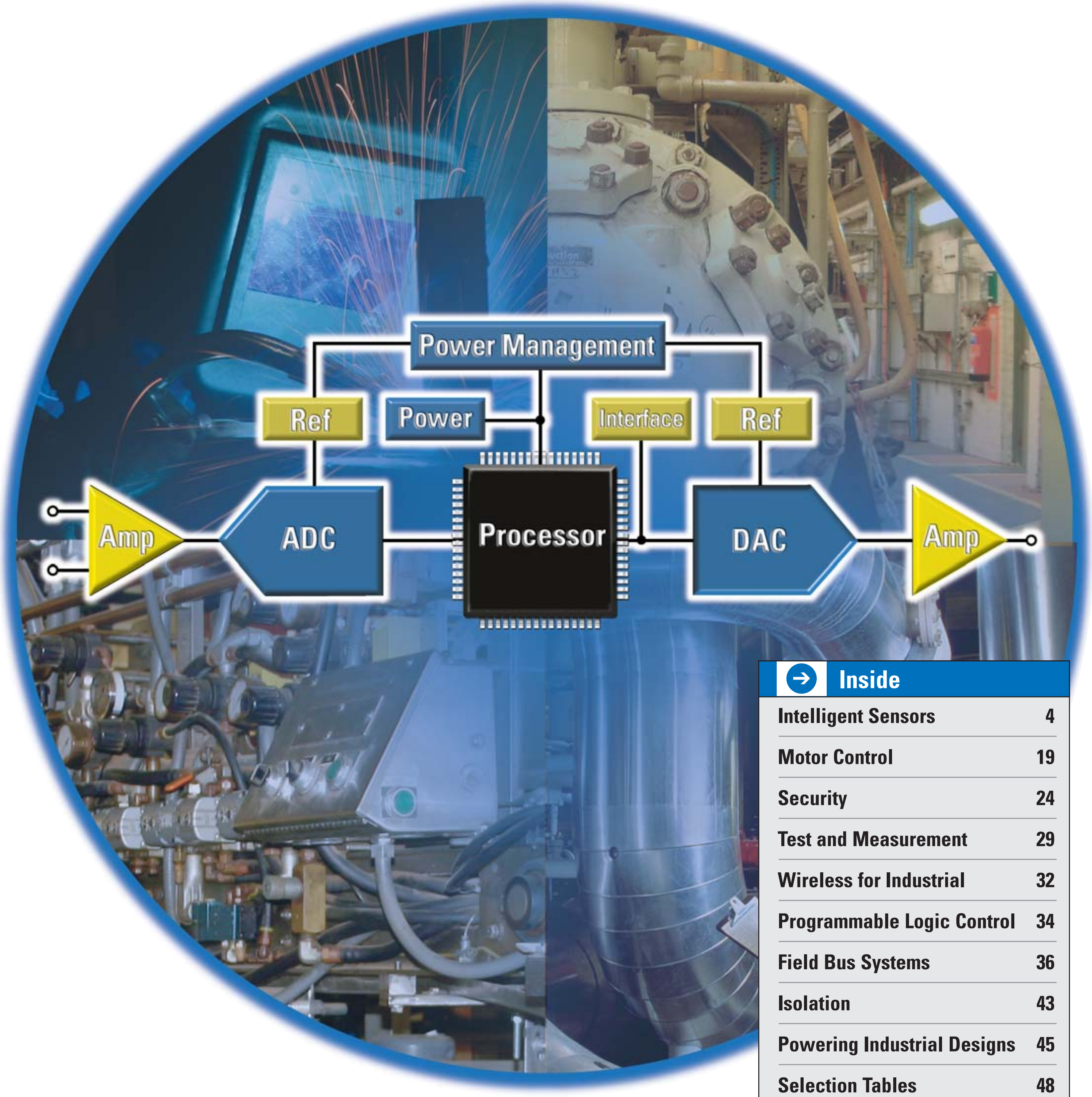
Industrial Solutions Guide

Amplifiers, Data Converters, Digital Signal Processors, Digital Temperature Sensors, Interface, Microcontrollers, Power Controllers, Power Management

1Q 2006



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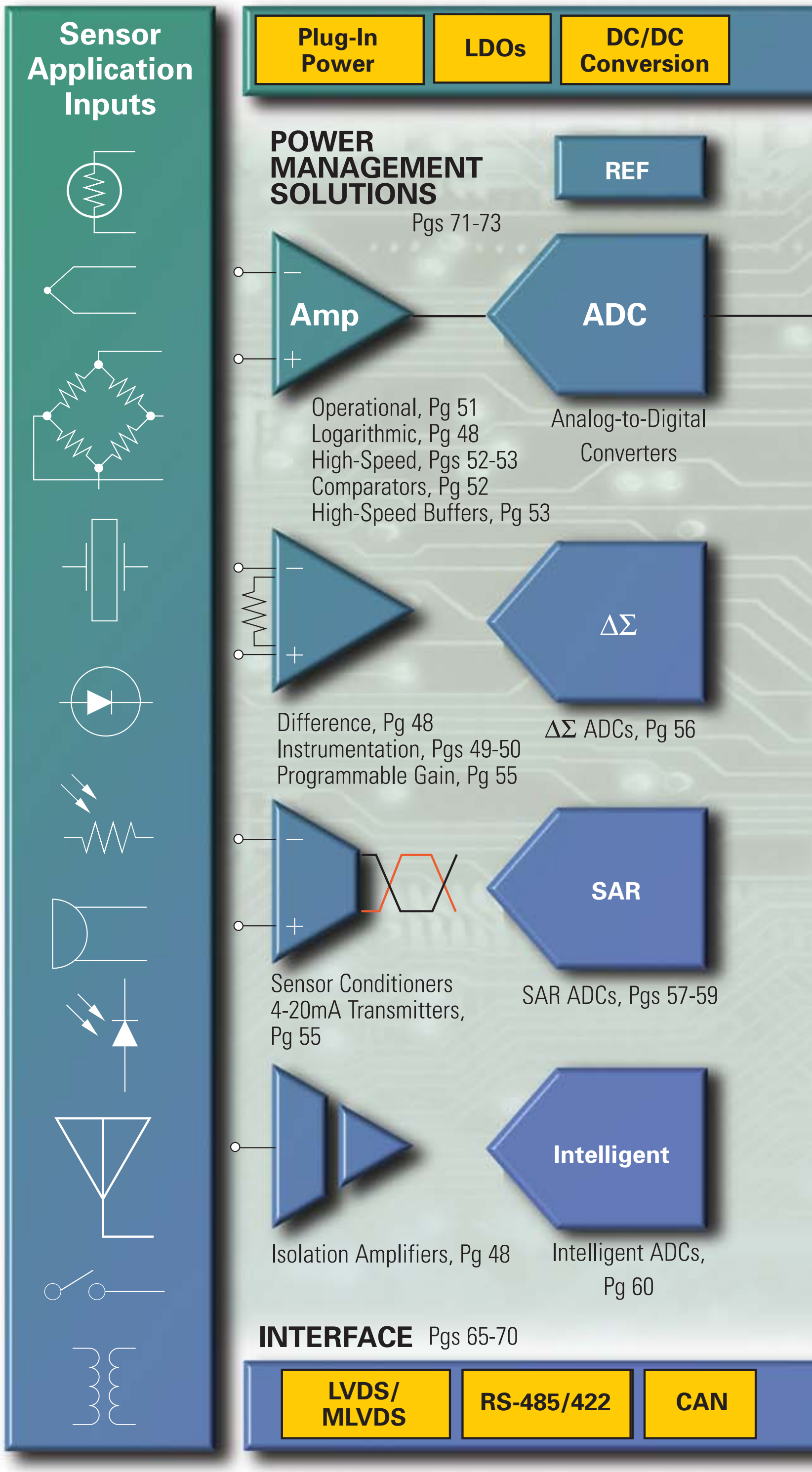
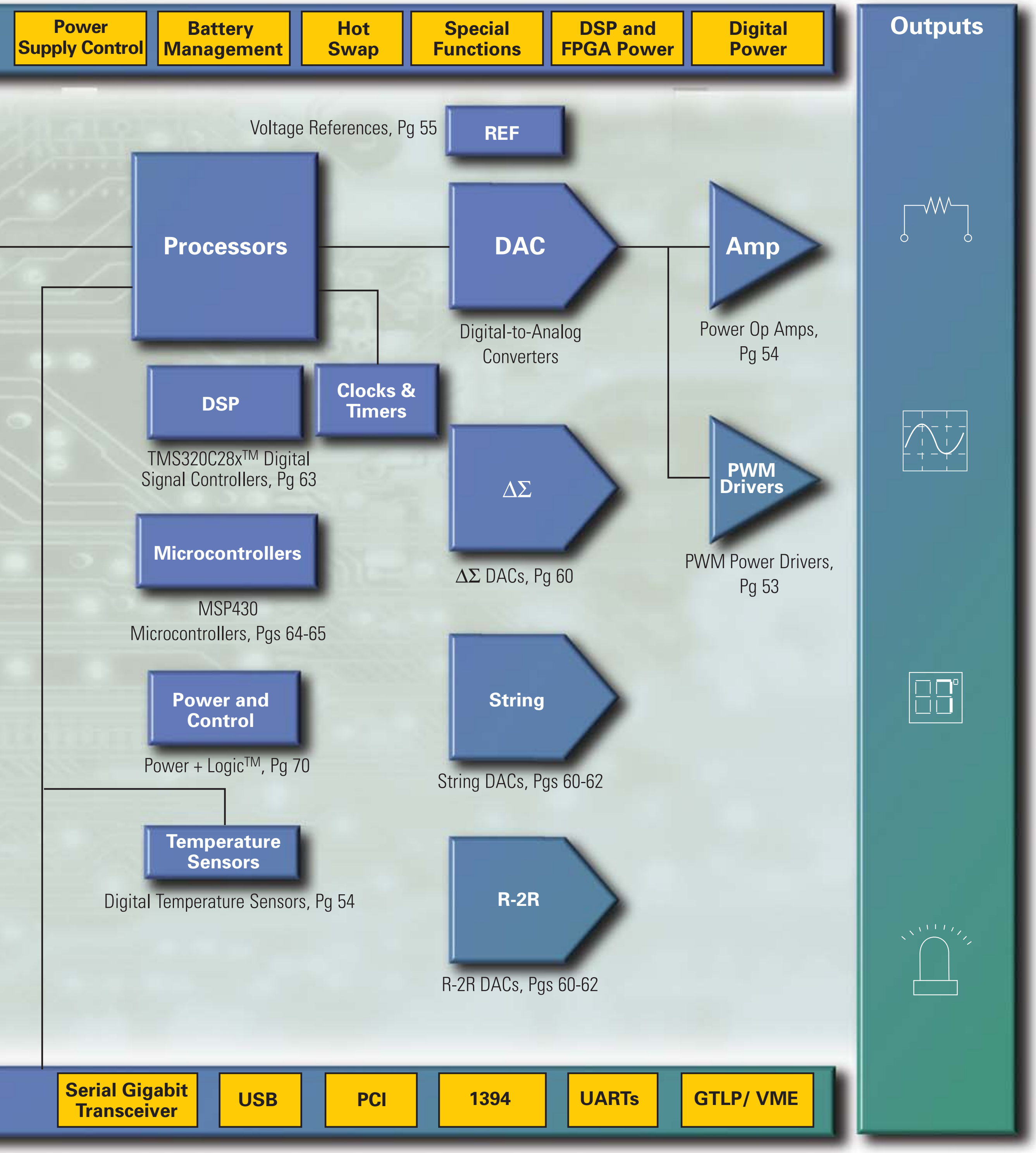


Complete Industrial Solutions from TI



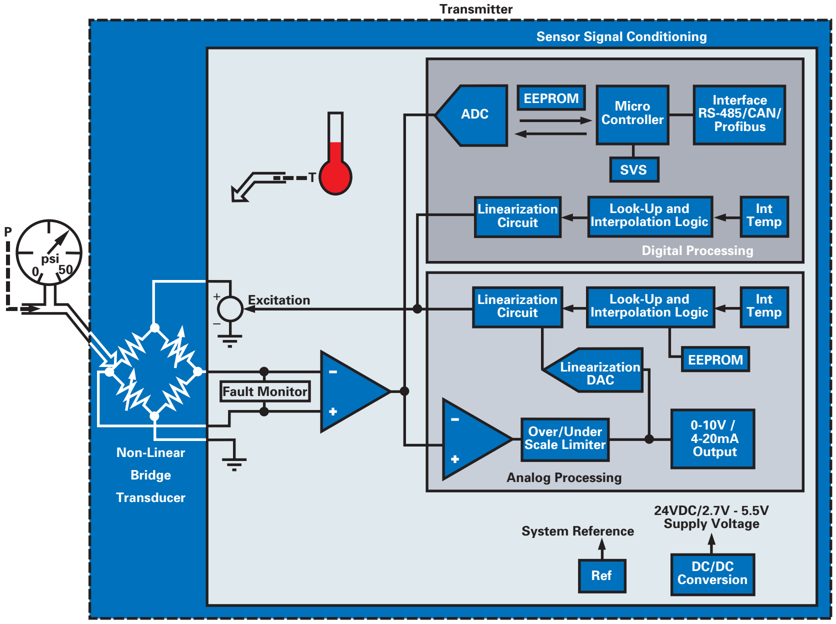
Pressure

Pressure sensors convert a physical value—weight, tire pressure, level, force, and flow—into a differential signal in the mV/V range and are referred to as metal thick-film, ceramic or piezo-resistive. The majority of designers use the cost-effective piezo-sensors (25mbar – 25bar). However, these are very nonlinear, temperature dependent and have large offset and offset drift. Plus, they require attention to electronic calibration and compensation.

The diagram (at right) shows the functional block diagram of a pressure signal conditioning system.

Sensor Signal Conditioning — performs all necessary functions to calibrate, compensate for temperature variance, scale, and linearize the sensor signal.

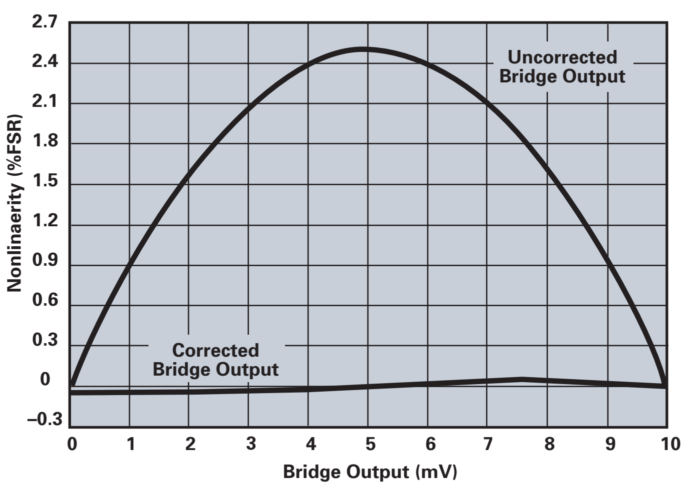
Analog/Digital Processing — there are two ways to convert and linearize the sensor signal. The analog technique results in an analog solution and provides an analog output. This technique is inexpensive and fast, but limited to a maximum of 11- to 16-bit resolution. Digital is more precise, up to 24 bits, and provides a digital output at moderate speed.



Pressure system functional block diagram.

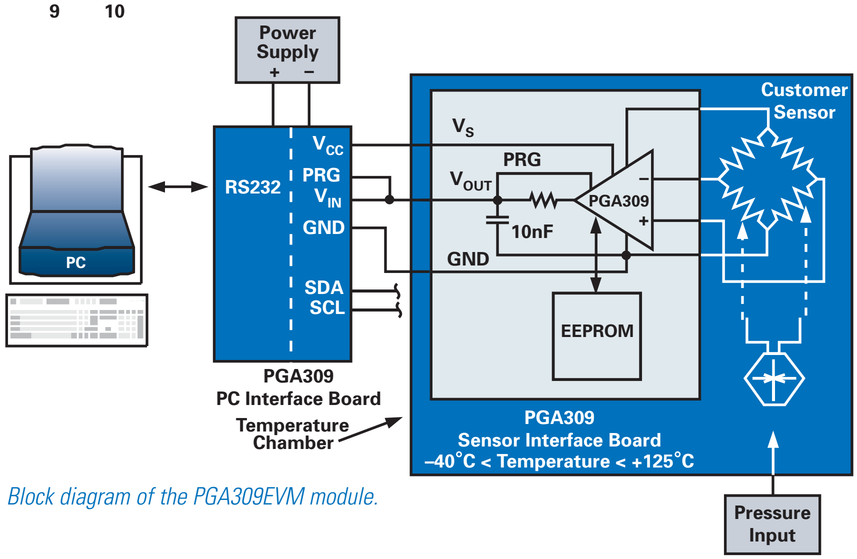
Calibration parameters are stored in an external nonvolatile memory to eliminate manual trimming and achieve long-term stability. An evaluation module, PGA309EVM (see below) includes software and calibration sheet for easy evaluation of your sensor + PGA309 combination.

The highly integrated, CMOS PGA309, available in TSSOP-16, is tailored for bridge pressure sensors and adds to TI's portfolio of highly flexible, lowest noise amplifier and instrumentation amplifier solutions that also include the OPAx227, OPAx132, OPA335, OPA735, INA326, INA327, INA118 and INA122.



PGA309 bridge pressure nonlinearity correction.

The bridge excitation linearization circuit is optimized for bridge pressure nonlinearities with a parabolic shape (see above). The linearization circuit is digitally programmable, but the pure analog signal conditioning side is handled by the same process as in TI's well-known 4-20mA transmitters, such as XTR105, XTR106 or XTR108. The heart of the PGA309 is a precision, low-drift programmable gain instrumentation amplifier using an auto-zero technique and includes a programmable fault monitor and over/underscale limiter. It also offers a digital temperature compensation circuit. Calibration is carried out either via a one-wire digital serial interface or through a two-wire industry-standard connection.



Block diagram of the PGA309EVM module.

Complete Voltage-Output, Programmable Bridge Sensor Signal Conditioner

PGA309

Get samples, datasheets, EVMs and app reports at:

www.ti.com/sc/device/PGA309

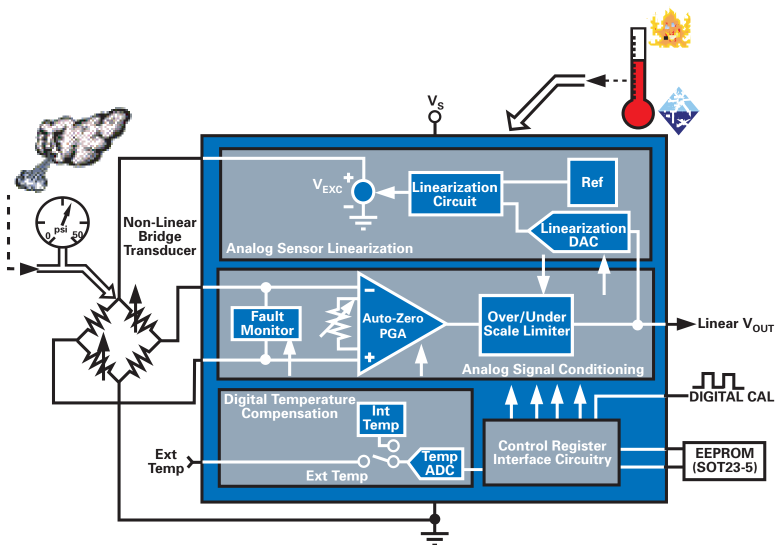
Real-world sensors have span and offset errors, ever changing over temperature. In addition, many bridge pressure sensors have a nonlinear output with applied pressure. The sensor conditioner, PGA309 is an ideal choice in combination with low-cost piezo resistive or ceramic thin-film pressure sensors.

Key Features

- Ratiometric or absolute voltage output
- Digitally calibrated via single-wire or two-wire interface
- Eliminates potentiometer and trimming
- Low, time-stable total adjusted error
- +2.7V to +5.5V operation
- Packaging: small TSSOP-16

Applications

- Bridge sensors
- Remote 4-20mA transmitters
- Strain, load, weight scales
- Automotive sensors



PGA309 functional block diagram.

Zero-Drift, Low Offset, Single-Supply Op Amps

OPA334, OPA335

Get samples, datasheets, EVMs and app reports at:

www.ti.com/sc/device/OPA334, www.ti.com/sc/device/OPA335

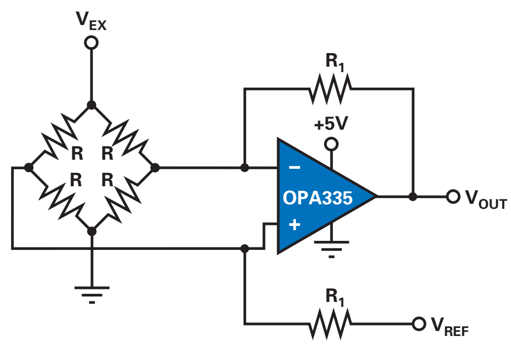
The OPA334 and OPA335 CMOS op amps use auto-zeroing techniques to simultaneously provide very low offset voltage and near-zero drift over time and temperature. These high-precision amps offer high input impedance and rail-to-rail output swing. New, OPA333 available 1Q 2006.

Key Features

- Low offset voltage: 5µV (max)
- Zero drift: 0.05µV/°C (max)
- Quiescent current: 285µA
- Packaging: SOT23-5, SOT23-6, SO-8, MSOP-10 (dual)

Applications

- Transducer applications
- Electronic scales
- Temperature measurement



OPA335 –5V supply bridge amplifier.

Pressure

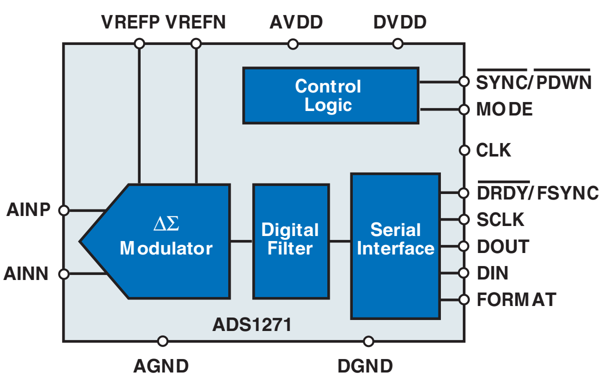
24-Bit, ΔΣ ADC with Excellent AC and DC Performance
ADS1271

Get samples, datasheets, EVMs and app reports at:
www.ti.com/sc/device/ADS1271

The ADS1271 is a 24-bit, delta-sigma ADC with up to 105kSPS data rate. It offers the unique combination of excellent DC accuracy and outstanding AC performance. The high-order, chopper-stabilized modulator achieves very low drift with low in-band noise. The onboard decimation filter suppresses modulator and signal out-of-band noise. The ADS1271 provides a usable signal bandwidth up to 90% of the Nyquist rate with only 0.005dB of ripple.

Key Features
- AC performance:
  - SNR: 109dB
  - Bandwidth: 50kHz
  - THD: –105dB
- DC accuracy:
  - Offset drift: 1.8µV/°C
  - Gain drift: 2ppm/°C
- Only 35mW dissipation in low-power mode

Applications
- Ideal for vibration/modal analysis, acoustics, dynamic strain gages and pressure sensors



ADS1271 block diagram.

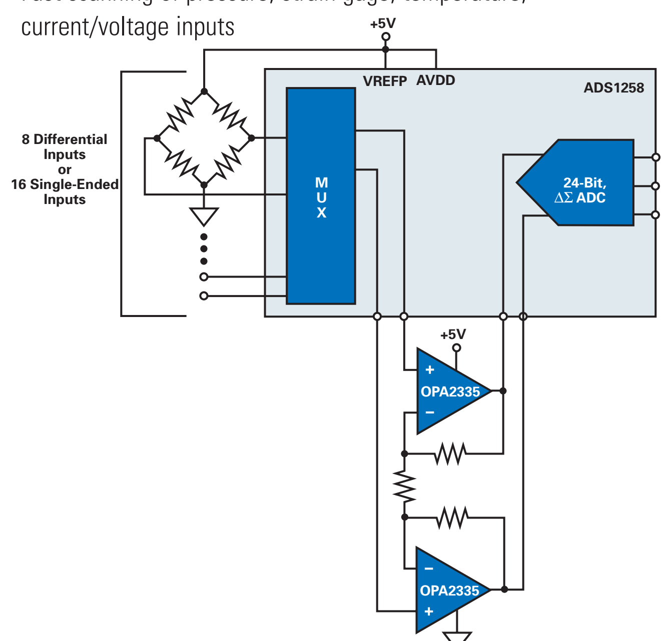
Fastest Cycling/Lowest Latency 24-Bit ADC
ADS1258

Get samples, datasheets, EVMs and app reports at:
www.ti.com/sc/device/ADS1258

The ADS1258 is a 16-channel, 24-bit delta-sigma ADC. The flexible multiplexer with external access allows the inclusion of a common gain stage prior to the ADC input. On-chip temperature, supply and reference monitors help to ensure system integrity with very low conversion latency of any 42µs which enables channel cycling at 23.7kSPS.

Key Features
- Data rate: 125kSPS
- Only 42µs latency:
  - Channel cycle at 23.7kSPS
  - Measure all 16 inputs in <672µs
- Performance:
  - 12µV RMS noise at 23.7kSPS cycling
  - Offset drift: 0.02µV/°C
  - Gain drift: 0.04ppm/°C
- Flexible multiplexer structure:
  - 16 single-ended or 8 differential inputs
  - External access for common gain stage
  - Auto-scan for low software overhead
- Single or dual-supply operation:
  - Analog: single 5V or ±2.5V
  - Digital: 2.7V to 5V

Applications
- High-speed, multiple-sensor data acquisition
- Fast scanning of pressure, strain gage, temperature, current/voltage inputs



ADS1258 functional block diagram.

Pressure

Device Recommendations

Device	Description	Key Features	Benefits	Other TI Solutions
Power Management Products				
DCP012405B	1W/5V DC/DC Converter	Miniature 24V DC/DC Converter with 1500V Galvanic Isolation, Integrated 5V LDO	Fully Integrated DC/DC Converter in a Miniature Package, High Isolation and Regulated Output, Smallest Height in the Industry	TPS54xx SWIFT™ Family, Highest Efficiency DC/DC Converter w/Integrated FET
TPS71501	LDO: 24V/1.2V to 15V	Adjustable LDO, Ultra-Low Quiescent Current 3.5µA to 50mA	Excellent for Low-Power Applications up to 1.2V	LM317, Lowest Cost LDO with 37V Input
Data Converters				
ADS1256	24-Bit ADC	24-Bit ADC, Input Buffer, PGA, Digital I/O	Highest Resolution (23 Bits Noise-Free) and Lowest Input Noise—Up to 30kSPS	ADS1218, Core of MSC121x Family with Additional Flash
ADS1258	24-Bit, 16-Channel ADC	24-Bit ADC, 125kSPS Data Rate	Flexible Multiplexer Structure, On-Chip Temperature	
MSC121x	8051-Based MCU with ADS1218 ΔΣ Converter Including Flash Memory	24-Bit ADC, Filters, PGA, Digital I/O, Sensor Excitation, Burn-Out Current Sources, Offset DACs, Four 16-Bit DACs, Temperature Sensor	Lowest Noise and Highest Integration in the Market, Includes All Necessary External Circuitry — All-in-One Solution	MSC1200, Low-Cost Version without DACs
ADS1271	24-Bit, 105kSPS ADC	Low Offset Drift: <1.8µV/°C, Passband Ripple <±0.005dB, THD <–105dB	24-Bit ADC with DC Accuracy Plus AC Performance at Highest Speed up to 105kSPS	PCM4202, PCM4204
References				
REF3125/30/33/40	References	Small Package, High Initial Accuracy, Low Drift	15ppm/°C Stable Reference for Precise Data Conversion	REF30xx with Max 50ppm/°C Drift
REF3212/20/25 30/33/40	References	Small Package, Excellent Low Drift Performance	4ppm/°C, 100µA, 4-Wire Connection, Portable Applications	REF31xx
Amplifiers				
OPA335	Zero-Drift Op Amp	CMOS 0.05µV/°C Drift, 5µV Offset, RRIO at 3.3VDC, Single Supply	Best Long-Term Stability for Industrial Use, Single Supply, Best in Class, Automotive Temp Range	OPA735, 12V Version with Improved Noise and Drift
INA326	High-Precision Instrumentation Amp	Single Supply 30nV/√Hz Noise, RRIO, CMOS	Low Noise, Excellent Long-Term Stability, Dual Supply Not Required	INA337, Automotive Temp Range, –40°C to +125°C
XTR115	4-20mA Transmitter Including Sensor Excitation	Includes All Functions to Generate 4-20mA Output Signal and Bridge Excitation	Lowest Cost All-in-One Solution (<$1) Up to 36V Supply Voltage, no Need for DC/DC Converter	XTR110 is Intended for 3-Wire Output
PGA309	Programmable Pressure Sensor Conditioner	Includes Sensor Excitation, Linearization and Temperature-Compensated Conditioning, ADC, DAC, Temp Sensor	Fully Integrated Sensor Conditioning System On a Chip (SOC), Small Package, Only 16-Bit ASSP on the Market	XTR108, Similar but is Targeted for PT100, Temp Sensors Included, 4-20mA Transceiver
TMP121	Digital Temp Sensor	Integrated Temp Sensor, ΔΣ ADC and SPI Interface to Convert Valve Temp into Digital Code	High Resolution and Accuracy, Extended Industrial Temperature Range, SOT-23 package	TMP175 (SMB-Bus Interface)
Interface				
SN65HVD1176	PROFIBUS Transceiver	Interfaces PROFIBUS Fieldbus to System Controller	Optimized for PROFIBUS, Up to 160 Users per Bus, Up to 40Mbps	SN65HVD485E, Low-Cost Version
SN65HVD251	CAN-Bus Transceiver	Interfaces CAN-Fieldbus to System Controller	Improved Drop-In Replacement for PCA82C251, Tolerates ±200V Transients	SNHVD233 (3.3V Version)
Processor				
MSP430F1121	16-Bit MCU with Flash	Lowest Power MCU in the Industry, 6µs Wake-Up	Reduces Heat in Sensor System, Reduces Cost of Power Source and Increases Lifetime	MSP430Cxx without Flash , Even Lower Power

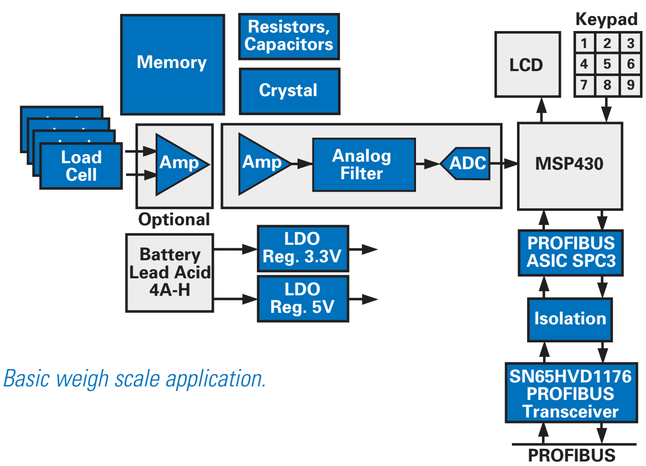
Weigh Scales

Electronic weigh scales are found in many industrial applications in some shape or form and are ubiquitous in today's food industry. Manufacturers of electronic weigh scales traditionally choose proprietary ASICs to tailor the performance of their analog front end for highest accuracy and stability. The diagram below shows an approach using standard products offering up to 23 noise-free bits of resolution.

A major challenge in designing weigh scales is the sampling of multiple load cells while offering extremely low input referred noise (RTI). The ADS1256 and ADS1232 offer input referred noise of 30nV and 17nV, respectively. Another important factor is the analog circuitry's long-term stability with regard to offset drift and gain. Here the accuracy of the amplified input signal, either single-ended or differential, must be guaranteed over years of operation. Auto-zero amplifiers, such as the OPA335 and the INA326 instrumentation amplifier, meet these stringent requirements by achieving offset drifts of 0.05µV/°C (OPA335) and 0.4µV/°C (INA326).

For an easy-to-use solution, the MSC1210 family offers a complete data acquisition system on a chip comprised of:

- An optimized 8051 core, (3-times faster than standard version at same power)
- A 24-bit, ΔΣ ADC with 22 ENOBs and 75nV (RTI)
- A PGA with gain steps from 0 to 128
- 2kB boot ROM and up to 32kB Flash memory



Basic weigh scale application.

Complete, High-Precision Weigh Scale Solution
ADS1232, ADS1234

Get samples, datasheets and app reports at:
www.ti.com/sc/device/ADS1232, www.ti.com/sc/device/ADS1234

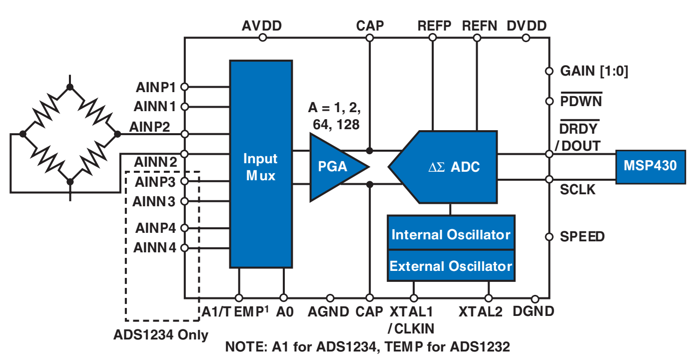
The ADS1232 and ADS1234 are designed as highly integrated delta-sigma ADCs for low-level, high-precision measurements, especially for weigh scale applications. The devices are comprised of a low-drift, low-noise instrumentation amplifier and a high-order, chopper-stabilized modulator followed by a digital filter in a monolithic device. Selectable gains of 1, 2, 64 or 128 allow full-scale differential input ranges of ±2.5V to ±19.5mV with a +5V reference. They also include a low-drift onboard oscillator as well as external crystal oscillator for the precise output data rate to reject both 50Hz and 60Hz simultaneously. ADS1232 and ADS1234 output data at 105SPS or 80SPS and are the ideal choice for weigh scale as well as bridge sensor applications.

Key Features

- Complete front-end solution for weigh scales
- Very low noise PGA:
  - Only 17NV input-referred noise with gain of 128
- High performance ΔΣ ADC:
  - 23.5 effective bits with gain of 1
- Onboard low-drift oscillator with optional external clocking
- Excellent 50Hz and 60Hz rejection: 100dB (min)
- Packaging:
  - ADS1232: 24-lead TSSOP
  - ADS1234: 28-lead TSSOP

Applications

- Weigh scales
- Bridge sensors
- Strain gauges
- Pressure sensors



Weigh scale application using ADS1232.

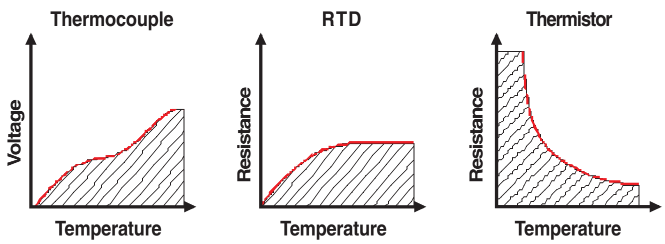
Weigh Scales

Device Recommendations

Device	Description	Key Features	Benefits	Other TI Solutions
Power Management Products				
TPS76301	Low-Power 150mA, Low-Dropout (LDO) Linear Regulator	Regulates 6V to 3.3V and 5V	Small Package	TPS76333
Amplifiers				
OPA335	Zero-Drift Op Amp	0.05µV/°C Drift, 5µV Offset, RRIO at 3.3VDC Single Supply	Best Long-Term Stability for Industrial Use, No Need for Dual Supply, Best in Class, Automotive Temp Range	OPA735, 12V Version of OPA335
INA326	High-Precision Instrumentation Amp	30nV/$\sqrt{Hz}$ Noise, RRIO, Single Supply	Lowest Noise in Industry and Best Long-Term Stability, No Need for Dual Supply	INA337, Automotive Temp Range –40°C to +125°C
PGA309	Programmable Pressure Sensor Conditioner	Includes Sensor Excitation, Linearization and Temperature-Compensated Conditioning, ADC, DAC, Temp Sensor	Fully Integrated Sensor Conditioning System On a Chip (SOC), Small Package, Only 16-Bit ASSP on the Market, Included 4-20mA Transceiver	XTR108, Similar but is Targeted for PT100, Temp Sensors
Data Converters				
ADS1256	24-Bit, 30kSPS ΔΣ ADC w/Multiplexer	Very Low Noise ADC with Programmable Data Rates Up to 30kSPS	Higher Data Rates, Very Low Noise	MSC1210
ADS1232	24-bit, 80SPS, ΔΣ ADC	Very Low Noise PGA, 24-Bit ADC, Onboard Oscillator	Complete Front-End Solution for Weight Scales	ADS1244/5
Interface				
SN65HVD1176	PROFIBUS RS-485	Optimized for PROFIBUS, 2.1V min., V_{OD} Low Bus Cap.	Improved Signal Fidelity and Enhanced Transmission Reliability	SN65HVD05
SN65HVD251	CAN-Bus Transceiver	Interfaces CAN-Fieldbus to System Controller	Improved Drop-In Replacement for PCA82C251, Tolerates ±200V Transients	SNHVD233
Processor				
MSP430F413	16-Bit, Ultra-Low-Power µcontroller	8kB Flash, 256 RAM, Comparator, 96 Segment LCD	Low-Power, Integrated LCD Driver and Flash	MSP430F417

Temperature

Temperature is the most frequently measured physical parameter and can be measured using a diverse array of sensors. All of them infer temperature by sensing some change in a physical characteristic. Three of the most common types are Thermocouples, Resistance Temperature Detectors (RTDs), and NTC-Thermistors.



Common types of thermocouples, RTDs and NTC-thermistors.

Thermocouples consist of two dissimilar metal wires welded together to form two junctions. Temperature differences between the junctions cause a thermoelectric potential (i.e. a voltage) between the two wires. By holding the reference junction at a known temperature and measuring this voltage, the temperature of the sensing junction can be deduced. Thermocouples have very large operating temperature ranges and the advantage of very small size. However, they have the disadvantages of small output voltages, noise susceptibility from the wire loop, and relatively high drift.

Resistance Temperature Detectors (RTDs) are wire winding or thin-film serpentines that exhibit changes in resistance with changes in temperature. While metals such as copper, nickel and nickel-iron are often used, the most linear, repeatable and stable RTDs are constructed from platinum. Platinum RTDs, due to their linearity and unmatched long-term stability, are firmly established as the international temperature reference transfer standard. Thin-film platinum RTDs offer performance matching for all but reference grade wire-wounds at improved cost, size and convenience. Early thin-film platinum RTDs suffered from drift, because their higher surface-to-volume ratio made them more sensitive to contamination. Improved film isolation and packaging have since eliminated these problems making thin-film platinum RTDs the first choice over wire-wounds and NTC thermistors.

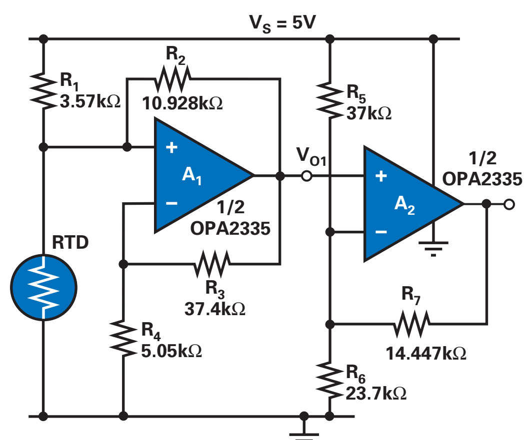
NTC Thermistors are composed of metal oxide ceramics, are low cost, and the most sensitive temperature sensors. They are also the most nonlinear and have a negative temperature coefficient. Thermistors are offered in a wide variety of sizes, base resistance values, and Resistance vs. Temperature (R-T) curves are available to facilitate both packaging and output linearization schemes. Often two thermistors are combined to achieve a more linear output. Common thermistors have interchangeabilities of 10% to 20%. Tight 1% interchangeabilities are available but at costs often higher than platinum RTDs. Common thermistors exhibit good resistance stability when operated within restricted temperature ranges and moderate stability (2%/1000 hr at 125°C) when operated at wider ranges.

Comparison of Temperature Sensor Attributes

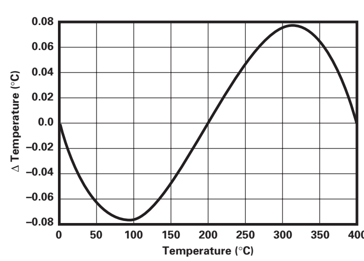
Criteria	Thermocouple	RTD	Thermistor
Cost-OEM Quality	Low	High	Low
Temperature Range	Very Wide –450°F to +4200°F	Wide –400°F to +1200°F	Short to Medium –100°F to +500°F
Interchangeability	Good	Excellent	Poor to Fair
Long-Term Stability	Poor to Fair	Good	Poor
Accuracy	Medium	High	Medium
Repeatability	Poor to Fair	Excellent	Fair to Good
Sensitivity (Output)	Low	Medium	Very High
Response	Medium to Fast	Medium	Medium to Fast
Linearity	Fair	Good	Poor
Self Heating	No	Very Low to Low	High
Point (End) Sensitive	Excellent	Fair	Good
Lead Effect	High	Medium	Low
Size/Packaging	Small to Large	Medium to Small	Small to Medium

Low-Cost PT100 Linearization Circuit for 0°C to 400°C

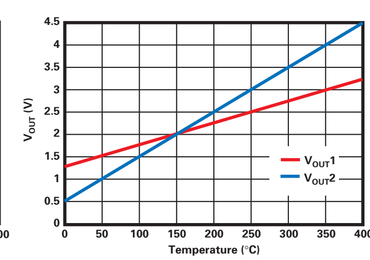
A low-cost RTD measurement circuit with linearization is achieved with just one dual operational amplifier, OPA2335, and seven resistors. The first stage linearizes a PT100 sensor over a temperature range from 0°C to 400°C, yielding a maximum temperature error of ±0.08°C. R_1 defines the initial excitation current of the RTD. R_3 and R_4 set the gain of the linearization stage to ensure the input of A_1 stays within its common-mode range. Rising temperature increases V_{01}. A fraction of V_{01} is fed back to the input via R_2 for linearization. Resistors, $R_1 – R_4$, are calculated so that the maximum excitation current through the RTD is close to 100μV to avoid measurement errors through self-heating.



OPA2335 PT100 linearization circuit.



Δ temp *vs. temp.*



V_{OUT} *vs. temp.*

Temperature

The second stage performs offset and gain adjustment. Here the linear slope of V_{01} is readjusted to provide a V_{02} slope of 10mV/°C within an output range of 0.5V to 4.5V.

Temperature Measurement of a Remote 3-Wire RTD via a 4-20mA Current Loop

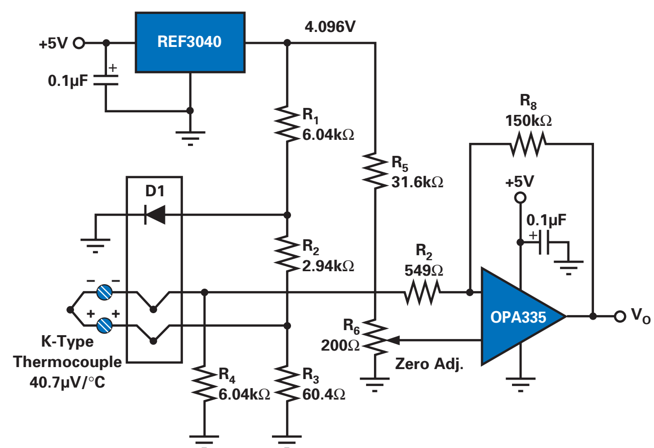
This circuit measures the temperature of a remote 3-wire RTD using the 4-20mA current transmitter, XTR112. The device provides two matched current sources for RTD excitation and line-resistance compensation. Internal linearization circuitry provides 2nd-order correction to the RTD, thus achieving a 40:1 improvement in linearity. I_{R1} is the excitation for the RTD. I_{R2} is the compensation current flowing through R_Z and R_{LINE1}. By choosing the value of R_Z to be equal to the RTD resistance at minimum temperature, the internal instrumentation amplifier (INA) only measures the temperature dependent difference in RTD resistance.

