

Standard Linear Guide



Amplifiers and Comparators
Data Converters
Interface
Power

Availability > Quality > Service > Support > Pricing



→ Contents

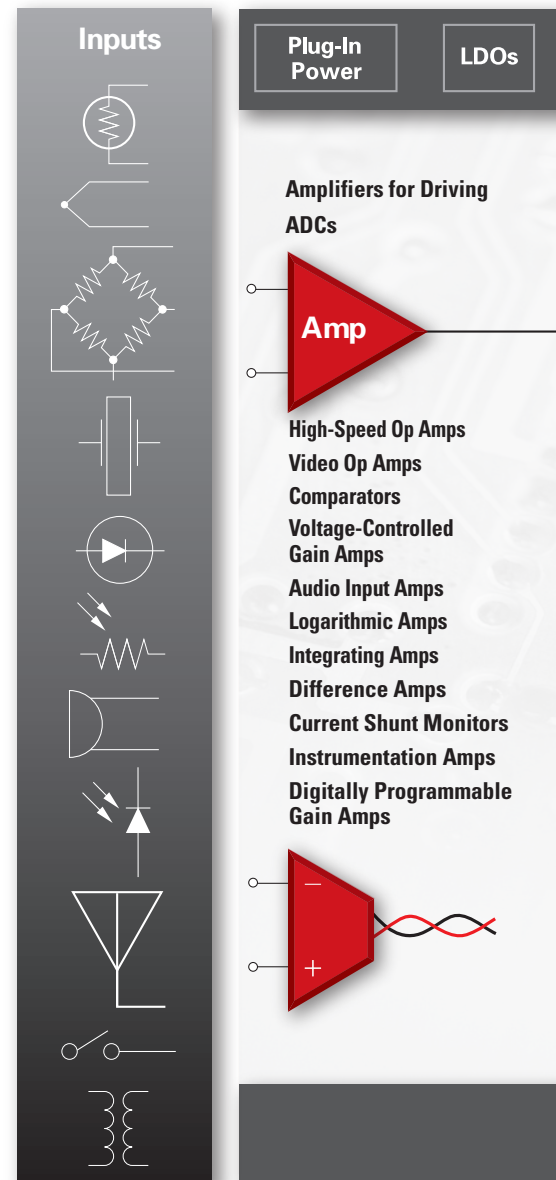
Texas Instruments (TI) offers a wide range of standard analog products. TI's products dedicated to the analog market are multimarket, general purpose products including signal conditioning circuits, power management, interface products and data converters. TI has developed the industry's largest selection of low-power and low-voltage analog parts with features designed to satisfy an extensive range of applications.

Standard Linear Design Considerations:

Choosing the right analog solution for an application involves the consideration of a variety of interrelated requirements. Designers must often consider available board space, performance objectives, multisource needs, cost and capacity among other requirements. This wide range of requirements can be narrowed to a manageable few:

- **Small Packaging:** TI offers industry standard packaging options. In addition, TI has a variety of small packages, including μ QFN and QFN.

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→ Introduction

In products where board space is a critical issue, TI has similar functions in small uQFN, QFN or SOT-23 options.

- **Performance:** TI's standard linear portfolio supports all supply voltage levels and power requirements. This wide variety of product choices means TI has the right product at the right performance level needed for any design.
- **Capacity:** TI is committed to providing the semiconductor capacity that our customers need to get to market fast and grow. TI has made significant capital

equipment and capacity expansions to support the growing demand for its comprehensive analog semiconductor portfolio. These investments enable TI to deliver the lead-times, performance, volumes and low costs that our analog customers need throughout product life cycles, which can span anywhere from five to 20 years.

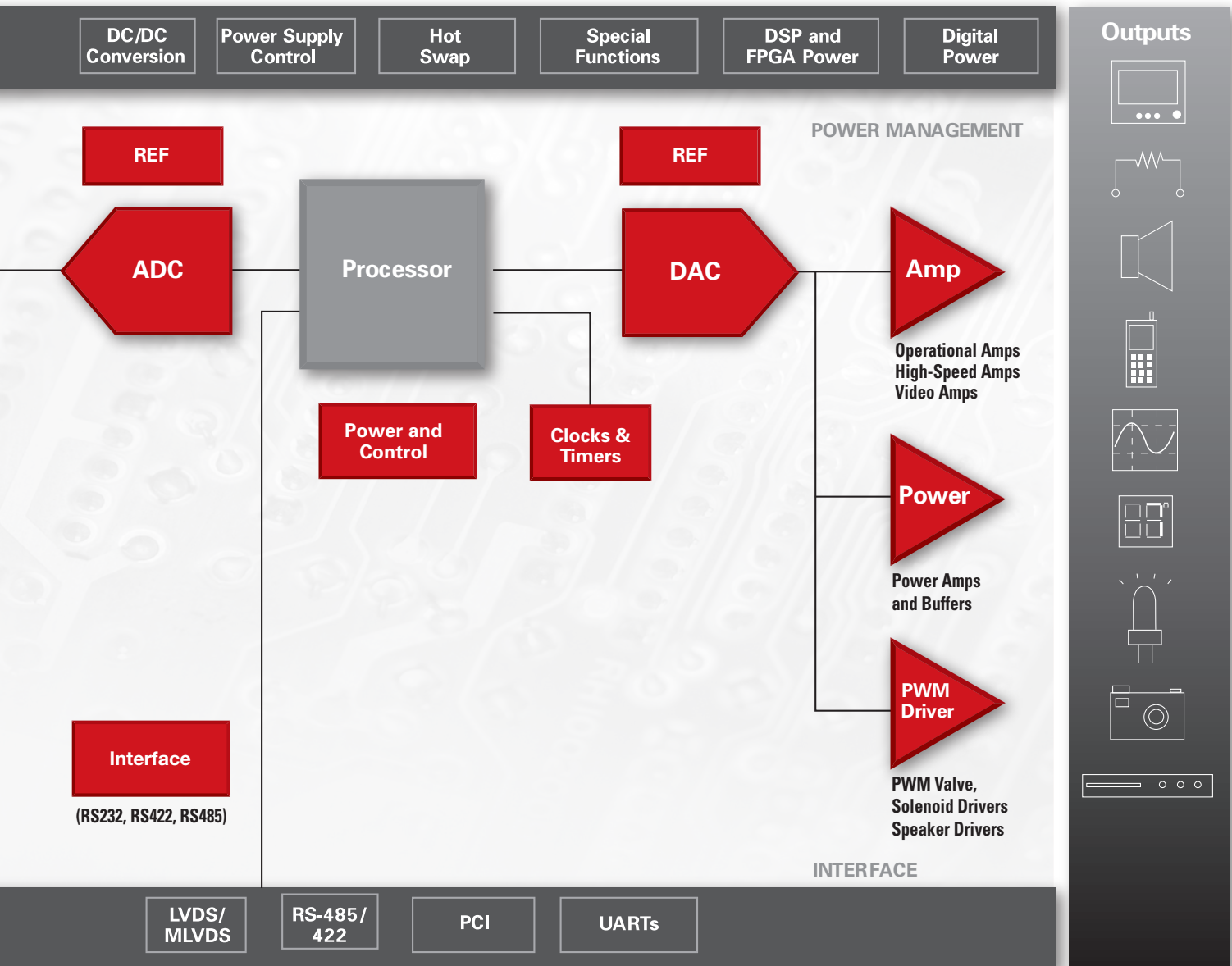
- **Application Support:** TI offers extensive application support through our Engineer 2 Engineer (E2E) online community located at: e2e.ti.com. Designers can find forums, videos, design notes, and

other extensive design support here.



TI E2E™ Community
engineer.to.engineer,
solving problems
e2e.ti.com

- **Cross Reference:** TI has compiled a large, searchable cross reference source for the entire standard linear portfolio, enabling designers to quickly find second source parts. The cross reference can be found at: www.ti.com/crossreference.



→ Overview

Standard power management products from Texas Instruments (TI) continue to provide optimized power solutions for portable and line-powered designs. Applications traditionally include power supplies for computing, telecom and networking systems, digital TVs, set-top boxes, video surveillance systems, and consumer electronics, such as smart phones, tablets, and digital cameras. TI has a broad portfolio of standard power management products that include standard pin to pin compatible linear regulators, switching regulators and LDOs. As new applications emerge with different power-design challenges, TI is continuing to evolve the standard power management solutions to meet their needs. TI is also working in partnership with developers of new technologies to enable these concepts to become reality.

Linear Regulators

Texas Instruments offers fixed and adjustable output linear regulators featuring an optimal combination of quiescent current, transient response, and low noise. These devices are ideal for battery-powered applications where both optimum heat dissipation and small dimensions are key factors.

Switching Regulators

Texas Instruments has developed a wide range of switching regulators that operate in step-up (boost), step-down (buck), and inverting modes. These devices are capable of generating a fixed or adjustable output voltage and offer up to 2 A of output current. Some of the features available in TI's portfolio of switching regulators are: low battery detector, user adjustable current limit, a variety of switching frequencies, and a reduced number of external components. This highly integrated, versatile family of products is intended to minimize external components in space challenged applications.

Low Dropout Regulators (LDO)

Texas Instruments growing portfolio of standard Low Drop Out (LDO) Linear Regulators offers customers superior performance in small packages and includes value-added features like thermal overload protection, safety current limits, and a shutdown mode that drastically reduces current consumption. TI offers fixed and adjustable output voltage options, up to 2.0 A of output current, and dropout voltages down to 80 mV. To help you select the best LDO for your application, TI offers a handy online parametric search tool to insure optimal performance.

Shunt Voltage Reference

Texas Instruments offers a wide range of precision shunt voltage references, which are great for applications requiring better performance than a zener diode can provide. Shunt regulators have the benefit of no input voltage max and excellent supply rejection (PSRR). They can be used to create negative or floating reference voltages.

Voltage Supervisors

Texas Instruments¹ voltage supervisors offer a wide range of adjustable and fixed sense values, from 3.3 V to 15 V. With TI's voltage supervisors, designers have reliable voltage management with an operating supply voltage range from 1.8 V to 40 V. These parts provide low voltage activation and are ideal for computer resets and delay timers.

→ Linear Regulators

Fixed Linear Regulators (1.5 A, 500 mA and 100 mA)

uA78xx, uA78Mxx, uA78LxxA

Get samples, datasheets and app reports at: www.ti.com/sc/device/uA78xx, [uA78Mxx](http://www.ti.com/sc/device/uA78Mxx) or [uA78LxxA](http://www.ti.com/sc/device/uA78LxxA)

Key Features

- Three-terminal regulators
- Output current up to:
 - o uA78xx series: 1.5 A
 - o uA78Mxx series: 500 mA
 - o uA78LxxA series: 100 mA
- Internal thermal overload protection
- High power dissipation capability
- Internal short-circuit current limiting
- Output transistor safe area compensation

Applications

- Power supplies
- Local regulations
- Set-top boxes

This series of fixed-voltage integrated-circuit voltage regulators is designed for a wide range of applications. These applications include on-card regulation for elimination of noise and distribution problems associated with single-point regulation. Each of these regulators can deliver up to 1.5 A (uA78xx), 500 mA (uA78Mxx) or 100 mA (uA78LxxA) of output current. The internal current-limiting and thermal-shutdown features of these regulators essentially make them immune to overload. In addition, to use as fixed-voltage regulators, these devices can be used with external components to obtain adjustable output voltages and currents, and also can be used as the power-pass element in precision regulators.

Voltage and Current Options

Output Current (mA)	2.5-V Output	3.3-V Output	5-V Output	6-V Output	8-V Output
100	uA78L02A	—	uA78L05A uA78L05	uA78L06A	uA78L08A uA78L08
500	—	uA78M33	uA78M05	uA78M06	uA78M08
1,500	—	—	uA7805	—	uA7808

Voltage and Current Options

Output Current (mA)	9-V Output	10-V Output	12-V Output	15-V Output	24-V Output
100	uA78L09A	uA78L10A	uA78L12A	uA78L15A	—
500	uA78M09	uA78M10	uA78M12	—	—
1,500	—	uA7810	uA7812	uA7815	uA7824

→ Linear Regulators

Adjustable Linear Regulators (1.5 A, 500 mA and 100 mA)

LM317, LM317M, LM317L, TL317

Get samples, datasheets and app reports at: www.ti.com/sc/device/LM317, [LM317M](http://www.ti.com/sc/device/LM317M), [LM317L](http://www.ti.com/sc/device/LM317L) or [TL317](http://www.ti.com/sc/device/TL317)

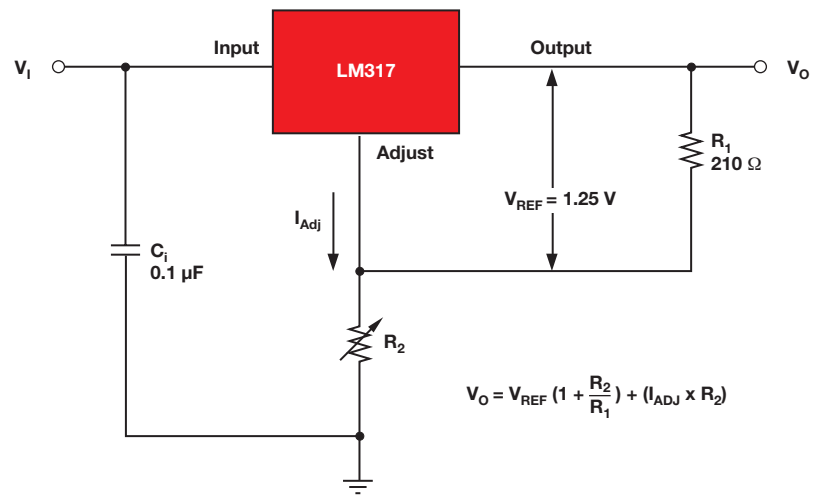
Key Features

- Output voltage range adjustable from 1.25 V to 37 V (LM317, LM317M) or 32 V (LM317L, TL317)
- Output current greater than 1.5 A (LM317), 500 mA (LM317M), or 100 mA (LM317L and TL317)
- Internal short-circuit current limiting
- Thermal overload protection
- Output safe area compensation

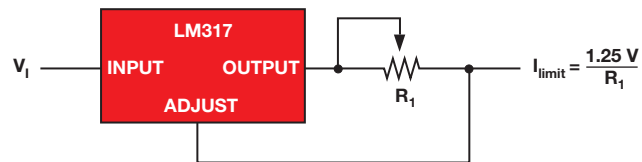
Applications

- Power supplies
- Current limiting

This series of parts are adjustable three-terminal positive-voltage regulators capable of supplying more than 1.5 A (LM317), 500 mA (LM317M), or 100 mA (LM317L and TL317) over an output voltage range of 1.25 V to 37 V (LM317, LM317M) or 32 V (LM317L, TL317). They are exceptionally easy to use and require only two external resistors to set the output voltage. Furthermore, both line and load regulation are better than standard fixed regulators. In addition to having higher performance than fixed regulators, these devices include on-chip current limiting, thermal overload protection and safe operating area protection. All overload protection remains fully functional, even if the ADJUST terminal is disconnected.



Adjustable voltage regulator.



Precision current-limiter circuit.

→ Switching Regulators

Pulse-Width Modulation Control Circuits

TL494, TL594

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL494 or [TL594](http://www.ti.com/sc/device/TL594)

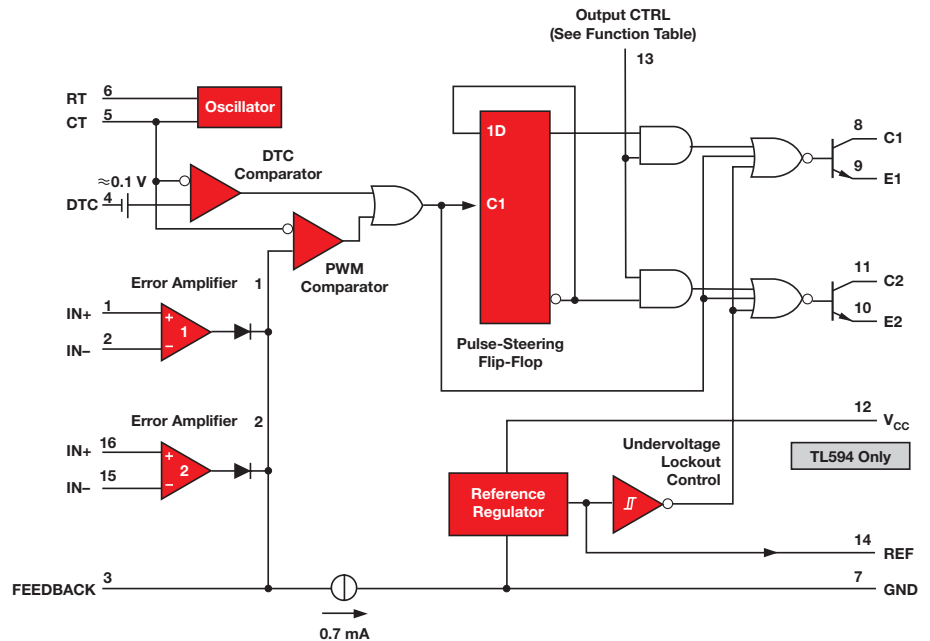
Key Features

- Complete PWM power-control circuitry
- Uncommitted outputs for 200-mA sink or source current
- Output control selects single-ended or push-pull operation
- Internal circuitry prohibits double pulse at either output
- Internal regulator provides a stable 5 V reference supply with 5% tolerance
- TL594 provides undervoltage lockout for low- V_{CC} conditions and 1% reference supply tolerance

Applications

- Switching regulators of either polarity
- Transformer-coupled DC/DC converters
- Transformerless voltage doublers

The TL494 and TL594 incorporate all of the functions required in the construction of a pulse-width modulation (PWM) control circuit on a single chip. Designed primarily for power-supply control, these devices offer the flexibility to tailor the power-supply control circuitry to a specific application. The TL494 and TL594 contain two error amplifiers, an on-chip adjustable oscillator, a dead-time control (DTC) comparator, a pulse-steering control flip-flop, a 5-V regulator with a precision of 5 percent (TL494) or 1 percent (TL594) and output control circuits. In addition, the TL594 provides an undervoltage lockout control circuit.



Functional block diagram.

→ Switching Regulators

Pulse-Width Modulation Controllers with Current-Limit Offset

SG2524, SG3524

Get samples, datasheets and app reports at: www.ti.com/sc/device/SG2524 or [SG3524](http://www.ti.com/sc/device/SG3524)

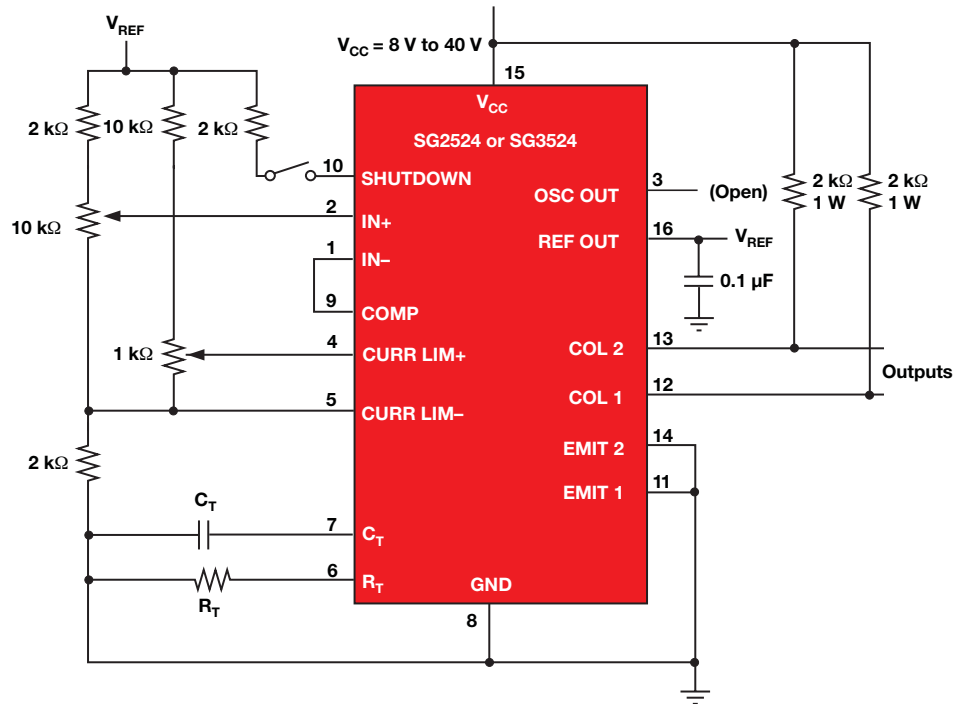
Key Features

- Complete pulse-width modulation (PWM) power control circuitry
- Uncommitted outputs for single-ended or push-pull applications
- Low standby current: 8 mA typical

Applications

- Switching regulators of either polarity
- Transformer-coupled DC/DC converters
- Transformerless voltage doublers
- Polarity converter applications employing fixed-frequency PWM techniques

The SG2524 and SG3524 incorporate all of the functions required in the construction of a regulating power supply, inverter, or switching regulator on a single chip. They can also be used as the control element for high-power-output applications. The complementary output allows either single-ended or push-pull applications. Each device includes an on-chip regulator, error amplifier, programmable oscillator, pulse-steering flip-flop, two uncommitted pass transistors, a high-gain comparator, and current-limiting and shutdown circuitry.



General test circuit.

→ Switching Regulators

Current-Mode Pulse-Width Modulation Controllers

TL284x, TL384x, TL284xB, TL384xB

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL284x, [TL384x](http://www.ti.com/sc/device/TL384x), [TL284xB](http://www.ti.com/sc/device/TL284xB) or [TL384xB](http://www.ti.com/sc/device/TL384xB)

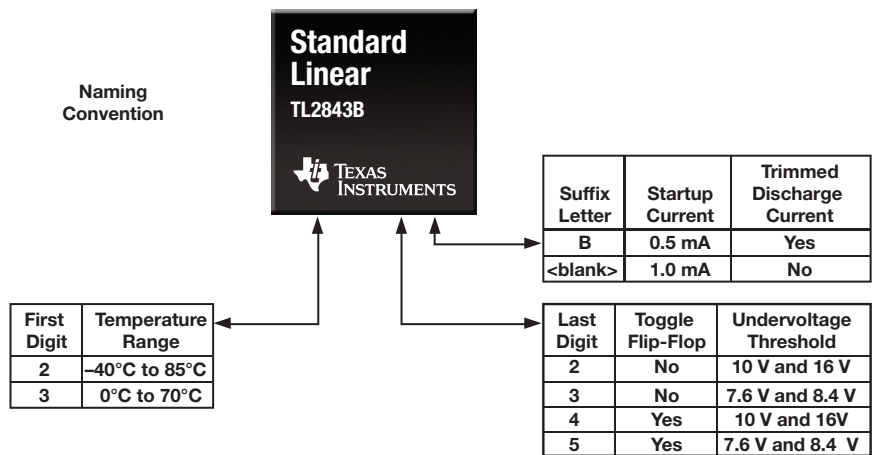
Key Features

- Optimized for offline and DC/DC converters
- Low startup current
- Automatic feed-forward compensation
- Pulse-by-pulse current limiting
- Undervoltage lockout with hysteresis
- Double-pulse suppression

Applications

- Switching regulators of either polarity
- Transformer-coupled DC/DC converters

The TL284x(B) and TL384x(B) series of control integrated circuits provide the features needed to implement offline or DC/DC fixed-frequency current-mode control schemes, with a minimum number of external components. Some of the internally implemented circuits are an undervoltage lockout (UVLO) featuring a startup current of less than 1 mA (0.5 mA for the TL284xB and TL384xB) and a precision reference trimmed for accuracy at the error amplifier input. Other internal circuits include logic to ensure latched operation, a pulse-width modulation (PWM) comparator (that also provides current-limit control), and a totem-pole output stage designed to source or sink high-peak current. Major differences between members of these series are the UVLO thresholds and maximum duty-cycle ranges.



→ Switching Regulators

1.5-A Peak Switching Regulators

MC33063A, MC34063A

Get samples, datasheets and app reports at: www.ti.com/sc/device/MC33063A or [MC34063A](http://www.ti.com/sc/device/MC34063A)

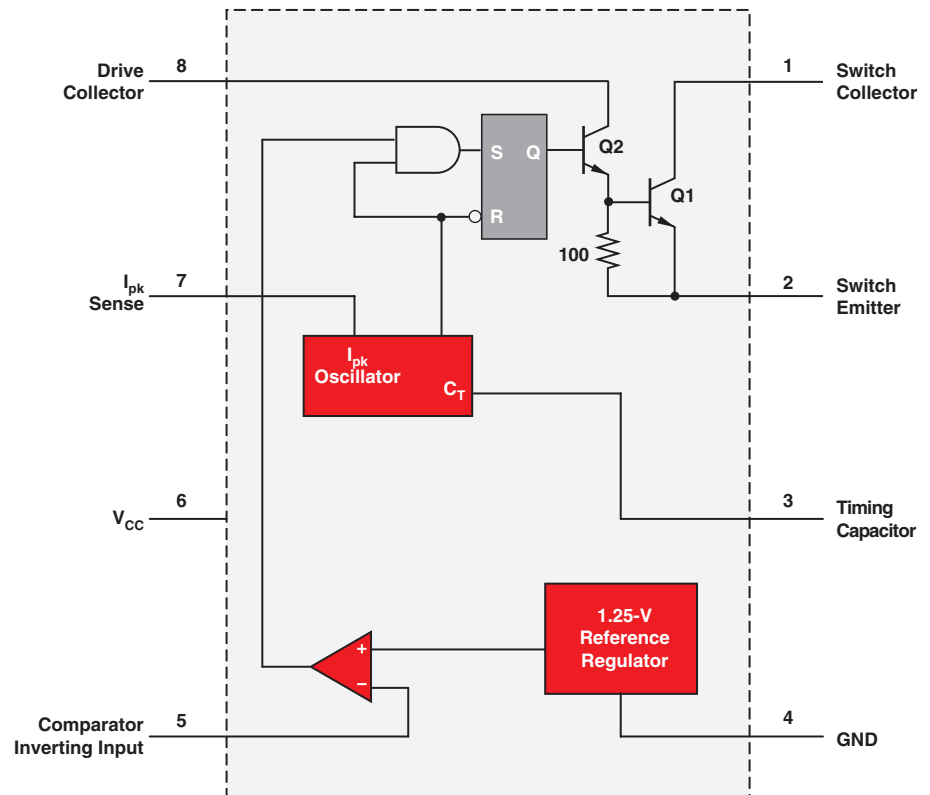
Key Features

- Wide-input voltage range: 3 V to 40 V
- High output switch current: up to 1.5 A
- Adjustable output voltage
- Oscillator frequency up to 100 kHz
- Precision internal reference: 2%
- Short-circuit current limiting
- Low standby current

Applications

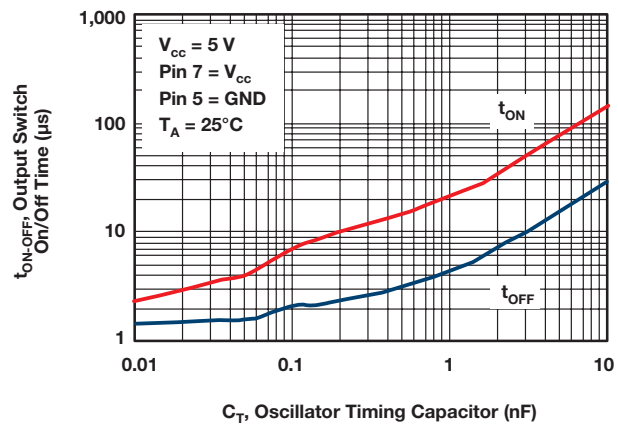
- Boost switching regulators
- Buck switching regulators
- Inverting switching regulators

The MC33063A and MC34063A are easy-to-use ICs containing all of the primary circuitry needed for building simple DC/DC converters. These devices primarily consist of an internal temperature-compensated reference, a comparator, an oscillator, a pulse-width modulation controller with active current limiting, a driver and a high-current output switch. The devices require minimal external components to build converters in the boost, buck and inverting topologies.



Functional block diagram.

Output Switch On/Off Time vs. Oscillator Timing Capacitor



→ Switching Regulators

800-mA Low-Dropout Adjustable and Fixed-Voltage Regulators

TLV1117, TLV1117-xx

Get samples, datasheets and app reports at: www.ti.com/sc/device/TLV1117 or [TLV1117-xx](http://www.ti.com/sc/device/TLV1117-xx)

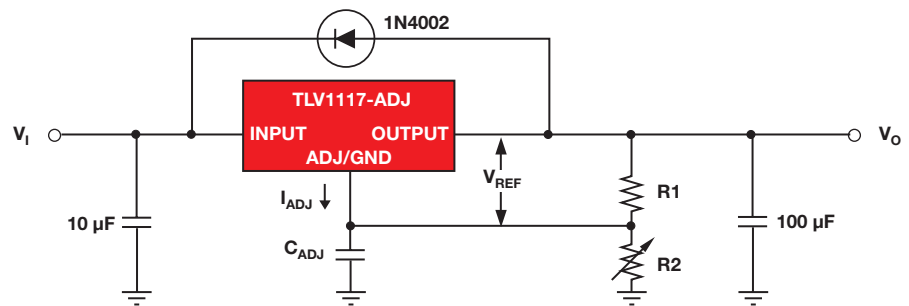
Key Features

- 1.5-V, 1.8-V, 2.5-V, 3.3-V, 5-V and adjustable-output voltage options
- Output current of 800 mA
- Specified dropout voltage at multiple current levels
- 0.2% line regulation max
- 0.4% load regulation max

Applications

- Power supplies
- Set-top boxes
- Laptops

The TLV1117 is a positive low-dropout voltage regulator designed to provide up to 800 mA of output current. The device is available in 1.5-V, 1.8-V, 2.5-V, 3.3-V, 5-V and adjustable-output voltage options. All internal circuitry is designed to operate down to 1-V input-to-output differential. Dropout voltage is specified at a maximum of 1.3 V at 800 mA, decreasing at lower load currents. The TLV1117 is designed to be stable with tantalum and aluminum electrolytic output capacitors having an ESR between 0.2 Ω and 10 Ω. Unlike pnp-type regulators, in which up to 10 percent of the output current is wasted as quiescent current, the quiescent current of the TLV1117 flows into the load, increasing efficiency.



$$V_{OUT} \text{ is calculated as: } V_{OUT} = V_{REF} \left(1 + \frac{R2}{R1}\right) + (I_{ADJ} \times R2)$$

Because I_{ADJ} typically is 55 µA, it is negligible in most applications.

Application information.

750-mA and 150-mA Low-Dropout Fixed-Voltage Regulators

TL750Mxx, TL750Lxx, TL751Lxx

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL750Mxx, [TL750Lxx](http://www.ti.com/sc/device/TL750Lxx) or [TL751Lxx](http://www.ti.com/sc/device/TL751Lxx)

Key Features

- Very low dropout voltage, less than 0.6 V at 150 mA (750 mA for the TL750Mxx)
- Very low quiescent current
- 60-V load-dump protection
- Overvoltage protection
- Internal thermal-overload protection
- Internal overcurrent-limiting circuitry

Applications

- Battery-powered systems
- Automotive (Q1 available)
- Set-top boxes

The TL750L, TL751L and TL750M series of fixed-output voltage regulators offer 5-V, 8-V, 10-V and 12-V options. The TL751L series also has an enable (ENABLE) input. When ENABLE is high, the regulator output is placed in the high-impedance state. This gives the designer complete control over power up, power down or emergency shutdown. This series of low-dropout positive-voltage regulators are specifically designed for battery-powered systems. These devices incorporate overvoltage and current-limiting protection circuitry, along with internal reverse-battery protection circuitry, to protect the devices and the regulated system. The series is fully protected against 60-V load-dump and reverse-battery conditions. Extremely low quiescent current during full-load conditions makes these devices ideal for standby power systems.

Low-Dropout Fixed-Voltage Regulators

Output Current (mA)	Shutdown	5-V Output	8-V Output	10-V Output	12-V Output
150	No	TL750L05	TL750L08	TL750L10	TL750L12
150	Yes	TL751L05	—	TL751L10	TL751L12
750	No	TL750M05	TL750M08	TL750M10	TL750M12

→ Low-Dropout Regulators

100-mA Ultra-Low-Dropout Fixed Regulators with Shutdown

LP2981-xx, LP2981A-xx

Get samples, datasheets and app reports at: www.ti.com/sc/device/LP2981-xx or [LP2981A-xx](http://www.ti.com/sc/device/LP2981A-xx)

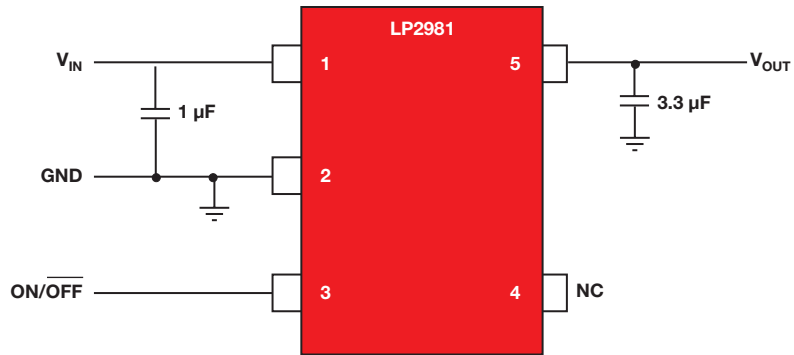
Key Features

- Output tolerance of 0.75% (A grade) or 1.25% (standard grade)
- Ultra-low dropout, typically 200 mV at full load of 100 mA
- Low quiescent current
- Shutdown current: 0.01 μ A typical
- ESD protection exceeds JESD 22

The LP2981 family of fixed-output, low-dropout regulators offers exceptional, cost-effective performance for both portable and nonportable applications. Available in fixed voltages of 2.8 V, 3 V, 3.3 V and 5 V, the family has an output tolerance of 0.75 percent for the A-grade devices (1.25 percent for the standard grade) and is capable of delivering 100-mA continuous load current. Standard regulator features such as overcurrent and overtemperature protection are included. The LP2981 has features that make this regulator an ideal candidate for a variety of portable applications, including low dropout, low quiescent current, shutdown and small packaging.

Applications

- Mobile phones
- Laptops
- Digital cameras and camcorders
- CD and MP3 players



Basic application circuit.

100-mA Low-Dropout Adjustable and Fixed-Voltage Regulators

LP2950-xx, LP2951-xx

Get samples, datasheets and app reports at: www.ti.com/sc/device/LP2950-xx or [LP2951-xx](http://www.ti.com/sc/device/LP2951-xx)

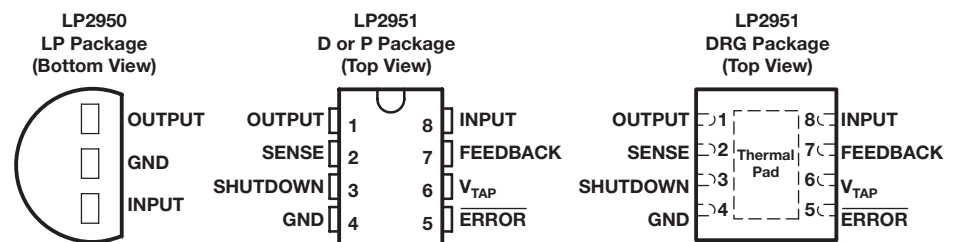
Key Features

- Wide input voltage range: up to 30 V
- Rated output current of 100 mA
- Low dropout: 380 mV (typical) at 100 mA
- Low quiescent current: 75 μ A (typical)
- Tight line regulation: 0.03% (typical)
- Tight load regulation: 0.04% (typical)

The LP2950 and LP2951 devices are bipolar, low-dropout voltage regulators that can accommodate a wide-input supply-voltage range of up to 30 V. The easy-to-use, three-pin LP2950 is available in fixed-output voltages of 5 V, 3.3 V and 3 V. However, the eight-pin LP2951 is able to output either a fixed or adjustable output from the same device. By tying the OUTPUT and SENSE pins together, and the FEEDBACK and VTAP pins together, the LP2951 outputs a fixed 5 V, 3.3 V or 3 V (depending on the version). Alternatively, by leaving the SENSE and VTAP pins open and connecting FEEDBACK to an external resistor divider, the output can be set to any value between 1.235 V to 30 V. The eight-pin LP2951 also offers additional functionality that makes it particularly suitable for battery-powered applications.

Applications

- Laptops
- Digital cameras and camcorders
- CD and MP3 players



Packaging information.

→ Low-Dropout Regulators

150 mA Low-Noise Low-Dropout Fixed Regulators with Shutdown

LP2985-xx, LP2985A-xx

Get samples, datasheets and app reports at: www.ti.com/sc/device/LP2985-xx or [LP2985A-xx](http://www.ti.com/sc/device/LP2985A-xx)

Key Features

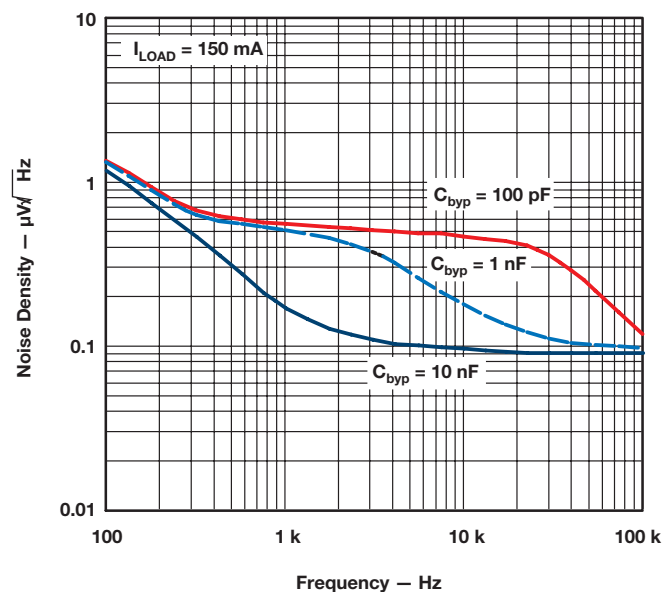
- Output tolerance of: 1% (A grade) or 1.5% (standard grade)
- Ultra-low dropout, typically 280 mV at full load of 150 mA
- Low quiescent current
- Shutdown current: 0.01 mA typical
- Low noise: 30 μV_{RMS} with 10-nF bypass capacitor
- ESD protection exceeds JESD 22

Applications

- Mobile phones
- Laptops
- Digital cameras and camcorders
- CD and MP3 players

The LP2985 family of fixed-output, low-dropout regulators offers exceptional, cost-effective performance for both portable and non-portable applications. Available in voltages of 1.8 V, 2.5 V, 2.8 V, 2.9 V, 3 V, 3.1 V, 3.3 V, 5 V and 10 V, the family has an output tolerance of 1 percent for the A version (1.5 percent for the non-A version) and is capable of delivering 150-mA continuous load current. Standard regulator features such as overcurrent and overtemperature protection are included. The LP2985 has a host of features that makes this regulator an ideal candidate for a variety of portable applications, including low dropout, low quiescent current, shutdown, low-ESR capacitor-friendly, low noise and small packaging.

Output Noise Density vs. Frequency



→ Shunt Voltage References

Adjustable Shunt Regulators (2.495 V to 36 V) (1 mA to 100 mA)

TL431, TL432, TL431A, TL432A, TL431B, TL432B

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL431, [TL432](http://www.ti.com/sc/device/TL432), [TL431A](http://www.ti.com/sc/device/TL431A), [TL432A](http://www.ti.com/sc/device/TL432A), [TL431B](http://www.ti.com/sc/device/TL431B) or [TL432B](http://www.ti.com/sc/device/TL432B)

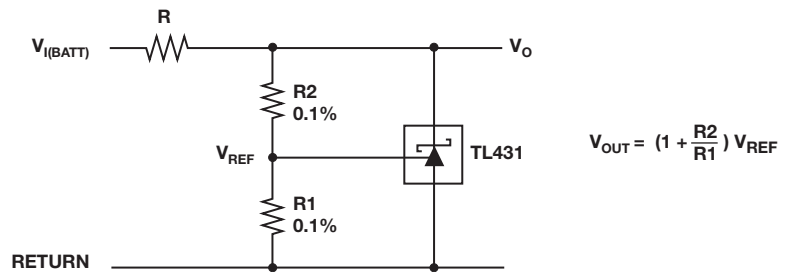
Key Features

- Reference voltage tolerance at 25°C: 0.5% (B grade), 1% (A grade), or 2% (standard grade)
- Low output noise
- 0.2-Ω typical output impedance
- Sink-current capability: 1 mA to 100 mA
- Adjustable output voltage to 36 V

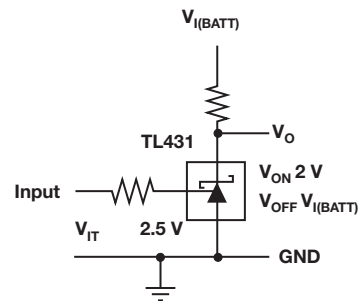
Applications

- Power supplies
- Reference generation
- Control systems

The TL431 and TL432 are three-terminal adjustable shunt regulators with specified thermal stability over applicable automotive, commercial and military temperature ranges. The output voltage can be set to any value between V_{REF} (approximately 2.5 V) and 36 V, with two external resistors. These devices have a typical output impedance of 0.2 Ω. Active output circuitry provides a very sharp turn-on characteristic, making these devices excellent replacements for Zener diodes in many applications such as onboard regulation, adjustable power supplies and switching power supplies. The TL432 has exactly the same functionality and electrical specifications as the TL431, but has different pinouts for the DBV, DBZ and PK packages. Both the TL431 and TL432 devices are offered in three grades, with initial tolerances (at 25°C) of 0.5 percent, 1 percent, and 2 percent, for the B, A and standard grades, respectively. In addition, low output drift vs. temperature ensures good stability over the entire temperature range.



Shunt regulator.



Comparator.

→ Shunt Voltage References

Adjustable Shunt Regulators (1.25 V to 6 V) (0.1 mA to 15 mA)

TLV431, TLV431A

Get samples, datasheets and app reports at: www.ti.com/sc/device/TLV431 or [TLV431A](http://www.ti.com/sc/device/TLV431A)

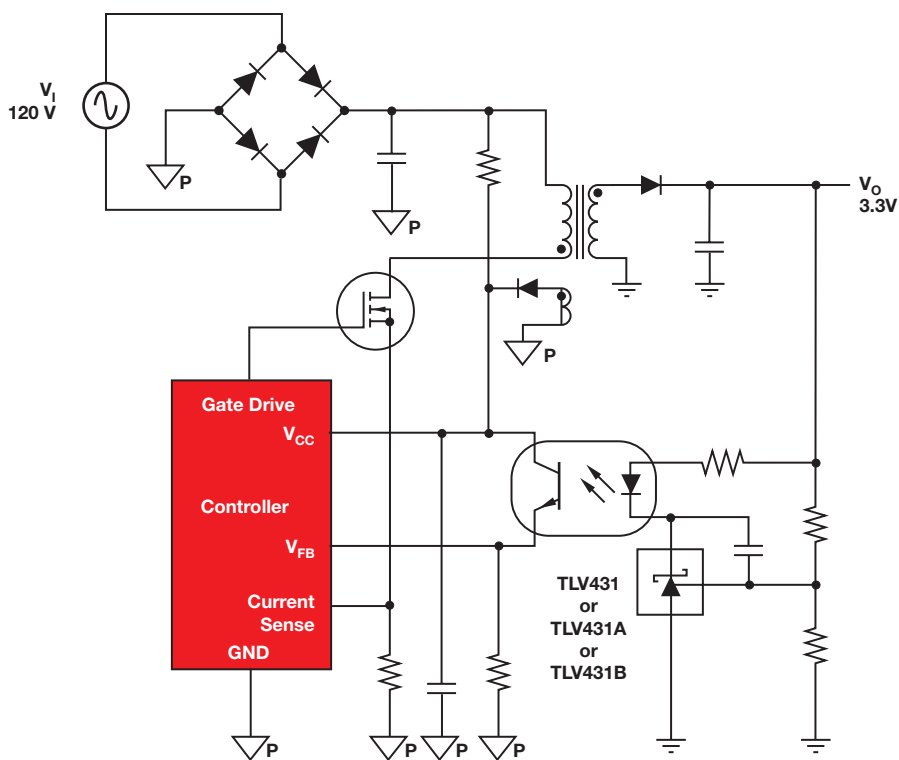
Key Features

- Low-voltage operation:
 $V_{REF} = 1.24 \text{ V}$
- Adjustable output voltage to 6 V
- Adjustable reference voltage tolerances at 25°C: 0.5% (TLV431B), 1% (TLV431A), and 1.5% (TLV431)
- Low operational cathode current: 80 μA typical
- 0.25- Ω typical output impedance

Applications

- Power supplies
- Reference generation
- Control systems

The TLV431 is a low-voltage three-terminal adjustable voltage reference with specified thermal stability over applicable industrial and commercial temperature ranges. Output voltage can be set to any value between V_{REF} (1.24 V) and 6 V with two external resistors. When used with an optocoupler, the TLV431 is an ideal voltage reference in isolated feedback circuits for 3-V to 3.3-V switching-mode power supplies. These devices have a typical output impedance of 0.25 Ω . Active output circuitry provides a very sharp turn-on characteristic, making this an excellent replacement for low-voltage Zener diodes in many applications, including on-board regulation and adjustable power supplies.



