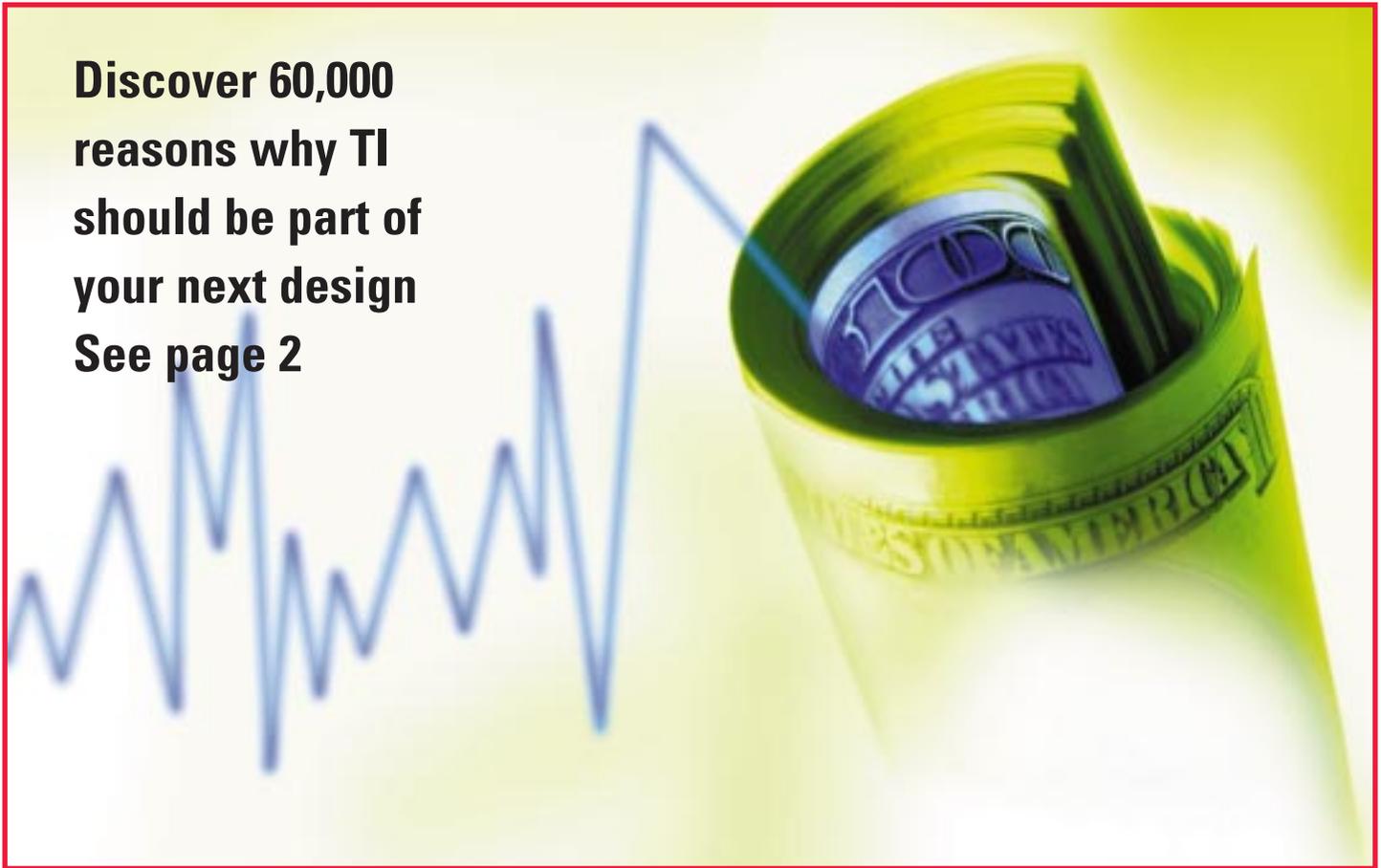


**AUGUST ■ 1998
VOLUME 28**

Showcase

**Discover 60,000
reasons why TI
should be part of
your next design
See page 2**



Inside

■ **Analog Design Challenge —
A chance to win \$60,000**
page 2

■ **Supply Voltage Supervisor and watch-
dog timer**
page 3

■ **Three high-quality stereo audio codecs**
pages 4 - 5

■ **Low-voltage differential signaling
(LVDS) family of devices plus EVM offer**
pages 6 - 7

■ **High-speed xDSL line driver/receiver
offers ultra-low distortion**
page 8

■ **Family of rail-to-rail I/O op amps drive
 ± 90 -mA loads**
page 9

■ **Low-voltage single-supply family of op
amps offers exceptional ac performance**
page 10

■ **Audio power amplifiers with 75-mW
stereo output drive**
page 11

■ **Universal op amp EVM offered with and
without devices attached**
page 12

■ **The industry's fastest 12-bit V_{OUT} DAC
available**

■ **New RF modulator/synthesizer simplifies
the design of IS-136 wireless handsets**
page 14

■ **Ultra-low power MCU - 0.1 μ A sleep mode**
page 15

■ **High-speed low-cost RS-232 interface
devices ideal for PC desktop applications**
page 16

■ **ESD protection at ± 15 -kV in data line
transceivers**
page 17

■ **New Data Transmission Line Circuits
Data Book**
page 18

ANALOG & MIXED SIGNAL

Features

- \$60,000 cash
- Design Challenge CD
- Free samples
- Discounts on EVM

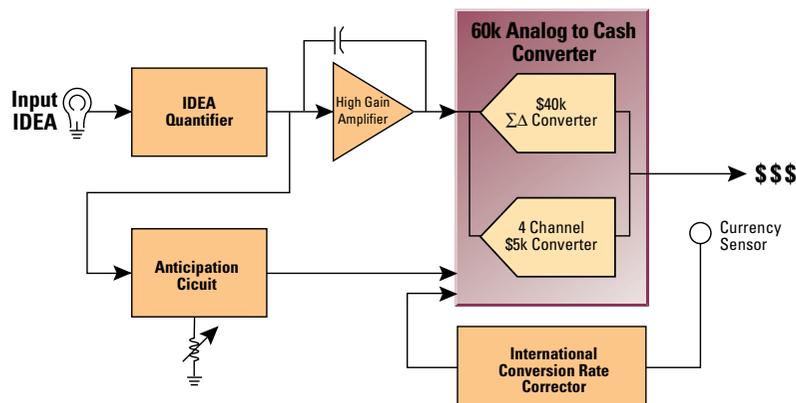
Convert Analog to Cash

The digital world can't function without analog – and we're putting up \$60,000 to prove it. Texas Instruments is awarding a total of \$60,000 in cash for designs that most inventively use our analog and mixed-signal products to address a real-world design challenge. Request your entry kit today and you'll receive TI's Analog Design Challenge CD packed with technical documentation and support information, along with free TI product sample offers and valuable discounts on your next EVM purchase.

The contest is open to anyone with a great idea. Enter on your own or grab a team from work. You'll experience firsthand the comprehensive line of products that made TI the world leader in Analog and Mixed-Signal.

Enter the \$60,000 Analog Design Challenge today! With our extensive design support and full line of analog and mixed-signal devices, the only way you can lose is by not entering .

The Analog Design Challenge is being conducted by CMP Media, Inc., and exclusively sponsored by Texas Instruments Incorporated.



To request an entry kit with complete contest rules:

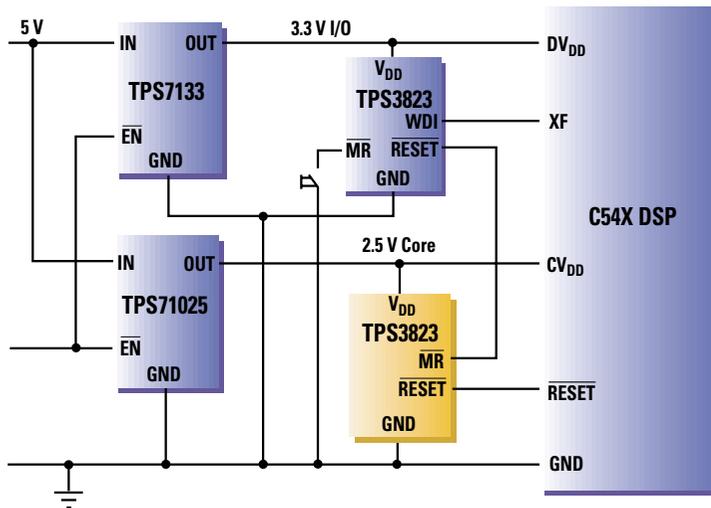
- check box below
- visit our Website: www.ti.com/sc/cash
- call 1-800-477-8924, ext. 5070
- fill out request form opposite this page

■ **Check box 01** to request an entry kit.

For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3236

POWER MANAGEMENT

Integrated supply voltage supervisor and watchdog timer in SOT-23 package



Texas Instruments new TPS3823-xx and TPS3824-xx microprocessor supervisory circuits combine precision supply voltage monitoring with a watchdog timer and a manual reset. They are the only fixed 2.5-V supervisors available in a micro-sized SOT-23 package. The TPS3823 offers a manual reset input, while the TPS3824 features a high-level reset output.

