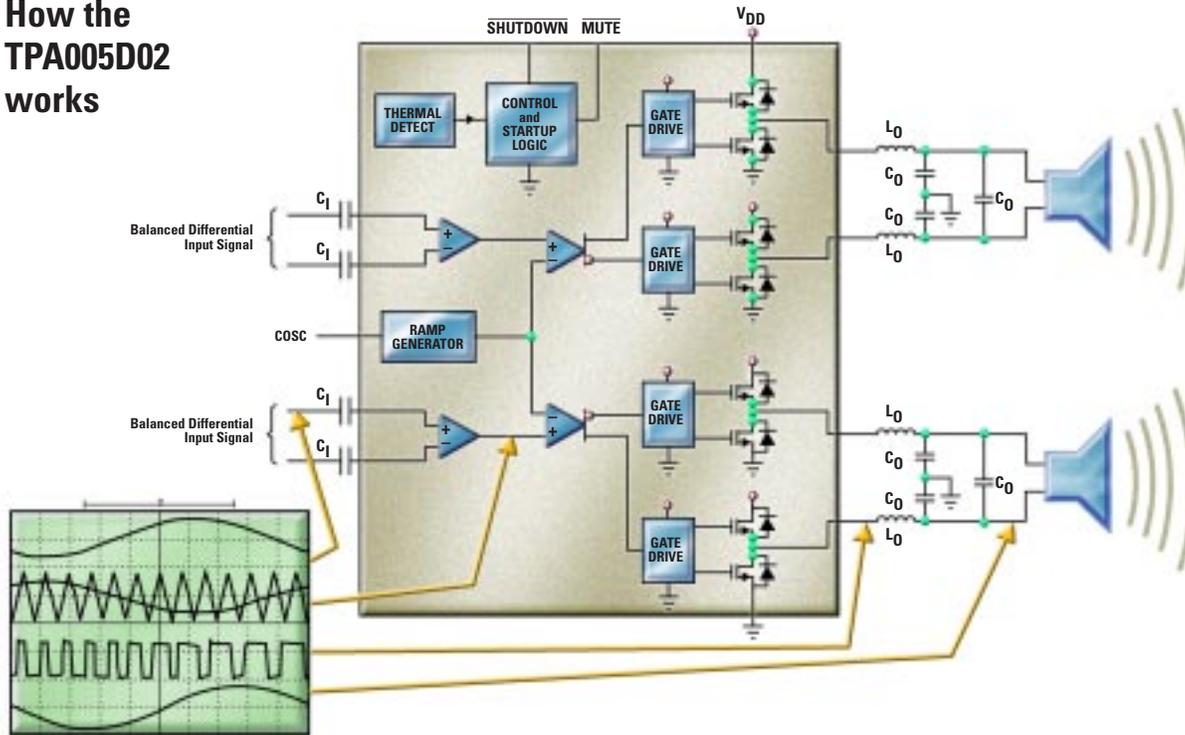
TPA005D02 EVM:
\$100.00

For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3237

AUDIO POWER AMPLIFIERS

audio amplifier sounds great

How the TPA005D02 works



from the high-frequency signal. Proper filtering assures the quality of the sound produced by the system. The block diagram illustrates this process.

Because of their compact size, low heat dissipation and power consumption, future generations of Class-D APAs will play an important role in digital sound systems. A typical application uses a personal computer (PC) as the centerpiece of a home entertainment system. Class-D APAs are criti-

cal to the development of digital speakers capable of Dolby® Digital or Dolby Surround® playback.

To help designers implement Class-D audio power amplifiers, TI has developed an evaluation module (SLOP223) fully compatible with its APA Plug-n-Play Platform, the only one of its kind in the industry. Also available is the Audio Power Analysis Program. The software tool helps designers make quick and accurate calculations on power requirements and thermal data using real .wav files.

To help maximize sound quality, a comprehensive application note on low-pass filtering will be available later in the fourth quarter of 1998. Full documentation for the TPA005D02 EVM includes a user's guide with reference designs and schematics. Gerber files are available on request.

■ **Check box 03** for a datasheet and technology brief.

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

DATA CONVERTERS

Product features

TLV5616

- 12-bit voltage output DAC
- Programmable settling time vs. ultra-low power consumption: 3 μ s/2.1 mW (typ) 9 μ s/900 μ W (typ)
- Power-down mode, 10 nA (typ)
- TMS320 DSP and SPI compatible interfaces
- Single 2.7-to-5.5-V supply
- Characterized for operation from -40° C to 85° C

Pick your speed with 10- and 12-bit,

The TLV5604, TLV5614 and TLV5616 belong to a versatile family of 10- and 12-bit digital-to-analog converters. They have programmable settling times as fast as 3 μ s (typical), thereby enabling you to choose the appropriate speed for your application.

In addition, they also have low power consumption, therefore saving battery life and dissipating less heat. For example, the TLV5616 dissipates only 900 μ W (typical) in the slow mode at 3 V. All three parts come with a powerdown feature to save energy when the parts are

The TLV56xx DAC family accepts a wide range of supply voltages ranging from 2.7 V to 5.5 V, giving you flexibility in your design

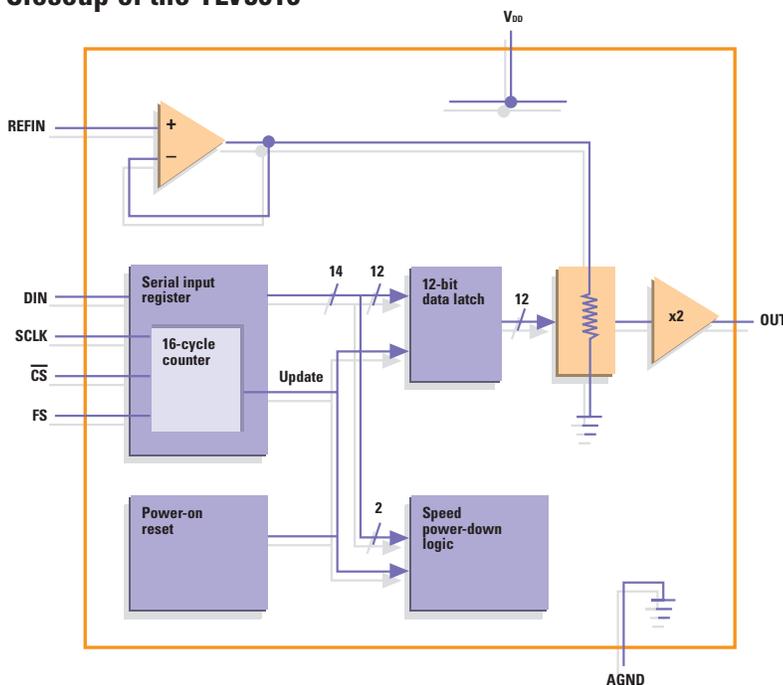
not being accessed.

They accept a wide range of supply voltages ranging from 2.7 V to 5.5 V, giving you flexibility in your design. They further provide flexibility by

allowing a glueless interface to TMS320, SPI, QSPI, and Microwire serial ports. They come in commercial and industrial temperature ranges extending their operation from -40° C to 85° C.

In order to improve stability and reduce settling time, the resistor string output voltage is buffered by an x2 gain rail-to-rail output buffer. The TLV5604 and TLV5614 have a separate supply for the digital serial interface and DACs, allowing you more flexibility in your design. The TLV5604 and TLV5614 also have simultaneous update capability allowing multiple DACs to be updated at the same time.

Closeup of the TLV5616



Typical applications

The features of the TLV5604, TLV5614 and TLV5616 make them well suited for applications such as:

- Battery powered test instruments
- Industrial process controls
- Machine and motion control devices
- Communications
- Digital servo control loops
- Mass storage devices

■ Check box 04 for a datasheet.