Flyback with isolation using TLV431, TLV431A or TLV431B as voltage reference and error amplifier.

→ Shunt Voltage References

Adjustable Shunt Regulators (1.25 V to 18 V) (0.1 mA to 70 mA)

TLVH431, TLVH431A

Get samples, datasheets and app reports at: www.ti.com/sc/device/TLVH431 or [TLVH431A](http://www.ti.com/sc/device/TLVH431A)

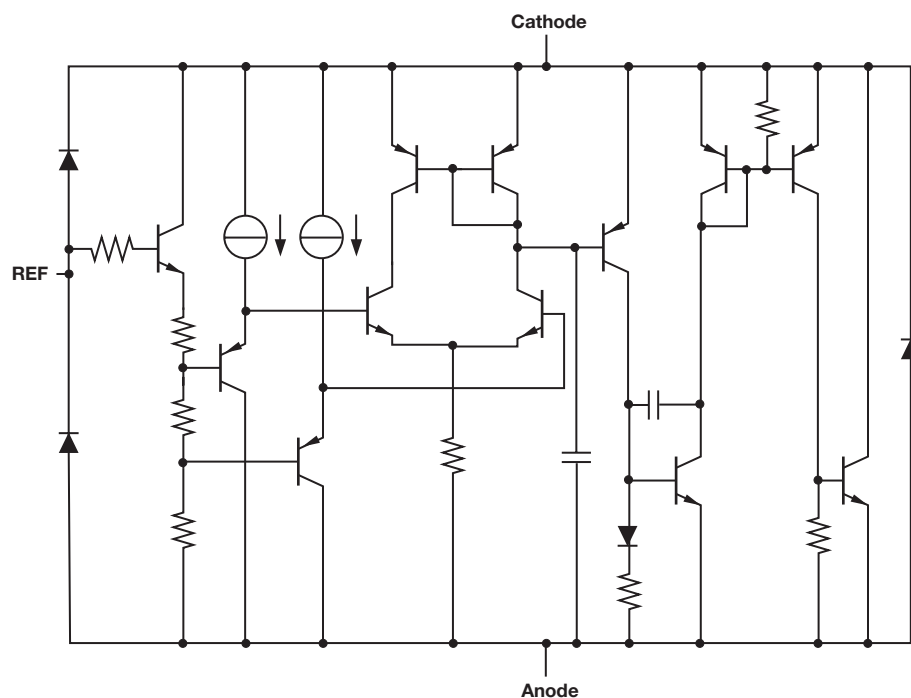
Key Features

- Low-voltage operation:
 $V_{REF} = 1.24 \text{ V}$
- Adjustable output voltage to 18 V
- Adjustable reference voltage tolerances at 25°C: 0.5% (B grade), 1% (A grade), and 1.5% (standard grade)
- Wide operational cathode current: 100 μA to 70 mA
- 0.25- Ω typical output impedance

Applications

- Power supplies
- Reference generation
- Control systems

The TLVH431 and TLVH431A are low-voltage three-terminal adjustable voltage references, with specified thermal stability over applicable industrial and commercial temperature ranges. Output voltage can be set to any value between V_{REF} (1.24 V) and 18 V with two external resistors. When used with an optocoupler, the TLVH431 and TLVH431A are ideal voltage references in isolated feedback circuits for 3-V to 3.3-V switching-mode power supplies. They have a typical output impedance of 0.25 Ω . Active output circuitry provides a very sharp turn-on characteristic, making the TLVH431 and TLVH431A excellent replacements for low-voltage Zener diodes in many applications, including on-board regulation and adjustable power supplies.



Equivalent schematic.

→ Shunt Voltage References

Fixed and Adjustable Shunt Regulators

TL4050, TL4051

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL4050 or [TL4051](http://www.ti.com/sc/device/TL4051)

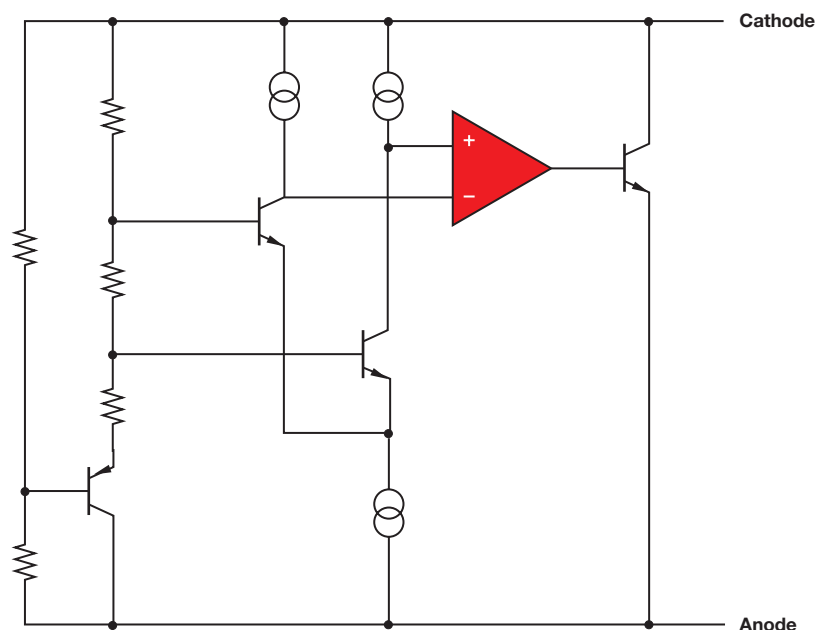
Key Features

- Fixed and adjustable outputs available: TL4051 offers both, TL4050 is fixed only
- Tight output tolerances and low temperature coefficient: Max 0.1%, 50 ppm/°C (A grade); Max 0.2%, 50 ppm/°C (B grade); Max 0.5%, 50 ppm/°C (C grade)
- Low output noise: 20 μV_{RMS} (TL4051), 41 μV_{RMS} (TL4050)
- Wide operating current range: 60 μA to 12 mA (TL4051) or 15 mA (TL4050)

Applications

- Data acquisition systems
- Power supplies
- Instrumentation and test equipment
- Process control

The TL4050 and TL4051 series of shunt voltage references are versatile easy-to-use references suitable for a wide array of applications. The devices are available in a fixed 1.225-V output (TL4051), 2.5-V, 4.096-V, 5-V or 10-V output (TL4050), or an adjustable output whose voltage is determined by an external resistor divider (TL4051). The device requires no external capacitors for operation and is stable with all capacitive loads. Additionally, the reference offers low dynamic impedance, low noise and low temperature coefficient to ensure a stable output voltage over a wide range of operating currents and temperatures. The TL4050 and TL4051 are offered in three initial tolerances, ranging from 0.1 percent (max) for the A grade to 0.5 percent (max) for the C grade.



Functional block diagram.

→ Shunt Voltage References

Very Low-Current Fixed-Voltage Shunt Regulators

LM285-1.2, LM385-1.2, LM385B-1.2, LM285-2.5, LM385-2.5, LM385B-2.5

Get samples, datasheets and app reports at: www.ti.com/sc/device/LM285-1.2, [LM385-1.2](http://www.ti.com/sc/device/LM385-1.2), [LM385B-1.2](http://www.ti.com/sc/device/LM385B-1.2), [LM285-2.5](http://www.ti.com/sc/device/LM285-2.5), [LM385-2.5](http://www.ti.com/sc/device/LM385-2.5) or [LM385B-2.5](http://www.ti.com/sc/device/LM385B-2.5)

Key Features

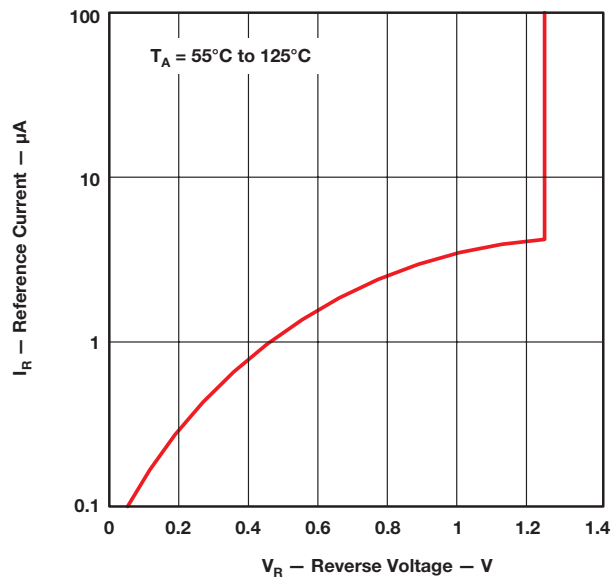
- Operating current ranges from 10 μA to 20 mA
- 1% to 3% initial voltage tolerances available
- Reference impedance: 1 Ω max at 25°C
- Very low power consumption

Applications

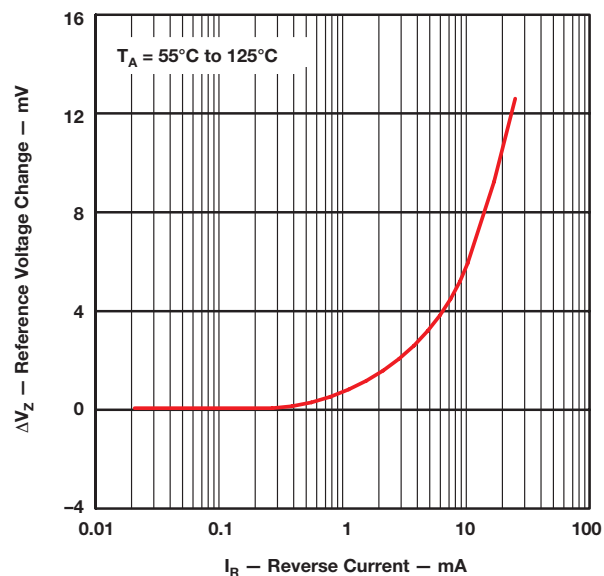
- Portable meter references
- Portable test instruments
- Battery-operated systems

These micropower two-terminal band-gap voltage references operate over a 10- μA to 20-mA (LM285-1.2, LM385-1.2) or 20- μA to 20-mA (LM285-2.5, LM385-2.5) current range and feature exceptionally low dynamic impedance and good temperature stability. On-chip trimming provides tight voltage tolerance. The band-gap reference for these devices has low noise and long-term stability. The design makes these devices exceptionally tolerant of capacitive loading, and thus easier to use in most reference applications. The wide dynamic operating temperature range accommodates varying current supplies, with excellent regulation. The extremely low power drain of this series makes them useful for micropower circuitry.

Reverse Current vs. Reverse Voltage



Reverse Current vs. Reverse Voltage



→ Shunt Voltage References

Fixed Shunt Regulator with Null Offset Pin

LT1009

Get samples, datasheets and app reports at: www.ti.com/sc/device/LT1009

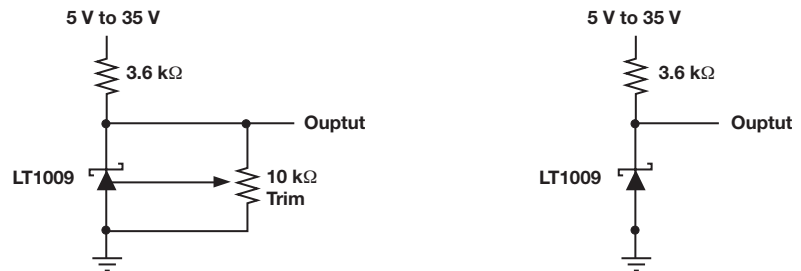
Key Features

- Excellent temperature stability
- Initial tolerance: 0.2% max
- Dynamic impedance: 0.6 Ω max
- Wide operating current range
- Needs no adjustment for minimum temperature coefficient

Applications

- 8-bit analog-to-digital converter and digital-to-analog converter references
- Digital voltmeters
- Current-loop measurements
- Control systems

The LT1009 reference circuit is a precision-trimmed 2.5-V shunt regulator featuring low dynamic impedance and a wide operating current range. The maximum initial tolerance is ± 5 mV in the LP package and ± 10 mV in the D and PW packages. The reference tolerance is achieved by on-chip trimming, which minimizes the initial voltage tolerance and the temperature coefficient. Although the LT1009 needs no adjustments, a third terminal (ADJ) allows the reference voltage to be adjusted ± 5 percent to eliminate system errors.



Reference circuits.

→ Voltage Supervisors

Voltage Supervisors

TL7702A, TL7705A, TL7709A, TL7712A, TL7715A

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL7702A, [TL7705A](http://www.ti.com/sc/device/TL7705A), [TL7709A](http://www.ti.com/sc/device/TL7709A), [TL7712A](http://www.ti.com/sc/device/TL7712A) or [TL7715A](http://www.ti.com/sc/device/TL7715A)

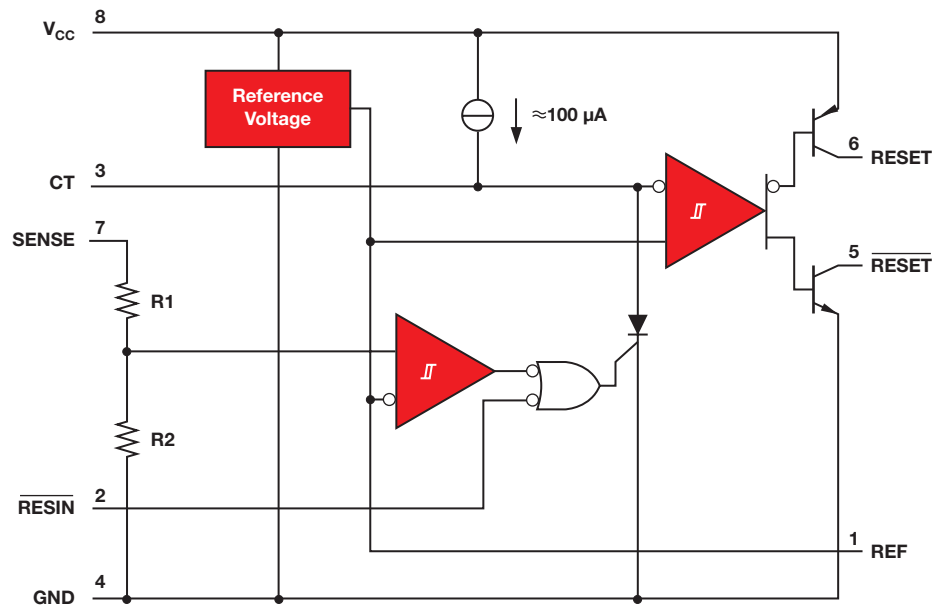
Key Features

- Power-on reset generator
- Automatic reset generation after voltage drop
- Wide supply-voltage range
- Precision voltage sensor
- Temperature-compensated voltage reference
- True and complement reset outputs
- Externally adjustable pulse duration

Applications

- Microcomputer resets
- Undervoltage lockout
- Delay timers

The TL77xxA family of integrated circuit supply-voltage supervisors is designed specifically for use as reset controllers in microprocessor systems. During power up, the $\overline{\text{RESET}}$ output becomes active (low) when V_{CC} attains a value approaching 3.6 V. At this point (assuming that SENSE is above $V_{\text{IT}+}$), the delay timer function activates a time delay, after which outputs $\overline{\text{RESET}}$ and RESET go inactive. When an undervoltage condition occurs during normal operation, $\overline{\text{RESET}}$ and RESET go active. The reset outputs remain active for a time delay after the voltage at the SENSE input exceeds the positive-going threshold value. During power down and when SENSE is below $V_{\text{IT}-}$, the outputs remain active until V_{CC} falls below 2 V.



Functional block diagram.

→ Voltage Supervisors

Voltage Supervisors with Low-Voltage Activation

TL7702B, TL7733B, TL7705B

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL7702B, [TL7733B](http://www.ti.com/sc/device/TL7733B) or [TL7705B](http://www.ti.com/sc/device/TL7705B)

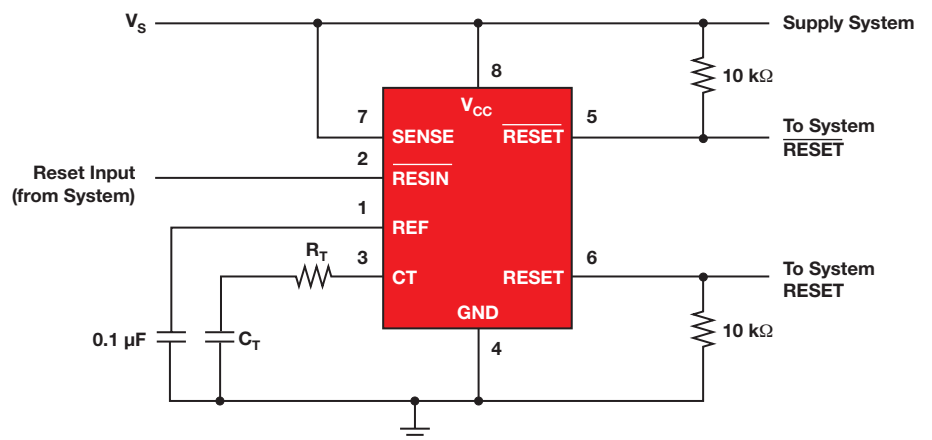
Key Features

- Power-on reset generator
- Automatic reset generation after voltage drop
- RESET output defined from $V_{CC} \geq 1\text{ V}$
- Precision voltage sensor
- Temperature-compensated voltage reference
- True and complement reset outputs
- Externally adjustable pulse duration

Applications

- Microcomputer resets
- Undervoltage lockout
- Delay timers

The TL7702B, TL7705B and TL7733B are integrated circuit supply-voltage supervisors designed for use as reset controllers in microprocessor systems. During power up, the $\overline{\text{RESET}}$ output becomes active (low) when V_{CC} attains a value approaching 1 V. As V_{CC} approaches 3 V (assuming that SENSE is above V_{T+}), the delay-timer function activates a time delay, after which outputs $\overline{\text{RESET}}$ and RESET go inactive. When an undervoltage condition occurs during normal operation, outputs $\overline{\text{RESET}}$ and RESET go active. The reset outputs remain active for a time delay after the voltage at the SENSE input exceeds the positive-going threshold value.



System reset controller with undervoltage sensing.

→ Voltage Supervisors

High-Accuracy Adjustable Voltage Supervisor

TL7700

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL7700

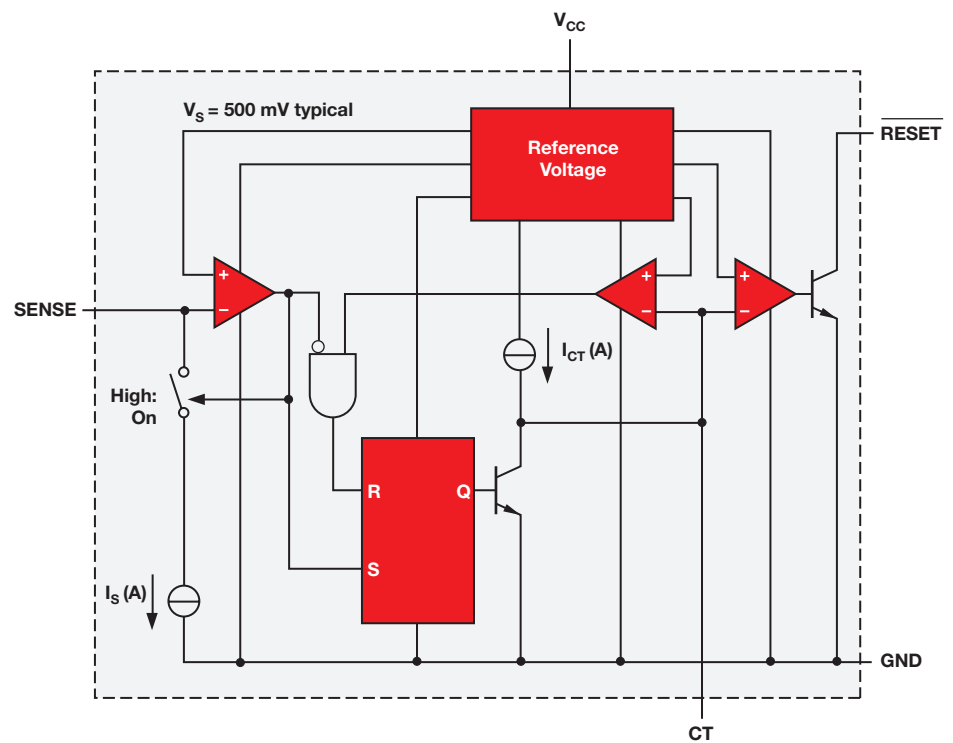
Key Features

- Adjustable sense voltage with two external resistors
- Adjustable hysteresis of sense voltage
- Wide operating supply-voltage range: 1.8 V to 40 V
- Wide operating temperature range
- Low power consumption
- Minimum external components

Applications

- Microcomputer resets
- Undervoltage lockout
- Delay timers

The TL7700 is a bipolar integrated circuit designed for use as a reset controller in microcomputer and microprocessor systems. The SENSE voltage can be set to any value greater than 0.5 V using two external resistors. The hysteresis value of the sense voltage can also be set by the same resistors. The device includes a precision voltage reference, fast comparator, timing generator and output driver, so it can generate a power-on reset signal in a digital system. The TL7700 has an internal 1.5-V temperature-compensated voltage reference from which all function blocks are supplied. Circuit function is very stable, with supply voltage in the 1.8-V to 40-V range. Minimum supply current allows use with AC line operation, portable battery operation and automotive applications.



Functional block diagram.

→ Voltage Supervisors

Three-Pin 5-V Fixed-Voltage Supervisor

TL7757

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL7757

Key Features

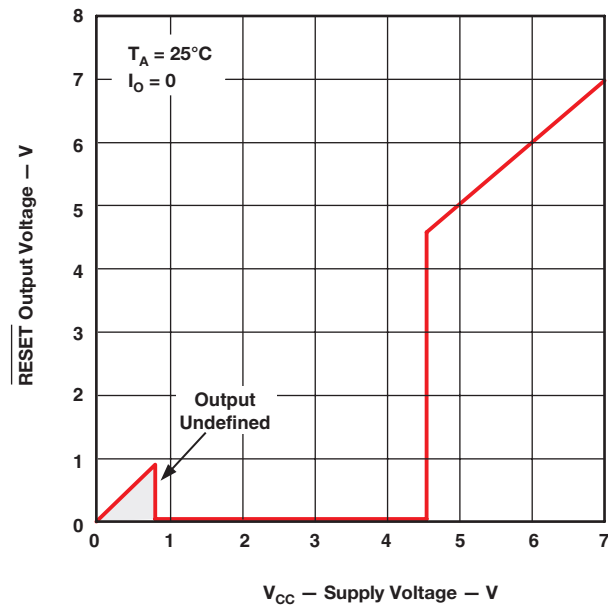
- Power-on reset generator
- Automatic reset generation after voltage drop
- Low standby current
- RESET output defined from $V_{CC} \geq 1\text{ V}$
- Precision threshold voltage: $4.55\text{ V} \pm 120\text{ mV}$
- High output sink capability: 20 mA
- Comparator hysteresis prevents erratic resets

Applications

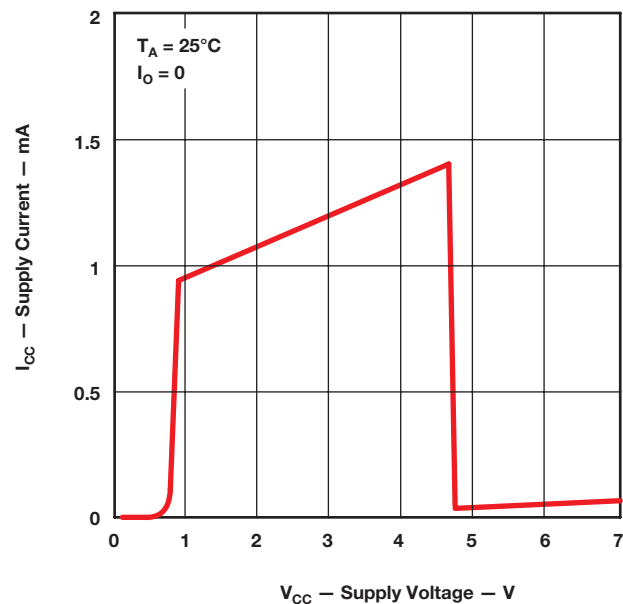
- Microcomputer resets
- Undervoltage lockout

The TL7757 is a supply-voltage supervisor designed for use in microcomputer and microprocessor systems. The supervisor monitors the supply voltage for undervoltage conditions. During power up, when the supply voltage V_{CC} attains a value approaching 1 V , the RESET output becomes active (low) to prevent undefined operation. If the supply voltage drops below threshold voltage level (V_{IT}), the RESET output goes to the active (low) level until the supply undervoltage fault condition is eliminated.

Supply Voltage vs. RESET Output Voltage



Supply Current vs. Supply Voltage



 Selection Tables

Linear Regulators

Part Number	Description	V _{IN} (Min) (V)	V _{IN} (Max) (V)	V _{OUT} (Min) (V)	V _{OUT} (Max) (V)	I _{OUT} (Max) (A)	I _q (typ) (mA)	V _{DO} (typ) (V)	Pin/Package	Price*
LM237	3 Pin 1.5 A Adjustable Negative Voltage Regulator	-4.2	-40	-37	-1.2	1.5	—	—	3T0-220	0.40
LM317	3/4 Pin 1.5 A Adjustable Positive Voltage Regulator	4.2	40	1.2	37	1.5	—	—	2PFM, 3DDPAK/TO-263, 3T0-220, 4SOT-223	0.36
LM317L	3/8 Pin 100 mA Adjustable Positive Regulator	3.7	38	1.2	32	0.1	—	—	3SOT-89, 3T0-92, 8SOIC, 8TSSOP	0.14
LM317M	3/4 Pin 500 mA Adjustable Positive Voltage Regulator	4.2	40	1.2	37	0.5	—	—	3PFM, 4SOT-223	0.40
LM337	3 Pin 1.5 A Adjustable Negative Voltage Regulator	-4.2	-40	-1.2	-37	1.5	—	—	3DDPAK/TO-263, 3PFM, 3T0-220	0.40
LP2951-50	Single Output, 100 mA, Fixed, Wide V _{IN} Range	1	30	1.2	30	0.1	0.075	0.3	8SOIC, 8SON	0.27
MC79L05A	3/8 Pin 100 mA Fixed (-5 V) Negative Voltage Regulator	-7	-20	-5	-5	0.1	6	1.7	3T0-92, 8SOIC	0.14
MC79L12	3 Pin 100 mA Fixed (-12 V) Negative Voltage Regulator	-14.5	-27	-12	-12	0.1	6.5	1.7	3T0-92	0.24
MC79L12A	3/8 Pin 100 mA Fixed (-12 V) Negative Voltage Regulator	-14.5	-27	-12	-12	0.1	6.5	1.7	3T0-92, 8SOIC	0.14
MC79L15A	3 Pin 100 mA Fixed (-15 V) Negative Voltage Regulator	-17.5	-30	-15	-15	0.1	6.5	1.7	3T0-92	0.22
TL317	3/8 Pin 100 mA Adjustable Positive Voltage Regulator	5	38	1.2	32	0.1	—	—	3T0-92, 8SO, 8SOIC, 8TSSOP	0.40
TL780-15	3 Pin 1.5 A Fixed 15 V Positive Voltage Regulator	17.5	30	15	15	1.5	8	2	3T0-220	0.40
TL780-12	3 Pin 1.5 A Fixed 12 V Positive Voltage Regulator	14.5	30	12	12	1.5	8	2	3T0-220	0.40
TL780-05	3 Pin 1.5 A Fixed 5 V Positive Voltage Regulator	7	25	5	5	1.5	8	2	3DDPAK/TO-263, 3T0-220	0.40
TL783	3 Pin 750 mA Adjustable Positive Voltage Regulator with 125 V _{IN}	21.5	150	1.2	125	0.7	—	—	3DDPAK/TO-263, 3T0-220	1.15
TLV1117	Single Output LDO, 800 mA, Fixed and Adj., Internal Current limit, Thermal Overload Protection	2.7	15	1.2	13.7	0.8	5	1.2	3DDPAK/TO-263, 3PFM, 3T0-220, 4SOT-223, 8SON	0.28
TLV1117-50	Single Output LDO, 800 mA, Fixed (5.0 V), Internal Current limit, Thermal Overload Protection	6.4	15	5	5	0.8	5	1.2	3PFM, 4SOT-223, 8SON	0.29
TLV1117-33	Single Output LDO, 800 mA, Fixed (3.3 V), Internal Current limit, Thermal Overload Protection	4.7	15	3.3	3.3	0.8	5	1.2	3PFM, 4SOT-223, 8SON	0.29
TLV1117-25	Single Output LDO, 800 mA, Fixed (2.5 V), Internal Current limit, Thermal Overload Protection	3.9	15	2.5	2.5	0.8	5	1.2	3PFM, 3T0-220, 4SOT-223, 8SON	0.29
TLV1117-18	Single Output LDO, 800 mA, Fixed (1.8 V), Internal Current limit, Thermal Overload Protection	3.2	15	1.8	1.8	0.8	5	1.2	3PFM, 4SOT-223, 8SON	0.29
TLV1117-15	Single Output LDO, 800 mA, Fixed (1.5 V), Internal Current limit, Thermal Overload Protection	2.9	15	1.5	1.5	0.8	5	1.2	3PFM, 4SOT-223, 8SON	0.29
UA78L02A	3/8 Pin 100 mA Fixed 2.6 V Positive Voltage Regulator	4.75	20	2.6	2.6	0.1	6	1.7	3SOT-89, 3T0-92, 8SOIC	0.16
UA78L05	3/8 Pin 100mA Fixed 5 V Positive Voltage Regulator	7	20	5	5	0.1	6	1.7	3SOT-89, 3T0-92, 8SOIC	0.14
UA78L05A	3/8 Pin 100 mA Fixed 5 V Positive Voltage Regulator	7	20	5	5	0.1	6	1.7	3SOT-89, 3T0-92, 8SOIC	0.25
UA78L06A	3 Pin 100 mA Fixed 6 V Positive Voltage Regulator	8.5	20	6.2	6.2	0.1	6	1.7	3SOT-89, 3T0-92	0.11
UA78L08	8 Pin 100 mA Fixed 8 V Positive Voltage Regulator	10.5	23	8	8	0.1	6	1.7	8SOIC	0.16
UA78L08A	3/8 Pin 100 mA Fixed 8 V Positive Voltage Regulator	10.5	23	8	8	0.1	6	1.7	3SOT-89, 3T0-92, 8SOIC	0.14
UA78L09A	3/8 Pin 100 mA Fixed 9 V Positive Voltage Regulator	11.5	24	9	9	0.1	6	1.7	3SOT-89, 3T0-92, 8SOIC	0.16

*Suggested resale price in U.S. dollars in quantities of 1,000.

→ Selection Tables

Linear Regulators (Continued)

Part Number	Description	V _{IN} (Min) (V)	V _{IN} (Max) (V)	V _{OUT} (Min) (V)	V _{OUT} (Max) (V)	I _{OUT} (Max) (A)	I _q (typ) (mA)	V _{DO} (typ) (V)	Pin/Package	Price*
UA78L10A	3/8 Pin 100 mA Fixed 10 V Positive Voltage Regulator	12.5	25	10	10	0.1	6	1.7	3SOT-89, 3TO-92, 8SOIC	0.14
UA78L12A	3/8 Pin 100 mA Fixed 12 V Positive Voltage Regulator	14.5	27	12	12	0.1	6	1.7	3SOT-89, 3TO-92, 8SOIC	0.14
UA78L15A	3/8 Pin 100 mA Fixed 15 V Positive Voltage Regulator	17.5	30	15	15	0.1	6	1.7	3SOT-89, 3TO-92, 8SOIC	0.14
UA78M05	3/4 Pin 500 mA Fixed 5 V Positive Voltage Regulator	7	25	5	5	0.5	6	2	3PFM, 3TO-220, 4SOT-223	0.29
UA78M06	3 Pin 500 mA Fixed 6 V Positive Voltage Regulator	8	25	6	6	0.5	6	2	3PFM	0.28
UA78M08	3/4 Pin 500 mA Fixed 8 V Positive Voltage Regulator	10.5	25	8	8	0.5	6	2	3PFM, 3TO-220, 4SOT-223	0.27
UA78M09	3 Pin 500 mA Fixed 9 V Positive Voltage Regulator	11.5	26	9	9	0.5	6	2	3PFM	0.28
UA78M10	3 Pin 500 mA Fixed 10 V Positive Voltage Regulator	12.5	28	10	10	0.5	6	2	3PFM	0.28
UA78M12	3 Pin 500 mA Fixed 12 V Positive Voltage Regulator	14.5	30	12	12	0.5	6	2	3PFM, 3TO-220	0.29
UA78M33	3/4 Pin 500 mA Fixed 3.3 V Positive Voltage Regulator	5.3	25	3.3	3.3	0.5	6	2	3PFM, 3TO-220, 4SOT-223	0.27
UA79M05	3 Pin 500 mA Fixed (-5 V) Negative Voltage Regulator	-7	-25	-5	-5	0.5	1	1.1	3PFM, 3TO-220	0.29
UA79M08	3 Pin 500 mA Fixed (-8 V) Negative Voltage Regulator	-10.5	-25	-8	-8	0.5	1	1.1	3PFM	0.28
UA723	14 Pin 150 mA Adjustable Positive Voltage Regulator	9.5	40	2	37	0.15	4	—	14PDIP, 14SO, 14SOIC	0.38
UA7805	3 Pin 1.5 A Fixed 5 V Positive Voltage Regulator	7	25	5	5	1.5	8	2	3DDPAK/TO-263, 3TO-220	0.36
UA7808	3 Pin 1.5 A Fixed 8 V Positive Voltage Regulator	10.5	25	8	8	1.5	8	2	3DDPAK/TO-263, 3TO-220	0.36
UA7810	3 Pin 1.5 A Fixed 10 V Positive Voltage Regulator	12.5	28	10	10	1.5	8	2	3DDPAK/TO-263, 3TO-220	0.38
UA7812	3 Pin 1.5 A Fixed 12 V Positive Voltage Regulator	14.5	30	12	12	1.5	8	2	3DDPAK/TO-263, 3TO-220	0.40
UA7815	3 Pin 1.5 A Fixed 15 V Positive Voltage Regulator	17.5	30	15	15	1.5	8	2	3DDPAK/TO-263, 3TO-220	0.38
UA7824	3 Pin 1.5 A Fixed 24 V Positive Voltage Regulator	27	38	24	24	1.5	8	2	3DDPAK/TO-263, 3TO-220	0.38
UA7905	3 Pin 1.5 A Fixed (-5 V) Negative Voltage Regulator	-7	-25	-5	-5	1.5	1.5	1.1	3DDPAK/TO-263, 3TO-220	0.38
UA7908	3 Pin 1.5 A Fixed (-8 V) Negative Voltage Regulator	-10.5	-25	-8	-8	1.5	1.5	1.1	3TO-220	0.38

*Suggested resale price in U.S. dollars in quantities of 1,000.

Internal Switching Regulators

Part Number	Description	Preset $V_{OUT}(V)$	Topology	V_{IN} (Min) (V)	V_{IN} (Max) (V)	V_{OUT} (Min) (V)	V_{OUT} (Max) (V)	I_{OUT} (Max) (A)	Switch Current Limit (typ) (A)	Switching Frequency (typ)(kHz)	Operating Temperature Range(°C)	Pin/Package	Price*
LM2575	1-A Simple Step-Down Adjustable Voltage Switching Regulator with Output Enable	Adjustable	Buck	4.75	40	1.23	37	1	3.2	52	-40 to 125	16PDIP	1.35
MC33063A	1.5-A Peak Boost/Buck/ Inverting Switching Regulator	Adjustable	Inverting Buck/Boost	3	40	1.25	40	0.75	1.5	Adjustable	-40 to 85	8PDIP, 8SOIC, 8SON	0.23
MC34063A	1.5-A Boost/Buck/ Inverting Switching Regulator	Adjustable	Buck, Inverting Buck/Boost	3	40	1.55	40	0.75	1.5	Adjustable	0 to 70	8PDIP, 8SOIC, 8SON	0.21
TL497A	500-mA Peak Step-Up, Step-Down, Inverting Switching Voltage Regulator	Adjustable	Inverting Buck/Boost	4.5	12	-25	30	0.5	0.5	Adjustable	-40 to 85, 0 to 70	14PDIP, 14SO, 14SOIC, 14TSSOP	0.90
TL499A	Wide-Range Power-Supply Controller	Adjustable	Boost	1.1	10	2.9	30	0.1	0.5	—	-20 to 85	8PDIP, 8SO	1.20
TL2575-33	1-A Simple Step-Down Switching Voltage Regulators	3.3	Buck	4.75	40	3.3	3.3	1	2.8	52	-40 to 125	16PDIP, 5DDPAK/ TO-263, 5TO-220	1.10
TL2575-15	1-A Simple Step-Down Switching Voltage Regulators	15	Buck	4.75	40	15	15	1	2.8	52	-40 to 125	16PDIP, 5DDPAK/ TO-263, 5TO-220	1.10
TL2575-12	1-A Simple Step-Down Switching Voltage Regulators	12	Buck	4.75	40	12	12	1	2.8	52	-40 to 125	16PDIP, 5DDPAK/ TO-263, 5TO-220	1.10
TL2575-05	1-A Simple Step-Down Switching Voltage Regulators	5	Buck	4.75	40	5	5	1	2.8	52	-40 to 125	16PDIP, 5DDPAK/ TO-263, 5TO-220	1.10
TL2575-ADJ	1-A Simple Step-Down Switching Voltage Regulators	Adjustable	Buck	4.75	40	1.23	37	1	2.8	52	-40 to 125	16PDIP, 5DDPAK/ TO-263, 5TO-220	1.10
TL2575HV-33	1-A Simple Step-Down Switching Voltage Regulators	3.3	Buck	4.75	60	3.3	3.3	1	2.8	52	-40 to 125	16PDIP, 5DDPAK/ TO-263, 5TO-220	1.15
TL2575HV-15	1-A Simple Step-Down Switching Voltage Regulators	15	Buck	4.75	60	15	15	1	2.8	52	-40 to 125	16PDIP, 5DDPAK/ TO-263, 5TO-220	1.15
TL2575HV-12	1-A Simple Step-Down Switching Voltage Regulators	12	Buck	4.75	60	12	12	1	2.8	52	-40 to 125	16PDIP, 5DDPAK/ TO-263, 5TO-220	1.15
TL2575HV-05	1-A Simple Step-Down Switching Voltage Regulators	5	Buck	4.75	60	5	5	1	2.8	52	-40 to 125	16PDIP, 5DDPAK/ TO-263, 5TO-220	1.15
TL2575HV-ADJ	1-A Simple Step-Down Switching Voltage Regulators	Adjustable	Buck	4.75	60	1.23	57	1	2.8	52	-40 to 125	16PDIP, 5DDPAK/ TO-263, 5TO-220	1.15

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

External Switching Regulators

Part Number	Description	Max Duty Cycle (%)	Topology	V _{IN} Start (Min) (V)	V _{IN} Run (Min) (V)	V _{IN} (Max) (V)	Reference Current (max) (mA)	Switch Output Current (Max) (mA)	Switching Frequency (Max) (kHz)	Operating Temp Range (°C)	Pin/Package	Price*
SG2524	Regulating Pulse-Width Modulator	45	Boost, Buck, Flyback, Forward, Full-Bridge, Half-Bridge, Push-Pull	8	8	40	50	50	500	-25 to +85	16PDIP, 16SOIC	0.50
SG3524	Regulating Pulse-Width Modulators	45	Boost, Buck, Flyback, Forward, Full-Bridge, Half-Bridge, Push-Pull	8	8	40	50	50	500	0 to +70	16PDIP, 16SO, 16SOIC	0.50
TL494	PWM Control Circuit	45	Boost, Buck, Flyback, Forward, Full-Bridge, Half-Bridge, Push-Pull	7	7	40	10	200	300	-40 to +85; 0 to +70	16PDIP, 16SO, 16SOIC, 16SSOP, 16TSSOP	0.25
TL594	Pulse-Width-Modulation (PWM) Control Circuit	45	Boost, Flyback, Forward	7	7	40	10	200	300	-40 to +85; 0 to +70	16PDIP, 16SO, 16SOIC, 16TSSOP	0.41
TL598	Pulse-Width-Modulation (Pwm) Control Circuit	45	Buck	7	7	40	10	200	300	0 to +70	16PDIP, 16SOIC	0.90
TL2842	Current-Mode PWM Controller	97	Boost, Flyback, Forward	17	11	30	20	200	500	-40 to +85	14SOIC, 8PDIP, 8SOIC	0.40
TL2842B	High-Performance Current-Mode PWM Controller	96	Boost, Flyback, Forward	17	11	30	20	200	500	-40 to +85	14SOIC, 8PDIP, 8SOIC	0.60
TL2843	Current-Mode PWM Controller	97	Boost, Flyback, Forward	9	8.2	30	20	200	500	-40 to +85	14SOIC, 8PDIP, 8SOIC	0.44
TL2843B	High-Performance Current-Mode PWM Controller	96	Boost, Flyback, Forward	9	8.2	30	20	200	500	-40 to +85	14SOIC, 8PDIP, 8SOIC	0.60
TL2844	Current-Mode PWM Controller	48	Boost, Flyback, Forward	17	11	30	20	200	500	-40 to +85	14SOIC, 8PDIP, 8SOIC	0.48
TL2844B	High-Performance Current-Mode PWM Controller	48	Boost, Flyback, Forward	17	11	30	20	200	500	-40 to +85	14SOIC, 8PDIP, 8SOIC	0.60
TL2845	Current-Mode PWM Controller	48	Boost, Flyback, Forward	9	8.2	30	20	200	500	-40 to +85	14SOIC, 8PDIP, 8SOIC	0.48
TL2845B	High-Performance Current-Mode PWM Controller	48	Boost, Flyback, Forward	9	8.2	30	20	200	500	-40 to +85	14SOIC, 8PDIP, 8SOIC	0.60
TL3842	Current-Mode PWM Controller	97	Boost, Flyback, Forward	17.5	11.5	30	20	200	500	0 to +70	14SOIC, 8PDIP, 8SOIC	0.40
TL3842B	High-Performance Current-Mode PWM Controller	96	Boost, Flyback, Forward	17.5	11.5	30	20	200	500	0 to +70	14SOIC, 8PDIP, 8SOIC	0.55
TL3843	Current-Mode PWM Controller	97	Boost, Flyback, Forward	9	8.2	30	20	200	500	0 to +70	14SOIC, 8PDIP, 8SOIC	0.40
TL3843B	High-Performance Current-Mode PWM Controller	96	Boost, Flyback, Forward	9	8.2	30	20	200	500	0 to +70	14SOIC, 8PDIP, 8SOIC	0.55
TL3844	Current-Mode PWM Controller	48	Boost, Flyback, Forward	17.5	11.5	30	20	200	500	0 to +70	14SOIC, 8PDIP, 8SOIC	0.43
TL3844B	High-Performance Current-Mode PWM Controller	48	Boost, Flyback, Forward	17.5	11.5	30	20	200	500	0 to +70	14SOIC, 8PDIP, 8SOIC	0.55
TL3845	Current-Mode PWM Controller	48	Boost, Flyback, Forward	9	8.2	30	20	200	500	0 to +70	14SOIC, 8PDIP, 8SOIC	0.43
TL3845B	High-Performance Current-Mode PWM Controller	48	Boost, Flyback, Forward	9	8.2	30	20	200	500	0 to +70	14SOIC, 8PDIP, 8SOIC	0.55

*Suggested resale price in U.S. dollars in quantities of 1,000.