R_{CM} is used to provide an additional voltage drop to bias the inputs of the XTR112 within the common-mode input range. The 0.01µF bypass capacitor minimizes common-mode noise. R_G sets the gain of the INA. For 2nd-order linearization, a fraction of the INA output voltage is fed back via the resistors, R_{LIN1} and R_{LIN2}. Internally, the output voltage is converted into a current and then added to the return current, I_{RET}, to yield an output current of $I_O = 4mA + V_{IN} \bullet 40/R_G$.

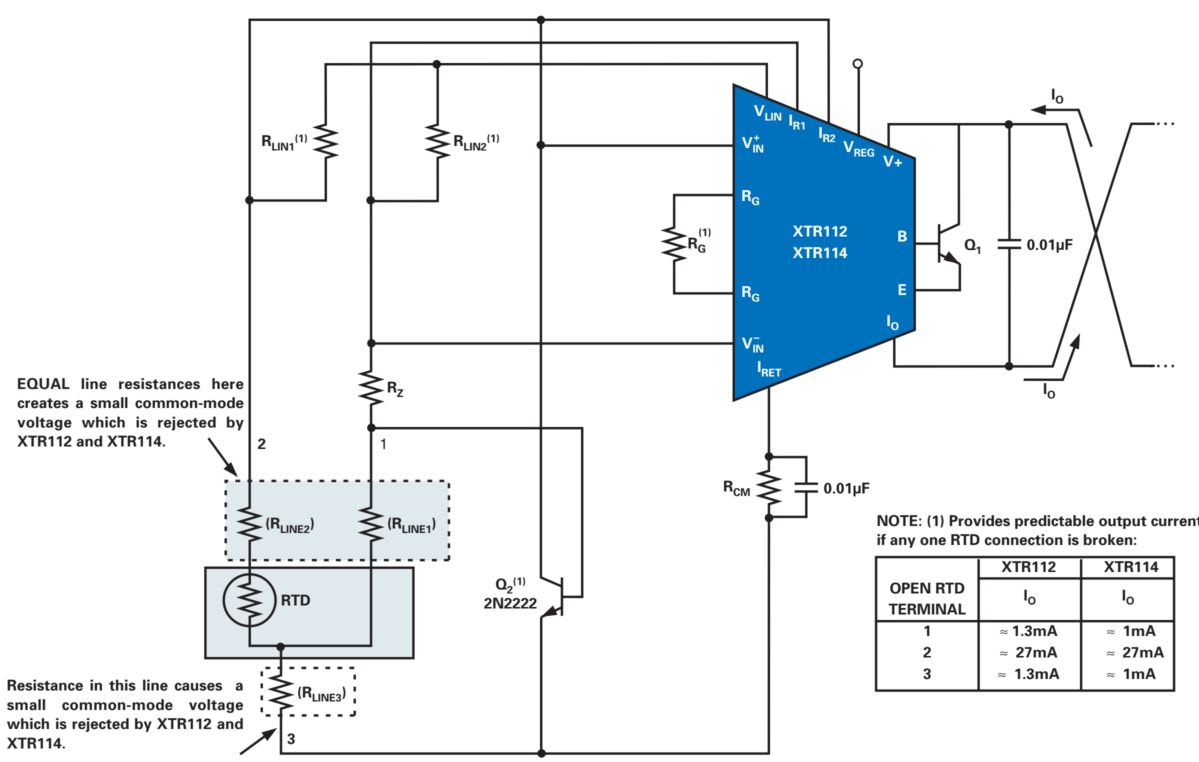
On the current-loop side, transistor, Q_1, conducts the majority of the signal-dependent 4-20mA loop current. This isolates most of the power dissipation from the internal precision circuitry of the XTR112, maintaining excellent accuracy. For detailed information on the calculation of the resistor values for various temperature ranges, refer to the XTR112 data sheet.

Temperature Measurement with a K-Type Thermocouple Using Wired Cold-Junction Compensation (CJC)

This thermocouple measurement circuit uses the auto-zero, single-supply amplifier, OPA335. A precision voltage reference, REF3040, provides the 4.096V bridge supply. The forward voltage of diode, D_1, has a negative temperature coefficient of –2mV/°C, and provides the cold-junction compensation via the resistor network R_1 to R_3. The zero-



OPA335 temperature measurement circuit.



OPEN RTD TERMINAL	XTR112 I_O	XTR114 I_O
1	≈ 1.3mA	≈ 1mA
2	≈ 27mA	≈ 27mA
3	≈ 1.3mA	≈ 1mA

Temperature measurement of a remotely located RTD.

Temperature

adjustment for a defined minimum temperature is achieved via R_6, while R_7 and R_8 set the gain for the output amplifier. The OPA335 provides a high DC open-loop gain of A_{OL} = 130dB, allowing 16-bit+ accuracy at high gain in low-voltage applications. The auto-zero operation removes the 1/f noise and provides an initial offset of 5µV (max) as well as an extremely low offset drift over temperature of 0.05µV/°C (max). Thus the OPA335 ideally suits single-supply, precision applications where high accuracy, low drift and low noise are imperative.

Autonomous Temperature Measurement System for Multiple Thermocouples Using MSC1200

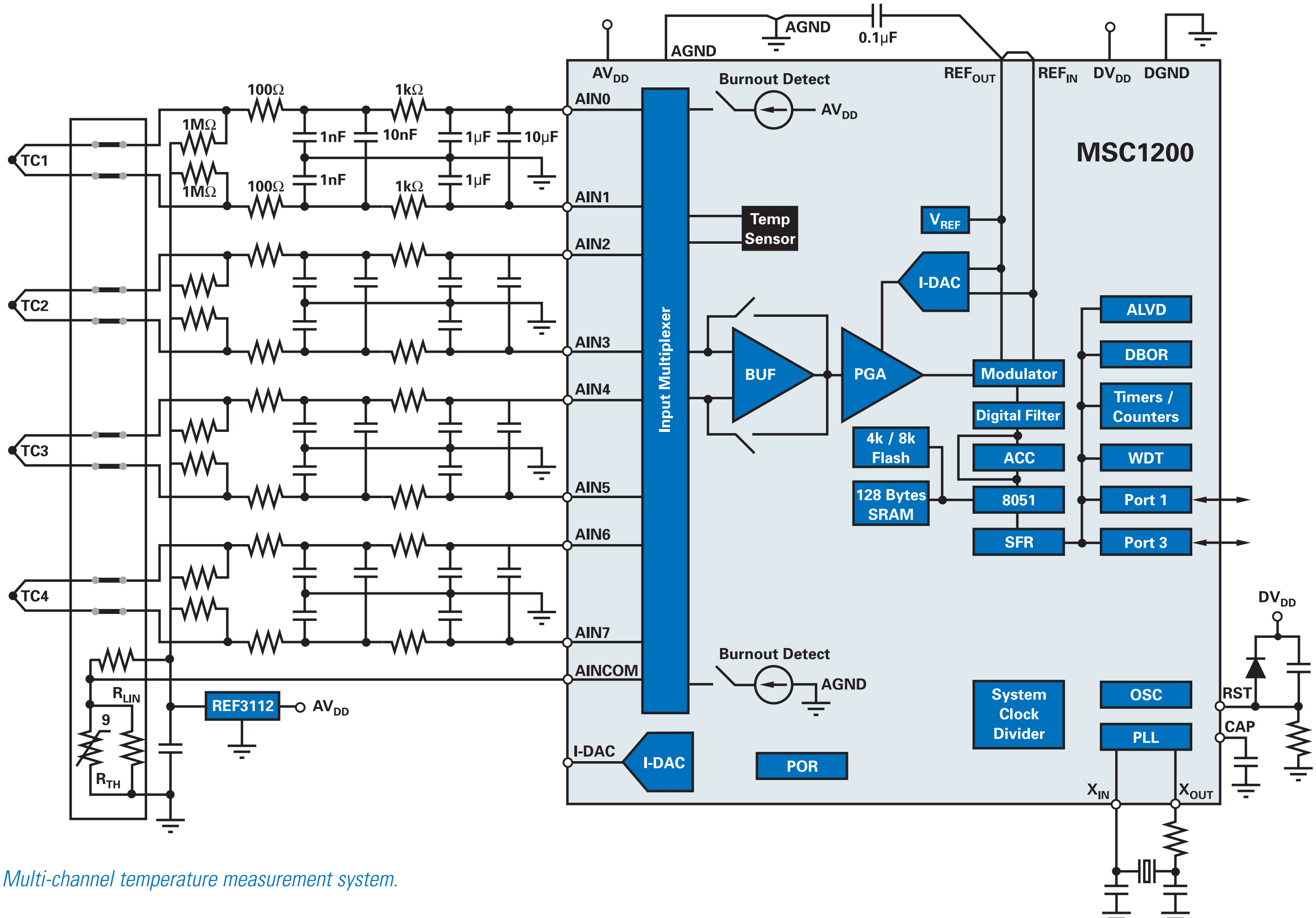
This temperature measurement system measures the differential output voltage of four different types of thermocouples, (T_{C1}–T_{C4}), and one reference temperature using the mixed-signal controller, MSC1200. The MSC1200 incorporates a ΔΣ ADC with 22-bits of effective resolution, with a versatile input multiplexer, a selectable input buffer, and a programmable gain amplifier (PGA) with gain adjustments from 1 to 128. The device includes on-chip Flash and SRAM memory and an improved 8051-CPU, running 3-times faster than the initial standard version at the same power consumption. An on-chip current digital-to-analog converter, (I-DAC), provides excitation current to the RTDs and thermistors.

Integrated Current Sources Allow for Sensor Burn-Out Detection

In the case of remotely located thermocouples, input RC low-pass filters remove differential and common-mode noise, which might have been picked up by the thermocouple leads running through a noisy environment. For the various types of thermocouples, different PGA settings may be required to reduce the analog input impedance. Low input impedance can cause compensation current to flow through a thermocouple. These currents disturb electron density (which the Seebeck effect is based on) thus generating wrong thermo-EMF readings at the thermocouple output. To provide consistently high input impedance, the input buffer must be enabled. This however reduces the input common-mode range to 50mV above analog ground and 1.5V below the positive analog supply. To ensure that the thermocouple signals are within that range, each input is biased via a 10kΩ to 100kΩ resistor. The bias voltage is provided by the precision voltage reference circuit, REF3112, which has an initial error of 0.2% and a temperature drift of 15ppm/°C.

Cold-Junction Compensation

Cold-junction compensation (CJC) is performed by reading the output voltage across a linearized thermistor circuit via A_{INCOM}.



Multi-channel temperature measurement system.

The versatility of the input mux allows assigning the positive and negative inputs of the buffer to any of the analog input pins. Thus, to measure the reference temperature differentially, one buffer input is connected to A_{INCOM}, while the other input is connected to the "low-end" input of any of the thermocouples ($A_{IN}1$, 3, 5 or 7). However, once an input has been selected, all subsequent differential measurements of the reference temperature should be made against the same "low-end" input. If the MSC1200 is close to the isothermal block, and based on the required accuracy, the on-chip temperature sensor could be used for CJC.

Constant Temperature Control for Thermoelectric Coolers with INA330

The INA330 is a precision amplifier designed for thermoelectric cooler (TEC) control in optical networking and medical analysis applications. It is optimized for use in 10kΩ thermistor-based temperature controllers. The INA330 provides thermistor excitation and generates an output voltage proportional to the difference in resistances applied to the inputs. It uses only one precision resistor plus the thermistor, thus providing an alternative to the traditional bridge circuit. This new topology eliminates the need for two precision resistors while maintaining excellent accuracy for temperature control applications. The INA330 offers very low 1/f noise throughout the life of the product. The low offset results in a 0.009°C temperature error from –40°C to +85°C.

An excitation voltage applied to the inputs, V_1 and V_2, creates the currents, I_1 and I_2, flowing through the thermistor (R_{THERM}) and the precision resistor (R_{SET}). An on-chip current-conveyor circuit produces the output current, $I_O = I_1 – I_2$. The output current, flowing through the external gain-setting resistor (R_G) is buffered internally and appears at the V_O pin. Any bias voltage applied to the other side of R_G adds to the output voltage, so that $V_O = I_O \bullet R_G + V_{ADJUST}$. This output voltage feeds a PID controller, which provides the input voltage to a TEC driver in bridge-tied-load configuration. The two operational amplifiers (OPA569) are CMOS, single-supply power amplifiers capable of driving load currents of up to 2A at 3V supply.

In this application, the temperature to be controlled is set by the DAC. If the temperature of the TEC rises above the set temperature, TEC current flows in one direction for cooling. If the temperature falls below the set-point, the current direction is reversed and the TEC heats. The dotted line indicates closed-loop thermal feedback from the TEC to the thermistor, which it is mechanically mounted to, but electrically isolated from.

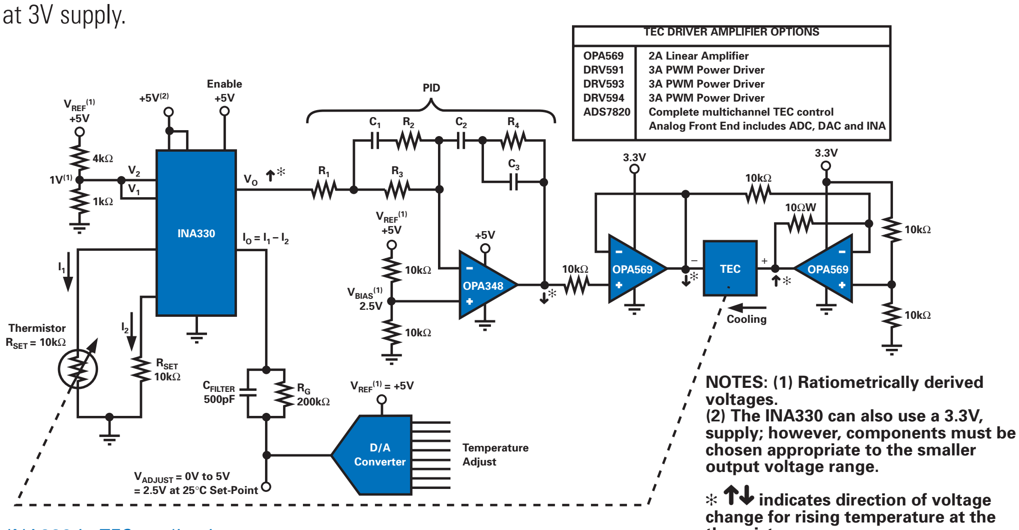
Constant Temperature Control for Thermoelectric Coolers with INA326

The INA326 is a high-performance, low-cost, precision instrumentation amplifier with rail-to-rail input and output. It's a true single-supply instrumentation amplifier with very low DC errors and input common-mode ranges that extend beyond the positive and negative rail. These features make it suitable for general-purpose to high-accuracy applications.

Excellent long-term stability and very low 1/f noise assure low offset voltage and drift. The INA326 is a two-stage amplifier with each gain stage set by R_1 and R_2, respectively. Overall gain is described by the equation: $G = 2 \bullet R_2/R_1$.

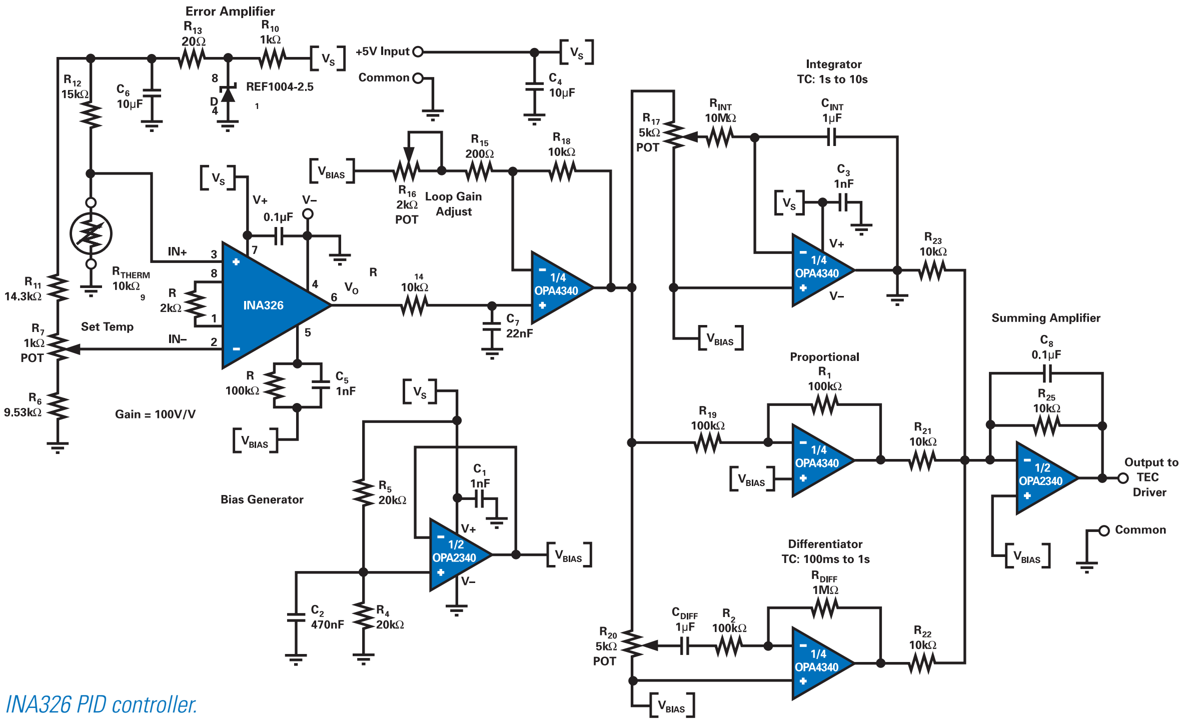
The INA326 measures the difference between the voltage of the temperature set-point (R_7), and the voltage across the thermistor (R_{THERM}). The differential input voltage is amplified by a factor of 100 ($G = 2 \bullet 100k\Omega/2k\Omega$) and fed, via an RC-lowpass filter into the PID controller. R_{14}, C_7 is an output filter that minimizes auto-correction circuitry noise.

The PID controller shown uses separate adjustment stages, allowing for optimized adjustment of controller parameters to the closed-loop system. Once these parameters have been determined, the existing circuitry consisting of five op amps for PID, summing and loop-gain adjustment can be converted into a single amplifier PID controller.



INA330 in TEC application.

Temperature



INA326 PID controller.

Digital Temperature Sensors with Two-Wire Interface
TMP75, TMP175

Get samples, datasheets and app reports at:

www.ti.com/sc/device/TMP75, www.ti.com/sc/device/TMP175

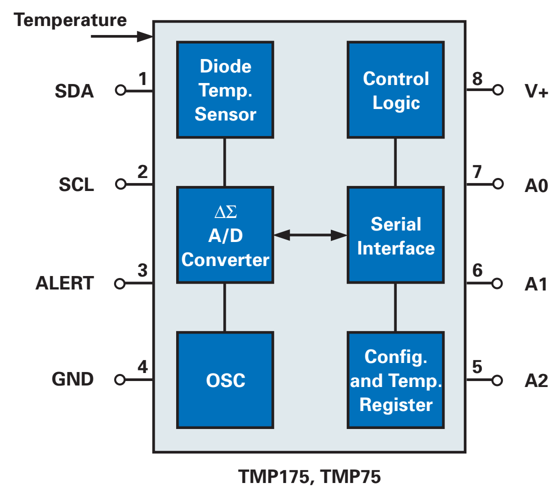
The TMP75 and TMP175 are two-wire, serial-output temperature sensors. The devices require no external components and are capable of reading temperatures with a resolution of 0.0625°C. The two-wire interface is SMBus compatible, which allows the TMP175 to have up to 27 devices on one bus and the TMP75 eight devices. Both feature SMBus alert functions and are ideal for extended temperature measurements found in industrial environments.

Key Features

- 27 addresses (TMP175)
- 8 addresses (TMP75)
- Digital output: two-wire serial interface
- Resolution: 9- to 12-bits, user selectable
- Accuracy:
  ±1.5°C (max) from –25°C to +85°C
  ±2.0°C (max) from –40°C to +125°C
- Low quiescent current: 50µA, 0.1µA standby
- Wide supply range: 2.7V to 5.5V
- Packaging: SO-8, MSOP-8

Applications

- Power-supply temperature monitoring
- Computer peripheral thermal protection
- Thermostat controls
- Environmental monitoring and HVAC
- Electromechanical device temperature



TMP175 functional block diagram.

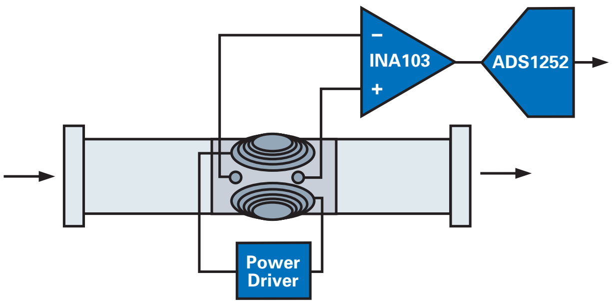
Flow Metering

The application requirements of flow measurement in industrial settings varies from low cost to very high precision and fast flow metering found in petrochemical and pharmaceutical plants. This section contains explanations of the most common techniques and offers various solutions for overcoming flow measurement obstacles.

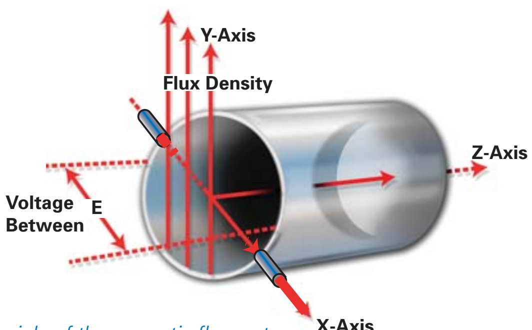
The Magnetic-Inductive Flowmeter

The magnetic-inductive flowmeter consists of a non-ferromagnetic tube wrapped with a magnetic coil. Electrodes in the tube's inner isolated surface are in contact with the liquid (must be conductive) that flows through the tube.

The coils around the pipe generate a magnetic field within the tube. The magnetic field inducts a voltage in the liquid, which is proportional to the speed of the liquid in the tube. This voltage is measured via the electrodes. As the measured voltage is very low, precise low-noise instrumentation amplifiers, such as the INA103, options are needed at the amplifier front end. Usually the voltage is digitized with precision ΔΣ ADCs such as the ADS1252.



The magnetic-inductive flowmeter.



The principle of the magnetic flowmeter.

The Coriolis Flowmeter

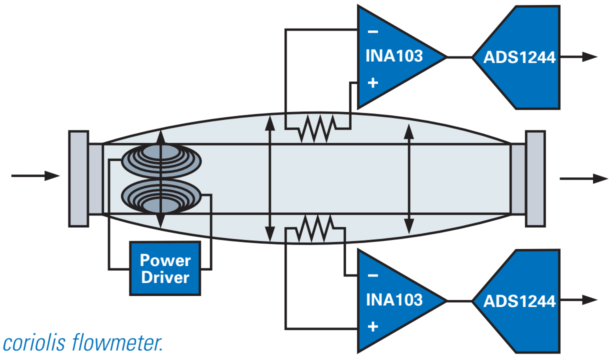
The coriolis flowmeter consists of a tube, which is forced into oscillation by a low-frequency power driver. Liquid particles flowing through the tube are deviated by the mechanical oscillation of the tube. These deviations are different in their signs, depending on their distance to the position of the power source. Close to the power source, the particles of the liquid are accelerated. In the area of the mechanical sensors the particles are decelerated. In the coriolis flow meter, the mechanical forces (which are decelerating) are measured/detected by inductive sensor systems. The very low resulting voltages are amplified by precision amplifiers and then digitized. The phase difference between the basic oscillation of the tube and the resulting inductive sensor signal describes the amount of mass-flow in the tube.

As the detected voltages are very low, a low-noise precision amplifier in the sensor front-end is required. For digitizing the measurement signal, a 2-channel precision ADC (ΔΣ) is needed as the phase-accuracy between the two channels has a direct impact on the measurements' accuracy.

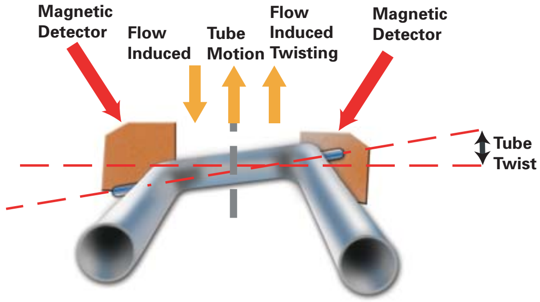
Differences Between the Two Measurement Techniques

The magnetic inductive system can only measure the liquid's speed through the tube. As the diameter of the tube is known, the volume of flow can be calculated. The liquid must have minimal electrical resistance. Non-conductive liquids can't be measured.

The coriolis technique makes it possible to actually measure the amount of mass flowing through the tube. This technique is more expensive.



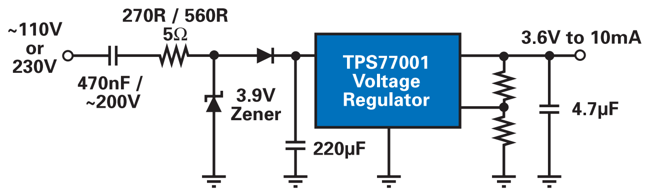
The coriolis flowmeter.



Operational principle of a coriolis mass flowmeter.

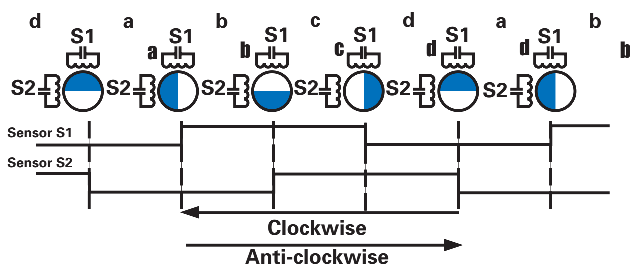
Flow Metering

Low-Cost Method:



TPS7701 functional block diagram.

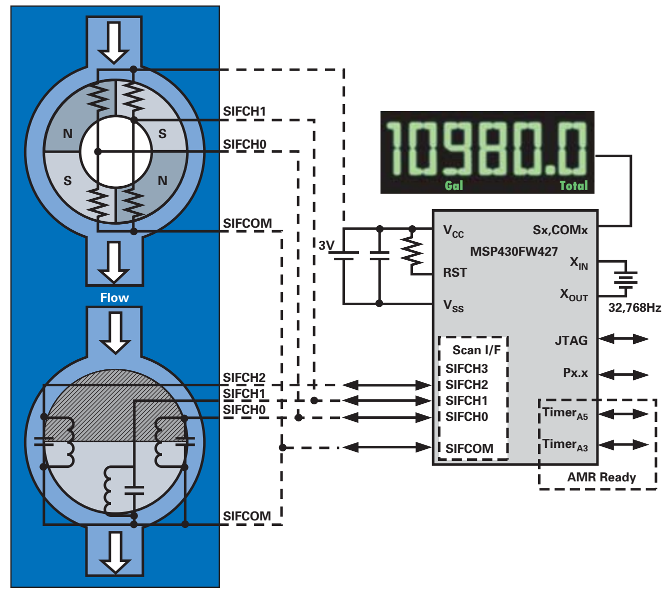
- Ultra-low-power MSP430 requires <10mA for the complete metering application
- No power transformers required for power supply management
- Simple capacitor-tapped power supply coupled with an LDO



Quadrature decoding, detect rotation, direction error detection.

Quadrature decoding example: Generation of an input signal with the two LC-type sensors, S_1 and S_2, are used. If the previous position of the damped plate is known, together with the current state, the rotation as well as the direction of rotation can be detected. For the digital signals, a "0" means the sensor is above the undamped part of the plate and "1" means it is above the damped area, the metal part. Additional sensors can be used for redundancy, but two sensors are sufficient to detect rotation and direction.

High-Precision Method:



MSP430FW427 single-chip flow meter.

- Two LC sensors or one GMR sensor are used (S1, S2)
- State machine in scan I/F enable to detect rotation, error and distortion
- Small battery meets life-cycle of 2 calibration periods due to scan I/F
- Various sensors and physical conditions are handled
- Performance for additional functions e.g. automatic meter reading at low power

Device Recommendations

Device	Description	Key Features	Benefits	Other TI Solutions
Reference				
REF3140	Voltage Reference	Drift = 20ppm/°C 4.097V, 0.2%	Very Low Drift, Tiny Package	REF02, REF102
Isolation Products				
DCV010515D	Dual Converter	Isolation Converter, $+5V_{IN}$, $\pm15V_{OUT}$	Low Noise, Small Board Data	DCP10515
DCV010505D	Dual Converter	Isolation Converter, $+5V_{IN}$, $\pm5V_{OUT}$	Low Noise, Small Board Data	DCP10505
Power Management Products				
TPS54110	SWIFT™ Buck Controller	Adjustable Output (0.9V-3.3V), 1.5A	Very Easy to Use, Flexible Output	TPS64200
Data Converters				
ADS8321	16-Bit, 100kSPS	Power = 2mW, 8-pin, SFDR = 86dB	Excellent Performance	ADS8320, ADS8325
ADS1251	24-Bit, 20kSPS	Small (8-Pin SSOP) and Easy to Use (Read Only Interface)	Only 7.5mW, Single 5V Supply	ADS1252
ADS1271	24-Bit, 105kSPS	AC Performance, DC Accuracy	Measure Up to 50kHz Bandwidths, Easy to Synchronize Multiple Converters	PEM4202
MSC121x	24-Bit ADC, MCU, REF DAC, PGA	8051 MCU with Integrated 24-Bit Up to 1kSPS ADC, 16-Bit DACs and Precision Reference, Eight Inputs and PGA	Cost Effective and Highest Integration All in a Single-Chip Solution	MSC1212, MSC1200

Linear Voltage Differential Transformer

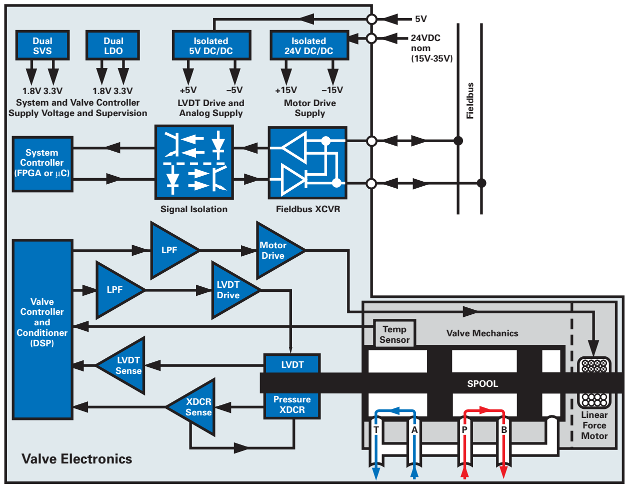
Hydraulic valves are used to direct the flow of liquid mediums, most commonly oil, from input ports to output ports. The direction of flow is determined by the position of a spool, which is driven by a linear force motor. Valve electronics are split into three core-subsystems:

Power Conversion — provides galvanic isolation between the valve power and the external fieldbus and auxiliary 24V supplies. It also provides regulated supply voltages to the individual functional blocks.

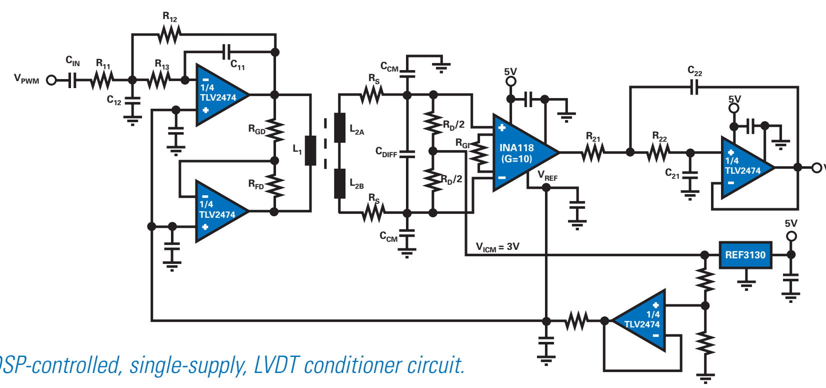
Fieldbus Interface and Control — provides galvanic isolation between the system controller and the fieldbus signals. The system controller translates the incoming data from the fieldbus into valve commands for the DSP, and vice versa, it translates the valve data from the DSP into fieldbus signals.

Valve Control — performs spool positioning, pressure and temperature measurement. It also indicates alarm conditions.

The valve controller receives a position command from the fieldbus via the system controller and drives the linear force motor until the output signal of the position sensor (LVDT = Linear Variable Differential Transformer) equals the input value of the position command. At the same time, pressure and temperature are monitored. An alarm condition is indicated if one of these sensors exceeds a pre-determined safety value.



Basic hydraulic valve diagram.



DSP-controlled, single-supply, LVDT conditioner circuit.

Device Recommendations

Device	Description	Key Features	Benefits	Other TI Solutions
Power Management Products				
UCC3823	PWM Controller	Universal PWM Controller for 24V, Isolated Boost Converter	Lowest Cost, Small Package	UCC3813, TL5001
DCR010505	1W/5V DC/DC Converter	Miniature 5V DC/DC Converter with 100V Galvanic Isolation, Integrated 5V LDO	Fully Integrated DC/DC Converter in Miniature Package, High Isolation and Regulated Output	DCP020505 (2W, Unregulated)
TPS70751	Dual LDO: 3.3V/1.8V	Two Regulated Output Voltages for DSP Split-Supply Systems with Power-Up Sequencing, 250mA Output Current	Industry's Most Integrated Supply Systems, with Power Good Indicator, UVL and Thermal Shutdown	TPS70851, TPS70251
TPS3305-18	Dual SVS: 3.3V/1.8V	Dual Supervisory Circuit for DSP and Processor Supplies Including POR Generator	Requires No External Capacitors, Temp-Compensated V_{REF}, Small Package	TPS3306-18, TPS3806I33
Amplifiers				
OPA4345	Quad, Low-Power Op Amp	Used as Active Low-Pass Filter to Convert PWM into Analog Signal	Low Power, Low Offset, Small Package, Low Cost	OPA4340, OPA4346
TLV2472	Dual, Single-Supply, High O/P Drive	Drives LVDT Sensor with ±25mA	No Cross-Over Distortion in BTL Configuration, Lowest Supply Voltage, Drives Up to ±35mA	TLC074, TLC084
INA118	Single/Dual Supply Inst. Amp	Senses LVDT Output with High Linearity	High Linearity at Lowest Supply Voltage	INA128
OPA544	Power Amplifier	Drives Linear Force Motor (±10V/1A)	Class AB amp with Current Limit and Thermal Shutdown	OPA548, OPA549, OPA569
PGA309	Programmable Pressure Sensor Conditioner	Includes Sensor Excitation, Linearization and Temperature-Compensated Conditioning	Fully Integrated Sensor Conditioning System on a Chip (SOC), Small Package	—
TMP121	Digital Temp Sensor	Integrates Diode Temp Sensor, ΔΣ ADC and SPI Interface to Convert Valve Temp into Digital Code for the DSP	High Resolution and Accuracy, Extended Industrial Temp Range, Ultra Small Package	TMP175 (SMBus Interface)
DRV1xx	Low-/High-Side Monitoring	Fixed/Adjustable Switching Frequency , 1.2A Output, Wide Supply	Ideal for Driving Electromechanical Devices	DRV590, DRV591
Interface				
SN65HVD1176	PROFIBUS Transceiver	Interfaces PROFIBUS Fieldbus to System Controller	Optimized for Bus, Up to 160 Users Per Bus, Up to 40Mbps, Benchmarked by Siemens as Reference Device	SN65HVD485E
SN65HVD251	CAN-Bus Transceiver	Interfaces CAN Fieldbus to System Controller	Improved Drop-In Replacement for PCA82C251, Tolerates ±200V Transients	SNHVD233 (3.3V Version)

Current Measurement

Current is one of the most common values measured in industrial applications. The Motor Control chapter (pages 20-23) describes precise current measurement using delta-sigma modulators and precision SAR ADCs that also require galvanic isolation. Another approach to directly measuring current uses instrumentation amplifiers which allow direct shunt measurements with common-mode voltages up to 60V.

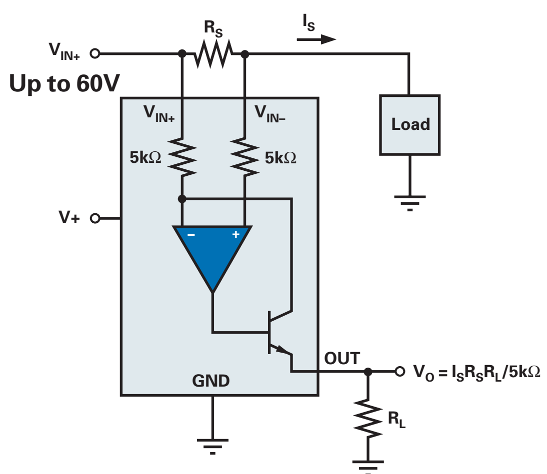
High-Side Current Shunt Monitors
INA138, INA168, INA170

Get samples and datasheets at: **www.ti.com/sc/device/INA138**, **www.ti.com/sc/device/INA168**, **www.ti.com/sc/device/INA170**

The INA138 and INA168 are high-side, unipolar, current shunt monitors with low quiescent current and are available in SOT23-5 packaging. Input common-mode and power supply voltages are independent and can range from 2.7V to 36V (IN138) or to 60V (INA168). The devices convert a differential input voltage to a current output. The current is converted back to a voltage with an external load resistor that sets any gain from 1 to over 100.

Key Features
- Wide supply range:
  - INA138: 2.7V to 36V
  - INA168: 2.7V to 60V
- Unidirectional current: INA138/9, INA168/9
- Bidirectional current: INA170
- Low quiescent current: 25μA
- Independent supply and common-mode voltages
- Wide temp range: –40°C to +125°C
- Packaging: SOT23-5

Applications
- Current shunt measurement in automotive, telephones, computers
- Portable and battery-backup systems
- Power management
- Precision current source



INA138, INA168 functional block diagram.

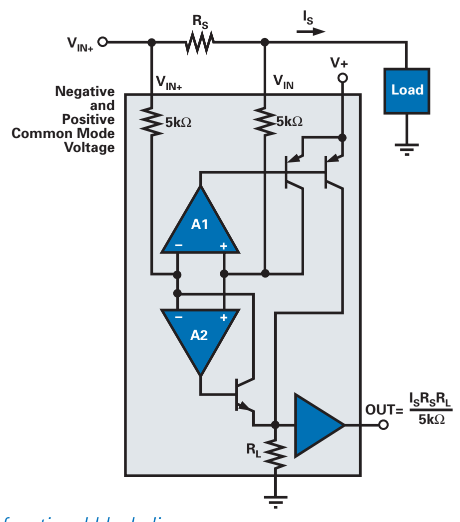
Current Shunt Monitor with –16V to +80V Common-Mode Range
INA193, INA194, INA195, INA196, INA197, INA198

Get samples and datasheets at: **www.ti.com/sc/device/PARTnumber** (Replace **PARTnumber** with **INA193**, **INA194**, **INA195**, **INA196**, **INA197** or **INA198**)

The INA193 - INA198 family of current shunt monitors with voltage output can sense drops across shunts at common-mode voltages from –16V to +80V, independent of the supply voltage. The devices are available with three output voltage scales: 20V/V, 50V/V and 100V/V. The 400kHz bandwidth simplifies use in current control loops.

Key Features
- Common-mode voltage range: –16V to +80V
- High accuracy: ±3% over temp
- Bandwidth: up to 400kHz
- Quiescent current: 250μA
- Three transfer functions available: 20V/V, 50V/V, 100V/V
- Packaging: SOT23

Applications
- Current shunt measurement in automotive, telephones, computers
- Portable and battery-backup systems
- Power management
- Use in PWM current control loops
- 16-bit, 1 channel, ±250mV input range: ADS1202
- 16-bit, 1 channel, ±250mV input range: ADS1203
- 16-bit, 4 channels, 0 to 5V input range: ADS1204



INA19x functional block diagram.

Digital Motor Control

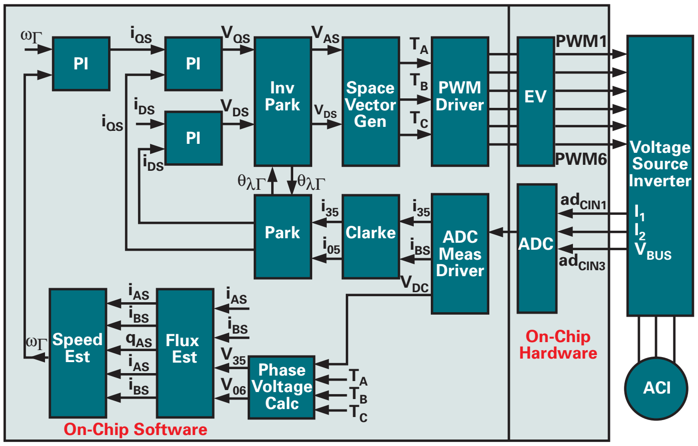
Today's motor control applications challenge electronic circuitry to achieve the highest efficiency, lowest power consumption and highest precision control. There are several motor types in which digital and analog solutions are increasing performance in motor control applications. Synchronous motors are also described as BLDC (Brushless DC) or PMSM (Permanent Magnet Synchronous Motors). The only difference between them is the shape of the induced voltage, resulting from two different manners of wiring the stator coils. The back-emf is trapezoidal in the BLDC motor, and sinusoidal in the PMSM motor. Digital techniques addressed by the C2000™ DSP controller make it possible to choose the correct control technique for each motor type. Processing power can extract the best performance from the machine and reduce system costs. Options include using sensorless techniques to reduce sensor cost, or even eliminate it; additionally, complex algorithms can help simplify the mechanical drive train design, also lowering system cost.

For asynchronous motors, speed regulation is a typical concern. Three phase inverters with a 6 PWM scheme are widely used for variable-speed drive applications. Depending on the application, a simple V/Hz open-loop (scalar) control where no feedback is required can be applied, or a vector control in which current, voltage and speed information is needed.

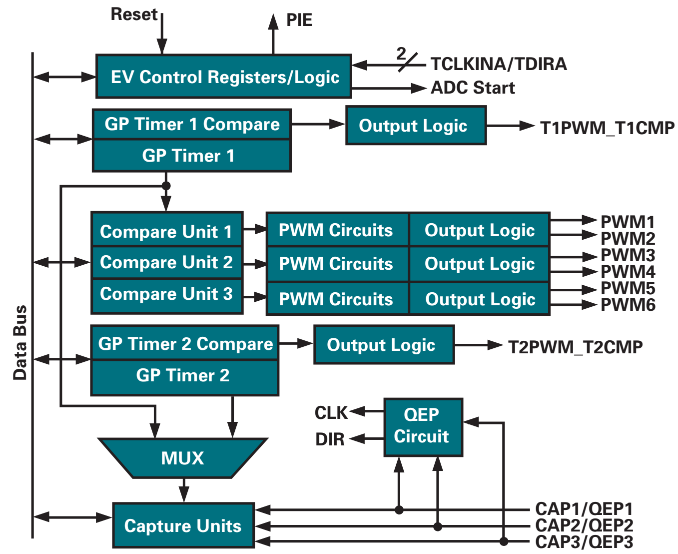
Scalar Control: (V/Hz)

- Simple to implement: only three sine waves feeding the motor are required
- Position information not required (optional):
  - Doesn't deliver good dynamic performance
  - Torque delivery not optimized for all speeds

Vector control, also called Field Oriented Control, allows designers to fulfill all of the "ideal" control requirements. Having information on all system parameters, such as phase current and bus voltage, allows delivery of the appropriate power at the right moment thanks to real-time control made possible by DSP integration and MIPS availability.



