

## VIDEO GRAPHICS

## Product Features

- Super-fast 3-D performance
- No compromise 2-D functionality and performance
- Advanced 3-D rendering for immersive gameplay
- Extensive software drivers for accelerated 3-D applications
- Characterized for operation from 0° - 70° C

## TI raises the bar on 3-D graphics performance with the TVP4010

The TVP4010 high-performance 3-D graphics processor combines workstation-class 3-D graphics acceleration and state of the art 2-D performance in a single chip.

All 3-D rendering operations are accelerated by the TVP4010 including Gouraud shading, depth buffering, texture mapping and alpha blending. Implemented around a scalable memory architecture, the TVP4010 reduces the cost and complexity of delivering high-performance 3-D graphics within a windowing environment making it ideal for a wide range of graphics products from PC boards to workstation accelerators. The device, which utilizes industry-leading PERMEDIA™ technology, is the

first in a line of products that will provide cost-effective, high performance 3D for mainstream consumer and commercial PC applications.

The system solution combines the TVP4010 with the TVP3026 RAMDAC. The TVP3026 is a cost-optimized 64-bit RAMDAC that features resolutions up to 1600x1200 with a 75 Hz refresh rates.

The TVP4010 delivers 42 Million textured pixels per second and 800K textured polygons per second. It has a 2 Gbyte per second block fill rate, and 120MB per second texture download rate. It also supports 30 frames per second of scaled, filtered video playback.

### System Details

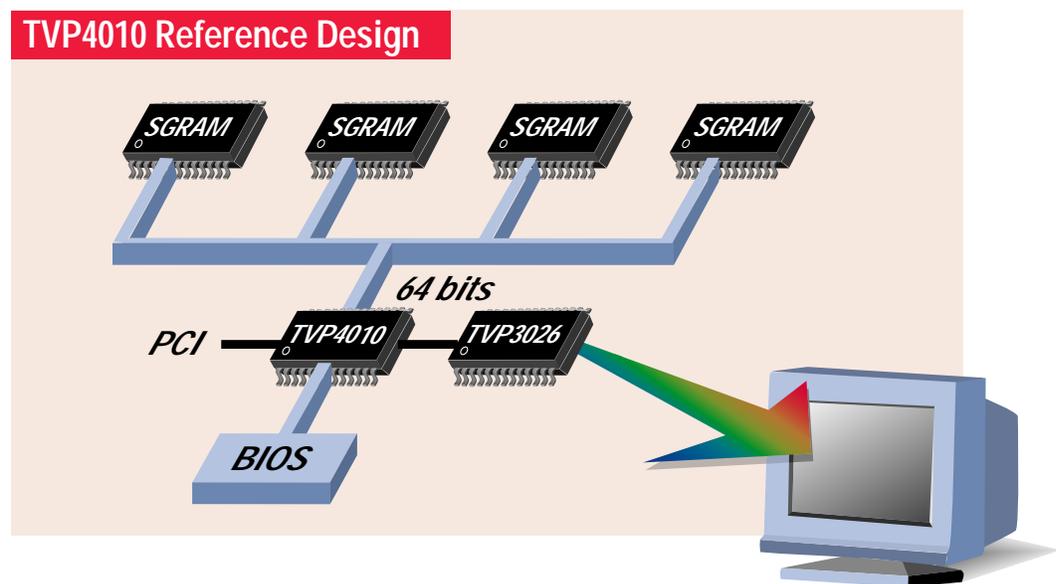
- ▼ 3.3-V supply, 2.5 W
- ▼ 256-pin BGA package
- ▼ Internal video timing generator
- ▼ Fast 32-bit LUT-DAC port
- ▼ ROM interface
- ▼ VESA DPMS and DDC

■ **Check box 01** for more information on the TVP4010 and TVP3026.

### Suggested resale price

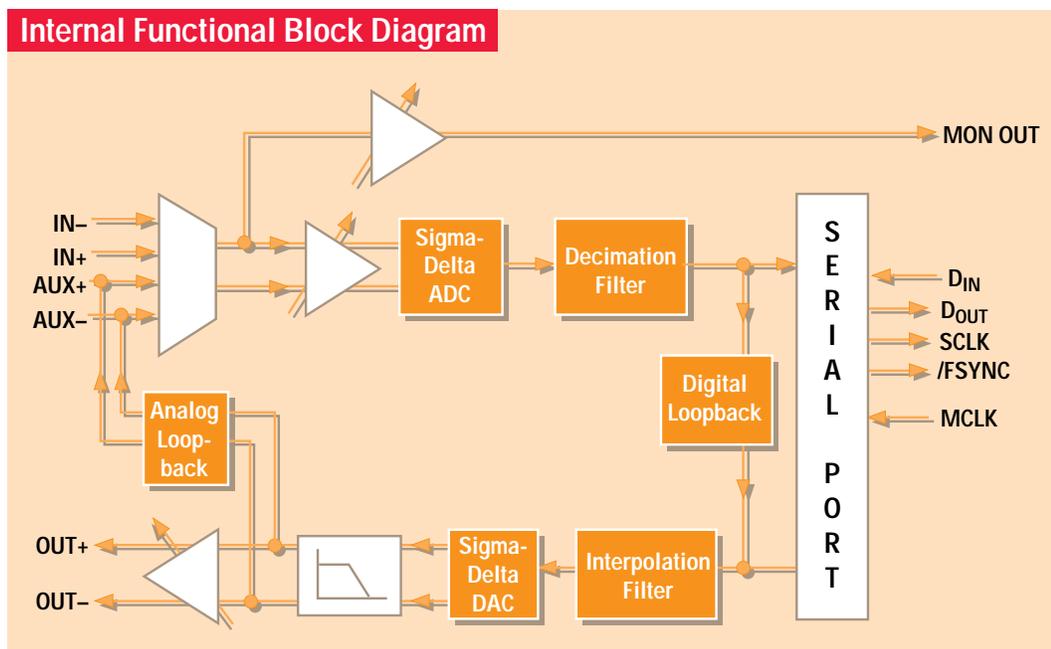
Quoted per device in quantities of 1,000