→ Selection Tables

Low Dropout Regulators

Part Number	Description	V _{OUT} (V)	V _{IN} (min) (V)	V _{IN} (max) (V)	I _q (typ) (mA)	Output Capacitor (μF)	Output Capacitor Type	I _{OUT} (max) (A)	V _{DO} (typ) (mV)	Accuracy (%)	Pin/Package	Price*
LP2950-30	Single Output LDO, 100 mA, Fixed (3.0 V), Wide V _{IN} Range	3	3.7	30	0.075	2.2	Electrolytic	.01	380	1.4	3T0-92	0.18
LP2950-33	Single Output LDO, 100 mA, Fixed (3.3 V), Wide V _{IN} Range	3.3	3.75	30	0.075	2.2	Electrolytic	0.1	380	1.4	3T0-92	0.18
LP2950-50	Single Output LDO, 100 mA, Fixed (5.0 V), Wide V _{IN} Range	5	5.45	30	0.075	1	Electrolytic	0.1	380	1.4	3T0-92	0.18
LP2951	Single Output LDO, 100 mA, Fixed(3.3 V), Wide V _{IN} Range	3.3 or Adjustable	1.68	30	0.075	2.2	Electrolytic	0.1	380	1.4	8SOIC	0.27
LP2951-30	Single Output LDO, 100 mA, Fixed (3.0 V), Wide V _{IN} Range, RESET Flag	3	3.6	30	0.075	2.2	Electrolytic	0.1	380	1.4	8SOIC, 8SON	0.27
LP2951-33	Single Output LDO, 100 mA, Fixed (3.3 V), Wide V _{IN} Range, RESET Flag	3.3	3.9	30	0.075	2.2	Electrolytic	0.1	380	1.4	8SOIC, 8SON	0.27
LP2951-50	Single Output, 100 mA, Fixed, Wide V _{IN} Range	5	5.6	30	0.075	2.2	Electrolytic	0.1	0.38	1.4	8SOIC, 8SON	0.27
LP2981-28	Single Output LDO, 100 mA, Fixed (2.8 V), Shutdown, 1.25% Tolerance	2.8	2.2	16	0.6	4.7	Tantalum	0.1	200	1.25	5SOT-23	0.36
LP2981-29	Single Output LDO, 100 mA, Fixed (2.9 V), Shutdown, 1.25% Tolerance	3	2.2	16	0.6	4.7	Tantalum	0.1	200	1.25	5SOT-23	0.36
LP2981-30	Single Output LDO, 100 mA, Fixed (3.0 V), Shutdown, 1.25% Tolerance	3	2.2	16	0.6	4.7	Tantalum	0.1	200	1.25	5SOT-23	0.32
LP2981-33	Single Output LDO, 100 mA, Fixed (3.3 V), Shutdown, 1.25% Tolerance	3.3	2.2	16	0.6	4.7	Tantalum	0.1	200	1.25	5SOT-23	0.32
LP2981-50	Single Output LDO, 100 mA, Fixed (5.0 V), Shutdown, 1.25% Tolerance	5	2.2	16	0.6	4.7	Tantalum	0.1	200	1.25	5SOT-23	0.36
LP2981A-28	Single Output LDO, 100 mA, Fixed (2.8 V), Shutdown, 0.75% Tolerance	2.8	2.2	16	0.6	4.7	Tantalum	0.1	200	0.75	5SOT-23	0.40
LP2981A-29	Single Output LDO, 100 mA, Fixed (2.9 V), Shutdown, 0.75% Tolerance	2.9	2.2	16	0.6	4.7	Tantalum	0.1	200	0.75	5SOT-23	0.40
LP2981A-30	Single Output LDO, 100 mA, Fixed (3.0 V), Shutdown, 0.75% Tolerance	3	2.2	16	0.6	4.7	Tantalum	0.1	200	0.75	5SOT-23	0.35
LP2981A-33	Single Output LDO, 100 mA, Fixed (3.3 V), Shutdown, 0.75% Tolerance	3.3	2.2	16	0.6	4.7	Tantalum	0.1	200	0.75	5SOT-23	0.35
LP2981A-50	Single Output LDO, 100 mA, Fixed (5.0 V), Shutdown, 0.75% Tolerance	5	2.2	16	0.6	4.7	Tantalum	0.1	200	0.75	5SOT-23	0.36
LP2985-18	Single Output LDO, 150 mA, Fixed (1.8 V), 1.5% Tolerance, Low Quiescent Current, Low Noise	1.8	2.05	16	0.85	4.7	Ceramic	0.15	280	1.5	5SOT-23	0.23
LP2985-25	Single Output LDO, 150 mA, Fixed (2.5 V), 1.5% Tolerance, Low Quiescent Current, Low Noise	2.5	2.5	16	0.85	4.7	Ceramic	0.15	280	1.5	5SOT-23	0.23

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

Low Dropout Regulators (Continued)

Part Number	Description	V _{OUT} (V)	V _{IN} (min) (V)	V _{IN} (max) (V)	I _q (typ) (mA)	Output Capacitor (μF)	Output Capacitor Type	I _{OUT} (max) (A)	V _{DO} (typ) (mV)	Accuracy (%)	Pin/Package	Price*
LP2985-28	Single Output LDO, 150 mA, Fixed (2.8 V), 1.5% Tolerance, Low Quiescent Current, Low Noise	2.8	2.5	16	0.85	4.7	Ceramic	0.15	280	1.5	5SOT-23	0.23
LP2985-29	Single Output LDO, 150 mA, Fixed (2.9 V), 1.5% Tolerance, Low Quiescent Current, Low Noise	2.9	2.5	16	0.85	4.7	Ceramic	0.15	280	1.5	5SOT-23	0.23
LP2985-30	Single Output LDO, 150 mA, Fixed (3.0 V), 1.5% Tolerance, Low Quiescent Current, Low Noise	3	2.5	16	0.85	4.7	Ceramic	0.15	280	1.5	5SOT-23	0.23
LP2985-33	Single Output LDO, 150 mA, Fixed (3.3 V), 1.5% Tolerance, Low Quiescent Current, Low Noise	3.3	2.5	16	0.85	4.7	Ceramic	0.15	280	1.5	5SOT-23	0.23
LP2985-50	Single Output LDO, 150 mA, Fixed (5.0 V), 1.5% Tolerance, Low Quiescent Current, Low Noise	5	2.5	16	0.85	4.7	Ceramic	0.15	280	1.5	5SOT-23	0.23
LP2985A-18	Single Output LDO, 150 mA, Fixed (1.8 V), 1.0% Tolerance, Low Quiescent Current, Low Noise	1.8	2.05	16	0.85	4.7	Ceramic	0.15	280	1	5SOT-23	0.25
LP2985A-25	Single Output LDO, 150 mA, Fixed (2.5 V), 1.0% Tolerance, Low Quiescent Current, Low Noise	2.5	2.5	16	0.85	4.7	Ceramic	0.15	280	1	5SOT-23	0.25
LP2985A-28	Single Output LDO, 150 mA, Fixed (2.8 V), 1.0% Tolerance, Low Quiescent Current, Low Noise	2.8	2.5	16	0.85	4.7	Ceramic	0.15	280	1	5SOT-23	0.25
LP2985A-29	Single Output LDO, 150 mA, Fixed (2.9 V), 1.0% Tolerance, Low Quiescent Current, Low Noise	2.9	2.5	16	0.85	4.7	Ceramic	0.15	280	1	5SOT-23	0.25
LP2985A-30	Single Output LDO, 150 mA, Fixed (3.0 V), 1.0% Tolerance, Low Quiescent Current, Low Noise	3	2.5	16	0.85	4.7	Ceramic	0.15	280	1	5SOT-23	0.25
LP2985A-33	Single Output LDO, 150 mA, Fixed (3.3 V), 1.0% Tolerance, Low Quiescent Current, Low Noise	3.3	2.5	16	0.85	4.7	Ceramic	0.15	280	1	5SOT-23	0.25
LP2985A-50	Single Output LDO, 150 mA, Fixed (5.0 V), 1.0% Tolerance, Low Quiescent Current, Low Noise	5	2.5	16	0.85	4.7	Ceramic	0.15	280	1	5SOT-23	0.25
TL-SCSI285	Single Output LDO, 620 mA, Fixed (2.85 V), SCSI Active Termination, Thermal Overload Protection	2.85	3.55	5.5	2	22	Tantalum	0.62	800	2	20TSSOP, 3TO-220	1.10
TL1963A-15	1.5-A Low-Noise Fast-Transient-Response LDO Regulator	1.5	2.1	20	1	10	Ceramic	1.5	340	3	4SOT-223, 5DDPAK/TO-263, 6SOT-223	1.10
TL1963A-18	1.5-A Low-Noise Fast-Transient-Response LDO Regulator	1.8	2.1	20	1	10	Ceramic	1.5	340	3	4SOT-223, 5DDPAK/TO-263, 6SOT-223	1.10

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

Low Dropout Regulators (Continued)

Part Number	Description	V _{OUT} (V)	V _{IN} (min) (V)	V _{IN} (max) (V)	I _q (typ) (mA)	Output Capacitor (μF)	Output Capacitor Type	I _{OUT} (max) (A)	V _{DO} (typ) (mV)	Accuracy (%)	Pin/Package	Price*
TL1963A-25	1.5-A Low-Noise Fast-Transient-Response LDO Regulator	2.5	2.1	20	1	10	Ceramic	1.5	340	3	4SOT23, 5DDPAK/TO-263, 6SOT-223	1.10
TL1963A-33	1.5-A Low-Noise Fast-Transient-Response LDO Regulator	3.3	2.1	20	1	10	Ceramic	1.5	340	3	4SOT-23, 5DDPAK/TO-263, 6SOT-223	1.10
TL5209	Single Output LDO, 500 mA, Adj. (1.3 to 6.5 V), Low Noise	Adjustable	2.5	16	8	2.2	Tantalum	0.5	500	2	8SOIC	0.39
TL750L05	Single Output LDO, 150 mA, Fixed (5.0 V), Low Quiescent Current, 60 V Load Dump Protection	5	6	26	1	10	Tantalum	0.15	600	4	3DDPAK/TO-263, 3PFM, 3TO-220, 3TO-92, 8SOIC	0.31
TL750L08	Single Output LDO, 150 mA, Fixed (8.0 V), Low Quiescent Current, 60 V Load Dump Protection	8	9	26	1	10	Tantalum	0.15	600	4	3TO-92, 8SOIC	0.31
TL750L10	Single Output LDO, 150 mA, Fixed (10.0 V), Low Quiescent Current, 60 V Load Dump Protection	10	11	26	1	10	Tantalum	0.15	600	4	3TO-92, 8SOIC	0.31
TL750L12	Single Output LDO, 150 mA, Fixed (12.0 V), Low Quiescent Current, 60 V Load Dump Protection	12	13	26	1	10	Tantalum	0.15	600	4	3TO-92, 8SOIC	0.31
TL750M05	Single Output LDO, 750 mA, Fixed (5.0 V), Low Quiescent Current, 60 V Load Dump Protection	5	6	26	60	10	Tantalum	0.75	500	2	3DDPAK/TO-263, 3PFM, 3TO-220	0.65
TL750M08	Single Output LDO, 750 mA, Fixed (8.0 V), Low Quiescent Current, 60 V Load Dump Protection	8	9	26	60	10	Tantalum	0.75	500	2	3PFM, 3TO-220	0.65
TL750M10	Single Output LDO, 750 mA, Fixed (10.0 V), Low Quiescent Current, 60 V Load Dump Protection	10	11	26	60	10	Tantalum	0.75	500	2	3PFM, 3TO-220	0.65
TL750M12	Single Output LDO, 750 mA, Fixed (12.0 V), Low Quiescent Current, 60 V Load Dump Protection	12	13	26	60	10	Tantalum	0.75	500	2	3PFM, 3TO-220	0.65
TL751L05	Single Output LDO, 150 mA, Fixed (5.0 V), Low Quiescent Current, 60 V Load Dump Protection	5	6	26	1	10	Tantalum	0.15	600	4	8SOIC	0.31
TL751L10	Single Output LDO, 150 mA, Fixed (10.0 V), Low Quiescent Current, 60 V Load Dump Protection	10	11	26	1	10	Tantalum	0.15	600	4	8PDIP, 8SOIC	0.31
TL751L12	Single Output LDO, 150 mA, Fixed (12.0 V), Low Quiescent Current, 60 V Load Dump Protection	12	13	26	1	10	Tantalum	0.15	600	4	8SOIC	0.31
TLV1117	Single Output LDO, 800 mA, Fixed and Adj., Internal Current Limit, Thermal Overload Protection	Adjustable	2.7	15	5	10	Tantalum	0.8	1,200	2.5	3DDPAK/TO-263, 3PFM, 3TO-220, 4SOT-223, 8SON	0.28
TLV1117-15	Single Output LDO, 800 mA, Fixed (1.5 V), Internal Current Limit, Thermal Overload Protection	1.5	2.9	15	5	10	Tantalum	0.8	1,200	2.5	3PFM, 4SOT-223, 8SON	0.29
TLV1117-18	Single Output LDO, 800 mA, Fixed (1.8 V), Internal Current Limit, Thermal Overload Protection	1.8	3.2	15	5	10	Tantalum	0.8	1,200	2.5	3PFM, 4SOT-223, 8SON	0.29

*Suggested resale price in U.S. dollars in quantities of 1,000.

→ Selection Tables

Low Dropout Regulators (Continued)

Part Number	Description	V _{OUT} (V)	V _{IN} (min) (V)	V _{IN} (max) (V)	I _q (typ) (mA)	Output Capacitor (μF)	Output Capacitor Type	I _{OUT} (max) (A)	V _{DO} (typ) (mV)	Accuracy (%)	Pin/Package	Price*
TLV1117-25	Single Output LDO, 800 mA, Fixed (2.5 V), Internal Current Limit, Thermal Overload Protection	2.5	3.9	15	5	10	Tantalum	0.8	1,200	2.5	3PFM, 3TO-220, 4SOT-223, 8SON	0.29
TLV1117-33	Single Output LDO, 800 mA, Fixed (3.3 V), Internal Current Limit, Thermal Overload Protection	3.3	4.7	15	5	10	Tantalum	0.8	1,200	2.5	3PFM, 4SOT-223, 8SON	0.29
TLV1117-50	Single Output LDO, 800 mA, Fixed (5.0 V), Internal Current Limit, Thermal Overload Protection	5	6.4	15	5	10	Tantalum	0.8	1,200	2.5	3PFM, 4SOT-223, 8SON	0.29
TLV2217-18	Single Output LDO, 500 mA, Fixed (1.8 V), Output Accuracy of 2%, Thermal Overload Protection	1.8	3	12	0.19	22	Tantalum	0.5	500	2	3PFM, 3TO-220	0.50
TLV2217-25	Single Output LDO, 500 mA, Fixed (2.5 V), Tight Output Accuracy of 2%, Thermal Overload Protection	2.5	3	12	0.19	22	Tantalum	0.5	500	2	20TSSOP, 3PFM, 3TO-220	0.50
TLV2217-33	Single Output LDO, 500 mA, Fixed (3.3 V), Tight Output Accuracy of 2%, Thermal Overload Protection	3.3	3	12	0.29	22	Tantalum	0.5	500	2	20TSSOP, 3PFM, 3TO-220	0.50

*Suggested resale price in U.S. dollars in quantities of 1,000.

Shunt Voltage Reference

Part Number	Description	Initial Accuracy @ 25°C (%)	Temp Coeff (typ) (ppm/°C)	Temp Coeff (Max) (ppm/°C)	V _O (V)	V _O Adj (Max) (V)	Min I _Z for Regulation (µA)	I _{OUT} /I _Z (Max) (mA)	Operating Temperature Range(°C)	Pin/Package	Price*
LM236-2.5	2.5-V Integrated Reference Circuit	2	13	33	2.49	—	400	10	–25 to 85	8SOIC	0.99
LM285-2.5	Micropower Voltage Reference	1.5	20	—	2.5	—	20	20	–40 to 85	3TO-92, 8SOIC	0.28
LM285-1.2	Micropower Voltage Reference	1	20	—	1.235	—	10	20	–40 to 85	3TO-92, 8SOIC	0.28
LM336-2.5	2.5-V Integrated Reference Circuit	4	10	34	2.49	—	400	10	0 to 70	3TO-92, 8SOIC	0.40
LM336B-2.5	Precision Voltage Reference	2	10	34	2.49	—	400	10	0 to 70	3TO-92, 8SOIC	0.40
LM385-2.5	Micropower Voltage Reference	3	20	—	2.5	—	20	20	0 to 70	3TO-92, 8SOIC, 8TSSOP	0.25
LM385-1.2	Micropower Voltage Reference	2	20	—	1.235	—	10	20	0 to 70	3TO-92, 8SO, 8SOIC, 8TSSOP	0.25
LM385B-2.5	Micropower Voltage Reference	1.5	20	—	2.5	—	20	20	0 to 70	3TO-92, 8SOIC, 8TSSOP	0.36
LM385B-1.2	Micropower Voltage Reference	1	20	—	1.235	—	10	20	0 to 70	8SOIC, 3TO-92, 8TSSOP	0.36
LM4040A10	10-V Precision Micropower Shunt Voltage Reference, 0.1% Accuracy	0.1	15	100	10	—	100	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	1.00
LM4040A20	2.048-V Precision Micropower Shunt Voltage Reference, 0.1% Accuracy	0.1	15	100	2.048	—	75	15	–40 to 85	3SOT-23, 5SC70	1.00
LM4040A25	2.5-V Precision Micropower Shunt Voltage Reference, 0.1% Accuracy	0.1	15	100	2.5	—	75	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	1.00
LM4040A30	3-V Precision Micropower Shunt Voltage Reference, 0.1% Accuracy	0.1	15	100	3	—	62	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	1.00
LM4040A41	4.096-V Precision Micropower Shunt Voltage Reference, 0.1% Accuracy	0.1	15	100	4.096	—	68	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	1.00
LM4040A50	5-V Precision Micropower Shunt Voltage Reference, 0.1% Accuracy	0.1	15	100	5	—	74	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	1.00
LM4040A82	8.192-V Precision Micropower Shunt Voltage Reference, 0.1% Accuracy	0.1	15	100	8.192	—	91	15	–40 to 85	3SOT-23, 5SC70	1.00
LM4040B10	10-V Precision Micropower Shunt Voltage Reference, 0.2% Accuracy	0.2	15	100	10	—	100	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.60
LM4040B20	2.048-V Precision Micropower Shunt Voltage Reference, 0.2% Accuracy	0.2	15	100	2.048	—	75	15	–40 to 85	3SOT-23, 5SC70	0.60
LM4040B25	2.5-V Precision Micropower Shunt Voltage Reference, 0.2% Accuracy	0.2	15	100	2.5	—	75	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.60
LM4040B30	3-V Precision Micropower Shunt Voltage Reference, 0.2% Accuracy	0.2	15	100	3	—	62	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.60
LM4040B41	4.096-V Precision Micropower Shunt Voltage Reference, 0.2% Accuracy	0.2	15	100	4.096	—	68	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.60

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

Shunt Voltage Reference (Continued)

Part Number	Description	Initial Accuracy @ 25°C (%)	Temp Coeff (typ) (ppm/°C)	Temp Coeff (Max) (ppm/°C)	V ₀ (V)	V ₀ Adj (Max) (V)	Min I _Z for Regulation (µA)	I _{OUT} /I _Z (Max) (mA)	Operating Temperature Range(°C)	Pin/Package	Price*
LM4040B50	5-V Precision Micropower Shunt Voltage Reference, 0.2% Accuracy	0.2	15	100	5	—	74	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.60
LM4040B82	8.192-V Precision Micropower Shunt Voltage Reference, 0.2% Accuracy	0.2	15	100	8.192	—	91	15	–40 to 85	3SOT-23, 5SC70	0.60
LM4040C10	10-V Precision Micropower Shunt Voltage Reference, 0.5% Accuracy	0.5	15	100	10	—	100	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.35
LM4040C20	2.048-V Precision Micropower Shunt Voltage Reference, 0.5% Accuracy	0.5	15	100	2.048	—	75	15	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.35
LM4040C25	2.5-V Precision Micropower Shunt Voltage Reference, 0.5% Accuracy	0.5	15	100	2.5	—	75	15	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.35
LM4040C30	3-V Precision Micropower Shunt Voltage Reference, 0.5% Accuracy	0.5	15	100	3	—	60	15	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.35
LM4040C41	4.096-V Precision Micropower Shunt Voltage Reference, 0.5% Accuracy	0.5	15	100	4.096	—	68	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.41
LM4040C50	5-V Precision Micropower Shunt Voltage Reference, 0.5% Accuracy	0.5	15	100	5	—	74	15	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.35
LM4040C82	8.192-V Precision Micropower Shunt Voltage Reference, 0.5% Accuracy	0.5	15	100	8.192	—	91	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.41
LM4040D10	10-V Precision Micropower Shunt Voltage Reference, 1% Accuracy	1	15	150	10	—	110	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.27
LM4040D20	2.048-V Precision Micropower Shunt Voltage Reference, 1% Accuracy	1	15	150	2.048	—	75	15	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.27
LM4040D25	2.5-V Precision Micropower Shunt Voltage Reference, 1% Accuracy	1	15	150	2.5	—	75	15	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.27
LM4040D30	3-V Precision Micropower Shunt Voltage Reference, 1% Accuracy	1	15	150	3	—	65	15	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.27
LM4040D41	4.096-V Precision Micropower Shunt Voltage Reference, 1% Accuracy	1	15	150	4.096	—	73	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.32
LM4040D50	5-V Precision Micropower Shunt Voltage Reference, 1% Accuracy	1	15	150	5	—	79	15	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.27
LM4040D82	8.192-V Precision Micropower Shunt Voltage Reference, 1% Accuracy	1	15	150	8.192	—	96	15	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.32
LM4041A12	1.2-V Precision Micropower Shunt Voltage Reference, 0.1% Accuracy	0.1	15	100	1.225	—	60	12	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.90
LM4041B12	1.2-V Precision Micropower Shunt Voltage Reference, 0.2% Accuracy	0.2	15	100	1.225	—	60	12	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.65
LM4041B	Adjustable Precision Micropower Shunt Voltage Reference, 0.2% Accuracy	0.2	15	100	1.225	15	60	12	–40 to 85	3SOT-23, 3TO-92, 5SC70	0.65

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

Shunt Voltage Reference (Continued)

Part Number	Description	Initial Accuracy @ 25°C (%)	Temp Coeff (typ) (ppm/°C)	Temp Coeff (Max) (ppm/°C)	V ₀ (V)	V ₀ Adj (Max) (V)	Min I _Z for Regulation (µA)	I _{out} /I _Z (Max) (mA)	Operating Temperature Range(°C)	Pin/Package	Price*
LM4041C12	1.2-V Precision Micropower Shunt Voltage Reference, 0.5% Accuracy	0.5	15	100	1.225	—	60	12	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.35
LM4041C	Adjustable Precision Micropower Shunt Voltage Reference, 0.5% Accuracy	0.5	15	100	1.225	15	60	12	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.35
LM4041D12	1.2-V Precision Micropower Shunt Voltage Reference, 1.0% Accuracy	1	15	150	1.225	—	60	12	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.27
LM4041D	Adjustable Precision Micropower Shunt Voltage Reference, 1.0% Accuracy	1	15	150	1.225	15	65	12	–40 to 125, –40 to 85	3SOT-23, 3TO-92, 5SC70	0.27
LT1009	2.5-V Integrated Reference Circuit	0.2	15	25	2.5	—	400	10	–40 to 85, 0 to 70	3TO-92, 8SOIC, 8TSSOP	0.60
TL430	Adjustable Shunt Regulator	5	120	200	2.75	30	2,000	100	0 to 70	3TO-92	0.70
TL431	Adjustable Precision Shunt Regulator	2	34	92	2.495	36	600	100	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3SOT-89, 3TO-92, 5SOT-23, 6SC70, 8SO, 8SOIC, 8PDIP, 8TSSOP	0.14
TL431A	Adjustable Precision Shunt Regulator	1	34	92	2.495	36	600	100	–40 to 85, 0 to 70, –40 to 125	3SOT-23, 3SOT-89, 3TO-92, 5SOT-23, 6SC70, 8PDIP, 8SO, 8SOIC, 8TSSOP	0.12
TL431B	Adjustable Precision Shunt Regulator	0.5	34	92	2.495	36	600	100	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3SOT-89, 5SOT-23, 8PDIP, 6SC70, 8SO, 8SOIC, 8TSSOP, 3TO-92	0.19
TL432	Adjustable Precision Shunt Regulator	2	34	92	2.495	36	600	100	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3SOT-89, 5SOT-23	0.14
TL432A	Adjustable Precision Shunt Regulator	1	34	92	2.495	36	600	100	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3SOT-89, 5SOT-23	0.14
TL432B	Adjustable Precision Shunt Regulator	0.5	34	92	2.495	36	600	100	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3SOT-89, 5SOT-23	0.31
TL1431	Precision Adjustable (Programmable) Shunt Reference	0.4	23	114	2.5	36	1,000	100	–40 to 125, 0 to 70	3TO-92, 8SOIC, 8TSSOP	0.14
TL4050A10	Precision Micropower Shunt Voltage Reference	0.1	20	50	10	—	100	15	–40 to 125, –40 to 85	3SOT-23, 5SC70	1.15
TL4050A25	Precision Micropower Shunt Voltage Reference	0.1	15	50	2.5	—	60	15	–40 to 125, –40 to 85	3SOT-23, 5SC70	1.15
TL4050A41	Precision Micropower Shunt Voltage Reference	0.1	20	50	4.096	—	68	15	–40 to 125, –40 to 85	3SOT-23, 5SC70	1.15
TL4050B10	PPrecision Micropower Shunt Voltage Reference	0.2	20	50	10	—	100	15	–40 to 125, –40 to 85	3SOT-23, 5SC70	0.75
TL4050B25	Precision Micropower Shunt Voltage Reference	0.2	15	50	2.5	—	60	15	–40 to 125, –40 to 85	3SOT-23, 5SC70	0.75
TL4050B41	Precision Micropower Shunt Voltage Reference	0.2	20	50	4.096	—	68	15	–40 to 125, –40 to 85	3SOT-23, 5SC70	0.75

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

Shunt Voltage Reference (Continued)

Part Number	Description	Initial Accuracy @ 25°C (%)	Temp Coeff (typ) (ppm/°C)	Temp Coeff (Max) (ppm/°C)	V ₀ (V)	V ₀ Adj (Max) (V)	Min I _z for Regulation (µA)	I _{OUT} /I _z (Max) (mA)	Operating Temperature Range (°C)	Pin/Package	Price*
TL4050C10	Precision Micropower Shunt Voltage Reference	0.5	20	50	10	—	100	15	–40 to 125, –40 to 85	3SOT-23, 5SC70	0.60
TL4050C25	Precision Micropower Shunt Voltage Reference	0.5	15	50	2.5	—	60	15	–40 to 125, –40 to 85	3SOT-23, 5SC70	0.60
TL4050C41	Precision Micropower Shunt Voltage Reference	0.5	20	50	4.096	—	68	15	–40 to 85, –40 to 125	3SOT-23, 5SC70	0.60
TL4050C50	Precision Micropower Shunt Voltage Reference	0.5	20	50	5	—	74	15	–40 to 125, –40 to 85	3SOT-23, 5SC70	0.60
TLV431	Low-Voltage Adjustable Precision Shunt Regulator	1.5	39	129	1.24	6	80	15	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3SOT-89, 3TO-92, 5SOT-23	0.23
TLV431A	Low-Voltage Adjustable Precision Shunt Regulator	1	39	129	1.24	6	80	15	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3SOT-89, 3TO-92, 5SOT-23, 8SOIC	0.32
TLV431B	Low-Voltage Adjustable Precision Shunt Regulator	0.5	39	129	1.24	6	80	15	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3TO-92, 3SOT-89, 5SOT-23, 6SC70	0.38
TLVH431	Low-Voltage Adjustable Precision Shunt Regulator	1.5	39	129	1.24	18	80	80	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3SOT-89, 3TO-92, 5SOT-23, 6SC70	0.27
TLVH431A	Low-Voltage Adjustable Precision Shunt Regulator	1	39	129	1.24	18	80	80	–40 to 125, 0 to 70, –40 to 85	3SOT-89, 5SOT-23, 6SC70, 3TO-92, 3SOT-23	0.31
TLVH431B	Low-Voltage Adjustable Precision Shunt Regulator	0.5	39	129	1.24	18	80	80	–40 to 125, 0 to 70, –40 to 85	3SOT-23, 3SOT-89, 6SC70, 3TO-92, 5SOT-23	0.41
TLVH432	Low-Voltage Adjustable Precision Shunt Regulator	1.5	39	129	1.24	18	80	80	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3SOT-89	0.27
TLVH432A	Low-Voltage Adjustable Precision Shunt Regulator	1	39	129	1.24	18	80	80	–40 to 125, –40 to 85, 0 to 70	3SOT-89, 3SOT-23	0.31
TLVH432B	Low-Voltage Adjustable Precision Shunt Regulator	0.5	39	129	1.24	18	80	80	–40 to 125, –40 to 85, 0 to 70	3SOT-23, 3SOT-89	0.41
LT1004-2.5	Micropower Integrated Precision Voltage Reference	0.8	20	—	2.5	—	20	20	–40 to 85, 0 to 70	8SOIC, 8TSSOP	0.50
LT1004-1.2	Micropower Integrated Precision Voltage Reference	0.3	20	—	1.235	—	10	20	–40 to 85, 0 to 70	8SOIC, 8TSSOP	0.50

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

Voltage Supervisors

Part Number	Description	V _{CC} (Min) (V)	V _{CC} (Max) (V)	I _q (typ) (uA)	# of Supplies Monitored	Output Driver Type/Reset Output	Reset Threshold Accuracy (%)	Time Delay(ms)	Threshold Voltage 1 (typ) (V)	Threshold Voltage 2 (typ) (V)	Pin/Package	Price*
TL7700	Single SVS with Programmable UV Threshold and Reset Time Delay	1.8	40	600	1	Active-Low, Open-Drain	1	Programmable	2.5	—	8MSOP, 8PDIP, 8SO, 8TSSOP	2.25
TL7702A	Single SVS with Programmable UV Threshold and Reset Time Delay	3.5	18	1,800	1	Active-Low, Open-Drain, Active-High, Open-Drain	2	Programmable	2.53	—	8PDIP, 8SOIC	0.27
TL7702B	Single SVS with Programmable UV Threshold and Reset Time Delay	3.6	18	1,800	1	Active-Low, Open-Drain, Active-High, Open-Drain	2	Programmable	2.53	—	8PDIP, 8SOIC	0.27
TL7705A	Single Supply Voltage Supervisor for 5 V Systems with Programmable Time Delay	3.5	18	1,800	1	Active-Low, Open-Drain, Active-High, Open-Drain	1.1	Programmable	4.55	—	8PDIP, 8SO, 8SOIC	0.27
TL7705B	Single Supply Voltage Supervisor for 5 V Systems with Programmable Time Delay	3.6	18	1,800	1	Active-Low, Open-Drain, Active-High, Open-Drain	2.2	Programmable	4.55	—	8PDIP, 8SOIC	0.31
TL7709A	Single SVS for 9 V Systems with Programmable Time Delay	3.5	18	1,800	1	Active-Low, Open-Drain, Active-High, Open-Drain	1.3	Programmable	7.6	—	8PDIP, 8SOIC	0.85
TL7712A	Single SVS For 12 V Systems with Programmable Time Delay	3.5	18	1,800	1	Active-Low, Open-Drain, Active-High, Open-Drain	1.9	Programmable	10.8	—	8PDIP, 8SOIC	0.85
TL7715A	Single SVS for 15V Systems with Programmable Time Delay	3.5	18	1,800	1	Active-Low, Open-Drain, Active-High, Open-Drain	2.2	Programmable	13.5	—	8PDIP, 8SOIC	0.85
TL7733B	Single Supply-Voltage Supervisor	3.6	18	1,800	1	Active-Low, Open-Drain, Active-High, Open-Drain	2.6	Programmable	3.08	—	8PDIP, 8SOIC	0.27
TL7757	Supply-Voltage Supervisor and Precision Voltage Detector	1	7	1,400	1	Active-Low, Open-Drain	2.6	0	4.55	—	3SOT-89, 3T0-92, 8SOIC	0.32
TL7759	4-Terminal SVS for 5 V Systems	1	7	1,400	1	Active-Low, Open-Drain, Active-High, Open-Drain	2.6	0	4.55	—	8PDIP, 8SO, 8SOIC, 8TSSOP	0.36
TL7770-12	Dual SVS, 12 V and Programmable with Programmable Time Delay	3.5	18	5,000	2	Active-low, open-drain	2	Programmable	10.9	1.5	16SOIC	2.60
TL7770-5	Dual SVS, 5 V and Programmable, with Programmable Time Delay	3.5	18	5,000	2	Active-Low, Open-Drain	2	Programmable	4.55	1.5	16PDIP, 16SOIC	1.75

*Suggested resale price in U.S. dollars in quantities of 1,000.

→ Overview

High Performance Operational Amplifiers (Op Amps) are designed to perform in real world analog applications. TI delivers a broad portfolio of amplifiers and linear solutions including Op Amps, Audio Amplifiers, Linear Amplifiers, Instrumentation Amplifiers, Programmable Gain Amplifiers, Current Shunt Monitors, Comparators and Variable Gain Amplifiers.

Operational Amplifiers

Texas Instruments offers a wide range of operational amplifiers, including high-speed, precision, and standard operational amplifiers. With both high- and low-voltage options, TI offers an operational amplifier to meet the needs of all systems and offers a wide supply range and low supply current drain.

Special Purpose Amplifiers

Texas Instruments offers many different types of special purpose amplifiers to help increase the power of signals in a variety of systems. High speed logarithm amplifiers have a wide bandwidth of 40 MHz. Norton amplifiers operate over a wide range of supply voltages, from 4.5 V to 32 V. TI's timers provide timing and oscillation delays from microseconds to hours and can output up to 200 mA. The final group of special purpose amplifiers are voltage reference devices that combine voltage reference with comparators and operational amplifiers, reducing overall chip count.

Audio Amplifiers

Today's consumers demand the best in audio. They want crystal-clear sound wherever they are in whatever format they want to use. TI delivers the technology to enhance a listener's audio experience. Our portfolio features all-digital components

as well as our digital and analog audio solutions.

Offering high performance and unparalleled integration, TI's programmable components provide design flexibility to produce broad functionality and true life-like sound at a competitive cost.

Comparators

Texas Instruments' comparators are typically used in devices as analog-to-digital converters (ADCs) to compare two voltages or currents and then indicate at the output which is larger. TI offers a wide supply range, from 2 V to 36 V, and a low supply current uses less power to operate the device. These features, along with fast response times rise time of 155 ns and fall time of 165 ns make TI's comparators the perfect choice for a wide variety of industrial and commercial uses.

General-Purpose Operational Amplifiers

LM358, LM324, TS321

Get samples, datasheets and app reports at: www.ti.com/sc/device/LM324, LM358 or TS321

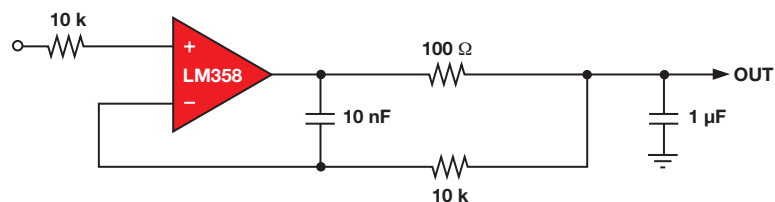
Key Features

- Wide supply range: 3 V to 32 V (TS321 30 V)
- Supply current independent of supply voltage: LM324: 0.8 mA, LM358: 0.7 mA, TS321: 0.5 mA
- Input voltage range includes ground
- Input voltage can exceed supply voltage safely
- Low input bias: 20 nA
- Open-loop voltage amplification: 100 V/mV
- Internal frequency compensation

Applications

- Transducer amplifiers
- DC amplification blocks
- Conventional operational amplifier circuits

TI's family of general-purpose high-voltage operational amplifiers consists of quad (LM324), dual (LM358) and single (TS321) independent high-gain frequency-compensated operational amplifiers that are designed specifically to operate from a single supply over a wide range of voltages. Operation from split supplies is also possible if the difference between the two supplies is 3 V to 32 V and V_{CC} is at least 1.5 V more positive than the input common-mode voltage.



Unity gain, high capacitance output.

Amplifiers and Comparators

→ High-Voltage Operational Amplifiers

Operational Amplifiers with JFET Inputs

TL03x, TL05x, TL06x, TL07x, TL08x (replace x with 1 for single, 2 for dual and 4 for quad)

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL03, [TL05](http://www.ti.com/sc/device/TL05), [TL06](http://www.ti.com/sc/device/TL06), [TL07](http://www.ti.com/sc/device/TL07), or [TL08](http://www.ti.com/sc/device/TL08)

Key Features

- Wide supply range: ± 5 V to ± 15 V
- Family includes a diverse range of power, speed and input offset choices
- Low power consumption option: 0.2 mA/Ch
- High-speed slew rate option: 20-V/ μ S
- Low input offset option: 0.8 mV max
- Low input bias current: <100 pA
- Output short circuit protection

Applications

- High fidelity and audio preamplifiers
- Sensor signal conditioning
- Active filters

TI's family of JFET-input operational amplifiers has been designed to offer a wider selection of operational amplifiers than any previously developed family. Each of these JFET-input operational amplifiers incorporates well-matched, high-voltage JFET and bipolar transistors in a monolithic integrated circuit. The devices feature high slew rates, low input bias and offset currents, and a low offset-voltage temperature or coefficient. Single version includes offset adjustment. On-chip offset-voltage trimming improves DC performance.

Part Number	TL031	TL051	TL061	TL071	TL081
V_{IO} maximum grades	1.5 mV 0.8 mV	1.5 mV 0.8 mV	15 mV 6 mV 3 mV	10 mV 6 mV 3 mV	15 mV 6 mV 3 mV
Supply current	0.22 mA	2.7 mA	0.2 mA	1.4 mA	1.4 mA
Slew rate	5.1 V/ μ S	20 V/ μ S	3.5 V/ μ S	13 V/ μ S	13 V/ μ S

General-Purpose Rail-to-Rail Output Operational Amplifiers

LMV321, LMV358, LMV324, LMV324S

Get samples, datasheets and app reports at: www.ti.com/sc/device/LMV321, [LMV358](http://www.ti.com/sc/device/LMV358), [LMV324](http://www.ti.com/sc/device/LMV324) or [LMV324S](http://www.ti.com/sc/device/LMV324S)

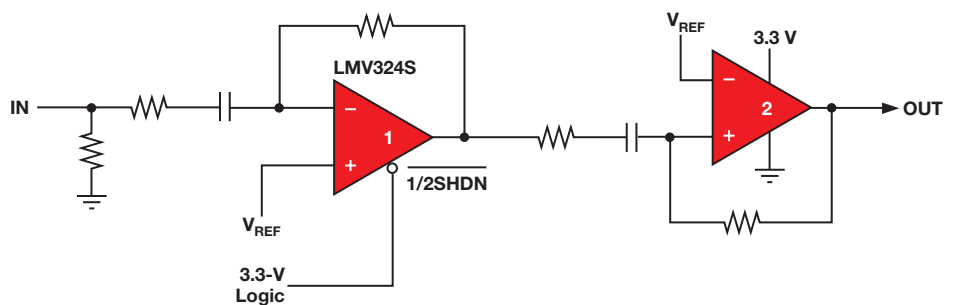
Key Features

- Specified 2.7-V and 5-V performance
- -40°C to 125°C operation
- Low-power shutdown mode, LMV324S only
- No crossover distortion
- Low supply currents: 130 μ A, 210 μ A, 410 μ A
- Rail-to-rail output swing
- ESD protection: 2 kV HBM, 1 kV CDM

Applications

- Cordless and cellular phones
- Laptops
- PDAs
- PCMIA

The LMV321/358/324 family offers single, dual and quad low-voltage operational amplifiers with rail-to-rail output swing. The LMV324S includes a power-saving shutdown feature that reduces supply current to a maximum of 5 μ A per channel when the amplifiers are not needed.



Two stage amplifier with shutdown.

Amplifiers and Comparators

Operational Amplifiers

Rail-to-Rail Output Operational Amplifiers

LMV821, LMV822, LMV824

Get samples, datasheets and app reports at: www.ti.com/sc/device/LMV821, [LMV822](http://www.ti.com/sc/device/LMV822) or [LMV824](http://www.ti.com/sc/device/LMV824)

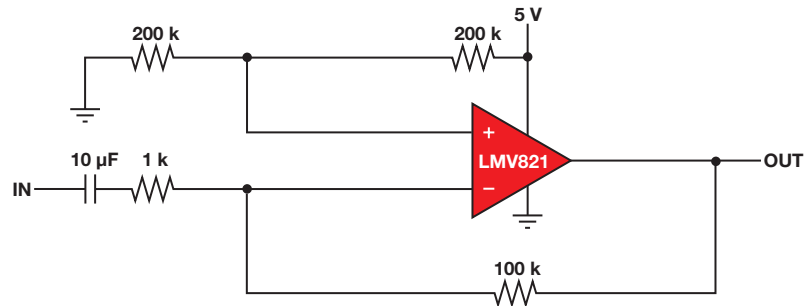
Key Features

- -40°C to 125°C operation
- No crossover distortion
- Low supply currents: 0.3 mA, 0.5 mA, 1 mA
- Rail-to-rail output swing
- ESD protection: 2-kV HBM, 1-kV CDM
- Higher bandwidth and faster slew rates available

Applications

- Cordless and cellular phones
- Laptops
- PC/MIA
- PDAs

The LMV821/822/824 family of devices offers a higher bandwidth (5.5 MHz typical) and faster slew rate (1.9 V/ms typical) than is available in the LMV321/358/324 family. Ultra-small DCK package options are available in both families for applications that require smaller designs.



High gain and bandwidth amplifier.