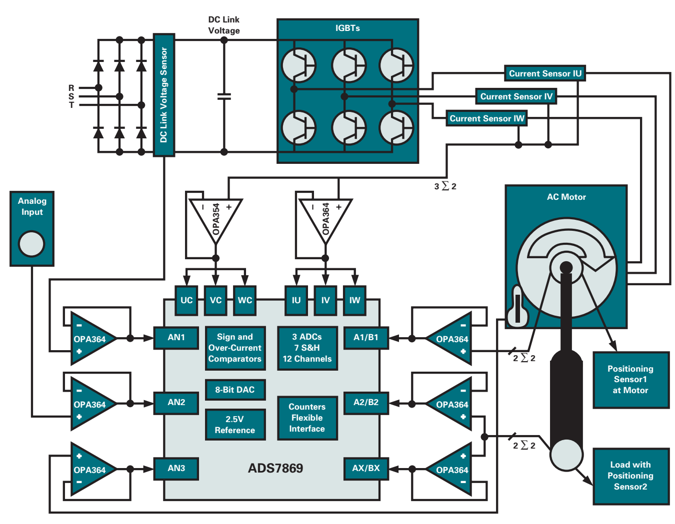
Vector control functional block diagram.



TMS320F2810 functional block diagram.

Servo Motor Control Application and Featured Products

The figure below is an example of a typical motor control circuit. The IU, IV and IW channels measure the motor's currents. The motor's position/speed and load are measured simultaneously by Ax, Bx, etc. using resolver or analog encoder sensors. Simultaneously sampling at least two currents or all three currents is important to achieving maximum accuracy in motor positioning. Good linearity and low offset of the ADC is mandatory. Channel A_{N1} measures the differential DC link voltage. Fast sampling in the range of 2µs or less per channel guarantees fast leakage current detection for IGBT control. A_{N3} measures the motor's temperature. The level input of the window comparators are connected to an 8-bit DAC for control purpose.



Servo motor control functional block diagram.

Asynchronous, DC and Servo Motors

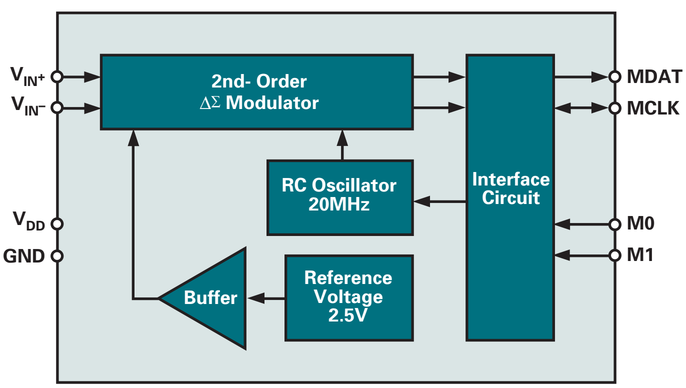
Current Shunt Modulator
ADS1203

Get samples, datasheets and EVMs at: **www.ti.com/sc/device/ADS1203**

The ADS1203 is a delta-sigma modulator with 95dB dynamic range, operating from a single +5V supply. The differential inputs are ideal for direct connection to transducers or low-level signals. It is available in an 8-lead TSSOP or 16-pin QFN (3x3) package.

Key Features
- Resolution: 16-bits
- Input range: ±250mV
- Linearity: ±1LSB (typ)
- Internal 2.5V reference

Family Members
- 16-bit, 1 channel, ±250mV input range: ADS1202
- 16-bit, 1 channel, ±250mV input range: ADS1203
- 16-bit, 4 channels, 0 to 5V input range: ADS1204
- 16-bit, 2 channels, 0 to 5V input range: ADS1205
- 16-bit, 1 channel, ±100mV input range: ADS1208
- INA139: high-side current-shunt monitor (diff. amplifier), up to 36V common-mode input
- INA169: high-side current-shunt monitor (diff. amplifier), up to 60V common-mode input



ADS1203 functional block diagram.

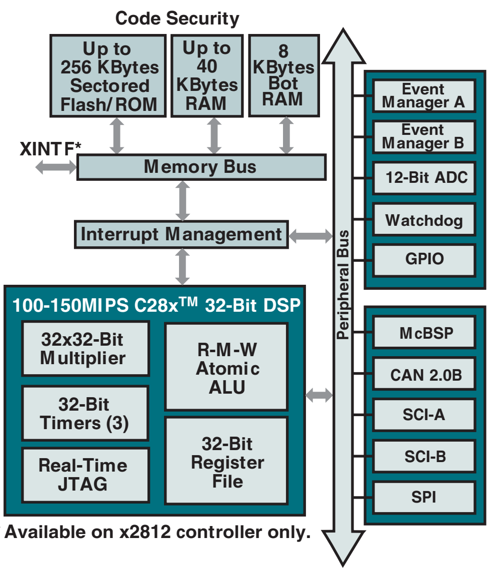
Controller Generation, Fixed Point
TMS320C28x™

Get samples, datasheets, tools and app reports at: www.**ti.com/c2000**

The C28x™ controllers are the industry's first 32-bit control-based DSPs with onboard reprogrammable Flash, factory programmed ROM, or cost effective RAM-only memory options and performance from 100 to 150 MIPS.

Specifications
- 32-bit, fixed-point C28x DSP core
- Up to 150-MIPS operation
- 1.8/1.9V core and 3.3V peripherals
- Easy-to-use software and development tools speed time-to-market

Applications
- Digital motor control
- Digital power supply
- Advanced sensing in industrial, automotive, medical and consumer markets



TMS320F2812 controller block diagram.

2+2 Channel Simultaneous Sampling, 16-Bit ADC
ADS8361

Get samples, datasheets and EVMs at: **www.ti.com/sc/device/ADS8361**

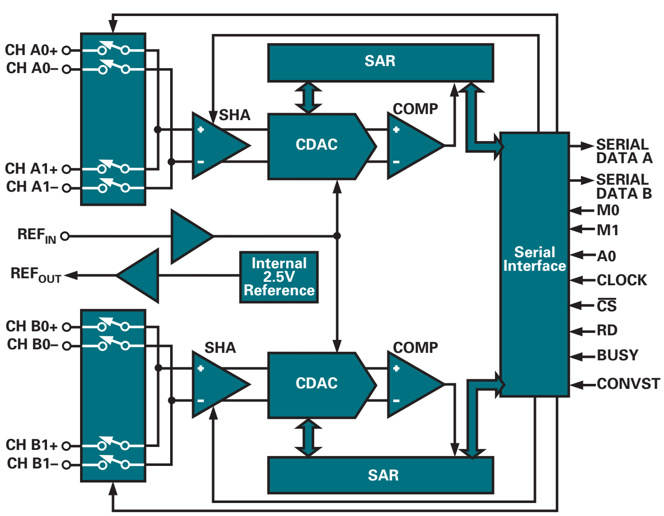
The ADS8361 is a 16-bit, 500kSPS ADC with four fully differential input channels grouped into two pairs for high-speed, simultaneous signal acquisition. The device offers a high-speed, dual serial interface and is available in an SSOP-24 package and specified over the –40°C to +85°C operating range.

Key Features

- Four fully differential input channels
- 2µs throughput per channel
- INL: ±3LSB (typ)
- Power consumption: 150mW
- Internal 2.5V reference
- Supply voltage: 2.7V to 5.5V
- Pin-compatible upgrade to ADS7861 (12- to 16-bit)

Family Member

- 12-bit, 2x2 channel, serial interface: ADS7861
- 12-bit, 2x2 channel, parallel interface: ADS7862
- 12-bit, 3x2 channel, parallel interface: ADS7864
- 16-bit, 2x2 channel, serial interface: ADS8361
- 16-bit, 6x1 channel, parallel interface: ADS8364



ADS8361 functional block diagram.

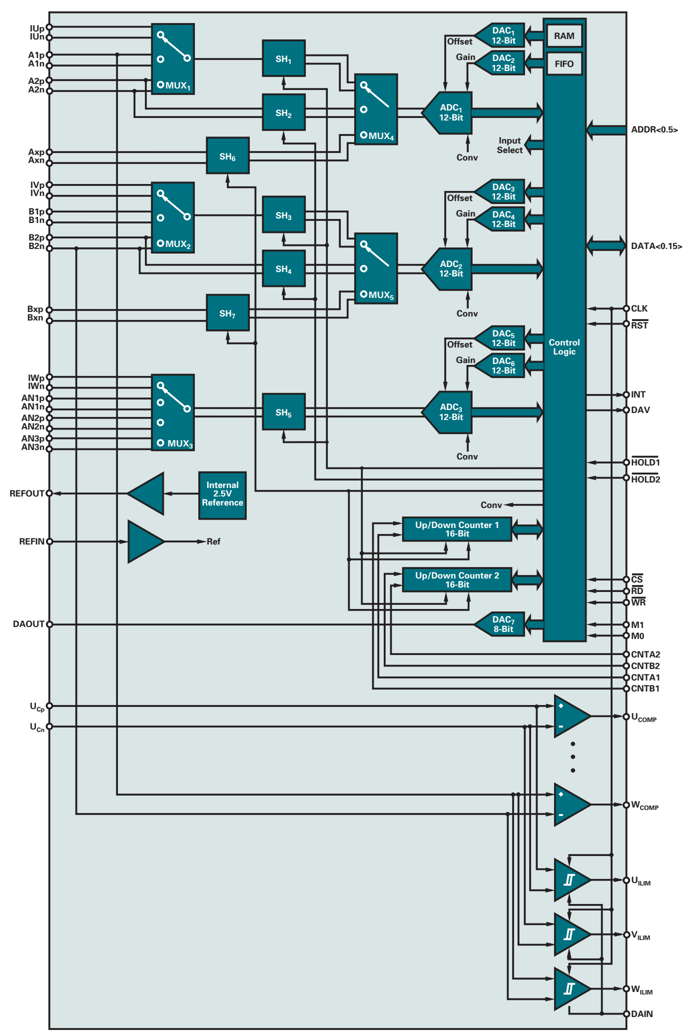
Complete Analog Front End
ADS7869

Get samples, datasheets and EVMs at: **www.ti.com/sc/device/ADS7869**

The ADS7869 is the next-generation successor of the well-known VECANA01 analog front end and includes three ADCs with a total of seven S/H capacitors and 12 fully differential input channels. There are four sign comparators connected to four input channels. The device offers a very flexible digital interface, featuring three different modes, starting from serial SPI, adjustable parallel up to the VECANA01-compatible mode. For position sensor analysis, two up-down counters are added on the silicon. This feature ensures that the analog input of the encoder is held at the same point of time as the counter value.

Key Features

- Resolution: 12-bits
- Sampling rate: 1MSPS
- INL: ±1LSB (typ)
- Two up-down counter modules on-chip
- Power consumption: 250mW
- Packaging: TQFP-100



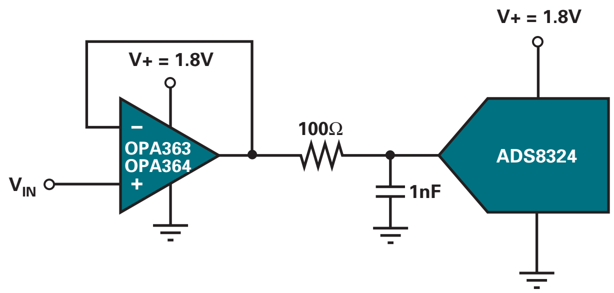
ADS7869 functional block diagram.

Asynchronous, DC and Servo Motors

1.8V, 7MHz, 90dB CMRR Rail-to-Rail I/O Op Amps
OPA363, OPA364

Get samples, datasheets and EVMs at: **www.ti.com/sc/device/OPA363 and www.ti.com/sc/device/OPA364**

The OPA363 and OPA364 families are high-performance CMOS op amps optimized for very low voltage, single-supply operation. Designed to operate on single supplies from 1.8V (±0.9V) to 5.5V (±2.25V), these amps are ideal for sensor amplification and signal conditioning in battery-powered systems. They are optimized for driving medium speed A/D converters (up to 100kHz) and offer excellent CMRR without the crossover associated with traditional complementary input stages. The input common mode range includes both the negative and positive supplies and the output voltage swing is within 10mV of the rails. All versions are specified for operation from –40°C to +125°C.



OPA363 functional block diagram.

Key Features
- Slew rate: 5V/µs
- Low offset: 500µV (max)
- Quiescent current: 750µA/channel (max)
- Available in single, dual and quad
- Packaging: SOT23-5, SO-8, MSOP-8, TSSOP-14, SO-14

Applications
- Signal conditioning
- Data acquisition
- Process control
- Test equipment
- Active filters

Device Recommendations

Device	Description	Key Features	Benefits	Other TI Solutions
Amplifiers				
OPA335	Zero-Drift Op Amp	0.05µV/°C Drift, 5µV Offset, RRIO at 3.3VDC, Single Supply	Best Long-Term Stability for Industrial Use, No Need for Dual Supply, Best in Class, Automotive Temp Range	OPA735, 12V Version with Improved Noise and Drift
INA326	High-Precision Instrumentation Amp	30nV/√Hz Noise, RRIO, Single Supply	Lowest Noise in the Industry and Best Long-Term Stability, No Need for Dual Supply	INA337, Automotive Temp Range, –40°C to +125°C
TMP121	Digital Temp Sensor	Integrated Diode Temp Sensor, ΔΣ ADC and SPI Interface to Convert Valve Temp into Digital Code or the DSP	High Resolution and Accuracy, Extended Industrial Temperature Range, Ultra Small Package	TMP175 (SMB-Bus Interface)
OPA227	Low Noise Amp	V_N = 3nV, CMRR > 120dB, V_S = 5 to 36V	Very Low Noise, Small Package	OPA350, OPA725
Interface				
SN65HVD1176	PROFIBUS Transceiver	Interfaces PROFIBUS Fieldbus to System Controller	Optimized for PROFIBUS, Up to 160 Users Per Bus, Up to 40Mbps	SN65HVD485E, Low-Cost Version
SN65HVD251	CAN-Bus Transceiver	Interfaces CAN-Fieldbus to System Controller	Improved Drop-In Replacement for PCA82C251, Tolerates ±200V Transients	SNHVD233 (3.3V Version)
Power Management Products				
REF3140	Voltage Reference	Drift = 20ppm/°C, 4.097V, 0.2%	Very Low Drift, Tiny Package	REF02, REF102
DCV010505D	Dual Converter	Isolation Converter, +5V_{IN}, ±5V_{OUT}	Low Noise, Small Board Area	DCP010505
TPS54110	SWIFT™ Buck Converter	Adjustable Output (0.9V to 3.3V), 1.5A	Very Easy to Use, Flexible Output	TPS64200
Data Converters				
ADS1206	V/F Converter	0-5V Input, 1-4MHz Output	Low Cost Direct DC-Link Current Measurement	INA19x, INA138
DAC7731	16-Bit, 5µs Settling Time	Output = ±10V, INL = 0.0015%	Small Package	DAC7741
Other				
FilterPro™	Free Design Software	Design Low Pass Filters, Quick, Easy	Free, www.ti.com/filterpro	—

Asynchronous, DC and Servo Motors

TMS320C28x™ Controller Generation

Device§	MIPS	Boot ROM	RAM	Flash/ ROM	Timers	CAP/ QEP	# PWM Channels	# Hi-Res PWM	12-Bit A/D Chs/ Conversion Time (ns)	EMIF	WD Timer	Comm Ports				I/O Pins	Core Voltage (V)	Packaging	($U.S.)+
												Other	SPI	SCI	CAN				
Flash Devices																			
TMS320**F2801**-PZA/S/Q§	100	8KB	12KB	32KB	9	2/1	6 + 2	3	16Ch/160	—	Y	I²C	2	1	1	32	1.8	100-LQFP	$5.79
TMS320**F2801**-GGMA/S/Q§	100	8KB	12KB	32KB	9	2/1	6 + 2	3	16Ch/160	—	Y	I²C	2	1	1	32	1.8	100-BGA	$5.79
TMS320**F2806**-PZA/S/Q§	100	8KB	20KB	64KB	15	4/2	12 + 4	4	16Ch/160	—	Y	I²C	4	2	1	32	1.8	100-LQFP	$8.69
TMS320**F2806**-GGMA/S/Q§	100	8KB	20KB	64KB	15	4/2	12 + 4	4	16Ch/160	—	Y	I²C	4	2	1	32	1.8	100-BGA	$8.69
TMS320**F2808**-PZA/S/Q§	100	8KB	36KB	128KB	15	4/2	12 + 4	4	16Ch/160	—	Y	I²C	4	2	2	32	1.8	100-LQFP	$11.52
TMS320**F2808**-GGMA/S/Q§	100	8KB	36KB	128KB	15	4/2	12 + 4	4	16Ch/160	—	Y	I²C	4	2	2	32	1.8	100-BGA	$11.52
TMS320**F2810**-PBKA/S/Q§	150	8KB	36KB	128KB	7	6/2	16	—	16Ch/80	—	Y	McBSP	1	2	1	56	1.9	128-LQFP	$13.81
TMS320**F2811**-PBKA/S/Q§	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	—	Y	McBSP	1	2	1	56	1.9	128-LQFP	$14.73
TMS320**F2812**-GHHA/S/Q§	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	179-BGA	$15.65
TMS320**F2812**-PGFA/S/Q§	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	176-LQFP	$15.65
RAM-Only Devices																			
TMS320**R2811**-PBKA/Q§	150	8KB	40KB	—	7	6/2	16	—	16Ch/80	—	Y	McBSP	1	2	1	56	1.9	128-LQFP	$ 9.11
TMS320**R2812**-GHHA/Q§	150	8KB	40KB	—	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	179-BGA	$10.63
TMS320**R2812**-PGFA/Q§	150	8KB	40KB	—	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	176-LQFP	$10.63
ROM Devices																			
TMS320**C2810**-PBKA/Q§	150	8KB	36KB	128KB	7	6/2	16	—	16Ch/80	—	Y	McBSP	1	2	1	56	1.9	128-LQFP	$7.05✦
TMS320**C2811**-PBKA/Q§	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	—	Y	McBSP	1	2	1	56	1.9	128-LQFP	$8.22✦
TMS320**C2812**-GHHA/Q§	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	179-BGA	$9.59✦
TMS320**C2812**-PGFA/Q§	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	176-LQFP	$9.59✦

+ Prices are quoted in U.S. dollars and represent year 2006 suggested resale pricing. All prices are subject to change. Customers are advised to obtain the most current and complete pricing information from TI prior to placing orders. TI may verify final pricing prior to accepting any order.

✦ Minimum volumes for C281x devices are 10 KU with NRE of $11,000.

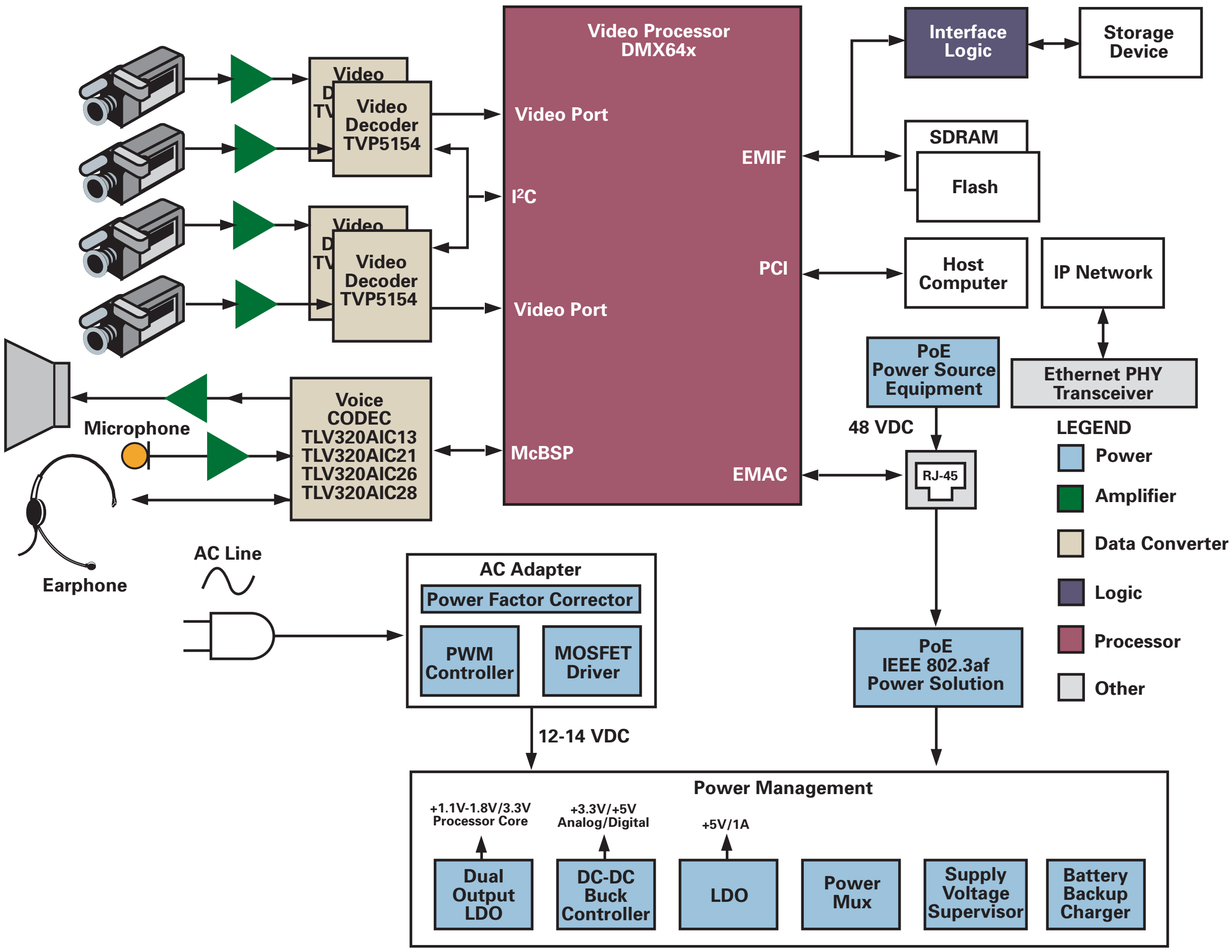
§ A = –40° to 85°C; S = –40 to 125°C (10% adder over A); Q = –40 to 125°C, Q100 qualified (15% adder over S)

All devices are available in PB-Free Green packaging.

Surveillance Cameras, Glass Breakage and Smoke Detectors

Surveillance IP Video Node Basics

Digital video surveillance systems include embedded image capture capabilities which allow video images or extracted information to be compressed, stored or transmitted over communication networks or digital data links. The TVP51xx video decoder family offers a high-performance, low-cost analog video interface supporting PAL/NTSC/SECAM video systems. Fast lock times and superior analog processing capabilities make them an ideal fit for any kind of streaming video applications. A typical audio subsystem consists of an audio codec and an audio amplifier. The TPA3007D1, based on the patented filter-free modulation scheme, is a high-efficiency, state-of-the-art, Class-D audio amplifier. TI's video surveillance solutions are primarily based on the high-performance TMS320DM64x digital media processors, which have on-chip video ports for easy connection to video devices. The DM64x devices are capable of handling both video and audio encode/decode for IP-based video surveillance applications. Cost-competitive video compression/decompression algorithms are available from TI or through our partner network for JPEG, MPEG2, MPEG4, H.264, and more. Audio compression/decompression algorithms are also available.



IP Video Node block diagram.

Surveillance Cameras, Glass Breakage and Smoke Detectors

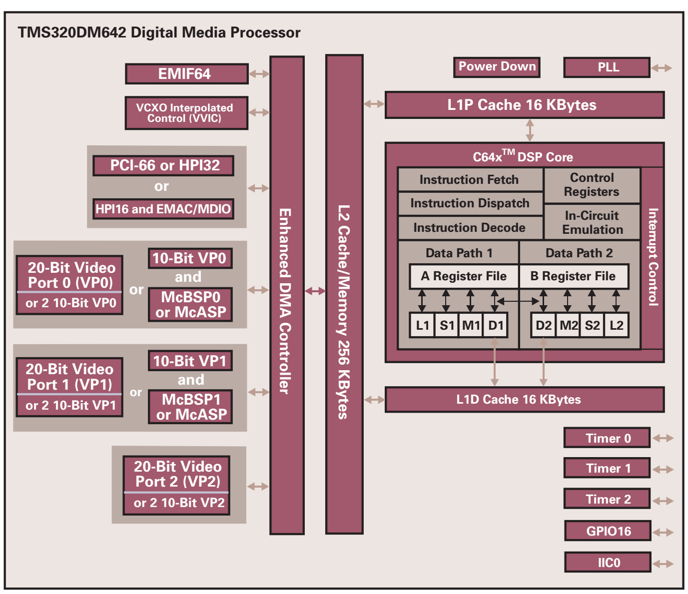
High-Performance Digital Signal Processors
TMS320DM64x

Get samples, datasheets and app reports at:
www.ti.com/sc/device/TMS320DM642

TI's video surveillance solutions are primarily based on the high-performance DM64x DSP-based digital media processors. The DM64x digital media processors have on-chip video ports for easy connection to video devices and are capable of handling both video and audio encode/decode for IP-based video surveillance applications. The single programmable digital media processor is a cost-effective solution, because the need for external PCI or EMAC is eliminated.

Key Features
- Performance up to 5760MIPS performance at 720MHz
- Multiple input/output glueless interfaces for common video and audio formats
- Performance real-time video encoding, decoding, or transcoding
- Three dual-channel video ports support simultaneous video input and output
- Advanced connectivity with 10/100 Ethernet MAC and 66MHz PCI
- Ready-to-use application software such as MPEG-4, MPEG-2, MPEG-1, WMV9, H.26L, H.263, H.261, M-JPEG, JPEG2000, JPEG, H.264 and more.

Applications
- Network camera-based surveillance and IP video nodes
- Video-on-demand set-top boxes, personal video recorders and digital media centers
- Statistical multiplexer and broadcast encoders
- IP-based video conferencing and IP-based videophones



TMS320DM642 digital media processor block diagram.

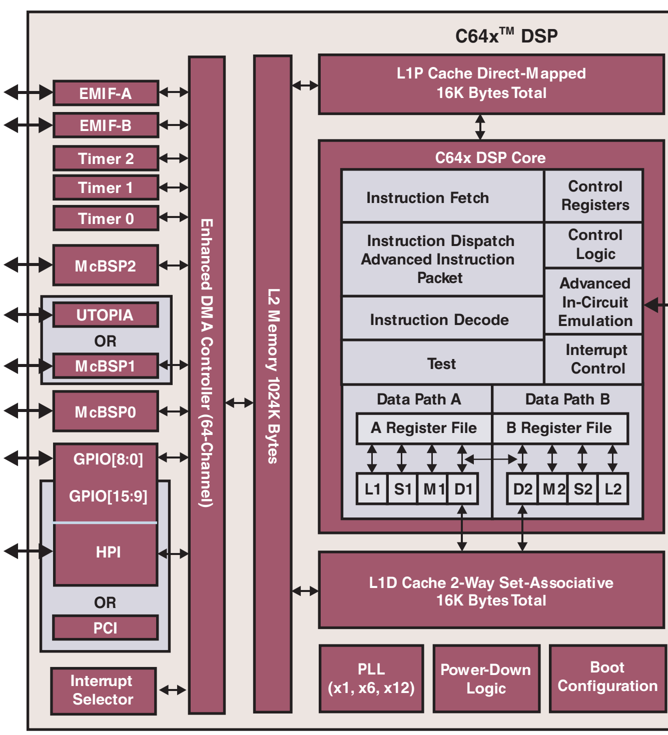
High-Performance Digital Signal Processors
TMS320C6414T, TMS320C6415T

Get samples, datasheets and app reports at:
www.ti.com/sc/device/TMS320C6414T,
www.ti.com/sc/device/TMS320C6415T

TMS320C64x™ DSPs offer the highest level of performance to meet the demands of the digital age. At clock rates up to 1GHz, the C64x™ DSPs can process information at a rate of more than 8000MIPS. TI's C64x DSPs are backed by an extensive selection of optimized algorithms and industry-leading development tools.

Key Features
- Highest in-class performance with production-class devices available up to 1GHz
- TMS320C64x DSPs are 100% code-compatible with TMS320C6000™ DSPs
- C64x DSPs offer up to 8000MIPS with costs as low as $20.00
- Advanced C Compiler and Assembly optimize efficiency and performance
- Packaging: 23/27mm BGA options

Applications
- Statistical multiplexers
- Broadcast encoders
- Video conferencing
- Video surveillance



TMS320C6415T DSP block diagram.

Surveillance Cameras, Glass Breakage and Smoke Detectors

Device Recommendations

Device	Description	Key Features	Benefits
Amplifiers			
TLV246x	Op Amp	Ideal for Audio Amplification, Low Power Consumption	Cost-Effective Solution with Low Noise and Small SOT-23 Package
TPA3007D1	Class-D Audio Power Amp	6.5W into an 8Ω Load from 12V Supply, 3rd Generation Modulation Technique, Short Circuit Protected	Replaces Large LC Filter with Small Ferrite Bead Filter, No Heatsink Required, Improved Efficiency, Improved SNR
Data Converters			
TVP5146	NTSC/PAL/SECAM 4 x10-Bit Digital Video Decoder w/Macrovision	Quad, 30MSPS, 10-Bit ADC, Supports Component YPrPb/RGB, Programmable Video Output Format, Certified Macrovision Copy Protection Detection, Built-In Video Processing, VBI Data Processor, I^2C Interface	10 Video Inputs, SCART Support, Includes a 5-line Adaptive Comb Filter for Best-in-Class Y/C Separation, 4 10-Bit, 30MSPS ADCs for Superior Noise Performance
TVP5150A	8-Bit Video Decoder (PAL, NTSC, SECAM)	Single 8-Bit ADC, Composite and S-Video Support, Built-In Video Processing, I^2C Interface	2 Video Inputs, 4-line Adaptive Comb Filter, Fast Lock Times, Extremely Low Power, Low Cost
TLV320AIC12	Dual-Channel Voice Codec	Programmable Sampling Rate Up to: Max 26kSPS w/On-Chip IIR/FIR Filter, Max 104kSPS w/IIR/FIR Bypassed, Built-In Amps for Microphones/Speakers	Directly Connect to McBSP without Logic, Interface with Multiple Analog I/Os DSP Software, Analog/Digital PGA to Increase Performance
Processor			
TMS320DM642	Video Processor	Ability to Perform Video/Audio Encode on Multiple Channels, Direct I/F to NTSC/PAL Decoder Through Video Ports/Audio Through McBSP	Cost Effective with Single Programmable DSP, No Need for External PCI or EMAC, Eliminates the Need for External FPGA
Power Management Products			
TPS2383	Power Sourcing Equipment Power Managers (PSEPM)	Internal PD Detection Signature Output, Internal PD Classification Output, Programmable Inrush Current Limit, 0.3Ω Low-Side FET Input, Internal Thermal Protection and UVLO Compliant to the PoE IEEE 802.3af Standard	Individually Manage Power for Up to 8 Ethernet Ports, All Operations of the TPS2383A are Controlled Through Register Read and Write Operations Over a Standard (Slave) I^2C Serial Interface
UCC1809/ 2809/3809	Current Mode PWM Controller	Programmable Soft Start with Active Low Shutdown	Anti-Cross Conduction Circuitry, Allows the Output to Sink Current by Allowing the Synchronous Rectifier to Turn on w/o the Switch Node Collapsing
TPS2370	Power Interface Switch	All Detection, Classification, Inrush Current Limiting and Switch FET Control Necessary for Compliance with IEEE 802.3af Standard	Low-Input Voltages (1.8V to 10V), Draws >12µA, Allowing Accurate Sensing of the External 24.9-kΩ Discovery Resistor
TPS76850	Fast-Transient-Response 1A LDO	Low Drop-Out = 230mV at 1A, 2% Tolerance, Open Drain Power Good, Thermal Shutdown Protection	Designed to Have a Fast Transient Response and be Stable with 10µF Low ESR Cap at Low Cost
TPS70148	Dual-Output LDO for DSP Systems	1.2V/1.5V/1.8V/2.5V/3.3V Options for Dual-Output Voltages, Selectable Power-Up Sequence for DSP Applications, Power-On Reset with Delay, Power Good, Two Manual Reset, Thermal Shutdown	Complete Power Management Solution Designed for TMS320™ DSP Family, Easy Programmability, Differentiated Features: Accuracy, Fast, Transient Response, SVS Supervisory, Reset and Enable Pins
TPS5130	Triple Sync Buck Controller with LDO	3 Independent Step-Down DC/DCs and 1 LDO, 1.1V-28V Input Range, 0.9V to 5.5V Output Range, Sync for High Efficiency, Auto PWM/SKIP Overvoltage/Current Protection, Short-Circuit Protection	On-Chip Sync Rectifier Drives Less Expensive N-Ch MOSFET, Allows Smaller Input Cap to Reduce Cost, Resistor-Less Current Protection Reduces External Part Count

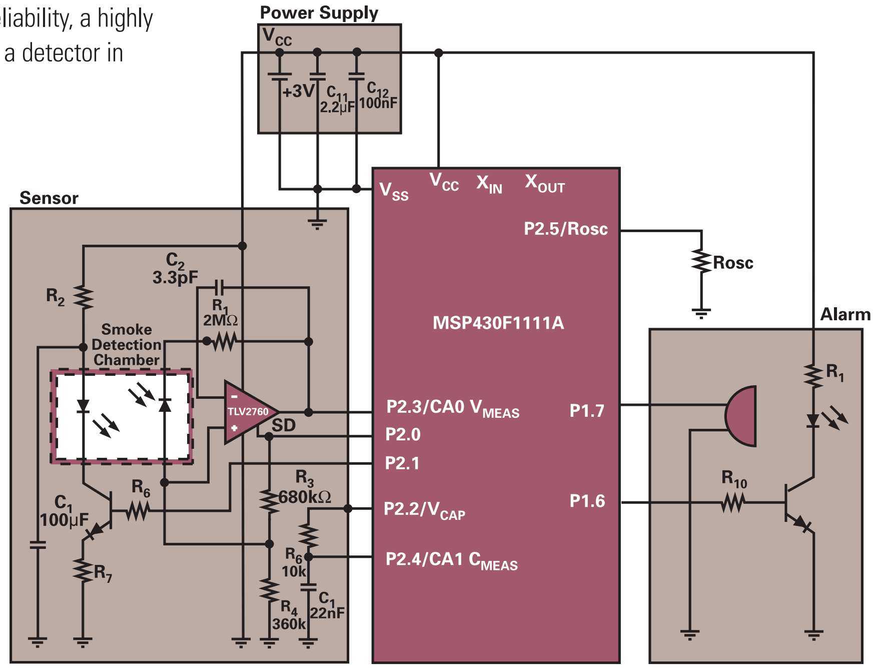
Surveillance Cameras, Glass Breakage and Smoke Detectors

Smoke Detector

Smoke detection is a critical application, not only because life can depend on the reliability of the sensor, but also because false alarms can be quite costly. There are several ways to detect smoke, but optical detection is the most common. In order to achieve high reliability, a highly integrated solution is desirable. Due to laws that require a detector in every room (e.g. in hotels) cost is also a decisive factor.

In order to achieve low maintenance costs, batteries must have several years of life which require a pulsed application with fast wake-up time, fast processing time and exceptionally low stand-by current. This makes the ultra-low-power MSP430 microcontroller an ideal choice for this application.

The figure at right, shows the heart of a smoke detector. A pulsed IR-transmitter and IR-receiver are located in a non-reflective measurement chamber which has to be protected against outside light, only light from the IR-transmitter, which is reflected by the smoke, can reach the IR-receiver. Two subsequent measurements are performed. The first measures the surrounding light when the IR-transmitter is switched off; the second measures reflected light when the IR-transmitter is switched on. This differential measurement method requires not only a high dynamic range linearity sensor and circuitry, but also a high linearity of the system.



Smoke detector block diagram.

Device Recommendations

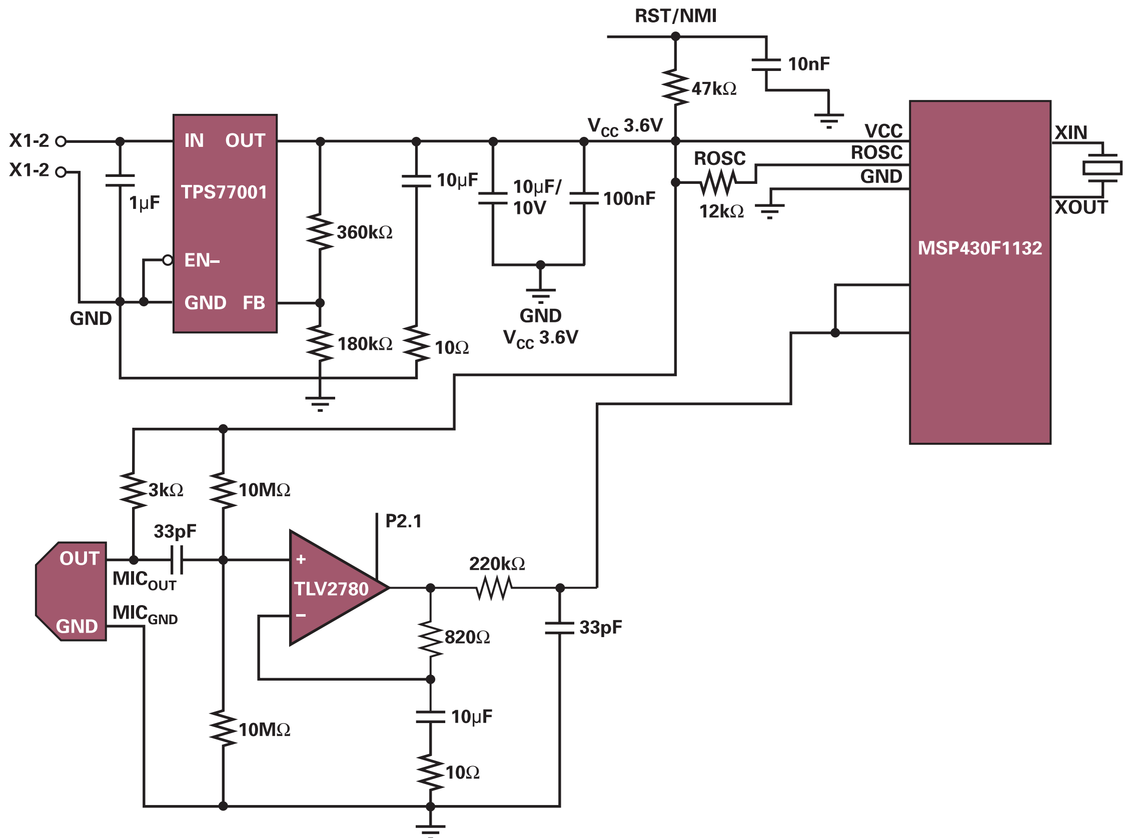
Device Type	Recommended Device	Device Characteristics
Microcontroller	MSP430F1111A	1.8V to 3.6V Lowest-Power µcontroller with Analog Comparator for Dual Slope A/D Conversion
Operational Amplifiers	OPAx340	Fast RRIO Transimpedance Amplifier with Trimmed Offset Voltage
	OPAx336	Low-Offset, Low-Drift, RRO Amplifier with Only 32µA Quiescent Current
	OPAx381	Fast, Zero-Drift Transimpedance Amplifier with <1mA Quiescent Current
	TLV247x	Fast, Lowest-Drift 0.4µV/°C, General-Purpose Amplifier with Shutdown
	TLV276x	Medium Speed, 1.8V RRIO Amplifier with Shutdown and Fast Turn On/Off Time
	TLV224x	1µA, 5kHz, RRIO Nanopower Operational Amplifier
	OPAx379	1.8V, 2µA, 100kHz, RRIO Nanopower Operational Amplifier

*New devices appear in **bold red**.*

Surveillance Cameras, Glass Breakage and Smoke Detectors

Glass Breakage Detector

The typical acoustic glass breakage sensor works by using a microphone to measure the sound spectrum of pressure differences in the glass. The first signal wave represents the vibration caused by an object hitting the glass. This frequency is in the 200kHz range. The second signal, in the 5kHz frequency range, occurs when the glass breaks. The figure below shows an implementation using a low dropout regulator, an amplifier and the MSP430 microcontroller with an onboard ADC. A fast rail-to-rail amplifier is needed to boost the transducer signal to the ADC input voltage range. All following stages are integrated into the MSP430 signal controller.



Glass breakage detector block diagram.

Device Recommendations

Device Type	Recommended Device	Device Characteristics
Microcontroller	MSP430F1132	1.8V to 3.6V V_{CC}, industry's lowest-power µcontroller with integrated 10-bit, 200kSPS ADC
Operational Amplifiers	TLV278x	Fast 8MHz GBW, 4.3V/µs SR, 1.8V, RRIO operational amplifier with shutdown
	OPAx363	Fast 7MHz GBW, 6V/µs SR, 1.8V, RRIO amplifier with excellent input linearity and shutdown
	OPA336	2.3V to 5.5V single supply, RRO within 3mV, 20µA/amp I_Q, 125µV (max) offset, 1pA bias current
	OPA348	1MHz BW, 2.1V to 5.5V single supply, RRIO, 45µA (typ) I_Q, 0.5pA bias current
	OPA381	18MHz GBW, extremely high precision, excellent long-term stability, low 1/f noise, 5 decades dynamic range, 800µA I_Q
Voltage Regulator	TPS77001	Adjustable, 50mA output current voltage regulator with low dropout and low quiescent current
Data Converter	ADS7866	Lower power family at 8-, 10-, 12-bit >200kSPS, 1.2V to 3.6V ADC

Electronic E-Meter

Electromechanical meters have been the standard for metering electricity since billing began. Today's electric companies are demanding more information from meters in the residential sector, where metering has typically been limited to kilowatt hours. New features such as multi-tariff billing, reactive energy measurement and power quality monitoring are desirable to improve generation, distribution, customer service and billing. In order to accommodate the advanced requirements not available in electromechanical meters, manufacturers have begun adopting all-electronic solutions. New energy measurement integrated circuits from TI enable accurate, dependable and robust meters with key features demanded by utility companies. TI offers the first single-chip IC for electronic meters along with analog products needed to complete a state-of-the-art e-meter design while saving the manufacturer valuable design time and cost of development.

Electronic E-Meter

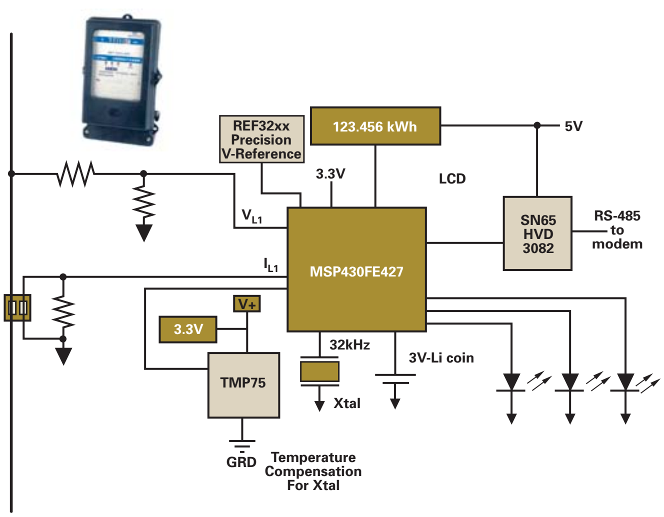
Industry's First Single-Chip IC for Electronic Energy Meters
- Single-chip solution for electronic e-meter application
- Single supplier solution
- Analog Front End (AFE) with coprocessor integrated in the ESP430CE1 module.
- Ultra-low-power MSP430FE42x for extremely long life cycles
- Main CPU can run mainly for communication like ripple control, tariff switching or sleep
- Provides shunts, current transformers (CT) and di/dt sensors like Rogowski coils

Calculated Results
- Active, reactive, apparent power
- Software programmable metering start current

Calculated Results (Cont.)
- Status
- Waveform samples
- Power factor
- DC removal
- Mains period
- RMS, peak values (current/voltage)
- Temperature
- Line cycle counter
- Automatic voltage drop detection – level select by software
- Tamper detection for single-phase, 2-wire metering

Next-Generation Electronic E-Meter

The MSP430FE42x is designed to meet the requirements of next-generation electronic e-meters including the ability to meet different international standards such as IEC62053-21/22/23 (Europe) and ANSI C12.XX (U.S.) High integration provides for an easy-to-use solution with the smallest size and lowest cost.