The $\overline{\text{RESET}}$ output is guaranteed asserted when V_{DD} reaches 1.1 V eliminating undefined states during power-up. After supply voltages reach operating thresholds, a fixed reset delay time of 200 ms ensures that the supply has stabilized and the system has been properly reset before processor operation is allowed. Reset thresholds are guaranteed to 2% accuracy.

Applications:

- Laptops
- Cellphones
- Portable battery-powered equipment
- Microprocessor and DSP monitoring

Product Features

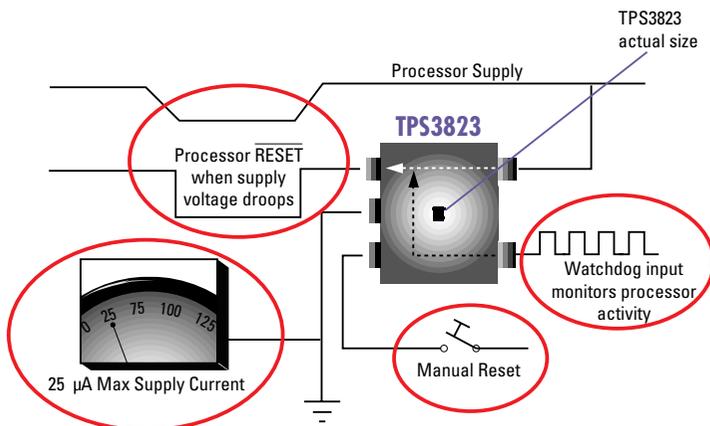
- 2.5-V, 3.0-V, 3.3-V and 5.0-V options
- Fixed delay time of 200 ms
- Watchdog timer
- 25- μA supply current max
- No external components required
- Characterized for operation from -40°C to 85°C

Suggested resale price

Quoted per device in quantities of 1,000

- TPS3823/25DBVR,
- TPS3824/25DBVR,
- TPS3823/30DBVR,
- TPS3824/30DBVR,
- TPS3823/33DBVR,
- TPS3824/33DBVR,
- TPS3823/50DBVR,
- TPS3824/50DBV:

\$0.92



■ Check box 02 for a datasheet.

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

MULTIMEDIA

Product Features

TLC320AD90/91

- Meets or exceeds AC'97 specifications
- 3.3-V or 5-V digital interface and power down mode
- Analog mixers with mono and stereo volume control
- Characterized for operation from 0°C to 70°C

TLC320AD80

- Analog volume and balance control
- TV baseband audio analog decoder
- 50/15-ms de-emphasis filter
- Two PCM audio ports
- I2S and SPI compatible
- Characterized for operation from 0°C to 70°C

Suggested resale price

Quoted per device in quantities of 1,000

TLC320AD90: \$4.30

TLC320AD91: \$2.65

TLC320AD80: \$4.90

Three new stereo audio codecs provide

TLC320AD90

The TLC320AD90 is a 16-bit digital audio codec that is fully compliant with Audio Codec '97 (AC'97) specifications. This high-performance device provides an integrated 600-Ω power amplifier, analog mixers, and volume control. The 'AD90 is an excellent choice for CD-quality digital audio systems such as audio/video conferencing, musical instruments, and high end PC audio cards.

The 'AD90 provides performance of 94 dB typical signal-to-noise ratio (SNR) on the digital-to-analog converter (DAC) and 93 dB on the analog-to-digital converter (ADC). The AC'97 specification for minimum SNR is 85 dB and 75 dB respectively. Also, high quality FIR and Bessel Linear Phase Filtering is used to improve audio quality.

The 'AD90 also exceeds other parameters like intermodulation distortion and crosstalk. For example, the specification requires 70 dB for crosstalk and the 'AD90 provides 100 dB. In addition, the common mode rejection ratio (CMRR) for the

CD-ROM inputs provides 76 dB rejection from CD-ROM servo motor noise present in PC audio systems. Similarly, the Power Supply Rejection Ratio (PSRR) allows high system performance in real-world environments.

Additional features include a 5-V or 3.3-V digital interface and a low-power mode with a standby current of 100 μA (typical). The TLC320AD90 is available in a 64-pin TQFP packaging.

TLC320AD91

The TLC320AD91 is a high quality, AC'97-compliant stereo audio codec for PC motherboard and add-in card audio applications. It performs full-duplex 18-bit codec functions at 48 K samples/second, and also provides a comprehensive analog mixer with 4 sets of stereo inputs, plus telephone, 2 microphone, and PC-beep inputs.

The 'AD91 provides performance of 90 dB typical SNR on the DAC and 80 dB SNR on the ADC. The codec also exceeds other parameters like intermodulation distortion and crosstalk,

and adds high quality FIR and Bessel Linear Phase Filtering as well as a 46 dB PSRR for improved audio quality in real-world environments.

Additional features include 5-V or 3.3-V digital interface with low power mode, mono and stereo volume control, and registered Microsoft Plug and Play Vendor ID. On-chip reference circuits generate the necessary bias voltages for the device. A 5-pin digital bi-directional serial interface allows transfer of control data, DAC, and ADC words to and from the AC'97 controller.

The 'AD91 is available in a 48-pin TQFP packaging.

TLC320AD80

The TLC320AD80 audio subsystem combines a 16-bit sigma-delta stereo audio DAC, analog volume and balance control, analog TV baseband control, de-emphasis filter and an analog wide-band multiplexer to provide a powerful and inexpensive solution for set-top box applications. The 'AD80 multiplexes two analog stereo inputs and one monaural

Device	Digital Interface	Sampling Rate	Resolution	DAC SNR	ADC SNR	MIC SNR	CMRR	PSRR	Load	Package
TLC320AD90	5 V or 3.3 V	48 kHz	16 bits	94 dB	93 dB	92 dB	76 dB	55 dB	600 Ω	64-pin
TLC320AD91	5 V or 3.3 V	48 kHz	18 bits	90 dB	80 dB	92 dB		46 dB		48-pin

Device	Sampling Rate	Resolution	SNR	Operating Power Dissipation
TLC320AD80	48 kHz	16 bits	85 dB	260 mW

For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3236

M U L T I M E D I A

consumer quality audio solutions

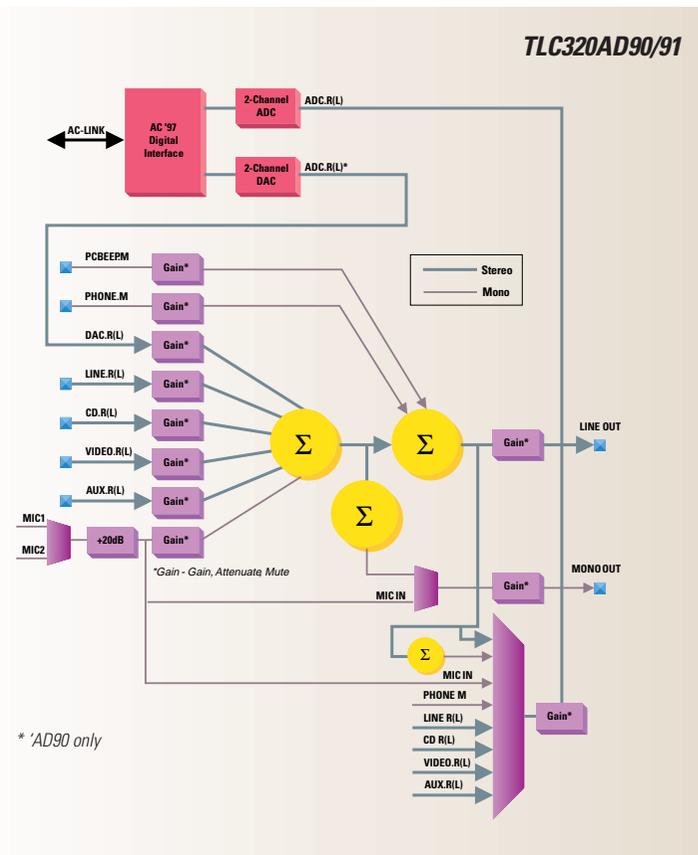
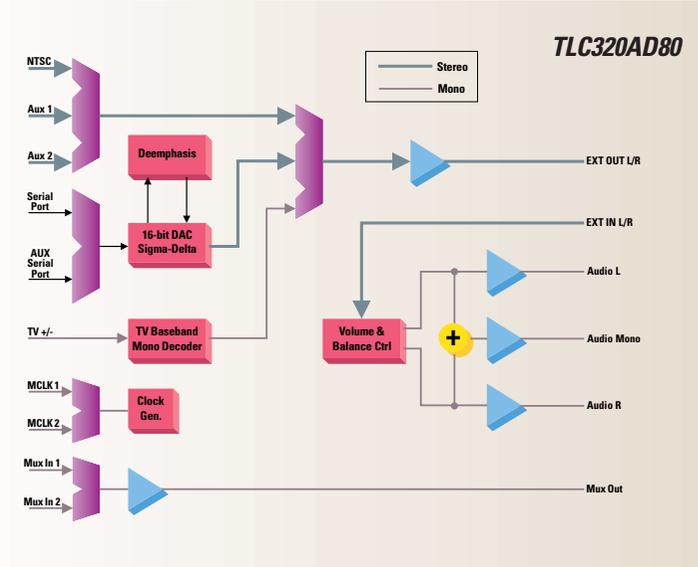
analog with the DAC outputs and routes this output externally or through volume and balance controls. An additional analog port accepts TV baseband signals and outputs monaural audio.