Rail-to-Rail Input and Output Operational Amplifiers

LMV931, LMV932, LMV934, LMV981, LMV982

Get samples, datasheets and app reports at: www.ti.com/sc/device/LMV931, [LMV932](http://www.ti.com/sc/device/LMV932), [LMV934](http://www.ti.com/sc/device/LMV934), [LMV981](http://www.ti.com/sc/device/LMV981) or [LMV982](http://www.ti.com/sc/device/LMV982)

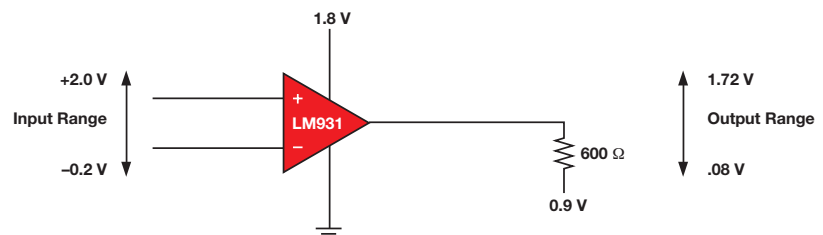
Key Features

- 1.8-V, 2.7-V, and 5-V specifications
- Rail-to-rail output swing
 - o 600-W load; 80 mV from rail
 - o 2 kW; 30 mV from rail
- V_{ICR} : 200 mV beyond rails
- Gain bandwidth: 1.4 MHz
- Supply current: 100 μA /amplifier
- Max V_{IO} : 4 mV
- Space-saving packages
- Shutdown on LMV981 and LMV982

Applications

- Automotive
- Communications (optical telecom, data/voice cable modems)
- Consumer electronics
- Industrial (utility/energy metering)
- Supply-current monitoring

The LMV93x and LMV98x families of operational amplifiers are low-voltage, low-power operational amplifiers that are well-suited for low-voltage and/or portable applications. These single, dual or quad operational amplifiers have rail-to-rail input and output capability for maximum signal swings in low-voltage applications. The LMV98x family of devices offers shutdown capability for additional power savings. Space-saving packages are available in both families for applications with the most demanding space constraints.



LM931 system block diagram.

Amplifiers and Comparators

→ Special-Purpose Operational Amplifiers

High-Speed Logarithm

TL441

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL441

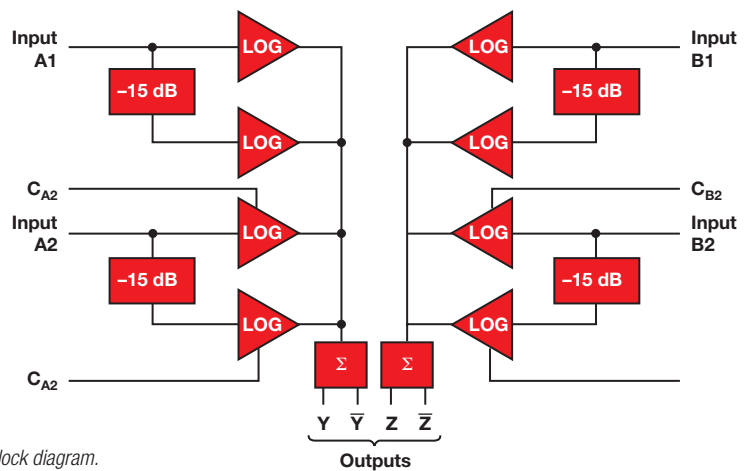
Key Features

- Excellent dynamic range
- Wide bandwidth: 40 MHz
- Built-in temperature compensation
- Log linearity (30 dB sections):
1 dB typical
- Wide-input voltage range:
10 mV to 1 V

Applications

- Data compression
- Analog compensation
- Log IF circuitry
- Video and log amplifiers

The TL441 amplifier circuit contains four 30-dB logarithmic stages. Gain in each stage is such that the output of each stage is proportional to the logarithm of the input voltage over the 30-dB input voltage range. Each half of the circuit contains two of these 30-dB stages summed together in one differential output that is proportional to the sum of the logarithms of the input voltages of the two stages. The four stages may be interconnected to obtain a theoretical input voltage range of 120 dB. In practice, this permits the input voltage range typically to be greater than 80 dB with log linearity of ± 0.5 dB. Bandwidth is from DC to 40 MHz.



Functional block diagram.

Norton Amplifiers

LM3900, LM2900

Get samples, datasheets and app reports at: www.ti.com/sc/device/LM3900 or [LM2900](http://www.ti.com/sc/device/LM2900)

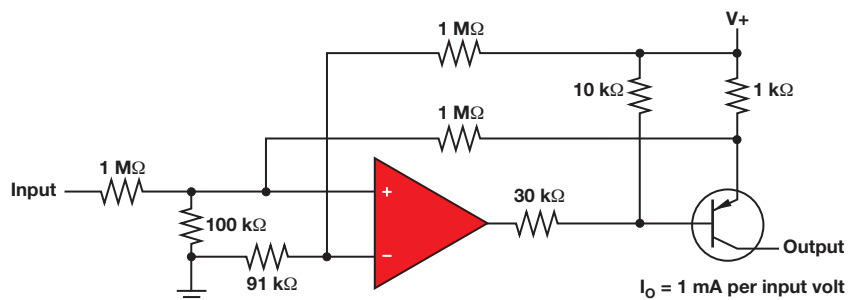
Key Features

- Wide range of supply voltages, single or dual supplies:
4.5 V to 32 V
- Wide bandwidth: 2.5 MHz
- Large-output voltage swing
- Output short-circuit protection
- Internal frequency compensation
- Low input bias current: 30 nA

Applications

- AC amplifiers
- High voltage comparators
- Active filters

LM3900 and LM2900 devices consist of four independent, high-gain frequency-compensated Norton operational amplifiers that are designed specifically to operate from a single supply over a wide range of voltages. Operation from split supplies is also possible. The low supply current drain is essentially independent of the magnitude of the supply voltage. These devices provide wide bandwidth and a large output voltage swing.



Voltage-controlled current source.

Amplifiers and Comparators

→ Special-Purpose Operational Amplifiers

Timers

NA555, NE555, SA555, SE555

Get samples, datasheets and app reports at: www.ti.com/sc/device/NA555, [NE555](http://www.ti.com/sc/device/NE555) or [SA555](http://www.ti.com/sc/device/SA555)

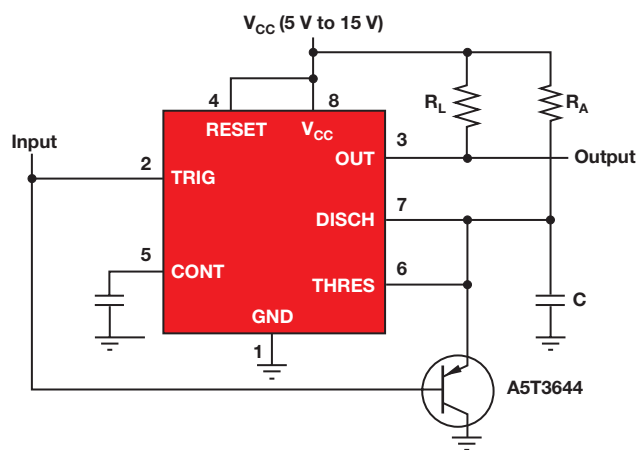
Key Features

- Timing from microseconds to hours
- Astable or monostable operation
- Adjustable duty cycle
- TTL-compatible output can sink or source up to 200 mA

Applications

- Clock generators
- Missing pulse detection
- Monostable flip-flops

These devices are precision timing circuits capable of producing accurate time delays or oscillation. In the time-delay or monostable mode of operation, the timed interval is controlled by a single external resistor and capacitor network. In the astable mode of operation, the frequency and duty cycle can be controlled independently with two external resistors and a single external capacitor. The threshold and trigger levels normally are two-thirds and one-third, respectively of V_{CC} . These levels can be altered by use of the control-voltage terminal. The output circuit is capable of sinking or sourcing current up to 200 mA. Operation is specified for supplies of 5 V to 15 V. with a 5-V supply. Output levels are compatible with TTL inputs.



Missing pulse detector.

Amplifiers and Comparators

→ Special-Purpose Operational Amplifiers

Amplifiers + Voltage Reference

TSM102, TSM104W

Get samples, datasheets and app reports at: www.ti.com/sc/device/TSM102 or [TSM104W](http://www.ti.com/sc/device/TSM104W)

Key Features

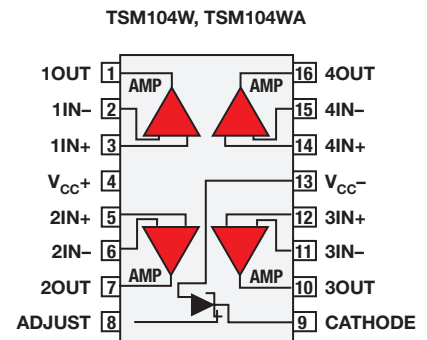
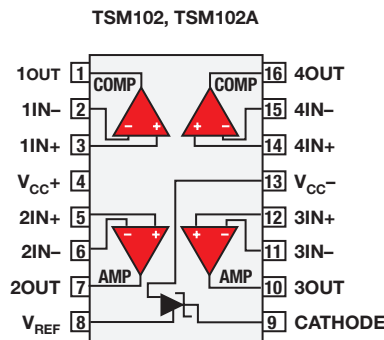
- Combination devices that include operational amplifiers, comparators and voltage reference
- TSM102 low supply current: 200 μ A
- TSM104W low supply current: 350 μ A
- Low-level output voltage
- Adjustable output voltage: V_{REF} to 36 V
- Wide sink current capability: 0.5 mA to 100 mA
- Latch-up immunity
- 0.4% (A-grade) and 1% (standard-grade) precision

Applications

- Switch-mode power supplies
- Battery chargers
- Voltage and current sensing
- Data-acquisition systems
- Alarms, detectors and sensors

The TSM102 combines the building blocks of a dual operational amplifier, a dual comparator and a precision voltage reference, all of which are often used to implement a wide variety of power-management functions, including overcurrent detection, undervoltage/overvoltage detection, power-good detection, window comparators, error amplifiers, etc. Additional applications include alarm and detector/sensor applications.

The TSM104W combines the building blocks of a quad operational amplifier and an adjustable voltage reference, both of which are often used in the control circuitry of switch-mode power supplies.



Amplifiers and Comparators

→ High-Voltage Audio Operational Amplifiers

High Precision, Low-Noise Audio Operational Amplifiers

NE5532, NE5534

Get samples, datasheets and app reports at: www.ti.com/sc/device/NE5532 or [NE5534](http://www.ti.com/sc/device/NE5534)

Key Features

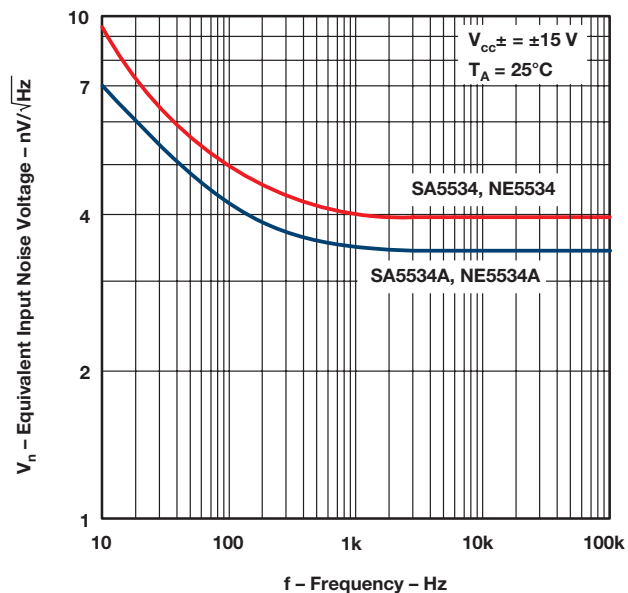
- Equivalent input noise voltage:
 - o NE5532: 5 nV $\sqrt{\text{Hz}}$ typical at 1 kHz
 - o NE5534: 3.5 nV $\sqrt{\text{Hz}}$ typical at 1 kHz
- Unity-gain bandwidth:
10 MHz typical
- Common-mode rejection ratio:
100 dB typical
- High DC voltage gain:
100 V/mV typical
- High slew rate
- Maximum output swing bandwidths
- Input protection diodes
- Output short-circuit protection

Applications

- Mixers
- Tone control
- Preamplifiers

TI's family of high-precision, low-noise audio operational amplifiers, the NE5532 and NE5534, are high-performance operational amplifiers combining excellent DC and AC characteristics. Features include very low noise, high output-drive capability, high unity-gain and maximum-output swing bandwidths, low distortion, and high slew rates. These operational amplifiers are compensated internally for unity-gain operations.

Equivalent Input Noise Voltage vs. Frequency



Amplifiers and Comparators

→ High-Voltage Audio Operational Amplifiers

Best Value, General-Purpose Audio Operational Amplifier

RC4558

Get samples, datasheets and app reports at: www.ti.com/sc/device/RC4558

Key Features

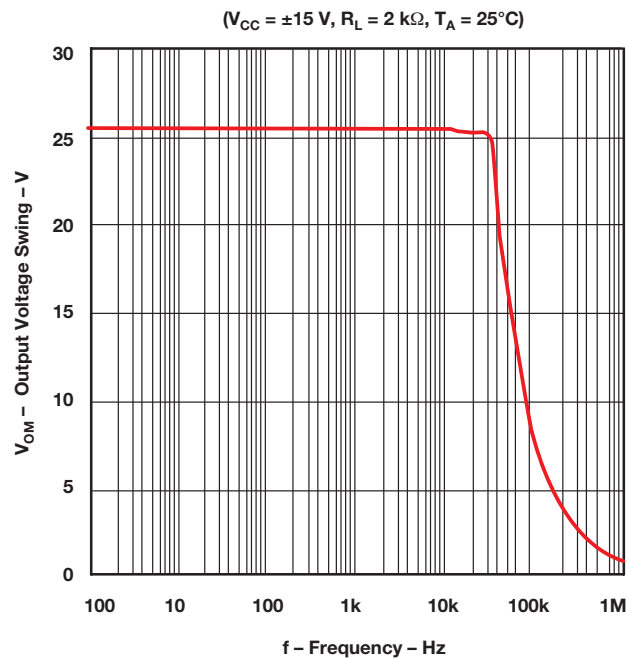
- Continuous short-circuit protection
- Wide common-mode and differential voltage ranges
- No frequency compensation required
- Low power consumption
- No latch-up
- Unity-gain bandwidth: 3 MHz typical
- Gain and phase match between amplifiers
- Low noise: 8 nV $\sqrt{\text{Hz}}$ typical at 1 kHz

Applications

- Active filters
- Mixers
- Preamplifiers

The RC4558 device is a dual general-purpose operational amplifier, with each half electrically similar to the mA741, except that offset null capability is not provided. The high common-mode input voltage range and the absence of latch-up make this amplifier ideal for voltage-follower applications. The RC4558 is short-circuit-protected and the internal frequency compensation ensures stability without external components.

Output Voltage Swing vs. Frequency



Amplifiers and Comparators

→ High-Voltage Audio Operational Amplifiers

High-Output-Current, Low-Noise Operational Amplifiers

RC4580

Get samples, datasheets and app reports at: www.ti.com/sc/device/RC4580

Key Features

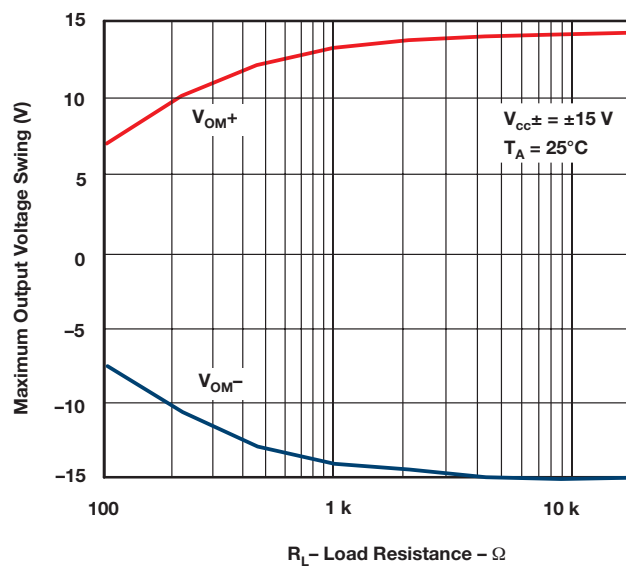
- Operating voltage: ± 2 V to ± 18 V
- Low noise voltage: $0.8 \mu\text{V}_{\text{rms}}$ typical
- Wide GBW: 12 MHz typical
- Low THD: 0.0005% typical
- Slew rate: 5 V/ μs typical

Applications

- Audio preamplifiers
- Active filters
- Headphone amplifiers
- Industrial measurement equipment

The RC4580 is a dual operational amplifier that is designed optimally for audio applications, such as improving tone control. It offers low noise, high gain bandwidth, low harmonic distortion and high output current, all of which make the device ideally suited for audio electronics such as audio preamplifiers and active filters, as well as industrial measurement equipment. When high output current is required, the RC4580 can also be used as a headphone amplifier. Due to its wide operating supply voltage, the RC4580 can also be used in low-voltage applications.

Maximum Output Voltage Swing vs. Load Resistance



Amplifiers and Comparators

→ High-Voltage Audio Operational Amplifiers

2.7-V to 15-V, Class-A Output Low-Noise Operational Amplifiers

TL971, TL972, TL974

Get samples, datasheets and app reports at: www.ti.com/sc/device/TL971, [TL972](http://www.ti.com/sc/device/TL972) or [TL974](http://www.ti.com/sc/device/TL974)

Key Features

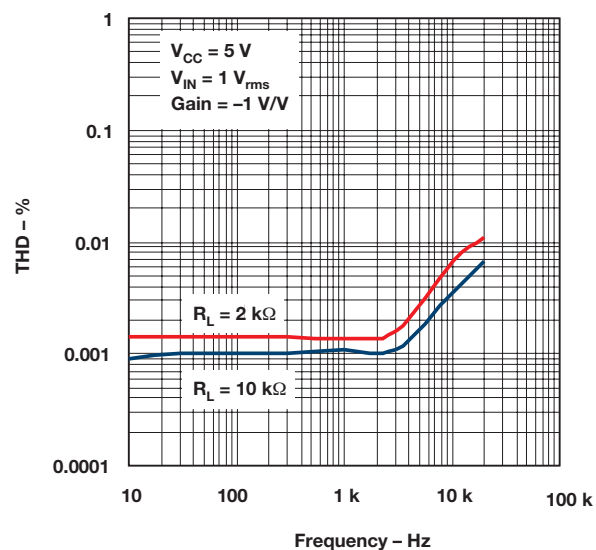
- Rail-to-rail output voltage swing: ± 2.4 V at $V_{CC} = \pm 2.5$ V
- Very low noise level: $4 \text{ nV}\sqrt{\text{Hz}}$
- Ultra-low distortion: 0.003%
- High dynamic features: 12 MHz, 5 V/ μs
- Operating range: 2.7 V to 12 V
- Latch-up performance exceeds 100 mA per JESD 78, Class II
- ESD performance tested per JESD 22

Applications

- Portable equipment (CD players, PDAs)
- Portable communications (cell phones, pagers)
- Instrumentation and sensors
- Professional audio circuits

The TL97x family of operational amplifiers operates at voltages as low as ± 1.35 V and features rail-to-rail-output signal swing. The TL97x boasts characteristics that make them particularly well suited for portable and battery-supplied equipment. Very low noise and low distortion characteristics make them ideal for audio preamplification. The TL971 is housed in the space-saving 5-pin SOT-23 package, which simplifies board design because of the ability to be placed anywhere (outside dimensions are 2.8 mm x 2.9 mm).

Total Harmonic Distortion vs. Frequency



→ High-Voltage Audio Operational Amplifiers

1.5 V to 5.5 V High-Output-Current Operational Amplifiers

TLV342, TLV342S

Get samples, datasheets and app reports at: www.ti.com/sc/device/TLV342 or [TLV342S](http://www.ti.com/sc/device/TLV342S)

Key Features

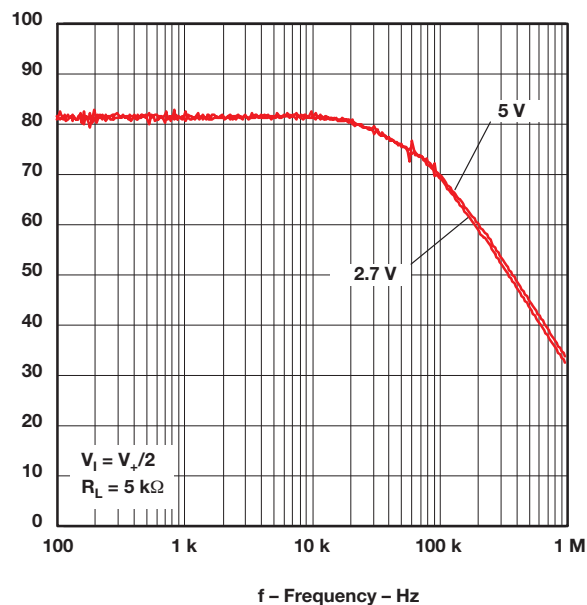
- 1.8-V and 5-V performance
- Low offset (A grade)
- Rail-to-rail output swing
- Wide common-mode input voltage range
- ESD protection exceeds JESD 22
- Gain bandwidth: 2.3 MHz typical
- Slew rate: 0.9 V/μs typical

Applications

- Cordless/cellular phones
- Consumer electronics (laptops, PDAs)
- Audio pre amps for voice
- Portable/battery-powered electronics
- Supply current or battery monitoring
- Buffers, filters or drivers

The TLV342 is a dual CMOS operational amplifier with low-voltage, low-power and rail-to-rail output swing capabilities. The PMOS input stage offers an ultra-low input bias current of 1 pA (typical) and an offset voltage of 0.3 mV (typical). For applications requiring excellent DC precision, the A grade (TLV34xA) has a low offset voltage of 1.25 mV (max) at 25°C. This single-supply amplifier is designed specifically for ultra-low-voltage (1.5-V to 5-V) operation, with a common-mode input voltage range that typically extends from 0.2 V to 0.5 V from the positive supply rail. Additional features include a 20-nV/√Hz voltage noise at 10 kHz, 2.3-MHz unity-gain bandwidth, and 0.9-V/μs slew rate. The TLV342 in the RUG package also offers a shutdown (SHDN) pin that can be used to disable the device.

CMRR vs. Frequency



Amplifiers and Comparators

→ Low-Voltage Audio Operational Amplifiers

1-V to 5-V, Class-A Output Low-Noise Operational Amplifiers

TLV2361, TLV2362

Get samples, datasheets and app reports at: www.ti.com/sc/device/TLV2361 or [TLV2362](http://www.ti.com/sc/device/TLV2362)

Key Features

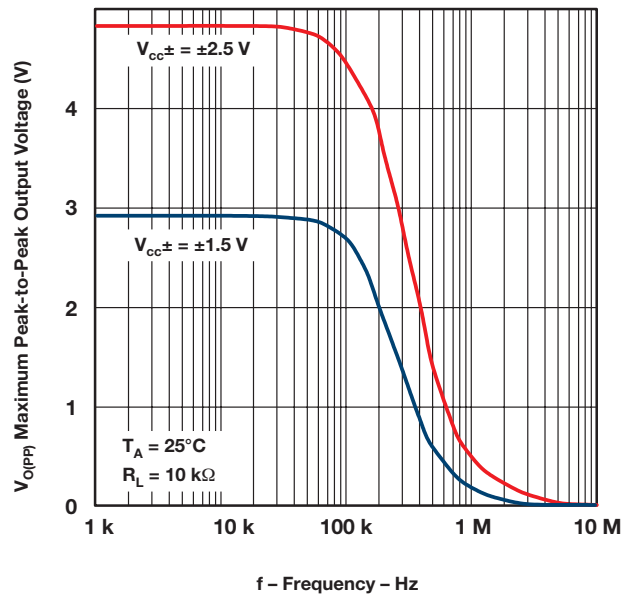
- Low supply voltage operation:
 $V_{CC} = \pm 1 \text{ V min}$
- Wide bandwidth: 7 MHz typical at
 $V_{CC\pm} = \pm 2.5 \text{ V}$
- High slew rate: 3 V/ μs typical at
 $V_{CC\pm} = \pm 2.5 \text{ V}$
- Wide output voltage swing: $\pm 2.4 \text{ V}$
typical at $V_{CC\pm} = \pm 2.5 \text{ V}$,
 $R_L = 10 \text{ k}\Omega$
- Low noise: 8 nV $\sqrt{\text{Hz}}$ typical at
 $f = 1 \text{ kHz}$

Applications

- Portable equipment
(CD players, PDAs)
- Portable communications
(cell phones, pagers)
- Instrumentation and sensors

TLV236x devices are high-performance dual operational amplifiers built using an original Texas Instruments bipolar process. These devices can be operated at a very low supply voltage ($\pm 1 \text{ V}$) while maintaining a wide output swing. TLV236x devices offer a dramatically improved dynamic range of signal conditioning in low-voltage systems. TLV236x devices also provide higher performance than other general-purpose operational amplifiers by combining higher unity-gain bandwidth and faster slew rates. With their low distortion and low-noise performance, these devices are well-suited for audio applications.

Maximum Peak-to-Peak Output Voltage vs. Frequency



Amplifiers and Comparators

→ High-Voltage Comparators

General-Purpose High-Voltage Comparators

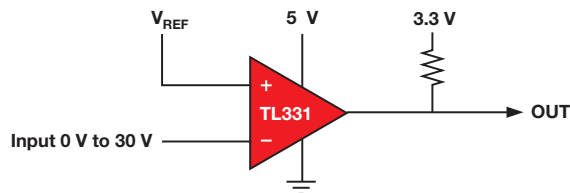
LM393, LM339, TL331

Get samples, datasheets and app reports at: www.ti.com/sc/device/LM393, [LM339](http://www.ti.com/sc/device/LM339), or [TL331](http://www.ti.com/sc/device/TL331)

Key Features

- Wide supply range: 2 V to 36 V
- Single or dual supplies
- Low supply current drain independent of supply voltage: 0.4 mA typical per comparator
- Input voltage range includes ground
- Low input bias and offset parameters: input bias current 25 nA typical; offset current 3 nA typical (LM193)
- Either input (not both) can exceed common-mode range beyond V_{CC} (up to max rated V_{CC}) while maintaining a valid output state
- Low-output saturation voltage

TI's family of general-purpose high-voltage comparators consists of single (TL331), dual (LM393) or quad (LM339) independent voltage comparators that are designed to operate from a single power supply over a wide range of voltages. Operation from dual supplies is also possible as long as the difference between the two supplies is 2 V to 36 V, and V_{CC} is at least 1.5 V more positive than the input common-mode voltage. Current drain is independent of the supply voltage. The outputs can be connected to other open-collector outputs to achieve wired-AND relationships. Full military temperature ranges are available.



Comparator with high-voltage (0 V to 30 V) input and low-voltage output.

Applications

- Hysteresis comparators
- Oscillators
- Window comparators

High-Speed High-Voltage Comparators

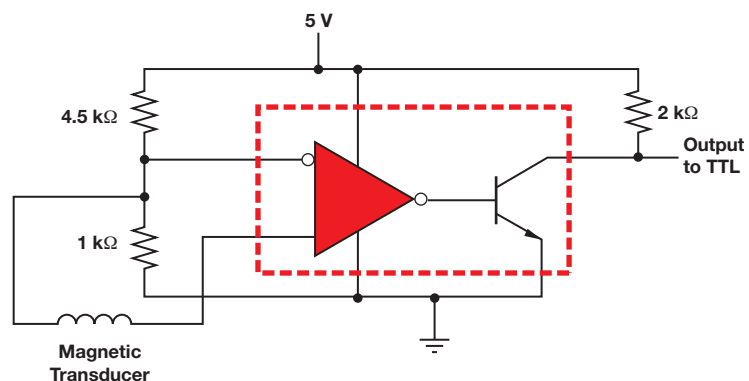
LM311, LM211

Get samples, datasheets and app reports at: www.ti.com/sc/device/LM311 or [LM211](http://www.ti.com/sc/device/LM211)

Key Features

- Fast response times: rise time 115 ns; fall time: 165 ns
- Strobe capability
- Maximum input bias current: 300 nA
- Maximum input offset current: 70 nA
- Supply range: 3.5 V to 30 V
- Available in Q-temp automotive

LM211 and LM311 are single high-speed voltage comparators. These devices are designed to operate from a wide range of power-supply voltages, including ± 15 -V supplies for operational amplifiers and 5-V supplies for logic systems. The output levels are compatible with most TTL and MOS circuits. These comparators are capable of driving lamps or relays and switching voltages up to 50 V at 50 mA. All inputs and outputs can be isolated from system ground. Offset balancing and strobe capabilities are available and the outputs can be wire-OR connected. If the strobe is low, the output is in the off state, regardless of the differential input.



LM311 block diagram.

Amplifiers and Comparators

→ Low-Voltage Comparators

General-Purpose Low-Voltage Comparators

LMV331, LMV393, LMV339

Get samples, datasheets and app reports at: www.ti.com/sc/device/LMV331, [LMV393](http://www.ti.com/sc/device/LMV393) or [LMV339](http://www.ti.com/sc/device/LMV339)

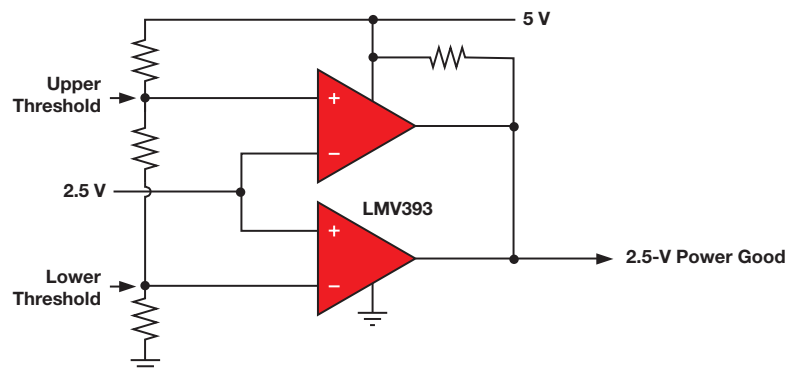
Key Features

- Specified 2.7-V and 5-V performance
- Low supply current as low as 60 A typical
- Input common-mode voltage range includes ground
- Low output saturation voltage: 200 mV with 4 mA load
- Open-collector output for maximum flexibility

Applications

- Portable consumer products
- Consumer goods
- Test and measurement

TI's family of general-purpose low-voltage comparators consists of single (LMV331), dual (LMV393) or quad (LMV339) independent voltage comparators that are designed to operate from a single power supply. Current drain is independent of the supply voltage. The outputs can be connected to other open-collector outputs to achieve wired-AND relationships. The LMV331, LMV339 and LMV393 are the most cost-effective solutions for applications where low-voltage operation, low power, space savings and price are the primary specifications in circuit design.



LMV393 window comparator.

Amplifiers and Comparators

→ Advanced Packaging

Standard Linear Parts in X2QFN (RUG) Packaging

TLV342, TLV342S

View packaging details at www.ti.com/analogpackaging

As electronics continue to permeate into new areas of automotive, medical, and industrial applications, packaging finds itself in the forefront of enabling new features required for growth in these markets. The need to further customize packaging for such applications will play a much bigger role moving forward in order to enable device solutions that previously were not possible. The need to provide package solutions to meet the size, thermal, electrical, and cost requirements of these dynamic markets is at a premium. TI continues to be a leader in such package development and offers two distinct package type

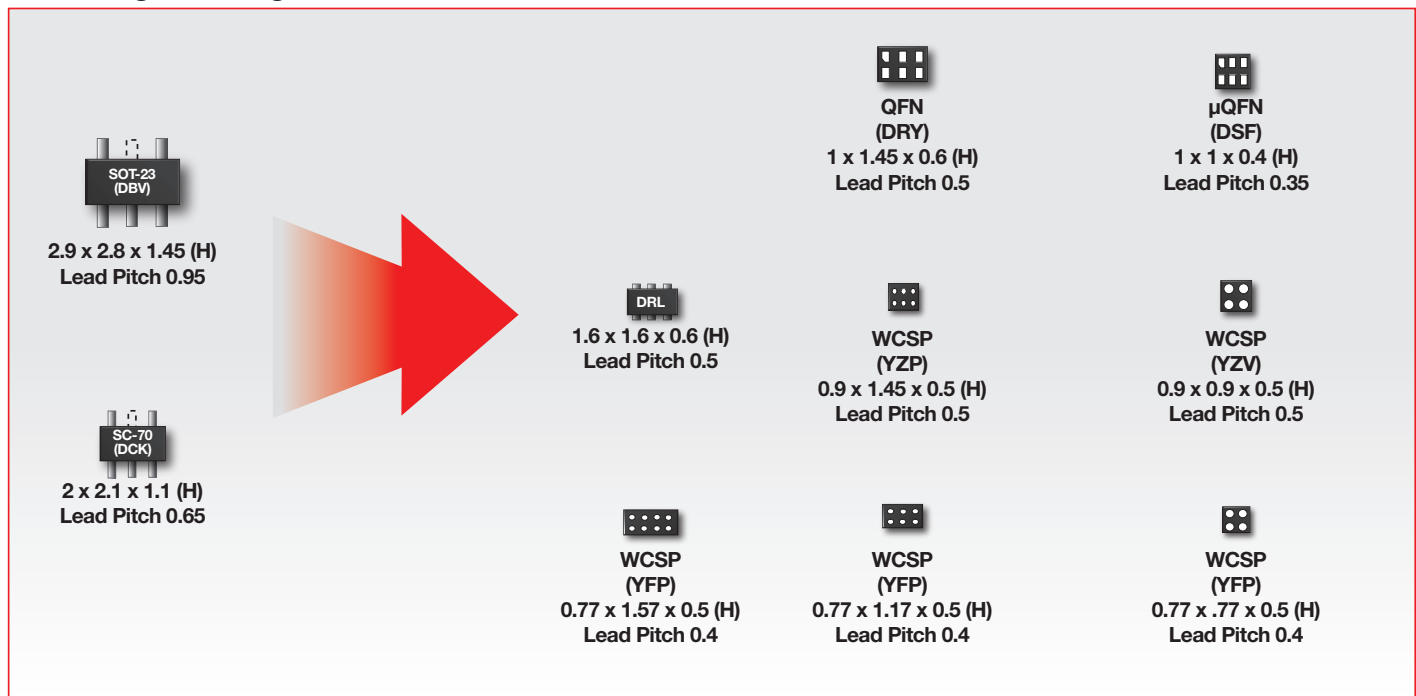
solutions to address today's, as well as tomorrow's, market needs. The broad NanoStar™ and μQFN package portfolio TI offers continues to be a focus of future development as the market demands higher performance in smaller packages. TI has developed and qualified fine pitch options in both package nodes. Our latest NanoStar™ additions include very small, 0.3 mm pitch offerings such as a 0.6 mm x 0.9 mm, 6-pin packages. The μQFN portfolio now includes a 1.0 mm x 1.0 mm (0.35 mm pitch) package, with 0.3 mm pitch offerings coming soon.



2 mm x 1.5 mm
Lead Pitch = 0.5 mm
Height Max. = 0.4 mm

X2QFN (RUG).

Little Logic Package Trend



Amplifiers and Comparators

→ Selection Tables

Low-Voltage Operational Amplifiers

Part Number	Description	Number of Channels	V _s (min) (V)	V _s (max) (V)	I _q per Channel (max) (mA)	GBW (typ) (MHz)	Slew Rate (typ) (V/us)	V _{IO} (25°C) (max) (mV)	Offset Drift (typ) (μV/C)	I _B (max) (pA)	CMRR (min) (dB)	V _n @ 1 kHz (typ) (nV/rtHz)	Single Supply	Rail-Rail	Pin/Package	Price*
LMV321	Single Low-Voltage Rail-to-Rail Output Operational Amplifier	1	2.7	5.5	0.17	1	1	7	5	250,000	50	39	Yes	Out	5SC70, 5SOT-23	0.26
LMV324	Quad Low-Voltage Rail-to-Rail Output Operational Amplifier	4	2.7	5.5	0.17	1	1	7	5	250,000	50	39	Yes	Out	14SOIC, 14TSSOP	0.30
LMV324S	Quad, Low-Voltage, RRO with Shutdown	4	2.7	5.5	0.17	1	1	7	5	250,000	50	39	Yes	Out	16SOIC, 16TSSOP	0.36
LMV341	Single Rail-to-Rail Output CMOS Operational Amplifier with Shutdown	1	2.5	5.5	0.17	1	1	4	1.7	120	56	40	Yes	Out	6SC70, 6SOT-23	0.30
LMV342	Dual Rail-to-Rail Output CMOS Operational Amplifier with Shutdown	2	2.5	5.5	0.17	1	1	4	1.7	120	56	40	Yes	Out	8MSOP, 8SOIC, 8VSSOP	0.33
LMV344	Quad Rail-to-Rail Output CMOS Operational Amplifier with Shutdown	4	2.5	5.5	0.17	1	1	4	1.7	120	56	40	Yes	Out	14SOIC, 14TSSOP	0.38
LMV358	Dual Low-Voltage Rail-to-Rail Output Operational Amplifier	2	2.7	5.5	0.17	1	1	7	5	250,000	50	39	Yes	Out	8MSOP, 8SOIC, 8TSSOP, 8VSSOP	0.30
LMV710	Single Low-Power, RRIO Operational Amplifier with High Output Current Drive and Shutdown	1	2.7	5	1.7	5	5	3	—	—	50	20	Yes	Out	5SC70, 5SOT-23	0.33
LMV711	Single Low-Power, RRIO Operational Amplifier with High Output Current Drive and Shutdown	1	2.7	5	1.7	5	5	3	—	—	50	20	Yes	Out	6SC70, 6SOT-23	0.33
LMV712	Low-Power Low-Noise High-Output RRIO Dual Operational Amplifier with Independent Shutdown	2	2.7	5	1.7	5	5	3	—	—	45	20	Yes	In, Out	10MSOP	0.45
LMV715	Single Low-Power RRIO Operational Amplifiers with High Output Current Drive and Shutdown	1	2.7	5	1.7	5	5	3	—	—	45	20	Yes	In, Out	6SC70, 6SOT-23	0.36
LMV721	10-MHz Low-Noise Low-Voltage Low-Power Operational Amplifiers	1	2.2	5	1.3	10	4.9	3	0.6	260,000	64	9	Yes	Out	5SC70, 5SOT-23	0.44
LMV722	10-MHz Low-Noise Low-Voltage Low-Power Operational Amplifiers	2	2.2	5	1.2	10	4.9	3	0.6	260,000	64	9	Yes	Out	8MSOP, 8SOIC	0.33
LMV821	Single Low-Voltage Operational Amplifiers with Rail-to-Rail Outputs	1	2.7	5.5	0.5	5	1.7	3.5	1	100,000	70	45	Yes	Out	5SC70, 5SOT-23	0.75
LMV822	Dual Low-Voltage Operational Amplifiers with Rail-to-Rail Outputs	2	2.7	5.5	0.4	5	1.7	3.5	1	100,000	70	45	Yes	Out	8MSOP, 8SOIC	0.39
LMV824	Quad Low-Voltage Operational Amplifiers with Rail-to-Rail Outputs	4	2.7	5.5	0.3	5	1.7	3.5	1	100,000	72	45	Yes	Out	14SOIC, 14TSSOP, 14TVSOP	0.42
LMV931	Single 1.8-V Operational Amplifiers with Rail-to-Rail Input and Output	1	1.8	5	0.185	1.4	0.35	4	5.5	75,000	60	60	Yes	In, Out	5SC70, 5SOT-23	0.29

*Suggested resale price in U.S. dollars in quantities of 1,000.

Amplifiers and Comparators

→ Selection Tables

Low-Voltage Operational Amplifiers (Continued)

Part Number	Description	Number of Channels	V _S (min) (V)	V _S (max) (V)	I _q per Channel (max) (mA)	GBW (typ) (MHz)	Slew Rate (typ) (V/μs)	V _{IO} (25°C) (max) (mV)	Offset Drift (typ) (μV/°C)	I _B (max) (pA)	CMRR (min) (dB)	V _n @ 1 kHz (typ) (nV/√Hz)	Single Supply	Rail-Rail	Pin/Package	Price*
LMV932	Dual 1.8-V Operational Amplifiers with Rail-to-Rail Input and Output	2	1.8	5	0.185	1.4	0.35	5.5	5.5	75,000	60	60	Yes	In, Out	8MSOP, 8SOIC	0.41
LMV934	Quad 1.8-V Operational Amplifiers with Rail-to-Rail Input and Output	4	1.8	5	0.185	1.4	0.35	5.5	5.5	75,000	60	60	Yes	In, Out	14SOIC, 14TSSOP	0.42
LMV981	Single 1.8-V Operational Amplifier with Rail-to-Rail Input and Output and Shutdown	1	1.8	5	0.185	1.4	0.35	4	5.5	65,000	60	60	Yes	In, Out	6SC70, 6SOT-23, 8X2QFN	0.55
LMV982	Dual 1.8-V Operational Amplifier with Rail-to-Rail Input and Output and Shutdown	2	1.8	5	0.185	1.4	0.35	5.5	5.5	65,000	60	60	Yes	In, Out	10MSOP	0.55
LPV321	Single, Low-Voltage, Low Power, RRO	1	2.7	5.5	0.012	0.237	0.1	7	4	50,000	50	146	Yes	Out	5SC70, 5SOT-23	0.32
LPV324	Quad, Low-Voltage, Low Power, RRO	4	2.7	5.5	0.0115	0.237	0.1	7	4	50,000	50	146	Yes	Out	14SOIC, 14TSSOP	0.36
LPV358	Dual, Low-Voltage, Low Power, RRO	2	2.7	5.5	0.01	0.237	0.1	7	4	50,000	50	146	Yes	Out	8MSOP, 8SOIC, 8VSSOP	0.33
TLV2361	Single High-Performance, Low-Voltage Operational Amplifier	1	2	5	2.25	6	3	6	—	150,000	85	9	—	Out	5SOT-23	0.45
TLV2362	Dual High-Performance, Low-Voltage Operational Amplifier	2	2	5	2.25	6	3	6	—	150,000	86	9	—	Out	8MSOP, 8PDIP, 8SOIC, 8TSSOP	0.55
TLV341	Low-Voltage, Rail-to-Rail Output CMOS Operational Amplifiers with Shutdown	1	1.5	5.5	0.15	2.3	0.9	4	1.9	3,000	50	33	Yes	Out	6SC70, 6SOT, 6SOT-23	0.38
TLV341A	Low-Voltage, Rail-to-Rail Output CMOS Operational Amplifiers with Shutdown	1	1.5	5.5	0.15	2.3	0.9	1.25	1.9	3,000	50	33	Yes	Out	6SC70, 6SOT-23	0.45
TLV342	Low-Voltage, Rail-to-Rail Output CMOS Operational Amplifiers	2	1.5	5.5	0.15	2.2	0.9	4	1.9	3,000	50	33	Yes	Out	10X2QFN, 8MSOP, 8SOIC	0.41
TLV342A	Low-Voltage, Rail-to-Rail Output CMOS Operational Amplifiers	2	1.5	5.5	0.15	2.2	0.9	1.25	1.9	3,000	50	33	Yes	Out	8SOIC	0.49
TLV342S	Low-Voltage Rail-to-Rail Output CMOS Operational Amplifiers with Shutdown	2	1.5	5.5	0.15	2.2	0.9	4	1.9	3,000	50	33	Yes	Out	10X2QFN	0.60

*Suggested resale price in U.S. dollars in quantities of 1,000.