Device Recommendations

Device	Description	Key Features	Benefits	Other TI Solutions
Microcontroller				
MSP430F427	Ultra-Low-Power, 16-Bit RISC CPU	Single-Chip IC for Electronic E-meter	Easily Integrated Solution in a Small Package and Lowest Cost	MSP430FE423/FE25
Interface				
SN65HVD3082E	5V, Half-Duplex RS-485 Transceiver	Ideal for Metering Applications, Low Power Consumption and Slew Rate Control	Cost-Effective Solution with Low-Power and Slew Rate Control	SN65HVD3085E
SN65LBC184	5V, Half-Duplex RS-485 Transceiver	Ideal for Metering Applications, Integrated Transient Voltage Protection and Slew Rate Control	Integrated Transient Voltage Protection for Highest Reliability	SN65LBC182
Data Converter				
ADS8364	6Ch, 16-Bit, 250kHz SAR	High-Speed Simultaneous Sampling ADC for	Fastest Control Loop to Secure Circuit Breaker Shut Off	ADS1204
Voltage Reference				
REF32xx	4ppm/°C, 100µA, SOT23-6, Series Voltage Reference	Very Low Drift, High Output Current ±10mA, High Accuracy 0.01%, Low Quiescent Current 100µA	Small Package, Excellent Performance, Competitive Price	REF31xx, REF30xx, REF29xx, REF02,
Amplifier				
OPA363	Rail-to-Rail, 1.8V, High CMRR, GBW 7MHz	Low Noise , No Crossover Distortion at Low Power	Ideal for Driving High-Speed and Precision 16-Bit ADCs	OPA2822, OPA350
Digital Temperature Sensor				
TMP75	Digital Temp Sensor with Two-Wire Interface	9 to 12-Bit User Selectable, ±1.5˚C (max) from –25˚C to +85˚C, Low Quiescent Current 50µA	Low Power, Small Package, High Resolution, Good Accuracy	TMP175, TMP100

Scientific Instrumentation

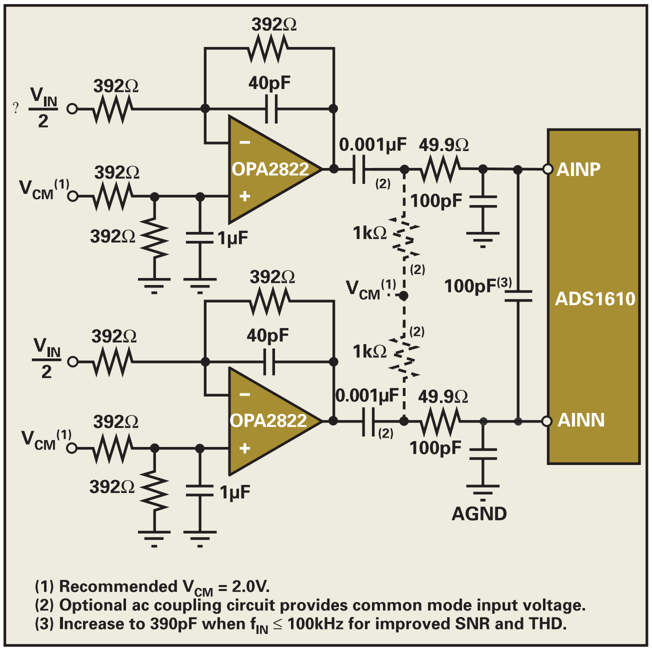
Scientific Instrumentation

In today's industrial scientific instrumentation applications, such as gas/liquid chromatography, mass spectrometry and vibration analysis, the analog signal requires processing with maximum resolution at the highest speed while achieving optimum signal-to-noise ratio, lowest ripple and THD. For automatic test equipment (ATE), an excellent DNL and INL are also expected.

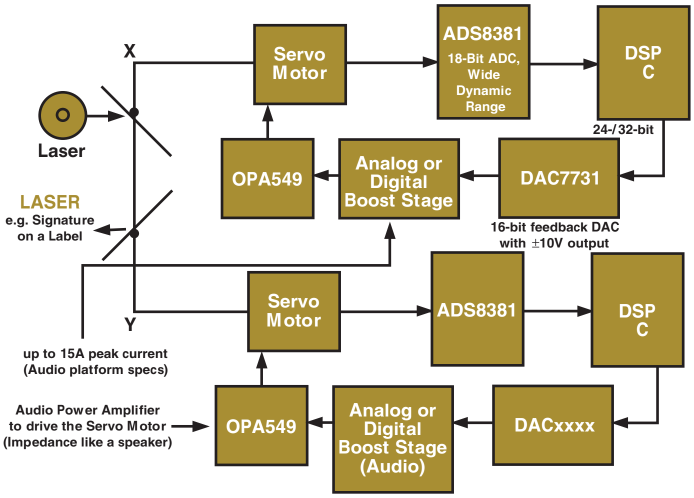
In gas chromatography applications, an ADC converts the signal and separates the desired frequency product from the mixture. Combining high resolution (16- to 18-bit range) with the highest speed (MHz range) while achieving high SNR is the major challenge.

The ADS160x family of 16-bit, high-speed, delta-sigma ADCs was developed for applications based on Adaptively Randomized Data Weighted Averaging (DWA) Algorithm architecture and works up to 10MHz (10MHz in 2x mode) bandwidth while achieving SFDR above 100dB.

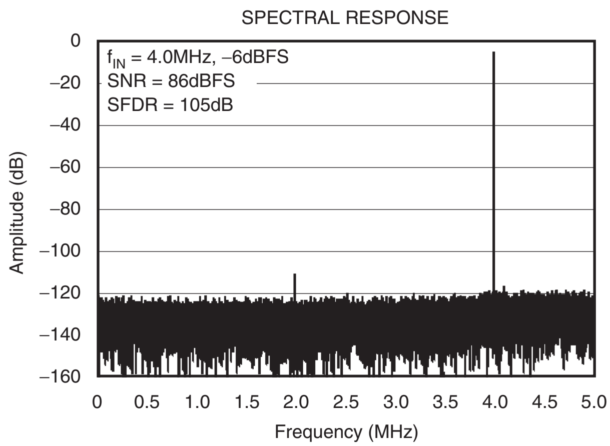
In applications such as mirror positioning for precision laser beam control, a very fast, high-resolution control loop is needed to achieve maximum accuracy and throughput. The ADC needs to have the lowest latency at maximum resolution to position the laser. The application below shows the ADS8381 (18-bit, 500kHz)—one of the fastest SAR ADCs available—with 112dB SFDR and 18-bits NMC.



Recommended high-speed ADC driver circuit using OPA2822.



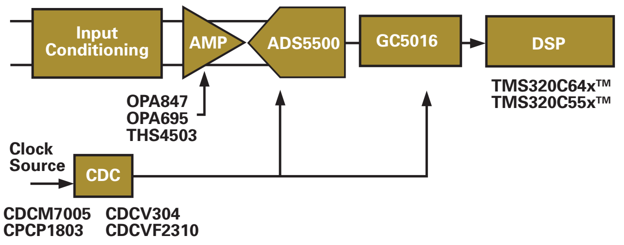
DWF1-364838 laser mirror positioning application, test and working principle: 1 mirror for 1 direction.



ADS1610 spectral response.

High-Speed Signal Analysis

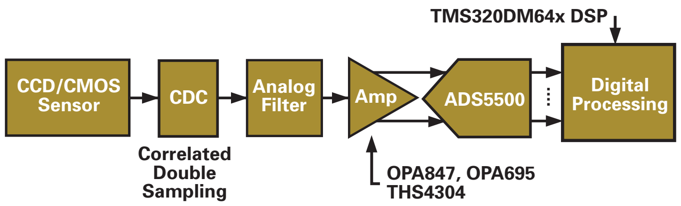
High-speed test and measurement applications are characterized by the need for high SNR, high sampling rate and other high-speed characteristics as determined by the system designer. Input signals may be large bandwidth and thus the input bandwidth of the ADC becomes critical. At the same time, to support input frequencies higher than 1/2 the ADC's sampling rate, undersampling is often applied, requiring the converter to perform well (SNR/SFDR) at these high input frequencies. Peripheral functions also have a dramatic impact on signal-chain performance. The amplifier driving the ADC has a direct impact on SNR/SFDR, thus it must be chosen carefully to maintain specified system performance. Additionally, ADC performance is critically impacted by clock jitter; thus, a low-jitter clock source can provide an ideal solution.



ADS5500 in test and measurement applications.

ADCs in Video and Imaging

The ADS5500's 14-bit resolution provides higher SNR to process high-quality images accurately, and simplifies the analog input circuitry by reducing the need for programmable gain amplifiers. Also, its high sample rate allows designers to scan images faster or oversample the input signal, which simplifies analog filter design and lowers system cost. The ADS5500's low power dissipation extends battery life in portable systems and provides cost savings due to the lower power supply and system thermal management requirements.



ADS5500 in video and imaging applications.

High-Performance ADCs

Device	Resolution (Bits)	Speed (MSPS)	SNR (dBc)	SFDR (dB)
ADS5444	13	250	68 at 230MHz IF	75 at 230MHz IF
ADS5440	13	210	68 at 230MHz IF	79 at 230MHz IF
ADS5500	14	125	69.5 at 100MHz IF	82 at 100MHz IF
ADS5424	14	105	74 at 50MHz IF	93 at 50MHZ IF
ADS5541	14	105	71 at 100MHz IF	86 at 100MHz IF
ADS5423	14	80	74 at 50MHz IF	94 at 50MHz IF
ADS5520	12	125	68.7 at 100MHz IF	82 at 100MHz IF
ADS5521	12	105	69 at 100MHz IF	86 at 100MHz IF

Additional Products

TI Solution	Device	Device Characteristics
High-Speed Amplifier	OPA695	Ultra-Wideband (1.4GHz), Current-Feedback, 2500V/µs Slew Rate (G=+2)
High-Speed Amplifier	THS9000/THS9001	50 to 350MHz Cascadeable Op Amp Optimized for High IF Frequencies
Digital-to-Analog Converter	DAC5686/DAC5687	Dual-Channel, 16-Bit, 500MSPS with Selectable 2x to 16x Interpolation Comms DAC
Digital Up/Down Converter	GC5016	Wideband, Quad, Channels Independently Configurable, Low Power
Clock Distribution Circuit	CDCM7005/CDC7005	Low-Phase Noise, Low-Skew Clock Synthesizer and Jitter Cleaner, 3.3V Supply
Digital Signal Processors	TMS320C64x™, TMS320C55x™	16-Bit, Fixed-Point DSPs, Up to 1GHz Clock Rates and 8-Giga MACs of Performance, With the Industry's Best Power-Consumption Benchmarks
Digital Signal Processor	TMS320C67x™	32-Bit DSPs With Up to 1G FLOPS of Floating-Point Processing Performance
High-Speed Amplifier	THS4509	Ultra-Low Noise, Wideband Amplifier

RF Applications

Industrial applications have had to wait many years for the availability of effective wireless solutions to overcome shop floor communications obstacles such as expensive cables and wiring costs. To date, efforts to simplify industrial interface has met with little success especially with more recent demands for lower power and overall system costs in applications such as metering, security systems, fire detectors and HVAC systems.

In response to these market demands, TI has introduced a multiband radio frequency (RF) transceiver, TRF6903, and transmitter, TRF4903. These devices can wirelessly transmit and/or receive up to 64kbps of data for the 315, 433, 868, and 915MHz industrial, scientific and medical (ISM) bands. The devices can interface easily to a baseband processor such as TI's MSP430. A synchronized data clock, provided by the TRF6903 and TRF4903, is programmable for most common data rates, eases baseband processing and reduces code complexity. The devices work exceptionally well with various MSP430 microprocessor family members and has complete EVM kits and software available.

The TRF6903 and TRF4903 are also single-chip solutions for low-cost multiband Frequency Shift Keying (FSK) or On/Off Keying (OOK) devices used to establish a frequency-programmable, half-duplex, bidirectional RF link. The devices operate down to 2.2V and are designed for low power consumption with a 0.6µA standby current.

For frequency hopping systems, these devices are the fastest and most efficient hoppers available. The TRF6903 and TRF4903 require no calibration when switching to a new frequency which makes them highly efficient at high data rates.

Features

- Transceiver (TRF6903) and Transmitter (TRF4903) available
- 315, 433, 868 and 915MHz operation
- Apt for frequency hopping protocols
- Clock recovery with training recognition
- Standby current: 0.6µA (typ)
- 2.2V to 3.6V operation
- Output power: +8dBm (typ)
- FSK/OOK modes of operation
- Data rates up to 64kbps
- Industrial temperature range: –40°C to +85°C

Tools Available

- Free samples
- Evaluation modules at $149 each:
  - MSP-TRF6903-DEMO: Two boards equipped with TRF6903 and MSP430F449
  - MSP-TRF4903-DEMO: Two boards equipped with TRF4903 and MSP430F449.

The EVM kits for the TRF6903 and TRF4903 are used to demonstrate a bidirectional RF link between the two boards and for prototyping by downloading new software code to the MSP430F449 using a JTAG connector. The schematic and board layouts can be used as a reference design if desired. A user's guide is included.

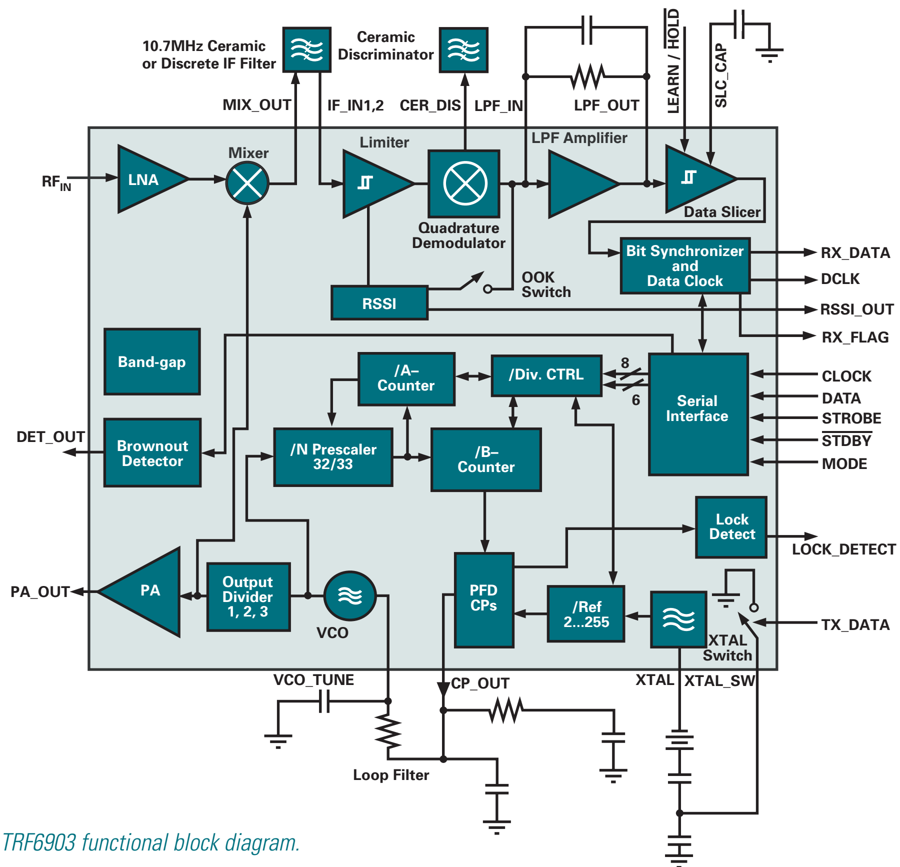
System Design Software

EasyRF™ tools for TRF6903: Calculates values for PLL filter, LNA, PA matching, crystal switch caps, IF matching and S/H capacitors.

EasyRF for TRF4903: Calculates values for PLL filter, PA matching, and crystal switch caps.

TRF6900 wireless connection for 315, 433, 868, and 915MHz operation.

To download these tools or for further information on ISM RF, please visit www.ti.com/ismrf



TRF6903 functional block diagram.

Wireless Communication Devices for Industrial Applications

Device	Description	Frequency (MHz) (min)	Frequency (MHz) (max)	Standards Supported	Output Power (dBm)	Operating Voltage (V) (min)	Operating Voltage (V) (max)	Current (µA)	Package	Price[1]
TRF6903	RF Transceiver	315	915	FSK, OOK	8	2.2	3.6	0.6	PQFP-48	$2.85
TRF6901	RF Transceiver	860	930	FSK, OOK	8	1.8	3.6	0.6	PQFP-48	$2.70
TRF6900A	RF Transceiver	850	950	FSK, Narrow-Band FM	5	2.2	3.6	0.5	PQFP-48	$3.20
TRF5901	RF Transceiver	902	928	FSK, Narrow-Band FM	5	3	3.6	0.5	PQFP-48	$3.20
TRF4903	RF Transmitter	315	915	FSK, OOK	8	2.2	3.6	0.6	TSSOP-24	$2.00
TRF4900	RF Transmitter	850	950	FSK, Narrow-Band FM	7	2.2	3.3	0.5	TSSOP-24	$1.90
TRF4400	RF Transmitter	420	450	FSK, Narrow-Band FM	7	2.2	3.6	0.5	TSSOP-24	$1.90

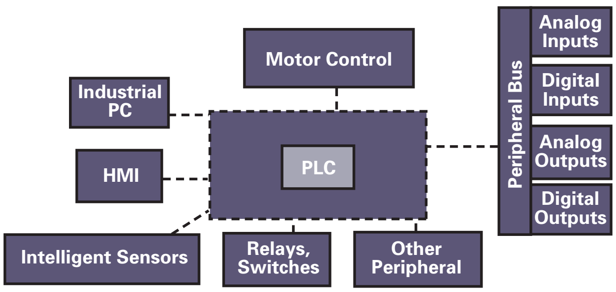
[1]*Suggested resale price in U.S. dollars in quantities of 1,000.*

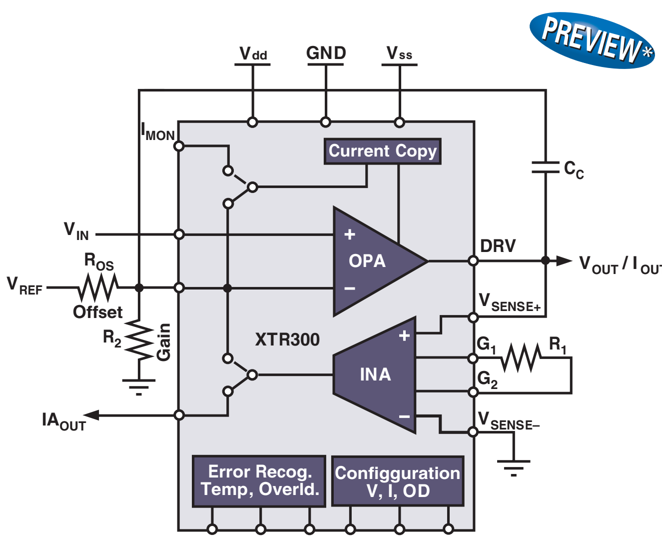
Input/Output Cards, Internal Communication/Interface/Isolation, Core Logic

Programmable Logic Controls (PLC) are widely used in industrial applications primarily in the areas of factory and process automation. PLC systems consist of different subsystems realized either as complete integrated systems or as base unit plus plug-in cards/ modules for different options.

Industrial Analog I/Os

PLCs and field extension modules control large numbers of electronic actuators, such as motors, solenoids and electronic ballasts. Due to the wide range of actuators and their different performance requirements, the XTR300 provides signals in the form of drive voltage or current with large voltage offset compliance. Typical voltage ranges are ±5V, ±10V, while current ranges include ±20mA, ±10mA, as well as 0-20mA and 4-20mA.





XTR300 functional block diagram.

In addition to these common ranges, many proprietary signal interfaces exist, which all have one problem in common; tailoring the electronic drive's design to match the required actuator's input.

To ease this design task, TI has developed an industrial analog current/voltage output driver, the XTR300. This device provides an operational amplifier working as a signal driver in the forward direction, and an instrumentation amplifier in the feedback loop.

Digital control sets the XTR300 into voltage-output or current-output mode. Error flags indicate over-temperature, load-error, and common-mode error.

For most applications the setting of just two resistor values (R_1 and R_2), as well as the selection between current or voltage mode, is sufficient to accommodate a wide range of output signals of up to ±25mA or ±17.5V.

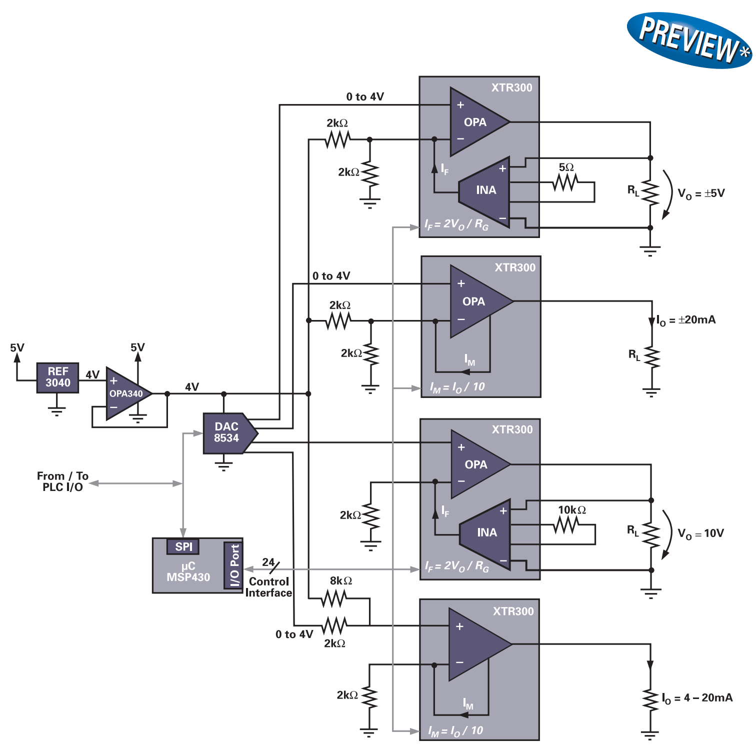
For more exotic output ranges, modification of the reference voltage, V_{REF}, and the gain resistor, R_{OS}, is possible.

The figure to the right (pg 35) shows a typical application for a single-channel output of ±10V or ±20mA, depending on the XTR300's digital control for either voltage or current mode.

A reference voltage is applied to the control DAC, DAC8531, and to the XTR300. The microcontroller performs device configuration, error monitoring and also provides the DAC input code. The analog output of the DAC8531 feeds the input of the XTR300, which then drives the load behind the terminal connector.

For a floating load, switch S_1 provides the option for establishing ground referred input signals to the instrumentation amplifier. The LC and RC networks perform RF- and LF-noise rejection.

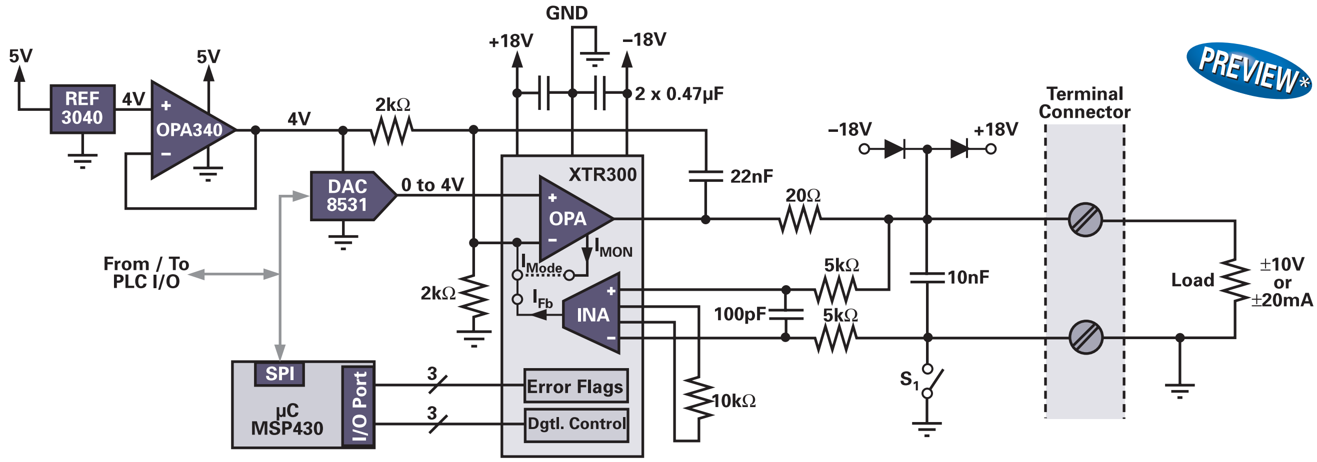
The multi-channel driver shown below uses a quad DAC, DAC8534, to control four XTR300 drivers, each providing a different output range.



Quad-channel drive with 4 x XTR300.

*Expected XTR300 release date, 2Q 2006.

Input/Output Cards, Internal Communication/Interface/Isolation, Core Logic



Single-channel drive with XTR300, V_{IN} = 0 – 4V, V_{OUT} = ±10V or I_{OUT} = ±20mA.

**Expected XTR300 release date, 2Q 2006.*

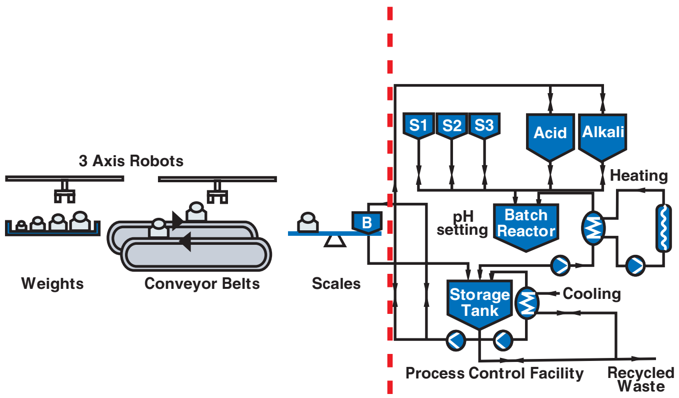
Device Recommendations

Device	Description	Key Features	Benefits	Other TI Solutions
Power Management Products				
REF3140	Voltage Reference	Drift = 20ppm/°C, 4.097V, 0.2%	Very Low Drift, Tiny Package	REF02, REF102
DCV010515D	Dual Converter	Isolation Converter, +5V_{IN}, ±15V_{OUT}	Low Noise, Small Board Area	DCP010515
DCV010505D	Dual Converter	Isolation Converter, +5V_{IN}, ±5V_{OUT}	Low Noise, Small Board Area	DCP010505
TPS54110	SWIFT™ Buck Converter	Adjustable Output (0.9V – 3.3V), 1.5A	Very Easy to Use, Flexible Output	TPS64200
Amplifiers				
INA118	Instrumentation Amp	Gain = 1 to 1000, CMRR > 110dB, 8-Pin	Very Low Power	INA128
ISO124	Isolation Amp	Isolation = 2400V, Output = ±10V	No External Components Required	ISO122
PGA204	Prog. Gain INA	Gain of 1, 10, 100, 1000, Precision	Small Package	PGA203
OPA227	Low Noise Amp	V_N = 3nV, CMRR > 120dB, V_S = 5–36V	Very Low Noise, Small Package	OPA350, OPA725
DRV591	PWM Driver	±3A Max, High Efficiency, Tiny Package	Single 5V Supply, Tiny Package	DRV104
OPA567	Linear Power Amp	2A, RRIO 300mV to Rail, Adj Current Limit	Unity Gain Stable, 2.7V to 5.5V supply, Shutdown, Small Package	OPA647
OPA569	Linear Power Amp	2.4A, RRO 200mV to Rail, Thermal Protection	Single 5V, Tiny Package, Complete Solution	OPA549
XTR300	I/O Driver	±10V, ±20mA, Input/Output	Multipurpose I/O Driver for All Industrial I/O Voltage Currents	—
Data Converters				
ADS8325	16-Bit, 100kSPS ADC	Power = 2mW, 8-Pin, SFDR = 86dB, Power = 82mW	Single 5V Supply, Power Only 2mW, Single 5V Supply for Bipolar	ADS8320
ADS8509	16-Bit, 250kHz, CMOS Bipolar ADC	250kHz Sampling Rate, ±2.0LSB Max INL, ±1LSB Max DNL, 16-Bit No Missing Code	SPI Compatible Serial Output with Daisy-Chain (TAG) Feature, Uses Internal and External Reference	ADS7809, ADS8508/7808
ADS8406	16-Bit, 1.25MSPS	Pseudo-Bipolar, Differential Input, –V_{REF} to V_{REF} 90dB SNR, –95dB THD at 100kHz Input	High-Speed Parallel Interface, Single 5V Analog Supply, Low Power, Zero Latency	ADS8412, ADS8402
ADS1251	24-Bit, 20kSPS ADC	Power = 155mW, 8-Pin, SFDR = 100dB,	Excellent Performance, Only 7.5mW, Single 5V Supply	ADS1252
ADS1258	16-Channel, 24-Bit ADC	125kSPS, Auto-scan Rate: 23.7kSPS, 24-Bit NMC	16 SE or 8 Diff, 2.8µV_{RMS} at 1.8kSPS, Fixed or Auto Channel Scan	—
DAC7731	16-Bit, 5µs Settling Time	Output = ±10V, INL = 0.0015%	Small Package	DAC7741
DAC7631	16-Bit, 10µs Settling time	Power < 2mW, Output = ±2.5V	Single 5V, Small Package	DAC7641
DAC8534	Quad, 16-Bit DAC	Low Power, 16-Bit Swing DAC	Excellent Price/Performance Ratio, Double Buffered Input Architecture	DAC8532
DAC8554	16-Bit, Quad Channel	Power Supply +2.7V to +5.5V	Power-On Reset to Zero-Scale, Schmitt-Triggered Inputs	—
DAC8811	16-Bit, Multiplying	±0.5LSB DNL, ±1LSB INL, Serial Input	4-Quadrant Multiplying Reference, ±10V V_{REF}, 3-Wire Interface	—
Interface				
PCI2050B	PCI-PCI Bridge	66MHz, 32-Bit	—	PCI2250
SN65HVD24	RS-485	Failsafe, Extended Common Mode, RX EQ	Only RX with EQ in Industry	SN65HVD23
SN65MLVD200A	M-LVDS Transceiver	100Mbps, 8-Pin Package	First M-LVDS Complete Transceiver	SN65MLVD202A
SN65HVD485E	Half-Duplex Transceiver	5V Supply, MSOP-8, 10Mbps	Thermal Shutdown Protection, Low Supply Current	—
TLK2201	Gigabit Ethernet TRX	10-Bit Interface, 1 – 1.6Gbps Serial	Power < 200mW	TLK1501, TLK1201
Other				
UAF42	Active Filter	Low-, High- or Band-Pass Filter	Fully Integrated Active Filter	RC Filter
MPC50x	Analog Mux	Analog Input = ±15V	—	—
FilterPro™	Free Design Software	Design Low Pass Filters, Quick, Easy	Free, www.ti.com/filterpro	—

*Preview devices are listed in **bold blue**.*

Factory Communications

Industrial Automation is the computerization of manufacturing and process steps, which workers can't carry out as fast, as precise or as often as a machine. Traditionally Industrial Automation has been separated into two major categories: Factory Automation and Process Automation.



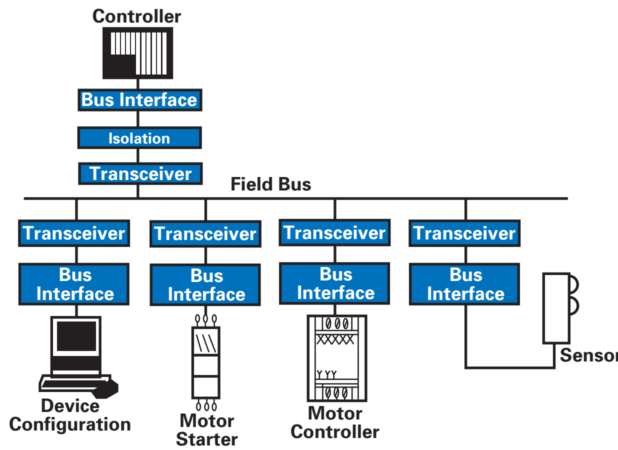
Factory Automation. *Process Automation.*

Factory Automation *senses and drives physical quantities such as pressure, temperature, flow, force vibration, mass and density. Applications typically require 10-12 bits of resolution and communicate at rates between 50 and 400kbps. However, there are several technologies that communicate at much faster signaling rates, such as PROFIBUS DP running at 12Mbps.*

Process Automation *performs compositional measurements such as conductivity, pH and chemical analysis in addition to physical quantities as in Factory Automation. Applications typically require 16-bits of resolution and communication rates between 10 and 50kbps.*

Nodes in Industrial Automation environments are grouped into three distinct families: controllers, sensors and actuator. As the name suggests, controllers are used to manage variables such as temperature based on pre-determined values and information provided by sensors. If the difference between a predetermined and sensed value exceeds a certain limit, the controller tries to manipulate the variable through an actuator such as a cooler. The number of nodes and the distance separating these nodes can vary greatly, which creates the need for specialized communications called industrial networks.

In the 1940s, process instrumentation used 3 to 15psi pressure signals for monitoring control devices. By the 1960s, the first standardized communication method was introduced—the 4-20mA technique of pure analog current-loop signaling. By the nature of the technology, every node requires its own set of cabling between the controller and itself, which creates a maze of cables, yet it is still used extensively in industrial networks. In the 1970s, industrial applications began using programmable logic controllers (PLCs) and digital computers. By the mid 1980s, industry's quest for a standardized all-digital field-bus became a reality. However, major industrial companies and countries, mainly Germany, France and the U.S., did not let go of their de facto standards, so multiple competing standards came into use such as PROFIBUS, InterBus, DeviceNet and others. These field-buses are simply all-digital, serial, two-way communication systems that serve as a Local Area Networks (LAN) for factory/plant instrumentation monitoring and device control.



Process automation system.

Requirements in Industrial Environments

Many hazards threaten the various electrical devices and it is difficult to encase or protect interface cabling. Both device and network must be able to maintain operation even under the most undesirable conditions. Common hazards include:

- Power surges (e.g. of nearby motors)
- Ground potential differences (e.g. due to equalizing currents)
- Electrostatic Discharge (ESD)
- Excessive number of nodes (e.g. in flow control many sensors and actuator)
- Long cable lengths in large factories

In order to maintain operation under such circumstances, devices need the following properties:

- Immunity to power surges (transient suppression)
- Wide common-mode range
- High ESD protection
- Low unit load, allowing for many nodes
- High output drive, high sensitivity, receiver equalization, pre-emphasis

Download *Interface Selection Guide* at: interface.ti.com

5V, RS-485 Transceivers with Integrated Transient Suppression

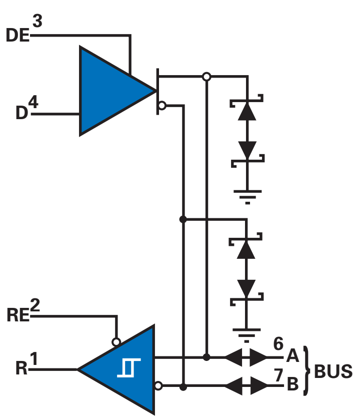
SN65LBC184, SN65LBC182

Get samples, datasheets and app reports at:
www.ti.com/sc/device/SN65LBC184,
www.ti.com/sc/device/SN65LBC182

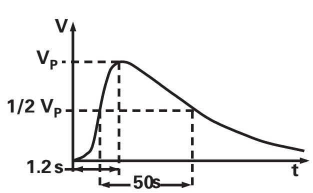
The SN65LBC184 differential data line transceiver is available in the trade-standard footprint of the SN75176 with built-in protection against high-energy noise transients. This feature provides a substantial increase in reliability for better immunity to noise surges coupled to the data cable over most existing devices. Use of these circuits provides a reliable low-cost, direct-coupled (with no isolation transformer) data line interface without requiring any external components. The SN65LBC184 can withstand over-voltage transients of 400W peak (typical). The conventional combination wave called out in IEC 61000-4-5 simulates the over-voltage transient and models a unidirectional surge caused by inductive switching and secondary lightning transients.

Key Features (LBC184)

- Integrated transient voltage suppression
- Standard RS-485 common-mode voltage range: –7V to 12V
- JEDEC and IEC ESD protection:
  - ±30kV IEC 61000-4-2, contact discharge
  - ±15kV IEC 61000-4-2, air-gap discharge
  - ±15kV EIA/JEDEC, human body model
- Up to 128 nodes on a bus (1/4 unit-load)



Functional logic diagram (positive logic).



Surge waveform combination wave.

Extended Common Mode Transceivers with Optional Receiver Equalization

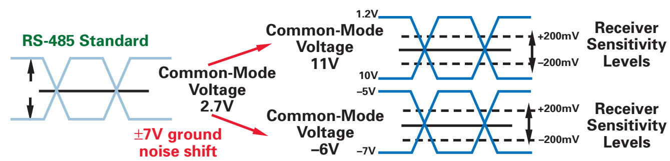
SN65HVD2x

Get samples, datasheets and app reports at:
www.ti.com/sc/device/SN65HVD20

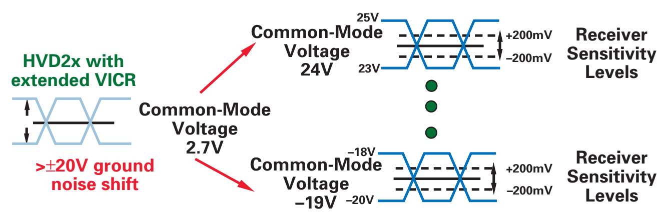
The SN65HVD2x device series offers a very wide input voltage operating range. The RS-485 standard requires functionality at DC-levels at the receiver input between –7V and +12V (±7V plus swing of up to 5V). These devices nearly triple this requirement and are fully functional between –20V and +25V, while surviving ±27V and transients up to 60V.

Key Features

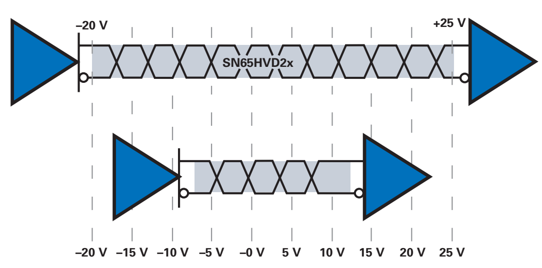
- Common-mode voltage range (–20V to +25V) more than doubles TIA/EIA-485 requirement
- Best-in-class ESD protection in the industry: 16kV HBM
- Up to 256 nodes on a bus (HVD21, 22 and 24) (1/8 unit-load)
- Optional receiver equalization (HVD23 and HVD24)



RS-485 standard operation.



HVD2x's wide common-mode voltage range.



SN65HVD2x extended common-mode voltage range.

Device Recommendations

Numbers	Cable Length and Signaling Rate	Number of Nodes
SN65HVD20	Up to 50m at 25Mbps	Up to 64
SN65HVD21	Up to 150m at 5Mbps (with Slew Rate Limit)	Up to 256
SN65HVD22	Up to 1200m at 500kbps (with Slew Rate Limit)	Up to 256
SN65HVD23	Up to 160m at 25Mbps (with Receiver Equalization)	Up to 64
SN65HVD24	Up to 500m at 3Mbps (with Receiver Equalization)	Up to 256

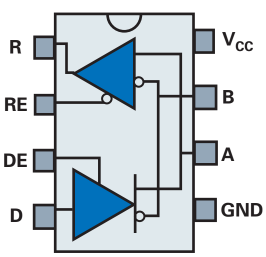
Factory Communications

PROFIBUS Transceiver
SN65HVD1176

Get samples, datasheets and app reports at:
www.ti.com/sc/device/SN65HVD1176

PROFIBUS is the most frequently used process-automation bus in Europe, and is growing in use in other regions. Despite this fact, the selection of suitable transceivers is very limited. In fact, for many years, TI's SN65ALS1176 has been the only device approved by the PROFIBUS User Organization. The reason for this is that a high output drive is required (minimum 2.1V differential) and at the same time, the bus-capacitance must not exceed 10pF. These requirements actually oppose each other and the combination is hard to achieve. The SN65HVD1176 fulfills all PROFIBUS requirements, plus offers very good noise rejection to common-mode noise and has significantly improved timing parameters.

Key Features
- Standard RS-485 common-mode voltage range: –7V to 12V
- High ESD protection of 10kV HBM
- Up to 160 nodes on a bus (1/5 unit-load)
- High output drive: differential output exceeds 2.1V



HVD1176 functional block diagram.

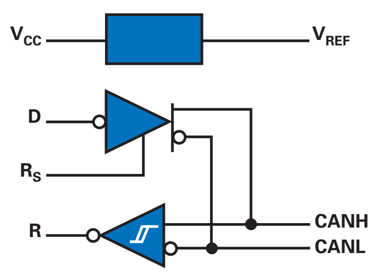
3.3V and 5V CAN Transceivers
SN65HVD23x, SN65HVD251

Get samples, datasheets, EVMs and app reports at:
www.ti.com/sc/device/PARTnumber
(Replace **PARTnumber** with **SN65HVD230**, **SN65HVD231**, **SN65HVD232**, **SN65HVD233**, **SN65HVD234**, **SN65HVD235** or **SN65HVD251)**

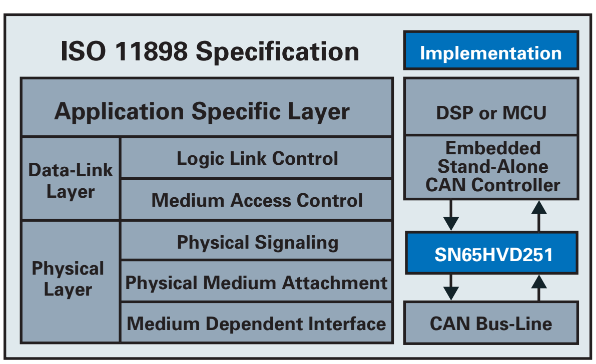
The SN65HVD251 (5V) and SN65HVD23x (3.3V) families of CAN transceivers are intended for use in harsh environment applications. They feature cross-wire, loss-of-ground, over-voltage and over-temperature protection, wide common-mode range and can withstand common-mode transients of ±200V. The SN65HVD230/1/2 operate over a –2V to 7V CMR on the bus, and can withstand common-mode transients of ±25V. SN65HVD233/4/5 and SN65HVD251 operate over a –7V to 12V CMR and will withstand transients of ±100V and ±50V, respectively.

Key Features (SN65HVD251)
- Drop-in improved replacements for the PCA82C250 and PCA82C251
- Bus-fault protection of ±36V
- Bus-pin ESD protection exceeds 14kV HBM
- High input impedance allows up to 120 SN65HVD251 nodes
- Meets or exceeds the requirements of ISO 11898

Applications
- CAN data buses:
  - DeviceNet data buses
  - Smart distributed systems (SDS)
- SAE J1939 standard data bus interface
- NMEA 2000 standard data bus interface
- ISO 11783 standard data bus interface



Functional diagram (positive logic).



High-Performance 1394-1995 Link Layer for Industrial and Bridge Applications
TSB42AC3

Get samples, datasheets, EVMs and app reports at:
www.ti.com/sc/device/TSB42AC3

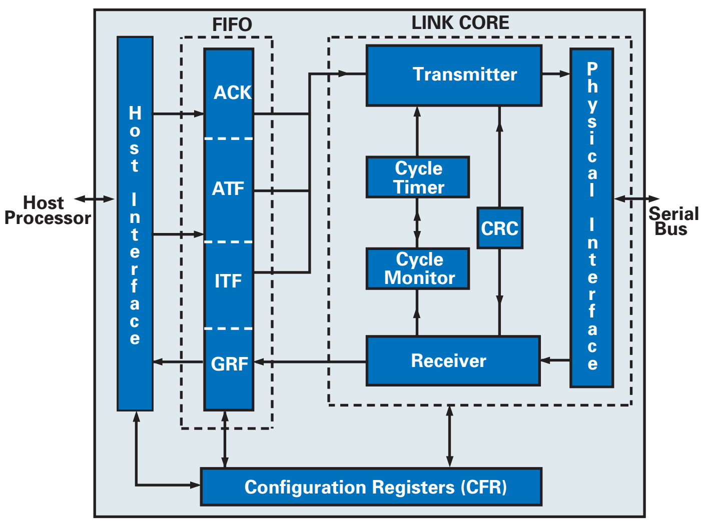
The TSB42AC3 is a 1394-1995 general-purpose link layer ideal for a wide range of applications. The TSB42AC3 provides a high-performance interface with the capability of transferring data between the 32-bit host controller and the 1394 PHY-link interface. The 1394 PHY-link interface provides the connection to the 1394 device. The LLC provides the control for transmitting and receiving 1394 packet data between the FIFO and PHY-link interface at rates of 50 (backplane only), 100, 200 and 400Mbit/s.