■ TVP4010GFN: \$38.12



## DATA CONVERTERS

## 16-bit Sigma Delta Analog Interface Circuit



The TLC320AD50 16-bit analog interface circuit (AIC) is a versatile analog front end for business audio and modem applications. It provides high resolution signal conversion using an oversampling sigma delta technique. The 'AD50 has internal 64 X oversampling on the ADC and 256 X oversampling on the DAC.

Differential outputs on the 'AD50 can drive a 600  $\Omega$  differential load. It offers master/slave capability with support for up to three slaves,

allowing this device to be used in multiple AIC applications such as voice-enabled modems. Additional applications include industrial process control, noise cancellation/suppression, and a variety of DSP systems requiring an interface to the analog world. With a 3-V interface and low power dissipation of only 120 mW typical, this device is also ideal for battery operated equipment and interfacing to 3-V DSPs.

This device provides a glueless interface via serial port

to the TMS320 family of TI Digital Signal Processors as well as to other industry standard DSPs. The 'AD50 offers the following options: selectable conversion rate, reset, power-down, communications protocol, serial clock rate, gain control and system test mode (digital and analog loopback test mode).

The device has a typical signal-to-total harmonic distortion (THD) of 90 dB on the ADC and the DAC. Both ADC and DAC offer 89 dB typical signal-to-noise ratio (SNR).

The TLC320AD50 device is available in 28-pin SOIC (DW) and 48-pin TQFP (PT) packages.

**Check box 02** for a datasheet.

## Product Features

- Master/Slave Mode (supports up to 3 slaves)
- Differential output drives 600  $\Omega$  load
- Single 5-V supply or 5 V analog and 3 V digital
- Power-down mode to 7.5 mW
- Input and output gain control
- Glueless DSP interface
- Characterized for operation from 0°C to 70°C

## Key Applications

- ▼ Modems: V.34+, DSVD, telephony
- ▼ PCMCIA fax modems
- ▼ DSP analog interface
- ▼ Noise suppression/cancellation
- ▼ Acoustical signal processing
- ▼ General Purpose 16-bit signal processing
- ▼ Industrial process control

## Suggested resale price

Quoted per device in quantities of 1,000

TLC320AD50CPT:  
\$5.30

TLC320AD50CDW:  
\$4.30

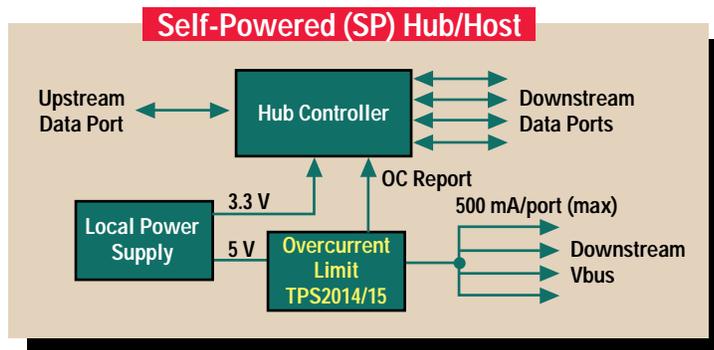
Read Showcase online and download datasheets at:

[www.ti.com/sc/showcase](http://www.ti.com/sc/showcase)

## Product Features

- Meets USB voltage regulation requirements
- Overcurrent logic response output
- 4.0 V to 5.5 V operating range (7 V max)
- Low  $r_{DS(on)}$ , 95 m $\Omega$  at 5 V
- Short-circuit and thermal protection
- Characterized for operation from 0°C to 85°C

# Power Distribution Devices Meet USB Specification



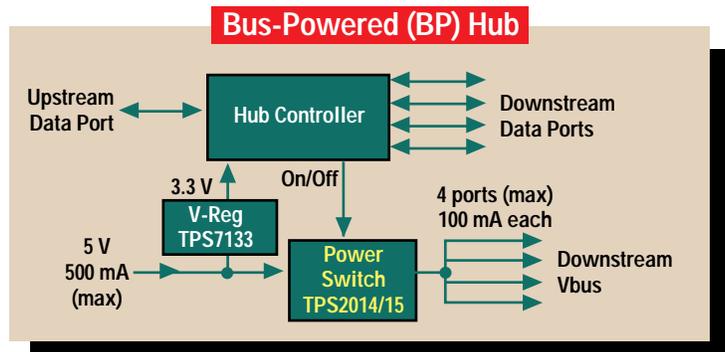
The TPS2014 and TPS2015 power-distribution devices provide an integrated power-management solution for the Universal Serial Bus (USB) voltage-bus interface. They feature the over-current response logic output, required in a Host controller by the USB specification. These devices include all of the discrete power MOSFETs, a logic section, current limiting, thermal protection, an undervoltage lockout, and an over-current logic response. They can be used as a general power distribution switch as well as a power management device for the USB interface. The current limiting and thermal shutdown features eliminate the need for discrete components such as fuses thereby providing maintenance free fault protection. Current limit reporting helps the system isolate a power fault to a defective port in a USB application. These features reduce compo-

nent count and improve system reliability, thus reducing repair costs and frequency.