The 'AD80 DAC provides 85 dB SNR typical, with nominal system power dissipation of 260 mW. Also, the sample rate for the device can be varied from a minimum of 8 kHz to a maximum of 48 kHz.

The optimized device integrates six audio input ports, two serial PCM audio inputs, two stereo analog audio inputs and two monaural analog audio inputs. Together, the ports are designed to decrease overall system cost with features like an internal decoder for TV baseband signals. Other features include a flexible stereo port that is I2S compatible, an SPI bus-compatible control interface, digital filtering, and on-chip timing and control.

Typical applications for the TLC320AD80 include Direct Broadcast Satellite (DBS) boxes, digital cable or telco set-top boxes, digital cable or telco set-top boxes, HDTV, digital audio broadcast receivers and video laser disks.

The 'AD80 is available in a 64-pin TQFP package.



* 'AD90 only

■ Check box 03 for a datasheet.

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

DATA TRANSMISSION

Product Features

- Meet or exceed ANSI TIA/EIA-644
- Single 3.3-V Supply
- Typical output voltage rise and fall times of 750 ps (400 Mbps)
- Power dissipation of 25 mW (typical) with one driver at 200 MHz and 60 mW (typical) with one receiver at 200 MHz
- Bus-terminal ESD protection exceeds 8 kV
- Receivers have fail-safe feature
- Characterized for operation in industrial temperature, from -40°C to 85°C

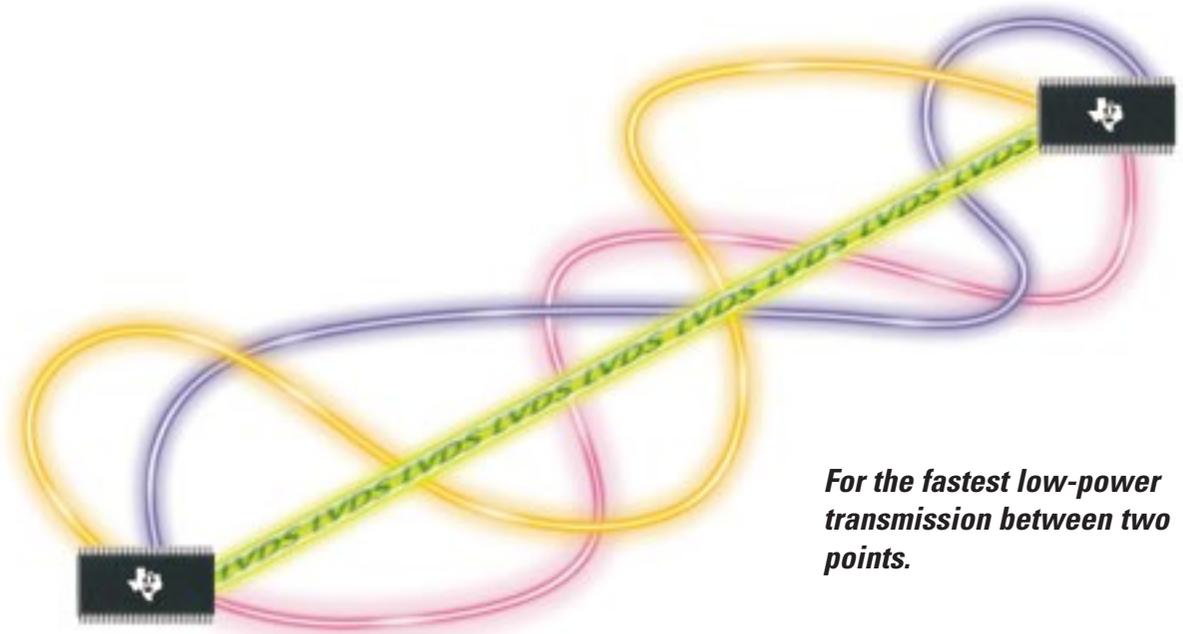
Suggested resale price

Quoted per device in quantities of 1000

SN65LVDS31D,
SN65LVDS32D,
SN65LVDS3486D,
SN65LVDS3487D:
 \$3.46

SN65LVDS9637D,
SN65LVDS9638D:
 \$1.84

TI's LVDS product portfolio continues to grow



For the fastest low-power transmission between two points.

Texas Instruments has established itself as the leader in Mixed-Signal and Analog products, and has 30 years of experience in the Data Transmission arena. TI's newest data transmission family, Low-Voltage Differential Signaling (LVDS), has recently increased its product portfolio to include guaranteed AC testing, quad drivers and receivers with enable, dual drivers and receivers, and a new Evaluation Module (EVM).

LVDS is a signaling method used for high-speed, low-power transmission of binary data over copper. It covers a wide range of applications for point-to-point and multidrop baseband data transmission over controlled impedance media of approximately $100\ \Omega$. The transmission media may be

printed circuit board (PCB) traces, backplanes or cables.

Compared to previous standards, TI's LVDS drivers and receivers offer speeds up to 400 Mbps, consume 1/8 the power of R5422, and radiate 1/10 the EMI of the best single-ended input/output (I/O). Designers who are presently using ECL and PECL technologies to attain speeds up to 400 Mbps will appreciate the ultra-low power of LVDS and the simplicity of its line termination, a single $100\text{-}\Omega$ resistor.

TI's LVDS drivers and receivers meet or exceed the requirements of ANSI TIA/EIA-644. LVDS low-voltage swings of 350 mV (typical), 3.3-V supply voltage, and current-mode drivers lower power consumption. The power dissipation of a

driver is 25 mW (typical) per driver at 200 MHz, while the power dissipation of a receiver is 60 mW (typical) at 200 MHz. In order to reach the high speeds of 400 Mbps, the driver has a typical output voltage rise and fall times of 750 ps. The driver's typical propagation delay time is 1.7 ns, while the receiver's typical propagation delay time is 1.4 ns. Both drivers and receivers are characterized for operation in industrial temperature, from -40°C to 85°C . TI recognizes the need for high ESD protection in the industry and therefore designed these products with a bus-terminal ESD protection which exceeds 8 kV. These products are offered in SOIC packaging.

For technical support, call (972) 644-5580.
 To order documentation, call 1-800-477-8924, ext. 3236

DATA TRANSMISSION

TIA/EIA-644 Drivers and Receivers

Products	Description	Footprint	Supply Voltage (V)	Package	Pin Count
SN65LVDS31	Quad driver	AM26LS31	3.3	SOIC	16
SN65LVDS32	Quad receiver	AM26LS32	3.3	SOIC	16
SN65LVDS3487	Quad driver	MC3487	3.3	SOIC	16
SN65LVDS3486	Quad receiver	MC3486	3.3	SOIC	16
SN65LVDS9638	Dual driver	μA9638	3.3	SOIC	8
SN65LVDS9637	Dual receiver	μA9637	3.3	SOIC	8

New Guaranteed AC Testing

The previously released quad driver and receiver, SN65LVDS31 and SN65LVDS32, have been re-characterized to include minimum and maximum AC testing. The new revised data sheets show the minimum and maximum propagation delay time of the drivers as well as the receivers. The driver's propagation delay time has a minimum of 1 ns and a maximum of 2.5 ns. The receiver's propagation delay time has a minimum of 1.4 ns and a maximum of 4.1 ns. These characteristics also apply to the new LVDS products, SN65LVDS3486/87 and SN65LVDS9637/38.

New Quad Driver and Receiver with Enable, SN65LVDS3487 and SN65LVDS3486

The new quad driver and receiver, SN65LVDS3487 and SN65LVDS3486, have enablers that allow the drivers and receivers to be turned on in pairs. This characteristic differentiates them from the previously released SN65LVDS31 and SN65LVDS32 which had to have all four drivers and receivers enabled at once. Designers will be able to choose the device which offers the most cost-effective solution to their application. The 'LVDS3487 and 'LVDS3486 follow the popular footprint of the MC3487 and MC3486.