Amplifiers and Comparators

→ Selection Tables

High-Voltage Operational Amplifiers

Part Number	Description	Number of Channels	V _S (min) (V)	V _S (max) (V)	I _q per Channel (max) (mA)	GBW (typ) (MHz)	Slew Rate (typ) (V/us)	V _{IO} (25°C) (max) (mV)	Offset Drift (typ) (μV/°C)	I _B (max) (pA)	CMRR (min) (dB)	V _n @ 1 kHz (typ) (nV/√Hz)	Single Supply	Rail-Rail	HiRel Avail.	Pin/Package	Price*
LF347	Quad General-Purpose JFET-input Operational Amplifier	4	7	36	2.75	3	13	10	18	200	70	18	—	—	—	14PDIP, 14SOIC	0.31
LF347B	Wide-Bandwidth JFET-input Quad Operational Amplifier	4	7	36	2.75	3	13	5	18	200	80	18	—	—	—	14PDIP, 14SOIC	0.31
LF353	Dual General-Purpose JFET-input Operational Amplifier	2	7	36	3.25	3	13	10	10	200	70	18	—	—	—	8PDIP, 8SOIC	0.22
LF411	Precision JFET-input Operational Amplifier	1	7	36	3.4	3	13	2	10	200	70	18	—	—	—	8PDIP, 8SOIC	0.70
LF412	Dual JFET-input Operational Amplifier	2	7	36	3.4	3	13	3	10	200	70	18	—	—	—	8PDIP, 8SOIC	0.70
LM224	Quadruple Operational Amplifier	4	3	32	0.3	1.2	0.5	5	—	150,000	70	35	Yes	—	—	14PDIP, 14SOIC	0.13
LM224A	Quadruple Operational Amplifier	4	3	32	0.3	1.2	0.5	3	—	80,000	70	35	Yes	—	—	14PDIP, 14SOIC	0.14
LM224K	Quadruple Operational Amplifier	4	3	32	0.3	1.2	0.5	5	—	150,000	70	35	Yes	—	—	14PDIP, 14SOIC	0.21
LM224KA	Quadruple Operational Amplifier	4	3	32	0.3	1.2	0.5	3	—	80,000	70	35	Yes	—	—	14PDIP, 14SOIC	0.21
LM248	Quadruple Operational Amplifier	4	8	36	1.125	1	0.5	6	—	200,000	70	—	—	—	—	14PDIP, 14SOIC	0.18
LM258	Dual Operational Amplifier	2	3	32	0.6	0.7	0.3	5	7	150,000	70	40	Yes	—	—	8MSOP, 8PDIP, 8SOIC	0.12
LM258A	Dual Operational Amplifier	2	3	32	0.6	0.7	0.3	3	7	100,000	70	40	Yes	—	—	8MSOP, 8PDIP, 8SOIC	0.15
LM2902	Quadruple Operational Amplifier	4	3	26	0.3	1.2	0.5	7	—	250,000	50	35	Yes	—	—	14PDIP, 14SO, 14SOIC, 14TSSOP	0.12
LM2902K	Quadruple Operational Amplifier	4	3	26	0.3	1.2	0.5	7	—	250,000	50	35	Yes	—	—	14PDIP, 14SO, 14SOIC, 14SSOP, 14TSSOP	0.13
LM2902KAV	Quadruple Operational Amplifier, Enhanced Voltage	2	3	26	0.3	1.2	0.5	2	—	250,000	60	35	Yes	—	—	14SOIC, 14TSSOP	0.28
LM2902KV	Quadruple Operational Amplifier, Enhanced Voltage	2	3	26	0.3	1.2	0.5	7	—	250,000	60	35	Yes	—	—	14SOIC, 14TSSOP	0.23
LM2904	Dual Operational Amplifier	2	3	26	0.6	0.7	0.3	7	7	250,000	50	40	Yes	—	—	8MSOP, 8PDIP, 8SO, 8SOIC, 8TSSOP	0.12
LM2904V	Dual Operational Amplifier, Enhanced Voltage	2	3	26	0.6	0.7	0.3	7	7	250,000	65	40	Yes	—	—	8SOIC, 8TSSOP	0.23
LM318	Single High-Speed Operational Amplifier	1	10	40	10	15	70	10	—	500,000	70	—	Yes	—	—	8PDIP, 8SO, 8SOIC	0.75
LM324	Quadruple Operational Amplifier	4	3	32	0.3	1.2	0.5	7	—	250,000	65	35	Yes	—	—	14PDIP, 14SO, 14SOIC, 14TSSOP	0.11

*Suggested resale price in U.S. dollars in quantities of 1,000.

Amplifiers and Comparators

→ Selection Tables

High-Voltage Operational Amplifiers (Continued)

Part Number	Description	Number of Channels	V _S (min) (V)	V _S (max) (V)	I _Q per Channel (max) (mA)	GBW (typ) (MHz)	Slew Rate (typ) (V/us)	V _{IO} (25°C) (max) (mV)	Offset Drift (typ) (μV/C)	I _B (max) (pA)	CMRR (min) (dB)	V _n @ 1 kHz (typ) (nV/rHz)	Single Supply	Rail-Rail	HiRel Avail.	Pin/Package	Price*
LM324A	Quadruple Operational Amplifier	4	3	32	0.3	1.2	0.5	3	—	100,000	65	35	Yes	—	—	14PDIP, 14SO, 14SOIC, 14SSOP, 14TSSOP	0.16
LM324K	Quadruple Operational Amplifier	4	3	32	0.3	1.2	0.5	7	—	250,000	65	35	Yes	—	—	14PDIP, 14SO, 14SOIC, 14TSSOP	0.19
LM324KA	Quadruple Operational Amplifier	4	3	32	0.3	1.2	0.5	3	—	100,000	65	35	Yes	—	—	14PDIP, 14SO, 14SOIC, 14TSSOP	0.21
LM348	Quad General-Purpose Operational Amplifier	4	8	36	1.125	1	0.5	6	—	200,000	70	—	—	—	—	14PDIP, 14SO, 14SOIC	0.18
LM358	Dual Operational Amplifiers	2	3	32	0.6	0.7	0.3	7	7	250,000	65	40	Yes	—	—	8MSOP, 8PDIP, SO, 8SOIC, 8TSSOP	0.10
LM358A	Dual Operational Amplifier	2	3	32	0.6	0.7	0.3	3	3	100,000	65	40	Yes	—	—	8MSOP, 8PDIP, 8SOIC, 8TSSOP	0.13
LP2902	Ultra-Low-Power Quadruple Operational Amplifier	4	3	32	0.037	0.1	0.05	4	10	20,000	80	—	Yes	—	—	14PDIP, 14SOIC, 14TSSOP	0.37
LP2904	Ultra-Low-Power Dual Operational Amplifiers	2	3	32	0.037	0.1	0.05	4	10	40,000	75	—	Yes	—	—	8SOIC	0.65
LP324	Ultra-Low-Power Quadruple Operational Amplifiers	4	3	32	0.037	0.1	0.05	4	10	10,000	80	—	Yes	—	—	14PDIP, 14SOIC, 14TSSOP	0.24
LP358	Ultra-Low-Power Dual Operational Amplifier	2	3	32	0.037	0.1	0.05	4	10	40,000	75	—	Yes	—	—	8SOIC	0.24
LT1013	Dual Precision Operational Amplifier	2	4	44	0.55	1	0.4	0.3	2.5	30,000	97	22	Yes	—	—	8PDIP, 8SOIC	1.15
LT1013D	Dual Precision Operational Amplifier	2	4	44	0.55	1	0.4	0.8	5	30,000	97	22	Yes	—	—	8PDIP, 8SOIC	1.15
LT1014	Quad Precision Operational Amplifier	4	5	44	0.55	1	0.4	0.3	2	30,000	97	22	Yes	—	Yes	14CDIP, 14PDIP, 20LCCC	3.45
LT1014A	Quad Precision Operational Amplifiers	4	5	22	0.5	1	0.4	0.18	2.5	20,000	100	22	Yes	—	Yes	14CDIP, 20LCCC	25.40
LT1014D	Quad Precision Operational Amplifier	4	5	44	0.55	1	0.4	0.8	5	30,000	97	22	Yes	—	—	14PDIP, 16SOIC	3.95
MC1458	Dual General-Purpose Operational Amplifier	2	10	30	2.8	1	0.5	6	—	500,000	70	45	—	—	—	8PDIP, 8SO, 8SOIC	0.20
MC1558M	Dual General-Purpose Operational Amplifier	2	10	30	2.5	1	0.5	5	—	500,000	70	45	—	—	Yes	20LCCC, 8CDIP	2.34
MC3303	Quadruple Low-Power Operational Amplifier	4	5	30	1.75	1	0.6	8	10	500,000	70	—	Yes	—	—	14PDIP, 14SOIC, 14TSSOP	0.38

*Suggested resale price in U.S. dollars in quantities of 1,000.

Amplifiers and Comparators

→ Selection Tables

High-Voltage Operational Amplifiers (Continued)

Part Number	Description	Number of Channels	V _S (min) (V)	V _S (max) (V)	I _q per Channel (max) (mA)	GBW (typ) (MHz)	Slew Rate (typ) (V/us)	V _{IO} (25°C) (max) (mV)	Offset Drift (typ) (uV/C)	I _B (max) (pA)	CMRR (min) (dB)	V _n @ 1 kHz (typ) (nV/rtHz)	Single Supply	Rail-Rail	HiRel Avail.	Pin/Package	Price*
MC33078	Dual High-Speed Low-Noise Operational Amplifier	2	10	36	2.5	16	7	2	2	750,000	80	4.5	—	—	—	8MSOP, 8PDIP, 8SOIC	0.30
MC3403	Quad Low-Power General-Purpose Operational Amplifier	4	5	30	1.75	1	0.6	10	10	500,000	70	—	Yes	—	—	14PDIP, 14SO, 14SOIC, 14TSSOP	0.34
OP07D	Low-Offset Voltage Operational Amplifier	1	6	36	5	0.6	0.3	0.15	0.7	12,000	94	9.8	—	—	—	8PDIP, 8SO, 8SOIC	0.55
RC4136	Quad General-Purpose Operational Amplifier	4	10	30	2.825	3	1.7	6	—	500,000	70	8	—	—	—	14PDIP	0.75
RC4560	Dual Audio Operational Amplifier	2	4	32	2.85	15	5.5	6	—	500,000	70	—	—	—	—	8PDIP, 8SOIC, 8TSSOP	0.41
TL022	Dual Low-Power General-Purpose Operational Amplifier	2	10	30	0.125	0.5	0.5	5	—	250,000	60	50	—	—	—	8PDIP, 8SO, 8SOIC	0.29
TL031	Enhanced JFET Low-Power Precision Operational Amplifier	1	10	30	0.28	1.1	5.1	1.5	5.9	200	75	41	—	—	—	8PDIP, 8SOIC	0.25
TL032	Dual Enhanced JFET Low-Power Precision Operational Amplifier	2	10	30	0.28	1.1	5.1	1.5	10.8	200	75	41	—	—	Yes	8PDIP, 8SO, 8SOIC	0.29
TL032A	Enhanced-JFET Low-Power Low-Offset Dual Operational Amplifier	2	10	30	0.28	1.1	5.1	0.8	10.8	200	75	41	—	—	—	8PDIP, 8SOIC	1.35
TL034	Quad Enhanced JFET Low-Power Precision Operational Amplifier	4	10	30	0.28	1.1	5.1	4	12	200	75	43	—	—	Yes	14PDIP, 14SO, 14SOIC, 14TSSOP	0.90
TL034A	Enhanced-JFET Low-Power Low-Offset Quad Operational Amplifier	4	10	30	0.28	1.1	5.1	1.5	12	200	75	43	—	—	—	14PDIP, 14SOIC	3.00
TL051	Enhanced JFET Precision Operational Amplifier	1	10	30	3.2	3.1	20	1.5	8	200	75	18	—	—	—	8PDIP, 8SOIC	0.25
TL051A	Enhanced-JFET Precision Operational Amplifier	1	10	30	3.2	3.1	20	0.8	8	200	75	18	—	—	—	8PDIP, 8SOIC	2.00
TL052	Dual Enhanced JFET Precision Operational Amplifier	2	10	30	2.8	3	20.7	1.5	8	200	75	19	—	—	Yes	8PDIP, 8SO, 8SOIC	0.29
TL052A	Enhanced-JFET Precision Dual Operational Amplifier	2	10	30	2.8	3	20.7	0.8	6	200	75	19	—	—	Yes	8PDIP, 8SOIC	1.20
TL054	Quad Enhanced JFET Precision Operational Amplifier	4	10	30	2.8	2.7	17.8	4	23	200	75	21	—	—	Yes	14PDIP, 14SO, 14SOIC	1.30
TL054A	Enhanced-JFET Precision Quad Operational Amplifier	4	10	30	2.8	2.7	17.8	1.5	23	200	75	21	—	—	Yes	14PDIP, 14SOIC	4.45
TL061	Low-Power JFET-Input General-Purpose Operational Amplifier	1	7	36	0.25	1	3.5	15	10	400	3	42	—	—	Yes	8PDIP, 8SO, 8SOIC	0.22

*Suggested resale price in U.S. dollars in quantities of 1,000.

Amplifiers and Comparators

→ Selection Tables

High-Voltage Operational Amplifiers (Continued)

Part Number	Description	Number of Channels	V _S (min) (V)	V _S (max) (V)	I _q per Channel (max) (mA)	GBW (typ) (MHz)	Slew Rate (typ) (V/us)	V _{IO} (25°C) (max) (mV)	Offset Drift (typ) (μV/°C)	I _B (max) (pA)	CMRR (min) (dB)	V _n @ 1 kHz (typ) (nV/√Hz)	Single Supply	Rail-Rail	HiRel Avail.	Pin/Package	Price*
TL082	JFET-Input Operational Amplifier	2	7	36	2.8	3	13	15	18	400	70	18	—	—	—	8PDIP, 8SO, 8SOIC, 8TSSOP	0.29
TL082A	JFET-Input Operational Amplifier	2	7	36	2.8	3	13	6	18	200	75	18	—	—	—	8PDIP, 8SO, 8SOIC	0.36
TL082B	JFET-Input Operational Amplifier	2	7	36	2.8	3	13	3	18	200	75	18	—	—	—	8PDIP, 8SOIC	0.60
TL084	JFET-Input Operational Amplifier	4	7	36	2.8	3	13	15	18	400	70	18	—	—	—	14PDIP, 14SO, 14SOIC, 14TSSOP	0.20
TL084A	JFET-Input Operational Amplifier	4	7	36	2.8	3	13	6	18	200	75	18	—	—	—	14PDIP, 14SO, 14SOIC	0.40
TL084B	JFET-Input Operational Amplifier	4	7	36	2.8	3	13	3	18	200	75	18	—	—	—	14PDIP, 14SOIC	0.60
TL092	JFET-Input Operational Amplifiers	2	6	36	2.5	1	0.6	15	10	400	70	34	Yes	—	—	8SO	0.55
TL288	JFET-Input Operational Amplifiers	2	10	30	2.8	3	18	1	8	200	80	19	—	—	—	8PDIP	2.20
TL3414A	Dual High Output Current Operational Amplifier	2	3	15	3	1.1	—	5	—	600,000	70	18	Yes	—	—	8PDIP, 8SOIC, 8TSSOP	0.47
TL343	Single Low-Power Operational Amplifier	1	3	30	2.8	1	1	10	10	500,000	70	—	Yes	—	—	5SOT-23	0.65
TL3472	High-Slew-Rate, Single-Supply Operational Amplifier	2	4	36	4.5	4	13	10	10	500,000	65	49	Yes	—	—	8PDIP, 8SOIC	0.31
TL3474	Quad, High Slew Rate, Single-Supply, Operational Amplifiers	4	4	36	4.5	4	13	10	10	500,000	65	49	Yes	—	—	14PDIP, 14SOIC, 14TSSOP	0.70
TL3474A	High-Slew-Rate, Single-Supply Operational Amplifiers	4	4	36	4.5	4	13	3	10	500,000	80	49	Yes	—	—	14PDIP, 14SOIC, 14TSSOP	0.85
TL971	Output Rail-to-Rail Very-Low-Noise Operational Amplifier	1	2.7	12	—	12	5	4	5	750	60	—	—	—	—	8SOIC	0.31
TL972	Output Rail-to-Rail Very-Low-Noise Operational Amplifier	2	2.7	12	—	12	5	4	5	750	60	—	—	—	—	8MSOP, 8PDIP, 8SOIC, 8TSSOP	0.40
TL974	Output Rail-to-Rail Very-Low-Noise Operational Amplifier	4	2.7	12	2.8	12	5	4	5	750,000	60	—	—	Yes	—	14PDIP, 14SOIC, 14TSSOP	0.47

*Suggested resale price in U.S. dollars in quantities of 1,000.

Amplifiers and Comparators

→ Selection Tables

High-Voltage Operational Amplifiers (Continued)

Part Number	Description	Number of Channels	V _S (min) (V)	V _S (max) (V)	I _q per Channel (max) (mA)	GBW (typ) (MHz)	Slew Rate (typ) (V/us)	V _{IO} (25°C) (max) (mV)	Offset Drift (typ) (uV/C)	I _B (max) (pA)	CMRR (min) (dB)	V _n @ 1 kHz (typ) (nV/rHz)	Single Supply	Rail-Rail	HiRel Avail.	Pin/Package	Price*
TS321	Low-Power Single Operational Amplifier	1	3	30	1	0.8	0.4	4	—	200,000	65	50	Yes	—	—	5SOT-23, 8SOIC	0.30
UA741	General-Purpose Operational Amplifier	1	7	36	2.8	1	0.5	6	—	1,500,000	70	—	—	—	Yes	8PDIP, 8SO, 8SOIC	0.16
UA747	Dual General-Purpose Operational Amplifier	2	7	36	2.8	1	0.5	6	—	1,500,000	70	—	—	—	Yes	14PDIP	0.60

*Suggested resale price in U.S. dollars in quantities of 1,000.

Special-Purpose Operational Amplifiers

Part Number	Description	Number of Channels	V _S (min) (V)	V _S (max) (V)	I _q per Channel (max) (mA)	GBW (typ) (MHz)	Slew Rate (typ) (V/us)	V _{IO} (25°C) (max) (mV)	I _B (max) (pA)	CMRR (min) (dB)	With Comparator	With Voltage Reference	Temp Range (°C)	Pin/Package	Price*
LM2900	Quadruple Norton Operational Amplifier (Current Input)	4	4.5	32	2.5	2.5	20	—	200,000	—	—	—	–40 to 85	14PDIP, 14SOIC	0.14
LM3900	Quadruple Norton Operational Amplifier (Current Input)	4	4.5	32	2.5	2.5	20	—	200,000	—	—	—	0 to 70	14PDIP, 14SOIC	0.13
LM392	Low-Power Operational Amplifier and Voltage Comparator	2	3	32	0.5	1	—	5	400,000	65	✓	—	0 to 70	8MSOP, 8PDIP, 8SOIC	0.60
TSM102	Dual Op Amp, Dual Comparator with Voltage Reference	4	3	30	0.375	2.1	2	4.5	200,000	70	✓	✓	–40 to 85	16SOIC, 16TSSOP	0.36
TSM102A	Dual Op Amp, Dual Comparator with Voltage Reference	4	3	30	0.375	2.1	2	4.5	200,000	70	✓	✓	–40 to 85	16SOIC, 16TSSOP	0.48
TSM104W	Quad Op Amp and Programmable Voltage Reference	4	3	30	0.6	0.9	0.3	5	150,000	70	—	✓	–40 to 105	16SOIC, 16TSSOP	0.33
TSM104WA	Quad Op Amp and Programmable Voltage Reference	4	3	30	0.6	0.9	0.3	3	150,000	70	—	✓	–40 to 105	16SOIC, 16TSSOP	0.45
TL103W	Dual Op Amp with Internal Reference	2	3	32	0.6	0.9	0.4	4	150,000	70	—	✓	–40 to 105	8SOIC	0.32
TL103WA	Dual Op Amp with Internal Reference	2	3	32	0.6	0.9	0.4	3	150,000	70	—	✓	–40 to 105	8SOIC	0.40

*Suggested resale price in U.S. dollars in quantities of 1,000.

Amplifiers and Comparators

→ Selection Tables

Timers

Part Number	Description	Number of Channels	V _{CC} (min) (V)	V _{CC} (max) (V)	Temperature Range (°C)	Pin/Package	Price*
NA555	Precision Timers	1	4.5	16	−40 to 105	8PDIP, 8SOIC	0.22
NA556	Dual Precision Timers	2	4.5	16	−40 to 105	14PDIP, 14SOIC	0.27
NE555	Single Precision Timer	1	4.5	16	0 to 70	8PDIP, 8SO, 8SOIC, 8TSSOP	0.10
NE556	Dual Precision Timer	2	4.5	16	0 to 70	14PDIP, 14SO, 14SOIC, 14SSOP	0.18
SA555	Precision Timer	1	4.5	16	−40 to 85	8PDIP, 8SOIC	0.13
SA556	Dual Precision Timer	2	4.5	16	−40 to 85	14PDIP	0.22

*Suggested resale price in U.S. dollars in quantities of 1,000.

Logarithmic Amplifier

Part Number	Description	Number of Input Channels	Number of Output Channels	Gain (typ) (mV/dB)	Input Impedance (Ohm)	Output Impedance (Ohms)	Rise Time (nS)	Pin/Package	Price*
TL441	Logarithmic Amplifier	4	2	8	500	200	20	16PDIP, 16SO	4.30

*Suggested resale price in U.S. dollars in quantities of 1,000.

Amplifiers and Comparators

→ Selection Tables

Audio Operational Amplifiers

Part Number	Description	Number of Channels	V _s (min) (V)	V _s (max) (V)	I _q per Channel (max) (mA)	GBW (typ) (MHz)	Slew Rate (typ) (V/us)	V _{IO} (25°C) (max) (mV)	I _B (max) (pA)	CMRR (min) (dB)	V _n at 1 kHz (typ) (nV/rHz)	Pin/Package	Price*
NE5532	Dual Low-Noise High-Speed Audio Operational Amplifier	2	10	30	4	10	9	4	800,000	70	5	8PDIP, 8SO, 8SOIC	0.40
NE5532A	Dual Low-Noise Operational Amplifier	2	10	30	4	10	9	4	800,000	70	5	8PDIP, 8SO, 8SOIC	0.50
NE5534	Low-Noise High-Speed Audio Operational Amplifier	1	10	30	8	10	13	4	1,500,000	70	4	8PDIP, 8SO, 8SOIC	0.45
NE5534A	Low-Noise Operational Amplifier	1	10	30	8	10	13	4	1,500,000	70	3.5	8PDIP, 8SOIC	0.50
RC4558	Dual General-Purpose Operational Amplifier	2	10	30	2.8	3	1.7	6	500,000	70	8	8MSOP, 8PDIP, 8SO, 8SOIC, 8TSSOP	0.09
RC4559	Dual High-Performance Operational Amplifier	2	10	30	2.8	4	2	6	250,000	80	—	8PDIP, 8SOIC	0.45
RC4580	Dual Audio Operational Amplifier	2	4	32	4.5	12	5	3	500,000	80	6.2	8PDIP, 8SOIC, 8TSSOP	0.45
SA5532	Dual Low-Noise Operational Amplifier	2	10	30	4	10	9	4	800,000	70	5	8PDIP, 8SOIC	0.44
SA5532A	Dual Low-Noise Operational Amplifier	2	10	30	4	10	9	4	800,000	70	5	8PDIP, 8SOIC	0.44
SA5534	Low-Noise Operational Amplifier	1	10	30	8	10	13	4	1,500,000	70	4	8PDIP, 8SO, 8SOIC	0.50
SA5534A	Low-Noise Operational Amplifier	1	10	30	8	10	13	4	1,500,000	70	3.5	8PDIP, 8SOIC	0.55
TL4581	Dual Low-Noise High-Drive Operational Amplifier	2	5	15	8	10	9	4	1,000,000	70	5	8PDIP, 8SO, 8SOIC	0.55
TL5580	Dual Low-Noise Wide-Bandwidth Precision Amplifier	2	4	32	4.5	12	5	1.5	500,000	85	7	8PDIP, 8SOIC, 8TSSOP	1.00
TL5580A	Dual Low-Noise Wide-Bandwidth Precision Amplifier	2	4	32	4.5	12	5	1	500,000	85	7	8PDIP, 8SOIC, 8TSSOP	1.30
TL971	Output Rail-to-Rail Very-Low-Noise Operational Amplifier	1	2.7	12	2.8	12	5	4	750	60	5	8SOIC	0.31
TL972	Output Rail-to-Rail Very-Low-Noise Operational Amplifier	2	2.7	12	2.8	12	5	4	750	60	5	8MSOP, 8PDIP, 8SOIC, 8TSSOP	0.40
TL974	Output Rail-to-Rail Very-Low-Noise Operational Amplifier	4	2.7	12	2.8	12	5	4	750,000	60	5	14PDIP, 14SOIC, 14TSSOP	0.47
TLV2361	Single High-Performance, Low-Voltage Operational Amplifier	1	2	5	2.25	6	3	6	150,000	85	9	5SOT-23	0.45

*Suggested resale price in U.S. dollars in quantities of 1,000.

→ Selection Tables

Audio Operational Amplifiers (Continued)

Part Number	Description	Number of Channels	V _S (min) (V)	V _S (max) (V)	I _q per Channel (max) (mA)	GBW (typ) (MHz)	Slew Rate (typ) (V/us)	V _{IQ} (25°C) (max) (mV)	I _B (max) (pA)	CMRR (min) (dB)	V _n at 1 kHz (typ) (nV/rHz)	Pin/Package	Price*
TLV2362	Dual High-Performance, Low-Voltage Operational Amplifier	2	2	5	2.25	6	3	6	150,000	86	9	8MSOP, 8PDIP, 8SOIC, 8TSSOP	0.55
TLV341	Low-Voltage, Rail-to-Rail Output CMOS Operational Amplifiers with Shutdown	1	1.5	5.5	0.15	2.3	0.9	4	3,000	50	33	6SC70, 6SOT, 6SOT-23	0.38
TLV341A	Low-Voltage, Rail-to-Rail Output CMOS Operational Amplifiers with Shutdown	1	1.5	5.5	0.15	2.3	0.9	1.25	3,000	50	33	6SC70, 6SOT-23	0.45
TLV342	Low-Voltage, Rail-to-Rail Output CMOS Operational Amplifiers	2	1.5	5.5	0.15	2.2	0.9	4	3,000	50	33	10X2QFN, 8MSOP, 8SOIC	0.41
TLV342A	Low-Voltage, Rail-to-Rail Output CMOS Operational Amplifiers	2	1.5	5.5	0.15	2.2	0.9	1.25	3,000	50	33	8SOIC	0.49
TLV342S	Low-Voltage Rail-to-Rail Output CMOS Operational Amplifiers with Shutdown	2	1.5	5.5	0.15	2.2	0.9	4	3,000	50	33	10X2QFN	0.60

*Suggested resale price in U.S. dollars in quantities of 1,000.

Amplifiers and Comparators

→ Selection Tables

High-Voltage Comparators

Part Number	Description	Number of Channels	I _q per Channel (max) (mA)	Output Current (min) (mA)	t _{RESP} Low- to - High (us)	V _s (min) (V)	V _s (max) (V)	V _{IO} (25°C) (max) (mV)	Output Type	Pin/Package	Price*
LM306	Single, Strobed, High Speed Differential Comparator with Push-Pull Outputs	1	10	100	0.028	15	24	5	Push-Pull	8PDIP, 8SOIC	0.95
LM3302	Quad, General Purpose Differential Comparator	4	0.2	6	0.3	2	28	20	Open Collector, Open Drain	14PDIP, 14SOIC	0.36
LM211	Differential Comparator with Strobes	1	6	50	0.115	3.5	30	3	Emitter, Open Collector	8PDIP, 8SOIC, 8TSSOP	0.18
LM239	Quad Differential Comparator	4	0.5	6	0.3	2	30	5	Open Collector, Open Drain	14PDIP, 14SOIC, 14TSSOP	0.13
LM239A	Quad Differential Comparator	4	0.5	6	0.3	2	30	2	Open Collector, Open Drain	14SOIC	0.15
LM2901	Quad Differential Comparator	4	0.5	6	0.3	2	30	7	Open Collector, Open Drain	14PDIP, 14SO, 14SOIC, 14TSSOP	0.12
LM2903	Dual Differential Comparator	2	0.5	6	0.3	2	30	7	Open Collector, Open Drain	8MSOP, 8PDIP, 8SO, 8SOIC, 8TSSOP	0.12
LM293	Dual Differential Comparator	2	0.5	6	0.3	2	30	5	Open Collector, Open Drain	8MSOP, 8PDIP, 8SOIC	0.12
LM293A	Dual Differential Comparator	2	0.5	6	0.3	2	30	2	Open Collector, Open Drain	8MSOP, 8SOIC	0.15
LM311	Differential Comparator with Strobes	1	7.5	50	0.115	3.5	30	7.5	Open Collector, Open Drain	8PDIP, 8SO, 8SOIC, 8TSSOP	0.18
LM339	Quad Differential Comparator	4	0.5	6	0.3	2	30	5	Open Collector, Open Drain	14PDIP, 14SO, 14SOIC, 14SSOP, 14TSSOP	0.11
LM339A	Quad Differential Comparator	4	0.5	6	0.3	2	30	2	Open Collector, Open Drain	14PDIP, 14SO, 14SOIC, 14SSOP, 14TSSOP	0.14
LM393	Dual Differential Comparator	2	0.5	6	0.3	2	30	5	Open Collector, Open Drain	8MSOP, 8PDIP, 8SO, 8SOIC, 8TSSOP	0.10
LM393A	Dual Differential Comparator	2	0.5	6	0.3	4	30	2	Open Collector, Open Drain	8MSOP, 8PDIP, 8SO, 8SOIC, 8TSSOP	0.16
LP211	Single, Low-Power, Strobed Differential Comparator with Open Collector and Emitter Outputs	1	0.3	25	1.2	3.5	30	7.5	Emitter, Open Collector	8SOIC	0.70
LP2901	Quad, Low-Power, General Purpose Differential Comparator	4	0.025	20	1.3	5	30	5	Open Collector, Open Drain	14PDIP, 14SOIC	0.30
LP311	Single, Low-Power, Strobed Differential Comparator with Open Collector and Emitter Outputs	1	0.3	25	1.2	3.5	30	7.5	Open Collector, Open Drain	8PDIP, 8SOIC	0.70
LP339	Quad, Low-Power, General Purpose Differential Comparator	4	0.025	20	1.3	5	30	5	Open Collector, Open Drain	14PDIP, 14SOIC	0.27
TL331	Single Differential Comparator	1	0.7	6	0.3	2	36	5	Open Collector, Open Drain	5SOT-23	0.23

*Suggested resale price in U.S. dollars in quantities of 1,000.

→ Selection Tables

Low-Voltage Comparators

Part Number	Description	Number of Channels	I _q per Channel (max) (mA)	Output Current (min) (mA)	t _{RESP} Low- to - High (us)	V _s (min) (V)	V _s (max) (V)	V _{IO} (25°C) (max) (mV)	Output Type	Pin/Package	Price*
TLV7256	Dual Comparator	2	0.02	5	0.5	1.8	5	7	Push-Pull	8VSSOP	0.47
TL712	Single Differential Comparator with Push-Pull Outputs	1	20	16	0.025	4.75	5.25	5	Push-Pull	8PDIP, 8SO, 8SOIC, 8TSSOP	0.95
TL714	Single High-Speed Differential Comparator with Push-Pull Outputs	1	12	16	0.006	4.75	5.25	10	Push-Pull	8PDIP, 8SOIC	2.40
LMV331	Single General Purpose Low-Voltage Comparator	1	0.12	10	0.2	2.7	5.5	7	Open Collector, Open Drain	5SC70, 5SOT-23	0.26
LMV339	Quad General Purpose Low-Voltage Comparators	4	0.075	10	0.2	2.7	5.5	7	Open Collector, Open Drain	14SOIC, 14TSSOP	0.39
LMV393	Dual General Purpose Low-Voltage Comparator	2	0.1	5	0.2	2.7	5.5	7	Open Collector, Open Drain	8MSOP, 8SOIC, 8TSSOP, 8VSSOP	0.30
TLV1391	Single Differential Comparator with Open Collector Outputs	1	0.15	0.6	0.18	2	7	5	Open Collector	5SOT-23	0.45
TLV7211	Single CMOS Comparator with Rail-to-Rail Input and Push-Pull Output	1	0.014	5	4	2.7	15	15	Push-Pull	5SOT-23, 6SC70, 8SOIC	0.45
TLV7211A	Single CMOS Comparator with Rail-to-Rail Input and Push-Pull Output	1	0.014	5	4	2.7	15	5	Push-Pull	5SOT-23, 6SC70, 8SOIC	0.60

*Suggested resale price in U.S. dollars in quantities of 1,000.

→ Overview

TI provides complete interface solutions that empower you to differentiate your products and accelerate time-to-market. These products are tailored to meet your design challenges. Our expertise in high-speed, mixed-signal circuits, system-on-a-chip integration, and advanced product development processes ensures you will receive the silicon, support tools, software, and technical documentation to create and deliver the best products on time and at competitive prices.

RS-422/RS-485

Texas Instruments offers a number of RS-422 and RS-485 interface devices that meet or exceed the industry standards. TI offers a low power (3.3 V) option and signaling rates of up to 35 Mbps. These devices have three state outputs: high, low, and off. TI's RS-422 and RS-485 have a variety of uses in industrial communication, LAN, and intersystem data links.

RS-232

TI's RS-232 devices are commonly used in computer serial ports for battery powered systems, notebooks, laptops, and PDAs. These devices generate their own higher voltage to drive the RS-232 and operate with a 3 V to 5.5 V supply. TI's RS-232 devices also offer ESD protection up to 15 kV, data transfer rates of up to 1,000 kbit/s, and a power down state to reduce the supply current.

Peripheral Drivers

TI's peripheral driver devices are the perfect choice for relay drivers, power supplies, motor control, incandescent lamps, and to drive MOSFET gates. These devices use logic gates and output transistors to switch large currents at high voltages. TI's devices are rated for high current outputs up to 500 mA and high voltage outputs up to 50 V.

Single RS485 Half-Duplex Interfaces

SN75176B

Get samples, datasheets and app reports at: www.ti.com/sc/device/SN75176B

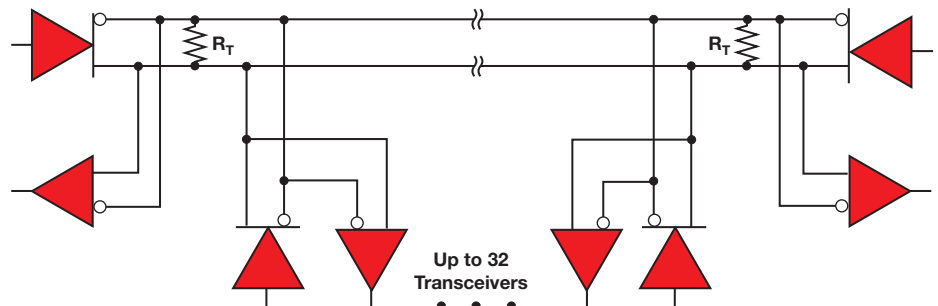
Key Features

- Bidirectional transceiver
- Meets or exceeds the requirements of ANSI standard TIA/EIA-485-A and ITU recommendations V.11 and X.27
- 3-state driver and receiver outputs
- Individual driver and receiver enables thermal shutdown protection
- Operates from single 5-V supply

Applications

- Industrial communication
- Local area networks
- Intersystem data links

The SN75176B differential bus transceiver is designed for bidirectional data communication on multipoint bus transmission lines. It is designed for balanced transmission lines and meets ANSI standard TIA/EIA-485-A and ITU recommendations V.11 and X.27. The SN75176B combines a 3-state differential line driver and a differential input line receiver, both of which operate from a single 5-V power supply. The driver and receiver have active-high and active-low enables, respectively, that can be connected together externally to function as a direction control. Positive and negative current limiting as well as thermal shutdown for protection from line-fault conditions are also provided.



Typical application circuit.

→ RS422/RS485 Interfaces

Dual RS422 Full Duplex Interfaces

SN75C1167, SN75C1168

Get samples, datasheets and app reports at: www.ti.com/sc/device/SN75C1167 or [SN75C1168](http://www.ti.com/sc/device/SN75C1168)

Key Features

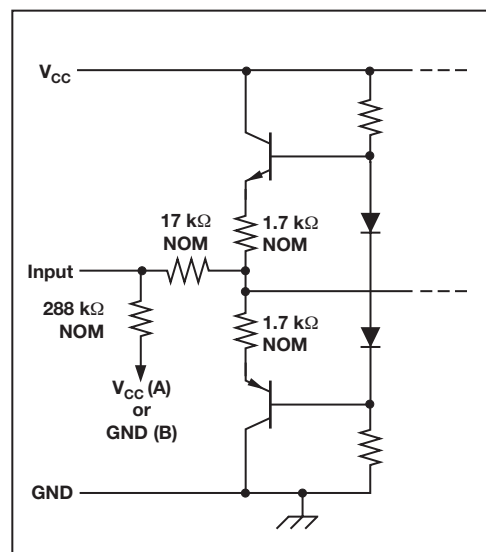
- Meets or exceeds standard TIA/EIA-422-B and ITU recommendation V.11
- BiCMOS process technology
- Low supply-current requirements 9 mA max
- Low pulse skew
- Receiver common-mode input voltage range of -7 V to 7 V
- Operate from single 5-V power supply
- Glitch-free power-up/power-down protection
- Receiver 3-state outputs active-low enable for SN75C1167 only

Applications

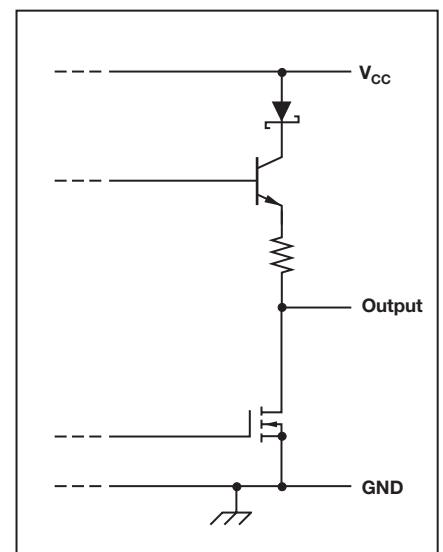
- Industrial communication
- Diagnostic test ports
- Intersystem data links

The SN75C1167 and SN75C1168 dual drivers and receivers are integrated circuits designed for balanced transmission lines. The devices meet TIA/EIA-422-B and ITU recommendation V.11. The SN75C1167 combines dual 3-state differential line drivers and 3-state differential line receivers, both of which operate from a single 5-V power supply. The driver and receiver have active-high and active-low enables, respectively, which can be connected together externally to function as direction control. The SN75C1168 driver has individual active-high enables.

Schematic of Inputs and Outputs



Equivalent of A or B input.



Typical of each driver output.

→ RS422/RS485 Interfaces

Quad RS422 Simplex

AM26C31 (Driver), AM26C32 (Receiver)

Get samples, datasheets and app reports at: www.ti.com/sc/device/AM26C31 or [AM26C32](http://www.ti.com/sc/device/AM26C32)

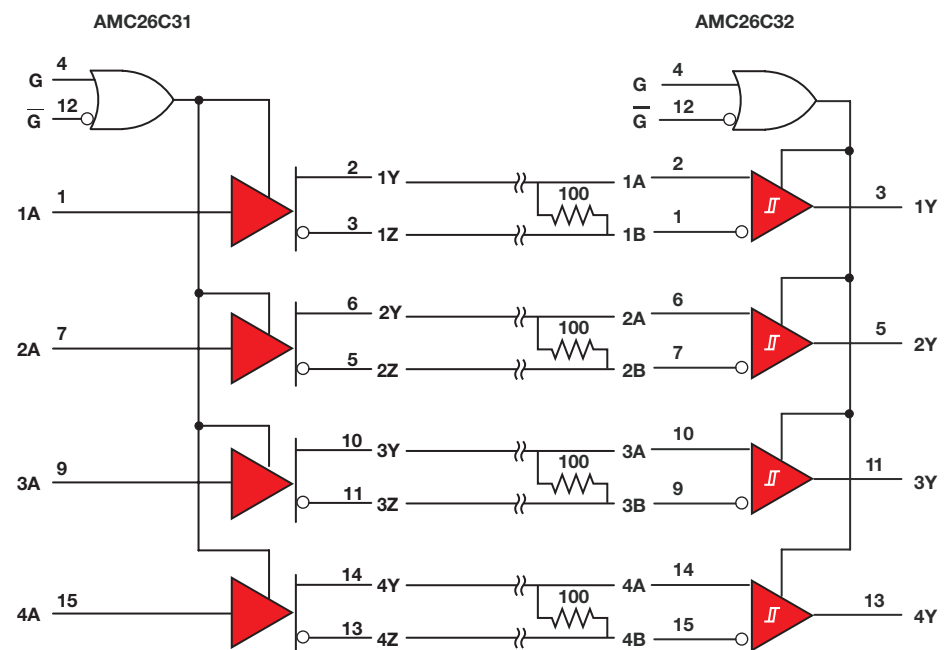
Key Features

- Meets or exceeds TIA/EIA-422-B and ITU V.11 standards
- Quadruple differential line driver (AM26C31) and receiver (AM26C32)
- Low power
- 3-state outputs
- BiCMOS circuitry for reduced power consumption without sacrificing speed

Applications

- Industrial communication
- Diagnostic test ports
- Intersystem data links

The AM26C31 is a quadruple differential line driver with complementary outputs designed to meet the requirements of TIA/EIA-422-B and ITU V.11. The 3-state outputs have high-current capability for driving balanced lines, such as twisted-pair or parallel-wire transmission lines, and provide the high-impedance state in power-off condition. The AM26C32 is a quadruple differential line receiver for balanced or unbalanced digital data transmission. The 3-state outputs permit connection directly to a bus-organized system. Both parts have enable functions for all four drivers and receivers to offer the choice of an active-high or active-low enable input.



Logic diagram.

→ RS422/RS485 Interfaces

3.3 V Quad RS422 Simplex

AM26LV31 (Driver), AM26LV32 (Receiver)

Get samples, datasheets and app reports at: www.ti.com/sc/device/AM26LV31 or [AM26LV32](http://www.ti.com/sc/device/AM26LV32)

Key Features

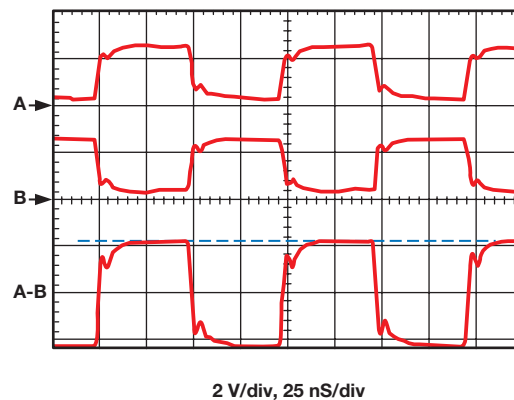
- Meets or exceeds TIA/EIA-422-B and ITU V.11 standards
- Low-voltage quadruple differential line driver (AM26LV31) and receiver (AM26LV32)
- Operates from single 3.3-V power supply
- Much lower power consumption than 5-V alternatives
- ESD protection for RS422 bus pins
- 3-state outputs
- Accepts 5-V logic inputs with 3.3-V supply

Applications

- Industrial communication
- Diagnostic test ports
- Intersystem data links

The AM26LV31 is a quadruple low-voltage, differential line driver with complementary outputs, designed to meet the requirements of TIA/EIA-422-B and ITU V.11. The 3-state outputs have high-current capability for driving balanced lines, such as twisted-pair or parallel-wire transmission lines, and provide the high-impedance state in power-off condition. The AM26LV32 is a quadruple low-voltage, differential line receiver for balanced or unbalanced digital data transmission. The 3-state outputs permit connection directly to a bus-organized system. Both parts have enable functions for all four drivers and receivers to offer the choice of an active-high or active-low enable input.