The TPS2014 and TPS2015, designed for USB applications, are enhanced versions of Texas Instruments TPS2010 family of power distribution switches.

while fully meeting the power regulation requirements of the USB specification.

The enhancements made in the TPS2014 and TPS2015 include an undervoltage lockout (UVLO), which ensures the device will power up in the off state, and an over-current logic output, which enables the device to report faults on a power bus back to a host controller. These new features coupled with controlled switching times, which minimize the current surges during switching, makes them ideal for USB power distribution applications. The TPS2014 and TPS2015 are available in a 8-pin SOIC package.



Like their predecessors, the TPS2014 and TPS2015 do not need a  $V_{DD}$  connection. Bias current is derived from the input pins. This power distribution switch design optimizes cost and  $r_{DS(on)}$  performance,

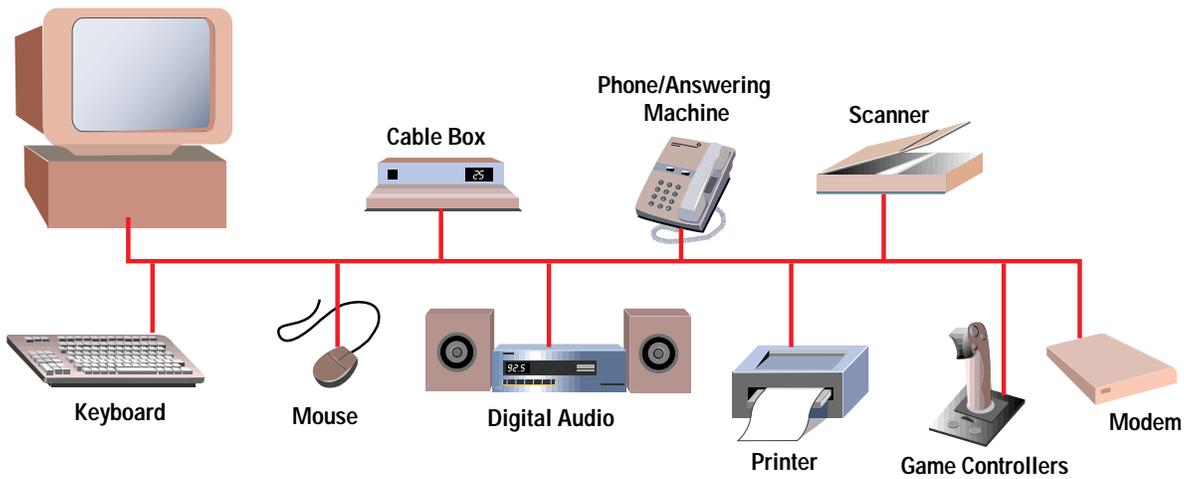
■ **Check Box 03** for samples and datasheets.

## Suggested resale price

Quoted per device in quantities of 1,000

- TPS2014D: \$0.94
- TPS2015D: \$0.94

S U P P L Y



**Universal Serial Bus Power Requirements**

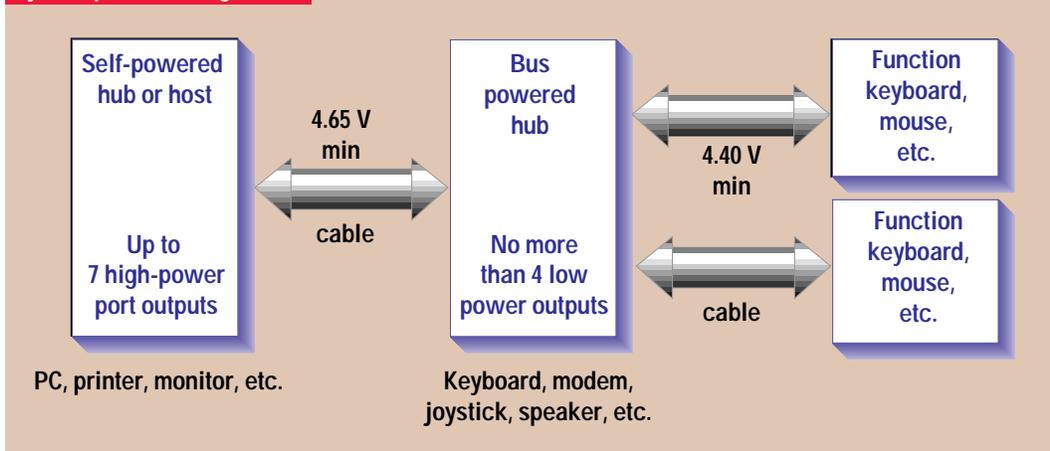
The Universal Serial Bus is a connectivity and data transmission protocol introduced to the personal computer market to improve the existing serial (RS-232) and parallel interfaces. This 12 Mb/s four wire interface features many advances over its predecessors: appliance type system, hot plug-and-play, automatic device recognition, automatic device driver unloading. USB has been conceived as a truly user friendly interface, where you would no longer have to open a PC or install device drivers

when you expand your system.