Suggested resale price

Quoted per device in quantities of 1,000

TLV5604CD:	\$4.91
TLV5614CD:	\$9.52
TLV5616CD:	\$3.15

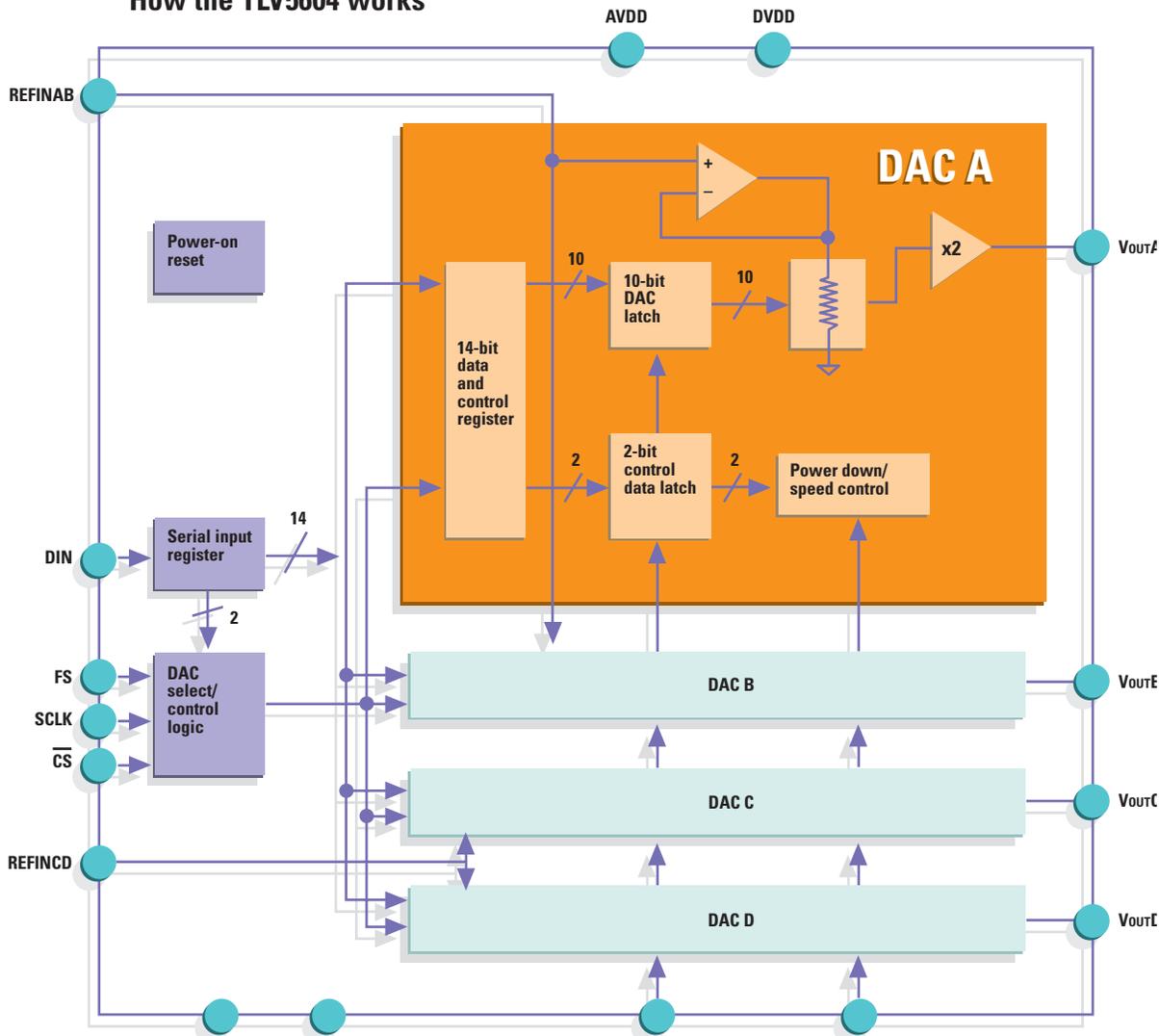
TI offers ADCs and DACs that are compatible with our family of powerful DSPs. A selection tool is available for choosing the best Data Converter for your application. Among the ADCs and DACs highlighted here, you will find a broad spectrum of speed and resolution choices. Visit the "Data Converters for DSPs" web page for more information, free samples, data sheets, application reports and evaluation modules: www.ti.com/sc/dsp

**For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3237**

DATA CONVERTERS

variable-speed, serial DACs

How the TLV5604 works



Product features

TLV5614

- 12-bit quadruple voltage output DAC
- Programmable settling time vs. power:
3 μ s/9.6 mW (typ)
9 μ s/3.6 mW (typ)
- Power-down mode, <10 nA (typ)
- TMS320 DSP and SPI compatible interfaces
- Dual 2.7-to-5.5-V supply (separate digital and analog supplies)

TLV5604

- 10-bit quadruple voltage output DAC
- Programmable settling time vs. ultra-low power:
2.5 μ s/9 mW (typ)
8.5 μ s/3 mW (typ)
- Power-down mode, 10 nA (typ)
- TMS320 DSP and SPI compatible interfaces
- Dual 2.7-to-5.5-V supply (separate digital and analog supplies)

The TLV56xx family at a glance

Part number	Resolution	Number of DACs	Settling time	Cost (1K units)	Package
TLV5604 SOIC, TSSOP	10	4	2.5 μ s / 9 mW 8.5 μ s / 3 mW	\$4.90	16-pin
TLV5614 SOIC, TSSOP	12	4	3 μ s / 9.6 mW 9 μ s / 3.6 mW	\$9.50	16-pin
TLV5616 SOIC	12	1	3 μ s / 2.1 mW 9 μ s / 900 μ W	\$3.15	8-pin

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

DATA CONVERTERS

Product features

■ Reconfigurable:
2 MSPS @ 10 bit,
3 MSPS @ 8 bit,
7 MSPS @ 4 bit

■ Wide input bandwidth for undersampling
≤120 MHz
@ -3 dB

■ Low operating supply current:
3.5 mA @ 5.5 V
(10 MHz)

■ Simultaneous sample and hold

■ Programmable conversion modes

Industry's first programmable resolution analog-to-digital converter

The industry's first high-speed, programmable resolution analog-to-digital converter (ADC) redefines system design for digital signal processor (DSP) applications.

The TLV1562 provides flexibility and ultimately, a first-to-market DSP solution for portable digital radios, paging systems, process and motor controls, remote sensing, automotive systems, servo controls and communications systems such as wireless local loops.

The resolution and sampling speed of the TLV1562 can be set to change dynamically during operation. Any of the three following combinations can be programmed: 10 bits resolution at 2 million samples per second (MSPS); 8 bits at 3 MSPS; and 4 bits at 7 MSPS. In addition, the device features a unique dual sample/hold (S/H) architecture enabling it to output a continuous stream of digital data for long periods of time. Its dual S/H channels can also be configured to minimize interrupt latency, thereby providing the flexibility to optimize it for your specific application.

The converter also includes an internal code-conversion capability that offloads process-

ing tasks from the DSP for improved system performance. The TLV1562 itself converts binary code into two's complement code and outputs this directly to the DSP, eliminating the need for the DSP to expend execution cycles on code conversion. It also offers a wide input bandwidth (75 MHz at -1 dB and >120 MHz at -3 dB) making it ideal for undersampling applications. Furthermore, it has programmable conversion modes, both interrupt driven and continuous modes, optimizing it for MIPS sensitive DSP applications.

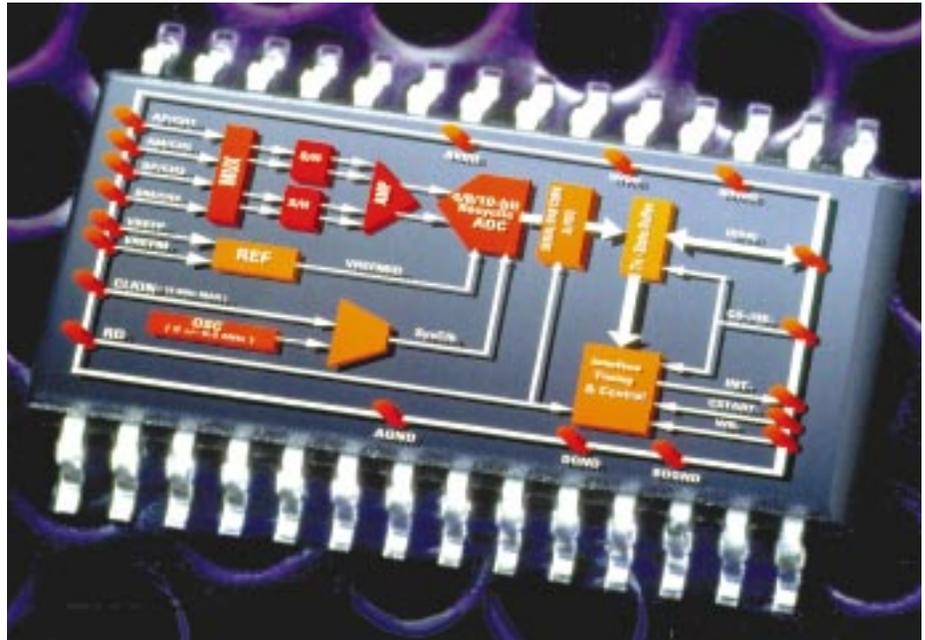
Finally, the TLV1562 has a wide power supply range from 2.7 V to 5.5 V. In power-sensi-

tive applications, such as mobile systems, the TLV1562 offers power consumption as low as 5 milliamps for 2.7-V systems or 8.5 milliamps for 5.5-V systems. It also has a DSP and micro-processor compatible DSP interface.