30 Meter Cable Waveforms



→ RS422/RS485 Interfaces

Triple Differential Bus Transceiver

SN75ALS170, SN75ALS170A, SN75ALS171, SN75ALS171A

Get samples, datasheets and app reports at: www.ti.com/sc/device/SN75ALS170, [SN75ALS170A](http://www.ti.com/sc/device/SN75ALS170A), [SN75ALS171](http://www.ti.com/sc/device/SN75ALS171) or [SN75ALS171A](http://www.ti.com/sc/device/SN75ALS171A)

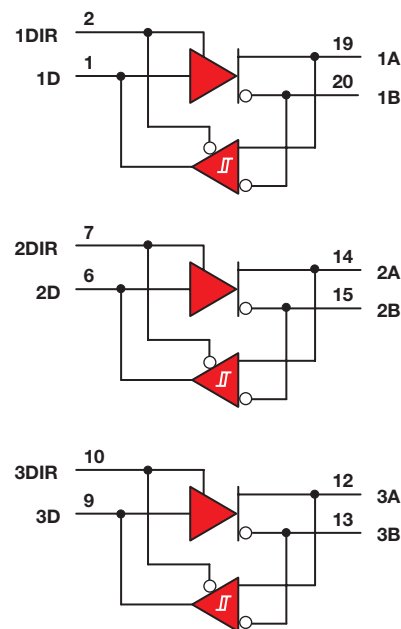
Key Features

- Three bidirectional transceivers
- Driver meets or exceeds ANSI standard EIA/TIA-422-B and RS-485 and ITU recommendation V.11
- Two skew limits available
- Designed to operate up to 20 million data transfers per second (FAST-20 SCSI)
- High-speed advanced low-power Schottky circuitry
- Designed for multipoint transmission on long bus lines in noisy environments
- Operates from a single 5-V supply

Applications

- SCSI bus interfaces
- Three-channel RS485s

The SN75ALS170, SN75ALS170A, SN75ALS171 and SN75ALS171A triple differential bus transceivers are monolithic integrated circuits designed for bidirectional data communication on multipoint bus transmission lines. Designed for balanced transmission lines, and the drivers meet ANSI standards EIA/TIA-422-B and RS-485; both the drivers and receivers meet ITU recommendation V.11. The SN75ALS170A and SN75ALS171A are designed for FAST-20 SCSI and can transmit or receive data pulses as short as 30 ns with a maximum skew of 5 ns. These parts operate from a single 5-V power supply.



Logic diagram.

→ RS232 Interfaces

Single- and Dual-Channel RS232 with Automatic Shutdown

TRS3221, TRS3222, TRS3221E, TRS3222E

Get samples, datasheets and app reports at: www.ti.com/sc/device/TRS3221, [TRS3222](http://www.ti.com/sc/device/TRS3222), [TRS3221E](http://www.ti.com/sc/device/TRS3221E) or [TRS3222E](http://www.ti.com/sc/device/TRS3222E)

Key Features

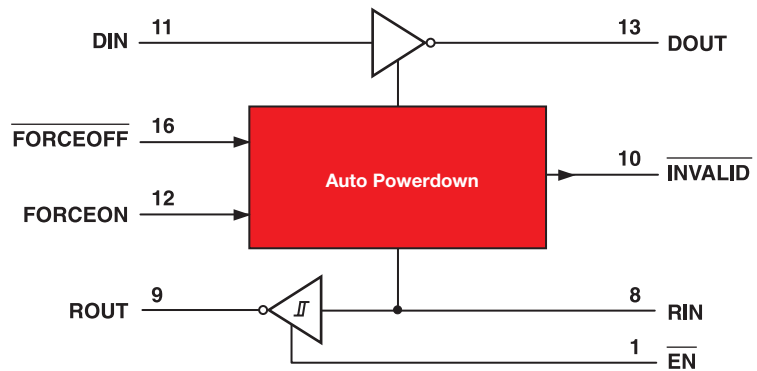
- Operates with 3-V to 5.5-V V_{CC} supply
- Single or dual driver and receiver
- Low standby current: 1 mA typical
- ESD protection exceeds ± 15 kV using human-body model (HBM)
 - o TRS3221E and TRS3222E provide IEC G1000-4-2 ESD protection
- Meets the requirements of TIA/EIA-232-F

Applications

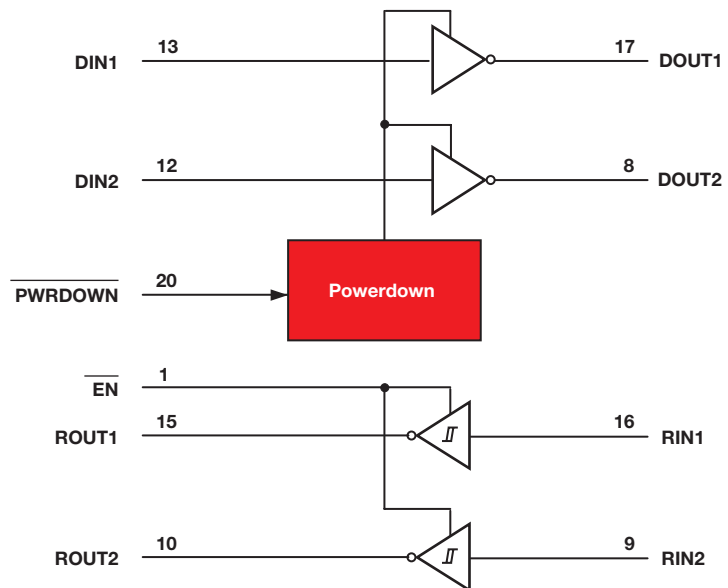
- Battery-powered, handheld, and portable equipment
- PDAs and palmtop PCs
- Notebooks, subnotebooks and laptops
- Digital cameras
- Mobile phones and wireless devices

The TRS3221 and TRS3221E consist of one line driver, one line receiver, and a dual charge-pump circuit with ± 15 -kV ESD protection pin-to-pin (serial-port connection pins, including GND). The TRS3222 and TRS3222E consist of two line drivers, two line receivers and a dual charge-pump circuit with ± 15 kV ESD protection pin-to-pin (serial-port connection pins, including GND). The devices meet the requirements of TIA/EIA-232-F and provide the electrical interface between an asynchronous communication controller and the serial-port connector. The charge pump and four small external capacitors allow operation from a single 3-V to 5.5-V supply. These devices operate at data signaling rates up to 250 Kbps and a maximum of 30-V/ μ s driver output slew rate (TRS3222E operates at up to 500 Kbps).

TRS3221



TRS3222



Functional diagrams.

→ RS232 Interfaces

Full DCE and DTE RS232 with Automatic Shutdown

TRS3238, TRS3243, TRS3238E, TRS3243E

Get samples, datasheets and app reports at: www.ti.com/sc/device/TRS3238, [TRS3243](http://www.ti.com/sc/device/TRS3243), [TRS3238E](http://www.ti.com/sc/device/TRS3238E) or [TRS3243E](http://www.ti.com/sc/device/TRS3243E)

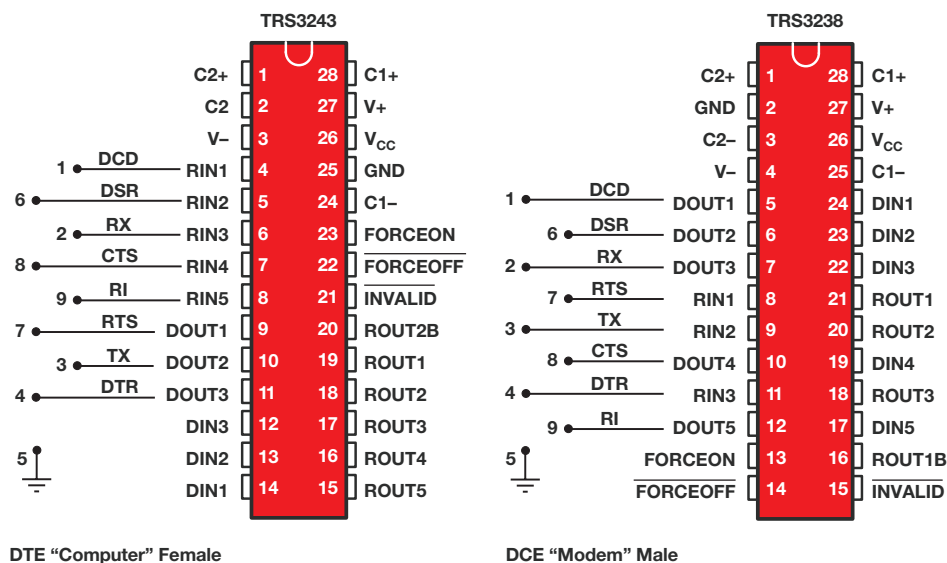
Key Features

- Multichannel drivers and receivers
- RS-232 bus-pin ESD protection exceeds ± 15 kV using human-body model (HBM)
- Meets or exceeds the requirements of TIA/EIA-232-F and ITU v.28 standards
- Operates with 3-V to 5.5-V V_{CC} supply
- Low standby current: 1 mA typical
- Always-active noninverting receiver output (ROUT1B)

Applications

- Battery-powered systems
- PDAs

These devices are multichannel line drivers/receivers with a dual charge-pump circuit and provide ± 15 -kV ESD (HBM) protection pin-to-pin (the TRS3238E and TRS3243E provide additional air-gap and contact discharge protection). The TRS3238 and TRS3238E provide five drivers and three receivers, while the TRS3243 and TRS3243E provide three drivers and five receivers. These devices meet the requirements of TIA/EIA-232-F and provide the electrical interface between notebook and subnotebook computer applications. The charge pump and four small external capacitors allow operation from a single 3-V to 5.5-V supply. The always-active noninverting output allows applications using the ring indicator to transmit data while the device is powered down.



TRS3243 and TRS3238 packages.

→ RS232 Interfaces

Low-Pin-Count Dual-Channel RS232

TRS3232, TRS3232E

Get samples, datasheets and app reports at: www.ti.com/sc/device/TRS3232 or [TRS3232E](http://www.ti.com/sc/device/TRS3232E)

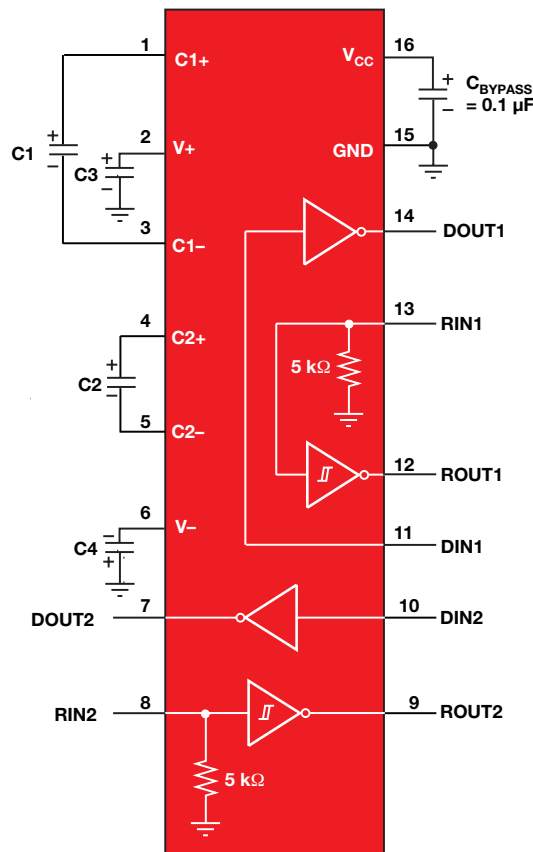
Key Features

- RS-232 bus-pin ESD protection exceeds ± 15 kV using human-body model (HBM)
- Meets or exceeds TIA/EIA-232-F and ITU v.28 standards
- Operates with 3-V to 5.5-V V_{CC} supply
- Two drivers and two receivers
- Low supply current
- Accepts 5-V logic input with 3.3-V supply

Applications

- Battery-powered systems
- PDAs
- Notebooks, laptops and palmtop PCs

TRS3232 devices consist of two line drivers, two line receivers and a dual charge-pump circuit with ± 15 -kV IEC ESD protection pin-to-pin (serial-port connection pins, including GND). The “E” suffix parts give additional ESD protection for contact and air-gap discharge protection. The device meets the requirements of TIA/EIA-232-F and provides the electrical interface between an asynchronous communication controller and the serial-port connector. The charge pump and four small external capacitors allow operation from a single 3-V to 5.5-V supply. The devices operate at data signaling rates up to 250 Kbps and a maximum of 30-V/ μ s driver output slew rate.



Each Driver⁽¹⁾

Input DIN	Output DOUT
H	L
L	H

(1) H = High Level
L = Low Level

Each Receiver⁽¹⁾

Input RIN	Output ROUT
L	H
H	L
Open	H

(1) H = High Level, L = Low Level
Open = Input Disconnected or Connected Driver Off

V_{CC}	C1	C2, C3, C4
3.3 V to ± 0.3 V	0.1 μ F	0.1 μ F
5 V to ± 0.5 V	0.047 μ F	0.33 μ F
3 V to 5.5 V	0.1 μ F	0.47 μ F

TRS3232 block diagram.

Interface

→ RS232 Interfaces

Full DCE and DTE RS232 Triple-Power Supplies

GD75232, GD65232, GD75323

Get samples, datasheets and app reports at: www.ti.com/sc/device/GD75232, [GD65232](http://www.ti.com/sc/device/GD65232), or [GD75323](http://www.ti.com/sc/device/GD75323)

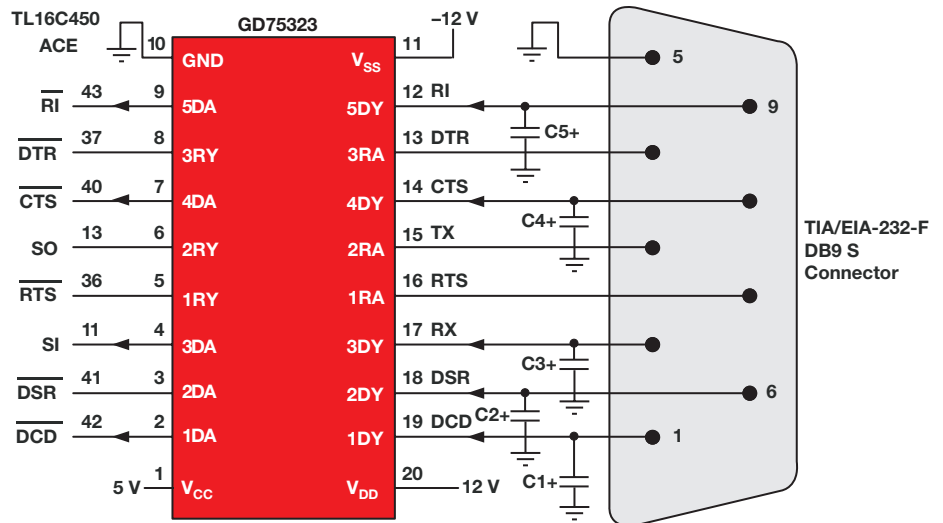
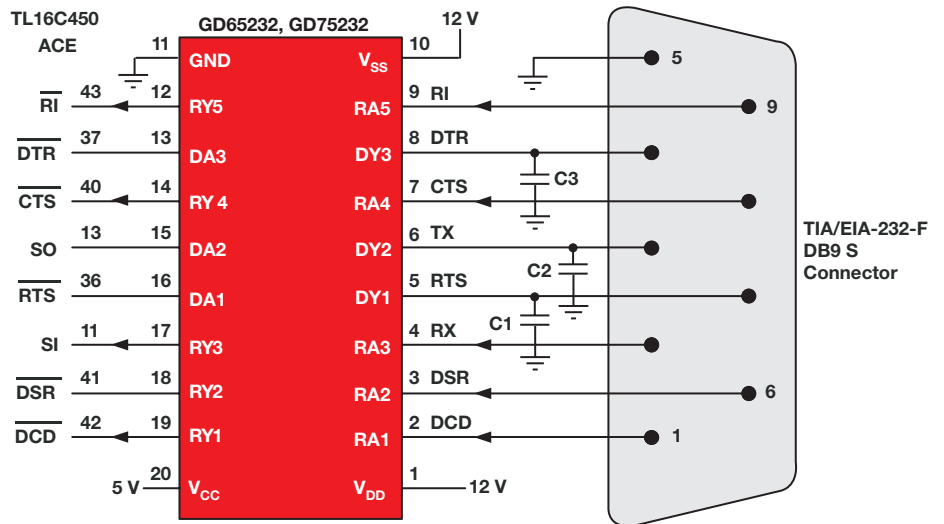
Key Features

- Single chip with easy interface between UART and serial-port connector of IBM PC/AT and compatibles
- Meets or exceeds the requirements of TIA/EIA-232-F and ITU V.28 standards
- Designed to support data rates up to 120 Kbps

Applications

- Battery-powered systems
- PDAs
- Notebooks, subnotebooks and laptops

The GD65232 and GD75232 combine three drivers and five receivers and allow easy interconnection of the UART and serial-port connector of an IBM PC/AT and compatibles. The GD75323 combines five drivers and three receivers. These parts comply with the requirements of the TIA/EIA-232-F and ITU V.28 standards. These standards are for data interchange between a host computer and a peripheral at signaling rates up to 20 Kbps. The switching speeds of these devices are fast enough to support rates up to 120 Kbps with lower capacitive loads.



Typical connections.



Remote 8-Bit I/O Expander for I²C Bus

PCF8574, PCF8574A

Get samples, datasheets and app reports at: www.ti.com/sc/device/PCF8574 or [PCF8574A](http://www.ti.com/sc/device/PCF8574A)

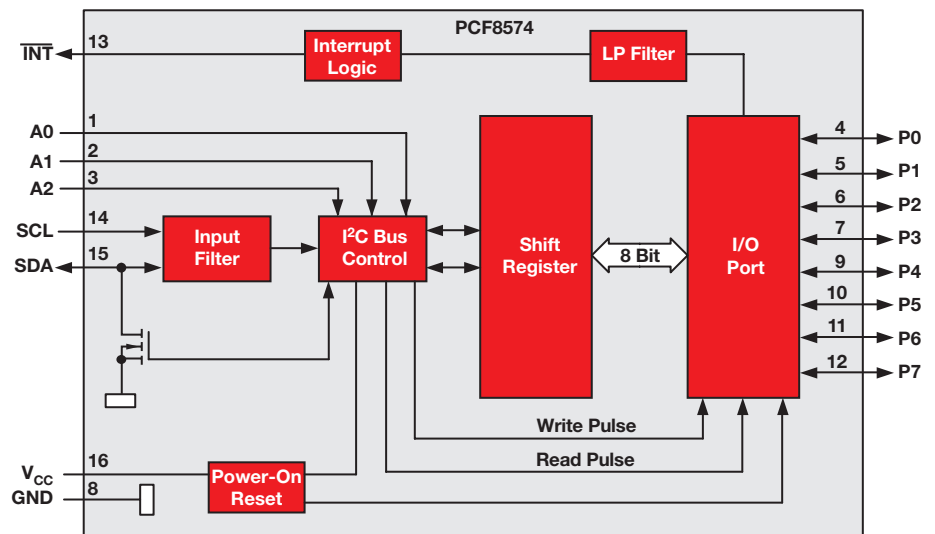
Key Features

- Low standby current consumption: 10 μ A max
- I²C to parallel port expander
- Open-drain interrupt output
- Latched outputs with high-current drive capability for directly driving LEDs
- Latch-up performance exceeds 100 mA per JESD 78, Class II
- Compatible with most microcontrollers

Applications

- Motherboards
- Embedded systems
- Multimedia applications

The PCF8574 and PCF8574A are 8-bit input/output (I/O) expanders for the two-line bidirectional bus (I²C) and are designed for 2.5-V to 6-V V_{CC} operation. These parts provide general-purpose remote I/O expansion for most microcontroller families via the I²C interface. The PCF8574 and PCF8574A feature an 8-bit quasi-bidirectional I/O port, including latched outputs with high-current drive capability for directly driving LEDs. Each quasi-bidirectional I/O can be used as an input or output without the use of a data-direction control signal.



Pin numbers shown are for the DW and N packages.

Logic diagram (positive logic).



Remote 16-Bit I²C and SMBus I/O Expander with Interrupt Output

PCF8575, PCF8575C

Get samples, datasheets and app reports at: www.ti.com/sc/device/PCF8575 or [PCF8575C](http://www.ti.com/sc/device/PCF8575C)

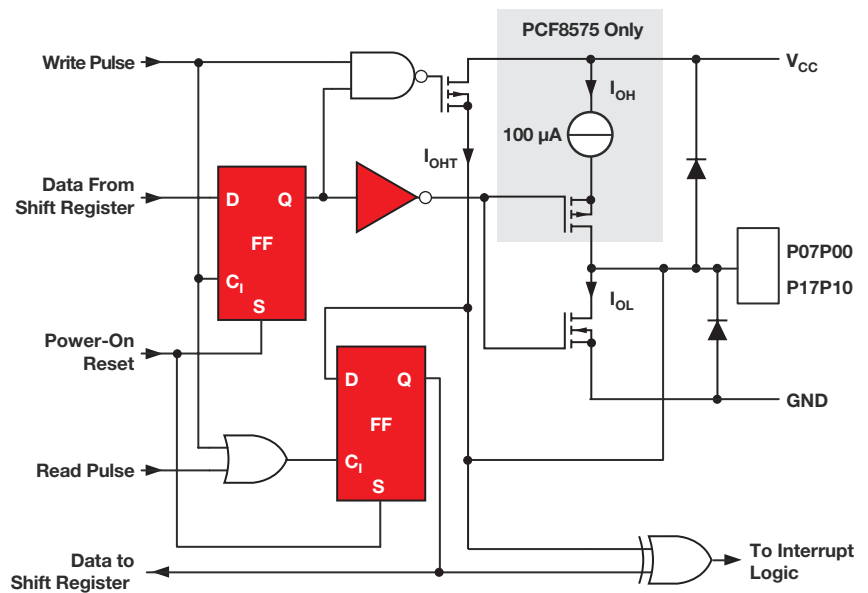
Key Features

- Low standby current consumption: 10 μ A max
- I²C to parallel-port expander
- Open-drain interrupt output
- 400 kHz fast I²C bus
- Latch-up performance exceeds 100 mA per JESD 78, Class II
- ESD protection exceeds JESD 22

Applications

- Motherboards
- Embedded systems
- Multimedia applications

The PCF8575 and PCF8575C are 16-bit input/output (I/O) expanders for the two-line bidirectional bus (I²C) and are designed for 2.5-V to 5.5-V (PCF8575) or 4.5-V to 5.5-V (PCF8575C) V_{CC} operation. These parts provide general-purpose remote I/O expansion for most microcontroller families via the I²C interface. The PCF8575 and PCF8575C feature a 16-bit quasi-bidirectional I/O port, including latched outputs with high-current drive capability for directly driving LEDs. Each quasi-bidirectional I/O can be used as an input or output without the use of a data-direction control signal.



Simplified schematic diagram for each p-port input/output.



Low Voltage 16-Bit I²C and SMBus I/O Expander

TCA6416A

Get samples, datasheets and app reports at: www.ti.com/sc/device/TCA6416A

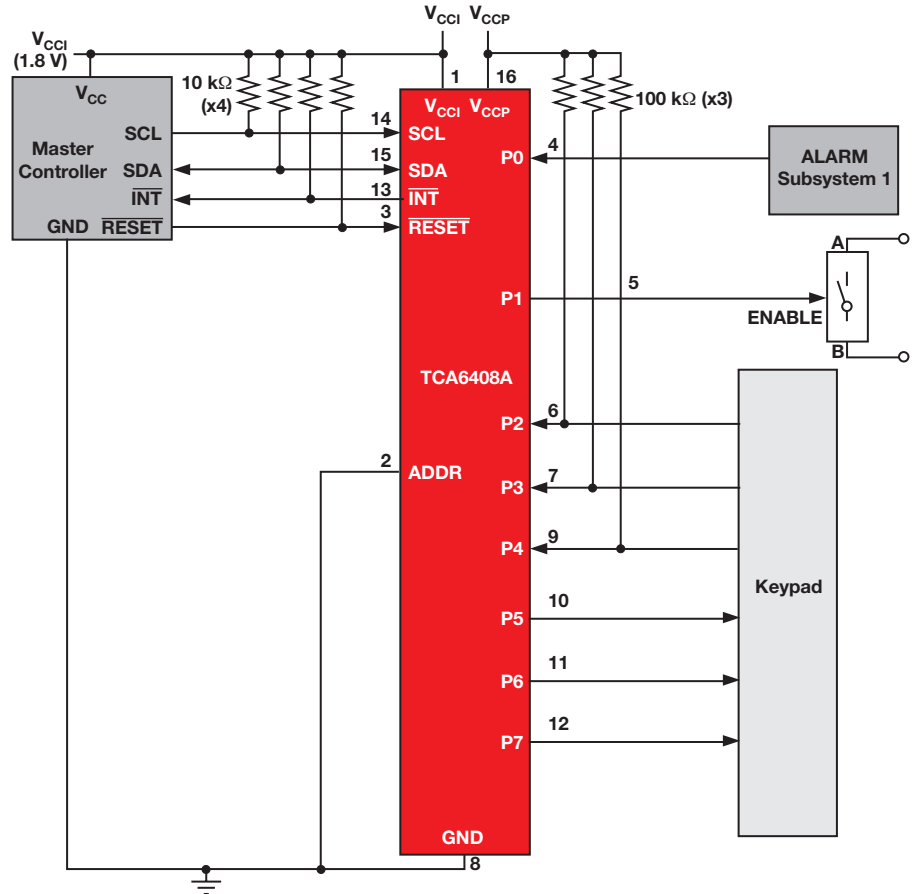
Key Features

- 16-bit I/O expander for two-line bidirectional bus
- Operating power supply voltage range: 1.65 V to 5.5 V
- Schmitt-Trigger action allows slow input transition and better switching noise immunity
- Active-low reset input
- Open-drain active-low interrupt output
- Three different package options, the smallest of which is a 25-ball 3 mm x 3 mm WCSP

Applications

- Housekeeping functions:
 - Temperature, fan, audio control
 - Humidity sensors
 - LED status
 - Hardware control monitor
 - Keypad control

The TCA6416A is a 16-bit I/O expander for the two-line bidirectional bus (I²C) and is designed to provide general-purpose remote I/O expansion for most microcontroller families via the I²C interface. The TCA6416A has a wide V_{CC} range of 1.65 V to 5.5 V, allowing this device to interface with next-generation microprocessors and microcontrollers.



Functional block diagram.



Low Voltage 8-Bit I²C and SMBus I/O Expander

TCA6408A, TCA7408

Get samples, datasheets and app reports at: www.ti.com/sc/device/TCA6408A or [TCA7408](http://www.ti.com/sc/device/TCA7408)

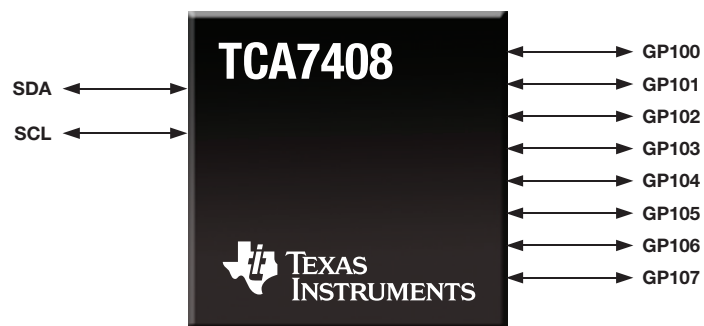
Key Features

- 8-bit I/O expander for two-line bidirectional bus
- Operating power supply voltage range: 1.65 V to 5.5 V
- Schmitt-Trigger action allows slow input transition and better switching noise immunity
- Active-low reset input
- Open-drain active-low interrupt output
- Internally programmable pull-up/pull-down resistors

Applications

- Housekeeping functions
 - Temperature, fan, audio control
 - Humidity sensors
 - LED status
 - Hardware control monitor
- Keypad control (up to 4 x 4 keypad or 16 buttons)

The TCA6408A and TCA7408 are 16-bit I/O expanders for the two-line bidirectional bus (I²C) and are designed to provide general-purpose remote I/O expansion for most microcontroller families via the I²C interface. These devices have a wide V_{CC} range of 1.65 V to 5.5 V, allowing them to interface with next-generation microprocessors and microcontrollers.



Functional block diagram.



Level-Translating I²C/SMBus Bus Repeater

TCA9509

Get samples, datasheets and app reports at: www.ti.com/sc/device/TCA9509

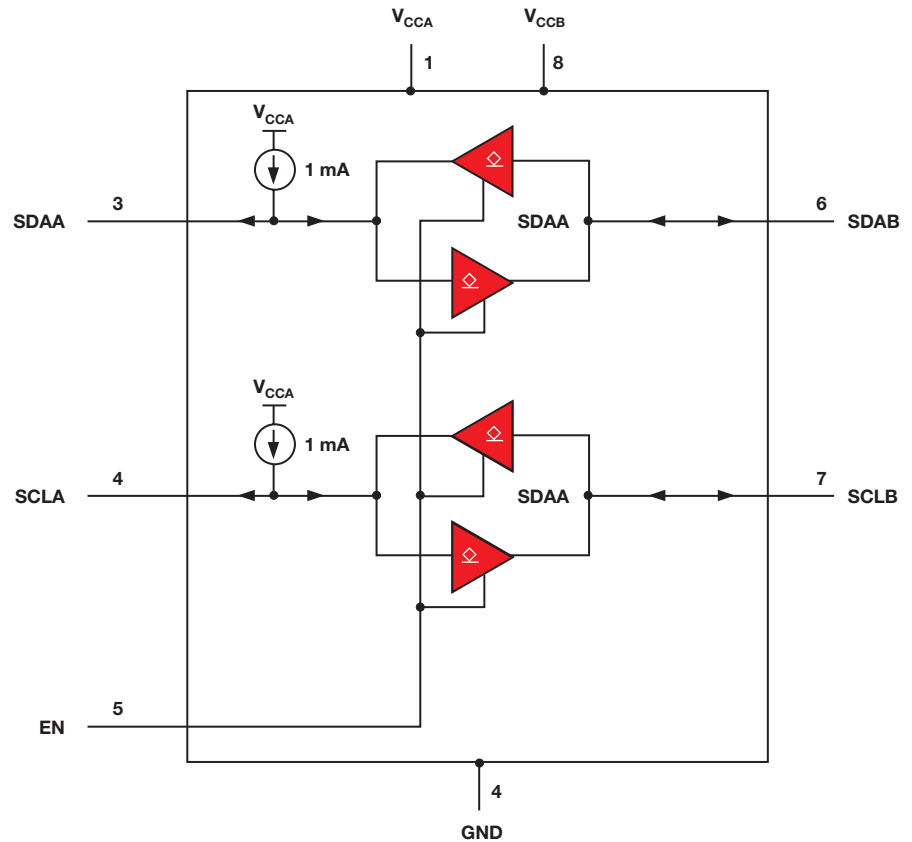
Key Features

- Two-channel bidirectional buffer
- I²C and SMBus compatible
- Operating power supply voltage range: 0.9 V to 5.5 V on B side
- Voltage level translation from 0.9 V to (V_{CCB} - 1V) and 2.7 V to 5.5 V
- Active-high repeater-enable input
- Accommodates standard mode and fast mode I²C devices and multiple masters

Applications

- Housekeeping functions
 - Temperature, fan, audio control
 - Humidity sensors
 - LED status
 - Hardware control monitor
- Keypad control (up to 4 x 4 keypad or 16 buttons)

The TCA9509 is an I²C bus/SMBus repeater for use in I²C/SMBus systems. It can also provide bidirectional voltage-level translation (up-translation/down-translation) between low voltages (down to 1.0 V) and higher voltages (2.7 V to 5.5 V) in mixed-mode applications. This device enables I²C and similar bus systems to be extended, without degradation of performance even during level shifting. The TCA9509 has two types of drivers A-side drivers and B-side drivers. The device can be used to isolate two halves of a bus for voltage and capacitance.



Functional block diagram.



Special Function Interface Devices

TCA8418E, TCA6507

Get samples, datasheets and app reports at: www.ti.com/sc/device/TCA8418E or [TCA6507](http://www.ti.com/sc/device/TCA6507)

Key Features

- TCA8418E: I²C controlled keypad scan IC with integrated ESD protection
 - o Supports QWERTY keypad operation plus GPIO expansion
 - o 10-Byte FIFO to store 10 key presses and releases
 - o 18 GPIOs can be configured into 8 inputs and 10 outputs

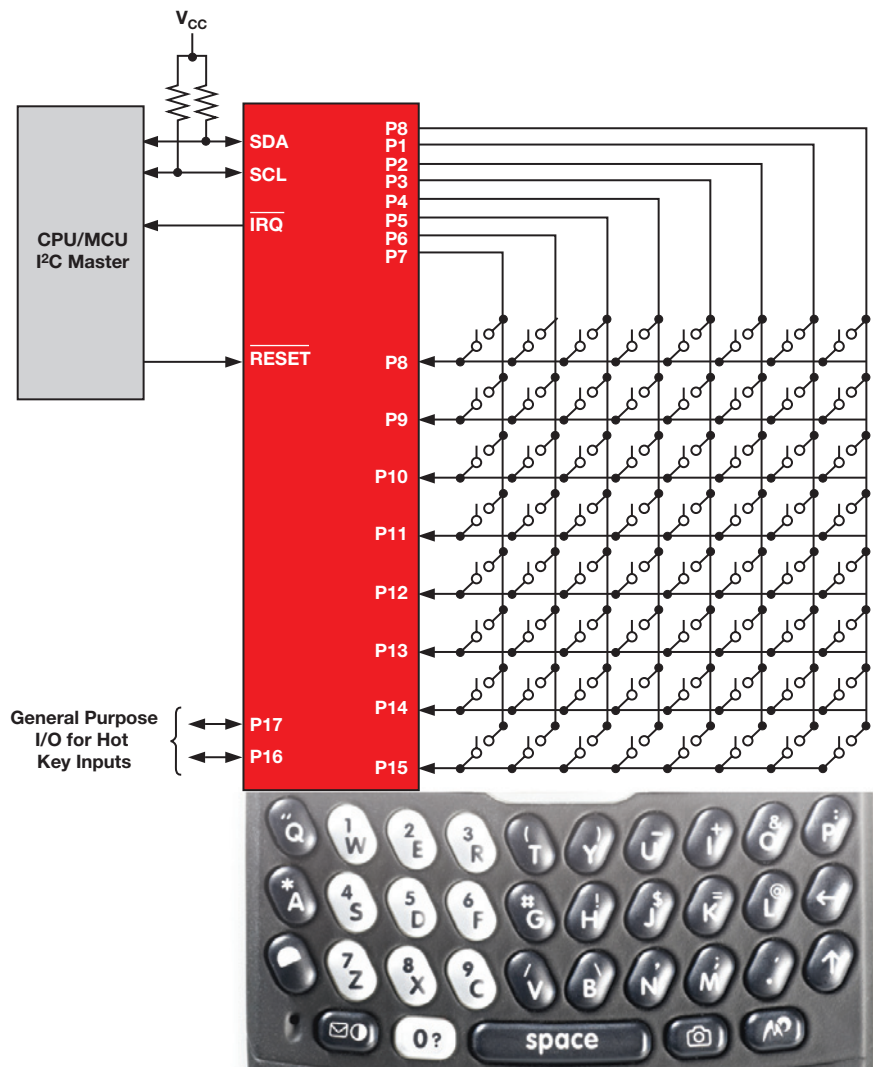
- TCA6507: Low-voltage 7-bit I²C and SMBus LED driver with intensity control and shutdown
 - o 7 LED driver outputs: on, off, blinking, fading at programmable rates
 - o Can be configured into two independent banks of LED drivers

Applications

- Smart phones
- PDAs
- GPS devices

The TCA8418E is a keypad scan device with integrated ESD protection. It can operate from 1.65 V to 3.6 V and has 18 general purpose inputs/outputs that can be used to support up to 80 keys via the I²C interface. This device frees up the processor from having to scan the keypad and provides power and bandwidth savings.

The TCA6507 is a 7-bit LED dimmer for the two-line bidirectional bus (I²C) and is designed to control (or dim) LEDs via the I²C interface. Without this device, the microprocessor or microcontroller must be actively involved in turning on and off the LEDs, using valuable processor time and overloading the I²C bus.



TCA8418E block diagram.

→ GPIB Buses

Octal Bus Transceiver for IEEE 488 GPIB

SN75160B, SN75161B

Get samples, datasheets and app reports at: www.ti.com/sc/device/SN75160B or [SN75161B](http://www.ti.com/sc/device/SN75161B)

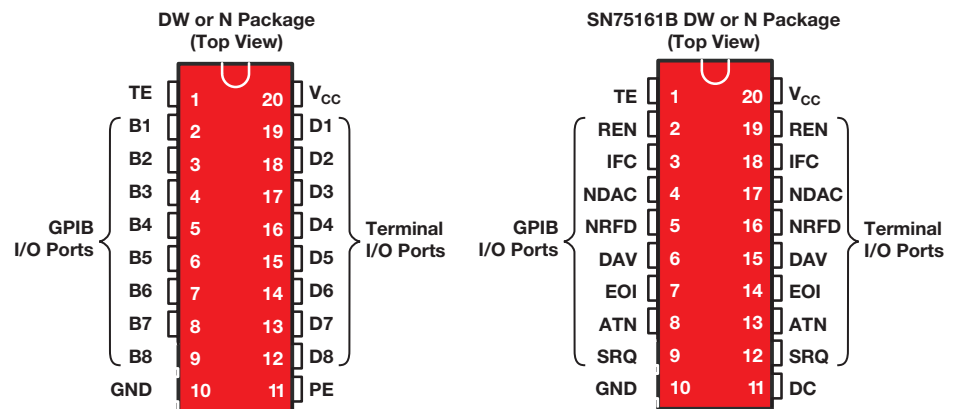
Key Features

- Meets IEEE standard 488-1978 (GPIB)
- 8-channel bidirectional transceivers
- Power-up/power-down protection (glitch-free)
- Designed to implement control bus interfaces
- High-speed, low-power Schottky circuitry
- Low power dissipation
- Fast propagation times: 22 ns max

Applications

- Test and measurement
- Data recording
- Automation

SN75160B and SN75161B eight-channel, general-purpose interface bus transceivers are monolithic, high-speed, low-power Schottky devices designed to meet the requirements of IEEE standard 488-1978. Each transceiver is designed to provide the bus-management and data-transfer signals between operating units of a single- or multiple-controller instrumentation system. When combined with the SN75160B octal bus transceiver, the SN75161B provides the complete 16-wire interface for the IEEE-488 bus. The SN75160B and SN75161B feature eight driver-receiver pairs connected in a front-to-back configuration to form input/output (I/O) ports at both the bus and terminal sides. A power-up/-down disable circuit is included on all bus and receiver outputs. This provides glitch-free operation during V_{CC} power-up and power-down.



SN75160B/SN75161B packaging.

→ GPIB Buses

Octal Bus Transceiver for IEEE 488 GPIB with Advanced Schottky Circuitry

SN75ALS160, SN75ALS162

Get samples, datasheets and app reports at: www.ti.com/sc/device/SN75ALS160 or [SN75ALS162](http://www.ti.com/sc/device/SN75ALS162)

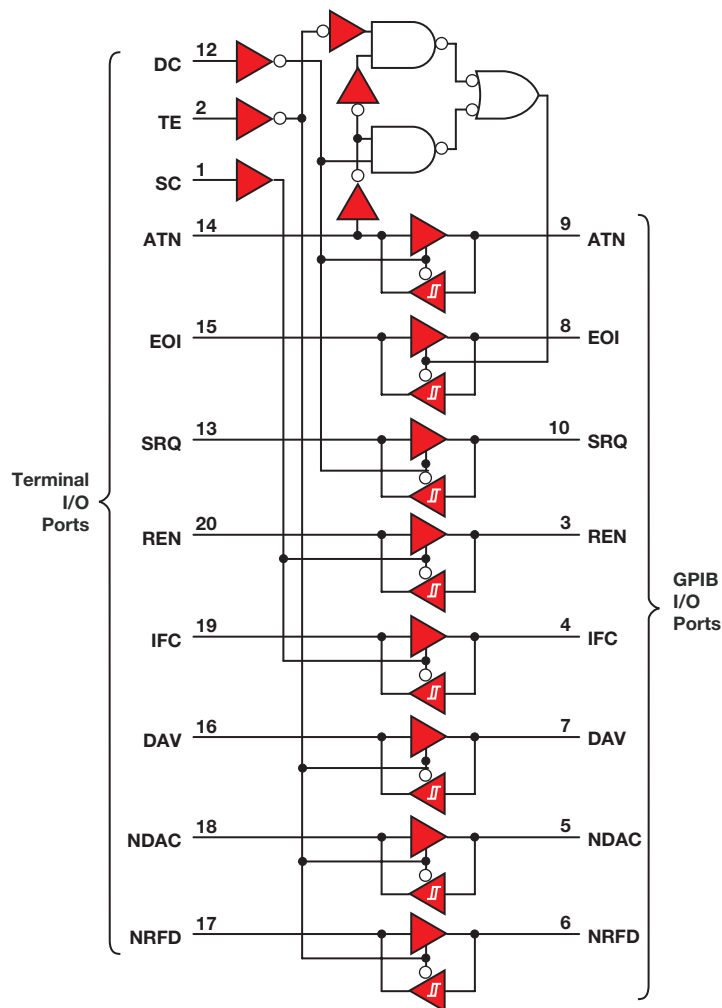
Key Features

- Meets IEEE standard 488-1978 (GPIB)
- 8-channel bidirectional transceivers
- Power-up/power-down protection (glitch-free)
- Designed to implement control bus interfaces
- High-speed advanced low-power Schottky circuitry
- Low power dissipation
- Fast propagation times: 20 ns max

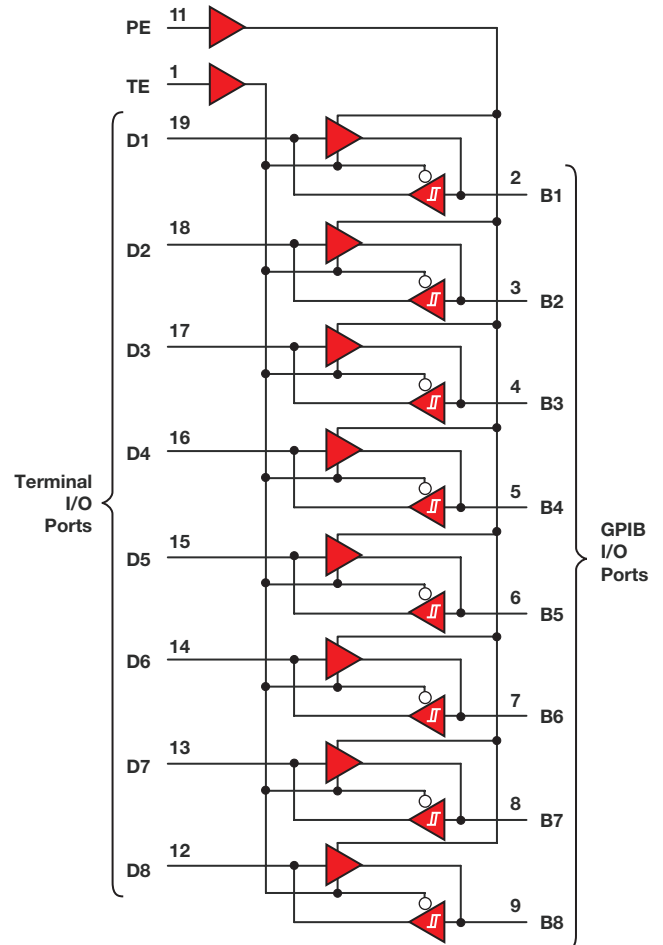
The SN75ALS162 eight-channel, general-purpose interface bus transceiver is a monolithic, high-speed, advanced low-power Schottky device designed to meet the requirements of IEEE standard 488-1978. Each transceiver is designed to provide the bus-management and data-transfer signals between operating units of a multiple-controller instrumentation system. When combined with the SN75ALS160 octal bus transceiver, the SN75ALS162 provides the complete 16-wire interface for the IEEE-488 bus. The SN75ALS162 features eight driver-receiver pairs connected in a front-to-back configuration to form input/output (I/O) ports at both the bus and terminal sides.