Not only is USB a new data transmission protocol, this interface is also designed to distribute power. The USB system is broken down into several categories for the express purpose of power management. The basic device types are: Host, Self-Power Hub, Bus-Powered Hub, High-power Bus-Powered Function, Low-power Bus-Powered Function. Every USB system will require a Host device to manage the system, and it will be able to communicate with up to 127 other devices if the system is properly configured.

In order to distribute power effectively USB devices must be designed to meet all of the specifications voltage drop and droop requirements. The Host or Self-powered hub should be designed to supply no less than 4.65 V to the voltage-bus at 500 mA per port. This voltage will be fed to another downstream device across a 5m cable (max). The Bus-powered hub which is powered by the 4.65 V must deliver no less 4.40 V to a maximum of 4 downstream ports at 100 mA per port.

**System power configuration**



Read Showcase online and download datasheets at:

[www.ti.com/sc/showcase](http://www.ti.com/sc/showcase)

## Product Features

- Complete cell phone power supply system
- Three independent LDOs
- 100 mA output with 100 mV dropout
- Microprocessor reset with 250 ms delay
- 10 mA charge pump driver
- Shutdown mode: 1  $\mu$ A
- Operating temperature of  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$

# Single-chip cellphone baseband power supply

The TPS9111 integrates a complete power supply for the baseband portion of a cellular phone handset. Power supply functions included are three programmable low-dropout regulators, a microprocessor supply monitor and reset, a charge pump and a 1.185 V bandgap reference. The high level of integration of the TPS9111 helps reduce design cycle time, lowers system costs, improves reliability and saves board space.

This device offers flexibility of design and operation that is not found in competitive products. Examples of this flexibility are seen in the operation of the three low dropout regulators. The regulators' outputs are programmable for 3.0 V or 3.3 V and may be powered up together or enabled independently for more

effective power management. All three of the regulators are rated at 100 mA. The PMOS design used in the regulators provides for very low dropout voltages of only 200 mV maximum and an operating quiescent current to only 120  $\mu$ A maximum; standby current is less than 1  $\mu$ A.

The TPS9111 also includes a microprocessor reset that generates a logic low on start up or when the output of the regulator falls below the reset trip threshold. The reset output remains in a logic low state for 250 ms after the regulated output reaches its normal range. The on-board charge pump driver may be configured as either a voltage doubler or inverter. In the inverting configuration, the charge pump can power an LCD or provide gate bias for a GaAs power amplifier.

A 5-V supply for flash memory programming, or for powering the Subscriber Identity Module (SIM) in GSM applications, can be achieved using the doubler configuration and an external LDO. It is also self-protected against operation in under-voltage and over-temperature conditions.

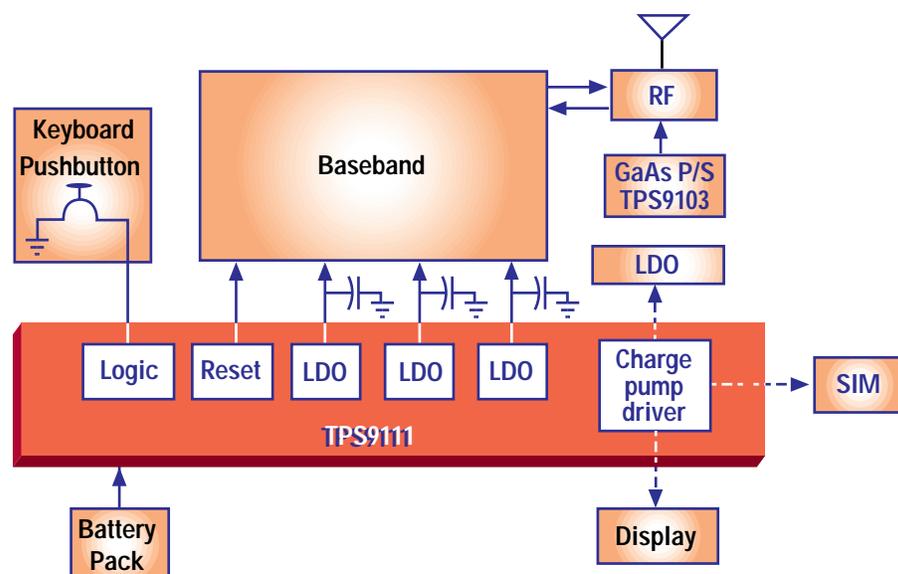
The device has the same power supply functions as the Texas Instruments TPS9104. However, in addition to a complete baseband power supply, the TPS9104 adds amplifiers on chip, including ringer and speaker power amplifiers capable of driving 32  $\Omega$  speakers and a low noise microphone amplifier. The TPS9111 is available in a 28-pin TSSOP package.

■ **Check box 04** for datasheets.