The TLV1562 is available in 28-pin TSSOP and SOIC packages.

TI offers ADCs and DACs that are compatible with our family of powerful DSPs. A selection tool is available for choosing the best Data Converter for your application: www.ti.com/sc/dsps

■ Check box 05 for a datasheet.



The TLV1562 provides flexibility and ultimately, a first-to-market DSP solution for portable digital radios, paging systems, process and motor controls, remote sensing, automotive systems, servo controls and communications systems such as wireless local loops.

Suggested resale price

Quoted per device in quantities of 1,000

TLV1562CDW: \$4.51

For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3237

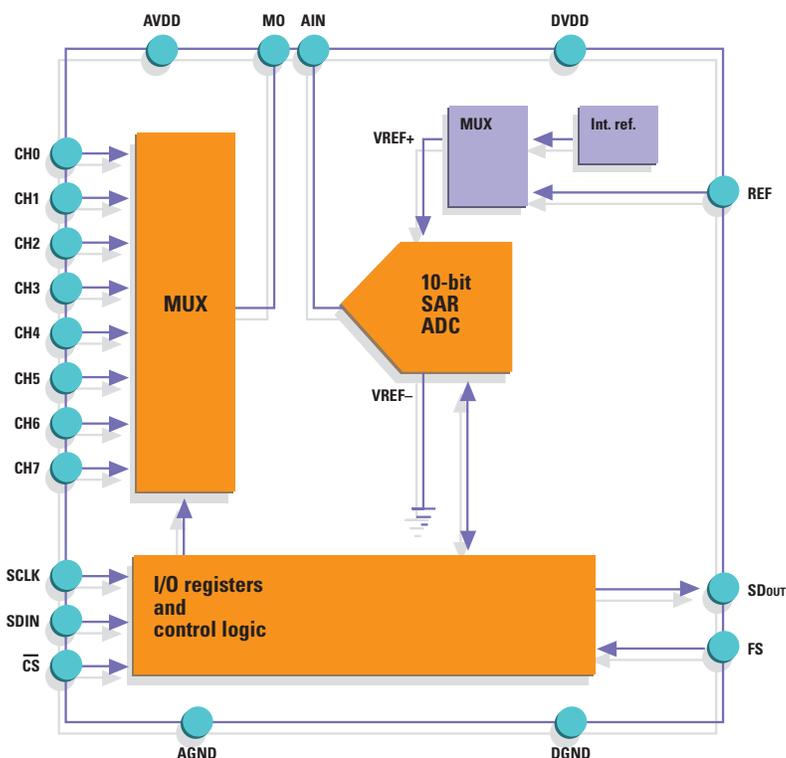
DATA CONVERTERS

High-speed, 10-bit serial ADC offers glueless interface

The TLV1570 is the fastest 10-bit, 8-channel, serial ADC that will interface gluelessly with TMS320 DSPs and a variety of industry-standard microcontrollers, for a range of engineering and industrial applications. This device accepts an analog input range from 0 V to 5.5 V and digitizes the input at 1.25 million samples per second (MSPS) at 5 V and 625 kSPS at 3 V, offering design flexibility as well as excellent performance.

The TLV1570 features a programmable internal voltage reference (3.8 V or 2.3 V) and operates from a single wide supply range of 2.7 V to 5.5 V. An internal MUX is independently accessible, which allows the user to insert a signal conditioning circuit such as an anti-aliasing filter or an amplifier, if required, between the MUX and the ADC. Therefore, one signal conditioning circuit can be used for all eight channels. Additionally, simple-to-program functions such as a unique auto-scan mode, voltage reference selection, and auto-power-down mode will benefit applications such as image sensor processing, process control, motor control, various

How TI's TLV1570 works



Typical applications

The TLV1570 is ideally suited for applications in:

- Automotive
- Digital servos
- Portable test instruments
- Process control
- Image sensor processing
- Mass storage
- General purpose DSP

automotive and digital servos.

Power dissipation in the TLV1570 is as low as 8 mW, making the ADC perfectly suited for portable applications. A 175- μ A auto-power-down mode or 3- μ A software power-down mode reduces power and heat further by significantly

reducing supply current whenever the conversion is not performed.

The TLV1570 has a typical Integral Non-Linearity (INL) of ± 0.65 LSB for applications that require the most demanding accuracy specifications. It is available in two options: the 20-pin SOIC and TSSOP packages.

TI offers ADCs and DACs that are compatible with our family of powerful DSPs. A selection tool is available for choosing the best Data Converter for your application: www.ti.com/sc/dsps

- Check box 06 for a datasheet.

Product features

- Fast throughput: 1.25 MSPS at 5 V, 625 kSPS at 3 V
- Eight analog input channels
- Low power dissipation: 40 mW at 5 V, 8 mW at 3 V
- Wide analog channel input: 0 V to AV_{DD}
- Programmable internal reference voltage
- Characterized for operation from 0° to 70° C

Suggested resale price

Quoted per device in quantities of 1,000

TLV1570CDW: \$3.70

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

DATA CONVERTERS

Product features

- Master/slave mode
- Differential output drives 600-Ω load
- Single 5-V supply or 5-V analog and 3-V digital
- Power-down mode
- Input and output gain control
- Glueless DSP interface
- Characterized for operation from -40° C to 85° C (AD50I)

Suggested resale price

Quoted per device in quantities of 1,000

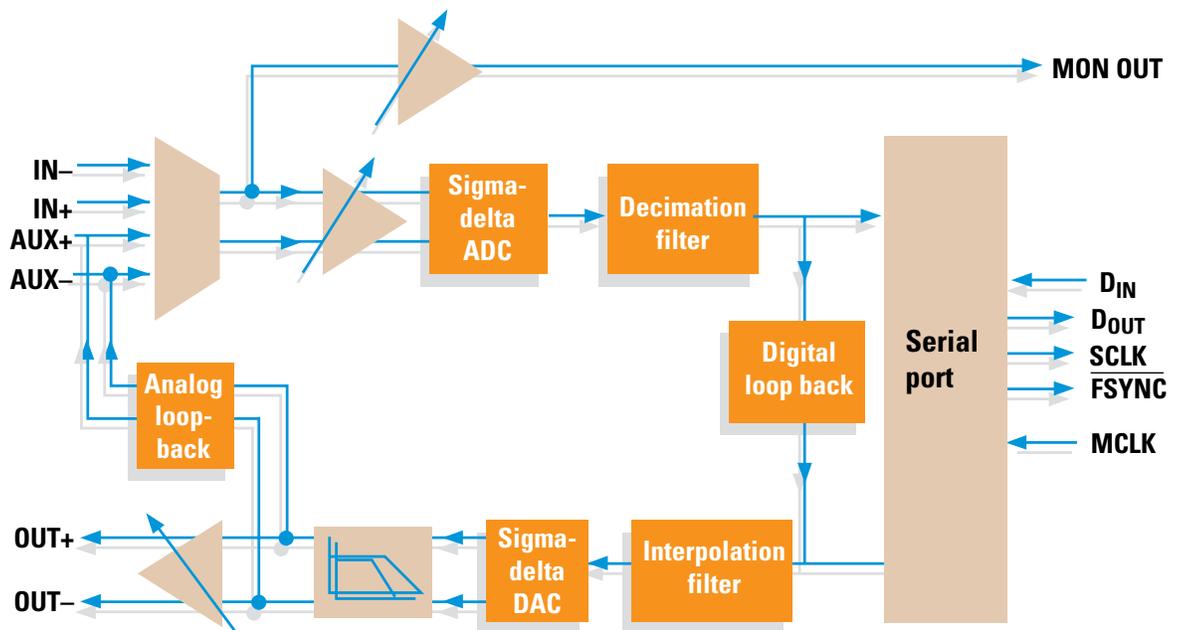
TLC320AD50C/52CDW: \$3.57

TLC320AD50C/52CDWR: \$3.57

TLC320AD50C/52CPT: \$4.28

TLC320AD50C/52CPTR: \$4.28

TLC320AD50C/50IDW: \$3.67



Options for analog interface applications

The TLC320AD50C/I and TLC320AD52 analog interface circuits (AICs) provide high-resolution A/D and D/A signal conversion using oversampling sigma-delta techniques. These 16-bit AICs can be used as an analog front end in modem applications, and also provide an ideal solution for business audio or motherboard audio applications. Additional applications include reduced-function modems for PDAs, point-of-sale terminals, and general DSP or MCU interface applications.

These 16-bit AICs can be used as an analog front end in modem applications, and also provide an ideal solution for business audio or motherboard audio applications.

One of the main features of the 'AD50C/I is its master/slave capability with support for up to three slaves. The TLC320AD52 provides identical functionality to the 'AD50C, but supports only one slave in master/slave mode.