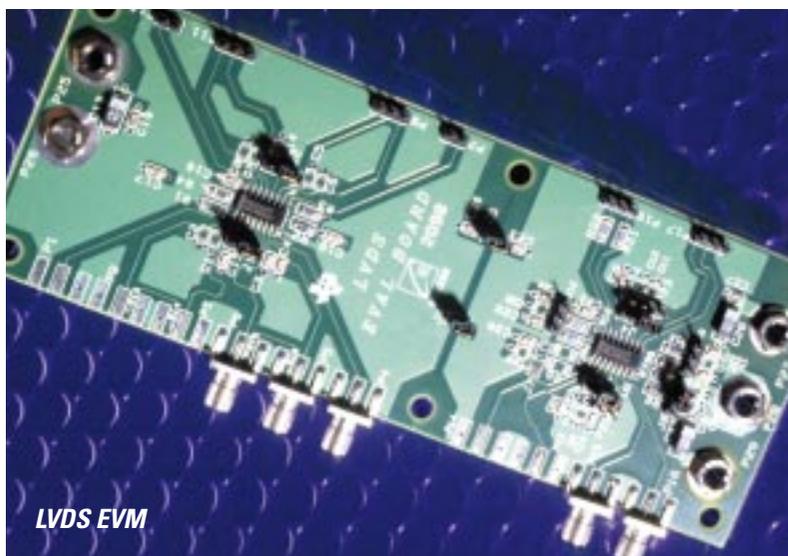
New Dual Driver and Receiver, SN65LVDS9638 and SN65LVDS9637

The new dual driver and receiver, the SN65LVDS9638 and SN65LVDS9637, respectively, broaden TI's LVDS products offerings. These devices have the same innovative characteristics as the quad drivers and receivers, with the only difference being the number of drivers and receivers per chip. The 'LVDS9638 and 'LVDS9637 follow the pin-configuration of μA9638 and μA9637, the industry's standard.

New LVDS EVM

A new EVM which allows designers to evaluate TI's LVDS products is now available. This EVM will let designers play with different LVDS configurations. The EVM can be set up for point-to-point transmit-receive configurations, a multidrop configuration, and even receive some 422 data into an LVDS receiver. Other topologies can also be created such as parallel drivers for high current mode, multipoint schemes with multiple driver/receiver (pseudo 485) and much more.

■ Check box 04 for a datasheet.



LVDS EVM

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

OPERATIONAL AMPLIFIERS

Product Features

- Ultra-low distortion: -72 dB @ 1 MHz, 25 Ω
- High output drive: $I_o = 480$ mA (typical)
- High speed: BW = 140 MHz S/R = 1000 V/μsec
- Independent power supply connections for low crosstalk
- Wide ±5-V to ±15-V supply voltage range
- PowerPAD™ package for enhanced thermal performance
- EVM available (see page 18)
- Characterized for operation from 0°C to 70°C and -40°C to 85°C

Lowest distortion xDSL line driver/receiver

Tomorrow's high speed xDSL Internet access technology will require drivers and receivers capable of transmitting high data rates over low impedance telephone lines with minimal distortion. The THS6002 from Texas Instruments is the answer.

The THS6002 is composed of four high-speed, current feedback operational amplifiers. Two of the four amplifiers are optimized as drivers, offering 480-mA typical output current, 1000-V/μs slew rate, and 140-MHz bandwidth. The other two amplifiers are configured as receivers and offer the same high performance at a lower output drive. Each amplifier also features individual power supply connections to minimize crosstalk between the devices.

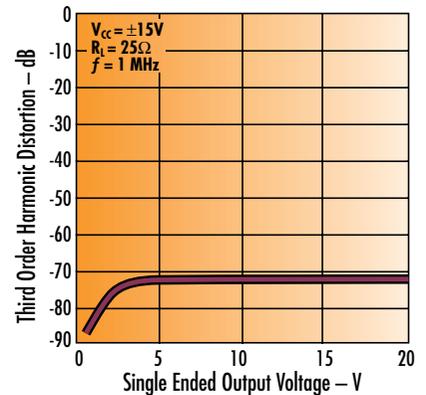
This device operates over a wide range of supply voltages, ranging from ±5 V to ±15 V, and can drive up to a 40-V peak-to-peak differential output voltage. This makes the THS6002 well suited for a variety of xDSL applications including ADSL and HDSL at the central office and remote terminals.

The THS6002 is available in a small, surface mount, thermally enhanced SOIC 20-pin PowerPAD package. For more information on this innovative new package, see the PowerPAD application note at <http://www.ti.com/sc/docs/psheets/abstract/apps/slma002.htm>.

Applications:

- ADSL
- HDSL
- Video Distribution

Distortion vs Output Voltage



■ Check box 05 for a datasheet.

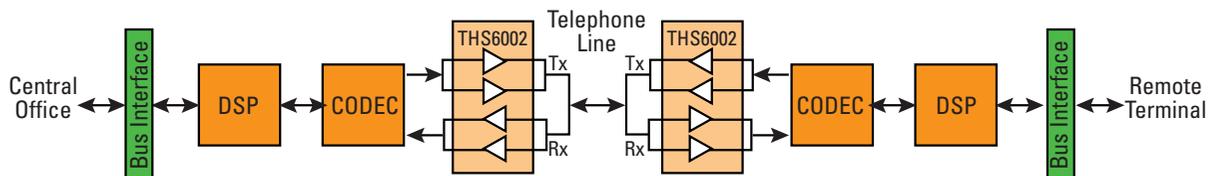
Suggested resale price

Quoted per device in quantities of 1,000

THS6002CDWP: \$5.67

THS6002IDWP: \$5.77

ADSL Function Block Diagram



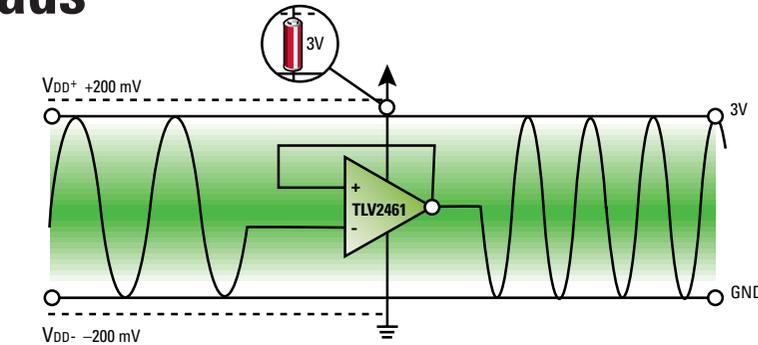
For technical support, call (972) 644-5580. To order documentation, call 1-800-477-8924, ext. 3236

OPERATIONAL AMPLIFIERS

Family of rail-to-rail I/O operational amplifier drive ±90-mA loads

The TLV246x family of low-voltage single supply operational amplifiers feature full rail-to-rail input and output operation. These devices operate over a supply voltage range of 2.7 V to 6 V, and are fully specified at 3 V and 5 V. The RRIO, superior ac performance (4.4-MHz bandwidth and 1.8-V/μs slew rate) and 250-Ω output drive are ideal for multiple applications including:

- Data acquisition circuits
- Portable equipment
- Cellular
- Telecom
- Signal conditioning



The TLV2461 in a buffer configuration

Each device is available with or without shutdown ($I_{SD} = 0.6 \mu A$) and in several package and temperature options. The table provides an overview of the corresponding part

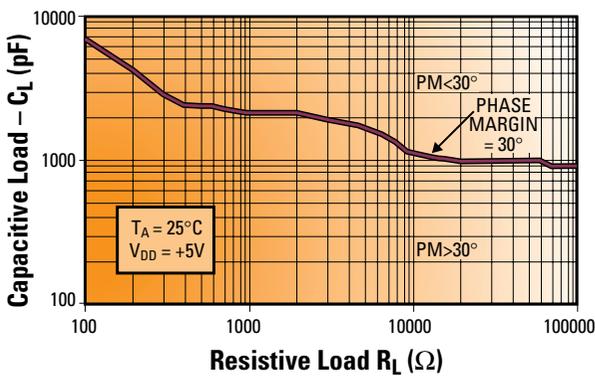
numbers and options, including the industry's first single op amp with shutdown in a SOT-23-6 package.

The TLV2462 and TLV2463 are available today in production volumes. The other family members are scheduled to be in full production by September 1, 1998.

For applications requiring increased ac performance, consider the TLV277x family.

■ **Check box 06** to receive a free datasheet and TI's new Universal Op Amp Board with TLV2462ID, TLV2771IDBV, and TLV2772IDGK samples soldered in place. For additional information on the EVM see page 12.

TLV246x Stability with Load



Product Features

- Rail-to-rail input and output (RRIO)
- Drives ±90-mA loads
- High bandwidth: 4.4 MHz
- Low noise: 11 nV/√Hz
- Input offset voltage: 100 μV
- Complete family of singles, duals, and quads
- Characterized for operation from 0°C to 70°C and -40°C to 125°C

Suggested resale price

Quoted per device in quantities of 1,000

- TLV2460CD: \$0.72
- TLV2461CD: \$0.62
- TLV2462CD: \$1.03
- TLV2463CD: \$1.13
- TLV2464CD: \$1.65
- TLV2465CD: \$1.75

TLV246x Family			Package Types				
Part No.	No. of Ch.	Shutdown†	SOT-23	MSOP	TSSOP	SOIC	PDIP
TLV2460‡	1	✓	6	—	—	8	8
TLV2461‡	1	—	5	—	—	8	8
TLV2462	2	—	—	8	—	8	8
TLV2463	2	✓	—	10	—	14	14
TLV2464‡	4	—	—	—	14	14	14
TLV2465‡	4	✓	—	—	16	16	16

† Outputs switch to high-impedance state in shutdown.