## Suggested resale price

Quoted per device in quantities of 1,000

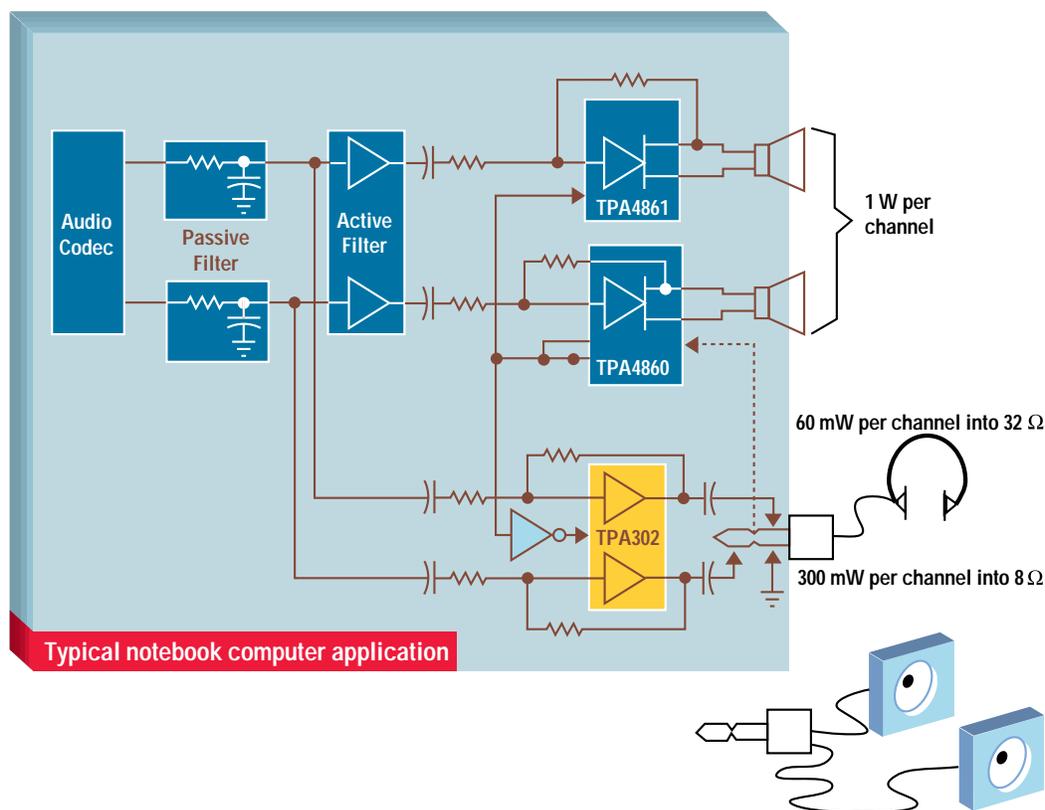
■ TPS9111PWLE:  
\$2.39



For more information, call 1-800-477-8924, ext. 3221

## AUDIO POWER AMPLIFIERS

## 300 mW stereo audio power amplifier offers 0.06% THD+N



The TPA302 is a stereo audio power amplifier specifically designed to drive 32  $\Omega$  headphones and small 8  $\Omega$  unpowered speakers. The TPA302 is capable of delivering 250 mW of continuous average power into an 8  $\Omega$  load at 0.06% THD+N or up to 300 mW at 1% THD+N. For headphone applications, the TPA302 delivers 60 mW of continuous average power with less than 0.06% THD+N.

The TPA302 requires only 5 mA (Max) of supply current.

It offers shutdown control for extending battery life. In shutdown mode the supply current is less than 1  $\mu$ A and along with 5 V and 3.3 V operation, make the device ideal for battery powered low voltage applications. The TPA302 also provides internal short circuit and thermal protection.

In notebook computer applications, the designer now has a complete stereo audio solution available from Texas Instruments.

The TPA302, along with the TPA4860 and TPA4861, offers stereo speaker and headphone drive. This gives the designer high quality sound from a PC power supply, as shown above. The TPA302 is available in 8-pin SOIC.

■ **Check box 05** for datasheets.

### Product Features

- High output power
  - 300 mW into 8  $\Omega$  @ 5 V
  - 80 mW into 32  $\Omega$  @ 5 V
- Ultra-low Distortion
  - <0.06% THD+N for 250 mW, 8  $\Omega$ , 5 V
  - <0.06% THD+N for 60 mW, 32  $\Omega$ , 5 V
- Low supply current...5 mA (Max)
- Shutdown Mode <1  $\mu$ A
- Short Circuit and Thermal Protection
- Specified at 3.3 V and 5 V
- Characterized for operation from  $-20^{\circ}\text{C}$  to  $85^{\circ}\text{C}$

### Suggested resale price

Quoted per device in quantities of 1,000

TPA302D: \$1.18

**Product Features**

- 25 ns rise/fall times, with 40 ns propagation delay
- 2 A peak output drive current
- 4 V to 14 V normal operating range
- 40 V internal regulator
- Resists latch-up
- 50  $\mu$ A max supply current – inputs high or low
- Characterized for operation from  $-40^{\circ}$  to  $125^{\circ}$ C