Other features of the 'AD50/52 AICs include internal 64X oversampling on the ADC and 256X oversampling on the DAC, as well as differential outputs that can drive a 600-Ω differential load. Options for all the devices include selectable conversion rate, reset, power down, communications protocol, serial clock rate, gain control and system test mode.

The 'AD50I is available in 28-pin SOIC (DW) package and the 'AD50C/52 is available in 28-pin SOIC (DW) and 48-pin TQFP (PT) packages.

■ **Check box 07** for a datasheet, data manual and EVM brochure.

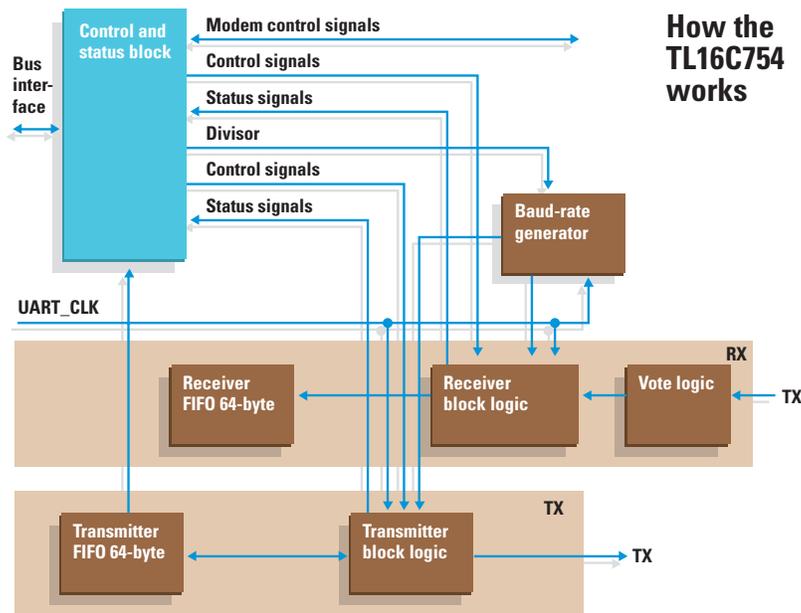
For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3237

UART

TL16C754 UART provides quad-channel integration and 64-byte FIFO

The TL16C754 is a four-channel universal asynchronous receiver/transmitter (UART) that provides serial-to-parallel data conversion from peripherals or modems and parallel-to-serial data conversion on data transmitted by the host. Applications include PCs, fax/modems, wireless systems, telecom equipment, or any application requiring an enhanced serial port.

The new device, which is pin-compatible with the TL16C554 quad UART, can be placed in an alternate mode (FIFO mode) relieving the processor of excessive software overhead by buffering received or transmitted characters. In addition, both the receiver and transmitter FIFOs can store up to 64 bytes, including three additional bits of error status per byte for the receiver FIFO. Primary outputs also allow for signaling of DMA transfers.



**How the
TL16C754
works**

Product features

- Programmable 16- or 64-byte FIFOs
- Selectable hardware and software flow control
- High baud rate (up to 3.2 Mbps)
- 3.3-V or 5-V supply
- Programmable sleep mode
- Characterized for operation from -40°C to 85°C

The new device, which is pin-compatible with the TL16C554 quad UART, can be placed in an alternate mode (FIFO mode) relieving the processor of excessive software overhead by buffering received or transmitted characters.

Another unique feature is selectable hardware and software flow control. Hardware flow control significantly reduces overhead and increases system efficiency by automatically controlling serial data flow using input and output signals. Software flow control automatically controls data flow using programmable $X_{\text{on}}/X_{\text{off}}$ characters.

The device provides quad-channel integration for reduced board space and cost. The complete status of each channel can be read at any time during functional operation by the processor. It also supports high

data throughput of up to 3.2 Mbps (60-MHz input clock), and contains a software interface for modem control operations.

The TL16C754 is available in 80-pin TQFP and 68-pin PLCC packages.

- **Check box 08** for a datasheet.

Suggested resale price

Quoted per device in quantities of 1,000

TL16C754PN: \$9.12

TL16C754FN: \$9.50

Read Showcase online and download datasheets at:

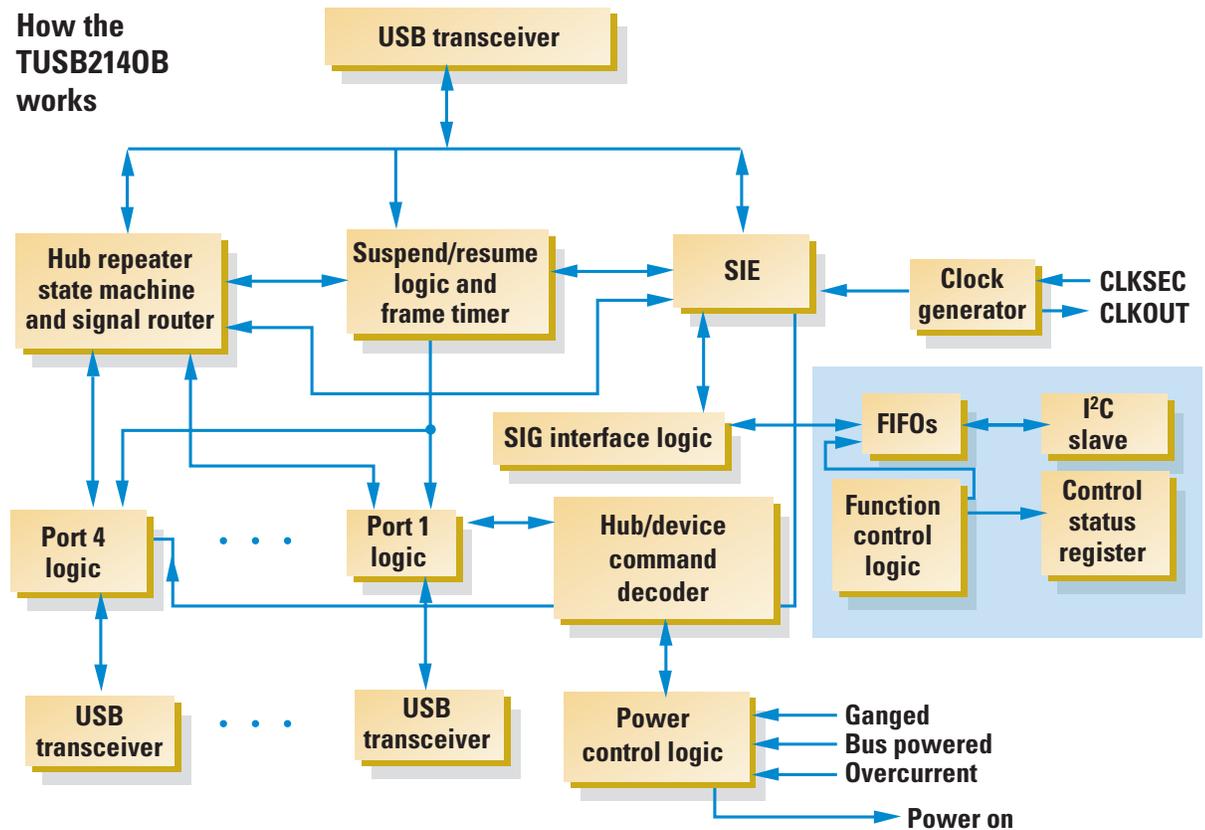
www.ti.com/sc/showcase

U S B

Product features

- Compliance to USB standard v1.0
- I²C circuitry
- Drop in hardware-only solution
- Integrated USB transceivers
- 3.3-V operation
- Supports self-powered and bus-powered mode
- Characterized for operation from 0° C to 70° C

How the TUSB2140B works



USB maximizes Windows 98 performance

With USB support built in to Windows® 98, users can now connect joysticks, video-conferencing cameras, scanners and other types of peripheral hardware to their PCs, without rebooting. It is also possible to connect more than one monitor to the same system for dual display desktops. Or, USB can be used to pull digital audio signals directly from the Internet, CDs, or DVD and convert them to analog sound in the speaker, rather than through an add-in sound card. This diminishes potential noise pollution from the PC and greatly enhances sound quality.

Designed to provide the interface between these new

USB peripherals and the host PC is the TUSB2140B, a compound 4-port, standard-compliant USB hub that also adds an embedded function. The embedded function is USB display class compatible, and includes a control endpoint and interrupt endpoint to support USB data transfers. The '2140B will also be available in a 44-pin PGT (LQFP) package in January 1999.