‡ Available in September 1998.

Read Showcase online and download datasheets at:

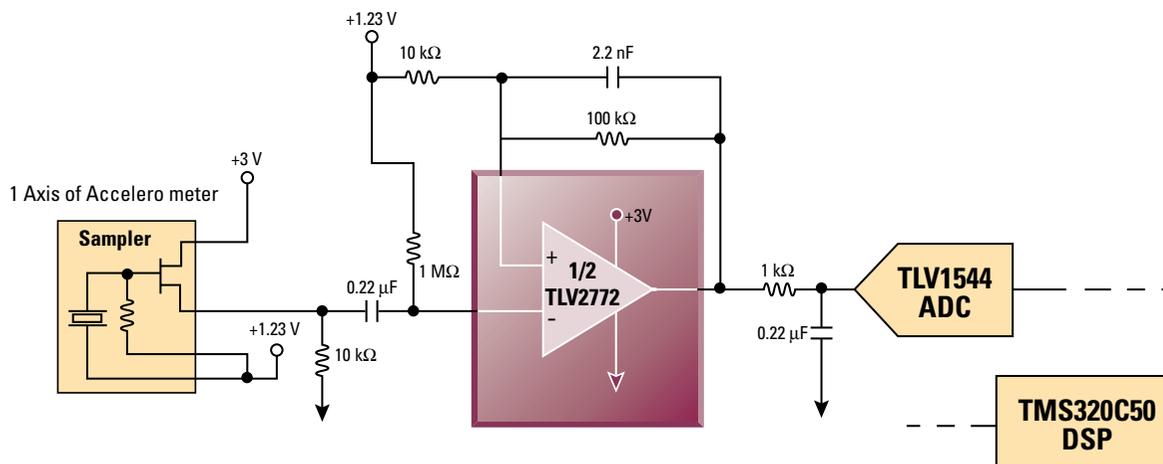
www.ti.com/sc/showcase

OPERATIONAL AMPLIFIERS

Product Features

- Exceptional ac performance: 5.1-MHz bandwidth 10.5-V/ μ s slew rate
- Rail-to-rail output
- Low noise: 17 nV/ $\sqrt{\text{Hz}}$
- Low input offset voltage: 360 μ V
- Complete family of singles, duals, and quads
- Characterized for operation from 0°C to 70°C and -40°C to 125°C

Maximum ac performance from low-voltage single-supply CMOS operational amplifiers



The TLV277x family provides the highest ac performance of any low-voltage single-supply CMOS operational amplifier. The 5.1-MHz bandwidth and 10.5-V/ μ s slew rate are suitable for applications previously requiring split-supply BiFETs and preamps for analog-to-digital converters. The low THD resulting from the high slew rate and 600- Ω output drive makes the TLV277x well suited

for telecom applications. Measurement, medical and industrial applications will benefit from the 360- μ V offset voltage and 17-nV/ $\sqrt{\text{Hz}}$ noise floor. These devices operate over a supply voltage range of 2.7 V to 5.5 V, and are fully specified at 3 V and 5 V. For designs that do not require the ac performance of the TLV277x family, consider the TLV24x2 or TLV246x family.

Suggested resale price

Quoted per device in quantities of 1,000

TLV2771CD: \$0.62

TLV2772CD: \$1.03

For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3236

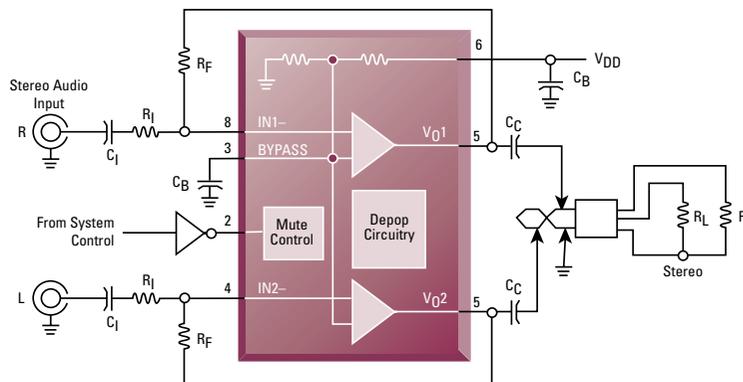
AUDIO POWER AMPLIFIERS

75-mW hi-fi low-voltage audio power amplifier

The TPA152 is a low-voltage audio power amplifier designed to drive stereo headphones. This amplifier delivers 75-mW stereo to a 32-Ω load with less than 0.01% THD+N across the entire audio frequency band. Its hi-fi sound quality makes it well suited for applications including:

- Portable CD players
- Notebook computers
- Voice recorders
- Headphone amplifiers
- Output buffer for audio CODECs in PCs

The TPA152 also features an integrated mid-rail generator. This circuitry minimizes component count by internally biasing the reference voltage. The need for an external



voltage divider is eliminated, saving time, board space and money.

TI is a recognized leader in providing audio power amplifier (APA) solutions. Each APA provides a unique set of features applicable to multiple designs.

The TPA152 is available in an 8-pin SOIC package.

Design Tools:

- Hardware EVMs: <http://www.ti.com/sc/docs/msp/tools/audio.htm>
- Power Analysis Program: <http://www.ti.com/sc/docs/msp/pran/audio.htm>
- Reference Designs: <http://www.ti.com/sc/docs/msp/tools/audio.htm>

Product Features

- Ultra-low THD+N: < 0.005% at 1 kHz
- 75-mW stereo output drive
- Internal mid-rail generator
- Depop circuitry
- Pin compatible with TPA302
- Characterized for operation from -40°C to 85°C

Texas Instruments Audio Power Amplifier Selection Guide

Device	Description	Output Power (W)	THD+N (%) typ	V _{CC} /V _{DD} (V)		I _{CC} /I _{DD} (mA) typ	PSRR (dB, 1 kHz) typ	Shutdown Control	Packages
				min	max				
TPA152	75 mW stereo, SE	0.075	0.005	2	5.5	5.5	81		8-pin SOIC
TPA301	350 mW mono, BTL	0.35	0.3	2	5.5	0.7	78	✓	8-pin SOIC*/MSOP*
TPA311	350 mW mono, SE/BTL	0.35	0.3	2	5.5	0.7	78	✓	8-pin SOIC*/MSOP*
TPA4861	1 W mono, BTL	1	0.2	2.7	5.5	3.5	56	✓	8-pin SOIC ⁺
TPA4860	1 W mono, BTL w/hp sense	1	0.2	2.7	5.5	3.5	56	✓	16-pin SOIC
TPA0202	2 W stereo, SE/BTL	2.0	0.05	3	5.5	19	75	✓	8-pin SOIC
TPA0102	1.5 W stereo, SE/BTL	1.5	0.05	3	5.5	19	75	✓	24-pin TSSOP*
TPA0103	1.75 W 3-channel stereo	1.75	0.05	3	5.5	19	80	✓	24-pin TSSOP*
TPA302	300 mW stereo, SE	0.3	1	2.7	5.5	4	45	✓	8-pin SOIC ⁺
TPA1517	6 W stereo SE	6	10	9.5	18	30	65	✓	20-pin SOIC*/DIP ⁺

SE = Single Ended

BTL = Bridged-Tied Load

hp = Headphone

* PowerPAD Package

+ Thermally Enhanced Package

Suggested resale price

Quoted per device in quantities of 1,000

TPA152D: \$0.77

■ Check box 08 for a datasheet.