**Suggested resale price**

Quoted per device in quantities of 1,000

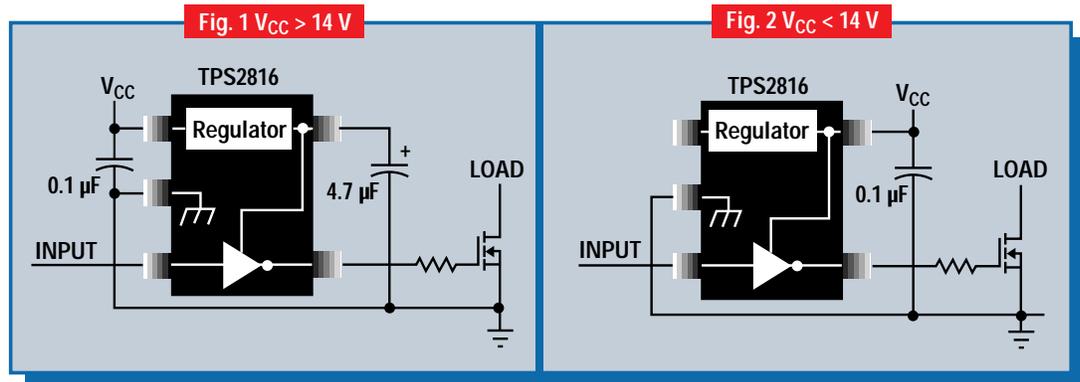
TPS2816DBV: \$0.45

TPS2817DBV: \$0.45

TPS2818DBV: \$0.45

TPS2819DBV: \$0.45

# Single, high-speed MOSFET drivers in SOT-23 packages



The TPS2816 through TPS2819 are low-cost, single-channel, high-speed MOSFET drivers, capable of delivering up to 2 A into highly capacitive loads. These MOSFET drivers follow the performance features of the previously released TPS2811 family of dual-channel drivers, but are single-channel devices in a SOT-23 package.

This family drives 1 nF loads with a maximum 25 ns rise/fall time and a maximum 40 ns propagation delay. The high speed of these devices provides maximum efficiency for high frequency operation. The internal design of these devices inherently minimizes shoot-through currents.

These devices include an internal voltage regulator that allows the 4 V to 14 V operating range to be extended to 40 V, for higher voltage applications. The regulator can power other PWM control circuitry provided the power dissipation requirements do not exceed the SOT-23 package limitations. The regulator input can be left disconnected if not used. Implementations with and without the internal regulator are shown above.

The TPS2816 and TPS2818 are single inverting drivers, and the TPS2817 and TPS2819 are single noninverting drivers. An additional feature in the TPS2816 and TPS2817 is the

implementation of an active pull-up circuit on the input pins. This eliminates the need for the external pull-up when using an open-collector PWM.

Ideally suited for applications such as: off-line power supplies and DC-DC converters up to 1-kW, motor drivers, and relay or solenoid drivers. These devices provide a cost effective solution in a 5-pin SOT-23 package.

■ **Check Box 06** for samples and datasheets.

Device	Function	Internal VREG	Package
TPS2811	Dual inverting	Yes	PDIP, SO, TSSOP
TPS2812	Dual noninverting	Yes	PDIP, SO, TSSOP
TPS2813	One inverting & one noninverting	Yes	PDIP, SO, TSSOP
TPS2814	Dual 2-input AND gate	No	PDIP, SO, TSSOP
TPS2815	Dual 2-input NAND gate	No	PDIP, SO, TSSOP
.....			
TPS2816	Single Inverting, with pull-up Input	Yes	SOT-23
TPS2817	Single Noninverting with pull-up Input	Yes	SOT-23
TPS2818	Single Inverting driver	Yes	SOT-23

OPERATIONAL AMPLIFIERS

# Wide input voltage, high output drive CMOS op amps

The TLV2432 and TLV2442 are a family of wide input voltage, high output drive CMOS operational amplifiers.

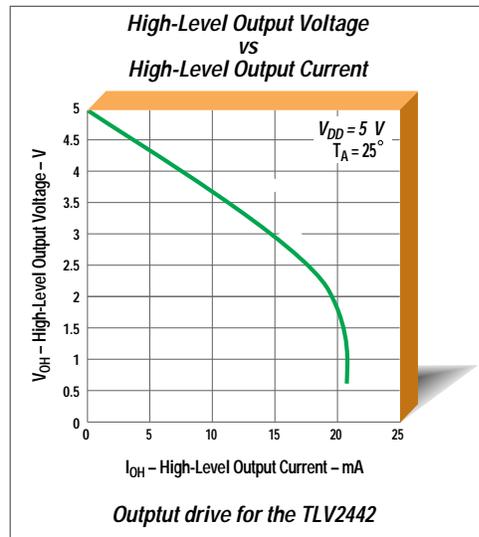
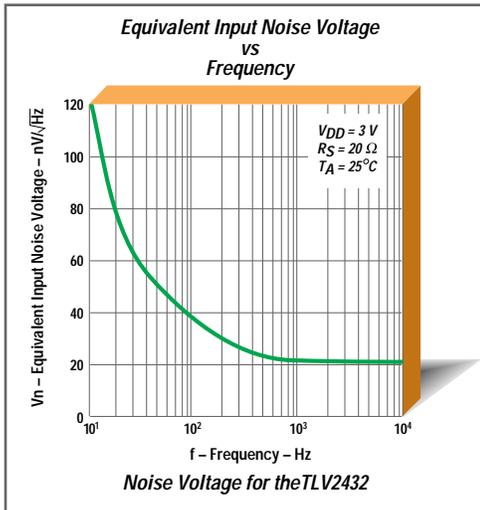
Both devices exhibit rail-to-rail output performance with single or split supplies making them an ideal choice when interfacing directly to Analog-to-Digital Converters (ADCs). The TLV2442 and TLV2432 gives the designer two speed vs. power options. The TLV2432 only requires 98  $\mu\text{A}$  per channel (typ) of supply current and is excellent for battery powered, low voltage applications. Along with micropower operation, the TLV2432 has only 22  $\text{nV}/\sqrt{\text{Hz}}$  ( @ 1 kHz) of input noise voltage.