Key Features

- Generic 32-bit, 50MHz host bus interface
- Programmable 10K byte total for asynchronous, isochronous and general FIFO
- Separate ACK FIFO register decreases SCK-tracking burden on the host
- Additional programmable status output to pins
- Completely software compatible with the TSB12LV01B
- IEEE 1149.1 JTAG interface to support board level scan testing

Applications

- Motor/motion/process control
- Industrial imaging



TSB42AC3 functional block diagram.

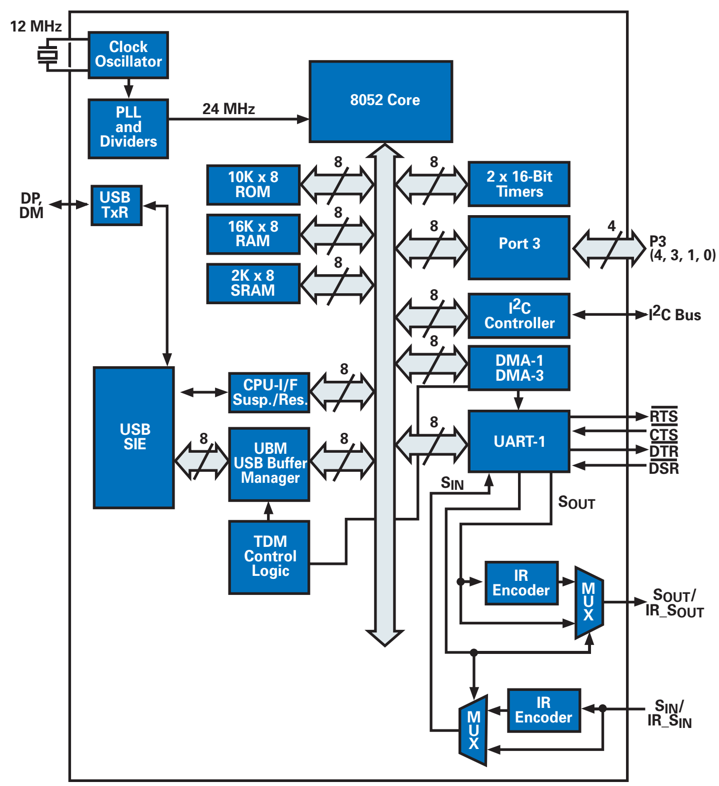
USB-to-Serial Bridge
TUSB3410

Get samples, datasheets, EVMs and app reports at:
www.ti.com/sc/device/TUSB3410

The TUSB3410 provides an easy way to move your UART device to a fast, flexible USB interface by bridging between a USB port and an enhanced UART serial port. The TUSB3410 contains all the necessary logic to communicate with the host computer using the USB bus. The TUSB3410 can be used to build an interface between a legacy serial peripheral device and a PC with USB ports, such as a legacy-free PC. An evaluation module can jump-start your USB development, or you can use it as a complete USB-to-RS-232 converter.

Key Features

- Built-in, two-channel DMA controller for USB/UART bulk I/O
- Enhanced UART features including programmable software/ hardware flow control and automatic RS-485 bus transceiver control, with and without echo



The TUSB3410 can support a total of three input and three output (interrupt, bulk) endpoints.

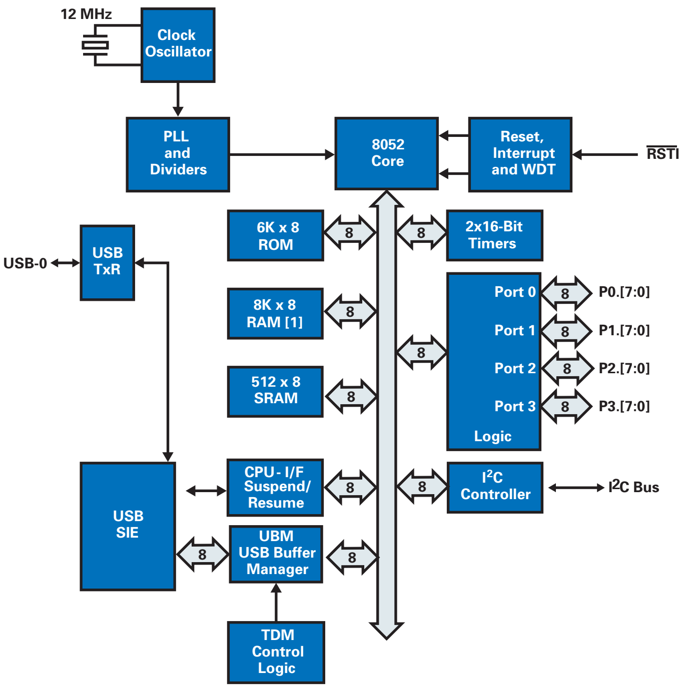
Factory Communications

USB-Based Controller with MCU GPIO
TUSB3210

Get samples, datasheets, EVMs and app reports at:
www.ti.com/sc/device/TUSB3210

The TUSB3210 is a USB-based controller with a general-purpose, industry-standard 8052 MCU and a 32 GPIO. It contains 8K x 8 RAM space for application development. The TUSB3210 is programmable, making it flexible enough to use for a variety of general USB I/O applications.

Key Features
- Supports 12Mbps USB data rate (full speed)
- Supports USB suspend/resume and remote wake-up operation
- Integrated 8052 microcontroller



TUSB3210 functional block diagram.

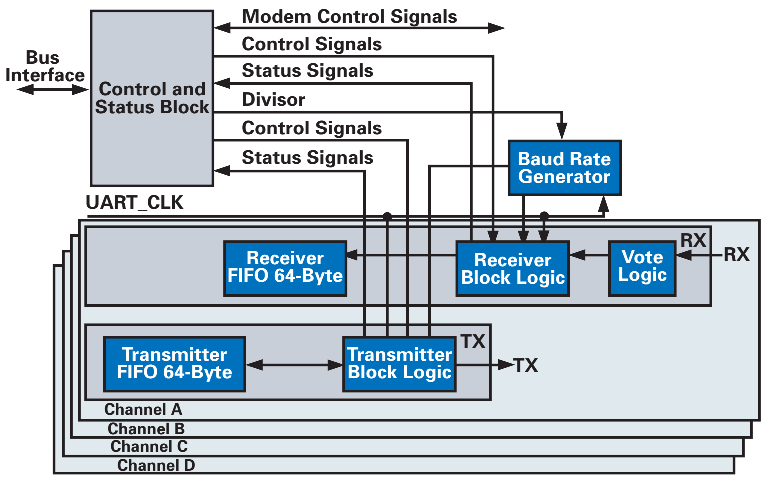
Quad UART with 64-Byte FIFO
TL16C754B

Get samples, datasheets and app reports at:
www.ti.com/sc/device/TL16C754B

Texas Instruments' wide portfolio of space-saving, performance-enhancing UARTs are pin-for-pin compatible with many leading UART manufacturers' devices.

Key Features
- 3.3V and 5V operating voltages available
- 64-byte programmable trigger-level FIFO buffering
- Up to 3.2Mbps data transfer rate

Applications
- Industrial automation controls
- Base stations
- Cell phones
- PCs



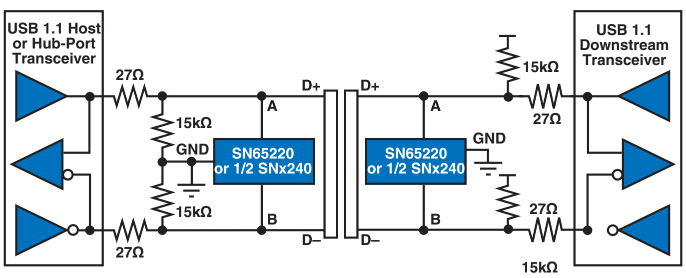
TL16C754B functional block diagram.

USB Port Transient Suppressors
SN65220, SN65240

Get samples, datasheets and app reports at:
www.ti.com/sc/device/SN65220, www.ti.com/sc/device/SN65240

The SN65220 is a single transient voltage suppressor and the SN65240 is a dual transient voltage suppressor designed to provide electrical transient protection to full-speed USB ports.

Key Features
- Designed to protect USB host, hub or peripheral ports
- Packaging: Tiny WCSP Chip-Scale



SN65220 functional block diagram.

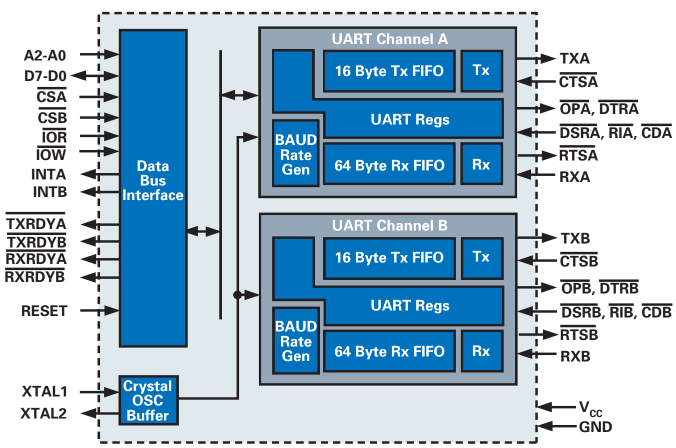
Dual Channel 16-Byte FIFOs UART
TL16C2550

Get samples, datasheets and app reports at:
www.ti.com/sc/device/TL16C2550

The TL16C2550 is a dual universal asynchronous receiver and transmitter (UART). It incorporates the functionality of two TL16C550D UARTs, each UART having its own register set and FIFOs. The two UARTs share only the data bus interface and clock source, otherwise they operate independently. Another name for the UART function is Asynchronous Communications Element (ACE), and these terms will be used interchangeably.

Key Features
- Up to 1.5Mbps (5V), 1.25Mbps (3.3V) and 1Mbps (2.5V) operation
- Programmable auto-RTS and auto-CTS
- Programmable baud rate generator
- Packaging: 5mm x 5mm 32-pin QFN (RHB) and 48-pin QFP

Applications
- Point-of-sale terminals
- Gaming terminals
- Portable applications
- Router control
- Cellular data



TL16C2550 functional block diagram.

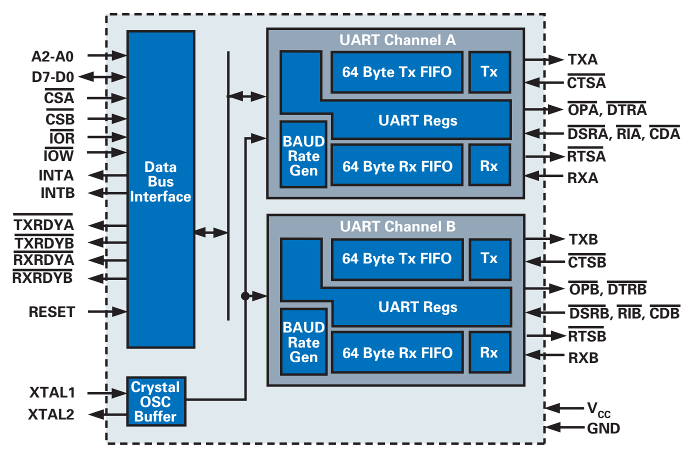
Dual Channel 64-Byte FIFOs UART
TL16C752B

Get samples, datasheets and app reports at:
www.ti.com/sc/device/TL16C752B

The TL16C752B is a dual universal asynchronous receiver/transmitter (UART) with 64-byte FIFOs, automatic hardware/software flow control, and data rates up to 3Mbps. The TL16C752B offers enhanced features. It has a transmission control register (TCR) that stores receiver FIFO threshold levels to start/stop transmission during hardware and software flow control. With the FIFO RDY register, the software gets the status of TXRDY/RXRDY for all four ports in one access. On-chip status registers provide the user with error indications, operational status, and modem interface control. System interrupts may be tailored to meet user requirements. An internal loopback capability allows onboard diagnostics. The TL16C752B is available in a 48-pin PT (LQFP) package.

Key Features
- TI patented programmable auto-RTS and auto-CTS
- X_{ON}/X_{OFF} software flow control
- Up to 3Mbps baud rate at 3.3V
- Programmable and selectable transmit and receive FIFO trigger levels

Applications
- Telecommunication routers
- Handheld terminals
- Mobile computing
- Factory automation



TL16C752B functional block diagram.

Factory Communications

Device Recommendations

Device	Channel(s)	FIFOs	Voltage(V)	Characterized Temp (°C)	Package(s)	Description	Price[1]
TL16C2550	2	16-Byte	2.5/3.3/5	0 to 70, –40 to 85	32-QFN, 44-PLCC, 48-TQFP	Dual UART with Programmable Auto-RTS and Auto-CTS	Call
TL16C2552	2	16-Byte	2.5/3.3/5	0 to 70, –40 to 85	32-QFN, 44-PLCC	Dual UART with Programmable Auto-RTS and Auto-CTS	Call
TL16C450	1	None	5	0 to 70	40-DIP, 44-PLCC	Single UART	$1.50
TL16C451	1	None	5	0 to 70	68-PLCC	Single UART with Parallel Port	$2.50
TL16C452	2	None	5	0 to 70	68-PLCC	Dual UART with Parallel Port	$2.55
TL16C550C	1	16-Byte	3.3/5	0 to 70, –40 to 85	40-DIP, 44-PLCC 48-LQFP, 48-TQFP	Single UART with Hardware Auto Flow Control	$1.75
TL16C550D	1	16-Byte	2.5/3.3/5	0 to 70, –40 to 85	32-QFN, 48-LQFP, 48-TQFP	Single UART with Hardware Auto Flow Control	$1.75
TL16C552	2	16-Byte	5	0 to 70	68-PLCC	Dual UART with Parallel Port, Recommend TL16C552A	$3.90
TL16C552A	2	16-Byte	5	0 to 70, –40 to 85	68-PLCC, 80-TQFP	Dual UART with Parallel Port	$3.85
TL16C554	4	16-Byte	5	0 to 70, –40 to 85	68-PLCC, 80-LQFP	Quad UART, Recommend TL16C554A	$6.05
TL16C554A	4	16-Byte	5	0 to 70, –40 to 85	68-PLCC, 80-LQFP	Quad UART with Hardware Auto Flow Control	$6.00
TL16C750	1	16-, 64-Byte	5	0 to 70, –40 to 85	44-PLCC, 64-LQFP	Single UART with Hardware Auto Flow Control Lower Power Modes	$3.70
TL16C752B	2	64-Byte	3.3	0 to 70, –40 to 85	48-LQFP, 48-TQFP	Dual UART with Hardware Auto Flow Control Lower Power Modes	$3.10
TL16C752C	2	64-Byte	2.5/3.3/5	0 to 70, –40 to 85	32-QFN, 48-TQFP	Dual UART with Hardware Auto Flow Control Lower Power Modes, RS-485 and IrDA interface	Call
TL16C754B	4	64-Byte	3.3/5	0 to 70, –40 to 85	68-PLCC, 80-LQFP	Dual UART with Hardware Auto Flow Control Lower Power Modes	$8.35
TL16C754C	4	64-Byte	2.5/3.3/5	0 to 70, –40 to 85	80-LQFP	Dual UART with Hardware Auto Flow Control Lower Power Modes	Call
TL16PC564B/BLV	1	16-, 64-Byte	3.3/5	0 to 70	100-BGA, 100-LQFP	Single UART with PCMCIA Interface	$5.90/$6.10
TL16PIR552	2	16-Byte	5	0 to 70	80-QFP	Dual UART with Selectable IR & 1284 Modes	$6.10

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

*Preview devices appear in **bold blue**.*

Digital Coupler and Isolation Amplifiers

There are many applications where it is desirable, even essential, that a sensor not have a direct (galvanic) electrical connection with the system to which it is supplying data in order to avoid either dangerous voltages or currents from one half of the system from damaging the other half. Such a system is said to be "isolated", and the area which passes a signal without galvanic connections is known as an "isolation barrier".

Isolation barrier protection works in both directions, and may be needed in either half of the system, sometimes both. Common applications requiring isolation protection are those where sensors may accidentally encounter high voltages, and the system it is driving must be protected. Or a sensor may need to be isolated from accidental high voltages arising downstream in order to protect its environment: examples include prevention of explosive gas ignition caused by sparks at sensor locations or protecting patients from electric shock by ECG, EEG and EMG test and monitoring equipment. The ECG application may require isolation barriers in both directions: the patient must be protected from the very high voltages (>7.5kV) applied by the defibrillator, and the technician handling the device must be protected from unexpected feedback.

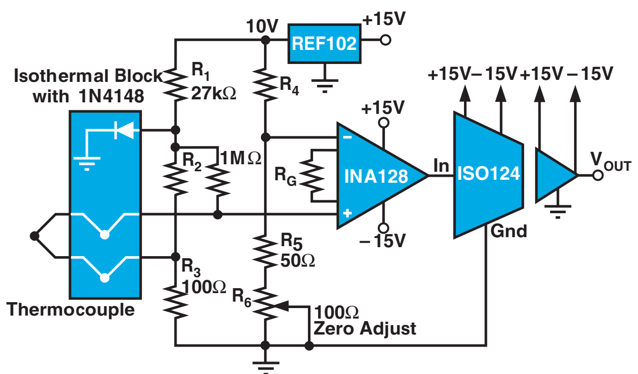
Applications for Isolation Amplifiers

- Sensor is at a high potential relative to other circuitry (or may become so under fault conditions)
- Sensor may not carry dangerous voltages, irrespective of faults in other circuitry (e.g. patient monitoring and intrinsically safe equipment for use with explosive gases)
- To break ground loops

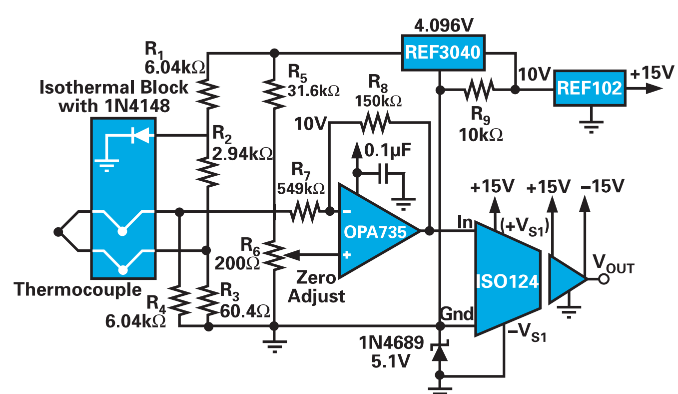
Isolation Amplifier Design

Obstacles in isolation amplifier design include offset, drift, gain accuracy, and nonlinearity or distortion. The high-performance isolation amplifier applies either linear optocouplers (LOCs), or modulators with digital capacitive isolation, either of which is implemented differentially to increase linearity over a large signal range. Isolation amps use dual-feedback circuit topology to significantly reduce distortion.

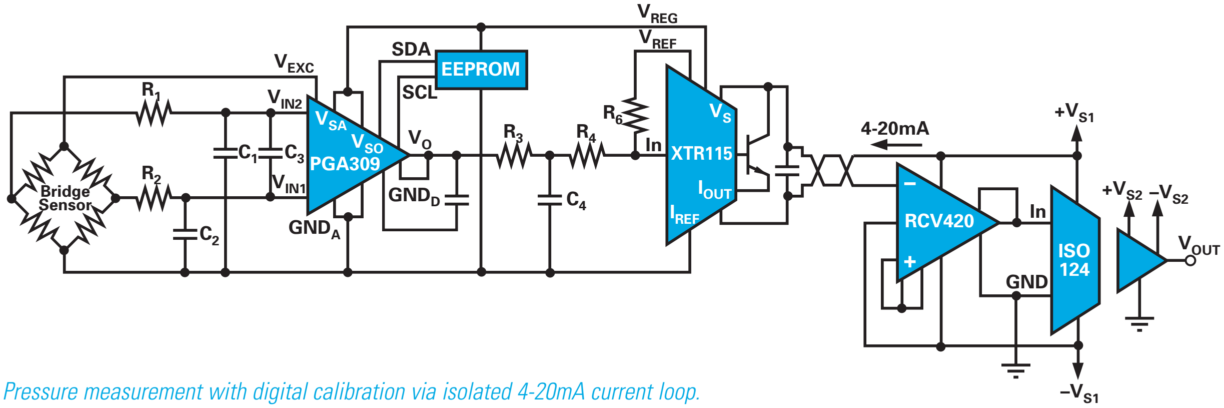
While feedback across the barrier corrects for these errors, it only does so as long as the circuit on each side of the barrier is an exact match. This is difficult to achieve as the circuits are not on the same piece of silicon. In integrated circuit isolation amplifiers, the output and feedback demodulator are made from “adjacent” die from the same silicon wafer, allowing for better matching than discrete designs.



Isolated temperature measurement with dual supplies.



Isolated temperature measurement with single supply.



Pressure measurement with digital calibration via isolated 4-20mA current loop.

Digital Coupler and Isolation Amplifiers

Galvanic Isolation Solutions

System designers must contend with poor power quality, ground faults, and lightning strikes interfering with or disrupting system performance. Additionally, the distance between the nodes on a network can be substantial and often AC outlets from different ground domains power the nodes. The potential difference between these ground domains may include a dc bias, 50 or 60Hz AC harmonics, and various transient noise components.

If these grounds are connected together by a cable logic ground or shielding, a ground loop can exist and current will flow into the cable. Ground-loop currents can have severe effects on a network, including the degradation of data, excessive EMI, component damage, and when the potential difference is large enough, a human electrical hazard.

New techniques that use magnetic coupling for isolation may still share the deficiencies of the older solutions such as the absence of a fail-safe output, an inability to operate with DC-only signals and a restricted operating temperature range. Additionally, new concerns associated with the inductors' susceptibility to external magnetic fields and curtailed operating life under high voltage conditions may arise.

TI isolation solutions are designed to eliminate problems associated with existing isolation technologies. Problems such as high power consumption, no fail-safe output, low signaling rates and high pulse-width distortion are common. When using optocouplers, the low efficiency with which the electro-optical conversion occurs is especially problematic as the amount of current required to turn on the phototransistor increases with the age of the part. This is due to the LED's reduction of light emission over time, which is accelerated by high operating temperatures.

The ISO721 and ISO722 provide isolation solutions solving all of these problems. Other isolation products currently in development at TI include multi-channel isolators, isolated CAN and RS-485 transceivers, isolated op amps, isolated data converters and an isolated gate controller interface.

3.3V High-Speed Digital Isolators
ISO721

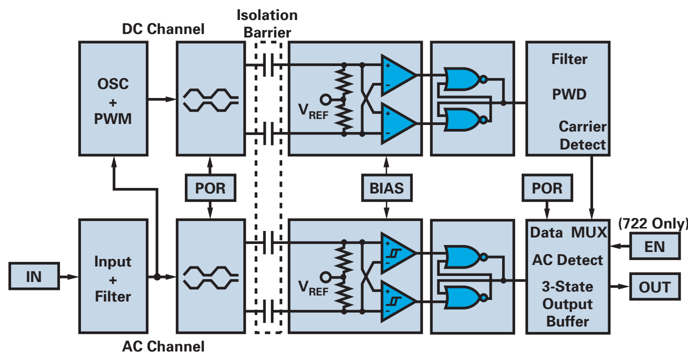
Get samples, datasheets and app reports at: **www.ti.com/sc/device/ISO721**

The ISO721 digital isolator is a logic input and output buffer separated by a silicon oxide (SiO_2) insulation barrier that provides galvanic isolation of up to 4000V. Used in conjunction with isolated power supplies, the device prevents noise currents on a data bus or other circuits from entering the local ground and interfering with or damaging sensitive circuitry.

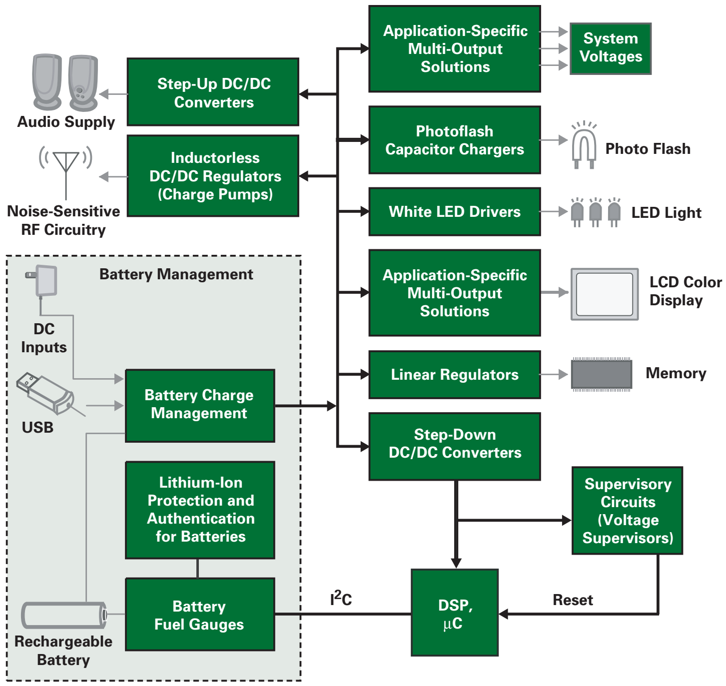
A binary input signal is conditioned, translated to a balanced signal, then differentiated by the capacitive isolation barrier. Across the isolation barrier, a differential comparator receives the logic transition information, then sets or resets a flip-flop and the output circuit accordingly. A periodic update pulse is sent across the barrier to ensure the proper dc level of the output. If this dc-refresh pulse is not received for more than 4µs, the input is assumed to be unpowered or not functional, and the fail-safe circuit drives the output to a logic high state.

Key Features

- 4000V isolation
- Fail-safe output
- Signaling rate up to 100Mbps
- UL 1577, IEC 60747-5-2 (VDE 0884, Rev. 2), IEC 61010-1 and CSA Approved
- 25kV/µs transient immunity



ISO721 functional block diagram.

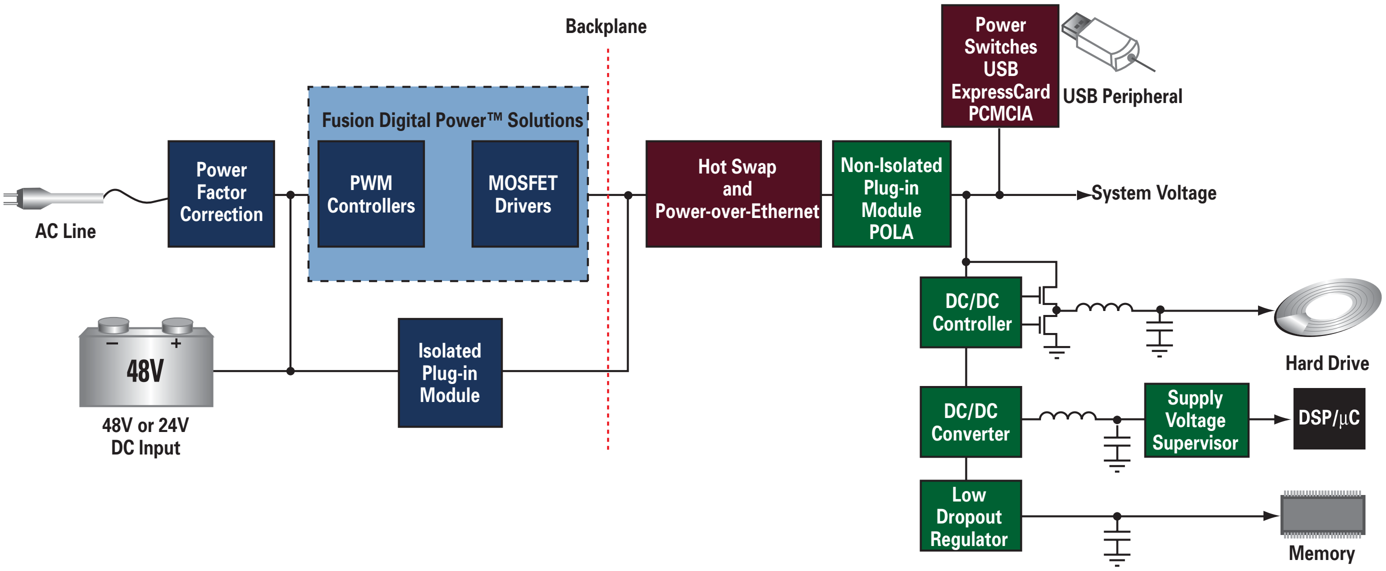


Power Management Solutions

Device	Description
Battery Chargers	
bq2002	NiMH/NiCd Charger for Current-Limited Power Supplies
bq2057	1- to 2-Cell Linear Li-Ion Charge Controller in MSOP
bq24100	1- to 3-Cell Li-Ion Fully Integrated Switch-Mode Charger in QFN
bq24200	1-Cell Li-Ion Fully Integrated Charger for Current-Limited Power Supplies
bq24010	1-Cell Li-Ion Fully Integrated Charger in QFN
bq24020	1-Cell Li-Ion Fully Integrated Charger for AC/DC Adapter and USB in QFN
bq24030	1-Cell Li-Ion Charger for AC/DC Adapter and USB with Dynamic Power Path Management in QFN
bq25010	Single-Chip Li-Ion Charger with Adjustable DC/DC Converter in QFN
Battery Fuel Gauges	
bq26220	1- to 2-Cell Li-Ion Battery Monitor with HDQ Interface
bq27000	1- to 2-Cell Li-Ion Battery Fuel Gauge with HDQ in QFN and WCSP
bq27200	1- to 2-Cell Li-Ion Battery Fuel Gauge with I²C in QFN and WCSP
bq20z80	2- to 4-Cell Li-Ion SMBus Battery Fuel Gauge with Impedance Track™ Technology
bq2084	2- to 4-Cell Li-Ion SMBus Battery Fuel Gauge
Battery Authentication and Protection	
bq26150	CRC-Based Battery Authentication IC
DC/DC Buck (Step-Down) Solutions for Core and I/O	
TPS62200	300mA, 1MHz Step-Down Converter with 12µA Quiescent Current in SOT-23
TPS62220	400mA, 1.25MHz Step-Down Converter with 15µA Quiescent Current in ThinSOT-23
TPS62300	500mA, 3MHz High-Accuracy Step-Down Converter with 1µH inductor in WCSP and QFN
TPS62050	800mA, 10V V_{IN} Step-Down Converter with 12µA Quiescent Current in QFN-10
TPS62040	1.2A, 1.25MHz Step-Down Converter with 18µA Quiescent Current in QFN-10
TPS64200	3A Step-Down Controller in SOT-23
TPS62110	Adjustable, $17V_{IN}$ and $1.5A_{OUT}$ Step-Down DC/DC Converter in 4x4 QFN
TPS63700	Adjustable, Up to $-15V_{OUT}$, Inverting DC/DC Converter in 3x3 QFN

Power Management Solutions (Continued)

Device	Description
Linear Regulators (LDO)	
TPS79718	10mA, 1.2µA Micro-Power LDO in SC-70
TPS71533	50mA, 3.2µA Micro-Power LDO in SC-70
TPS76301	100mA, Low-Cost LDO in SOT-23
TPS72118	150mA, Low-Noise, Low-V_{IN} LDO in SOT-23
TPS79301	200mA, Low-Noise, High PSRR LDO in SOT-23 and WCSP
TPS79901	200mA, Ultra-Low Noise, High PSRR LDO in WCSP
TPS71157	250mA, Dual Output, Ultra-Low Noise, High PSRR LDO in WCSP
TPS73601	400mA, Cap-Free, Reverse-Leakage Protection LDO in SOT-23 and QFN
TPS79501	500mA, Low-Noise, High PSRR LDO in SOT-223
TPS79601	1A, Low-Noise, High PSRR LDO in SOT-223
LED Backlight and Camera Flash Solutions	
TPS61041	250mA Switch Boost Converter, up to 28V in SOT-23
TPS61042	500mA Switch, Current-Regulated Boost Converter in QFN
TPS61060	375mA Switch, Current-Regulated, Synchronous Boost Converter in QFN and WCSP
REG71055	Low-Cost Charge Pump for Up to 3 Parallel White LED in ThinSOT-23
TPS60230	5-Channel, Current-Regulated White LED Charge Pump in QFN
TPS60231	3-Channel, Current Regulated White LED Charge Pump in QFN
TPS65552A	Xenon FLASH Charger for Digital Still Cameras with Integrated IGBT Driver
TPS61020	1.5A Switch Boost Converter in QFN for White LED FLASH
DC/DC Boost (Step-Up) Solutions	
TPS61041	250mA Switch Boost Converter, Up to 28V in SOT-23
TPS61040	400mA Switch Boost Converter, Up to 28V in SOT-23
TPS61070	600mA Switch Boost Converter in ThinSOT-23 for 1- and 2-Cell Alkaline Applications
TPS61010	1A Switch Boost Converter
TPS61020	1.5A Switch Boost Converter in QFN
TPS61030	4A Switch Boost Converter in QFN
Display Power Solutions	
TPS61045	375mA Switch Boost Converter, Up to 28V in QFN
TPS65110	3-Channel Small Form-Factor LTPS Display Power Supply in QFN
TPS65120	4-Channel Small Form-Factor TFT Display Power Supply in QFN
TPS65130	2-Channel, Positive/Negative Power Supply for OLED Displays in QFN
TPS65100	4-Channel Large Form-Factor TFT Display Power Supply
Supply Voltage Supervisors	
TPS3836E18	250nA, Supply Voltage Supervisor in SOT-23
TPS3808G01	2.4µA, Programmable Delay Supply Voltage Supervisor in SOT-23
TPS3801-01	9µA, Ultra-Small Supply Voltage Supervisor in SC-70
TPS3110E12	1.2µA, Dual Supply Voltage Supervisor in SOT-23
TPS3806I33	3µA, Dual Supply Voltage Supervisor in SOT-23
Complete Power Management Units	
TPS65010	1-Cell Li-Ion Charger, 1.2A and 400mA Step-Down Converter, 2 LDO with I²C in QFN



System Power Solutions for Industrial Applications

Device	Description
DC/DC Controllers	
TPS40057	Wide Input (8V-40V) Up to 1MHz Frequency Synchronous Buck Controller, Source/Sink with Prebias
TPS40061	Wide Input (10V-55V) Up to 1MHz Frequency Synchronous Buck Controller, Source/Sink
TPS40100	Midrange Input (4.5V-18V) Synchronous Buck Controller with Advanced Sequencing and Output Margining
TPS40200	8-Pin SO, 4.5-52V Cost Optimized Buck
TPS43000	Multi-Topology (Buck, Boost, Sepic) High Frequency DC/DC Controller
UC3572	Negative Output Flyback Pulse Width Modulator
DC/DC Converters	
TPS54110	3V to 6V Input, 1.5A Output Synchronous-Buck PWM Switcher
TPS54310	3V to 6V Input, 3A Output Synchronous-Buck PWM Switcher with Integrated FETs
TPS54350	4.5V to 20V Input, 3A Output Synchronous-Buck PWM Switcher with Integrated FET
TPS54610	3V to 6V Input, 6A Output Synchronous-Buck PWM Switcher with Integrated FETs
PWM Controllers	
UCC38C42	BiCMOS Low-Power Current Mode PWM Controller
UCC3809	Economy Primary Side Controller
UCC3813	Low Power Economy BiCMOS Current Mode PWM
MOSFET Drivers	
UCC27323	Dual 4A Peak, High-Speed Low-Side Power MOSFET Drivers
UCC27423	Dual 4A, High-Speed Low-Side MOSFET Drivers with Enable
Hot Swap Controllers	
TPS2490/1	+9V to +80V Positive High-Voltage Power-Limiting Hot Swap Controller
TPS2393	Full Featured –48V Hot Swap Power Manager
TPS2391	Simple –48V Hot Swap Controller
Power-over-Ethernet (PoE)	
TPS2375	IEEE 802.3af PoE Powered Device Controllers
TPS23750	IEEE 802.3af PD Controller with Integrated DC/DC
TPS2384	Quad Ethernet Power Sourcing Equipment Power Manager

How to Power Your Industrial Application

TI offers extensive online information on powering industrial designs.

(1) Controllers for Typical Industrial Power Supplies

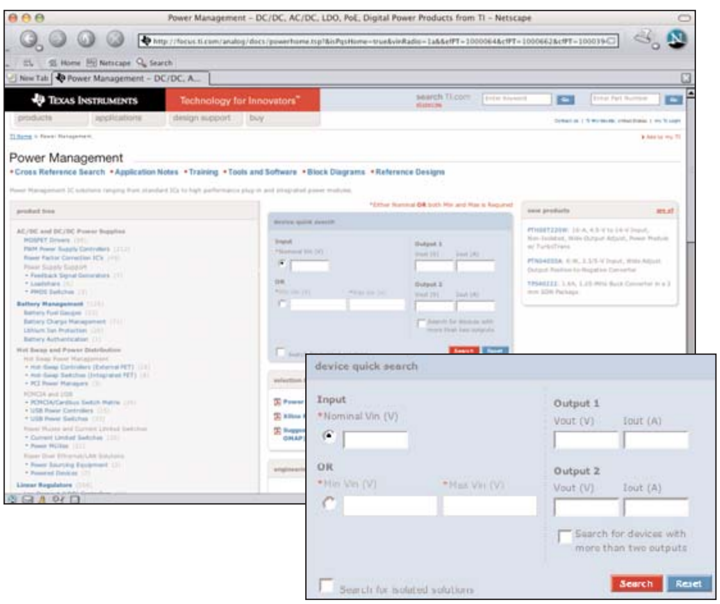
The TPS40054/55/57 and TPS40060/61 are families of synchronous buck controllers with input voltage ranges of 8V to 40V and 10V to 55V, respectively. Learn more about these products at: www.ti.com/sc/device/tps40054

(2) Controllers for Economic Power Supply Design

The TPS40200 offer an industrial input voltage range from 4.5V to 52V. Their flexible PWM control architecture allows cost-optimized power supplies for a variety of industrial control solutions. More details at: www.ti.com/sc/device/tps40200

(3) Select an Appropriate Device Using TI's PQS Tool

Visit power.ti.com, click on the "Power Quick Search" tool and enter the desired input and output voltage(s). This tool provides recommendations from our many product portfolios, including DC/DC controllers, DC/DC converters, low-dropout linear regulators, PWM controllers and complete module solutions.

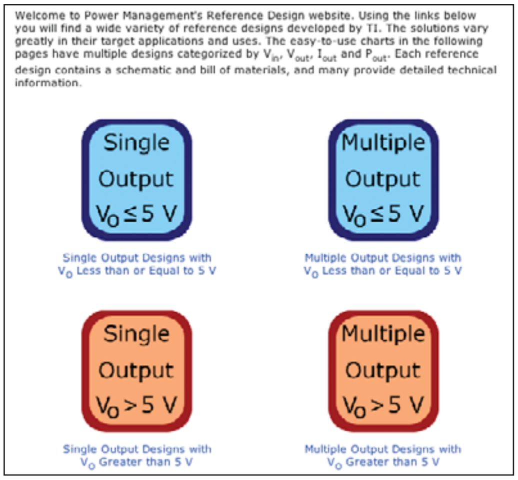


(4) Reference Design Resources

Our reference design home page features solutions including schematics and detailed bills of materials. Go to power.ti.com, select "Design Resources" and then "Reference Designs".

(5) Not Sure Which Architecture Will Fit?

The Power Supply Topology poster, available at: http://focus.ti.com/lit/ml/sluw001a/sluw001a.pdf, provides typical power supply devices for each topology. The Power Management Applications Solutions brochure, available at: http://focus.ti.com/lit/ml/slub007/slub007.pdf, lists relevant application notes.

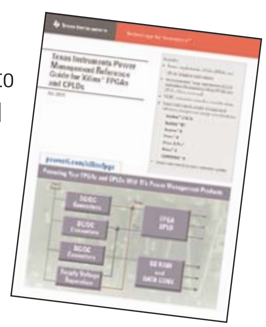


(6) Power Management Selection Guide

This guide provides an overview of TI's extensive power supply product portfolio. You can download the guide at: http://power.ti.com/selectionguide

(7) Powering Xilinx and Altera FPGAs

TI offers a variety of ready-to-use solutions to power core and I/O voltages for Altera® and Xilinx® FPGAs. Web pages for Altera (www.ti.com/alterafpga) and Xilinx (www.ti.com/xilinxfpga) feature Power Management Reference Guides, along with downloadable schematics and bills of material for each design.



Amplifiers

Difference Amplifiers Selection Guide

Device	Description	Spec Temp Range	Ch.	Gain	Offset (µV) (max)	Offset Drift (µV/°C) (max)	CMRR (dB) (min)	BW (MHz) (typ)	Output Voltage Swing (V) (min)	Power Supply (V)	I_Q (mA) (max)	Package(s)	Price[1]
General Purpose													
INA159	High-Speed, Single Supply	EI[2]	1	0.2	500	1.5 (typ)	86	1.5	(V+) – 0.1 to (V–) +0.048	1.8 to 5.5	1.4	MSOP-8	$1.60
INA132	Micropower, High-Precision	I[2]	1, 2	1	250	5	76	0.3	(V+) – 1 to (V–) + 0.5	+2.7 to +36	0.185	DIP, SO	$1.05
INA133	High-Precision, Fast	I[2]	1, 2	1	450	5	80	1.5	(V+) – 1.5 to (V–) + 1	±2.25 to ±18	1.2	SOIC-8/-14	$1.05
INA143	High-Precision, G = 10 or 0.01	I[2]	1, 2	10, 0.1	250	3	86	0.15	(V+) – 1 to (V–) + 0.5	±2.25 to ±18	1.2	SOIC-8/-14	$1.05
INA145	Resistor Programmable Gain	I[2]	1, 2	1-1000	1000	103	76	0.5	(V+) – 1 to (V–) + 0.5	±1.35 to ±18	0.7	SOIC-8	$1.50
INA152	Micropower, High-Precision	I[2]	1	1	750	5	86	0.7	(V+) – 0.2 to (V–) + 0.2	+2.7 to +20	0.65	MSOP-8	$1.20
INA154	High-Speed, Precision, G = 1	I[2]	1	1	750	20	80	3.1	(V+) – 2 to (V–) + 2	±4 to ±18	2.9	SOIC-8	$1.05
INA157	High-Speed, G = 2 or 0.5	I[2]	1	2, 0.5	500	20	86	4	(V+) – 2 to (V–) + 2	±4 to ±18	2.9	SOIC-8	$1.05
Audio													
INA134	Low Distortion: 0.0005%	I[2]	1, 2	1	1000	2[3]	74	3.1	(V+) – 2 to (V–) + 2	±4 to ±18	—	SOIC-8/-14	$1.05
INA137	Low Distortion, G = 0.5 or 2	I[2]	1, 2	2, 0.5	1000	2[3]	74	4	(V+) – 2 to (V–) + 2	±4 to ±18	2.9	SOIC-8/-14	$1.05
High Common-Mode Voltage													
INA117	±200V CM Range	I[2]	1	1	1000	20	86	0.2	(V+) – 5 to (V–) + 5	±5 to ±18	—	SOIC-8	$2.70
INA146	±100V CM Range, Prog. Gain	I[2]	1	0.1-100	5000	100[3]	70	0.55	(V+) – 1 to (V–) + 0.1 5	±1.35 to ±18	0.7	SOIC-8	$1.70
INA148	±200V CM Range, 1MΩ Input	I[2]	1	1	5000	100[3]	70	0.1	(V+) – 1 to (V–) + 0.2 5	±1.35 to ±18	0.3	SOIC-8	$2.10
High-Side Current Shunt Monitors													
INA138	36V (max)	EI[2]	1	200µA/V	1000	1[3]	100	0.8	0 to (V+) – 0.8	+2.7 to 36	0.045	SOT23-5	$0.99
INA139	High-Speed, 40V (max)	EI[2]	1	1-100	1000	1	100	4.4	0 to (V+) – 0.9	+2.7 to 40	0.125	SOT23-5	$0.99
INA168	60V (max)	EI[2]	1	200µA/V	1000	1[3]	100	0.8	0 to (V+) – 0.8	+2.7 to 60	0.045	SOT23-5	$1.25
INA169	High-Speed, 60V (max)	EI[2]	1	1-100	1000	1	100	4.4	0 to (V+) – 0.9	+2.7 to 60	0.125	SOT23-5	$1.25
INA19x	–16V to 36V CM Range	EI[2]	1	100V/V	2000	1	100	0.4	0.4 (V+) – 0.1	+2.7 to 13.5	0.9	SOT23-5	$0.80
INA170	High-Side, Bi-Directional	I[2]	1	1-100	1000	1	100	0.4	0 to (V+) – 0.9	+2.7 to 60	0.125	MSOP-8	$1.25

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]I = –40°C to +85°C. EI = –40°C to +125°C. [3]Denotes single supply. *New products are listed in **bold red**.*

Logarithmic Amplifiers Selection Guide

Device	Spec[2] Temp Range	Scale Factor (V/decade)	Input Current Range (nA) (min)	Input Current Range (mA) (max)	Conformity Error (Initial 5 Decades) (%) (max)	Conformity Error (Initial 5 Decades) (%/°C) (typ/temp)	Offset Voltage (Input Amplifiers) (mV) (max)	V_S (V) (min)	V_S (V) (max)	I_Q Per Ch. (mA) (max)	Reference Type	Auxiliary Op Amps	Package(s)	Price[1]
LOG101	C3	1	0.1	3.5	0.2	0.0001	1.5	±4.5	±18	1.5	External	—	SO-8	$6.95
LOG102	C	1	1	1	0.3	0.0002	1.5	±4.5	±18	2	External	2	SO-14	$7.25
LOG104	C3	0.5	0.1	3.5	0.2	0.0001	1.5	±4.5	±18	1.5	External	—	SO-8	$6.95
LOG112	C3	0.5	0.1	3.5	0.2	0.00001	1.5	±4.5	±18	1.75	2.5V Internal	1	SO-14	$7.90
LOG2112[3]	C3	0.5	0.1	3.5	0.2	0.00001	1.5	±4.5	±18	1.75	2.5V Internal	1	SO-16	$11.35
LOG114	C3	0.375	0.1	3.5	0.2	0.001	4	±2.25	±5	15	2.5V Internal	2	QFN-16	$8.90

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]C = 0°C to 70°C; C3 = –5°C to 75°C. [3]Dual LOG112. *Preview devices appear in **bold blue**.*

Isolation Amplifiers Selection Guide

Device	Description	Spec[2] Temp Range	Isolation Voltage Cont Peak (DC) (V)	Isolation Voltage Pulse/ Test Peak (V)	Isolation Mode Rejection DC (dB) (typ)	Gain Nonlinearity (%) (max)	Input Offset Voltage Drift (±µV/°C) (max)	Small-Signal Bandwidth (kHz) (typ)	Package(s)	Price[1]
ISO120	1500-Vrms Isolation, Buffer	WI	2121	2500	160	0.01	150	60	DIP-24	$68.20
ISO121	3500-Vrms Isolation, Buffer	I2	4950	5600	—	0.01	—	60	CERDIP-16	$66.35
ISO122	1500-Vrms Isolation, Buffer	I2	2121	2400	160	0.02	200	50	DIP-16, SOIC-28	$9.40
ISO124	1500-Vrms Isolation, Buffer	I2	2121	2400	140	0.01	—	50	DIP-16, SOIC-28	$7.20
Digital Couplers										
ISO150	Dual, Bi-Directional Digital Coupler	I	1500	2400	—	—	—	—	DIP-12, SO-12	$7.47

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]WI = –55°C to +125°C; I2 = –25°C to +85°C; I = –40°C to +85°C.