Applications

- Test and measurement
- Data recording
- Automation



SN75ALS162.



SN75ALS160.

→ Peripheral Drivers

50-V, 500-mA Open-Collector, Multichannel Drivers

ULN2003A, ULN2004A, ULN2803A

Get samples, datasheets and app reports at: www.ti.com/sc/device/ULN2003A, [ULN2004A](http://www.ti.com/sc/device/ULN2004A) or [ULN2803A](http://www.ti.com/sc/device/ULN2803A)

Key Features

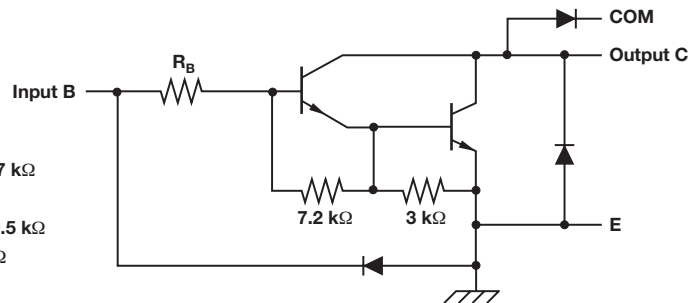
- High-voltage, high-current Darlington transistor arrays
- 500-mA rated collector current (single output)
- High-voltage outputs: 50 V
- Output clamp diodes
- Inputs compatible with various types of logic

Applications

- Relay drivers
- Hammer drivers
- Lamp drivers
- Display drivers

The ULN2003A, ULN2004A and ULN2803A are high-voltage, high-current Darlington transistor arrays. The ULN2003A and ULN2004A each consist of seven npn Darlington pairs, while the ULN2803A consists of eight npn Darlington pairs. All parts feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of a single Darlington pair is 500 mA and the Darlington pairs can be paralleled for higher current capability.

ULN2803A: $R_B = 2.7 \text{ k}\Omega$
 ULN/ULQ2003A: $R_B = 2.7 \text{ k}\Omega$
 ULN2003AI: $R_B = 2.7 \text{ k}\Omega$
 ULN/ULQ2004A: $R_B = 10.5 \text{ k}\Omega$
 ULN2004AI: $R_B = 10.5 \text{ k}\Omega$



Schematics (each Darlington pair).

Dual Very-High Speed, High-Current, Open-Collector Peripheral Drivers

SN75451B, SN75452B, SN75453B, SN75454B

Get samples, datasheets and app reports at: www.ti.com/sc/device/SN75451B, [SN75452B](http://www.ti.com/sc/device/SN75452B), [SN75453B](http://www.ti.com/sc/device/SN75453B) or [SN75454B](http://www.ti.com/sc/device/SN75454B)

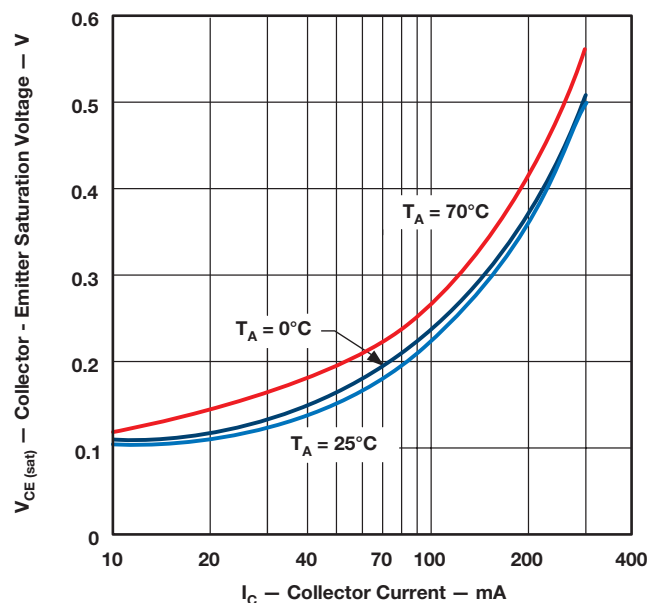
Key Features

- Characterized for use to 300 mA
- High-voltage outputs
- High-speed switching
- TTL-compatible diode-clamped inputs
- Plastic DIP (P) with copper lead frame provides cooler operation and improved reliability

Applications

- High-speed logic buffers
- Power drivers
- Relay drivers
- Lamp drivers

The SN75451B through SN75454B are dual peripheral drivers designed for use in systems that employ TTL logic. These parts are designed to ensure freedom from latch-up and diode-clamped inputs. The SN75451B, SN75452B, SN75453B and SN75454B are dual peripheral AND, NOR, OR and NOR drivers, respectively, with the output of the logic gates internally connected to the bases of the npn output transistors.



→ Peripheral Drivers

Dual MOSFET Driver

SN75372

Get samples, datasheets and app reports at: www.ti.com/sc/device/SN75372

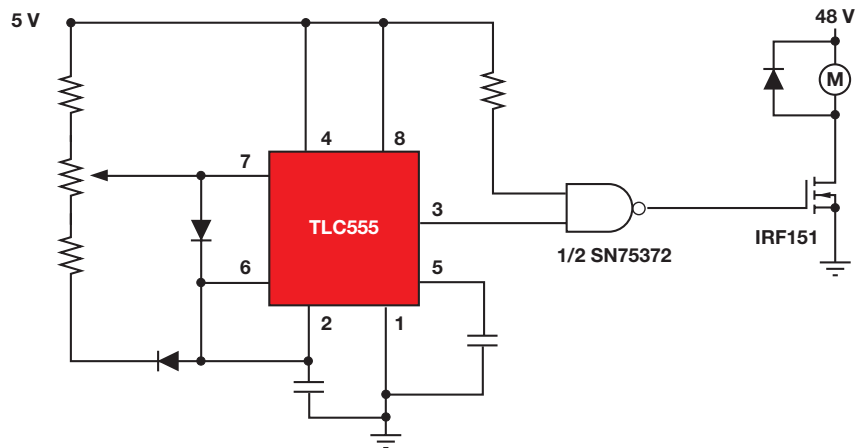
Key Features

- Dual MOSFET driver capable of driving high-capacitance loads at high speeds
- Output supply voltage range up to 24 V
- Low standby power dissipation

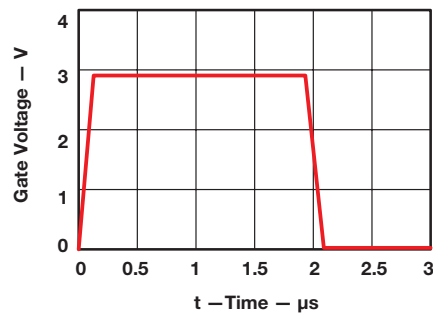
Applications

- Power supplies
- Motor control
- Actuator control

The SN75372 is a dual NAND gate interface circuit designed to drive power MOSFETs from TTL inputs. It provides high current and voltage necessary to drive large capacitive loads at high speeds. The device operates from a V_{CC1} of 5 V and a V_{CC2} of up to 24 V.



Functional block diagram.



Application information.

→ Peripheral Drivers

Quadruple Half-H Peripheral Drivers

L293, L293D

Get samples, datasheets and app reports at: www.ti.com/sc/device/L293 or [L293D](http://www.ti.com/sc/device/L293D)

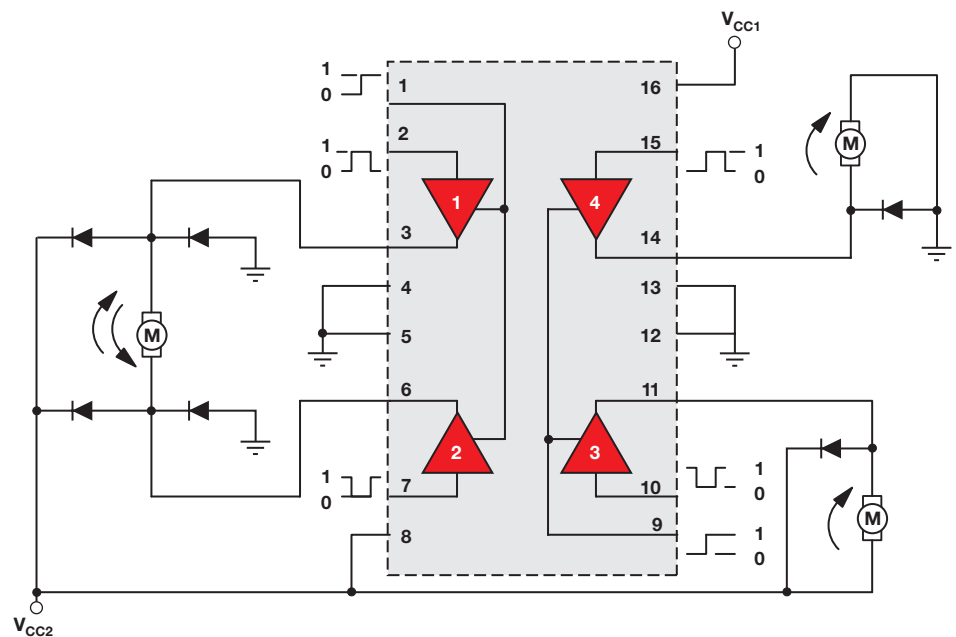
Key Features

- Wide supply voltage range: 4.5 V to 36 V
- Separate input logic supply
- Internal ESD protection
- High noise immunity inputs
- Output current 1 A per channel (1.2 A for L293D)
- Output clamp diodes for inductive transient suppression (L293D)

Applications

- Relay drivers
- Solenoid drivers
- DC and bipolar stepping motor drivers

The L293 and L293D are quadruple high-current, half-H drivers. The L293 is designed to provide bidirectional drive currents of up to 1 A at voltages from 4.5 V to 26 V. The L293D is designed to provide bidirectional drive currents of up to 600 mA at voltages from 4.5 V to 36 V. Both devices are designed to drive inductive loads. All inputs are TTL compatible and each output is a complete totem-pole drive circuit, with a Darlington transistor sink and a pseudo-Darlington source. The drivers are enabled in pairs and with the proper data inputs, each pair of drivers forms a full-H (or bridge) reversible drive suitable for solenoid or motor applications.



Functional block diagram.

 Selection Tables

RS422

Part Number	Description	# of TX/RX	Supply Voltage(s) (V)	Signaling Rate (Mbps)	ESD (kV)	I _{cc} (max) (mA)	Footprint	RS-422	RS-423	Pin/Package	Price*
AM26C31	Quadruple Differential Line Driver	4 TX/0 RX	5	10	2	3	AM26LS31	Yes	—	16PDIP, 16SO, 16SOIC, 16SSOP, 16TSSOP	0.60
AM26C32	Quadruple Differential Line Receiver	0 TX/4 RX	5	10	2	15	AM26LS32	Yes	Yes	16PDIP, 16SO, 16SOIC, 16TSSOP	0.60
AM26LS31	Quadruple Differential Line Driver	4 TX/0 RX	5	10	2	80	AM26LS31	Yes	—	16PDIP, 16SO, 16SOIC, 16SSOP	0.45
AM26LS32A	Quadruple Differential Line Receiver	0 TX/4 RX	5	10	2	70	AM26LS32	Yes	Yes	16PDIP, 16SO, 16SOIC, 16TSSOP	0.45
AM26LS33A	Quadruple Differential Line Receiver ± 15 V Common Mode Range	0 TX/4 RX	5	10	0.5	70	AM26LS32	Yes	Yes	16PDIP, 16SOIC	0.40
AM26LV31E	Low-Voltage High-Speed Quadruple Differential Line Driver with ± 15 -kV IEC ESD Protection	4 TX/0 RX	3.3	32	15	0.1	AM26LS31	Yes	—	16SO, 16SOIC, 16TSSOP, 16VQFN	0.90
AM26LV32	Low-Voltage High-Speed Quadruple Differential Line Receiver	0 TX/4 RX	3.3	10	2	17	AM26LS32	Yes	—	16SO, 16SOIC	0.75
AM26LV32E	Low-Voltage High-Speed Quadruple Differential Line Receiver with ± 15 -kV IEC ESD	0 TX/4 RX	3.3	32	15	17	AM26LS32	Yes	—	16SO, 16SOIC, 16TSSOP, 16VQFN	1.05
MC3486	Quadruple Differential Line Receiver with 3-State Outputs	0 TX/4 RX	5	10	2	85	MC3486	Yes	Yes	16PDIP, 16SO, 16SOIC	0.50
MC3487	Quadruple Differential Line Driver	4 TX/0 RX	5	10	2	85	MC3487	Yes	—	16PDIP, 16SO, 16SOIC	0.50
SN65C1167	Dual Differential Drivers and Receivers	2 TX/2 RX	5	10	2	9	MC34050	Yes	—	16SO	1.10
SN65C1167E	Dual Differential Drivers and Receivers with ± 15 -kV IEC ESD Protection	2 TX/2 RX	5	10	15	9	MC34050	Yes	—	16SO, 16TSSOP, 16VQFN	1.10
SN65C1168	Dual Differential Drivers and Receivers	2 TX/2 RX	5	10	2	9	MC34051	Yes	—	16PDIP, 16SO, 16TSSOP	0.99
SN65C1168E	Dual Differential Drivers and Receivers with ± 15 -kV IEC ESD Protection	2 TX/2 RX	5	10	15	9	MC34051	Yes	—	16SO, 16TSSOP, 16VQFN	0.80
SN751177	Dual Differential Driver/Receiver Pairs	2 TX/2 RX	5	10	2	110	MC34050	Yes	—	16PDIP, 16SO	1.60
SN751178	Dual Differential Driver/Receiver Pairs	2 TX/2 RX	5	10	2	110	MC34051	Yes	—	16PDIP, 16SO	1.60
SN75157	Dual Differential Line Receiver	0 TX/2 RX	5	4	2	50	SN75157	Yes	Yes	8PDIP, 8SO, 8SOIC	1.75
SN75158	Dual Differential Line Driver	2 TX/0 RX	5	10	2	50	SN75158	Yes	Yes	8PDIP, 8SO, 8SOIC	1.60
SN75159	Dual Differential Line Driver with 3-State Outputs	2 TX/0 RX	5	10	2	65	SN75159	Yes	—	14PDIP, 14SOIC	2.60
SN75172	Quadruple Differential Line Driver	4 TX/0 RX	5	4	2	60	AM26LS31	Yes	—	16PDIP, 20SOIC	1.45
SN75173	Quadruple Differential Line Receiver	0 TX/4 RX	5	10	2	70	AM26LS32	Yes	—	16PDIP, 16SO, 16SOIC	1.45
SN75174	Quadruple Differential Line Driver	4 TX/0 RX	5	4	2	60	MC3487	Yes	—	16PDIP, 20SOIC	1.45
SN75175	Quadruple Differential Line Receiver	0 TX/4 RX	5	10	2	70	MC3486	Yes	Yes	16PDIP, 16SO, 16SOIC	1.45
SN75176A	Differential Bus Transceiver	1 TX/1 RX	5	10	2	50	SN75176	Yes	—	8PDIP, 8SOIC	0.36

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

RS422 (Continued)

Part Number	Description	# of TX/RX	Supply Voltage(s) (V)	Signaling Rate (Mbps)	ESD (kV)	I _{cc} (max) (mA)	Footprint	RS-422	RS-423	Pin/Package	Price*
SN75176B	Differential Bus Transceiver	1 TX/1 RX	5	10	2	70	SN75176	Yes	—	8PDIP, 8SO, 8SOIC	0.36
SN75178B	Differential Bus Repeaters	1 TX/1 RX	5	10	2	70	SN75176	Yes	—	8PDIP	2.15
SN75179B	Differential Driver and Receiver Pair	1 TX/1 RX	5	10	2	70	SN75179	Yes	—	8PDIP, 8SO, 8SOIC	0.80
SN7534050	Dual Differential Drivers and Receivers	2 TX/2 RX	5	10	2	110	MC34050	Yes	—	16PDIP, 16SO	1.60
SN7534051	Dual Differential Drivers and Receivers	2 TX/2 RX	5	10	2	110	MC34051	Yes	—	16PDIP, 16SO	1.60
SN75ALS1177	Dual Differential Drivers and Receivers	2 TX/2 RX	5	10	2	50	MC34050	Yes	—	16PDIP, 16SO	3.24
SN75ALS1178	Dual Differential Drivers and Receivers	2 TX/2 RX	5	10	2	50	MC34051	Yes	—	16PDIP, 16SO	3.24
SN75ALS172A	Quadruple Differential Line Driver	4 TX/0 RX	5	20	2	55	AM26LS31	Yes	—	16PDIP, 20SOIC	2.65
SN75ALS173	Quadruple Differential Line Receiver	0 TX/4 RX	5	10	2	24	AM26LS32	Yes	Yes	16PDIP, 16SO	2.90
SN75ALS174A	Quadruple Differential Line Driver	4 TX/0 RX	5	20	2	55	MC3487	Yes	—	16PDIP, 20SOIC	1.90
SN75ALS175	Quadruple Differential Line Receiver	0 TX/4 RX	5	10	2	24	MC3486	Yes	Yes	16PDIP, 16SO	2.29
SN75ALS176	Differential Bus Transceiver	1 TX/1 RX	5	35	2	30	SN75176	Yes	—	8PDIP, 8SOIC	1.15
SN75ALS176A	Differential Bus Transceiver	1 TX/1 RX	5	35	2	30	SN75176	Yes	—	8PDIP, 8SOIC	1.30
SN75ALS176B	Differential Bus Transceiver	1 TX/1 RX	5	35	2	30	SN75176	Yes	—	8PDIP, 8SOIC	1.30
SN75ALS180	Differential Driver and Receiver Pair	1 TX/1 RX	5	25	2	30	SN75ALS180	Yes	—	14PDIP, 14SOIC	1.80
SN75ALS181	Differential Driver and Receiver Pair	1 TX/1 RX	5	10	2	30	SN75ALS180	Yes	—	14PDIP, 14SO	1.62
SN75ALS191	Dual Differential Line Driver	2 TX/0 RX	5	20	2	40	uA9638	Yes	—	8PDIP, 8SO, 8SOIC	0.99
SN75ALS192	Quadruple Differential Line Driver	4 TX/0 RX	5	20	2	45	AM26LS31	Yes	—	16PDIP, 16SO, 16SOIC	0.36
SN75ALS193	Quadruple Differential Line Receiver	0 TX/4 RX	5	20	2	35	AM26LS32	Yes	Yes	16PDIP, 16SOIC	0.27
SN75ALS194	Quadruple Differential Line Driver	4 TX/0 RX	5	20	2	45	MC3487	Yes	—	16PDIP, 16SO, 16SOIC	0.85
SN75ALS195	Quadruple Differential Line Receiver	0 TX/4 RX	5	20	2	35	MC3486	Yes	Yes	16PDIP	1.65
SN75C1167	Dual Differential Drivers and Receivers	2 TX/2 RX	5	10	2	9	MC34050	Yes	—	16PDIP, 16SO, 16SSOP	0.90
SN75C1168	Dual Differential Drivers and Receivers	2 TX/2 RX	5	10	2	9	MC34051	Yes	—	16PDIP, 16SO, 16SSOP, 16TSSOP	0.99
TL3695	Differential Bus Transceiver	1 TX/1 RX	5	10	2	50	SN75176	Yes	—	8PDIP, 8SOIC	0.99
UA9637A	Dual Differential Line Receiver	0 TX/2 RX	5	10	2	50	uA9637	Yes	Yes	8PDIP, 8SO, 8SOIC	0.50
UA9638	Dual High-Speed Differential Line Driver	2 TX/0 RX	5	15	2	65	uA9638	Yes	—	8PDIP, 8SOIC	0.27
UA9639	Dual Differential Line Receiver	0 TX/2 RX	5	10	2	50	uA9639	Yes	Yes	8PDIP	0.54

*Suggested resale price in U.S. dollars in quantities of 1,000.

RS485

Part Number	Description	# of TX/RX	Supply Voltage(s) (V)	Signaling Rate (Mbps)	Duplex	Common Mode Range	ESD (kV)	Temp Range (C)	I _{cc} (max) (mA)	Fail Safe	Footprint	Pin/Package	Price*
SN65175	Quadruple Differential Line Receiver	0 TX/ 4 RX	5	10	Simplex	-7 to 12	2	-40 to 85	70	None	MC3486	16SOIC	1.60
SN65176B	Differential Bus Transceiver	1 TX/ 1 RX	5	10	Half	-7 to 12	2	-40 to 105	70	None	SN75176	8PDIP, 8SOIC	0.36
SN65ALS176	Differential Bus Transceiver	1 TX/ 1 RX	5	35	Half	-7 to 12	2	-40 to 85	30	Open	SN75176	8SOIC	1.25
SN65ALS180	Differential Driver and Receiver Pair	1 TX/ 1 RX	5	25	Full	-7 to 12	2	-40 to 85	30	Open	SN75ALS180	14SOIC	1.80
SN65C1168	Dual Differential Drivers and Receivers	2 TX/ 2 RX	5	10	Full	-7 to 12	2	-40 to 85	9	Open	MC34051	16PDIP, 16SO, 16TSSOP	0.99
SN65HVD3082E	Ultra-Low Power, Optimized for Low Speeds	1 TX/ 1 RX	5	0.2	Half	-7 to 12	15	-40 to 85	0.9	Short, Open, Idle	SN75176	8MSOP/PDIP/ SOIC	0.90
SN65HVD3085E	Ultra-Low Power, Optimized for Medium Speeds	1 TX/ 1 RX	5	1	Half	-7 to 12	15	-40 to 85	0.9	Short, Open, Idle	SN75176	8MSOP/SOIC	1.00
SN65HVD3088E	Ultra-Low Power, Optimized for High Speeds	1 TX/ 1 RX	5	20	Half	-7 to 12	15	-40 to 85	0.9	Short, Open, Idle	SN75176	8MSOP/SOIC	1.10
SN65HVD485E	Half Duplex Transceiver	1 TX/ 1 RX	5	10	Half	-7 to 12	15	-40 to 85	2	Open	SN75176	8MSOP/SOIC/ PDIP	0.75
SN65HVD3080E	Ultra-Low Power, Optimized for Medium Speeds	1 TX/ 1 RX	5	0.2	Full	-7 to 12	16	-40 to 85	0.75	Short, Open, Idle	LBC180	10MSOP	1.20
SN65HVD3083E	Ultra-Low Power, Optimized for Medium Speeds	1 TX/ 1 RX	5	1	Full	-7 to 12	16	-40 to 85	0.75	Short, Open, Idle	LBC180	10MSOP	1.20
SN65HVD3086E	Ultra-Low Power, Optimized for High Speeds	1 TX/ 1 RX	5	20	Full	-7 to 12	16	-40 to 85	0.75	Short, Open, Idle	LBC180	10MSOP, 14SOIC	1.35
SN751177	Dual Differential Driver/Receiver Pairs	2 TX/ 2 RX	5	10	Full	-7 to 12	2	0 to 70	110	None	MC34050	16PDIP, 16SO	1.60
SN751178	Dual Differential Driver/Receiver Pairs	2 TX/ 2 RX	5	10	Full	-7 to 12	2	0 to 70	110	Open	MC34051	16PDIP, 16SO	1.60
SN75157	Dual Differential Line Receiver	0 TX/ 2 RX	5	4	Simplex	-7 to 12	2	0 to 70	50	None	SN75157	8PDIP, 8SO, 8SOIC	1.75
SN75172	Quadruple Differential Line Driver	4 TX/ 0 RX	5	4	Simplex	-7 to 12	2	0 to 70	60	None	AM26LS31	16PDIP, 20SOIC	1.45
SN75173	Quadruple Differential Line Receiver	0 TX/ 4 RX	5	10	Simplex	-7 to 12	2	0 to 70	70	Open	AM26LS32	16PDIP, 16SO, 16SOIC	1.45
SN75174	Quadruple Differential Line Driver	4 TX/ 0 RX	5	4	Simplex	-7 to 12	2	0 to 70	60	None	MC3487	16PDIP, 20SOIC	1.45
SN75175	Quadruple Differential Line Receiver	0 TX/ 4 RX	5	10	Half	-7 to 12	2	0 to 70	70	None	MC3486	16PDIP, 16SO, 16SOIC	1.45
SN75176A	Differential Bus Transceiver	1 TX/ 1 RX	5	10	Half	-7 to 12	2	0 to 70	50	None	SN75176	8PDIP, 8SOIC	0.36
SN75176B	Differential Bus Transceiver	1 TX/ 1 RX	5	10	Half	-7 to 12	2	0 to 70	70	None	SN75176	8PDIP, 8SO, 8SOIC	0.36
SN75178B	Differential Bus Repeaters	1 TX/ 1 RX	5	10	Full	-7 to 12	2	0 to 70	70	None	SN75176	8PDIP	2.15
SN75179B	Differential Driver and Receiver Pair	1 TX/ 1 RX	5	10	Full	-7 to 12	2	0 to 70	70	None	SN75179	8PDIP, 8SO, 8SOIC	0.80
SN75ALS1177	Dual Differential Drivers and Receivers	2 TX/ 2 RX	5	10	Full	-7 to 12	2	0 to 70	50	Open	MC34050	16PDIP, 16SO	3.24
SN75ALS1178	Dual Differential Drivers and Receivers	2 TX/ 2 RX	5	10	Full	-7 to 12	2	0 to 70	50	Open	MC34051	16PDIP, 16SO	3.24

*Suggested resale price in U.S. dollars in quantities of 1,000.

RS485 (Continued)

Part Number	Description	# of TX/RX	Supply Voltage(s) (V)	Signaling Rate (Mbps)	Duplex	Common Mode Range	ESD (kV)	Temp Range (C)	I _{CC} (max) (mA)	Fail Safe	Footprint	Pin/Package	Price*
SN75ALS170	Triple Differential Bus Transceiver	3 TX/ 3 RX	5	20	Half	-7 to 12	2	0 to 70	90	Open	SN75ALS170	20SOIC	5.60
SN75ALS170A	Triple Differential Bus Transceiver	3 TX/ 3 RX	5	20	Half	-7 to 12	2	0 to 70	90	Open	SN75ALS170	20SOIC	4.97
SN75ALS171	Triple Differential Bus Transceiver	3 TX/ 3 RX	5	20	Half	-7 to 12	2	0 to 70	90	Open	SN75ALS171	20SOIC	5.60
SN75ALS171A	Triple Differential Bus Transceiver	3 TX/ 3 RX	5	20	Half	-7 to 12	2	0 to 70	90	Open	SN75ALS171	20SOIC	6.00
SN75ALS172A	Quadruple Differential Line Driver	4 TX/ 0 RX	5	20	Simplex	-7 to 12	2	0 to 70	55	None	AM26LS31	16PDIP, 20SOIC	2.65
SN75ALS173	Quadruple Differential Line Receiver	0 TX/ 4 RX	5	10	Simplex	-7 to 12	2	0 to 70	24	Open	AM26LS32	16PDIP, 16SO	2.90
SN75ALS174A	Quadruple Differential Line Driver	4 TX/ 0 RX	5	20	Simplex	-7 to 12	2	0 to 70	55	None	MC3487	16PDIP, 20SOIC	1.90
SN75ALS175	Quadruple Differential Line Receiver	0 TX/ 4 RX	5	10	N/A	-7 to 12	2	0 to 70	24	Open	MC3486	16PDIP, 16SO	2.29
SN75ALS176	Differential Bus Transceiver	1 TX/ 1 RX	5	35	Half	-7 to 12	2	0 to 70	30	Open	SN75176	8PDIP, 8SOIC	1.15
SN75ALS176A	Differential Bus Transceiver	1 TX/ 1 RX	5	35	Half	-7 to 12	2	0 to 70	30	Open	SN75176	8PDIP, 8SOIC	1.30
SN75ALS176B	Differential Bus Transceiver	1 TX/ 1 RX	5	35	Half	-7 to 12	2	0 to 70	30	Open	SN75176	8PDIP, 8SOIC	1.30
SN75ALS180	Differential Driver and Receiver Pair	1 TX/ 1 RX	5	25	Full	-7 to 12	2	0 to 70	30	Open	SN75ALS180	14PDIP, 14SOIC	1.80
SN75ALS181	Differential Driver and Receiver Pair	1 TX/ 1 RX	5	10	Full	-7 to 12	2	0 to 70	30	Open	SN75ALS180	14PDIP, 14SO	1.62
TL3695	Differential Bus Transceiver	1 TX/ 1 RX	5	10	Half	-7 to 12	2	0 to 70	50	Open	SN75176	8PDIP, 8SOIC	0.99

*Suggested resale price in U.S. dollars in quantities of 1,000.

RS232

Part Number	Description	Data Rate (kbps)	Drivers Per Package	Receivers Per Package	Supply Voltage(s) (V)	ESD HBM (kV)	I _{CC} (max) (mA)	Single Supply	1.8 V or 2.5 V Support	IEC-61000-4-2 Support	Pin/Package	Price*
UA9636A	Dual Line Driver with Adjustable Slew Rate	7+	2	0	±12.0	—	±18	—	—	—	8PDIP, 8SOIC	0.40
SN75C1154	Quadruple Low-Power Drivers/Receivers	95	4	4	±12.0 and 5.0	—	±0.25	—	—	—	20PDIP, 20SOIC	0.95
SN65C1154	Quadruple Low-Power Drivers/Receivers	95	4	4	±12.0 and 5.0	—	±0.25 and 2.0	—	—	—	20PDIP	1.10
SN75C3222E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD (HBM) Protection	100	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	20SOIC, 20SSOP, 20TSSOP	1.30
SN65C3223E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD (HBM) Protection	100	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	20SOIC, 20SSOP, 20TSSOP	1.30
SN75LBC241	Low-Power LinBiCMOS Multiple Drivers and Receivers	100	4	5	5	—	8	Yes	—	—	28SOIC	2.60
TRS202E	5-V Dual RS-232 Line Driver/Receiver with ±15-kV ESD Protection	120	2	2	5	±15	15	Yes	—	Yes	16PDIP, 16SOIC, 16TSSOP	0.48

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

RS232 (Continued)

Part Number	Description	Data Rate (kbps)	Drivers Per Package	Receivers Per Package	Supply Voltage(s) (V)	ESD HBM (kV)	I _{CC} (max) (mA)	Single Supply	1.8 V or 2.5 V Support	IEC-61000-4-2 Support	Pin/Package	Price*
TRS232	Dual RS-232 Driver/Receiver with IEC61000-4-2 Protection	120	2	2	5	±2	10	Yes	—	—	16PDIP, 16SO, 16SOIC	0.60
TRS213	5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	120	4	5	5	±15	20	Yes	—	—	28SOIC, 28SSOP	1.00
TRS211	5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	120	4	5	5	±15	20	Yes	—	—	28SSOP	1.15
TRS208	5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	120	4	4	5	±15	20	Yes	—	—	24SOIC, 24SSOP	1.00
TRS207	5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	120	5	3	5	±15	20	Yes	—	—	24SSOP	1.00
TRS202	5-V Dual RS-232 Line Driver/Receiver with ±15-kV ESD Protection	120	2	2	5	±15	15	Yes	—	—	16SOIC	0.55
TL145406	Triple RS-232 Drivers/Receivers	120	3	3	±9.0 and 5.0	±2	±25 and 20	—	—	—	16PDIP, 16SOIC	1.05
SN75LBC187	Multichannel EIA-232 Driver/Receiver with Charge Pump	120	3	5	5	—	30	Yes	—	—	28SSOP	4.35
SN75C185	Low-Power Multiple Drivers and Receivers	120	3	5	±12.0 and 5.0	±2	±0.25 and 0.75	—	—	—	20PDIP, 20SOIC	1.10
SN75C1406	Triple Low-Power Drivers and Receivers	120	3	3	±12.0 and 5.0	±2	±0.25	—	—	—	16PDIP, 16SO, 16SOIC	0.90
SN752232	Dual RS-232 Port	120	6	10	±9.0 and 5.0	—	±50 and 60	—	—	—	48SSOP, 48TSSOP	0.90
SN75196	Multiple RS-232 Driver and Receiver	120	5	3	±9.0 and 5.0	±10	±32 and 20	—	—	—	20PDIP, 20SOIC	0.68
SN75185	Multiple RS-232 Drivers and Receivers	120	3	5	±9.0 and 5.0	±10	±25 and 30	—	—	—	20PDIP, 20SOIC, 20SSOP, 20TSSOP	0.45
SN65C1406	Triple Low-Power Drivers and Receivers	120	3	3	±12.0 and 5.0	—	±0.25 and 2.0	—	—	—	16SOIC	2.20
MAX232	Dual EIA-232 Driver/Receiver	120	2	2	5	±2	10	Yes	—	—	16PDIP, 16SO, 16SOIC	0.48
MAX213	5-V Multichannel RS-232 Line Driver/Receiver with 15-kV ESD Protection	120	4	5	5	±15	20	Yes	—	—	28SOIC, 28SSOP	1.00
MAX211	5-V Multichannel RS-232 Line Driver/Receiver with 15-kV ESD Protection	120	4	5	5	±15	20	Yes	—	—	28SOIC, 28SSOP	1.00
MAX208	5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	120	4	4	5	±15	20	Yes	—	—	24SOIC, 24SSOP	1.10
MAX207	5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	120	5	3	5	±15	20	Yes	—	—	24SOIC, 24SSOP	1.00
MAX202	5-V Dual RS-232 Line Driver/Receiver with ±15-kV ESD Protection	120	2	2	5	±15	15	Yes	—	—	16SOIC, 16TSSOP	0.48
LT1030	Quadruple Low-Power Line Driver	120	4	0	±15.0	—	1	—	—	—	14PDIP, 14SOIC	1.60

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

RS232 (Continued)

Part Number	Description	Data Rate (kbps)	Drivers Per Package	Receivers Per Package	Supply Voltage(s) (V)	ESD HBM (kV)	I _{CC} (max) (mA)	Single Supply	1.8 V or 2.5 V Support	IEC-61000-4-2 Support	Pin/Package	Price*
GD75323	Multiple RS-232 Drivers and Receivers	120	5	3	±9.0 and 5.0	—	±32 and 20	—	—	—	20SOIC	0.41
GD75232	Multiple RS-232 Drivers and Receivers	120	3	5	±9.0 and 5.0	—	±25 and 30	—	—	—	20PDIP, 20SOIC, 20SSOP, 20TSSOP	0.34
GD65232	Multiple RS-232 Drivers and Receivers	120	3	5	±9.0 and 5.0	—	±25 and 38	—	—	—	20SOIC, 20TSSOP	0.34
SN75LV4737A	3.3-V/5-V Multichannel RS-232 Line Driver/Receiver	128	3	5	3.3 or 5.0	±4	20.7	Yes	—	—	28SSOP	3.20
TRS222	5-V Dual RS-232 Line Driver/Receiver with ±15-kV ESD Protection	200	2	2	5	±15	10	Yes	—	—	18PDIP, 18SOIC	1.15
MAX222	5-V Dual RS-232 Line Driver/Receiver with ±15-kV ESD Protection	200	2	2	5	±15	10	Yes	—	—	18PDIP, 18SOIC	1.15
TRS3386E	RS-232 Transceiver with Split Supply Pin for Logic Side	250	3	2	3.3 or 5.0 and 1.8	±15	1	—	Yes	Yes	20SOIC, 20TSSOP	1.95
TRS3232E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	250	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	16SOIC, 16SSOP, 16TSSOP	1.00
TRS3221E	3-V to 5.5-V Single-Channel RS-232 Line Driver/Receiver with ±15-kV IEC ESD Protection	250	1	1	3.3 or 5.0	±15	1	Yes	—	Yes	16SSOP, 16TSSOP	0.90
TRS232E	Dual RS-232 Driver/Receiver with IEC61000-4-2 Protection	250	2	2	5	±15	10	Yes	—	Yes	16PDIP, 16SOIC, 16TSSOP	0.65
TRSF23243	3-V to 5.5-V Dual RS-232 Port	250	6	10	3.3 or 5.0	±15	2	Yes	—	—	48SSOP, 48TSSOP	3.05
TRS3243	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV IEC ESD Protection	250	3	5	3.3 or 5.0	±15	1	Yes	—	—	28SOIC, 28SSOP, 28TSSOP	0.90
TRS3238	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD (HBM) Protection	250	5	3	3.3 or 5.0	±15	2	Yes	—	—	28TSSOP	1.20
TRS3232	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	250	2	2	3.3 or 5.0	±15	1	Yes	—	—	16SOIC, 16SSOP, 16TSSOP	1.00
TRS3223	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	250	2	2	3.3 or 5.0	±15	1	Yes	—	—	20SSOP	1.15
TRS3222	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	250	2	2	3.3 or 5.0	±15	1	Yes	—	—	20SSOP	1.30
TRS3221	3-V to 5.5-V Single-Channel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	250	1	1	3.3 or 5.0	±15	1	Yes	—	—	16SSOP, 16TSSOP	0.90
MAX3386E	RS-232 Transceiver with Split Supply Pin for Logic Side	250	3	2	3.3 or 5.0 and 1.8	±15	1	—	Yes	Yes	20SOIC, 20TSSOP	1.95
MAX3232E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV IEC ESD Protection	250	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	16SOIC, 16SSOP, 16TSSOP	1.00

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

RS232 (Continued)

Part Number	Description	Data Rate (kbps)	Drivers Per Package	Receivers Per Package	Supply Voltage(s) (V)	ESD HBM (kV)	I _{CC} (max) (mA)	Single Supply	1.8 V or 2.5 V Support	IEC-61000-4-2 Support	Pin/Package	Price*
MAX3221E	3-V to 5.5-V Single-Channel RS-232 Line Driver/Receiver	250	1	1	3.3 or 5.0	±15	1	Yes	—	Yes	16SSOP, 16TSSOP	0.90
MAX232E	Dual RS-232 Driver/Receiver with IEC61000-4-2 Protection	250	2	2	5	±15	10	Yes	—	Yes	16PDIP, 16SOIC, 16TSSOP	0.65
SN75C23243	3-V to 5.5-V Dual RS-232 Port	250	6	10	3.3 or 5.0	±15	2	Yes	—	—	48SSOP, 48TSSOP	4.15
SN65C23243	3-V to 5.5-V Dual RS-232 Port	250	6	10	3.3 or 5.0	±15	2	Yes	—	—	48SSOP, 48TSSOP	4.15
MAX3243	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD (HBM) Protection	250	3	5	3.3 or 5.0	±15	1	Yes	Yes	—	28SOIC, 28SSOP, 28TSSOP	0.90
MAX3238	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	250	5	3	3.3 or 5.0	±15	2	Yes	—	—	28SSOP, 28TSSOP	1.20
MAX3232	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	250	2	2	3.3 or 5.0	±15	1	Yes	—	—	16SOIC, 16SSOP, 16TSSOP	1.00
MAX3223	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	250	2	2	3.3 or 5.0	±15	1	Yes	—	—	20SOIC, 20SSOP, 20TSSOP	1.15
MAX3222	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	250	2	2	3.3 or 5.0	±15	1	Yes	—	—	20SOIC, 20SSOP, 20TSSOP	1.30
MAX3221	3-V to 5.5-V Single-Channel RS-232 Line Driver/Receiver	250	1	1	3.3 or 5.0	±15	1	Yes	—	—	16SSOP, 16TSSOP	0.90
SN75LPE185	Low-Power Multiple Drivers and Receivers with Enable	256	3	5	±12.0 and 5.0	±15	+0.8/–0.625 and 1	—	—	—	24PDIP, 24SOIC	2.30
SN75LP196	Low-Power Multiple RS-232 Drivers and Receivers	256	5	3	±12.0 and 5.0	±15	±0.8 and 1	—	—	—	20SOIC, 20SSOP	2.15
SN75LP1185	Low-Power Multiple RS-232 Drivers and Receivers	256	3	5	±12.0 and 5.0	±15	+0.8/–0.625 and 1	—	—	—	20PDIP, 20SOIC, 20SSOP	1.80
SN75C198	Quadruple Low-Power Line Drivers	300	4	0	±12.0	—	±0.16	—	—	—	14PDIP, 14SOIC	2.70
SN75C188	Quadruple Low-Power Line Driver	300	4	0	±12.0	±2	±0.16	—	—	—	14PDIP, 14SO, 14SOIC, 14SSOP	0.34
SN75188	Quadruple Line Driver	300	4	0	±9.0	±2	±34	—	—	—	14PDIP, 14SO, 14SOIC	0.22
SN751701	Line Driver and Receiver	300	1	1	±12.0	—	+14/–6.1	—	—	—	8SO	1.30
MC1488	Quadruple Line Driver	300	4	0	±9.0	—	±34	—	—	—	14PDIP	0.20
TRS3238E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD (HBM) Protection	400	5	3	3.3 or 5.0	±15	2	Yes	—	Yes	28SOIC, 28SSOP, 28TSSOP	1.20
MAX3238E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD (HBM) Protection	400	5	3	3.3 or 5.0	±15	2	Yes	—	Yes	28SOIC, 28SSOP, 28TSSOP	1.20
SN75155	Line Driver and Receiver	400	1	1	±12.0	±2	+14/–6.1	—	—	—	8PDIP, 8SOIC	0.72

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

RS232 (Continued)

Part Number	Description	Data Rate (kbps)	Drivers Per Package	Receivers Per Package	Supply Voltage(s) (V)	ESD HBM (kV)	I _{CC} (max) (mA)	Single Supply	1.8 V or 2.5 V Support	IEC-61000-4-2 Support	Pin/Package	Price*
SN75150	Dual Line Driver	450	2	0	±12.0	±2	+22/-20	—	—	—	8PDIP, 8SOIC	0.72
TRS3318E	2.5-V 460-KbpsRS-232 Transceiver with ±15-kV ESD Protection	460	2	2	2.25 to 3.0	±15	2	Yes	—	Yes	20SSOP, 20TSSOP	0.99
TRS3318	2.5-V 460-KbpsRS-232 Transceiver with ±15-kV ESD Protection	460	2	2	2.25 to 3.0	±15	2	Yes	Yes	—	20SSOP, 20TSSOP	0.90
MAX3318E	2.5-V 460-KbpsRS-232 Transceiver with IEC 61000-4-2 ESD-Protection	460	2	2	2.25 to 3.0	±15	2	Yes	—	Yes	20SSOP, 20TSSOP	0.99
MAX3318	2.5-V 460-KbpsRS-232 Transceiver with ±15-kV ESD Protection	460	2	2	2.25 to 3.0	±15	2	Yes	Yes	—	20SSOP, 20TSSOP	0.90
TRS3243E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV IEC ESD Protection	500	3	5	3.3 or 5.0	±15	1	Yes	—	Yes	28SOIC, 28SSOP, 28TSSOP, 32QFN	0.90
TRS3223E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV IEC ESD Protection	500	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	20SOIC, 20SSOP, 20TSSOP	1.15
TRS3222E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	500	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	20SOIC, 20SSOP, 20TSSOP	1.30
MAX3243E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15kV IEC ESD Protection	500	3	5	3.3 or 5.0	±15	1	Yes	—	Yes	28SOIC, 28SSOP, 28TSSOP, 32QFN	0.90
MAX3223E	3-V to 5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	500	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	20SOIC, 20SSOP, 20TSSOP	1.15
MAX3222E	3-V to 5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	500	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	20SOIC, 20SSOP, 20TSSOP	1.30
TRS3253E	RS-232 Transceiver with Split Supply Pin For Logic Side	1,000	3	5	3.3 or 5.0 and 1.8	±15	1	—	Yes	Yes	32VQFN	1.50
TRSF3238E	TRSF3238E	1,000	5	3	3.3 or 5.0	±15	2	Yes	—	Yes	28SOIC, 28SSOP	1.45
TRSF3232E	3-V to 5.5-V Two-Channel RS-232 1-Mbit/s Line Driver/Receiver	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	16SOIC, 16SSOP, 16TSSOP	1.15
TRSF3223E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	20SOIC, 20SSOP, 20TSSOP	1.30
TRSF3222E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	20SOIC, 20SSOP, 20TSSOP	1.30
TRSF3221E	3-V to 5.5-V Single-Channel RS-232 1-Mbit/s Line Driver/Receiver with ±15-kV IEC ESD Protection	1,000	1	1	3.3 or 5.0	±15	1	Yes	—	Yes	16SSOP, 16TSSOP	0.75
TRS3237E	3-V to 5.5-V Multichannel RS-232 1-MBit/s Line Driver/Receiver	1,000	5	3	3.3 or 5.0	±15	2	Yes	—	Yes	28SOIC, 28SSOP, 28TSSOP	1.35

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables

RS232 (Continued)

Part Number	Description	Data Rate (kbps)	Drivers Per Package	Receivers Per Package	Supply Voltage(s) (V)	ESD HBM (kV)	I _{CC} (max) (mA)	Single Supply	1.8 V or 2.5 V Support	IEC-61000-4-2 Support	Pin/Package	Price*
TRS3227E	3-V to 5.5-V Single-Channel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	1,000	1	1	3.3 or 5.0	±15	2	Yes	—	Yes	16SSOP	1.40
TRSF3243	3-V to 5.5-V Multichannel RS-232 Compatible Line Driver/Receiver	1,000	3	5	3.3 or 5.0	±15	1	Yes	—	—	28SSOP, 28TSSOP	1.45
TRSF3232	3-V to 5.5-V Multichannel RS-232 Compatible Line Driver/Receiver	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	—	16SOIC	1.15
TRS3227	3-V to 5.5-V Single-Channel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	1,000	1	1	3.3 or 5.0	±15	2	Yes	—	—	16SSOP	1.40
SN75C3238E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD (HBM) Protection	1,000	5	3	3.3 or 5.0	±15	2	Yes	—	Yes	28SOIC, 28SSOP	1.45
SN75C3232E	3-V to 5.5-V Two Channel RS-232 1-Mbit/s Line Driver/Receiver with ±15-kV IEC ESD Protection	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	16SOIC, 16SSOP, 16TSSOP	1.15
SN75C3223E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD (HBM) Protection	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	20SOIC, 20SSOP, 20TSSOP	1.30
SN75C3221E	3-V to 5.5-V Single Channel RS-232 1-Mbit/s Line Driver/Receiver	1,000	1	1	3.3 or 5.0	±15	1	Yes	—	Yes	16SSOP, 16TSSOP	0.75
SN65C3238E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD (HBM) Protection	1,000	5	3	3.3 or 5.0	±15	2	Yes	—	Yes	28SOIC, 28SSOP	1.45
SN65C3232E	3-V to 5.5-V Two Channel RS-232 1-Mbit/s Line Driver/Receiver with ±15-kV IEC ESD Protection	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	16SOIC, 16SSOP, 16TSSOP	1.15
SN65C3222E	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver with ±15-kV ESD (HBM) Protection	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	Yes	20SOIC, 20SSOP, 20TSSOP	1.30
SN65C3221E	3-V to 5.5-V Single Channel RS-232 1-Mbit/s Line Driver/Receiver	1,000	1	1	3.3 or 5.0	±15	1	Yes	—	Yes	16SSOP, 16TSSOP	0.75
MAX3237E	3-V to 5.5-V Single Channel RS-232 1-Mbit/s Line Driver/Receiver	1,000	5	3	3.3 or 5.0	±15	2	Yes	—	Yes	28SOIC, 28SSOP, 28TSSOP	1.35
MAX3227E	3-V to 5.5-V Single-Channel RS-232 Line Driver/Receiver	1,000	1	1	3.3 or 5.0	±15	2	Yes	—	Yes	16SSOP	1.40
SN75C3243	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	1,000	3	5	3.3 or 5.0	±15	1	Yes	—	—	28SOIC, 28SSOP, 28TSSOP	1.10
SN75C3238	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	1,000	5	3	3.3 or 5.0	±15	2	Yes	—	—	28SOIC, 28SSOP, 28TSSOP	1.65
SN75C3232	3-V to 5.5-V Two Channel RS-232 Compatible Line Driver/Receiver	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	—	16SOIC, 16SSOP, 16TSSOP	1.30

*Suggested resale price in U.S. dollars in quantities of 1,000.