The associated FIFOs and control registers for these endpoints are fully integrated within the device. In addition, an Inter IC (I²C) 2-wire serial interface is provided for a local microcontroller to access the FIFOs and control registers. It also contains state machine functionality to respond to USB

requests providing both quick response time and minimize software overhead in the attached microcontroller.

USB compatible transceivers are provided for all upstream and downstream ports. All external downstream ports support both full and low-speed connection by automatically setting the slew rate according to the speed of the device attached to the port.

To reduce power consumption, the '2140B supports ganged mode as well as per port mode for power switching and overcurrent conditions, as well as a self-powered and bus-powered mode.

■ **Check box 09** for a datasheet and data manual.

Suggested resale price

Quoted per device in quantities of 1,000

TUSB2140BN:
\$2.85

TUSB2140BPGT:
\$2.30

For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3237

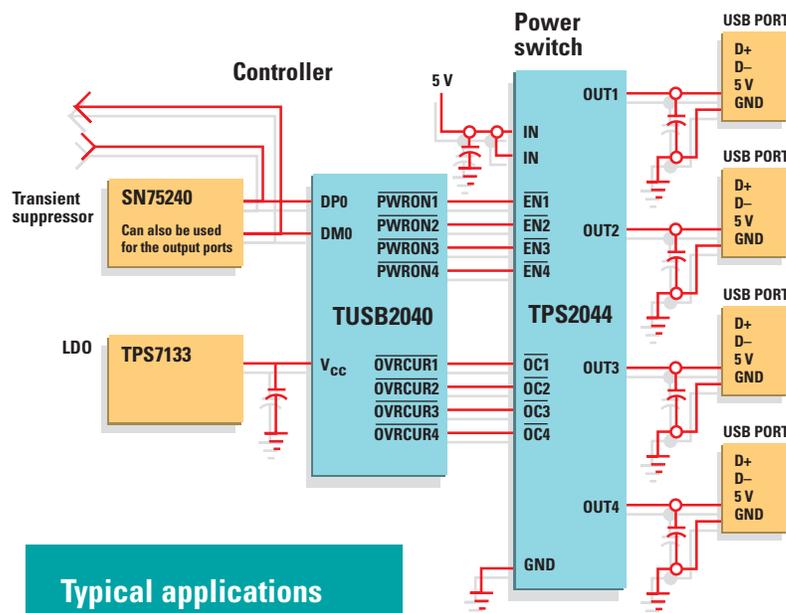
POWER DISTRIBUTION

Fully independent USB power distribution switches offer multilevel thermal protection

The new TPS204x/5x family of fully independent power distribution switches are designed to meet both the needs of USB and general power distribution applications. This device family integrates the multiple features required for implementing a USB power interface into a single package.

TI's patented dual temperature threshold circuit enables the switches in the TPS204x/5x family to function individually. This permits dual and quad switch packages to detect and disable only the switches that are in over-current, allowing other USB devices to continue normal operation. Other independent features include:

- Enables (low or high) — allows the power switches to be turned on or off.
- Over-current response — provides logic feedback during over current conditions.
- Low $r_{DS(on)}$ (135 m Ω)



Typical applications

- Notebook computers
- Desktop computers
- Personal digital assistance (PDAs)
- Digital cameras
- Telephones
- Bar-code scanners
- General instrumentation
- Board-level power segmentation.

max) enables full USB compliance without increasing the supply voltage.

The TPS204x/5x family of devices provides a cost effective means of switching power to USB ports and other power distribution applications.

This family is also available in SOIC and DIP packages.

- Check box 10 for a datasheet and app note.

Product features

- Fully independent power distribution switches
- Low on resistance: 135 m Ω max $r_{DS(on)}$ up to 125° C
- Responds to fault conditions in 45 μ sec (typ)
- Operating voltage range from 2.7 V to 5 V
- 4.0 ms controlled rise/fall time
- 0.9 A (typ) current limit
- Characterized for operation from -40° C to 125° C

TPS20xx family at a glance

Part No. SOIC	Part No. DIP	Pin Count	Type	Enable
TPS2041D	TPS2041P	8	Single	Low
TPS2042D	TPS2042P	8	Dual	Low
TPS2044D	TPS2044N	16	Quad	Low
TPS2051D	TPS2051P	8	Single	High
TPS2052D	TPS2052P	8	Dual	High
TPS2054D	TPS2054N	16	Quad	High

Suggested resale price

Quoted per device in quantities of 1,000

TPS2041D:	\$0.87
TPS2042D:	\$1.04
TPS2044D:	\$1.72
TPS2051D:	\$0.87
TPS2052D:	\$1.04
TPS2054D:	\$1.72

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

LDO REGULATOR

Product features

- Dual output voltages, 3.3 V and adjustable from 1.2 to 9.75 V
- Dual active-low resets with 200 ms delay
- Output current 0 to 750 mA either output, 2-W max dissipation for total device
- Low supply current, typically 800 μ A total
- ± 2 -percent accuracy for 3.3-V output; ± 3 percent for adjustable output
- Characterized for operation from -40° C to 125° C

First integrated dual regulator simplifies powering split-voltage DSPs

Texas Instruments new TPS73HD301 combines a 3.3-V and an adjustable low dropout regulator with dual processor reset outputs in a single high-power surface mount package.

Typically, new DSPs or microprocessors require two voltages — one to power the peripheral interface and one to power the core sections. The dual-output regulator eliminates three or more components from power supply designs for split-voltage DSPs or processors. Packaged in TI's patented PowerPAD™ TSSOP package, the TPS73HD301 can supply

Applications

- Low-power microprocessor and DSP designs
- Wireless base stations, handsets
- Modems
- Portable battery-powered equipment

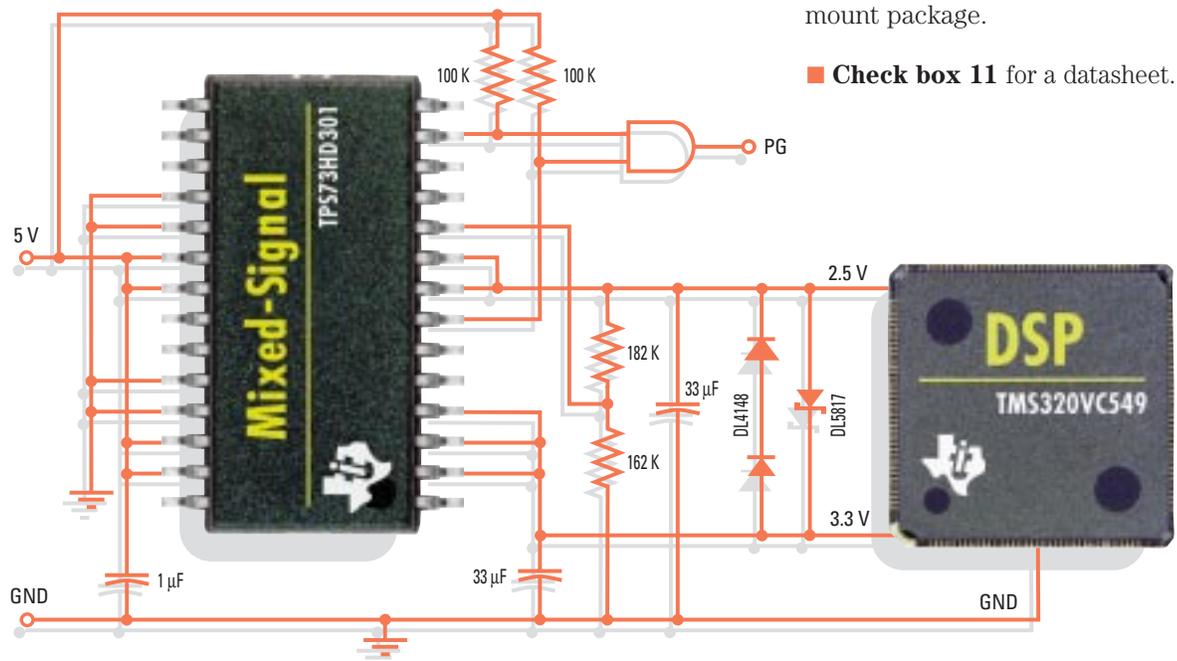
750 mA from either output, with a 2-W power dissipation limit for the total package. The device is capable of supplying power to multiple low-power DSPs, reducing both system power consumption and board space.

The TPS73HD301 uses a PMOS low-power design that enables a dual regulator with micropower supply current requirements and very low dropout voltages. Typical dropout for the 3.3-V output is only 350 mV at the full rating of 750-mA output. Supply current for the entire device is a maximum of 1.1 mA over all specified conditions. Total accuracy for the 3.3-V output is ± 2 percent; tolerance on the adjustable output is ± 3 percent. Programming the adjustable regulator output is accomplished using an external resistor divider.

The TPS73HD301 is offered in a PowerPAD TSSOP surface-mount package.