Amplifiers

Single-Supply Instrumentation Amplifiers Selection Guide

Device	Description	Spec[2] Temp Range	Gain	Non Linearity (%) (max)	Input Bias Current (nA) (max)	Offset at G = 100 (µV) (max)	Offset Drift (µV/°C) (max)	CMRR at G = 100 (dB) (min)	BW at G = 100 (kHz) (min)	Noise at 1kHz ($nV/\sqrt{Hz}$) (typ)	Power Supply (V)	I_Q per Amp (mA) (max)	Package(s)	Price[1]
Single-Supply, Low Power I_Q < 525µA per Instrumentation Amp														
INA321	RRO, SHDN, Low Offset, Gain Error	WI	5 to 10000	0.01	0.01	1000	7[3]	90	50	100	2.7 to 5.5	0.06	MSOP-8	$1.10
INA2321	Dual INA321	WI	5 to 10000	0.01	0.01	1000	7[3]	90	50	100	2.7 to 5.5	0.06	TSSOP-14	$1.75
INA322	RRO, SHDN, Low Cost	WI	5 to 10000	0.01	0.01	10000	7	60	50	100	2.7 to 5.5	0.06	MSOP-8	$0.95
INA2322	Dual INA322	WI	5 to 10000	0.01	0.01	10000	7	60	50	100	2.7 to 5.5	0.06	TSSOP-14	$1.50
INA122	µpower, RRO, CM to Ground	I	5 to 10000	0.012	25	250	3	90	5	60	2.2 to 36	0.085	SOIC-8	$2.10
INA332	RRO, Wide BW, SHDN	WI	5 to 1000	0.01	0.01	10000	7[3]	60	500	100	2.7 to 5.5	0.1	MSOP-8	$0.85
INA2332	Dual INA332	WI	5 to 1000	0.01	0.01	10000	7[3]	60	500	100	2.7 to 5.5	0.1	MSOP-8	$1.35
INA126	µpower, < 1V V_{SAT}, Low Cost	I	5 to 10000	0.012	25	250	3	83	9	35	2.7 to 36	0.2	SO/MSOP-8	$1.05
INA2126	Dual INA126	I	5 to 10000	0.012	25	250	3	83	9	35	2.7 to 36	0.2	SO/MSOP-16	$1.70
INA118	Precision, Low Drift, Low Power[4]	I	1 to 10000	0.002	5	55	0.7	107	70	10	2.7 to 36	0.385	SOIC-8	$4.15
INA331	RRO, Wide BW, SHDN	WI	5 to 1000	0.01	0.01	500	5[3]	90	2000	46	2.7 to 5.5	0.5	MSOP-8	$1.10
INA2331	Dual INA331	WI	5 to 1000	0.01	0.01	1000	5[3]	80	2000	46	2.7 to 5.5	0.5	TSSOP-14	$1.80
INA125	Internal Ref, Sleep Mode[4]	I	4 to 10000	0.01	25	250	2	100	4.5	38	2.7 to 36	0.525	SOIC-16	$2.05
Single-Supply, Low Input Bias Current I_B < 100pA														
INA155	Low Offset, RRO, SR = 6.5V/µs	WI	10, 50	0.015	0.01	1000	5[3]	86	110	40	2.7 to 5.5	2.1	MSOP-8	$1.10
INA156	Low Offset, RRO, Low Cost, SR = 6.5V/µs	WI	10, 50	0.015	0.01	8000	5[3]	86	110	40	2.7 to 5.5	2.1	SOIC-8, MSOP-8	$0.95
INA321	RRO, SHDN, Low Offset, Gain Error	WI	5 to 10000	0.01	0.01	1000	7[3]	90	50	100	2.7 to 5.5	0.06	MSOP-8	$1.10
INA2321	Dual INA321	WI	5 to 10000	0.01	0.01	1000	7[3]	90	50	100	2.7 to 5.5	0.06	TSSOP-14	$1.75
INA322	RRO, SHDN, Low Cost	WI	5 to 10000	0.01	0.01	10000	7	60	50	100	2.7 to 5.5	0.06	MSOP-8	$0.95
INA2322	Dual INA322	WI	5 to 10000	0.01	0.01	10000	7	60	50	100	2.7 to 5.5	0.06	TSSOP-14	$1.50
INA331	RRO, Wide BW, SHDN	WI	5 to 1000	0.01	0.01	500	5[3]	90	2000	46	2.7 to 5.5	0.5	MSOP-8	$1.10
INA2331	Dual INA331	WI	5 to 1000	0.01	0.01	1000	5[3]	80	2000	46	2.7 to 5.5	0.5	TSSOP-14	$1.80
INA332	RRO, Wide BW, SHDN	WI	5 to 1000	0.01	0.01	10000	7[3]	60	500	100	2.7 to 5.5	0.1	MSOP-8	$0.88
INA2332	Dual INA332	WI	5 to 1000	0.01	0.01	10000	7[3]	60	500	100	2.7 to 5.5	0.1	TSSOP-14	$1.35
Single-Supply, Precision V_{OS} < 300µA, Low V_{OS} Drift														
INA118	Precision, Low Drift, Low Power[4]	I	1 to 10000	0.002	5	55	0.7	107	70	10	2.7 to 36	0.385	SOIC-8	$4.15
INA326	RRIO, Auto Zero, CM > Supply, Low Drift	I	0.1 to 10000	0.01	2	100	0.4	100	1	33	2.7 to 5.5	3.4	MSOP-8	$1.80
INA327	RRIO, Auto Zero, SHDN, CM > Supply, Low Drift	I	0.1 to 10000	0.01	2	100	0.4	100	1	33	2.7 to 5.5	3.4	MSOP-10	$1.95
INA337	RRIO, Auto Zero, Low Drift, CM > Supply	EI	0.1 to 10000	0.01	2	100	0.4	106	1	33	2.7 to 5.5	3.4	MSOP-8	$1.80
INA338	RRIO, Auto Zero, Low Drift, CM > Supply, SHDN	EI	0.1 to 10000	0.01	2	100	0.4	106	1	33	2.7 to 5.5	3.4	MSOP-10	$1.95
INA122	µpower, RRO, CM to Ground	I	5 to 10000	0.012	25	250	3	90	5	60	2.2 to 36	0.085	SOIC-8	$2.10
INA125	Internal Ref, Sleep Mode[4]	I	4 to 10000	0.01	25	250	2	100	4.5	38	2.7 to 36	0.525	SOIC-16	$2.05
INA126	µpower, < 1V V_{SAT}, Low Cost	I	5 to 10000	0.012	25	250	3	83	9	35	2.7 to 36	0.2	SO/MSOP-8	$1.05
INA2126	Dual INA126	I	5 to 10000	0.012	25	250	3	83	9	35	2.7 to 36	0.2	SO/MSOP-16	$1.70
Signal Amplifiers for Temperature Control					**I_B (nA)**	**Temp Error[5]**			**1/F Noise**					
INA330	Optimized for Precision 10K Thermistor Applications	I	—	—	0.2[3]	—	0.009°C[3]	—	1	0.0001 °C pp	2.7 to 5.5	3.6	MSOP-10	$1.55

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]WI = –55°C to +125°C; I = –40°C to +85°C; EI = –40°C to +125°C. [3]Typical. [4]Internal +40-V input protection. [5]–40°C to +85°C.

Amplifiers

Dual-Supply Instrumentation Amplifiers Selection Guide

Device	Description	Spec[2] Temp Range	Gain	Non Linearity (%) (max)	Input Bias Current (nA) (max)	Offset at G = 100 (µV) (max)	Offset Drift (µV/°C) (max)	CMRR at G = 100 (dB) (min)	BW at G = 100 (kHz) (min)	Noise at 1kHz (nV/√Hz) (typ)	Power Supply (V)	I_Q per Amp (mA) (max)	Package(s)	Price[1]
Dual-Supply, Low Power I_Q < 850µA per Instrumentation Amp														
INA122	µpower, RRO, CM to Ground	I	5 to 10000	0.012	25	250	3	90	5	60	±1.3 to ±18	0.085	DIP-8, SOIC-8	$2.10
INA126[3]	µpower, < 1V V_{SAT}, Low Cost	I	5 to 10000	0.012	25	250	3	83	9	35	±1.35 to ±18	0.2	DIP/SO/MSOP-8	$1.05
INA118	Precision, Low Drift	I	1 to 10000	0.002	5	55	0.7	107	70	10	±1.35 to ±18[4]	0.385	SOIC-8	$4.15
INA121	Low Bias, Precision	I	1 to 10000	0.005	0.05	500	5	100	50	20	±2.25 to ±18[4]	0.525	SO-8	$2.50
INA125	Internal Ref, Sleep Mode[4]	I	4 to 10000	0.01	25	250	2	100	4.5	38	±1.35 to ±18	0.525	SOIC-16	$2.05
INA128[3]	Precision, Low Noise, Low Drift[4]	I	1 to 10000	0.002	5	60	0.7	120	200	8	±2.25 to ±18	0.8	SOIC-8	$3.05
INA129	Precision, Low Noise, Low Drift AD620 Second Source[4]	I	1 to 10000	0.002	5	60	0.7	120	200	8	±2.25 to +18	0.8	SOIC-8	$3.05
INA141[3]	Precision, Low Noise, Low Drift, Pin Compatible with AD6212[4]	I	10, 100	0.002	5	50	0.7	110	200	8	±2.25 to +18	0.8	SOIC-8	$3.05
Dual-Supply, Low Input Bias Current I_B < 100pA														
INA110	Fast Settle, Low Noise, Wide BW	C	1,10,100, 200, 500	0.01	0.05	280	2.5	106	470	10	±6 to ±18	4.5	CDIP-16	$7.00
INA121	Precision	I	1 to 10000	0.005	0.05	500	5	100	50	20	±2.25 to ±18[4]	0.525	SO-8	$2.50
INA111	Fast Settle, Low Noise, Wide BW	I	1 to 10000	0.005	0.02	520	6	106	450	10	±6 to ±18	4.5	SO-16	$4.20
INA116	Ultra Low I_B 3 fA (typ), with Buffered Guard Drive Pins[4]	I	1 to 10000	0.01	0.0001	5000	40	80	70	28	±4.5 to ±18	1.4	SO-16	$4.20
Dual-Supply, Precision V_{OS} < 300µA, Low V_{OS} Drift														
INA114	Precision, Low Drift[4]	I	1 to 10000	0.002	2	50	0.25	110	10	11	±2.25 to ±18	3	SO-16	$4.20
INA115	Precision, Low Drift, with Gain Sense Pins[4]	I	1 to 10000	0.002	2	50	0.25	120	10	11	±2.25 to ±18	3	SO-16	$4.20
INA131	Low Noise, Low Drift[4]	I	100	0.002	2	50	0.25	110	70	12	±2.25 to ±18	3	PDIP-8	$3.80
INA141[3]	Precision, Low Noise, Pin Com. w/AD6212	I	10, 100	0.002	5	50	0.7	110	200	8	±2.25 to ±18[4]	0.8	SOIC-8	$3.55
INA118	Precision, Low Drift	I	1 to 10000	0.002	5	55	0.7	107	70	10	±1.35 to ±18[4]	0.385	SOIC-8	$4.15
INA128[3]	Precision, Low Noise, Low Drift[4]	I	1 to 10000	0.002	5	60	0.7	120	200	8	±2.25 to ±18	0.8	SOIC-8	$3.05
INA129	Precision, Low Noise, Low Drift, AD620 Second Source[4]	I	1 to 10000	0.002	5	60	0.7	120	200	8	±2.25 to ±18	0.8	SOIC-8	$3.05
INA122	µpower, RRO, CM to Ground	I	5 to 10000	0.012	25	250	3	90	5	60	±1.3 to ±18	0.085	SOIC-8	$2.10
INA125	Internal Ref, Sleep Mode[4]	I	4 to 10000	0.01	25	250	2	100	4.5	38	±1.35 to ±18	0.525	SOIC-16	$2.05
INA126[3]	µpower, < 1V V_{SAT}, Low Cost	I	5 to 10000	0.012	25	250	3	83	9	35	±1.35 to ±18	0.2	SO/MSOP-8	$1.05
INA101	Low Noise, Wide BW, Gain Sense Pins	C	1 to 10000	0.007	30	259	23	100	25000	13	±5 to ±18	8.5	TO-100, CDIP-14, PDIP-14, SO-16	$7.90
INA110	Fast Settle, Low Noise, Low Bias, Wide BW	C	1,10,100, 200, 500	0.01	0.05	280	2.5	106	470	10	±6 to ±18	4.5	CDIP-16	$7.00
Dual-Supply, Lowest Noise														
INA103	Precision, Fast Settle, Low Drift, Audio, Mic Pre Amp, THD+N = 0.0009%	C	1, 100	0.0006[5]	12000	255	1.2[5]	100	800	1	±9 to ±25	13	SO-16	$5.00
INA163	Precision, Fast Settle, Low Drift, Audio, Mic Pre Amp, THD+N = 0.002%	I	1 to 10000	0.0006[5]	12000	300	1.2[5]	100	800	1	±4.5 to ±18	12	SOIC-14	$2.50
INA166	Precision, Fast Settle, Low Drift, Audio, Mic Pre Amp, THD+N = 0.09%	I	2000	0.005	12000	300	2.5[5]	100	450	1.3	±4.5 to ±18	12	SO-14 Narrow	$5.95
INA217	Precision, Low Drift, Audio, Mic Pre Amp, THD+N = 0.09%, SSM2017 Replacement	I	1 to 10000	0.0006[5]	12000	300	1.2[5]	–100	800	1.3	±4.5 to ±18	12	SO-16	$2.50

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]I = –40°C to +85°C; C = 0°C to 70°C. [3]Parts also available in dual version. [4]Internal +40-V input protection. [5]Typical.

Operational Amplifiers Selection Guide

Device	Description	Package Options	S, D, T, Q[2]	Offset (mV) (max)	Drift (µV/°C) (typ)	I_B (pA) (max)	Noise 1kHz (nV/√Hz)	GBW (MHz) (typ)	SR (V/µs) (typ)	V_{IN} Low (min)	V_{IN} High (max)	V_{OUT} Low	V_{OUT} High	V_{SUP}	I_Q / Amp (mA) (max)	Price[1]
Bipolar Input—Low Offset, Low Drift																
OPA228	Very Low Noise, G>5	SOIC	S, D, Q	0.075	0.1	10nA	3	33	10	(V–) +2	(V+) –2	(V–) +2	(V+) –2	±2.5 to ±18	3.8	$1.10
OPA227	Very Low Noise Bipolar	SOIC	S, D, Q	0.075	0.1	10nA	3	8	2.3	(V–) +2	(V+) –2	(V–) +2	(V+) –2	±2.5 to ±18	3.8	$1.65
OPA277	Lowest Offset/Drift	**QFN**	S, D, Q	0.02	0.1	1nA	8	1	0.8	(V–) +2	(V+) –2	(V–) +0.5	(V+) –1.2	±2 to ±18	0.825	$0.85
OPA234	Single Supply, General Purpose	MSOP	S, D, Q	0.1	0.5	25nA	25	0.35	0.2	(V–) –0.1	(V+) –1	(V–) +0.1	(V+) –1	2.7 to 36	0.3	$1.30
TLV2451	Good Speed/Power	SOT23	S, D, Q	1.5	0.3	5nA	51	0.22	0.12	(V–)	(V+)	(V–) +0.03	(V+) –0.07	2.7 to 6.0	0.035	$0.60
OPA241	Low Power, Single Supply	SOIC	S, D, Q	0.25	0.4	20nA	45	0.035	0.01	(V–) –0.2	(V+) –1	(V–) +0.1	(V+) –0.1	2.7 to 36	0.03	$1.15
FET-Input—Low Noise, Wide Bandwidth																
OPA627	DiFET, Lowest THD+N	SOIC	S	0.5	2.5	10	5.6	16	55	(V–) +4	(V+) –4	(V–) +3.5	(V+) –3.5	±4.5 to ±18	7.5	$12.25
OPA134	0.00008% THD+N, Audio	SOIC	S, D, Q	2	2	100	8	8	20	(V–) +2.5	(V+) –2.5	(V–) +0.5	(V+) –0.5	±2.5 to ±18	5	$0.95
OPA132	0.00008% THD+N, Precision	SOIC	S, D, Q	0.5	2	50	8	8	20	(V–) +2.5	(V+) –2.5	(V–) +0.5	(V+) –0.5	±2.5 to ±18	4.8	$1.45
OPA137	Lost Cost FET, SOT23	SOIC	S, D, Q	3	2.5	100	45	1	3.5	(V–) +3	(V+)	(V–) +0.5	(V+) –1.2	±2.5 to ±18	0.27	$0.60
OPA130	Low Power, FET	SOIC	S, D, Q	1	2	20	16	1	2	(V–) +2	(V+) –2	(V–) +1.2	(V+) –1.5	±2.5 to ±18	0.65	$1.40
CMOS—Low Input Bias Current (I_B), Rail-to-Rail In and Out																
OPA355	High-Speed, RRO	SOT23	S, D, T	9	7	50	5.8	200	300	(V–) –0.2	(V+) –1	(V–) –0.1	(V+) –1.5	2.5 to 5.5	11	$1.90
OPA365	Outstanding ADC Driver Low THD+N	SOT23	S, D, Q	0.5	4	10	5	50	25	(V–) –0.2	(V+) +0.2	(V–) +0.01	(V+) –0.01	2.2 to 5.5	5	—
OPA350	Excellent ADC Driver Amp, Low Offset	MSOP	S, D, Q	0.5	4	10	8	38	22	(V–) –0.1	(V+) +0.1	(V–) +0.05	(V+) –0.05	2.5 to 5.5	7.5	$1.30
OPA725/6	Low-Noise, High-Speed	SOT23	S,D	3	4	200	15	20	30	(V–)	(V+) –2.5	(V–) +0.1	(V+) –0.1	4 to 12	6.2	$0.90
OPA727	e-trim™, Low Offset,Drift	QFN	S	0.15	0.3	100	6	20	30	(V–)	(V+) –2.5	(V–) +0.1	(V+) –0.1	4 to 12	4.3	$1.45
TLC081	Low Cost, Shutdown	MSOP	S, D, Q	1.9	1.2	50	8.5	10	16	(V–)	(V+) –1.5	(V–) +0.25	(V+) –0.9	4.5 to 16	2.5	$0.50
TLV2781	1.8V, 8MHz, Shutdown	SOT23	S, D, Q	3	8	15	18	8	4.3	(V–) –0.2	(V+) +0.2	(V–) +0.07	(V+) –0.02	1.8 to 3.6	0.82	$0.65
OPA743	12V, RRIO, SOT23	SOT23	S, D, Q	1.5	8	10	30	7	10	(V–) –0.1	(V+) +0.1	(V–) +0.075	(V+) –0.075	3.5 to 12	1.5	$0.95
OPA364	1.8V, High CMRR, Low Offset	SOT23	S, D, Q	0.5	2	10	17	7	5	(V–) –0.1	(V+) +0.1	(V–) +0.02	(V+) –0.02	1.8 to 5.5	0.75	$0.60
OPA340	Low Offset, Excellent Swing	SOT23	S, D, Q	0.5	2.5	10	25	5.5	6	(V–) –0.3	(V+) +0.3	(V–) +0.005	(V+) –0.005	2.5 to 5.5	0.95	$0.80
TLC2272	Dual or Quad, RRIO	TSSOP	D, Q	0.95	2	60	9	2.18	3.6	(V–)	(V+) –1.5	(V–) +0.15	(V+) –0.01	4.4 to 16	1.5	$0.65
TLC220x	SS, Low Noise	SOIC	S, D	0.2	0.5	10	8	1.8	2.5	(V–)	(V+) –2.3	(V–) +0.05	(V+) –0.3	4.6 to 16	1.5	$1.75
OPA348	Lowest Power 1MHz Amp	SC-70	S, D, Q	5	2	10	35	1	0.5	(V–) –0.2	(V+) +0.2	(V–) +0.018	(V+) –0.018	2.5 to 5.5	0.065	$0.45
OPA703/4	RRIO, SOT23/G>5	SOT23	S, D, Q	0.75	4	10	45	1	0.6	(V–) –0.3	(V+) +12.3	(V–) +0.045	(V+) –0.05	4 to 12	0.2	$1.30
TLV2761	1.8V µpower	SOT23	S, D, Q	3.5	9	15	95	0.5	0.2	(V–) –0.2	(V+) +0.2	(V–) +0.01	(V+) –0.01	1.8 to 3.6	0.028	$0.65
OPA347	High Speed/Power, Dual in WCSP	**WCSP**, SC-70	S, D, Q	6	2	10	60	0.35	0.17	(V–) –0.2	(V+) +0.2	(V–) +0.005	(V+) –0.005	2.3 to 5.5	0.034	$0.48
TLC2252	Dual or Quad, RRO, Low Power	TSSOP	D, Q	1.5	0.5	60	19	0.2	0.12	(V–)	(V+) –1	(V–) +0.15	(V+) –0.1	4.4 to 16	0.07	$0.65
OPA336	µpower, Low Offset	SOT23	S, D, Q	0.125	1.5	10	40	0.1	0.03	(V–) –0.2	(V+) –1	(V–) +0.1	(V+) –0.1	2.3 to 5.5	0.032	$0.40
OPA379	µpower, Low Noise	SC-70	S, D, Q	1.5	2	25	80	0.09	0.015	(V–) –0.2	(V+) +0.2	(V–) +0.01	(V+) –0.01	1.8 to 5.5	0.005	
OPA349	Excellent Speed, Power, 1.8V	SC-70	S, D, Q	10	15	10	300	0.07	0.02	(V–) –0.2	(V+) +0.2	(V–) +0.3	(V+) –0.3	1.8 to 5.5	0.002	$0.75
TLV2401	Ultra-Low Power	SOT23	S, D, Q	1.2	3	300	500	0.005	0.002	(V–) –0.1	(V+) +0.2	(V–) +0.15	(V+) –0.05	2.5 to 16	0.95µA	$0.80
Auto-Zero Autocalibration—Highest Precision, Lowest Drift																
OPA380	High Speed Trans. Amp	MSOP	S,D	0.025	0.1	50	5.8	90	80	(V–)	(V+) –1.8	(V–)	(V+) –0.4	2.7 to 5.5	9.5	$1.95
OPA381	Low Power Precision TIA	QFN	S	0.025	0.1	50	10	18	12	(V–)	(V+) –1.8	(V–)	(V+) –0.4	2.7 to 5.5	1	$1.45
TLC450x	SS, Auto Cal	SOIC	S, D	0.08	1	500	12	4.7	2.5	(V–)	(V+) –2.3	(V–) +0.1	(V+) –0.1	4.0 to 6.0	1.5	$1.35
OPA335	5V Auto-Zero	SOT23	S, D	0.005	0.02	200	1.4µVp-p	2	1.6	(V–) –0.1	(V+) –1.5	(V–) +0.015	(V+) –0.015	2.7 to 5.5	0.3	$1.00
OPA734/5	12V Auto-Zero	SOT23	S,D	0.005	0.05	200	150	1.6	1.5	(V–) –0.1	(V+) –1.5	(V–) +0.02	(V+) –0.02	2.7 to 12	0.75	$1.25
OPA333	µpower Auto-Zero	SC-70	S, D	0.01	0.05	50	1µVp-p	0.35	0.05	(V–) –0.1	(V+) +0.1	(V–) +0.01	(V+) –0.01	1.8 to 5.5	0.02	—

[1]*Suggested resale price in U.S. dollars in quantities of 1,000.*
[2]*S = single; D = dual; T = triple; Q = quad.*

New products are listed in ***bold red****. Preview products are listed in* ***bold blue****.*

Amplifiers

Comparators Selection Guide

Device	Description	Ch.	I_Q Per Ch. (mA), (max)	Output Current (mA) (min)	t_{RESP} Low-to-High (µs)	V_S (V) (min)	V_S (V) (max)	V_{OS} (25°C) (mV) (max)	Output type	Package(s)	Price[1]
High Speed											
TLV3501	Ultra High-Speed, Rail-Rail	1, 2	5	—	0.0045	2.7	5.5	6.5	Push-Pull	SOT23, SOIC	$1.50
TL714	High-Speed, 10mV (typ) Hysteresis	1	12	16	0.006	4.75	5.25	10	Push-Pull	PDIP, SOIC	$2.16
TL3016	High-Speed, Low Offset	1	12.5	—	0.0078	5	10	3	Open-Drain/Collector	SOIC, TSSOP	$0.95
TL3116	Ultra Fast, Low Power, Precision	1	14.7	—	0.0099	5	10	3	Open-Drain/Collector	SOIC, TSSOP	$0.95
TL712	Single, High-Speed	1	20	16	0.025	4.75	5.25	5	Push-Pull	PDIP, SOIC, SOP	$0.83
Low Power I_Q <0.5mA											
TLV370x	Nanopower, Push-Pull, RRIO	1, 2, 4	0.0008	—	36	2.5	16	5	Push-Pull	MSOP, PDIP, SOIC, SOT23, TSSOP	$0.60
TLV349x	Low Voltage, Speed/Power	1, 2	0.0012	—	<0.1	1.8	5.5	15	Push-Pull	SOT23, SOIC, TSSOP	$0.42
Combination Comparators and Op Amps											
TLV230x	Sub-µpower, RRIO	2	0.0017	—	55	2.5	16	5	Open Drain/Collector	MSOP, PDIP, SOIC, TSSOP	$0.90
TLV270x	Sub-µpower, RRIO	2, 4	0.0019	—	36	2.5	16	5	Push-Pull	MSOP, PDIP, SOIC, TSSOP	$0.90
Comparator with On-Chip Voltage Reference											
TLV3011	µpower Open-Drain with Built-in 1.242V Ref	1	0.003	5	6	1.8	5.5	15	Open Drain/Collector	SC70, SOT23	$0.75
TLV3012	µpower Push-Pull with Built-in 1.242V Ref	1	0.005	0.5	6	1.8	5.5	12	Push-Pull	SC70, SOT23	$0.75

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

High-Speed Amplifiers Selection Guide

Device	Ch.	SHDN	Supply Voltage (V)	A_{CL} (min)	BW at A_{CL} (MHz) (typ)	BW G = +2 (MHz) (typ)	GBW Product (MHz) (typ)	Slew Rate (V/µs)	Settling Time 0.1% (ns) (typ)	THD 2Vpp G = 1.1MHz (dB) (typ)	Differential Gain (%)	Differential Phase (°)	V_N (nV/√Hz) (typ)	V_{OS} (mV) (max)	Package(s)	Price[1]
Fully Differential																
THS4130/31	1	Y	5, ±5, ±15	1	150	90	90	52	78	–97	—	—	1.3	2	SOIC, MSOP PowerPAD™	$3.50
THS4150/51	1	Y	5, ±5, ±15	1	150	81	100	650	53	–84	—	—	7.6	7	SOIC, MSOP PowerPAD, Leadless MSOP PowerPAD	$4.70
THS4502/03	1	Y	5, ±5	1	370	175	300	2800	6.3	–100	—	—	6	7	SOIC, MSOP PowerPAD, Leadless MSOP PowerPAD	$4.00
THS4504/05	1	Y	5, ±5	1	260	110	210	1800	20	–100	—	—	8	7	SOIC, MSOP PowerPAD, Leadless MSOP PowerPAD	$1.75
CMOS Amplifiers																
OPA354	1	—	2.5 to 5.5	1	250	90	100	150	30	—	0.02	0.09	6.5	8	SOT23, SOIC PowerPAD	$0.75
OPA2354	2	—	2.5 to 5.5	1	250	90	100	150	30	—	0.02	0.09	6.5	8	SOIC PowerPAD, MSOP	$1.20
OPA4354	4	—	2.5 to 5.5	1	250	90	100	150	30	—	0.02	0.09	6.5	8	SOIC, TSSOP	$1.80
OPA355	1	Y	2.5 to 5.5	1	450	100	200	300	30	—	0.02	0.05	5.8	9	SOT23, SOIC	$0.90
OPA2355	2	Y	2.5 to 5.5	1	450	100	200	300	30	—	0.02	0.05	5.8	9	MSOP	$1.50
OPA3355	3	Y	2.5 to 5.5	1	450	100	200	300	30	—	0.02	0.05	5.8	9	SOIC	$1.90
OPA356	1	—	2.5 to 5.5	1	450	100	200	300	30	—	0.02	0.05	5.8	9	SOT23, SOIC	$0.90
OPA2356	2	—	2.5 to 5.5	1	450	100	200	300	30	—	0.02	0.05	5.8	9	SOIC, MSOP	$1.50
OPA357	1	Y	2.5 to 5.5	1	250	90	100	150	30	—	0.02	0.09	6.5	8	SOT23, SOIC PowerPAD	$0.75
OPA2357	2	Y	2.5 to 5.5	1	250	90	100	150	30	—	0.02	0.09	6.5	8	MSOP	$1.20
OPA358	1	Y	2.7 to 3.3	1	75	—	80	55	—	—	0.3	0.7	5.8	6	SC-70	$0.45
FET-Input																
OPA656	1	—	±5	1	500	200	230	290	—	–80	0.02	0.05	7	1.8	SOT23, SOIC	$3.35
OPA657	1	—	±5	7	350	300	1600	700	10	–80	—	—	4.8	1.8	SOT23, SOIC	$3.80
THS4131	1	N	5, ±5, ±15	1	150	90	90	52	78	–97	—	—	2		SOIC, MSOP PowerPAD	$3.50

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

High-Speed Amplifiers Selection Guide (Continued)

Device	Ch.	SHDN	Supply Voltage (V)	A_{CL} (min)	BW at A_{CL} (MHz) (typ)	BW G = +2 (MHz) (typ)	GBW Product (MHz) (typ)	Slew Rate (V/µs)	Settling Time 0.1% (ns) (typ)	THD 2Vpp G = 1.1MHz (dB) (typ)	Differential Gain (%)	Differential Phase (°)	V_N (nV/√Hz) (typ)	V_{OS} (mV) (max)	Package(s)	Price[1]
Voltage Feedback																
OPA820	1, 2, 4	N	5, ±5	1	800	240	280	240	18	–84	0.01	0.03	0.75	1	SOP,SOIC	$0.90
OPA842	1	—	±5	1	400	56	200	400	15	—	0.003	0.008	2.7	1.2	SOT23, SO	$1.55
OPA843	1	—	±5	3	500	65	800	1000	7.5	—	0.001	0.012	2	1.2	SOT23, SO	$1.60
OPA846	1, 2	—	±5	7	500	—	1750	625	15	—	0.02	0.02	1.2	0.5	SOT23, SOIC	$1.70
OPA847	1	—	±5	12	600	—	3900	950	20	—	—	—	0.85	0.5	SOT23, SOIC	$2.00
OPA2613	2	N	5, ±5	1	230	110	125	70	40	–94	—	—	1	1	SOIC	$1.55
THS4031/32	1, 2	—	±5, ±15	2	100	100	200	100	60	–72	0.015	0.025	1.6	2	SOIC, MSOP PowerPAD™	$2.00
THS4011/12	1, 2	N	±5, ±15	1	290	50	100	310	37	–80	0.006	0.01	6	6	SOIC, MSOP PowerPAD	$2.30
THS4051/52	1, 2	N	±5, ±15	1	70	38	—	240	60	–82	0.01	0.01	10	10	SOIC, MSOP PowerPAD	$1.10
THS4081/82	1, 2	N	±5, ±15	1	175	—	100	230	43	–64	0.01	0.05	7	4.5	SOIC, MSOP PowerPAD	$1.80
THS4271	1	Y	5, ±5, 15	1	1400	390	400	1000	25	–110	0.007	0.004	3	10	SOIC, MSOP PowerPAD	$2.85
Voltage-Limiting Amplifiers																
OPA698	1	N	5, ±5	1	450	215	250	1100	—	–93	0.012	0.008	5.6	5	SOIC	$2.00
OPA699	1	N	5, ±5	4	260	—	1000	1400	—	—	0.012	0.008	4.1	5	SOIC	$2.05
Current Feedback																
OPA691	1, 2, 3	Y	5, ±5	1	280	255	—	2100	8	–93	0.07	0.02	1.7	2.5	SOT23, SOIC	$1.55
OPA695	1	Y	5, ±5	1	1700	1400	—	4300	—	–86	0.04	0.007	3	3	SOT23, SOIC	$1.35
OPA684	1, 2, 3, 4	Y	5, ±5	1	210	160	—	820	—	–77	0.04	0.02	3.7	0.35	SOT23, SOIC	$1.35
OPA683	1, 2	Y	5, ±5	1	200	150	—	540	—	–84	0.06	0.03	4.4	3.5	SOT23, SOIC	$1.20
OPA694	1	N	±5	1	1500	690	—	1700	13	—	0.03	0.015	4.1	3	SOT23, SOIC	$1.25
THS3091/95	1, 2	Y	±5, ±15	1	235	210	—	5000	42	–72	0.013	0.02	2	3	SOIC, SOIC PowerPAD	$3.60
THS3110/12	1, 2	Y	±5, ±15	1	100	90	—	1300	27	–78	0.01	0.03	6	8	SOIC, MSOP PowerPAD	$1.85
THS3120/22	1, 2	N	±5, ±15	1	130	—	—	1500	11	–53	0.007	0.018	2	8	SOIC, MSOP PowerPAD	$2.25

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

High-Speed Buffer Amplifiers Selection Guide

Device	Spec[2] Temp Range	V_S ±15 (V)	V_S ±5 (V)	V_S +5 (V)	A_{CL} Min Stable Gain (V/V)	BW at ACL (MHz)	Slew Rate (V/µs)	Settling Time 0.01% (ns) (typ)	I_Q (mA) (typ)	THD (FC = 1MHz) (dB) (typ)	Diff Gain (%)	Diff Phase (°)	V_{OS} (mV) max	I_B (µA) max	Package(s)	Price[1]
BUF162	I	N	±5	Yes	1	1600	9000	—	5.8	80	0.06	0.02	±30	±7	SOIC, MSOP, PowerPAD™	$1.60
BUF634	I	Yes	Yes	Yes	1	180	2000	200	250	—	0.4	0.1	100	20	DIP, SOIC, TO220-5, DDPak-5	$3.05
OPA633	C	Yes	Yes	—	1	260	2500	50	100	—	—	0.1	15	35	DIP	$5.45

[1]*Suggested resale price in U.S. dollars in quantities of 1,000.* [2]*I = –40°C to +85°C; C = 0°C to 70°C.*

For a complete product listing visit amplifier.ti.com

PWM Power Drivers Selection Guide

Device	Temp Range[2]	Output Current (A) (min)	Saturation Voltage (V) (max)	I_Q (mA) (max)	V_S (V) (min)	V_S (V) (max)	Duty Cycle (%) (min)	Duty Cycle (%) (max)	Package(s)	Price[1]
Single Switch										
DRV101	I	1.9	1	5	9	60	10	90	TO-220, DDPAK	$3.85
DRV102	WI	2	2.2	9	8	60	10	90	TO-220, DDPAK	$3.85
DRV103	I	3	0.6	0.8	8	32	10	90	SO-8, SO-8 PowerPAD™	$1.60
DRV104	I	1.2	0.65	1	8	32	10	90	14-lead PowerPAD	$1.60

[1]*Suggested resale price in U.S. dollars in quantities of 1,000.* [2]*I = –40°C to +85°C; WI = –55°C to +125°C.*

Amplifiers

Power Operational Amplifiers Selection Guide

Device	Spec[2] Temp Range	I_{OUT} (A)	V_S (V)	Bandwidth (MHz)	Slew Rate (V/µs)	I_Q (mA) (max)	V_{OS} (mV) (max)	V_O Drift (µV/°C) (max)	I_B (nA) (max)	Package(s)	Price[1]
OPA445/B	I2	0.015	10 to 40	2	15	4.7	5-3	10	0.05	TO-99, DIP-8, SO-8	$4.75
OPA452	EI	0.05	20 to 80	1.8	7.2	5.5	3	5	0.1	TO220-7, DDPak-7	$2.55
OPA453	EI	0.05	20 to 80	7.5	23	5.5	3	5	0.1	TO220-7, DDPak-7	$2.55
OPA541	I2	10	±10 to ±40	Full Power 55kHz	10	20	1	30	0.05	TO-3, ZIP	$11.10
OPA544	I	2	20 to 70	1.4	8	12	5	10	0.1	TO220-5, DDPak-5	$6.88
OPA2544	I	2	20 to 70	1.4	8	12	5	10	0.1	ZIP11	$12.00
OPA547	I	0.5	8 to 60	1	6	10	5	25	500	TO220-7, DDPak-7	$4.35
OPA548	I	3	8 to 60	1	10	17	10	30	500	TO220-7, DDPak-7	$6.00
OPA549	I	8	8 to 60	0.9	9	26	5	20	500	ZIP11	$12.00
OPA551	EI	0.2	8 to 60	3	15	7	3	7	0.1	DIP-8, SO-8, DDPak-7	$2.40
OPA552	EI	0.2	8 to 60	12	24	7	3	7	0.1	DIP-8, SO-8, DDPak-7	$1.75
OPA561	EI	1.2	7 to 16	17	50	50	20	50	0.1	HTSSOP-20	$2.65
OPA569	I	2	2.7 to 5.5	1.2	1.2	6	2	1.3 (typ)	10µA	SO-20 PowerPAD™	$3.10
TLV411x	EI	0.3	2.5 to 6	2.7	1.6	1	3.5	3	0.05	PDIP, MSOP, SOIC	$0.75

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]I2 = –25°C to +85°C; I = –40°C to +85°C; EI = –40°C to +125°C.