→ Selection Tables

RS232 (Continued)

Part Number	Description	Data Rate (kbps)	Drivers Per Package	Receivers Per Package	Supply Voltage(s) (V)	ESD HBM (kV)	I _{CC} (max) (mA)	Single Supply	1.8 V or 2.5 V Support	IEC-61000-4-2 Support	Pin/Package	Price*
SN75C3223	3-V to 5-V Multichannel RS-232 Compatible Line Driver/Receiver	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	—	20SOIC, 20SSOP, 20TSSOP	1.45
SN75C3222	3-V to 5.5-V Multichannel RS-232 Compatible Line Driver/Receiver	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	—	20SOIC, 20SSOP, 20TSSOP	1.45
SN75C3221	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	1,000	1	1	3.3 or 5.0	±15	1	Yes	—	—	16SOIC, 16SSOP, 16TSSOP	1.30
SN65C3243	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	1,000	3	5	3.3 or 5.0	±15	1	Yes	—	—	28SOIC, 28SSOP, 28TSSOP	1.80
SN65C3238	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	1,000	5	3	3.3 or 5.0	±15	2	Yes	—	—	28SOIC, 28SSOP, 28TSSOP	1.80
SN65C3232	3-V to 5.5-V Two Channel RS-232 Compatible Line Driver/Receiver	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	—	16SOIC, 16SSOP, 16TSSOP	1.40
SN65C3223	3-V to 5-V Multichannel RS-232 Compatible Line Driver/Receiver	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	—	20SOIC, 20SSOP, 20TSSOP	1.60
SN65C3222	3-V to 5.5-V Multichannel RS-232 Compatible Line Driver/Receiver	1,000	2	2	3.3 or 5.0	±15	1	Yes	—	—	20SOIC, 20SSOP, 20TSSOP	1.60
SN65C3221	3-V to 5.5-V Multichannel RS-232 Line Driver/Receiver	1,000	1	1	3.3 or 5.0	±15	1	Yes	—	—	16SSOP, 16TSSOP	1.40
MAX3227	3-V to 5.5-V Single-Channel RS-232 Line Driver/Receiver with ±15-kV ESD Protection	1,000	1	1	3.3 or 5.0	±15	2	Yes	—	—	16SSOP	1.40
SN75C189A	Quadruple Low-Power Line Receiver	>1,000	0	4	5	—	0.7	Yes	—	—	14PDIP, 14SO, 14SOIC, 14SSOP	0.34
SN75C189	Quadruple Low-Power Line Receiver	>1,000	0	4	5	—	0.7	Yes	—	—	14PDIP, 14SO, 14SOIC	0.34
SN75189A	Quadruple Line Receiver	>1,000	0	4	5	—	26	Yes	—	—	14PDIP, 14SO, 14SOIC	0.22
SN75189	Quadruple Line Receiver	>1,000	0	4	5	—	26	Yes	—	—	14PDIP, 14SO, 14SOIC	0.22
SN75154	Quadruple Differential Line Receiver	>1,000	4	4	5.0 or 12.0	—	35 or 40	Yes	—	—	16PDIP, 16SO, 16SOIC	0.72
MC1489A	Quadruple Line Receiver	>1,000	0	4	5	—	26	Yes	—	—	14PDIP	0.25
MC1489	Quadruple Line Receiver	>1,000	0	4	5	—	26	Yes	—	—	14PDIP	0.25

*Suggested resale price in U.S. dollars in quantities of 1,000.

 Selection Tables
I²C

Part Number	Description	Max Frequency (kHz)	I ² C Address	V _{CC} Range (V)	# of I/Os	Interrupt Output	Reset Input	I/O Type	Pin/Package	Price*
PCF8574	Remote 8-Bit I/O Expander for I ² C-Bus	100	0100 xxx	2.5 to 6.0	8	Yes	No	Push-Pull	16PDIP, 16QFN, 16SOIC, 20TSSOP, 20TVSOP, 20VQFN	1.00
PCF8574A	Remote 8-Bit I/O Expander for I ² C-Bus	100	0111 xxx	2.5 to 6.0	8	Yes	No	Push-Pull	16PDIP, 16SOIC, 20TSSOP, 20TVSOP, 20VQFN	1.00
PCF8575	Remote 16-Bit I ² C and SMBus I/O Expander with Interrupt Output	400	0100 xxx	2.5 to 5.5	16	Yes	No	Push-Pull	24SOIC, 24SSOP, 24SSOP/QSOP, 24TSSOP, 24TVSOP, 24VQFN	1.45
PCF8575C	Remote 16-Bit I ² C and SMBus I/O Expander with Interrupt Output	400	0100 xxx	4.5 to 5.5	16	Yes	No	Open-Drain	24SOIC, 24SSOP, 24SSOP/QSOP, 24TSSOP, 24TVSOP, 24VQFN	1.45
TCA6416A	Low Voltage 16-Bit I ² C and SMBus I/O Expander with Interrupt Output, Reset and Configuration Registers	400	0100 00x	1.65 to 5.5	16	Yes	Yes	Push-Pull	24TSSOP, 24QFN, 24BGA	0.85
TCA7408	Low Voltage 8-Bit I ² C and SMBus I/O Expander with Interrupt Output, Reset, I/O Direction Registers and Programmable Pull-Up/Pull-Down Resistors	400	1000 011	1.65 to 3.6	8	Yes	Yes	Push-Pull	16CSP	TBD
TCA6408A	Low Voltage 8-Bit I ² C and SMBus I/O Expander with Interrupt Output, Reset and Configuration Registers	400	0100 00x	1.65 to 5.5	8	Yes	Yes	Push-Pull	16TSSOP, 16QFN, 16UQFN,	0.75
TCA9509	Level-Translating I ² C/SMBus Repeater	400	—	0.9 to 5.5	—	—	—	Open Drain	8X2QFN	0.65
TCA8418E	I ² C Controlled Keypad Scan IC	1,000	0100 00x	1.65 to 3.6	18	Yes	Yes	Push-Pull	25DSBGA	1.20
TCA6507	Low-Voltage 7-Bit I ² C and SMBus LED Driver with Intensity Control and Shutdown	400	1000 101	1.65 to 3.6	7	—	Yes	Open Drain	14TSSOP, 12X2QFN, 12BGA	0.75

*Suggested resale price in U.S. dollars in quantities of 1,000.

I/O Expanders

Device	Max Frequency (Hz)	I ² C Address	V _{CC} Range (V)	No. of I/Os	Additional Features					I/O Type	
					Low Power	Interrupt	Reset	Configuration Registers	5-V-Tolerant I/O	Push-Pull	Open-Drain
PCA9536	400	1000 001	2.3 to 5.5	4-bit	—	—	—	✓	✓	✓	—
PCA6107	400	0011 xxx	2.3 to 5.5	8-bit	✓	✓	✓	✓	✓	✓	✓
PCA9534	400	0100 xxx	2.3 to 5.5	8-bit	✓	✓	—	✓	✓	✓	—
PCA9534A	400	0111 xxx	2.3 to 5.5	8-bit	✓	✓	—	✓	✓	✓	—
PCA9538	400	1110 0xx	2.3 to 5.5	8-bit	✓	✓	✓	✓	✓	✓	—
PCA9554A	400	0111 xxx	2.3 to 5.5	8-bit	—	✓	—	✓	✓	✓	—
PCA9554	400	0100 xxx	2.3 to 5.5	8-bit	—	✓	—	✓	✓	✓	—
PCA9557	400	0011 xxx	2.3 to 5.5	8-bit	✓	—	✓	✓	✓	✓	✓
PCA9535	400	0100 xxx	2.3 to 5.5	16-bit	✓	✓	—	✓	✓	✓	—
PCA9539	400	1110 1xx	2.3 to 5.5	16-bit	✓	✓	✓	✓	✓	✓	—
PCA9555	400	0100 xxx	2.3 to 5.5	16-bit	—	✓	—	✓	✓	✓	—
PCF8574	100	0100 xxx	2.5 to 6.0	8-bit	—	✓	—	—	—	✓	—
PCF8574A	100	0111 xxx	2.5 to 6.0	8-bit	—	✓	—	—	—	✓	—
PCF8575	400	0100 xxx	2.5 to 5.5	16-bit	—	✓	—	—	—	✓	—
PCF8575C	400	0100 xxx	4.5 to 5.5	16-bit	—	✓	—	—	—	—	✓

→ Selection Tables

Hubs, Buffers and Repeaters

Device	Max Frequency (Hz)	I ² C Address	V _{CC} Range (V)	Channel Width	Enable Pin	EXP Pin	I ² C Bus Capacitance Supported		5-V-Tolerant I/O	I/O Type	
							Master Side (pF)	Each Slave Side (pF)		Push-Pull	Open-Drain
PCA9515A	400	None	2.3 to 5.5	2	✓	—	400	400	✓	—	✓
PCA9517	400	None	0.9 to 5.5	2	✓	—	400	400	✓	—	✓
PCA9518	400	None	3.0 to 3.6	5	✓	✓	400	400	✓	—	✓
P82B715	1,000	None	3.0 to 12.0	2	—	—	—	—	—	—	—
P82B96	400	None	2.0 to 15.0	2	—	—	400	400	✓	—	✓
PCA9548A	400	None	2.3 to 5.5	8	—	—	400	400	✓	—	✓
TCA4311	400	None	2.7 to 5.5	2	—	—	—	—	✓	—	✓

I²C Special Functions

Device	Function	Max Frequency (kHz)	I ² C Address	V _{CC} Range (V)	Low Voltage	Enable Pin	5-V-Tolerant I/O	Push-Pull I/O Type	Open-Drain I/O Type
TCA6507	LED Driver	400	100 0101	1.65 to 3.6	✓	✓	✓	—	✓
PCA9306	Voltage Translator	400	None	0 to 5.5	—	✓	✓	—	—

GPIO Buses

Part Number	Description	Supply Voltage(s) (V)	Driver tpd (ns)	Receiver tpd (ns)	I _{CC} (max) (mA)	Standard	IEEE 488 (GPIOB)	IEEE 896.1	Pin/Package	Price*
SN75160B	Octal General-Purpose Interface Bus Transceiver	5	20	22	110	IEEE 488 (GPIOB)	Yes	—	20PDIP, 20SOIC	1.45
SN75161B	Octal General-Purpose Interface Bus Transceiver	5	20	35	110	IEEE 488 (GPIOB)	Yes	—	20PDIP, 20SOIC	1.45
SN75162B	Octal General-Purpose Interface Bus Transceiver	5	20	35	110	IEEE 488 (GPIOB)	Yes	—	24SOIC	1.45
SN75ALS160	Octal General-Purpose Interface Bus Transceiver	5	20	18	80	IEEE 488 (GPIOB)	Yes	—	20PDIP, 20SOIC	1.75
SN75ALS162	Octal General-Purpose Interface Bus Transceiver	5	20	14	75	IEEE 488 (GPIOB)	Yes	—	24SOIC	4.15
SN75ALS056	Trapezoidal-Waveform Octal Interface Bus Transceiver	5	19	18	75	IEEE 896.1 (BTL)	—	Yes	20PDIP, 20SOIC	4.20
SN75ALS057	Trapezoidal-Waveform Quad Interface Bus Transceiver	5	19	18	40	IEEE 896.1 (BTL)	—	Yes	20PDIP, 20SOIC	4.20
SN75ALS161	Octal General-Purpose Interface Bus Transceiver	5	20	14	75	IEEE 488 (GPIOB)	Yes	—	20PDIP, 20SOIC	5.05

*Suggested resale price in U.S. dollars in quantities of 1,000.

Multiplexers and Switches

Device	Max Frequency (Hz)	I ² C Address	V _{CC} Range (V)	Channel Width	Additional Features				I/O Type	
					Interrupt	Reset	Simultaneously Active Channels	5-V-Tolerant I/O	Push-Pull	Open-drain
PCA9543A	400	1110 0xx	2.3 to 5.5	2-channel	✓	✓	1 to 2	✓	—	✓
PCA9544A	400	1110 xxx	2.3 to 5.5	4-channel	✓	—	1	✓	—	✓
PCA9545A	400	1110 0xx	2.3 to 5.5	4-channel	✓	✓	1 to 4	✓	—	✓
PCA9546A	400	1110 xxx	2.3 to 5.5	4-channel	—	✓	1 to 4	✓	—	✓
PCA9548A	400	1110 xxx	2.3 to 5.5	8-channel	—	✓	1 to 8	✓	—	✓

Peripheral Drivers

Part Number	Description	Peak Output Current (mA)	Output Voltage (max) (V)	Delay Time (typ) (ns)	Input Compatibility	Switching Voltage (max) (V)	Drivers Per Package	GATE	Quad Half - H	Output Clamp Diodes	Pin/Package	Price*
DS3680	Quad Telephone Relay Drivers	100	-60	1,000	CMOS, TTL	-60	4	BUFFER	—	Yes	14PDIP, 14SOIC	0.28
L293	Quadruple Half-H Drivers	2,000	36	800	TTL	36	4	BUFFER	Yes	—	16PDIP	2.20
L293D	Quadruple Half-H Drivers	1,200	36	800	TTL	36	4	BUFFER	Yes	Yes	16PDIP	2.20
SN75372	Dual MOSFET Drivers	500	24	20	TTL	24	2	NAND	—	Yes	8PDIP, 8SO, 8SOIC	1.62
SN75374	Quadruple MOSFET Drivers	500	24	20	TTL	24	4	NAND	—	Yes	16PDIP, 16SOIC	1.98
SN75437A	Quadruple Peripheral Drivers	750	70	1,950	CMOS, TTL	35	4	INVERT	—	Yes	16PDIP	1.58
SN754410	Quadruple Half-H Drivers	2,000	36	800	CMOS, TTL	36	4	BUFFER	Yes	Yes	16PDIP	1.35
SN75451B	Dual Very-High Speed, High-Current Peripheral Drivers	500	30	18	TTL	20	2	AND	—	—	8PDIP, 8SO, 8SOIC	0.36
SN75452B	Dual Very-High Speed, High-Current Peripheral Drivers	500	30	26	TTL	20	2	NAND	—	—	8PDIP, 8SO, 8SOIC	0.36
SN75453B	Dual Very-High Speed, High-Current Peripheral Drivers	500	30	18	TTL	20	2	OR	—	—	8PDIP, 8SO, 8SOIC	0.36
SN75454B	Dual Very-High Speed, High-Current Peripheral Drivers	500	30	27	TTL	20	2	NOR	—	—	8PDIP, 8SO, 8SOIC	0.36
SN75462	Dual High-Voltage, High-Current Peripheral Drivers	500	35	45	TTL	30	2	NAND	—	—	8PDIP, 8SOIC	0.68
SN75463	Dual High-Voltage, High-Current Peripheral Drivers	500	35	30	TTL	30	2	OR	—	—	8PDIP	0.97
SN75468	High-Voltage, High-Current Darlington Transistor Arrays	500	100	250	CMOS, TTL	50	7	INVERT	—	Yes	16PDIP, 16SO, 16SOIC	0.45
SN75469	High-Voltage, High-Current Darlington Transistor Arrays	500	100	250	CMOS	50	7	INVERT	—	Yes	16PDIP, 16SOIC	0.36
SN75471	Dual High-Voltage, High-Current Peripheral Drivers	500	70	30	TTL	55	2	AND	—	—	8PDIP, 8SOIC	0.43
SN75472	Dual High-Voltage, High-Current Peripheral Drivers	500	70	45	TTL	55	2	NAND	—	—	8PDIP, 8SOIC	0.36
SN75477	Dual Peripheral Drivers	500	100	200	CMOS, TTL	55	2	NAND	—	Yes	8PDIP, 8SOIC	0.36
SN75478	Dual Peripheral Drivers	500	100	200	CMOS, TTL	55	2	OR	—	Yes	8PDIP	0.63
TPL9201	8-Channel Relay Driver with Integrated 5 V LDO and Zero-Volt Detection	150	16.5	10, 80	CMOS	16.5	8	INVERT	—	Yes	20HTSSOP, 20PDIP	0.50
TPL9202	8-Channel Relay Driver with Integrated 5 V LDO and Brown-Out Detection	150	16.5	10, 80	CMOS	16.5	8	INVERT	—	Yes	20HTSSOP	0.50
ULN2002A	High-Voltage, High-Current Darlington Transistor Arrays	500	50	250	CMOS	50	7	INVERT	—	Yes	16PDIP	0.21
ULN2003A	High-Voltage, High-Current Darlington Transistor Arrays	500	50	250	CMOS, TTL	50	7	INVERT	—	Yes	16PDIP, 16SO, 16SOIC, 16TSSOP	0.21
ULN2003AI	High-Voltage, High-Current Darlington Transistor Array	500	50	250	CMOS, TTL	50	7	INVERT	—	Yes	16PDIP, 16SOIC, 16TSSOP	0.24
ULN2004A	High-Voltage, High-Current Darlington Transistor Array	500	50	250	CMOS	50	7	INVERT	—	Yes	16PDIP, 16SO, 16SOIC	0.21
ULN2004AI	High-Voltage, High-Current Darlington Transistor Array	500	50	250	CMOS, TTL	50	7	INVERT	—	Yes	16PDIP, 16SO, 16SOIC	0.24
ULN2803A	Darlington Transistor Array	500	50	130	CMOS, TTL	50	8	INVERT	—	Yes	18PDIP, 18SOIC	0.45

*Suggested resale price in U.S. dollars in quantities of 1,000.

→ Overview

TI delivers a broad portfolio of data converters, touch screen controllers, analog front ends, audio converters and CODECs. Featuring high-performance 8-bit to 18-bit SAR ADCs, 16-bit to 24-bit delta-sigma ADCs, 10-bit to 16-bit pipeline ADCs, and 8-bit to 20-bit DACs, TI has a data converter for all your analog and mixed-signal applications.

Analog-to-Digital Data Converters

TI's A/D data converters convert an input analog voltage or current to a digital value proportional to the magnitude of the analog voltage or current. The devices have efficient power management and power monitoring along with a power-down feature, making it ideal for battery operated systems. TI's A/D data converters have a wide analog (2.2 V to 5.5 V) and digital (1.65 V to 5.5 V) supply range as well as sampling rates up to 2,000 kSPS and are perfect for many industrial and commercial uses.

Digital-to-Analog Data Converters

Texas Instruments' Digital-to-Analog converter (DAC) portfolio includes high accuracy (± 1 LSB INL), 2 or 4 quadrant capable Multiplying Digital to Analog Converters (MDACs) that provide high performance solutions. Choose your output buffer to meet your application needs, i.e., low offset, high-voltage, high-speed (fast slew rate).

14-/12-/10-/8-Bit, 2-Ch, 2MSPS, Single-Ended, Pseudo-Differential; In/Out, microPower SAR ADCs ADS7945, ADS7946, ADS7947, ADS7948, ADS7949

Get samples, datasheets and EVMs at: www.ti.com/sc/device/PARTnumber (Replace **PARTnumber** with **ADS7945, ADS7946, ADS7947, ADS7948, ADS7949**)

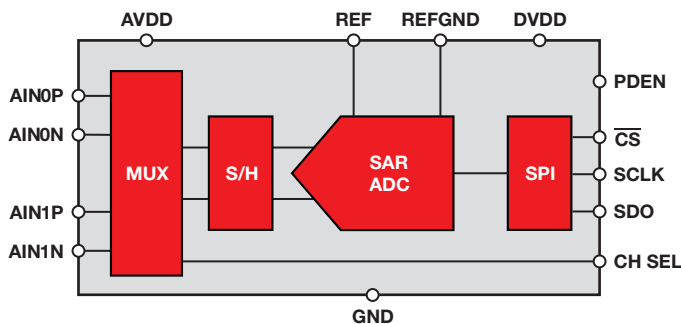
Key Features

- ± 1 LSB offset and gain drift (max)
- 72 dB SNR (12-bit, min)
- True 12-bit performance
- Dedicated power-down mode enable pin
- Auto power-down scales to 7.7 μ W/kSPS at 3 V
- Pseudo-differential inputs
- 2.8 V to 5.25 V supply range
- 2.5 V to 5.25 V reference range
- 1.8 V to 5 V logic family compatible
- SPI interface
- 3 mm x 3 mm QFN package

Applications

- Optical networking
- Instrumentation and control systems
- X-Y positioning
- Portable systems
- Battery monitoring
- High speed data acquisition

The ADS7945/6/7/8/9 dual-channel, low-power, 8-/10-/12-/14-bit, 2-MSPS ADCs offer outstanding performance. The wide reference and supply range enables these devices to be used in both low-cost 5 V applications in addition to low-power 3.3 V applications. As a result of the high-precision gain and offset stability of the devices, there is no need to calibrate gain and offset over temperature, which reduces system complexity and development time. Lastly, the pseudo-differential inputs reduce the need for common mode DC signal conditioning circuitry, which lowers system cost and complexity and increases system reliability.



ADS7947/8/9 functional block diagram

➔ Analog-to-Digital Converters – SAR ADCs

Ultra-Small, Low-Power, SPI-Compatible, 16-Bit Analog-to-Digital Converter

ADS1118

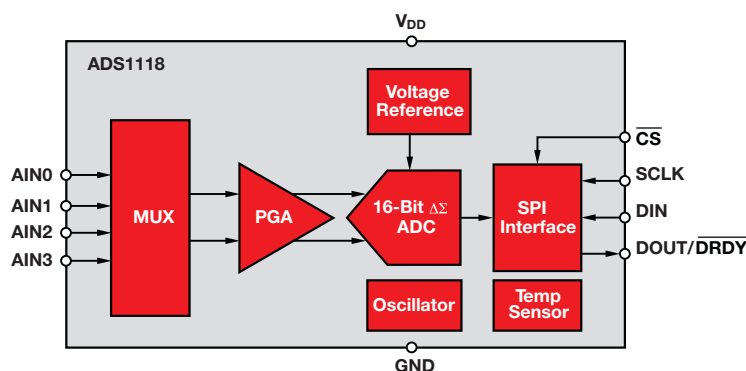


Get samples and datasheets at: www.ti.com/sc/device/ADS1118

Key Features

- Ultra-small QFN package:
2 mm × 1.5 mm × 0.4 mm
- Wide supply range: 2.0 V to 5.5 V
- Low current consumption:
 - Continuous mode: 150 microA
 - Single-shot mode: auto shutdown
- Programmable data rate:
8 SPS to 860 SPS
- Internal low-drift
- Voltage reference
- Internal oscillator
- Internal PGA
- Four single-ended or two differential inputs
- Internal temperature sensor

The ADS1118 is a precision analog-to-digital converter (ADC) with 16 bits of resolution offered in an ultra-small, leadless QFN-10 package or an MSOP-10 package. The ADS1118 is designed with precision, power and ease of implementation in mind. It features an onboard reference and oscillator. Data is transferred via an SPI-compatible serial interface. The ADS1118 operates from a single power supply ranging from 2 V to 5.5 V.



ADS1118 functional block diagram.

Applications

- Portable instrumentation
- Consumer goods
- Battery monitoring
- Temperature measurement
- Factory automation/process controls

ADS1115 Product Family

Device	Resolution (Bits)	Maximum Sample Rate (SPS)	Comparator	PGA	Input Channels (Differential/Single Ended)
ADS1113	16	860	No	No	1/1
ADS1114	16	860	Yes	Yes	1/1
ADS1115	16	860	Yes	Yes	2/4
ADS1013	12	3300	No	No	1/1
ADS1014	12	3300	Yes	Yes	1/1
ADS1015	12	3300	Yes	Yes	2/4

Data Converters

➔ Analog-to-Digital Converters – SAR ADCs

12-Bit Four-Channel MUX Input, microPower SAR ADC with Intelligent System Power Control ADS7924

Get samples, datasheets and EVMs at: www.ti.com/sc/device/ADS7924

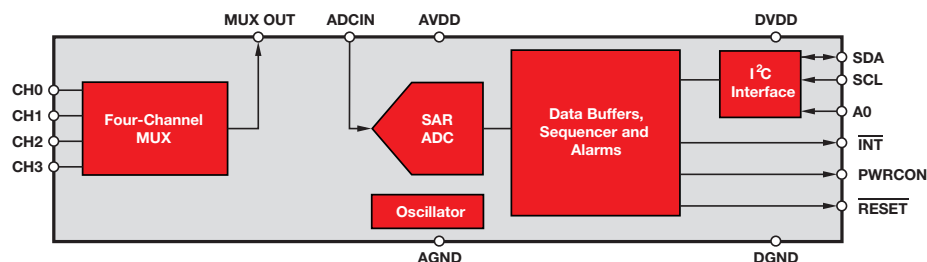
Key Features

- microPower monitoring:
 - Four-channel scanning 5 μ W/10 ms:
 - <1 μ A of power-down current
- Programmable interrupt pin controls shutdown/wakeup
- Auto power-down control
PWRCON pin allows shutdown of external op amp
- Wide supply range:
 - Analog supply: 2.2 V to 5.5 V
 - Digital supply: 1.65 V to 5.5 V
- Small footprint: 3 mm \times 3 mm QFN

Applications

- Portable and battery-powered systems
 - Medical
 - Remote sensor signal monitoring
- Energy harvesting

The ADS7924 features a low-power ADC core, support for low-supply operation and a flexible measurement sequencer that essentially eliminates power consumption between conversions. Additionally, through the use of dedicated data registers and onboard-programmable digital threshold comparators, each input can trigger an alarm condition, resulting in an interrupt generated to the host microcontroller. The combination of data buffering, programmable threshold comparisons and alarm interrupts minimizes the time and power expended by the host microcontroller dedicated to supervising the ADS7924. The result is a complete monitoring system for power-critical applications such as battery-powered equipment and energy-harvesting systems.



ADS7924 functional block diagram.

Data Converters

➔ Analog-to-Digital Converters – SAR ADCs

12-Bit 1-MSPS 16-/12-/8-/4-Channel microPower ADCs

ADS7xx

Get samples, datasheets and app reports at: www.ti.com/sc/device/PARTnumber (Replace **PARTnumber** with **ADS7950**, **ADS7951**, **ADS7952** or **ADS7953**)

Key Features

- 1-MHz sample rate serial device
- Zero latency
- 20-MHz serial interface
- Two software-selectable unipolar, input ranges: 0 V to 2.5 V and 0 V to 5 V
- Auto and manual modes for channel selection
- Input bandwidth: 47 MHz at 3 dB
- Analog supply range: 2.7 V to 5.25 V
- I/O supply range: 1.7 V to 5.25 V
- Four individually configurable GPIOs for TSSOP package devices; one GPIO for QFN devices
- Typical power dissipation: 14.5 mW (+VA = 5 V, +VBD = 3 V) at 1 MSPS
- 38-, 30-pin TSSOP and 32-, 24-pin QFN packages

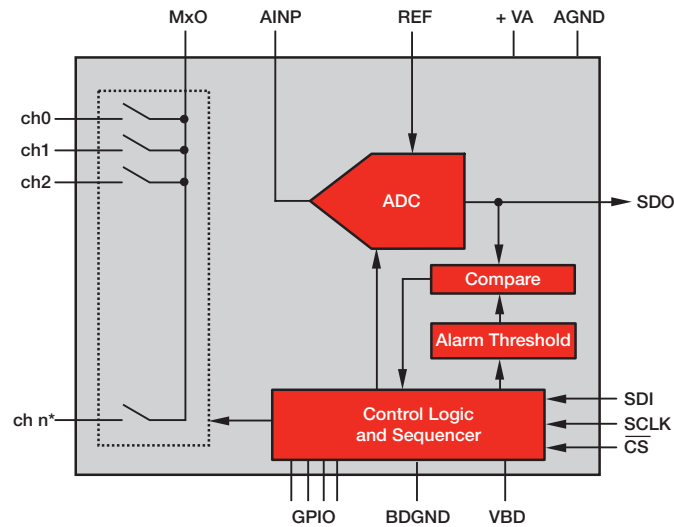
The ADS79xx is a 12-/10-/8-bit multichannel analog-to-digital converter family. The devices include a capacitor based SAR ADC with inherent sample and hold. The devices accept a wide analog supply range from 2.7 V to 5.25 V. Very low power consumption makes these devices suitable for battery-powered and isolated power supply applications. A wide 1.7-V to 5.25-V I/O supply range facilitates a glueless interface with the most commonly used CMOS digital hosts. The devices offer an attractive power-down feature. This is extremely useful for power saving when the device is operated at lower conversion speeds.

Micropower Multichannel ADS79xx Family

Number of Channels	Resolution		
	12 Bit	10 Bit	8 Bit
16	ADS7953	ADS7957	ADS7961
12	ADS7952	ADS7956	ADS7960
8	ADS7951	ADS7955	ADS7959
4	ADS7950	ADS7954	ADS7958

Applications

- IPLC/IPC
- Battery-powered systems
- Medical instrumentation
- Digital power supplies
- Touch screen controllers
- High-speed data-acquisition systems
- High-speed closed-loop systems



Note: n* is number of channels (16, 12, eight or four) depending on the device from the ADS79xx family.

Note: A number of GPIOs are available in TSSOP package devices only. QFN package devices offer only one GPIO.

ADS79xx block diagram.

Data Converters

Device	Res. (Bits)	Sample Rate (kSPS)	Power (mW)	Number of Input Channels	Interface	Input Voltage (V)	V _{REF}	Linearity (%)	Package(s)	Price*
ADS7830	8	75	0.675	8 SE/4 Diff	Serial, I ² C	V _{REF}	Int/Ext	0.19	TSSOP-16	1.40
ADS7868	8	200	0.25	1 SE, 1 P _{Diff}	Serial, SPI	V _{DD} (1.2 V to 3.6 V)	Ext	0.1	SOT23-6	0.80
ADS7827	8	250	0.6	1 P _{Diff}	Serial, SPI	V _{REF}	Ext	0.2	QFN-8	1.00
ADS7958	8	1,000	12.5	4 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.112	TSSOP-30	1.25
ADS7959	8	1,000	12.5	8 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.112	TSSOP-30	1.65
ADS7960	8	1,000	12.5	12 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.112	TSSOP-38	2.05
ADS7961	8	1,000	12.5	16 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.112	TSSOP-38	2.45
ADS7949	8	2,000	7	2 P _{Diff}	Serial, SPI	V _{REF}	Ext	0.000234375	3x3 QFN-16	0.99
ADS7826	10	200	0.6	1 P _{Diff}	Serial, SPI	V _{REF}	Ext	0.0048	QFN-8	1.25
ADS7867	10	200	0.25	1 SE, 1 P _{Diff}	Serial, SPI	V _{DD} (1.2 V to 3.6 V)	Ext	0.05	SOT23-6	1.40
ADS7954	10	1,000	12.5	4 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.078	TSSOP-30	2.10
ADS7955	10	1,000	12.5	8 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.078	TSSOP-30	2.70
ADS7956	10	1,000	12.5	12 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.078	TSSOP-38	3.30
ADS7957	10	1,000	12.5	16 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.078	TSSOP-38	3.90
ADS7948	10	2,000	7	2 P _{Diff}	Serial, SPI	V _{REF}	Ext	0.000146484	3 x 3 QFN-16	1.70
ADS1000	12	0.128	0.3	1 SE/1 Diff	Serial, I ² C	PGA (1-8), V _{DD}	Ext	0.0125	SOT23-6	0.65
ADS1013	12	3.3	0.3	1 SE/1 Diff	Serial, I ² C	±2.048	Int	0.0244	MSOP-10, x2QFN-10	0.90
ADS1014	12	3.3	0.3	1 SE/1 Diff	Serial, I ² C	PGA (2/3-16), V _{DD}	Int	0.0244	MSOP-10, x2QFN-10	1.00
ADS1015	12	3.3	0.3	4 SE/2 Diff	Serial, I ² C	PGA (2/3-16), V _{DD}	Int	0.0244	MSOP-10, x2QFN-10	1.10
ADS7823	12	50	0.75	1 SE	Serial, I ² C	V _{REF}	Ext	0.024	VSSOP-8	2.85
ADS7828	12	50	0.675	8 SE/4 Diff	Serial, I ² C	V _{REF}	Int/Ext	0.024	TSSOP-16	3.35
ADS7924	12	100	0.5	4 SE	Serial, I ² C	V _{REF}	Ext	0.122	3 x 3 QFN-16	1.25
ADS7817	12	200	2.3	1 Diff	Serial, SPI	±V _{REF} at +V _{REF}	Ext	0.024	SOIC-8, VSSOP-8	1.95
ADS7816	12	200	1.9	1 P _{Diff}	Serial, SPI	V _{REF}	Ext	0.024	PDIP, SOIC, VSSOP-8	1.95
ADS7822	12	200	0.6	1 P _{Diff}	Serial, SPI	V _{REF}	Ext	0.018	PDIP, SOIC, VSSOP-8	1.55
ADS7866	12	200	0.25	1 SE, 1 P _{Diff}	Serial, SPI	V _{DD} (1.2 V to 3.6 V)	Ext	0.024	SOT23-6	1.85
ADS7841	12	200	0.84	4 SE/2 Diff	Serial, SPI	V _{REF} , ±V _{REF} at V _{REF}	Ext	0.024	SSOP-16	2.50
TLC2574	12	200	29	4 SE	Serial, SPI	±10	Ext	0.024	SOIC-20, TSSOP-20	5.30
ADS7844	12	200	0.84	8 SE/4 Diff	Serial, SPI	V _{REF} , ±V _{REF} at V _{REF}	Ext	0.024	SSOP-20	2.90
TLC2578	12	200	29	8 SE	Serial, SPI	±10	Ext	0.024	SOIC-24, TSSOP-24	5.80
ADS7818	12	500	11	1 P _{Diff}	Serial, SPI	5	Int	0.024	PDIP-8, VSSOP-8	2.50
ADS7835	12	500	17.5	1 SE	Serial, SPI	±2.5	Int	0.024	VSSOP-8	2.75
ADS7861	12	500	25	2 x 2 Diff	Serial, SPI	±2.5 at +2.5	Int/Ext	0.024	SSOP-24, QFN-32	4.05
ADS7852	12	500	13	8 SE	P12	5	Int/Ext	0.024	TQFP-32	3.40
ADS7950	12	1,000	12.5	4 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.024	TSSOP-30	2.50
ADS8634	12	1,000	22.5	4 P _{Diff}	Serial, SPI	+5, 10, ±5, ±10, ±12	Int/Ext	0.021	4 x 4 QFN-24	2.70
ADS7951	12	1,000	12.5	8 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.024	TSSOP-30	3.30
ADS8638	12	1,000	22.5	8 P _{Diff}	Serial, SPI	+5, 10, ±2.5, ±5, ±10	Int/Ext	0.021	4 x 4 QFN-25	3.70

*Suggested resale price in U.S. dollars in quantities of 1,000.

Data Converters (Continued)

Device	Res. (Bits)	Sample Rate (kSPS)	Power (mW)	Number of Input Channels	Interface	Input Voltage (V)	V _{REF}	Linearity (%)	Package(s)	Price*
ADS7945	14	2,500	10	2 Diff	Serial, SPI	V _{REF}	Ext	TBD	3 x 3 QFN-16	2.15
ADS7946	14	2,500	10	2 P _{Diff}	Serial, SPI	V _{REF}	Ext	TBD	3 x 3 QFN-16	2.05
ADS7947	12	2,000	7	2 P _{Diff}	Serial, SPI	V _{REF}	Ext	0.0073	3 x 3 QFN-16	1.95
ADS7948	10	2,000	7	2 P _{Diff}	Serial, SPI	V _{REF}	Ext	0.0146	3 x 3 QFN-16	1.70
ADS7949	8	2,000	7	2 P _{Diff}	Serial, SPI	V _{REF}	Ext	0.0234	3 x 3 QFN-16	0.99
ADS7952	12	1,000	12.5	12 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.024	TSSOP-38	4.10
ADS7953	12	1,000	12.5	16 SE	Serial, SPI	V _{REF} (2.5 V)	Ext	0.024	TSSOP-38	4.90
ADS7947	12	2,000	7	2 P _{Diff}	Serial, SPI	V _{REF}	Ext	7.32422E-05	3 x 3 QFN-16	1.95
ADS7871	14	40	6	8 SE/4 Diff	Serial, SPI	PGA (1, 2, 4, 8, 10, 16, 20)	Int	0.03	SSOP-28	5.00
TLC3544	14	200	20	4 SE	Serial, SPI	4	Int/Ext	0.006	SOIC-20, TSSOP-20	6.00
TLC3548	14	200	20	8 SE	Serial, SPI	4	Int/Ext	0.006	SOIC-24, TSSOP-24	6.40
ADS1013	12	3.3	0.3	1 SE/1 Diff	Serial, I ² C	±2.048	Int	0.0244	MSOP-10, x2QFN-10	0.90
ADS1014	12	3.3	0.3	1 SE/1 Diff	Serial, I ² C	PGA (2/3-16), V _{DD}	Int	0.0244	MSOP-10, x2QFN-10	1.00
ADS1015	12	3.3	0.3	4 SE/2 Diff	Serial, I ² C	PGA (2/3-16), V _{DD}	Int	0.0244	MSOP-10, x2QFN-10	1.10
ADS1100	16	0.128	0.3	1 SE/1 Diff	Serial, I ² C	PGA (1-8), V _{DD}	Ext	0.0125	SOT23-6	1.80
ADS1110	16	0.24	0.7	1 SE/1 Diff	Serial, I ² C	PGA (1-8), 2.048	Int	0.01	SOT23-6	1.95
ADS1112	16	0.24	0.7	3 SE/2 Diff	Serial, I ² C	PGA (1-8), 2.048	Int	0.01	MSOP-10, SON-10	2.65
ADS1113	16	0.86	0.3	1 SE/1 Diff	Serial, I ² C	±2.048	Int	0.0015	MSOP-10, x2QFN-10	1.85
ADS1114	16	0.86	0.3	1 SE/1 Diff	Serial, I ² C	PGA (2/3-16), V _{DD}	Int	0.0015	MSOP-10, x2QFN-10	2.00
ADS1118	16	0.86	0.3	4 SE/2 Diff	Serial, SPI	PGA (2/3-16), V _{DD}	Int	0.0015	MSOP-10, x2QFN-10	2.25
ADS1115	16	0.86	0.3	4 SE/2 Diff	Serial, I ² C	PGA (2/3-16), V _{DD}	Int	0.0015	MSOP-10, x2QFN-10	2.25
ADS8331	16	500	10.6	4 SE, 4 P _{Diff}	Serial, SPI	V _{REF} (2.5)	Int/Ext	0.0031	4 x 4 QFN-24	13.50
ADS8332	16	500	10.6	8 SE, 8 P _{Diff}	Serial, SPI	V _{REF} (2.5)	Int/Ext	0.0031	4 x 4 QFN-24	15.00
ADS8329	16	1,000	20	1 SE, 1 P _{Diff}	Serial, SPI	V _{REF} (4.2 V at 5 V, 2.5 V at 2.7 V Supply)	Ext	0.0026	TSSOP-16	11.25
ADS8330	16	1,000	15.5	2 SE, 2 P _{Diff}	Serial, SPI	V _{REF} (5 V at 5 V, 2.5 V at 2.7 V Supply)	Ext	0.0026	TSSOP-16, 4 x 4 QFN-16	11.85
ADS1131	18	0.08	1.6	1 SE/1 Diff	Serial	0.02	Ext	0.0008	TSSOP-16	1.95
ADS1230	20	0.08	3	1 SE/1 Diff	Serial	0.02	Ext	0.003	TSSOP-16	2.50
ADS1231	20	0.08	1.6	1 SE/1 Diff	Serial	0.02	Ext	0.003	TSSOP-16	2.10
ADS1225	24	0.08	0.5	1 Diff	Serial	5	Ext	0.0015	QFN-16	2.75
ADS1226	24	0.08	0.5	2 Diff	Serial	5	Ext	0.0015	QFN-16	2.95
ADS1222	24	0.24	0.5	2 SE/2 Diff	Serial	5	Ext	0.0015	TSSOP-14	2.95
ADS1224	24	0.24	0.5	4 SE/4 Diff	Serial	5	Ext	0.0015	TSSOP-20	3.25

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