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

OPERATIONAL AMPLIFIERS

Product Features

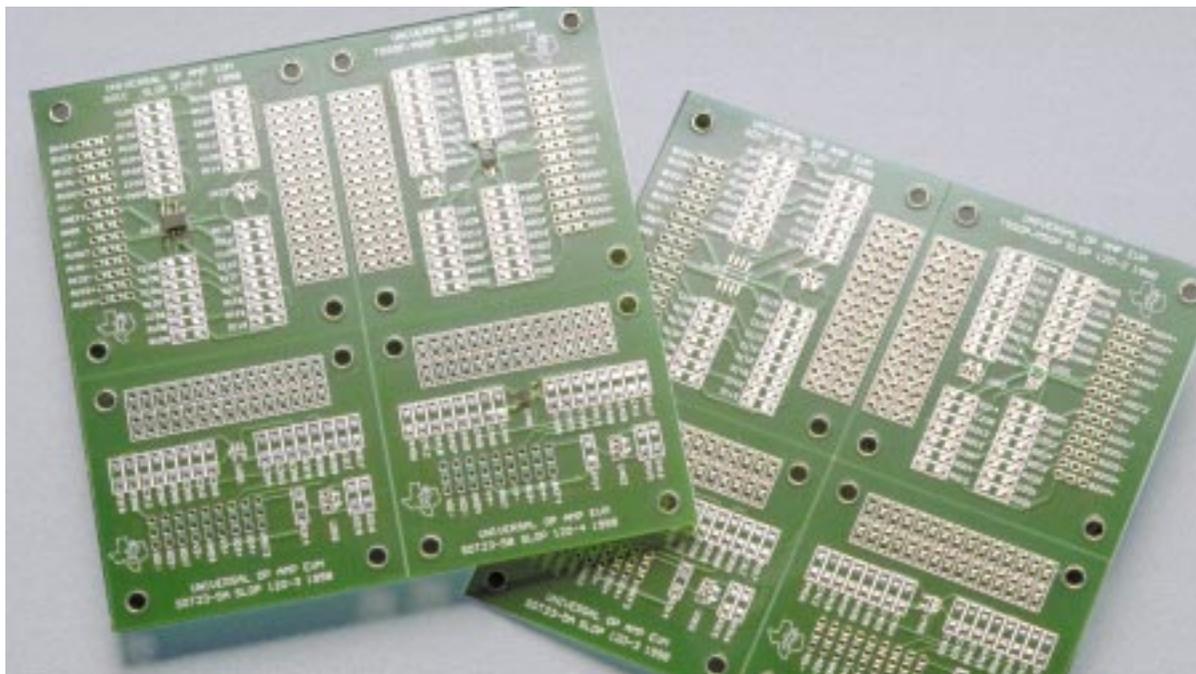
■ Designed to evaluate single and dual op amps in SOT-23-5, MSOP, TSSOP, and SOIC packages

■ Eliminates need for through-hole packages

■ Complete User's Guide features detailed schematics, board layout, and several example circuits

■ IT'S FREE!

Universal Operational Amplifiers evaluation module



An industry first, the Universal Op Amp Evaluation Model.

The Universal Op Amp Evaluation Module is a printed circuit board (PCB) that greatly reduces design time and eliminates the need for PDIP packages for evaluation. The module is optimized for multiple circuit layouts including:

- Voltage follower
- Noninverting amplifier
- Inverting amplifier

- Simple or algebraic summing amplifier
- Difference amplifier

- Current to voltage converter
- Voltage to current converter

- Integrator/low pass filter
- Differentiator/high pass filter
- Instrumentation amplifier
- Sallen-Key filter

The board is comprised of four circuit development areas which can be easily separated into stand-alone modules. Two areas are for single op amps in SOT-23-5 packages.

The remaining two modules are for dual op amps in TSSOP, MSOP and SOIC packages. A User's Guide provides complete schematics of the board, its layout, and easy-to-follow example circuits.

The Universal Op Amp Module and its User's Guide are available at no cost.

See the TLV246x and TLV277x feature articles in this issue of Showcase on page 9. Members from each family are available in evaluation kits which include the Universal Op Amp Module.

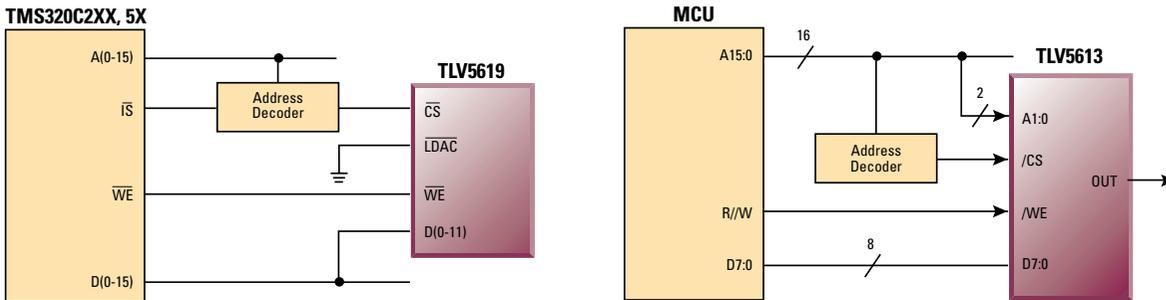
■ **Check box 09** for a free kit with and without devices attached.

Suggested resale price

FREE

For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3236

S P E E D

Introducing the industry's fastest 12-bit V_{OUT} DACs

These new 12-bit digital-to-analog converters (DACs) deliver conversion speeds not available from other voltage-output DACs. The TLV5613 and TLV5619 both feature 1- μ s typical setting time while operating from a single wide supply range of 2.7 to 5.5 V. The faster analog-output dynamic performance means not having to use current-output DACs and the external output buffers they require for current-to-voltage conversion.

The TLV5613 features a parallel (8+4 bit) bus compati-

ble with most 8-bit microprocessors. The TLV5613 has a low power mode (0.87 mW with 3-V supply), power-down mode, and two address lines that determine whether the parallel data consists of LSB, MSB, or control data. The TLV5619 features a 12-bit TMS320 (DSP) and microprocessor compatible parallel interface. The digital input data of the TLV5613 and TLV5619 is double buffered so that the output can be updated asynchronously using the LDAC pin. The output of both devices are buffered by a x2 gain rail-

to-rail amplifier which features a Class-A output stage to improve stability and reduce setting time.

The TLV5613 and TLV5619 are perfectly suited for applications such as telecom line cards, mass storage, zip drives, industrial process control, and battery powered test instruments. Both devices are offered in a 20-pin SOIC or TSSOP packages, and are available in commercial (0°C to 70°C) and industrial (-40°C to 85°C) temperature ranges.

■ Check box 10 for a datasheet.

Product Features

TLV5613

- 8- and 4-bit interface
- 1 μ s/4.2 mW-fast mode
- 3.5 μ s/1.2 mW-slow mode
- Power-down mode (10 nA)
- 2.7- to 5.5-V single supply

TLV5619

- 12-bit TMS320 DSP compatible interface
- 1 μ s setting time (typ)
- 4.3 mW for 3-V supply
- 2.7- to 5.5-V single supply

The Growing Family of Single-Supply, Voltage-Output, Easy to Use DACs from TI

Products	Resolution	Output	Supply Voltage (V)	Package	Description
TLC5615	10	Serial	5-V	8-pin SOIC	Single DAC
TLC5617A	10	Serial	5-V	8-pin SOIC	Dual, programmable DAC
TLV5618A	12	Serial	5-V	8-pin SOIC	Dual, programmable DAC
TLV5613	12	Parallel	2.7 to 5.5-V	20-pin SOIC/TSSOP	8+4 microprocessor DAC
TLV5619	12	Parallel	2.7 to 5.5-V	20-pin SOIC/TSSOP	12-bit DSPS DAC

Suggested resale price

Quoted per device in quantities of 10,000

TLV5613CDW: \$3.90

TLV5619CDW: \$3.90

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

DATA CONVERTERS

Product Features

- 20 MSPS, 10-bit resolution ADC
- 5-V single-supply operation
- Low power dissipation ... 107 mW Typ
- Pin-compatible with the AD876
- Characterized for operation over Commercial (0°C to 70°C) and Industrial (-40°C to 85°C)

10-Bit, 20 MSPS ADC provides high resolution and speed with 33% power savings

The TLC876 is a single-supply, 10-bit, 20 MSPS analog-to-digital converter (ADC) which allows designers to reduce board space, lower power dissipation, improve bus efficiency, increase flexibility and lower system cost. This ADC's speed and resolution make it ideal in digital video systems, digital cameras, scanners, communications systems and other cost-sensitive, high performance applications.

The device, designated the TLC876, is pin-compatible with the current market alternative and offers several key improvements. The TLC876's power

consumption is only 107-mW, 33 percent lower than competitive device. Designers experiencing bus delays will find the TLC876 significantly reduces enable and disable times (5 ns vs. 150 ns), improving bus efficiency and system throughput.

The TLC876 analog input has been designed to allow inputs as low as ground. This permits the system designer to eliminate level shifting stages prior to the ADC, saving board space and cost. Additionally, the reference input impedance is two times higher, reducing the drive requirements and cost of the reference drive circuitry.

The TLC876 guarantees differential non-linearity (DNL) of less than 1-LSB and delivers 54 dB of signal-to-noise ratio (SNL).