Digital Temperature Sensors Selection Guide

Device	Supply Voltage (V)	Interface	–25 to 85°C Accuracy (°C max)[2]	Quiescent Current (µA) max	Resolution (Bits)	Programmable Temp Alert	Max Operating Temp (°C)	Package	Price[1]
TMP100	2.7 to 5.5	2-Wire	±2	45	9 to 12	—	150	SOT23	$0.75
TMP101	2.7 to 5.5	2-Wire	±2	45	9 to 12	✓	150	SOT23	$0.80
TMP175	2.7 to 5.5	2-Wire	±1.5	50	12	✓	127	SO-8	$0.85
TMP75	2.7 to 5.5	2-Wire	±1.5	50	12	✓	127	SO-8	$0.70
TMP121	2.7 to 5.5	SPI	±1.5	50	12	—	150	SOT23	$0.90
TMP122	2.7 to 5.5	SPI	±1.5	50	9 to 12	✓	150	SOT23	$0.99
TMP123	2.7 to 5.5	SPI	±1.5	50	12	—	150	SOT23	$0.90
TMP124	2.7 to 5.5	SPI	±1.5	50	12	—	150	SO-8	$0.70
TMP125	2.7 to 5.5	SPI	±2.0	50	10	—	125	SOT23-6	$0.80
TMP141	2.7 to 5.5	SensorPath	±2	170	10	—	127	SOT23	$0.65
TMP300	1.8 to 18	Analog and Comparator Outputs	±2	100	—	Resistor Prog. with 5°C/10°C Hysteresis	150	SC-70	$0.70
TMP301	1.8 to 18	Comparator Output	±2	50	—	Resistor Prog. with 5°C/10°C Hysteresis	150	SC-70	$0.70

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]All digital temp sensors have a ±0.5°C typical accuracy. *Preview products are listed in **bold blue**.*

4-20mA Transmitters and Receivers Selection Guide

Device	Description	Sensor Excitation	Loop Voltage (V)	Full-Scale Input Range	Output Range (mA)	Additional Power Available (V at mA)	Package(s)	Price[1]
2-Wire General Purpose								
XTR101	I_A with Current Excitation	Two 1mA	11.6 to 40	5mV to 1V	4-20mA	—	DIP-14, SOIC-16	$8.70
XTR115	I_{IN} to I_{OUT} Converter, External Resistor Scales V_{IN} to I_{IN}	V_{REF} = 2.5V	7.5 to 36	40µA to 200µA	4-20mA	—	SOIC-8	$1.05
XTR116	I_{IN} to I_{OUT} Converter, External Resistor Scales V_{IN} to I_{IN}	V_{REF} = 4.096V	7.5 to 36	40µA to 200µA	4-20mA	—	SOIC-8	$1.05
XTR117	I_{IN} to I_{OUT} Converter, External Resistor Scales V_{IN} to I_{IN}	V_{REF} = 5.0V	7.5 to 36	40µA to 200µA	4-20mA	—	MSOP-8, DFN 8	$0.90
3-Wire General Purpose								
XTR110	Selectable Input/Output Ranges	V_{REF} = 10V	13.5 to 40	0V to 5V, 0V to 10V	4-20mA, 0-20mA, 0-25mA	—	DIP-16, SOIC-16	$7.10
4-20mA Current Loop Receiver								
RCV420	4-20mA Input, 0V to 5V Output	V_{REF} = 10V	±40V	4-20mA	0V to 5V	—	DIP-16	$3.55
2-Wire RTD Conditioner with Linearization								
XTR105	100Ω RTD Conditioner	Two 800µA	7.5 to 36	5mV to 1V	4-20mA	5.1 at 1	DIP-14, SOIC-14	$4.00
XTR112	High-Resistance RTD Conditioner	Two 250µA	7.5 to 36	5mV to 1V	4-20mA	5.1 at 1	SOIC-14	$4.00
XTR114	High-Resistance RTD Conditioner	Two 100µA	7.5 to 36	5mV to 1V	4-20mA	5.1 at 1	SOIC-14	$4.00
2-Wire Bridge Sensor Conditioner with Linearization								
XTR106	Bridge Conditioner	5V and 2.5V	7.5 to 36	5mV to 1V	4-20mA	5.1 at 1	DIP-14, SOIC-14	$4.00
2-Wire RTD Conditioner with Digital Calibration for Linearization, Span and Offset								
XTR108	100Ω to 1kΩ RTD Conditioner, 6-Channel Input Mux, Extra Op Amp Can Convert to Voltage Sensor Excitation, Calibration Stored in External EEPROM	Two 500µA	7.5 to 24	5mV to 320mV	4-20mA	5.1 at 2.1	SSOP-24	$3.35
Bridge Conditioner with Digital Calibration for Linearization, Span and Offset Over Temperature								
PGA309	Complete Digitally Calibrated Bridge Sensor Conditioner, Voltage Output, Calibration Stored in External EEPROM, One-Wire/Two-Wire Interface	V_{EXC} = V_S, 2.5V, 4.096V	N/A	1mV/V to 245mV/V	0.1V to 4.9V at V_S=+5V	—	TSSOP-16	$3.40
XTR300	Output Driver for Industrial and Process Control Loops User Selects V or I	—	±17.5V	±17V	±17.5V, ±20mA	—	5 x 5 QFN	—

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

*New products are listed in **bold red**. Preview products are listed in **bold blue**.*

Voltage References Selection Guide

Device	Description	Output (V)	Initial Accuracy (%) max	Drift (ppm/°C) max	Long-Term Stability (ppm/1000hr) (typ)	Noise 0.1 to 10Hz (µVp-p) (typ)	I_Q max (mA)	Temperature Range (°C)	Output Current (mA)	Package(s)	Price[1]
REF32xx	Precision, µpower	1.25, 2.048, 2.5 3.0, 3.3, 4.096	0.2	7	55	17 to 53	0.12	–40 to +125	±10	SOT23-6	$1.70
REF31xx	Precision, µpower	1.25, 2.048, 2.5 3.0, 3.3, 4.096	0.2	15	24	15 to 30	0.1	–40 to +125	±10	SOT23-3	$1.10
REF30xx	µpower, Bandgap	1.25, 2.048, 2.5, 3.0, 3.3, 4.096	0.2	50	24	20 to 45	0.05	–40 to +125	25	SOT23-3	$0.60
REF02B	Low Drift, Low Noise, Buried Zener	5	0.13	10	50	4	1.4	–25 to +85	+21, –0.5	PDIP-8, SOIC-8	$2.65
REF102A	Low Drift, Low Noise, Buried Zener	10	0.1	10	20	5	1.4	–25 to +85	+10, –5	PDIP-8, SOIC-8	$1.75
REF102B	Low Drift, Low Noise, Buried Zener	10	0.05	5	20	5	1.4	–25 to +85	+10, –5	PDIP-8, SOIC-8	$4.40
REF1112	Nanopower 1.25V Shunt	1.25	0.2	30	60	25	0.0012	–40 to +125	1A to 5mA	SOT-23	$0.85
REF102C	Ultra-Low Drift, Low Noise, Buried Zener	10	0.025	2.5	20	5	1.4	–25 to +85	+10, –5	PDIP-8, SOIC-8	$5.10
Current References											
REF200	Dual Current Reference with Current Mirror	Two 100µA	±1µA	25 (typ)	—	1µAp-p	—	–25 to +85	50µA to 400µA3	PDIP-8, SOIC-8	$2.60

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

Data Converters

ΔΣ ADCs Selection Guide

Device	Res. (Bits)	Sample Rate (kSPS)	Number of Input Channels	Interface	Input Voltage (V)	V_{REF}	Linearity (%)	NMC (Bits)	Power (mW)	Package(s)	Price[1]
ADS1258	24	125	16 SE/8 Diff	Serial, SPI	±5	Ext	0.001	24	44	QFN-48	$8.95
ADS1271	24	105	1 Diff	Serial, SPI	±2.5	Ext	0.0015	24	35-100	TSSOP-16	$5.90
ADS1252	24	41	1 SE/1 Diff	Serial	±5	Ext	0.0015	24	40	SOIC-8	$5.60
ADS1255	24	30	2 SE/1 Diff	Serial, SPI	PGA (1-64), ±5V	Ext	0.001	24	35	SSOP-20	$8.25
ADS1256	24	30	8 SE/4 Diff	Serial, SPI	PGA (1-64), ±5V	Ext	0.001	24	35	SSOP-28	$8.95
ADS1251	24	20	1 SE/1 Diff	Serial	±5	Ext	0.0015	24	7.5	SOIC-8	$5.60
ADS1253	24	20	4 SE/4 Diff	Serial	±5	Ext	0.0015	24	7.5	SSOP-16	$6.70
ADS1254	24	20	4 SE/4 Diff	Serial	±5	Ext	0.0015	24	4	SSOP-20	$6.70
ADS1210/11	24	16	1/4 SE/1/4 Diff	Serial, SPI	PGA (1-16), ±5	Int/Ext	0.0015	24	27.5	PDIP-18/24, SOIC-18/24, SSOP-28	$10.25/ $10.90
ADS1216	24	0.78	8 SE/4 Diff	Serial, SPI	PGA (1-128), ±2.5	Int/Ext	0.0015	24	0.6	TQFP-48	$5.00
ADS1217	24	0.78	8 SE/4 Diff	Serial, SPI	PGA (1-128), ±5	Int/Ext	0.0012	24	0.8	TQFP-48	$5.00
ADS1218	24	0.78	8 SE/4 Diff	Serial, SPI	PGA (1-128), ±2.5	Int/Ext	0.0015	24	0.8	TQFP-48	$5.50
ADS1222	24	0.24	2 SE/2 Diff	Serial	±5	Ext	0.0015	24	0.5	TSSOP-14	$2.95
ADS1224	24	0.24	4 SE/4 Diff	Serial	±5	Ext	0.0015	24	0.5	TSSOP-20	$3.25
ADS1232	24	0.8	2 SE/2 Diff	Serial	PGA (1-128), ±2.5	Ext	0.0015	24	3	TSSOP-24	$3.90
ADS1234	24	0.8	4 SE/4 Diff	Serial	PGA (1-128), ±2.5	Ext	0.0015	24	3	TSSOP-28	$4.50
ADS1244	24	0.015	1 SE/1 Diff	Serial	±5	Ext	0.0008	24	0.3	MSOP-10	$2.95
ADS1245	24	0.015	1 SE/1 Diff	Serial	±2.5	Ext	0.0015	24	0.5	MSOP-10	$3.10
ADS1240	24	0.015	4 SE/2 Diff	Serial, SPI	PGA (1-128), ±2.5	Ext	0.0015	24	0.6	SSOP-24	$3.80
ADS1241	24	0.015	8 SE/4 Diff	Serial, SPI	PGA (1-128), ±2.5	Ext	0.0015	24	0.5	SSOP-28	$4.20
ADS1242	24	0.015	4 SE/2 Diff	Serial, SPI	PGA (1-128), ±2.5	Ext	0.0015	24	0.6	TSSOP-16	$3.60
ADS1243	24	0.015	8 SE/4 Diff	Serial, SPI	PGA (1-128), ±2.5	Ext	0.0015	24	0.6	TSSOP-20	$3.95
ADS1212/13	22	6.25	1/4 SE/1/4 Diff	Serial, SPI	PGA (1-16), ±5	Int/Ext	0.0015	22	1.4	PDIP-18/24, SOIC-18/24, SSOP-28	$7.70/ $9.00
ADS1250	20	25	1 SE/1 Diff	Serial, SPI	PGA (1-8), ±4	Ext	0.003	20	75	SOIC-16	$6.95
ADS1100	16	0.128	1 SE/1 Diff	Serial, I^2C	PGA (1-8), V_{DD}	Ext	0.0125	16	0.3	SOT23-6	$1.80
ADS1110	16	0.24	1 SE/1 Diff	Serial, I^2C	PGA (1-8), ±2.048	Int	0.01	16	0.7	SOT23-6	$1.95
ADS1112	16	0.24	3 SE/2 Diff	Serial, I^2C	PGA (1-8), ±2.048	Int	0.01	16	0.7	MSOP-10, SON-10	$2.65
TLC7135	14	3	1 SE/1 Diff	MUX BCD	$\pm V_{REF}$	Ext	0.005	4.5 Dig	5	PDIP-28, SOIC-28	$1.95
ADS1000	12	0.128	1 SE/1 Diff	Serial, I^2C	PGA(1-8), V_{DD}	Ext	0.0125	12	0.3	SOT23-6	$0.99
ADS1010	12	0.25	1 SE/1 Diff	Serial, I^2C	PGA(1-8), ±2.048	Int	0.01	12	0.7	SOT23-6	$1.10
ADS1012	12	0.24	3 SE/1 Diff	Serial, I^2C	PGA(1-8), ±2.048	Int	0.01	12	0.7	MSOP-10, SON-10	$1.45
Delta-Sigma (ΔΣ) ADCs for Measuring Low-Level Currents (Photodiodes)											
DDC101	20	10	1	Serial	500pC	Ext	0.025	20	170	SOIC-24	$23.00
DDC112	20	3	2	Serial	50-1000pC	Ext	0.025	20	80	SOIC-28, TQFP-32	$12.10
DDC114	20	3	4	Serial	12-350pC	Ext	0.025	20	55	QFN-48	$18.00
DDC118	20	3	8	Serial	12-350pC	Ext	0.025	20	110	QFN-48	$32.00

[1]*Suggested resale price in U.S. dollars in quantities of 1,000.* *New products are listed in **bold red**. Preview products are listed in **bold blue**.*

Wide Bandwidth Delta-Sigma (ΔΣ) ADCs Selection Guide

Device	(Bits)	Sample Rate (kSPS)	Bandwidth (kHz)	Number of Input Channels	Interface	Input Voltage (V)	SNR (dB)	THD (dB)	Power (mW)	Package	Price[1]
ADS1271	24	105	51	1 Diff	Serial	±2.5	109	–105	35-100	TSSOP-16	$5.90
ADS1625	18	1.25MSPS	615	1 Diff	P18	±3.75	93	–103	520	TQFP-64	$37.60
ADS1626	18	1.25MSPS	615	1 Diff	P18 w/FIFO	±3.75	93	–103	520	TQFP-64	$39.60
ADS1610	16	10MSPS	4900	1 Diff	P16	±3	84	–96	1000	TQFP-64	—
ADS1605	16	5MSPS	2450	1 Diff	P16	±3.75	88	–101	570	TQFP-64	$32.05
ADS1606	16	5MSPS	2450	1 Diff	P16 w/FIFO	±3.75	88	–101	570	TQFP-64	$33.75
ADS1602	16	2.5MSPS	1230	1 Diff	Serial	±3	91	–103	550	TQFP-48	$23.00
ADS1601	16	1.25MSPS	615	1 Diff	Serial	±3	92	–105	350	TQFP-48	$14.00

[1]*Suggested resale price in U.S. dollars in quantities of 1,000.* *New products are listed in **bold red**. Preview products are listed in **bold blue**.*

SAR ADCs Selection Guide

Device	Res. (Bits)	Sample Rate (kSPS)	Number of Input Channels	Interface	Input Voltage (V)	V_{REF}	Linearity (%)	NMC	SINAD (dB)	Power (mW)	Package(s)	Price[1]
ADS8380	18	600	1 SE, 1 PDiff	Serial, SPI	V_{REF}	Int/Ext	0.0015	18	91	115	6 X 6 QFN-28	$16.50
ADS8382	18	600	1 Diff	Serial, SPI	$\pm V_{REF}$ (4.2V) at $V_{REF}/2$	Int/Ext	0.0012	18	96	115	6 X 6 QFN-28	$16.95
ADS8381	18	580	1 SE, 1 PDiff	P8/P16/P18	V_{REF}	Ext	0.0015	16	93	115	TQFP-48	$16.65
ADS8383	18	500	1 SE, 1 PDiff	P8/P16/P18	V_{REF}	Ext	0.0026	18	85	110	TQFP-48	$15.75
ADS8411	16	2000	1 SE, 1 PDiff	P8/P16	V_{REF}	Int	0.0038	16	87	155	TQFP-48	$22.00
ADS8412	16	2000	1 Diff	P8/P16	$\pm V_{REF}$ (4.2V) at $V_{REF}/2$	Int	0.0038	16	90	155	TQFP-48	$23.05
ADS8401	16	1250	1 SE, 1 PDiff	P8/P16	V_{REF}	Int	0.0053	16	85	155	TQFP-48	$12.55
ADS8402	16	1250	1 Diff	P8/P16	$\pm V_{REF}$ (4.2V) at $V_{REF}/2$	Int	0.0053	16	88	155	TQFP-48	$13.15
ADS8405	16	1250	1 SE, 1 PDiff	P8/P16	V_{REF}	Int/Ext	0.003	16	85	155	TQFP-48	$14.10
ADS8406	16	1250	1 Diff	P8/P16	$\pm V_{REF}$ (4.2V) at $V_{REF}/2$	Int/Ext	0.003	16	90	155	TQFP-48	$14.70
ADS8371	16	750	1 SE, 1 PDiff	P8/P16	V_{REF}	Ext	0.0023	16	87	130	TQFP-48	$12.00
ADS8370	16	600	1 SE, 1 PDiff	Serial, SPI	V_{REF}	Int/Ext	0.0015	16	90	110	6 X 6 QFN-28	$12.50
ADS8372	16	600	1 Diff	Serial, SPI	$\pm V_{REF}$ (4.2V) at $V_{REF}/2$	Int/Ext	0.0012	16	94	110	6 X 6 QFN-28	$13.00
ADS8322	16	500	1 PDiff	P8/P16	5	Int/Ext	0.009	15	83	85	TQFP-32	$7.10
ADS8323	16	500	1 Diff	P8/P16	±2.5V at 2.5	Int/Ext	0.009	15	83	85	TQFP-32	$7.10
ADS8361	16	500	2 x 2 Diff	Serial, SPI	±2.5V at +2.5	Int/Ext	0.00375	14	83	150	SSOP-24	$10.35
ADS8509	16	250	1 SE	Serial, SPI	+4, 5, 10; ±3.3, 5, 10	Int/Ext	0.003	16	86	70	SOIC-20, SSOP-28	$12.95
ADS8505	16	250	1 SE	P16	±10	Int/Ext	0.0045	16	86	70	SOIC-28, SSOP-28	$12.95
ADS8342	16	250	SE	P8/P16	±2.5	Ext	0.006	16	85	200	TQFP-48	$11.30
ADS7811	16	250	1 SE	P16	±2.5	Int/Ext	0.006	15	87	200	SOIC-28	$36.15
ADS7815	16	250	1 SE	P16	±2.5	Int/Ext	0.006	15	84	200	SOIC-28	$21.30
ADS8364	16	250	1 x 6 Diff	P16	±2.5V at +2.5	Int/Ext	0.0045	14	82.5	413	TQFP-64	$18.10
TLC4541	16	200	1 SE	Serial, SPI	V_{REF}	Ext	0.0038	16	84.5	17.5	SOIC-8, VSSOP-8	$6.85
TLC4545	16	200	1 PDiff	Serial, SPI	V_{REF}	Ext	0.0038	16	84.5	17.5	SOIC-8, VSSOP-8	$6.85
ADS7805	16	100	1 SE	P8/P16	±10	Int/Ext	0.0045	16	86	81.5	PDIP-28, SOIC-28	$21.80
ADS7809	16	100	1 SE	Serial, SPI	+4, 10, ±3.3, 5, 10	Int/Ext	0.0045	16	88	81.5	SOIC-20	$21.80
ADS8320	16	100	1 PDiff	Serial, SPI	V_{REF}	Ext	0.012	15	84	1.95	VSSOP-8	$5.15
ADS8321	16	100	1 Diff	Serial, SPI	$\pm V_{REF}$ at $+V_{REF}$	Ext	0.012	15	84	5.5	VSSOP-8	$5.15
ADS8325	16	100	1 PDiff	Serial, SPI	V_{REF}	Ext	0.006	16	91	2.25	VSSOP-8, QFN-8	$5.90
ADS8341	16	100	4 SE/2 Diff	Serial, SPI	V_{REF}	Ext	0.006	15	86	3.6	SSOP-16	$7.40
ADS8343	16	100	4 SE/2 Diff	Serial, SPI	$\pm V_{REF}$ at V_{REF}	Ext	0.006	15	86	3.6	SSOP-16	$7.45
ADS8344	16	100	8 SE/4 Diff	Serial, SPI	V_{REF}	Ext	0.006	15	86	3.6	SSOP-20	$8.00
ADS8345	16	100	8 SE/4 Diff	Serial, SPI	$\pm V_{REF}$ at V_{REF}	Ext	0.006	15	85	3.6	SSOP-20	$8.00
ADS7807	16	40	1 SE	Serial, SPI/P8	4, 5, ±10	Int/Ext	0.0022	16	88	28	PDIP-28, SOIC-28	$27.40
ADS7813	16	40	1 SE	Serial, SPI	+4, 10, ±3.3, 5, 10	Int/Ext	0.003	16	89	35	PDIP-16, SOIC-16	$21.30
ADS7825	16	40	4 SE	Serial, SPI/P8	±10	Int/Ext	0.003	16	83	50	PDIP-28, SOIC-28	$29.55
ADS7891	14	3000	1 SE	P8/P14	2.5	Int	0.009	14	78	90	TQFP-48	$10.50
ADS7890	14	1250	1 SE	Serial, SPI	2.5	Int	0.009	14	78	90	TQFP-48	$10.50
TLC3541	14	200	1 SE	Serial, SPI	V_{REF}	Ext	0.006	14	81.5	17.5	SOIC-8, VSSOP-8	$5.00
TLC3544	14	200	4 SE/2 Diff	Serial, SPI	4	Int/Ext	0.006	14	81	20	SOIC-20, TSSOP-20	$6.00
TLC3545	14	200	1 Diff	Serial, SPI	V_{REF}	Ext	0.006	14	81.5	17.5	SOIC-8, VSSOP-8	$5.00
TLC3548	14	200	8 SE/4 Diff	Serial, SPI	4	Int/Ext	0.006	14	81	20	SOIC-24, TSSOP-24	$6.40
TLC3574	14	200	4 SE	Serial, SPI	±10	Ext	0.006	14	79	29	SOIC-24, TSSOP-24	$6.85
TLC3578	14	200	8 SE	Serial, SPI	±10	Ext	0.006	14	79	29	SOIC-24, TSSOP-24	$8.65
ADS8324	14	50	1 Diff	Serial, SPI	$\pm V_{REF}$ at $+V_{REF}$	Ext	0.012	14	78	2.5	VSSOP-8	$4.15
ADS7871	14	40	8 SE/4 Diff	Serial, SPI	PGA (1, 2, 4, 8, 10, 16, 20)	Int	0.03	13	—	6	SSOP-28	$5.00
ADS7881	12	4000	1 SE	P8/P12	2.5	Int	0.024	12	71.5	110	TQFP-48	$7.35
ADS7869	12	1000	12 Diff	Serial, SPI/P12	±2.5 at +2.5	Int/Ext	0.048	11	—	175	TQFP-100	$14.60
ADS7886	12	1000	1 SE, 1 PDiff	Serial, SPI	V_{DD} (2.35V to 5.25V)	Ext (V_{DD})	0.036	12	70	17.5	SOT23-6, SC-70	$2.25
ADS7810	12	800	1 SE	P12	±10	Int/Ext	0.018	12	71	225	SOIC-28	$27.80
ADS7818	12	500	1 PDiff	Serial, SPI	5	Int	0.024	12	70	11	PDIP-8, VSSOP-8	$2.50

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

*New products are listed in **bold red**. Preview products are listed in **bold blue**.*

Data Converters

SAR ADCs Selection Guide (Continued)

Device	Res. (Bits)	Sample Rate (kSPS)	Number of Input Channels	Interface	Input Voltage (V)	V_{REF}	Linearity (%)	NMC	SINAD (dB)	Power (mW)	Package(s)	Price[1]
ADS7834	12	500	1 PDiff	Serial, SPI	2.5	Int	0.024	12	70	11	VSSOP-8	$2.45
ADS7835	12	500	1 Diff	Serial, SPI	±2.5	Int	0.024	12	72	17.5	VSSOP-8	$2.75
ADS7852	12	500	8 SE	P12	5	Int/Ext	0.024	12	72	13	TQFP-32	$3.40
ADS7861	12	500	2 x 2 Diff	Serial, SPI	±2.5 at +2.5	Int/Ext	0.024	12	70	25	SSOP-24	$4.05
ADS7862	12	500	2 x 2 Diff	P12	±2.5 at +2.5	Int/Ext	0.024	12	71	25	TQFP-32	$5.70
ADS7864	12	500	3 x 2 Diff	P12	±2.5 at +2.5	Int/Ext	0.024	12	71	52.5	TQFP-48	$6.65
TLC2551	12	400	1 SE	Serial, SPI	V_{REF}	Ext	0.024	12	72	15	SOIC-8, VSSOP-8	$3.95
TLC2552	12	400	2 SE	Serial, SPI	V_{REF}	Ext	0.024	12	72	15	SOIC-8, VSSOP-8	$3.95
TLC2554	12	400	4 SE	Serial, SPI	4	Int/Ext	0.024	12	71	9.5	SOIC-16, TSSOP-16	$5.30
TLC2555	12	400	1 PDiff	Serial, SPI	V_{REF}	Ext	0.024	12	72	15	SOIC-8, VSSOP-8	$3.95
TLC2558	12	400	8 SE	Serial, SPI	4	Int/Ext	0.024	12	71	9.5	SOIC-20, TSSOP-20	$5.30
ADS7800	12	333	1 SE	P8/P12	±5, 10	Int	0.012	12	72	135	CDIP SB-24, PDIP-24	$30.50
ADS8508	12	250	1 SE	Serial, SPI	+4, 10, ±3.3, 5, 10	Int/Ext	0.011	12	73	70	SSOP-28, SOIC-20	$8.90
ADS8504	12	250	1 SE	P8/P16	±10	Int/Ext	0.011	12	72	70	SSOP-28, SOIC-28	$8.90
ADS7866	12	200	1 SE/1 PDiff	Serial, SPI	V_{DD} (1.2V to 3.6V)	Ext	0.024	12	70	0.25	SOT23-6	$2.15
ADS7816	12	200	1 PDiff	Serial, SPI	V_{REF}	Ext	0.024	12	72	1.9	PDIP-8, SOIC-8, VSSOP-8	$1.95
ADS7817	12	200	1 Diff	Serial, SPI	$\pm V_{REF}$ at $+V_{REF}$	Ext	0.024	12	71	2.3	SOIC-8, VSSOP-8	$1.95
ADS7841	12	200	4 SE/2 Diff	Serial, SPI	V_{REF}, $\pm V_{REF}$ at V_{REF}	Ext	0.024	12	72	0.84	SSOP-16	$2.50
ADS7842	12	200	4 SE	P12	V_{REF}	Ext	0.024	12	72	0.84	SSOP-28	$3.10
ADS7844	12	200	8 SE/4 Diff	Serial, SPI	V_{REF}, $\pm V_{REF}$ at V_{REF}	Ext	0.024	12	72	0.84	SSOP-20	$2.90
TLC2574	12	200	4 SE	Serial, SPI	±10	Ext	0.024	12	79	29	SOIC-20, TSSOP-20	$5.30
TLC2578	12	200	8 SE	Serial, SPI	±10	Ext	0.024	12	79	29	SOIC-24, TSSOP-24	$5.80
TLV2541	12	200	1 SE	Serial, SPI	V_{REF}	Ext	0.024	12	72	2.8	SOIC-8, VSSOP-8	$3.85
TLV2542	12	200	2 SE	Serial, SPI	V_{REF}	Ext	0.024	12	72	2.8	SOIC-8, VSSOP-8	$3.85
TLV2544	12	200	4 SE	Serial, SPI	+2, 4	Int/Ext	0.024	12	70	3.3	SOIC-16, TSSOP-16	$4.20
TLV2545	12	200	1 PDiff	Serial, SPI	+5.5 ($V_{REF} = V_{DD}$)	Ext	0.024	12	72	2.8	SOIC-8, VSSOP-8	$3.85
TLV2548	12	200	8 SE	Serial, SPI	+2, 4	Int/Ext	0.024	12	70	3.3	SOIC-20, TSSOP-20	$4.85
TLV2553	12	200	11 SE	Serial, SPI	V_{REF}	Ext	0.024	12	—	2.43	SOIC-20, TSSOP-20	$3.40
TLV2556	12	200	11 SE	Serial, SPI	V_{REF}	Int/Ext	0.024	12	—	2.43	SOIC-20, TSSOP-20	$3.55
ADS7829	12	125	1 PDiff	Serial, SPI	V_{REF}	Ext	0.018	12	71	0.6	QFN-8	$1.50
AMC7823	12	200	8 SE I/O DAS	Serial, SPI	5	Int/Ext	0.024	12	74	100	QFN-40	$9.75
AMC7820	12	100	8 DAS	Serial, SPI	5	Int	0.024	12	72 (typ)	40	TQFP-48	$3.75
ADS7804	12	100	1 SE	P8/P16	±10	Int/Ext	0.011	12	72	81.5	PDIP-28, SOIC-28	$14.05
ADS7808	12	100	1 SE	Serial, SPI	+4, 10 , ±3.3, 5, 10	Int/Ext	0.011	12	73	81.5	SOIC-20	$10.85
ADS7822	12	75	1 PDiff	Serial, SPI	V_{REF}	Ext	0.018	12	71	0.6	PDIP-8, SOIC-8, VSSOP-8,	$1.55
TLC2543	12	66	11 SE	Serial, SPI	V_{REF}	Ext	0.024	12	—	5	CDIP-20, PDIP-20, PLCC-20, SOIC-20, SSOP-20	$4.45
TLV2543	12	66	11 SE	Serial, SPI	V_{REF}	Ext	0.024	12	—	3.3	PDIP-20, SOIC-20, SSOP-20	$4.45
ADS7823	12	50	1 SE	Serial, I^2C	V_{REF}	Ext	0.024	12	71	0.75	VSSOP-8	$2.85
ADS7828	12	50	8 SE/4 Diff	Serial, I^2C	V_{REF}	Int/Ext	0.024	12	71	0.675	TSSOP-16	$3.35
ADS7870	12	50	8 SE	Serial, SPI	PGA(1, 2, 4, 8, 10, 16, 20)	Int	0.06	12	72	4.6	SSOP-28	$4.15
ADS7806	12	40	1 SE	Serial, SPI/P8	+4, 5, ±10	Int/Ext	0.011	12	73	28	PDIP-28, SOIC-28	$12.75
ADS7812	12	40	1 SE	Serial, SPI	+4, 10, ±3.3, 5, 10	Int/Ext	0.012	12	74	35	PDIP-16, SOIC-16	$11.80
ADS7824	12	40	4 SE	Serial, SPI/P8	±10	Int/Ext	0.012	12	73	50	PDIP-28, SOIC-28	$13.10
ADS1286	12	37	1 PDiff	Serial, SPI	V_{REF}	Ext	0.024	12	72	1	PDIP-8, SOIC-8	$2.80
TLV1570	10	1250	8 SE	Serial, SPI	2V, V_{REF}	Int/Ext	0.1	10	60	9	SOIC-20, TSSOP-20	$3.80
TLV1571	10	1250	1 SE	Serial, SPI	V_{REF}	Ext	0.1	10	60	12	SOIC-24, TSSOP-24	$3.70

[1]*Suggested resale price in U.S. dollars in quantities of 1,000.* *New products are listed in **bold red**.*

SAR ADCs Selection Guide (Continued)

Device	Res. (Bits)	Sample Rate (kSPS)	Number of Input Channels	Interface	Input Voltage (V)	V_{REF}	Linearity (%)	NMC	SINAD (dB)	Power (mW)	Package(s)	Price[1]
TLV1572	10	1250	1 SE	Serial, SPI	V_{REF}	Ext	0.1	10	60	8.1	SOIC-8	$3.30
TLV1578	10	1250	8 SE	Serial, SPI	V_{REF}	Ext	0.1	10	60	12	TSSOP-32	$3.85
ADS7887	10	1000	1 SE, 1 PDiff	Serial, SPI	V_{DD} (2.35V to 5.25V)	Ext (V_{DD})	0.073	10	61	17.5	SOT23-6, SC-70	$1.65
TLC1514	10	400	4 SE/3 Diff	Serial, SPI	+5.5 ($V_{REF} = V_{DD}$)	Int/Ext	0.012	10	60	10	SOIC-16, TSSOP-16	$2.90
TLC1518	10	400	8 SE/7 Diff	Serial, SPI	+5.5 ($V_{REF} = V_{DD}$)	Int/Ext	0.012	10	60	10	SOIC-20, TSSOP-20	$3.45
ADS7867	10	200	1 SE, 1 PDiff	Serial, SPI	V_{DD} (1.2V to 3.6V)	Ext	0.05	10	61	0.25	SOT23-6	$1.55
ADS7826	10	200	1 PDiff	Serial, SPI	V_{REF}	Ext	0.0048	10	62	0.6	QFN-8	$1.25
TLV1504	10	200	4 SE	Serial, SPI	+2, 4	Int/Ext	0.05	10	60	3.3	SOIC-16, TSSOP-16	$2.65
TLV1508	10	200	8 SE	Serial, SPI	+2, 4	Int/Ext	0.05	10	60	3.3	SOIC-20, TSSOP-20	$3.15
TLC1550	10	164	1 SE	P10	V_{REF}	Ext	0.05	10	—	10	PLCC-28, SOIC-24	$3.90
TLC1551	10	164	1 SE	P10	V_{REF}	Ext	0.1	10	—	10	PLCC-28, SOIC-24	$3.35
TLV1544	10	85	4 SE	Serial, SPI	V_{REF}	Ext	0.1	10	—	1.05	SOIC-16, TSSOP-16	$1.95
TLV1548	10	85	8 SE	Serial, SPI	V_{REF}	Ext	0.1	10	—	1.05	CDIP-20, LCCC-20, SSOP-20	$2.30
TLC1542	10	38	11 SE	Serial, SPI	V_{REF}	Ext	0.05	10	—	4	CDIP-20, LCCC-20, PDIP-20, PLCC-20, SOIC-20	$2.50
TLC1543	10	38	11 SE	Serial, SPI	V_{REF}	Ext	0.1	10	—	4	PLCC-20, SOIC-20, SSOP-20	$1.90
TLC1549	10	38	1 SE	Serial, SPI	V_{REF}	Ext	0.1	10	—	4	PDIP-8, SOIC-8	$1.71
TLV1543	10	38	11 SE	Serial, SPI	V_{REF}	Ext	0.1	10	—	2.64	CDIP-20, LCCC-20, PDIP-20, PLCC-20, SOIC-20, SSOP-20	$2.15
TLV1549	10	38	1 SE	Serial, SPI	V_{REF}	Ext	0.1	10	—	1.32	PDIP-8, SOIC-8	$1.85
TLC1541	10	32	11 SE	Serial, SPI	V_{REF}	Ext	0.1	10	—	6	PDIP-20, PLCC-20, SOIC-20	$3.20
TLV571	8	1250	1 SE	P8	V_{REF}	Ext	0.5	8	49	12	SOIC-24, TSSOP-24	$2.35
ADS7888	8	1000	1 SE, 1 PDiff	Serial, SPI	V_{DD} (2.35V to 5.25V)	Ext (V_{DD})	0.2	8	49	17.5	SOT23-6, SC-70	$1.25
TLC0820A	8	392	1 SE	P8	V_{REF}	Ext	0.2	8	—	37.5	PLCC-20, SOIC-20, SSOP-20	$1.90
ADS7827	8	250	1 PDiff	Serial, SPI	V_{REF}	Ext	0.2	8	48	0.6	QFN-8	$1.00
ADS7868	8	200	1 SE, 1 PDiff	Serial, SPI	V_{DD} (1.2V to 3.6V)	Ext	0.1	8	50	0.25	SOT23-6	$1.35
TLC545	8	76	19 SE	Serial, SPI	V_{REF}	Ext	0.2	8	—	6	PDIP-28, PLCC-28	$3.10
ADS7830	8	75	8 SE/4 Diff	Serial, I^2C	V_{REF}	Int/Ext	0.19	8	50	0.675	TSSOP-16	$1.40
TLV0831	8	49	1 SE	Serial, SPI	+3.6 ($V_{REF} = V_{DD}$)	Ext	0.2	8	—	0.66	PDIP-8, SOIC-8	$1.40
TLC548	8	45.5	1 SE	Serial, SPI	V_{REF}	Ext	0.2	8	—	9	PDIP-8, SOIC-8	$1.20
TLV0832	8	44.7	2 SE/1 Diff	Serial, SPI	V_{REF}	Ext	0.2	8	—	5	PDIP-8, SOIC-8	$1.40
TLV0834	8	41	4 SE/2 Diff	Serial, SPI	V_{REF}	Ext	0.2	8	—	0.66	PDIP-14, SOIC-14, TSSOP-14	$1.45
TLC541	8	40	11 SE	Serial, SPI	V_{REF}	Ext	0.2	8	—	6	PDIP-20, PLCC-20, SOIC-20	$1.50
TLC549	8	40	1 SE	Serial, SPI	V_{REF}	Ext	0.2	8	—	9	PDIP-8, SOIC-8	$0.95
TLV0838	8	37.9	8 SE/4 Diff	Serial, SPI	V_{REF}	Ext	0.2	8	—	0.66	PDIP-20, SOIC-20, TSSOP-20	$1.45
TLC0831	8	31	1 Diff	Serial, SPI	V_{REF}	Ext	0.2	8	—	3	PDIP-8, SOIC-8	$1.40
TLC542	8	25	11 SE	Serial, SPI	V_{REF}	Ext	0.2	8	—	6	PDIP-20, PLCC-20, SOIC-20	$1.50
TLC0832	8	22	2 SE/1 Diff	Serial, SPI	V_{REF}	Ext	0.2	8	—	12.5	PDIP-8, SOIC-8	$1.40
TLC0834	8	20	4 SE/2 Diff	Serial, SPI	V_{REF}	Ext	0.2	8	—	3	PDIP-14, SOIC-14	$1.45
TLC0838	8	20	8 SE/4 Diff	Serial, SPI	V_{REF}	Ext	0.2	8	—	3	PDIP-20, SOIC-20, TSSOP-20	$1.45

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

*New products are listed in **bold red**.*

Data Converters

8051-Based Intelligent ΔΣ ADC Selection Guide

Device	ADC Res. (Bits)	Sample Rate (kSPS)	Number of Input Channels	Input Voltage (V)	V_{REF}	CPU Core	Program Memory (kB)	Program Memory Type	SRAM (kB)	Power (mW/V)	DAC Output (Bits)	Price[1]
MSC1200Y3	24	1	8 Diff/8 SE	PGA (1-128), ± 2.5	Int	8051	8	Flash	0.1	3/2.7-5.25	8-Bit IDAC	$6.45
MSC1201Y3	24	1	6 Diff/6 SE	PGA (1-128), ± 2.5	Int	8051	8	Flash	0.1	3/2.7-5.25	8-Bit IDAC	$5.95
MSC1210Y5	24	1	8 Diff/8 SE	PGA (1-128), ± 2.5	Int	8051	32	Flash	1.2	4/2.7-5.25	16-Bit PWM	$12.00
MSC1211Y2	24	1	8 Diff/8 SE	PGA (1-128), ± 2.5	Int	8051	4	Flash	1.2	4/2.7-5.25	4 x 16-Bit I/VDAC	$17.50
MSC1211Y5	24	1	8 Diff/8 SE	PGA (1-128), ± 2.5	Int	8051	32	Flash	1.2	4/2.7-5.25	4 x 16-Bit I/VDAC	$20.95
MSC1213Y2	24	1	8 Diff/8 SE	PGA (1-128), ± 2.5	Int	8051	4	Flash	1.2	4/2.7-5.25	2 x 16-Bit I/VDAC	$12.65
MSC1213Y5	24	1	8 Diff/8 SE	PGA (1-128), ± 2.5	Int	8051	32	Flash	1.2	4/2.7-5.25	2 x 16-Bit I/VDAC	$15.95
MSC1202Y3	16	2	6 Diff/6 SE	PGA (1-128), ± 2.5	Int	8051	8	Flash	0.2	3/2.7-5.25	8-Bit IDAC	$4.95

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

*New products are listed in **bold red**. Preview products are listed in **bold blue**.*

ΔΣ DACs Selection Guide

Device	Res. (Bits)	Settling Time (ms)	Number of Output DACs	Interface	Output (V)	V_{REF}	Linearity (%)	Monotonic (Bits)	Power (mW)	Package	Price[1]
DAC1220	20	10	1	Serial, SPI	5	Ext	0.0015	20	2.5	SSOP-16	$6.65
DAC1221	16	2	1	Serial, SPI	2.5	Ext	0.0015	16	1.2	SSOP-16	$5.25

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

String and R-2R DACs Selection Guide

Device	Architecture	Res. (Bits)	Settling Time (µs)	Number of Output DACs	Interface	Output (V)	V_{REF}	Linearity (%)	Monotonic (Bits)	Power (mW) (typ)	Package(s)	Price[1]
DAC7654	R-2R	16	12	4	Serial, SPI	±2.5	Int	0.0015	16	18	LQFP-64	$21.80
DAC7664	R-2R	16	12	4	P16	±2.5	Int	0.0015	16	18	LQFP-64	$20.75
DAC7634	R-2R	16	10	4	Serial, SPI	$+V_{REF}$, $\pm V_{REF}$	Ext	0.0015	15	7.5	SSOP-48	$19.95
DAC7641	R-2R	16	10	1	P16	$+V_{REF}$, $\pm V_{REF}$	Ext	0.0015	15	1.8	TQFP-32	$6.30
DAC7642	R-2R	16	10	2	P16	$+V_{REF}$, $\pm V_{REF}$	Ext	0.0015	15	2.5	LQFP-32	$10.55
DAC7643	R-2R	16	10	2	P16	$+V_{REF}$, $\pm V_{REF}$	Ext	0.0015	15	2.5	LQFP-32	$10.55
DAC7644	R-2R	16	10	4	P16	$+V_{REF}$, $\pm V_{REF}$	Ext	0.0015	15	7.5	SSOP-48	$19.95
DAC7734	R-2R	16	10	4	Serial, SPI	$+V_{REF}$, $\pm V_{REF}$	Ext	0.0015	16	50	SSOP-48	$31.45
DAC712	R-2R	16	10	1	P16	±10	Int	0.003	15	525	SOIC-28	$14.50
DAC714	R-2R	16	10	1	Serial, SPI	±10	Int	0.0015	16	525	SOIC-16	$14.50
DAC715	R-2R	16	10	1	P16	+10	Int	0.003	16	525	SOIC-28	$15.85
DAC716	R-2R	16	10	1	Serial, SPI	+10	Int	0.003	16	525	SOIC-16	$15.85
DAC7631	R-2R	16	10	1	Serial, SPI	$+V_{REF}$, $\pm V_{REF}$	Ext	0.0015	15	1.8	SSOP-20	$5.85
DAC7632	R-2R	16	10	2	Serial, SPI	$+V_{REF}$, $\pm V_{REF}$	Ext	0.0015	15	2.5	LQFP-32	$10.45
DAC7744	R-2R	16	10	4	P16	$+V_{REF}$, $\pm V_{REF}$	Ext	0.0015	16	50	SSOP-48	$31.45
DAC8501	String	16	10	1	Serial, SPI	V_{REF} /MDAC	Ext	0.0987	16	0.72	VSSOP-8	$3.00
DAC8531	String	16	10	1	Serial, SPI	$+V_{REF}$	Ext	0.0987	16	0.72	VSSOP-8, QFN 3 x 3	$3.00
DAC8532	String	16	10	2	Serial, SPI	$+V_{REF}$	Ext	0.0987	16	1.35	VSSOP-8	$5.35
DAC8544	String	16	8	4	Parallel	$+V_{REF}$	Ext	0.025	16	4.75	QFN 5 x 5	$9.75
DAC8534	String	16	10	4	Serial, SPI	$+V_{REF}$	Ext	0.0987	16	2.7	TSSOP-16	$9.75
DAC8541	String	16	10	1	P16	$+V_{REF}$	Ext	0.096	16	0.72	TQFP-32	$3.00
DAC8554	String	16	10	4	Serial, SPI	$+V_{REF}$	ext	0.0122	16	1	MSOP-8, SON-8	$3.45
DAC8571	String	16	10	1	Serial, I^2C	$+V_{REF}$	Ext	0.0987	16	0.42	MSOP-8	$2.95
DAC8574	String	16	10	4	Serial, I^2C	$+V_{REF}$	Ext	0.0987	16	2.7	TSSOP-16	$10.25
DAC7731	R-2R	16	5	1	Serial, SPI	+10, ±10	Int/Ext	0.0015	16	100	SSOP-24	$8.20
DAC7742	R-2R	16	5	1	P16	+10, ±10	Int/Ext	0.0015	16	100	LQFP-48	$8.70
DAC7741	R-2R	16	5	1	P16	+10, ±10	Int/Ext	0.0015	16	100	LQFP-48	$8.30

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

*New products are listed in **bold red**.*

String and R-2R DACs Selection Guide (Continued)