The TLV2442 offers 1.75 MHz of gain-bandwidth and 1.3  $\text{V}/\mu\text{s}$  slew rate for applications demanding higher speed. This AC performance is obtained at only a cost of 750  $\mu\text{A}$  per channel (typ) of supply current. Tighter input offset voltage grades are available for both devices and offer the user a maximum input offset voltage of only 950  $\mu\text{V}$ . This low input offset voltage coupled with a noise voltage of 18  $\text{nV}/\sqrt{\text{Hz}}$  (TLV2442), offers the designer an amplifier for precision applications. The

common-mode input range has been extended over previous CMOS amplifiers making these devices available for a wider range of applications. This wide input dynamic range makes these amplifiers good choices for interfacing with Digital-to-Analog Converters (DACs). The

TLV2432 and TLV2442 can also drive 600  $\Omega$  loads for telecom applications.

This family of products is ideal for your next generation



Output drive for the TLV2442

applications. The expanded feature set allows engineers more flexibility with their designs. These products are ideal upgrades to the TI TLC27x family of op amps. The TLV24x2 family is characterized at 3 and 5 V and available in 8-pin SOIC and TSSOP packages.

■ **Check box 07** for datasheets.

## Product Features

- Output swing includes both supply rails
- $V_{ICR} \dots @ 5\text{V} = -0.25\text{V to } 4.75\text{V (typ)}$
- 600  $\Omega$  Output Drive
- $V_n \dots 18\text{ nV}/\sqrt{\text{Hz}}$  Typ at 1 kHz (TLV2442)
- $I_{DD} \dots 98\text{ }\mu\text{A}$  per channel typ (TLV2432)
- $V_{IO} \dots 950\text{ }\mu\text{V typ}$  (TLV24x2A)
- Low input bias Current...1 pA typ
- Fully specified over commercial (0°C to 70°C) and industrial (-40°C to 85°C) temperature ranges

## Suggested resale price

Quoted per device in quantities of 1,000

- TLV2432CDR: \$1.06
- TLV2432IDR: \$1.16
- TLV2442CDR: \$1.06
- TLV2442IDR: \$1.16

Device	$I_{DD}$ mA (typ)	$I_{IB}$ pA (typ/max)	$V_{DD}$ V	$V_{IO}$ mV (typ)	$V_{ICR}$ V (typ)	$V_o$ V (typ)	$V_n$ nV/ $\sqrt{\text{Hz}}$ (typ)	GBW MHz (typ)	S/R V/ $\mu\text{s}$ (typ)
TLV2432	0.195	1/150	2.7 to 10	0.3	-0.25 to 2.75	0.02 to 2.98	22	0.5	0.25
TLV2442	1.5	1/150	2.7 to 10	0.3	-0.25 to 2.5	0.02 to 2.98	18	1.75	1.3

All parameters specified at  $V_{DD} = 3\text{V}$

Read Showcase online and download datasheets at:

[www.ti.com/sc/showcase](http://www.ti.com/sc/showcase)

OPERATIONAL AMPLIFIERS

# Single channel self-calibrating op amp

## Product Features

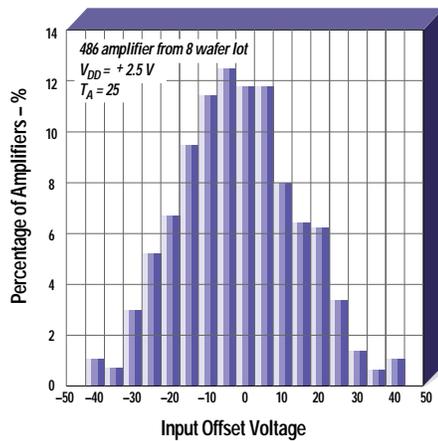
- Self-Cal  $V_{I0}$  40 mV max (TLC4501A)
- Rail-to-rail output voltage swing
- High output drive capability (50 mA)
- 300 ms typical calibration time
- 5-V single supply operation
- Standard pinout
- Operation over commercial (0°C to 70°C) and industrial (-40°C to 85°C) temperature ranges

## Suggested resale price

Quoted per device in quantities of 1,000

- TLC4501CD: \$0.89
- TLC4501ACD: \$1.11
- TLC45011D: \$0.98
- TLC4501AID: \$1.21

Distribution of TLC4501 input offset voltage



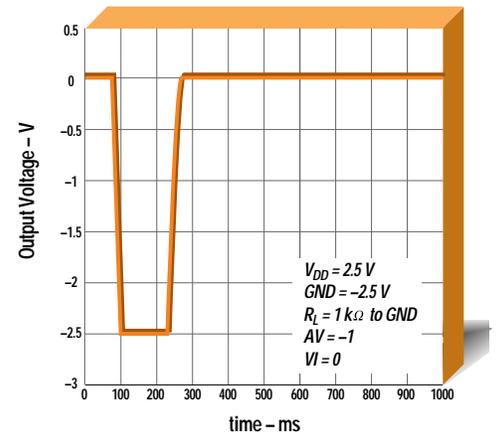
The TLC4501 single-channel operational amplifier utilizes a new digital self-calibrating technique that eliminates many of the worries of designing with traditional precision operational amplifiers. The device uses on-chip digital and analog processing to achieve a precision of 40  $\mu$ V maximum by automatically nulling its input offset voltage during power up. For designers of data acquisition systems, portable digital scales, test and measurement equipment, portable medical systems

and other precision systems, the device offers an appealing alternative to noisy chopper-stabilized op amps and higher-cost precision bipolar op amps. The TLC4501 single-channel op amp uses the same kind of self-calibrating scheme as TI's dual-channel TLC4502, featured in Showcase volume 20.