■ Check box 11 for a datasheet.

How the TPS73HD301 works



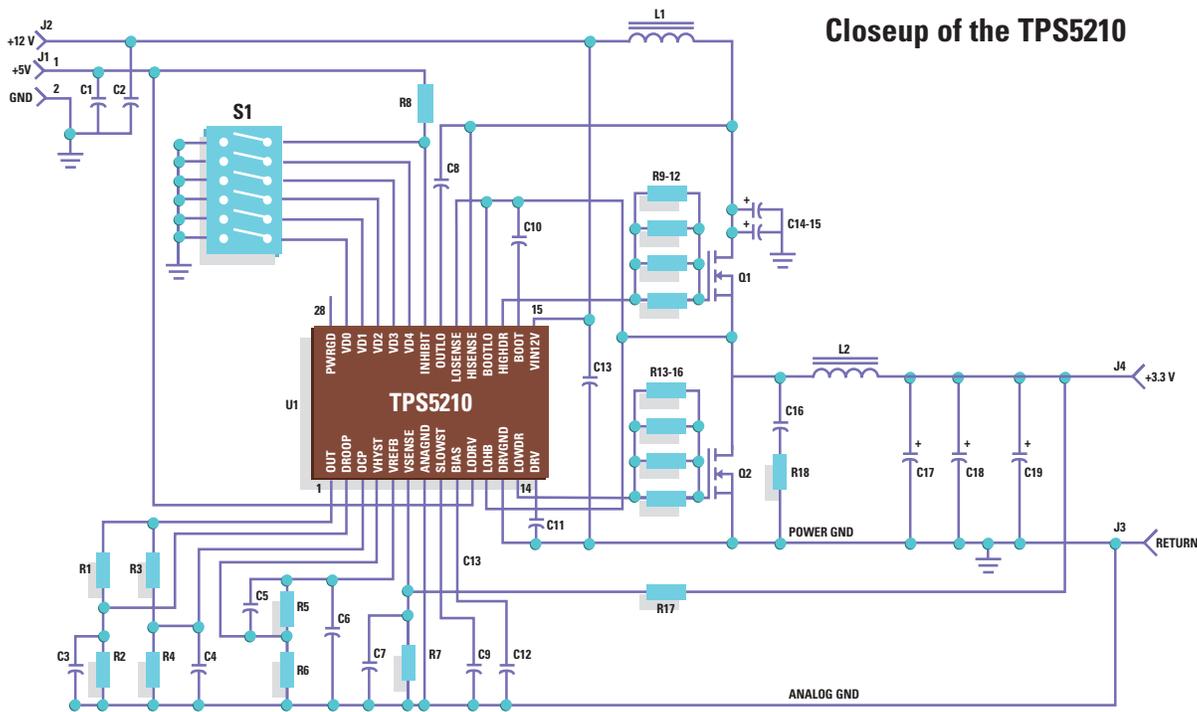
Suggested resale price

Quoted per device in quantities of 1,000

TPS73HD301QPW::
\$2.66

For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3237

PROCESSOR POWER



Closeup of the TPS5210

Programmable synchronous buck regulator controllers

The TPS5210 is a fast and efficient Programmable-Synchronous Buck Regulator Controller. This device can be used for accurately controlling the powering of high performance microprocessors used in workstations, servers and next generation desktop computers where power requirements may be 40 to 80 watts for the processor alone.

An internal 5-bit DAC and ± 1 -percent reference are used to program the output voltage between 1.3 to 3.5 V in 50-mV increments. The TPS5210 employs a hysteretic controller with droop compensation that tightly regulates the output voltage, and dramatically reduces the overshoot and undershoot caused by load transients. With its wide loop bandwidth, the hysteretic

An internal 5-bit DAC and ± 1 -percent reference are used to program the output voltage between 1.3 to 3.5 V in 50-mV increments.

controller provides a load transient response that is only limited by the propagation delay and the output LC filter. The propagation delay from the hysteretic converter to the output drivers is only 250-nsec maximum. The output drivers employ overcurrent shutdown and crossover protection eliminating the possibility of destructive faults in the output FETs.

A soft-start current source, proportional to the reference voltage, eliminates variations in

the soft-start timing when programmed changes are made to the output voltage. Internal circuitry monitors the output voltage to generate a Power Good signal and for overvoltage protection. The Power Good pin is pulled low when the programmed output voltage falls below 93 percent; and the output drivers are disabled when the output exceeds 15 percent of the programmed value. Inhibit and undervoltage lockout are provided to assure that the 12-V supply voltage and the system supply voltage (5 V or 3.3 V) are within their operating limits before the controller starts. The output driver circuits include 2-A drivers with an internal 8-V gate-drive voltage regulator.

The TPS5210 is available in both a 28-pin SOIC and 28-pin PowerPad package.

■ Check box 12 for a datasheet and app note.

Product features

- ± 1 -percent reference over full operating temperature range
- Synchronous Rectifier Driver > 90 percent efficiency
- 30-V rated floating high-side driver
- Programmable output voltage range of 1.3 V to 3.5 V
- User Adjustable Hysteretic Controller
- Droop compensation
- Adjustable overcurrent protection
- Characterized for operation from 0° C to 125° C

Suggested resale price

Quoted per device in quantities of 1,000

TPS5210DW: \$2.33

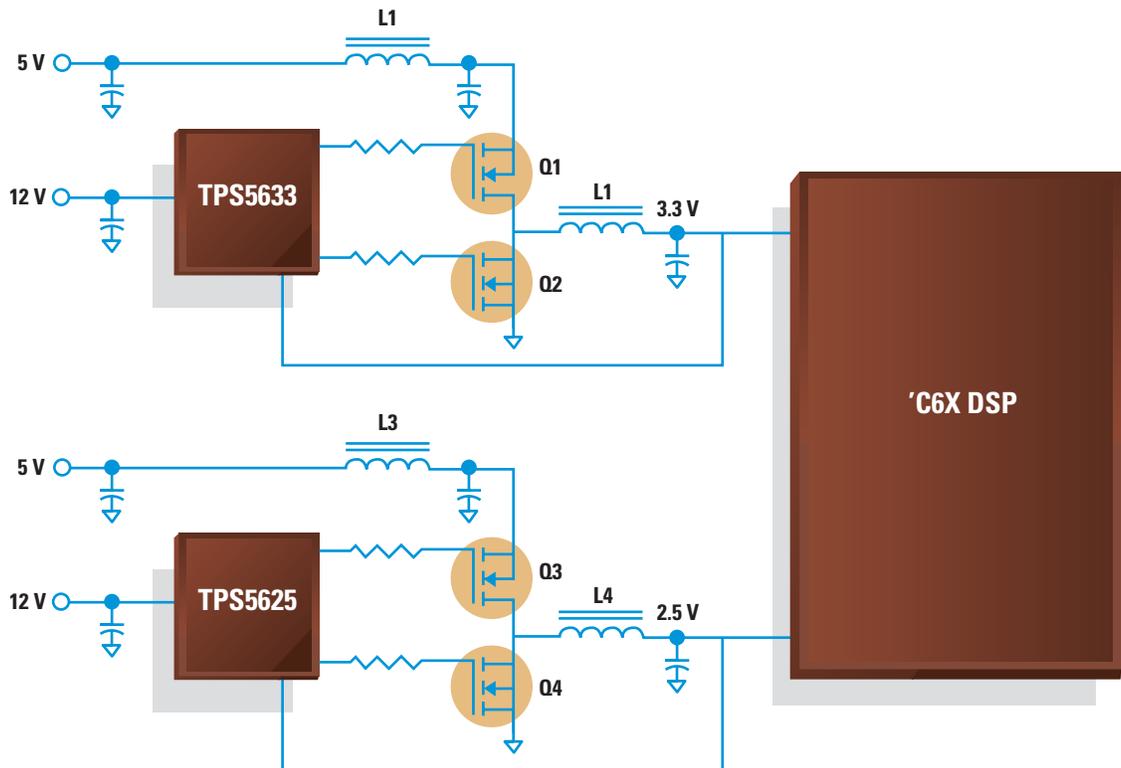
Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

PROCESSOR POWER

Product features

- ± 1 -percent reference over full operating temperature range
- Synchronous rectifier driver
- Four fixed output voltage options
- User adjustable hysteretic controller
- Low supply current... 3-mA typ
- Lossless Current Sensing
- Characterized for operation from 0° C to 125° C



Supply controllers deliver performance

With the onset of the digital revolution, DSPs are becoming prominent in a large number of high performance applications. The TPS56xx family of Synchronous Buck Hysteretic Regulator Controllers address the rapidly transitioning current demands associated with these applications.