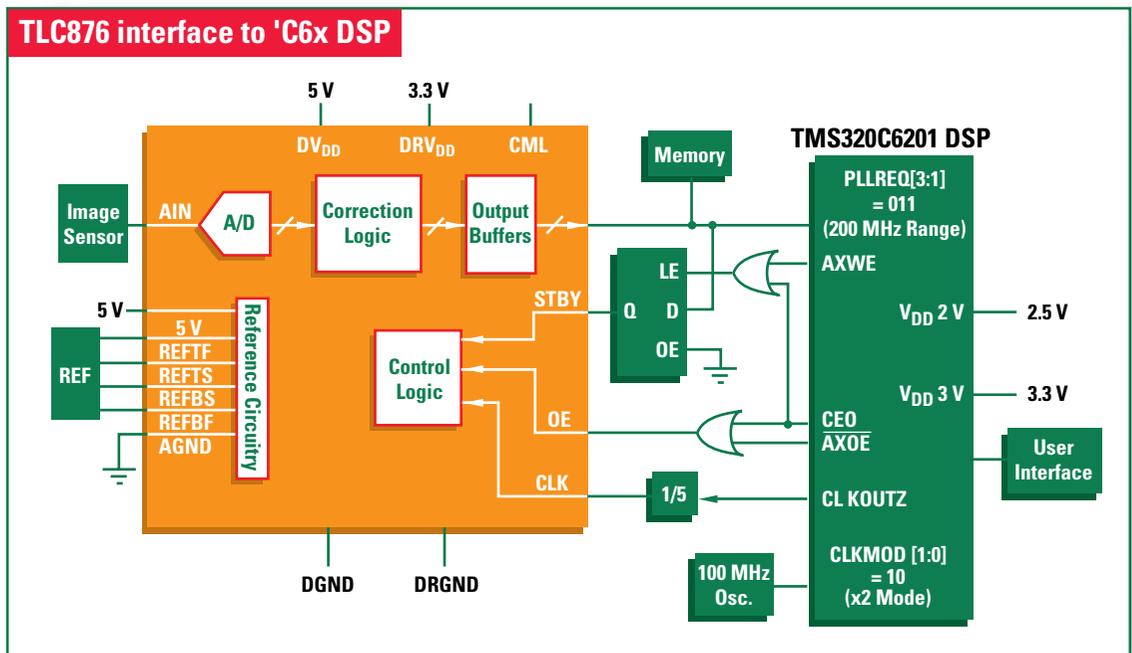
The TLC876 features three-state outputs, and both inputs and outputs are compatible with 3-V and 5-V logic. The TLC876 is available in 28-pin SOIC or 28-pin SSOP packaging.

■ Check box 11 for a datasheet.

Suggested resale price

Quoted per device in quantities of 1,000

TLC876CDW: \$2.89



For technical support, call (972) 644-5580. To order documentation, call 1-800-477-8924, ext. 3236

MIXED SIGNAL CONTROLLER

Ultra & low power MCU – 0.1 μA sleep mode

The MSP430 family offers designers the high-performance of a 16-bit RISC microcontroller with integrated peripherals at a significant reduction in power consumption. This combination is ideal for applications such as utility metering, industrial metering, high-precision portable measurement and home measurement such as thermostats and smoke detectors.

At 0.1 μA sleep power and fully operational active power of only 400 μA, the MSP430 can extend battery life up to ten times longer than traditional low power MCUs. With a performance rating of 4 MIPS, the MSP430 delivers an industry leading 1200 MIPS per Watt (Active Power).

The MSP430 offers 5 user-defined power-down modes. The most commonly used is low power mode 3 (LPM3) where (in a 3-V system) the MSP430

typically draws only 2 μA of current and requires a maximum of only 6 μ seconds to wake up and be in full active mode (with peripherals up and all clocks fully synchronized).

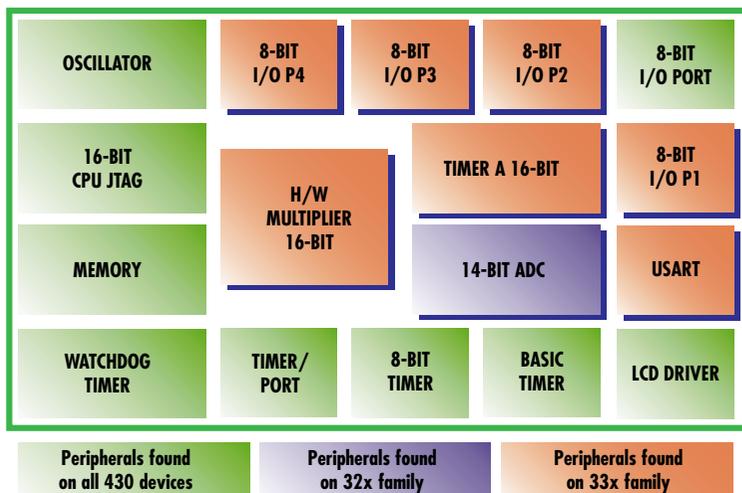
The MSP430 is currently offered in three versions. The MSP430x31x is the most cost optimized and serves as the basis for the other 430 families. It features several timer modules. A 16-bit (Timer_A) module can support five capture/compare registers and five outputs. A watchdog timer can be used as a 15-bit watchdog or interval timer. The Timer Port module can be used for slope A/D conversions or, as one 16-bit or two 8-bit timer/counters. Finally there is an 8-bit timer/counter module supporting serial communication protocols. An on-chip LCD Driver is capable of driving up to 120 segments (33x) in 1-4 MUX mode and is standard on all MSP430x3xx devices.

Packaging

31x	48	SSOP
	56	SSOP
32x	64	TQFP
	64	QFP
33x	68	PLCC
	100	QFP

Product Features

- In volumes of 100ku, ROM-coded devices begin at \$1.75
- Sleep mode power (0.1 μA) is 10x lower than other 8/16-bit MCU
- Active mode power (400 μA) is 2.5x lower than other 8/16-bit MCU
- Allows for battery life of 10 years compared to 2-3 years
- High-resolution on-chip 14-bit A/D
- V_{CC} range of 2.5 – 5.5 V (ROM parts)
- Characterized for operation from –40°C to 85°C



■ Check box 12 for a datasheet and product bulletin.

Suggested resale price

10ku OTP: \$4.50
100ku ROM: \$1.75

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

DATA TRANSMISSION

Product Features

■ Low-cost RS-232 interface solution

■ High-speed (256K bps) data signaling rate

■ Industry best ± 15 kV HBM ESD protection pin-to-pin (serial port pins, including GND)

■ Low power consumption 5-V, ± 12 -V supplies

■ Temperature range of 0°C to 70°C

High-speed RS-232 interface devices ideal for PC desktop applications

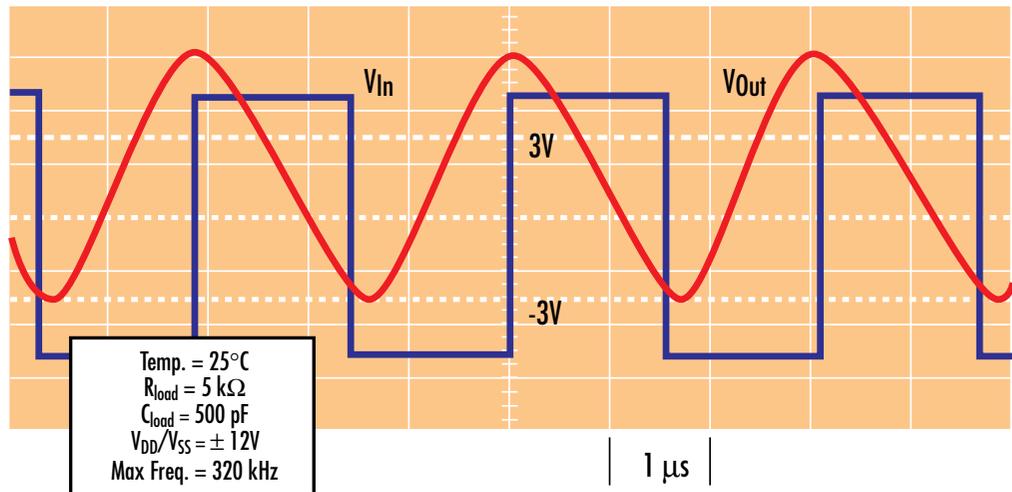


Figure 1: SN75LP185A Driver Output

Two high-speed, fully TIA/EIA-232-F data transmission standard compliant interface devices are now available. The SN75LP185A and the SN75LPE185 are low-power, single-chip PC host interface devices designed to operate at data rates up to 256 K bits per second (bps). Both contain electromagnetic interference (EMI) reduction circuitry and driver outputs that clamp to approximately 6 V, reducing overall system noise. The SN75LPE185 provides the same functionality as the SN75LP185A with addition of option for high-impedance driver and receiver outputs and a wake-up mode. Both devices are excellent interfaces between desktop PCs and peripherals and they complement TI's extensive line of data transmission products for the RS-422, RS-485, Fibre Channel,

low-voltage differential signaling (LVDS), universal serial bus (USB), IEEE 1394 and other standards.

End Equipment Applications

Applications for the SN75LP185A and the SN75LPE185 include PC and Desktop Applications such as:

- Printers
- Scanners
- Mice
- External modems
- Plotters
- Test equipment

Both the SN75LP185A and the SN75LPE185 are optimized for IBM™ PC compatible serial ports. These devices transmit and receive 4 μ s pulses, equivalent to 256 kbps and have a maximum slew rate of 30 V/ μ s. Figure 1 shows how the 'LP185A driver output, with an input voltage of 0 to 5 V, performs at room temperature with 5 k Ω and 500 pF load (equivalent to about three meters of cable). Note, the maximum 'LP185A

frequency achieved meets RS-232 input threshold sensitivity of ± 3 V.