The TLC4501 calibration technique is identical to the TLC4502, featured in Showcase volume 20.

The TLC4501 offers designers a highly desirable combination of excellent DC precision, low noise (12  $nV/\sqrt{Hz}$ ), high output drive capability and low distortion. Additionally, with a gain bandwidth product of 4.7 MHz (typ) and a slew rate of 2.5 V/ms (typ), the TLC4501 is also a good choice for applications requiring good AC

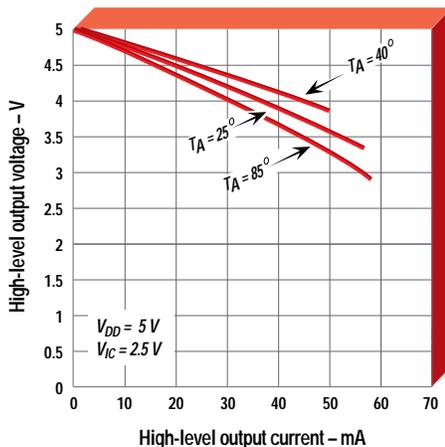
Calibration time at 25°C



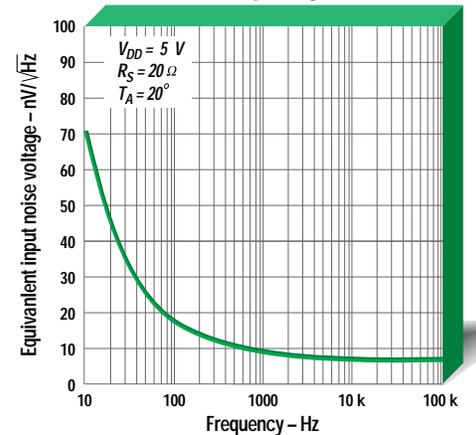
performance. TLC4501 also features rail-to-rail output swing which, combined with high drive, makes it ideal for interfacing with A-D converters. And when designing battery-powered applications, the low supply current (1.25 mA) and 5-V single supply operation makes the TLC4501 an excellent choice. The device is available in 8-pin SOIC packaging.

■ **Check box 08** for datasheets.

High-level output voltage vs High-level output current



Equivalent input noise voltage vs Frequency



For more information, call 1-800-477-8924, ext. 3221

## VOLTAGE REGULATORS

## Adjustable inverting DC-DC converter

The TPS6755 inverting dc-dc converter provides negative supplies up to 200 mA. The device gives power supply designers a simple solution to inverting a positive low voltage input to a obtain a negative output. The device is a current mode pulse width modulator (PWM) with a P-channel MOSFET power switch. The TPS6755 offers a low 1.8 mA supply current, 78% (typical) efficiency, and simple design requirements. These features make it useful in applications requiring small layout areas and battery-saving performance. Typical applications include computer peripherals, hard disk drives and a variety of handheld and portable designs.

The 200 mA negative output voltage is adjustable to between  $-2.7$  and  $-9$  volts, depending on the input voltage level. Minimum input voltage is 2.7 V. The sum of the input voltage and the absolute value of the output voltage may not exceed 11.7 V. A logic enabled

shutdown mode reduces battery drain to just 10  $\mu$ A.

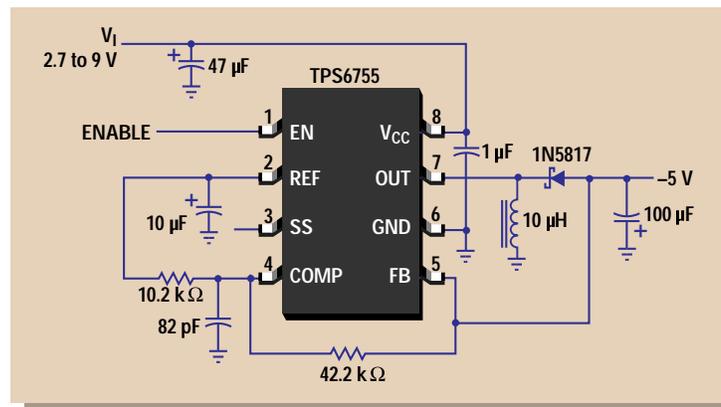
Required external components include a 10 mH inductor, output and input filter capacitors, reference filter capacitor, a Schottky rectifier and two resistors for setting the output voltage, as shown in the diagram below. A 160-kHz oscillator lets you use small surface mount components and simplifies noise filtering techniques.

Soft start, which causes the output voltage to increase at a controlled rate, may be implemented with the addition of one

capacitor. Other features include an internal 1.2 V reference capable of sourcing 125  $\mu$ A to external loads. The TPS6755 also has over-current limiting and an undervoltage lockout that prevents turn-on of the MOSFET power switch during power up.

The TPS6755 is designed to be pin-compatible with the MAX755 inverting PWM regulator and is offered in 8-pin plastic DIP and SOIC packages.

■ **Check box 09** for a datasheet.



## Product Features

- Adjustable negative output @ 200 mA
- 2.7 V to 9 V input range
- 160 kHz current mode PWM controller
- Power down mode 1  $\mu$ A
- 78% typical efficiency
- Operating temperature  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$

## Suggested resale price

Quoted per device in quantities of 1,000

■ TPS6755ID:  
\$1.59

■ TPS6755IP:  
\$1.59

Read Showcase online and download datasheets at:

[www.ti.com/sc/showcase](http://www.ti.com/sc/showcase)