This is accomplished by using a fast hysteretic controller with user adjustable hysteresis that responds within 250 ns of any change in load requirements to dramatically reduce overshoot and undershoot caused by the load transients. A resistor divider internally sets the output voltage with an accuracy of ± 1 percent over the full operating temperature range. Overcurrent shutdown and crossover protec-

A resistor divider internally sets the output voltage with an accuracy of ± 1 percent over the full operating temperature range.

tion are provided for the output drivers to eliminate the possibility of destructive faults in the output FETs. The output voltage is monitored to provide a Power Good signal and overvoltage protections. Power Good will go low if the output voltage drops below 93 percent of nominal, and the output drivers will be latched off if the output voltage rises 15 percent

above nominal. Additionally, the TPS56xx family has inhibit and undervoltage lockout features to assure that the 12-V supply voltage and the system supply voltage (5 V or 3.3 V) are within proper operating range before the controller starts.

The controller includes 2-A rated drivers and an internal 8-V drive regulator that can easily provide sufficient power for high-performing DSPs. Output voltages available include 1.5 V (TPS5615), 1.8 V (TPS5618), 2.5 V (TPS5625) and 3.3 V (TPS5633).

The TPS56xx family is available in a 28-pin TSSOP PowerPad package. An EVM with a reference design is available.

■ **Check box 13** for a datasheet and user's guide.

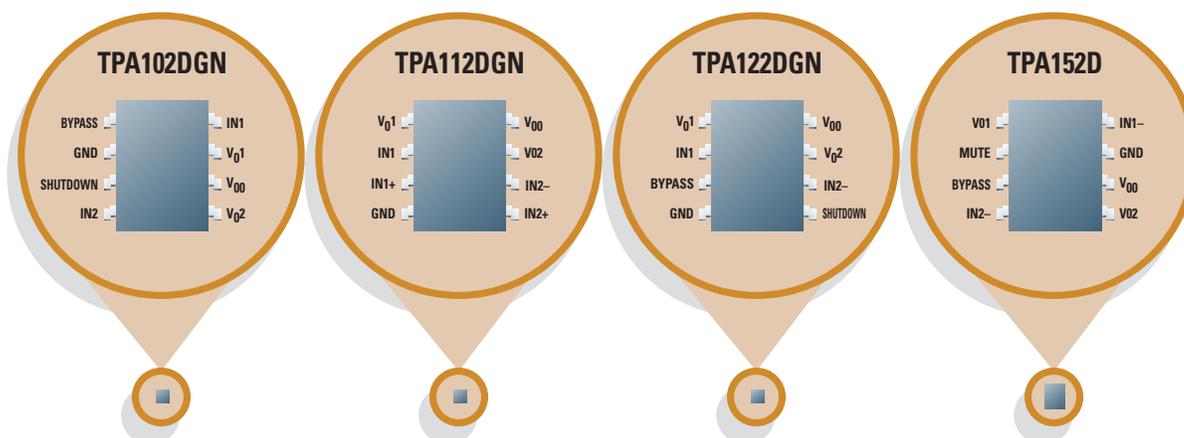
Suggested resale price

Quoted per device in minimum quantities of 1,000

TPS56xx:	\$2.20
TPS5616:	1.5 V
TPS5618:	1.8 V
TPS5625:	2.5 V
TPS5633:	3.3 V

For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3237

AUDIO POWER AMPLIFIERS



Low-voltage audio power amp family

The latest family in TI's broad line of linear audio power amplifiers (APAs) includes the TPA102, TPA112, TPA122 and TPA152.

All four devices are designed for stereo headphone applications in portable equipment including notebook computers, voice recorders and CD players.

Each device features a different pinout providing maximum versatility in any layout. In addition, the TPA152, TPA102, and TPA122 have mid-rail generator circuitry that

Design tools

Hardware EVMs and Reference Designs

■ www.ti.com/sc/docs/msp/tools/audio.htm

Power Analysis Program

■ www.ti.com/sc/docs/msp/pran/audio.htm

minimizes component count by internally biasing the reference voltage. The need for an external voltage divider is eliminated to save time, board space and money.

The TPA152 is a hi-fi device that delivers 75 mW to a 32- Ω load with less than 0.01 percent THD+N across the entire audio frequency band. Its hi-fi quality is ideal in output buffer applica-

tions for audio CODECs in PCs as well as headphone driver sockets.

Extensive hardware and software support tools are available for all TI APAs. TPA1x2 EVMs and other design tools can be ordered or

downloaded from TI's web site.

The TPA102, TPA112 and TPA122 are available in both 8-pin MSOP packages. The TPA112, TPA122, and TPA152 are available in 8-pin SOIC packages.

■ **Check box 14** for a datasheet.

Product features

- 150-mW stereo output drive
- Internal mid-rail generator
- Depop circuitry
- Ultra small MSOP packaging
- Extensive support tools
- Characterized for operation from -40°C to 85°C

Audio power amplifier selection guide

Device	Description	THD+N (%)	VCC/VDD (V)		ICC/IDD (mA)	PSRR (dB, 1 kHz)	Shutdown control	Packages
		typ	min	max				
TPA102	150 mW stereo, SE	0.1	2.5	5.5	1.5	76	✓	8-pin MSOP
TPA112	150 mW stereo, SE	0.1	2.5	5.5	1.5	76	✓	8-pin SOIC/MSOP
TPA122	150 mW stereo, SE	0.1	2.5	5.5	1.5	76	✓	8-pin SOIC/MSOP
TPA152	75 mW stereo, SE	0.005	2	5.5	5.5	81		8-pin SOIC

Suggested resale price

Quoted per device in quantities of 1,000

TPA102DGN: \$0.64

TPA112D: \$0.50

TPA112DGN: \$0.64

TPA122D: \$0.50

TPA122DGN: \$0.64

TPA152D: \$0.77

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

IN BRIEF

Product features

- 50-mA output for low-power applications
- Five fixed-voltage options of 3.0 V, 3.2 V, 3.3 V, 3.8 V and 5.0 V
- Low dropout voltage, typically 120 mV, full load
- Standby mode reduces supply current to < 1 μ A
- Characterized for operation from -40° C to 125° C

Suggested resale price

TPS76030DBVR:
TPS76032DBVR:
TPS76033DBVR:
TPS76038DBVR:
TPS76050DBVR:
 \$0.36

Product features

- Over-voltage protection
- Under-voltage protection
- Power-Good indication
- Short-circuit turn-on protection
- Internal control debounce: 38 ms
- Input noise deglitching
- Wide supply voltage range: 4 V to 15 V

Suggested resale price

TPS5510D: \$0.52
TPS5511D: \$0.52

SOT-23 50-mA low-dropout regulator

The TPS760xx family of low dropout voltage regulators provides the correct combination of low-voltage options, small package size and efficient operation for low-power portable and handheld applications. The new regulators are built with a proprietary PMOS process that yields outstanding performance in specifications critical to battery-powered operation. Dropout voltage, a key concern in battery-powered applications, is only 180 mV maximum at the full 50-mA output limit. Supply current is 1.2 mA under full load conditions and just 130 μ A under no

TPS760xx family at a glance

Device	Voltage	Package	1K Price
TPS76030DBVR	3.0 V	SOT-23	\$0.36
TPS76032DBVR	3.2 V	SOT-23	\$0.36
TPS76033DBVR	3.3 V	SOT-23	\$0.36
TPS76038DBVR	3.8 V	SOT-23	\$0.36
TPS76050DBVR	5.0 V	SOT-23	\$0.36

load. Low dropout and supply current are critical for promoting longer useful battery life. When circuit operation is not required, power to operate these regulators may be further reduced to 1 μ A by using a logic enable to place the devices in a standby mode. A wide input voltage range of up to 16 V adds to the design flexibility of the devices.

- **Check box 15** for a datasheet.

Typical applications

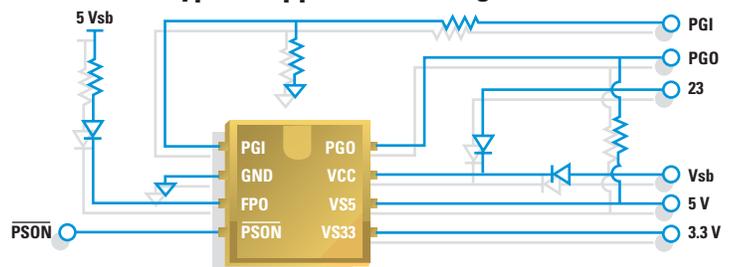
The TPS760xx family was developed for today's low-power systems and is especially useful in these applications:

- Cellular phones and other portable communications
- Post regulation in switch-mode power supplies
- Instrumentation
- Laptops
- PDAs
- Other personal electronics

3-channel power supply supervisors for desktop PC

The TPS5510 and '5511 are 3-channel power supply supervisors designed to minimize external components required for personal computer switching power supply systems. Combining basic supply voltage supervision and protection circuits in a single chip, these devices reduce PCB space as well as increase system reliability. Features of the TPS5510/11 include:

- Over-voltage protection and lock-out for 12 V, 5 V and 3.3 V
- Under-voltage protection and lock-out for 5 V and 3.3 V
- Short-circuit turn-on protection
- Power-good indication

Typical application using TPS5510

- Remote ON/OFF control with a 38-ms de-bounce
- 73- μ s width noise de-glitches for all input pins
- Wide supply voltage range of 4 V to 15 V

The short-circuit turn-on protection acts to shut the system down within 75-ms of operation if it detects a short-circuit at the output, thereby

preventing damage to the system. The noise de-glitches at the input pins help to filter and eliminate the effects of noise at the input end.