Availability, Packaging and Pricing:

The SN75LP185A is available in a 20-pin small-outline integrated circuit (SOIC) and planned for a 20-pin shrink small-outline package (SSOP) and in a 20-pin thin shrink small-outline package (TSSOP). The SN75LPE185 is available in a 24-pin SSOP, a 24-pin TSSOP and a 24-pin SOIC.

More information regarding TI's interface products is available on the World Wide Web at <http://www-s.ti.com/sc/docs/psheets/pids2.htm>.

■ Check box 13 for a datasheet.

Suggested resale price

Quoted per device in minimum quantities of 2,000

SN75LP185A: \$1.41

SN75LPE185: \$1.41

For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3236

DATA TRANSMISSION

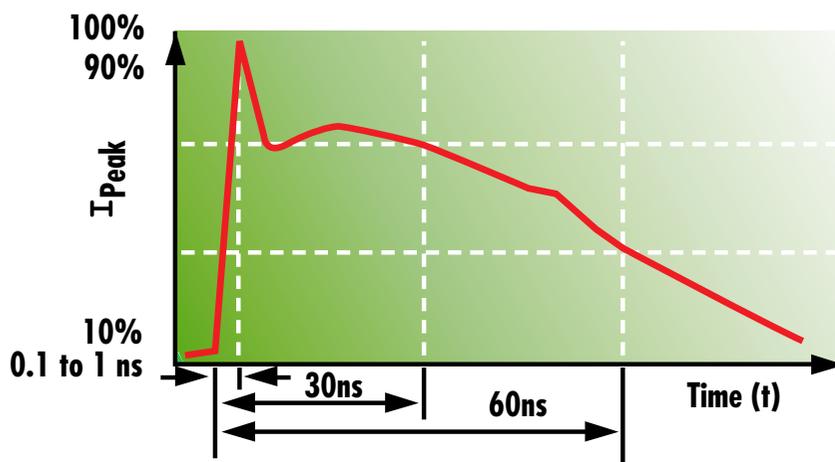
±15-kV ESD protection in SN65LBC184 and SN75LBC184

The SN65LBC184 and SN75LBC184 are differential data line transceivers that offer integrated transient voltage protection up to 400-W peak. This feature provides significant protection from large overvoltage transients on the bus pins which can be caused by secondary effects of a lightning strike or power system switching disturbances.

These previously released products have recently been tested to comply with the IEC

1000-4-2 requirements. These devices have an ESD protection on the bus pins of ±15 kV using IEC 1000-4-2 Air-gap Discharge, ±8 kV using IEC 1000-4-2 Contact Discharge, and ±15 kV using the Human Body Model (HBM). The SN65LBC184 and SN75LBC184 provide substantial benefits for improved reliability and enhanced system performance resulting in total system cost savings. Both devices are available in 8-pin DIP(P) and SOIC(D).

■ **Check box 14** for a datasheet.



IEC 1000-4-2 Current Waveform

Product Features

- ESD Protection on bus pins
 - ±15 kV Human Body Model (HBM)
 - ±8 kV IEC 1000-4-2, Contact Discharge
 - ±15 kV IEC 1000-4-2, Air-gap Discharge
- Transceiver with integrated transient voltage protection
- Circuit damage protection of 400-W peak (typical)
- Ranked among EDN's Hot 100 products of 1997
- Characterized for operation:
 - SN65LBC184: -40°C to 85°C
 - SN75LBC184: 0°C to 70°C

Suggested resale price

Quoted per device in quantities of 1000

SN65LBC184P,
SN65LBC184D: \$2.12

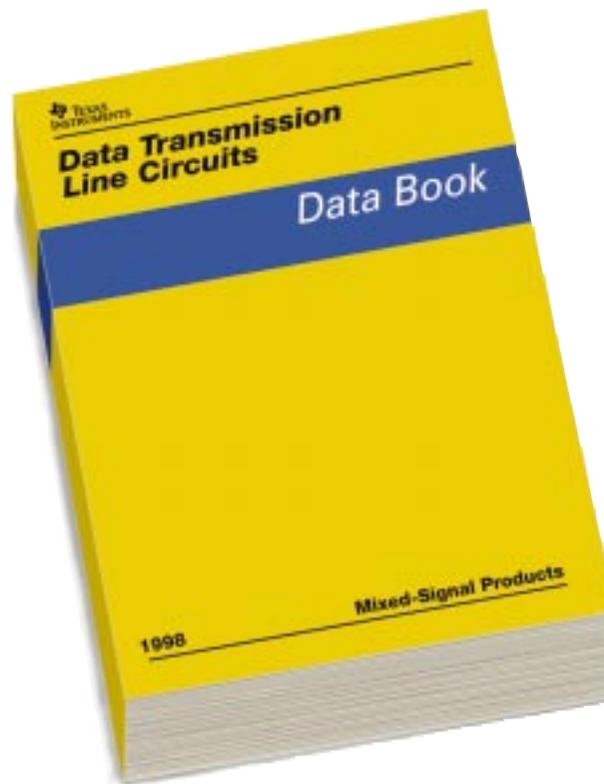
SN75LBC184P,
SN75LBC184D: \$1.98

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

DATA TRANSMISSION

New Data Transmission Data Book just out!



Texas Instruments has just published its new 1998 Data Transmission Line Circuits Data Book. This volume, from TI's Mixed Signal Products division, contains technical information on its family of data line drivers, receivers and transceivers. These products support many popular data transmission standards, and can connect electronic devices and systems at high data rates over significant cable lengths.

New products offered in the 1998 databook include:

- Drivers and receivers that meet or exceed ANSI/TIA/EIA-644 standard (LVDS)
- Dual-mode LVDS/SE SCSI transceiver
- ANSI/TIA/EIA-485-A transceiver with integrated transient voltage suppression
- ANSI/TIA/EIA-232-F drivers and receivers with 15-kV ESD

The databook also contains a selection guide and cross-reference guide, along with Applications data, and full ordering and packaging mechanical information.

To order see the check box information below.

■ **Check box 15** for a copy of this new databook.

**For technical support, call (972) 644-5580.
To order documentation, call 1-800-477-8924, ext. 3236**

E V M K I T S

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 x 5800.

THS6002	Dual differential line Driver and Receiver	\$75.00
TIR2000	High-speed IrDA controller	\$99.00
TLC876/TLV876	10-bit, 20-MSPS ADC	\$125.00
TLC320AD50	16-bit sigma delta AIC	\$75.00
TMS320C54x	C54x DSK plus and 'ADSD EVN	\$2.24
TLC320AD55	16-bit sigma delta AIC	\$75.00
TLC320AD56	16-bit sigma delta AIC	\$75.00
TMS320C5x	For use with AD55/56, C5xDSP DSK	\$99.00
TLC320AD75C	ADA for digital audio applications	\$500.00
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
TLC5510	8-bit, 20 MSPS ADC	\$120.00
TLC5540	8-bit, 40 MSPS ADC	\$120.00
TLC2543	5 V, 12-bit ADC	\$75.00
TLV2543	3 V, 12-bit ADC	\$75.00
TLC2932	50 MHz Phase Lock Loop	\$85.00
TSL230	Light-to-frequency converter	\$89.95
PC404-13 (TSL213)	200 DPI linear array	\$124.95
TSL215	200 DPI linear array	\$127.95
PC404-401 (TSL401)	400 DPI linear array	\$124.95
PC404-1401 (TSL1401)	400 DPI linear array	\$124.95
PC404-1402 (TSL1402)	400 DPI linear array	\$127.95
Audio amps	Audio power amp Plug-n-Play (basekit)	\$150.00
LVDS EVM	Quad Driver and Receiver	\$35.00
TSBKBACKPL	Backplane card	\$2000.00
TSBKPCITST	PCILynx™ and 200 Mbps phy – feature rich board	\$1000.00
TSBKPCI	PCILynx™ and 200 Mbps phy – value board	\$275.00
TSBKGPCILYNX	TSB12LV31/TSB21LV03 peripheral kit	\$1000.00
TSBKPRPHRL	Peripheral Card	\$1000.00
TUSBK4HUB	4-Port stand-alone hub kit	\$349.00
TUSBK7HUB	7-Port stand-alone hub kit	\$399.00

Read Showcase online and download datasheets at:

www.ti.com/sc/showcase

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

Texas Instruments Incorporated

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

Forwarding and return
postage guaranteed.
Address correction requested.

ANALOG & MIXED-SIGNAL

Showcase

Editor Nancy S. Waters

Design Dittmar Creative

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

PowerPad is a trademark of Texas Instruments Incorporated.

Asia

Phone
 International +886-2-23786800
 Domestic Local Access Code TI Number
 Australia 1-800-881-011 -800-800-1450
 China 10811 -800-800-1450
 Hong Kong 800-96-1111 -800-800-1450
 India 000-118 -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.

Printed in the U.S.A. at ColorDynamics, Allen, Texas A030598

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