Both devices are characterized for operation from -40° C to 125° C and they are available in 8-pin SOIC and PDIP packages.

- **Check box 16** for a datasheet.

E V M K I T S

Audio Power Amp

Plug-n-Play EVM kit	Base platform	\$225.00
TPA4860	Plug-n-Play module	\$50.00
TPA4861	Plug-n-Play module	\$50.00
TPA0102PWP	Plug-n-Play module	\$70.00
TPA0103	Plug-n-Play module	\$70.00
TPA1517NE	Plug-n-Play module	\$70.00
TPA1517DWP	Plug-n-Play module	\$70.00
MIC/MIXER	Plug-n-Play module	\$70.00
DC/DC Converter	Plug-n-Play module	\$70.00
TPA102	Plug-n-Play module	\$50.00
TPA112	Plug-n-Play module	\$50.00
TPA122	Plug-n-Play module	\$50.00
TPA0202	Plug-n-Play module	\$50.00
TPA302	Plug-n-Play module	\$50.00
TPA301	Plug-n-Play module	\$50.00
TPA311	Plug-n-Play module	\$50.00
TPA311	Plug-n-Play module	\$50.00
TPA152	Plug-n-Play module	\$50.00
TPA005D02	Class D module	\$100.00

Power Management

TPS2014	PCMCIA distribution switch	\$0.00
TPS9104	Cellphone P/S with audio PAs	\$50.00
TPS6735	5 V, 200 mA inverting dc-dc converter	\$50.00
TL5001EVM-087	5 V to 3.3 V, 3-Amp buck converter	\$75.00
TL5001EVM-089	9 V to 3.3 V, 3-Amp synchronous-buck converter	\$85.00
TL5001EVM-097	9 V to 5/3.3 V, 2.6-Amp buck converter	\$45.00
TL5001EVM-101	5 V to 3.3 V, 3-Amp buck converter	\$50.00
TL5001EVM-102	5 V to 2.5 V, 3-Amp buck converter	\$50.00
TL5001EVM-103	5 V to 1.8 V, 3-Amp buck converter	\$50.00
TPS5633EVM-104	5 V-to-3.3 V, 8-A Synchronous-buck converter	\$60.00
TPS5625EVM-105	5 V-to-2.5 V, 8-A Synchronous-buck converter	\$60.00
TPS5618EVM-106	5 V-to-1.8 V, 8-A Synchronous-buck converter	\$60.00
TPS5615EVM-115	5 V-to-1.5 V, 8-A Synchronous-buck converter	\$60.00

DSP

Audio Power Amp

Plug-n-Play EVM kit	Base platform	\$225.00
TPA4860	Plug-n-Play module	\$50.00
TPA4861	Plug-n-Play module	\$50.00
TPA0102PWP	Plug-n-Play module	\$70.00
TPA0103	Plug-n-Play module	\$70.00
TPA1517NE	Plug-n-Play module	\$70.00
TPA1517DWP	Plug-n-Play module	\$70.00
MIC/MIXER	Plug-n-Play module	\$70.00
DC/DC Converter	Plug-n-Play module	\$70.00
TPA102	Plug-n-Play module	\$50.00
TPA112	Plug-n-Play module	\$50.00
TPA122	Plug-n-Play module	\$50.00
TPA0202	Plug-n-Play module	\$50.00
TPA302	Plug-n-Play module	\$50.00
TPA301	Plug-n-Play module	\$50.00
TPA311	Plug-n-Play module	\$50.00
TPA311	Plug-n-Play module	\$50.00
TPA152	Plug-n-Play module	\$50.00
TPA005D02	Class D module	\$100.00

Power Management

TPS2014	PCMCIA distribution switch	\$0.00
TPS9104	Cellphone P/S with audio PAs	\$50.00
TPS6735	5 V, 200 mA inverting dc-dc converter	\$50.00
TL5001EVM-087	5 V to 3.3 V, 3-Amp buck converter	\$75.00
TL5001EVM-089	9 V to 3.3 V, 3-Amp synchronous-buck converter	\$85.00
TL5001EVM-097	9 V to 5/3.3 V, 2.6-Amp buck converter	\$45.00
TL5001EVM-101	5 V to 3.3 V, 3-Amp buck converter	\$50.00
TL5001EVM-102	5 V to 2.5 V, 3-Amp buck converter	\$50.00
TL5001EVM-103	5 V to 1.8 V, 3-Amp buck converter	\$50.00
TPS5633EVM-104	5 V-to-3.3 V, 8-A Synchronous-buck converter	\$60.00
TPS5625EVM-105	5 V-to-2.5 V, 8-A Synchronous-buck converter	\$60.00
TPS5618EVM-106	5 V-to-1.8 V, 8-A Synchronous-buck converter	\$60.00
TPS5615EVM-115	5 V-to-1.5 V, 8-A Synchronous-buck converter	\$60.00

DSP

Each EVM kit contains a fully-assembled evaluation board, data sheet, and a User's Guide for the evaluation board. Some kits also include applications notes, plus necessary software, cables and connectors. To order any of the EVM kits listed, please call our toll-free order desk number **1-800-477-8924, ext. 5800.**

TI Worldwide Technical Support

Internet

TI Semiconductor Home Page

<http://www.ti.com/sc>

TI Distributors

<http://www.ti.com/sc/docs/distmenu.htm>

Product Information Centers

Americas

Phone +1(972) 644-5580
Fax +1(972) 480-7800
Email sc-infomaster@ti.com

Europe, Middle East, and Africa

Phone
Deutsch +49-(0) 8161 80 3311
English +44-(0) 1604 66 3399
Francais +33-(0) 1-30 70 11 64
Italiano +33-(0) 1-30 70 11 67
Fax +33-(0) 1-30-70 10 32
Email epic@ti.com

Japan

Phone
International +81-3-3457-0972
Domestic 0120-81-0026
Fax
International +81-3-3457-1259
Domestic 0120-81-0036
Email pic-japan@ti.com

ANALOG & MIXED-SIGNAL

Showcase

Editor	Nancy Waters
Design	Stan Hulen Design
Editorial Board	David Slatter Charles Wray Rob Saunier Angela Bailey

Mixed-Signal & Analog Products Showcase is a publication of Texas Instruments.

© 1998 Texas Instruments Incorporated

Windows is a registered trademark of Microsoft Corporation.

Power+ is a trademark of Texas Instruments Incorporated.

Dolby and Dolby Surround are trademarks of Dolby Laboratories, Inc.



Asia

Phone

International	+886-2-23786800	
Domestic	<u>Local Access Code</u>	<u>TI Number</u>
Australia	1-800-881-011	-800-800-1450
China	10811	-800-800-1450
Hong Kong	800-96-1111	-800-800-1450
India	000-117	-800-800-1450
Indonesia	001-801-10	-800-800-1450
Korea	080-551-2804	-
Malaysia	1-800-800-011	-800-800-1450
New Zealand	000-911	-800-800-1450
Philippines	105-11	-800-800-1450
Singapore	800-0111-111	-800-800-1450
Taiwan	080-006800	-
Thailand	0019-991-1111	-800-800-1450

Fax

886-2-2378-6808

Email

tiasia@ti.com

Important Notice: The products and services of Texas Instruments and its subsidiaries described herein are sold subject to TI's standard terms and conditions of sale. Customers are advised to obtain the most current and complete information about TI products and services before placing orders. TI assumes no liability for applications assistance, customer's applications or product designs, software performance, or infringement of patents. The publication of information regarding any other company's products or services does not constitute TI's approval, warranty or endorsement thereof.

© 1998 Texas Instruments Incorporated

Printed in the USA at ColorDynamics, Allen, Texas **B100598**

Texas Instruments Incorporated

P.O. Box 172228
Denver, Colorado 80217-9271

Forwarding and return
postage guaranteed.
Address correction requested.

BULK RATE
U.S. POSTAGE
PAID
DALLAS, TEXAS
PERMIT NO. 2758