Device	Architecture	Res. (Bits)	Settling Time (µs)	Number of Output DACs	Interface	Output (V)	V_{REF}	Linearity (%)	Monotonic (Bits)	Power (mW) (typ)	Package(s)	Price[1]
DAC8811	R-2R	16	0.5	1	Serial, SPI	$\pm V_{REF}$/MDAC	Ext	0.0015	16	0.025	MSOP-8, SON-8	$8.50
DAC8814	R-2R	16	1.0	4	Serial, SPI	$\pm V_{REF}$/MDAC	Ext	0.0015	16	0.0275	SSOP-28	$19.27
DAC8830	R-2R	16	1.0	1	Serial, SPI	$+V_{REF}$	Ext	0.0015	16	0.015	SOIC-8	$7.95
DAC8831	R-2R	16	1.0	1	Serial, SPI	$+V_{REF}$	Ext	0.0015	16	0.015	SOIC-14	$7.95
DAC8803	R-2R	14	1.0	4	Serial, SPI	$\pm V_{REF}$/MDAC	Ext	0.0061	14	0.0275	SSOP-28	$14.40
DAC8801	R-2R	14	0.5	1	Serial, SPI	$\pm V_{REF}$/MDAC	Ext	0.0061	14	0.025	MSOP-8, SON-8	$5.50
DAC7512	String	12	10	1	Serial, SPI	V_{CC}	Ext	0.38	12	0.7	VSSOP-8, SOT23-6	$1.45
DAC7513	String	12	10	1	Serial, SPI	$+V_{REF}$	Ext	0.38	12	0.5	VSSOP-8, SSOP-8	$1.45
DAC7571	String	12	10	1	Serial, I^2C	$+V_{REF}$	Ext	0.096	12	0.7	SOP-6, SOT23-6	$1.55
DAC7573	String	12	10	4	Serial, I^2C	$+V_{REF}$	Ext	0.096	12	3	TSSOP-16	$6.15
DAC7574	String	12	10	4	Serial, I^2C	$+V_{REF}$	Ext	0.096	12	3	MSOP-10	$6.15
DAC7611	R-2R	12	7	1	Serial, SPI	4.096	Int	0.012	12	2.5	PDIP-8, SOIC-8	$2.55
DAC7612	R-2R	12	7	2	Serial, SPI	4.096	Int	0.012	12	3.75	SOIC-8	$2.70
DAC7613	R-2R	12	10	1	P12	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	1.8	SSOP-24	$2.50
DAC7614	R-2R	12	10	4	Serial, SPI	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	20	PDIP-16, SOIC-16, SSOP-20	$6.70
DAC7615	R-2R	12	10	4	Serial, SPI	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	20	PDIP-16, SOIC-16, SSOP-20	$6.70
DAC7616	R-2R	12	10	4	Serial, SPI	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	3	SOIC-16, SSOP-20	$5.40
DAC7617	R-2R	12	10	4	Serial, SPI	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	3	SOIC-16, SSOP-20	$5.40
DAC7621	R-2R	12	7	1	P12	4.096	Int	0.012	12	2.5	SSOP-20	$2.75
DAC7624	R-2R	12	10	4	P12	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	20	PDIP-28, SOIC-28	$10.25
DAC7625	R-2R	12	10	4	P12	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	20	PDIP-28, SOIC-28	$10.25
DAC7714	R-2R	12	10	4	Serial, SPI	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	45	SOIC-16	$11.45
DAC7715	R-2R	12	10	4	Serial, SPI	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	45	SOIC-16	$11.45
DAC7724	R-2R	12	10	4	P12	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	45	PLCC-28, SOIC-28	$11.85
DAC7725	R-2R	12	10	4	P12	$+V_{REF}$, $\pm V_{REF}$	Ext	0.012	12	45	PLCC-28, SOIC-28	$11.85
DAC7551	String	12	5	1	Serial, SPI	$+V_{REF}$	Ext	0.012	12	0.27	SON-12	$1.40
DAC7552	String	12	5	2	Serial, SPI	$+V_{REF}$	Ext	0.024	12	0.675	QFN-16	$2.35
DAC7553	String	12	5	2	Serial, SPI	$+V_{REF}$	Ext	0.024	12	0.675	QFN-16	$2.35
DAC7554	String	12	5	4	Serial, SPI	$+V_{REF}$	Ext	0.0244	12	3.5	MSOP-10	$5.60
DAC7558	String	12	5	8	Serial, SPI	$+V_{REF}$	Ext	0.012	12	4.5	QFN-32	$10.40
DAC811	R-2R	12	4	1	P12	+10, ±5, 10	Int	0.006	12	625	CDIP SB-28, PDIP-28, SOIC-28	$11.00
DAC813	R-2R	12	4	1	P12	+10, ±5, 10	Int/Ext	0.006	12	270	PDIP-28, SOIC-28	$12.60
TLV5614	String	12	3	4	Serial, SPI	$+V_{REF}$	Ext	0.1	12	3.6	SOIC-16, TSSOP-16	$7.45
TLV5616	String	12	3	1	Serial, SPI	$+V_{REF}$	Ext	0.1	12	0.9	VSSOP-8, PDIP-8, SOIC-8	$2.60
TLV5618A	String	12	2.5	2	Serial, SPI	$+V_{REF}$	Ext	0.08	12	1.8	CDIP-8, PDIP-8, SOIC-8, LCCC-20	$4.75
DAC7545	R-2R	12	2	1	P12	$\pm V_{REF}$/MDAC	Ext	0.012	12	30	SOIC-20	$5.25
DAC7541	R-2R	12	1	1	P12	$\pm V_{REF}$/MDAC	Ext	0.012	12	30	PDIP-18, SOP-18	$6.70
DAC8043	R-2R	12	1	1	Serial, SPI	$\pm V_{REF}$/MDAC	Ext	0.012	12	2.5	SOIC-8	$5.25
TLV5610	String	12	1	8	Serial, SPI	$+V_{REF}$	Ext	0.4	12	18	SOIC-20, TSSOP-20	$8.50
TLV5613	String	12	1	1	P8	$+V_{REF}$	Ext	0.1	12	1.2	SOIC-20, TSSOP-20	$2.60
TLV5619	String	12	1	1	P12	$+V_{REF}$	Ext	0.08	12	4.3	SOIC-20, TSSOP-20	$2.60
TLV5630	String	12	1	8	Serial, SPI	$+V_{REF}$	Int/Ext	0.4	12	18	SOIC-20, TSSOP-20	$8.85
TLV5633	String	12	1	1	P8	+2, 4	Int/Ext	0.08	12	2.7	SOIC-20, TSSOP-20	$4.70
TLV5636	String	12	1	1	Serial, SPI	+2, 4	Int/Ext	0.1	12	4.5	SOIC-8, VSSOP-8	$3.65
TLV5638	String	12	1	2	Serial, SPI	+2, 4	Int/Ext	0.1	12	4.5	SOIC-8, CDIP-8, LCCC-20	$3.25

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

New products are listed in ***bold red****.*

Data Converters

String and R-2R DACs Selection Guide (Continued)

Device	Architecture	Res. (Bits)	Settling Time (µs)	Number of Output DACs	Interface	Output (V)	V_{REF}	Linearity (%)	Monotonic (Bits)	Power (mW) (typ)	Package(s)	Price[1]
TLV5639	String	12	1	1	P12	+2, 4	Int/Ext	0.1	12	2.7	SOIC-20, TSSOP-20	$3.45
DAC7800	R-2R	12	0.8	2	Serial, SPI	1mA	Ext	0.012	12	1	PDIP-16, SOIC-16	$13.55
DAC7801	R-2R	12	0.8	2	P12	1mA	Ext	0.012	12	1	PDIP-24, SOIC-24	$17.95
DAC7802	R-2R	12	0.8	2	P12	1mA	Ext	0.012	12	1	PDIP-24, SOIC-24	$14.00
DAC7811	R-2R	12	0.2	1	Serial, SPI	$\pm V_{REF}$/MDAC	Ext	0.0120	12	0.0275	MSOP-10, SON-8	$3.15
DAC7821	R-2R	12	0.2	1	P12	$\pm V_{REF}$/MDAC	Ext	0.0120	12	0.0275	QFN-20, TSSOP-20	$3.15
TLC5615	String	10	12.5	1	Serial, SPI	$+V_{REF}$	Ext	0.1	10	0.75	PDIP-8, SOIC-8, VSSOP-8	$1.90
DAC6571	String	10	9	1	Serial, I^2C	V_{DD}	Ext	0.195	10	0.5	SOP-6	$1.40
DAC6573	String	10	9	4	Serial, I^2C	$+V_{REF}$	Ext	0.195	10	1.5	TSSOP-16	$3.05
DAC6574	String	10	9	4	Serial, I^2C	$+V_{REF}$	Ext	0.195	10	1.5	VSSOP-10	$3.05
TLV5604	String	10	3	4	Serial, SPI	$+V_{REF}$	Ext	0.05	10	3	SOIC-16, TSSOP-16	$3.70
TLV5606	String	10	3	1	Serial, SPI	$+V_{REF}$	Ext	0.15	10	0.9	SOIC-8, VSSOP-8	$1.30
TLV5617A	String	10	2.5	2	Serial, SPI	$+V_{REF}$	Ext	0.1	10	1.8	SOIC-8	$2.25
TLV5608	String	10	1	8	Serial, SPI	$+V_{REF}$	Ext	0.4	10	18	SOIC-20, TSSOP-20	$4.90
TLV5631	String	10	1	8	Serial, SPI	$+V_{REF}$	Int/Ext	0.4	10	18	SOIC-20, TSSOP-20	$5.60
TLV5637	String	10	0.8	2	Serial, SPI	+2, 4	Int/Ext	0.1	10	4.2	SOIC-8	$3.20
TLC5620	String	8	10	4	Serial, SPI	$+V_{REF}$	Ext	0.4	8	8	PDIP-14, SOIC-14	$1.50
TLC5628	String	8	10	8	Serial, SPI	$+V_{REF}$	Ext	0.4	8	15	PDIP-16, SOIC-16	$2.45
TLV5620	R-2R	8	10	4	Serial, SPI	$+V_{REF}$	Ext	0.2	8	6	PDIP-14, SOIC-14	$1.00
TLV5621	R-2R	8	10	4	Serial, SPI	$+V_{REF}$	Ext	0.4	8	3.6	SOIC-14	$1.65
TLV5628	String	8	10	8	Serial, SPI	$+V_{REF}$	Ext	0.4	8	12	PDIP-16, SOIC-16	$2.20
DAC5571	String	8	8	1	Serial, I^2C	V_{DD}	Int	0.195	8	0.5	SOP-6	$0.90
DAC5573	String	8	8	4	Serial, I^2C	$+V_{REF}$	Ext	0.195	8	1.5	TSSOP-16	$2.55
DAC5574	String	8	8	4	Serial, I^2C	$+V_{REF}$	Ext	0.195	8	1.5	VSSOP-10	$2.55
TLC7225	R-2R	8	5	4	P8	$+V_{REF}$	Ext	0.4	8	75	SOIC-24	$2.35
TLC7226	R-2R	8	5	4	P8	$\pm V_{REF}$	Ext	0.4	8	90	PDIP-20, SOIC-20	$2.15
TLV5623	String	8	3	1	Serial, SPI	$+V_{REF}$	Ext	0.2	8	2.1	SOIC-8, VSSOP-8	$0.99
TLV5625	String	8	3	2	Serial, SPI	$+V_{REF}$	Ext	0.2	8	2.4	SOIC-8	$1.70
TLV5627	String	8	2.5	4	Serial, SPI	$+V_{REF}$	Ext	0.2	8	3	SOIC-16, TSSOP-16	$2.05
TLV5624	String	8	1	1	Serial, SPI	+2, 4	Int/Ext	0.2	8	0.9	SOIC-8, VSSOP-8	$1.60
TLV5629	String	8	1	8	Serial, SPI	Ext	Ext	0.4	8	18	SOIC-20, TSSOP-20	$3.15
TLV5632	String	8	1	8	Serial, SPI	+2, 4	Int/Ext	0.4	8	18	SOIC-20, TSSOP-20	$3.35
TLV5626	String	8	0.8	2	Serial, SPI	+2, 4	Int/Ext	0.4	8	4.2	SOIC-8	$1.90
TLC7524	R-2R	8	0.1	1	P8	1mA	Ext	0.2	8	5	PDIP-16, PLCC-20, SOIC-16, TSSOP-16	$1.45
TLC7528	R-2R	8	0.1	2	P8	1mA	Ext	0.2	8	7.5	PDIP-20, PLCC-20, SOIC-20, TSSOP-20	$1.55
TLC7628	R-2R	8	0.1	2	P8	2mA	Ext	0.2	8	20	SOIC-20, PDIP-20	$1.45

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

*Preview products are listed in **bold blue**.*

Data Converters/Digital Signal Controllers

High-Speed DACs Selection Guide

Device	Res. (Bits)	Supply (V)	Update Rate (MSPS)	Settling Time (ns)	Number of DACs	Power Typ (mW)	DNL max (±LSB)	INL max (±LSB)	Package(s)	Price[1]
DAC904	14	3.0 to 5.0	165	30	1	170	1.75	2.5	28-SOP, 28-TSSOP	$7.35
THS5671A	14	3.0 to 5.0	125	35	1	175	3.5	7	28-SOP, 28-TSSOP	$7.35
DAC5687	16	1.8/3.3	500	12	2	750 to 1400	3	6	100-HTQFP	$22.50
DAC902	12	3.0 to 5.0	165	30	1	170	1.75	2.5	28-SOP, 28-TSSOP	$5.95
THS5661A	12	3.0 to 5.0	125	35	1	175	2.0	4	28-SOP, 28-TSSOP	$6.60
DAC900	10	3.0 to 5.0	165	30	1	170	0.5	1	28-SOP, 28-TSSOP	$4.20
THS5651A	10	3.0 to 5.0	125	35	1	175	0.5	1	28-SOP, 28-TSSOP	$4.50
DAC2904	14	3.3 to 5.0	125	30	2	310	—	—	48-TQFP	$12.00
DAC2902	12	3.3 to 5.0	125	30	2	310	2.5	3	48-TQFP	$10.70
DAC2900	10	3.3 to 5.0	125	30	2	310	1	1	48-TQFP	$6.00
DAC5652	10	3.0 to 3.6	200	20	1	290	0.5	1	48-TQFP	$7.60
DAC5662	12	3.0 to 3.6	200	20	2	330	2	2	48-TQFP	$10.70
DAC5672	14	3.0 to 3.6	200	20	2	330	3	4	48-TQFP	$13.25
DAC5675A	14	3.3	400	12	1	660	2	4	48-HTQFP	$25.00
DAC5686	14	1.8/3.3	500	12	2	400	9	12	100-HTQFP	$19.75
DAC2932	12	2.7 to 3.3	40	25	2	29	0.5	2	48-TQFP	$8.35
DAC5674	12	1.8/3.3	400	20	1	420	2	3.5	48-HTQFP	$15.00

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

TMS320C28x™ Controller Generation

Device[§]	MIPS	Boot ROM	RAM	Flash/ ROM	Timers	CAP/ QEP	# PWM Channels	# Hi-Res PWM	12-Bit A/D Chs/ Conversion Time (ns)	EMIF	WD Timer	Comm Ports Other	SPI	SCI	CAN	I/O Pins	Core Voltage (V)	Packaging	($U.S.)[+]
Flash Devices																			
TMS320**F2801**-PZA/S/Q[§]	100	8KB	12KB	32KB	9	2/1	6 + 2	3	16Ch/160	—	Y	I^2C	2	1	1	32	1.8	100-LQFP	$5.79
TMS320**F2801**-GGMA/S/Q[§]	100	8KB	12KB	32KB	9	2/1	6 + 2	3	16Ch/160	—	Y	I^2C	2	1	1	32	1.8	100-BGA	$5.79
TMS320**F2806**-PZA/S/Q[§]	100	8KB	20KB	64KB	15	4/2	12 + 4	4	16Ch/160	—	Y	I^2C	4	2	1	32	1.8	100-LQFP	$8.69
TMS320**F2806**-GGMA/S/Q[§]	100	8KB	20KB	64KB	15	4/2	12 + 4	4	16Ch/160	—	Y	I^2C	4	2	1	32	1.8	100-BGA	$8.69
TMS320**F2808**-PZA/S/Q[§]	100	8KB	36KB	128KB	15	4/2	12 + 4	4	16Ch/160	—	Y	I^2C	4	2	2	32	1.8	100-LQFP	$11.52
TMS320**F2808**-GGMA/S/Q[§]	100	8KB	36KB	128KB	15	4/2	12 + 4	4	16Ch/160	—	Y	I^2C	4	2	2	32	1.8	100-BGA	$11.52
TMS320**F2810**-PBKA/S/Q[§]	150	8KB	36KB	128KB	7	6/2	16	—	16Ch/80	—	Y	McBSP	1	2	1	56	1.9	128-LQFP	$13.81
TMS320**F2811**-PBKA/S/Q[§]	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	—	Y	McBSP	1	2	1	56	1.9	128-LQFP	$14.73
TMS320**F2812**-GHHA/S/Q[§]	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	179-BGA	$15.65
TMS320**F2812**-PGFA/S/Q[§]	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	176-LQFP	$15.65
RAM-Only Devices																			
TMS320**R2811**-PBKA/Q[§]	150	8KB	40KB	—	7	6/2	16	—	16Ch/80	—	Y	McBSP	1	2	1	56	1.9	128-LQFP	$9.11
TMS320**R2812**-GHHA/Q[§]	150	8KB	40KB	—	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	179-BGA	$10.63
TMS320**R2812**-PGFA/Q[§]	150	8KB	40KB	—	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	176-LQFP	$10.63
ROM Devices																			
TMS320**C2810**-PBKA/Q[§]	150	8KB	36KB	128KB	7	6/2	16	—	16Ch/80	—	Y	McBSP	1	2	1	56	1.9	128-LQFP	$7.05✦
TMS320**C2811**-PBKA/Q[§]	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	—	Y	McBSP	1	2	1	56	1.9	128-LQFP	$8.22✦
TMS320**C2812**-GHHA/Q[§]	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	179-BGA	$9.59✦
TMS320**C2812**-PGFA/Q[§]	150	8KB	36KB	256KB	7	6/2	16	—	16Ch/80	Y	Y	McBSP	1	2	1	56	1.9	176-LQFP	$9.59✦

[+] *Prices are quoted in U.S. dollars and represent year 2006 suggested resale pricing. All prices are subject to change. Customers are advised to obtain the most current and complete pricing information from TI prior to placing orders. TI may verify final pricing prior to accepting any order.*

✦ *Minimum volumes for C281x devices are 10 KU with NRE of $11,000.*

[§] *A = –40° to 85°C; S = –40 to 125°C (10% adder over A); Q = –40 to 125°C, Q100 qualified (15% adder over S)*

All devices are available in PB-Free Green packaging.

Microcontrollers

MSP430 Ultra-Low-Power Microcontrollers Selection Guide

Device	Prgm. (kB)	SRAM	I/O	Timer A	Timer B	DMA	USART	SPI, I²C	SVS	BOR	MPY	Comp A	Temp Sensor	ADC Ch/Res	DAC Ch/Res	Package(s)	Price[1]
Flash/ROM-Based x1xx Family with 16-Bit Watchdog (V_{CC} 1.8V to 3.6V)																	
MSP430F1101A	1	128	14	3	—	—	—	—	—	—	—	✓	—	Slope	—	20-SOIC, 20-TSSOP 20-TVSOP, 24-QFN	$0.99
MSP430C1101	1	128	14	3	—	—	—	—	—	—	—	✓	—	Slope	—	20-SOP, 20-TSSOP, 24-QFN	$0.60
MSP430F1111A	2	128	14	3	—	—	—	—	—	—	—	✓	—	Slope	—	20-SOIC, 20-TSSOP 20-TVSOP, 24-QFN	$1.35
MSP430C1111	2	128	14	3	—	—	—	—	—	—	—	✓	—	Slope	—	20-SOP, 20-TSSOP, 24-QFN	$1.10
MSP430F1121A	4	256	14	3	—	—	—	—	—	—	—	✓	—	Slope	—	20-SOIC, 20-TSSOP 20-TVSOP, 24-QFN	$1.70
MSP430C1121	4	256	14	3	—	—	—	—	—	—	—	✓	—	Slope	—	20-SOP, 20-TSSOP, 24-QFN	$1.35
MSP430F1122	4	256	14	3	—	—	—	—	—	✓	—	—	✓	5/10	—	20-SOIC, 20-TSSOP, 32-QFN	$2.00
MSP430F1132	8	256	14	3	—	—	—	—	—	✓	—	—	✓	5/10	—	20-SOIC, 20-TSSOP, 32-QFN	$2.25
MSP430F1222	4	256	22	3	—	—	1	—	—	✓	—	—	✓	8/10	—	28-SOIC, 28-TSSOP, 32-QFN	$2.40
MSP430F1232	8	256	22	3	—	—	1	—	—	✓	—	—	✓	8/10	—	28-SOIC, 28-TSSOP, 32-QFN	$2.50
MSP430F122	4	256	22	3	—	—	1	—	—	—	—	✓	—	Slope	—	28-SOIC, 28-TSSOP, 32-QFN	$2.15
MSP430F123	8	256	22	3	—	—	1	—	—	—	—	✓	—	Slope	—	28-SOIC, 28-TSSOP, 32-QFN	$2.30
MSP430C1331	8	256	48	3	3	—	1	—	—	—	—	✓	—	Slope	—	64-TQFP, 64-QFN	$2.00
MSP430C1351	16	512	48	3	3	—	1	—	—	—	—	✓	—	Slope	—	64-TQFP, 64-QFN	$2.30
MSP430F133	8	256	48	3	3	—	1	—	—	—	—	✓	✓	8/12	—	64-LQFP, 64-TQFP, 64-QFN	$3.00
MSP430F135	16	512	48	3	3	—	1	—	—	—	—	✓	✓	8/12	—	64-LQFP, 64-TQFP, 64-QFN	$3.60
MSP430F147	32	1024	48	3	7	—	2	—	—	—	✓	✓	✓	8/12	—	64-LQFP, 64-TQFP, 64-QFN	$5.05
MSP430F148	48	2048	48	3	7	—	2	—	—	—	✓	✓	✓	8/12	—	64-LQFP, 64-TQFP, 64-QFN	$5.75
MSP430F149	60	2048	48	3	7	—	2	—	—	—	✓	✓	✓	8/12	—	64-LQFP, 64-TQFP, 64-QFN	$6.05
MSP430F1471	32	1024	48	3	7	—	2	—	—	—	✓	✓	—	Slope	—	64-LQFP, 64-QFN	$4.60
MSP430F1481	48	2048	48	3	7	—	2	—	—	—	✓	✓	—	Slope	—	64-LQFP, 64-QFN	$5.30
MSP430F1491	60	2048	48	3	7	—	2	—	—	—	✓	✓	—	Slope	—	64-LQFP, 64-QFN	$5.60
MSP430F155	16	512	48	3	3	✓	1	✓	✓	✓	—	✓	✓	8/12	2/12	64-LQFP	$4.95
MSP430F156	24	1024	48	3	3	✓	1	✓	✓	✓	—	✓	✓	8/12	2/12	64-LQFP	$5.55
MSP430F157	32	1024	48	3	3	✓	1	✓	✓	✓	—	✓	✓	8/12	2/12	64-LQFP	$5.85
MSP430F167	32	1024	48	3	7	✓	2	✓	✓	✓	✓	✓	✓	8/12	2/12	64-LQFP	$6.75
MSP430F168	48	2048	48	3	7	✓	2	✓	✓	✓	✓	✓	✓	8/12	2/12	64-LQFP	$7.45
MSP430F169	60	2048	48	3	7	✓	2	✓	✓	✓	✓	✓	✓	8/12	2/12	64-LQFP	$7.95
MSP430F1610	32	5120	48	3	7	✓	2	✓	✓	✓	✓	✓	✓	8/12	2/12	64-LQFP	$8.25
MSP430F1611	48	10240	48	3	7	✓	2	✓	✓	✓	✓	✓	✓	8/12	2/12	64-LQFP	$8.65
MSP430F1612	55	5120	48	3	7	✓	2	✓	✓	✓	✓	✓	✓	8/12	2/12	64-LQFP	$8.95
Flash-Based F2xx Family with 16 MIPS and 16-Bit Watchdog (V_{CC} 1.8-3.6V)																	
MSP430F2001	1	128	10	2	—	—	—	—	—	✓	—	✓[2]	—	Slope	—	14-TSSOP, 14-PDIP, 16-QFN	$0.55
MSP430F2011	2	128	10	2	—	—	—	—	—	✓	—	✓[2]	—	Slope	—	14-TSSOP, 14-PDIP, 16-QFN	$0.70
MSP430F2002	1	128	10	2	—	—	✓	—	—	✓	—	—	✓	1/10	—	14-TSSOP, 14-PDIP, 16-QFN	$0.99
MSP430F2012	2	128	10	2	—	—	✓	—	—	✓	—	—	✓	1/10	—	14-TSSOP, 14-PDIP, 16-QFN	$1.15
MSP430F2003	1	128	10	2	—	—	✓	—	—	✓	—	—	✓	1/16	—	14-TSSOP, 14-PDIP, 16-QFN	$1.49
MSP430F2013	2	128	10	2	—	—	✓	—	—	✓	—	—	✓	1/16	—	14-TSSOP, 14-PDIP, 16-QFN	$1.65
MSP430F2101	1	128	16	3	—	—	—	—	—	✓	—	✓[2]	—	Slope	—	20-TSSOP, 20-SOIC, 24-QFN	$0.90
MSP430F2111	2	128	16	3	—	—	—	—	—	✓	—	✓[2]	—	Slope	—	20-TSSOP, 20-SOIC, 24-QFN	$0.99
MSP430F2121	4	256	16	3	—	—	—	—	—	✓	—	✓[2]	—	Slope	—	20-TSSOP, 20-SOIC, 24-QFN	$1.35
MSP430F2131	8	256	16	3	—	—	—	—	—	✓	—	✓[2]	—	Slope	—	20-TSSOP, 20-SOIC, 24-QFN	$1.70
MSP430F2234	8	512	32	3	3	—	✓	—	—	✓	—	—	—	1/10	2/Amp	38-TSOP, 40-QFN	$2.75
MSP430F2254	16	512	32	3	3	—	✓	—	—	✓	—	—	—	1/10	2/Amp	38-TSOP, 40-QFN	$3.15
MSP430F2274	32	1024	32	3	3	—	✓	—	—	✓	—	—	—	1/10	2/Amp	38-TSOP, 40-QFN	$3.55

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]Comparator µA+.

*Preview devices appear in **bold blue**.*

Microcontrollers/Interface

MSP430 Ultra-Low-Power Microcontrollers Selection Guide (Continued)

Device	Prgm. (kB)	SRAM (B)	I/O	Timer A	Timer B	USART, USCI[2]	LCD Segments	DMA	SVS	BOR	MPY	Comp A	Temp Sensor	ADC Ch/Res	DAC Ch/Res	Package(s)	Price[1]
Flash/ROM-Based x4xx Family with LCD Driver and 16-bit Watchdog (V_{CC} 1.8V - 3.6V) (Continued)																	
MSP430F412/C412	4	256	48	3	—	—	96	—	✓	✓	—	✓	—	Slope	—	64-LQFP, 64-QFN	$2.60/1.90
MSP430F413/C413	8	256	48	3	—	—	96	—	✓	✓	—	✓	—	Slope	—	64-LQFP, 64-QFN	$2.95/2.10
MSP430F415	16	512	48	3, 5	—	—	96	—	✓	✓	—	✓	—	Slope	—	64-LQFP, 64-QFN	$3.40
MSP430F417	32	1024	48	3, 5	—	—	96	—	✓	✓	—	✓	—	Slope		64-LQFP, 64-QFN	$3.90
MSP430FW423	8	256	48	3, 5	—	—	96	—	✓	✓	—	✓	—	Slope	Flow-meter	64-LQFP	$3.75
MSP430FW425	16	512	48	3, 5	—	—	96	—	✓	✓	—	✓	—	Slope	Flow-meter	64-LQFP	$4.05
MSP430FW427	32	1024	48	3, 5	—	—	96	—	✓	✓	—	✓	—	Slope	Flow-meter	64-LQFP	$4.45
MSP430F4250	16	256	32	3	—	—	56	—	—	✓	—	—	✓	1/16	1/12	64-LQFP	$3.10
MSP430F4260	24	256	32	3	—	—	56	—	—	✓	—	—	✓	1/16	1/12	64-LQFP	$3.45
MSP430F4270	32	256	32	3	—	—	56	—	—	✓	—	—	✓	1/16	1/12	48-SSOP, 48-QFN	$3.80
MSP430F423	8	256	14	3	—	1	128	—	✓	✓	✓	—	✓	3/16	—	48-SSOP, 48-QFN	$4.50
MSP430F425	16	512	14	3	—	1	128	—	✓	✓	✓	—	✓	3/16	—	48-SSOP, 48-QFN	$4.95
MSP430F427	32	1024	14	3	—	1	128	—	✓	✓	✓	—	✓	3/16	—	64-LQFP	$5.40
MSP430FE423	8	256	14	3	—	1	128	—	✓	✓	✓	—	✓	3/16	E-meter	64-LQFP	$4.85
MSP430FE425	16	512	14	3	—	1	128	—	✓	✓	✓	—	✓	3/16	E-meter	64-LQFP	$5.45
MSP430FE427	32	1024	14	3	—	1	128	—	✓	✓	✓	—	✓	3/16	E-meter	64-LQFP	$5.95
MSP430F435	16	512	48	3	3	1	128/160	—	✓	✓	—	✓	✓	8/12	—	80-LQFP, 100-LQFP	$4.45
MSP430F436	24	1024	48	3	3	1	128/160	—	✓	✓	—	✓	✓	8/12	—	80-LQFP, 100-LQFP	$4.70
MSP430F437	32	1024	48	3	3	1	128/160	—	✓	✓	—	✓	✓	8/12	—	80-LQFP, 100-LQFP	$4.90
MSP430FG437	32	1024	48	3	3	1	128	✓	✓	✓	—	✓	✓	12/12	2/12	80-LQFP	$6.50
MSP430FG438	48	2048	48	3	3	1	128	✓	✓	✓	—	✓	✓	12/12	2/12	80-LQFP	$7.35
MSP430FG439	60	2048	48	3	3	1	128	✓	✓	✓	—	✓	✓	12/12	2/12	80-LQFP	$7.95
MSP430F447	32	1024	48	3	7	2	128	—	✓	✓	✓	✓	✓	8/12	—	100-LQFP	$5.75
MSP430F448	48	2048	48	3	7	2	128	—	✓	✓	✓	✓	✓	8/12	—	100-LQFP	$6.50
MSP430F449	60	2048	48	3	7	2	128	—	✓	✓	✓	✓	✓	8/12	—	100-LQFP	$7.05
MSP430FG4616	92	4096	80	3	7	1, 2	160	✓	✓	✓	✓	✓	✓	12/12	2/12	100-LQFP	9.45
MSP430FG4617	92	8192	80	3	7	2, 2	160	✓	✓	✓	✓	✓	✓	12/12	2/12	100-LQFP	9.35
MSP430FG4618	116	8192	80	3	7	2, 2	160	✓	✓	✓	✓	✓	✓	12/12	2/12	100-LQFP	10.35
MSP430FG4619	120	4096	80	3	7	2, 2	160	✓	✓	✓	✓	✓	✓	12/12	2/12	100-LQFP	$9.95

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]Includes UART, IrDA, SPI and I^2C. *Preview products appear in **bold blue**.*

CAN Selection Guide

Supply Voltage (V)	Device	Description	Transient Pulse Protection (V)	I_{CC} max (mA)	ESD (kV)	Bus Fault Protection (V)	Footprint	Temp Range (°C)	Package(s)	Price[1]
5	SN65HVD251	Standby, improved drop-in for PCA82C250/1	–200 to 200	65	14	±36	PCA82C250	–40 to 125	8-PDIP, 8-SOIC	$0.90
5	**SN65HVD1040**	Improved drop-in replacement for TJA1040	–200 to 200	70	6	–27 to 40	TJA1040	–40 to 125	8-SOIC	—
5	**SN65HVD1050**	Improved drop-in replacement for TJA1050	–200 to 200	70	6	–27 to 40	TJA1050	–40 to 125	8-SOIC	—
5	SN65LBC031	500Kbps	–150 to 100	20	2	–5 to 20	SN75LBC031	–40 to 125	8-SOIC	$1.50
3.3	SN65HVD230	Standby mode	–25 to 25	17	16	–4 to 16	PCA82C250	–40 to 85	8-SOIC	$1.35
3.3	SN65HVD231	Sleep mode	–25 to 25	17	16	–4 to 16	PCA82C250	–40 to 85	8-SOIC	$1.35
3.3	SN65HVD232	Cost effective	–25 to 25	17	16	–4 to 16	SN65HVD232	–40 to 85	8-SOIC	$1.30
3.3	SN65HVD230Q	Automotive temp, standby mode	–25 to 25	17	15	–7 to 16	PCA82C250	–40 to 125	8-SOIC	$1.55
3.3	SN65HVD231Q	Automotive temp, sleep mode	–25 to 25	17	15	–7 to 16	PCA82C250	–40 to 125	8-SOIC	$1.55
3.3	SN65HVD232Q	Automotive temp, cost effective	–25 to 25	17	15	–7 to 16	SN65HVD232	–40 to 125	8-SOIC	$1.50
3.3	SN65HVD233	Standby mode, diagnostic loop-back	–100 to 100	6	16	±36	—	–40 to 125	8-SOIC	$1.50
3.3	SN65HVD234	Standby mode, sleep mode	–100 to 100	6	16	±36	—	–40 to 125	8-SOIC	$1.45
3.3	SN65HVD235	Standby mode, autobaud loop-back	–100 to 100	6	16	±36	—	–40 to 125	8-SOIC	$1.50

[1]Suggested resale price in U.S. dollars in quantities of 1,000. All devices have a signaling rate of 1Mbps except LBC031. *Preview products appear in **bold blue**.*

Interface

RS-485 Selection Guide

No. of Dr/Rx		Supply (V)	Enables	Device	Features	Signaling Rate (Mbps)	ESD (kV)	Receiver Fail-Safe	Nodes	Package(s)	Price[1]
1/1	Half-Duplex	3.3	DE, RE	SN65HVD12	3.3V Supply – Low-Speed Slew-Rate Control	1	15	Short, Open, Idle	256	8-PDIP, 8-SOIC	$1.75
			DE, RE	SN65HVD11	3.3V Supply – Low-Speed Slew-Rate Control	10	15	Short, Open, Idle	256	8-PDIP, 8-SOIC	$1.80
			DE, RE	SN65HVD10	3.3V Supply – High-Speed Signaling	25	15	Short, Open, Idle	64	8-PDIP, 8-SOIC	$1.85
		3 to 5	DE, RE	SN65HVD08	Wide Supply Range: 3 to 5.5V	10	15	Short, Open, Idle	256	8-PDIP, 8-SOIC	$1.90
		5	DE, RE	SN65HVD3082E	Low Power Mode, Optimized for Low-Speed	0.2	15	Short, Open, Idle	256	8-PDIP, 8-SOIC, 8-MSOP	$0.90
			DE, RE	SN65HVD3085E	Low Power Mode, Optimized for Mid-Speed	1	15	Short, Open, Idle	256	8-PDIP, 8-SOIC, 8-MSOP	$0.90
			DE, RE	SN65HVD3088E	Low Power Mode, Optimized for High-Speed	10	15	Short, Open, Idle	256	8-PDIP, 8-SOIC, 8-MSOP	$1.00
			DE, RE	SN65HVD485E	Half Duplex Transceiver	10	15	Open	64	8-PDIP, 8-SOIC, 8-MSOP	$0.70
			DE, RE	SN65HVD1176	PROFIBUS Transceiver, EN 50170	40	10	Short, Open, Idle	160	8-SOIC	$1.55
			DE, RE	SN65HVD22	–20V to 25V Common Mode Operation	0.5	16	Short, Open, Idle	256	8-PDIP, 8-SOIC	$1.65
			DE, RE	SN65HVD21	–20V to 25V Common Mode, 5Mbps	5	16	Short, Open, Idle	256	8-PDIP, 8-SOIC	$1.65
			DE, RE	SN65HVD20	–20V to 25V Common Mode, 25Mbps	25	16	Short, Open, Idle	64	8PDIP, 8-SOIC	$1.65
			DE, RE	SN65HVD23	Receiver Equalization, 160 Meters at 25 Mbps	25	16	Short, Open, Idle	64	8-PDIP, 8-SOIC	$1.80
			DE, RE	SN65HVD24	Receiver Equalization, 500 Meters at 3 Mbps	3	16	Short, Open, Idle	256	8-PDIP, 8-SOIC	$1.80
			DE, RE	SN65HVD07	Strong Driver Outputs – Low Signal Rate	1	16	Short, Open, Idle	256	8-PDIP, 8-SOIC	$1.50
			DE, RE	SN65HVD06	Strong Driver Outputs – Mid Signal Rate	10	16	Short, Open, Idle	256	8-PDIP, 8-SOIC	$1.55
			DE, RE	SN65HVD05	Strong Driver Outputs – Fast Signal Rate	40	16	Short, Open, Idle	64	8-PDIP, 8-SOIC	$1.60
			DE, RE	SN65LBC176	Low Power	10	2	Open	32	8-PDIP, 8-SOIC	$0.90
			DE, RE	SN65LBC176A	Low Power, Fast Signaling, ESD Protection	30	12	Open	32	8-PDIP, 8-SOIC	$1.20
			DE, RE	SN65LBC184	Transient Protection, IEC Air, Contact, Surge	0.25	30	Open	128	8-PDIP, 8-SOIC	$1.30
			DE, RE	SN65LBC182	IEC ESD Protection, Air and Contact Tests	0.25	15	Open	128	8-PDIP, 8-SOIC	$1.05
			DE, RE	SN65ALS176	Fast Signaling, Skew: 15ns	35	2	Open	32	8-SOIC	$1.26
			DE, RE	SN65176B	Cost Effective	10	2	None	32	8-PDIP, 8-SOIC, 8-SOP	$0.44
	Full-Duplex	3.3	No	SN65HVD30	3.3V Supply, no Enables, 25Mbps	25	15	Short, Open, Idle	64	8-SOIC	Preview
			No	SN65HVD31	3.3V Supply, no Enables, 5Mbps	5	15	Short, Open, Idle	256	8-SOIC	Preview
			No	SN65HVD32	3.3V Supply, no Enables, 1Mbps	1	15	Short, Open, Idle	256	8-SOIC	Preview
			DE, RE	SN65HVD33	3.3V Supply, with Enables, 25Mbps	25	15	Short, Open, Idle	64	14-SOIC	$1.70
			DE, RE	SN65HVD34	3.3V Supply, with Enables, 5Mbps	5	15	Short, Open, Idle	256	14-SOIC	$1.70
			DE, RE	SN65HVD35	3.3V Supply, with Enables, 1Mbps	1	15	Short, Open, Idle	256	14-SOIC	$1.70
		5	No	SN65HVD50	Strong Bus Outputs, no Enables, 25Mbps	25	15	Short, Open, Idle	64	8-SOIC	Preview
			No	SN65HVD51	Strong Bus Outputs, no Enables, 5Mbps	5	15	Short, Open, Idle	256	8-SOIC	Preview
			No	SN65HVD52	Strong Bus Outputs, no Enables, 1Mbps	1	15	Short, Open, Idle	256	8-SOIC	Preview
			No	SN65LBC179	Low Power, without Enable	10	2	Open	32	8-PDIP, 8-SOIC	$0.85
			No	SN65LBC179A	High Signaling Rate, High ESD w/o Enables	30	10	Open	32	8-PDIP, 8-SOIC	$1.10
			DE, RE	SN65HVD53	Strong Bus Outputs, with Enables, 25Mbps	25	15	Short, Open, Idle	64	14-SOIC	$1.60
			DE, RE	SN65HVD54	Strong Bus Outputs, with Enables, 5Mbps	5	15	Short, Open, Idle	256	14-SOIC	$1.60
			DE, RE	SN65HVD55	Strong Bus Outputs, with Enables, 1Mbps	1	15	Short, Open, Idle	256	14-SOIC	$1.60
			DE, RE	SN65LBC180	Low Power, with Enables	10	2	Open	32	14-PDIP, 14-SOIC, 16-QFN	$1.05
			DE, RE	SN65LBC180A	High Signaling Rate, High ESD with Enables	30	10	Open	32	14-PDIP, 14-SOIC	$1.35
			DE, RE	SN65ALS180	High Signaling Rate, with Enables	25	2	Open	32	14-SOIC	$1.71
3/3	Triple		Separate DIR	SN65LBC170	FAST-20 SCSI, Skew: 3ns	30	12	Open	32	20-SOIC, 16-SSOP	$4.10
			DE, Triple RE	SN65LBC171	FAST-20 SCSI, Skew: 3ns	30	12	Open	32	20-SOIC, 20-SSOP	$4.10
4/0	Quad-Drivers		Complementary	SN65LBC172	Low Power	10	2	—	32	16-PDIP, 20-SOIC	$1.80
			Complementary	SN65LBC172A	High Signaling Rate, High ESD	30	13	—	32	16-PDIP, 16-SOIC, 20-SOIC	$2.40
			Pairwise	SN65LBC174A	Low Power	10	2	—	32	16-PDIP, 20-SOIC	$1.90
			Pairwise	SN65LBC174A	High Signaling Rate, High ESD	30	13	—	32	16-PDIP, 16-SOIC, 20-SOIC	$2.50
3/3	Quad-Receivers		Complementary	SN65LBC173	Low Power	10	2	Open	32	16-PDIP, 16-SOIC	$1.15
			Complementary	SN65LBC173A	High Signaling Rate, High ESD, Low Power	50	6	Short, Open, Idle	32	16-PDIP, 16-SOIC	$1.50
			Pairwise	SN65LBC175	Low Power	10	2	Open	32	16-PDIP, 16-SOIC	$1.10
			Pairwise	SN65LBC175A	High Signaling Rate, High ESD, Low Power	50	6	Short, Open, Idle	32	16-PDIP, 16-SOIC	$1.40
			Pairwise	SN65175	Standard	10	2	None	32	16-PDIP, 16-SOIC, 16-SOP	$2.70

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

RS-232 Selection Guide

Device	Description	Drivers per Pkg.	Receivers per Pkg.	Supply Voltage(s) (V)	I_{CC} (mA) (max)	Footprint	Package(s)	Price[1]
TL145406	Triple RS-232 Drivers/Receivers	3	3	±12, 5	20	MC14506	PDIP, SOIC	$0.94
GD75232	Multiple RS-232 Drivers and Receivers	3	5	±12, 5	20	GD75232	PDIP, SOIC, SSOP, TSSOP	$0.22
MAX3243	3V to 5.5V Multichannel RS-232 Line Driver/Receiver with ±15kV ESD (HBM) Protection	3	5	3.3, 5	1	MAX3243	SOIC, SSOP, TSSOP	$0.99
MAX202	5V Dual RS-232 Line Driver/Receiver with ±15kV ESD Protection	2	2	5	15	MAX202	SOIC, TSSOP	$0.58
MAX207	5V Multichannel RS-232 Line Driver/Receiver with ±15kV ESD Protection	5	3	5	20	MAX207	SOIC, SSOP	$1.08
MAX211	5V Multichannel RS-232 Line Driver/Receiver with ±15kV ESD Protection	4	5	5	20	MAX211	SOIC, SSOP	$1.08
MAX222	5V Dual RS-232 Line Driver/Receiver with ±15kV ESD Protection	2	2	5	10	MAX222	SOIC	$1.26
SN65C3243	3V to 5.5V Multichannel RS-232 Line Driver/Receiver	3	5	3.3 or 5	1	MAX3234	SOIC, SSOP, TSSOP	$3.46
SN75185	Multiple RS-232 Drivers and Receivers	3	5	±12, 5	30	SN75185	PDIP, SOIC	$0.43
SN75C185	Low-Power Multiple Drivers and Receivers	3	5	±12, 5	0.75	SN75C185	PDIP, SOIC	$0.90
SN75C3234	3V to 5.5V Multichannel RS-232 Line Driver/Receiver	3	5	3.3 to 5	1	MAX3243	SOIC, SSOP, TSSOP	$2.02
SN75LBC187	Multichannel EIA-232 Driver/Receiver with Charge Pump	3	5	5	30	SN75LBC187	SSOP	$3.60
SN75LP1185	Low-Power Multiple RS-232 Drivers and Receivers	3	5	5, ±12	1	SN75LP185	PDIP, SOIC, SSOP	$1.53
SN75LPE185	Low-Power Multiple Drivers and Receivers	3	5	5, ±12	1	SN75LP185	PDIP, SOIC, SSOP, TSSOP	$1.62
SN75LV4737A	3V to 5.5V Multichannel RS-232 Line Driver/Receiver	3	5	3 or 5	1	MAX3243	SOIC, SSOP, TSSOP	$2.61
LT1030	Quad Low-Power Line Driver	4	0	±5	1	LT1030	PDIP, SOIC	$0.81
MC1488	Quad Line Driver	4	0	±9	25	MC1488	PDIP	$0.20
SN55188	Quad Line Driver	4	0	±9		MC1488	CDIP, CFP, LCCC	$1.97
SN75188	Quad Line Driver	4	0	±9	25	MC1488	PDIP, SOIC, SOP	$0.18
SN75C188	Quad Low-Power Line Driver	4	0	±12	0.16	MC1488	PDIP, SOIC, SOP, SSOP	$0.31
SN75C198	Quad Low-Power Line Driver	4	0	±12	0.32	—	PDIP, SOIC	$2.25
SN75154	Quad Differential Line Receiver	4	4	5 or 12	35	SN75154	PDIP, SOIC, SOP	$0.41
SN75C1154	Quad Low-Power Drivers/Receivers	4	4	±12, 5	—	—	PDIP, SOIC, SOP	$0.76
SN75LBC241	Low-Power LinBiCMOS™ Multiple Drivers and Receivers	4	5	5	8	MAX241	SOIC	$1.73
GD75323	Multiple RS-232 Drivers and Receivers	5	3	±12, 5	32	GD75323	SOIC	$0.22
MAX3238	3V to 5.5V Multichannel RS-232 Line Driver/Receiver	5	3	3.3, 5	2	MAX3238	SSOP, TSSOP	$1.13
SN65C3238	3V to 5.5V Multichannel RS-232 Line Driver/Receiver	5	3	3.3 or 5	2	MAX3238	SOIC, SSOP, TSSOP	$3.24
SN75196	Multiple RS-232 Driver and Receiver	5	3	±12, 5	20	SN75196	PDIP, SOIC	$0.41
SN75C3238	3V to 5.5V Multichannel RS-232 Line Driver/Receiver	5	3	3.3 or 5	2	MAX3238	SOIC, SSOP, TSSOP	$2.81
SN75LP196	Low-Power Multiple RS-232 Drivers and Receivers	5	3	5, ±12	1	SN75LP185	PDIP, SOIC, SSOP, TSSOP	$1.53
SN65C23243	3V to 5.5V Dual RS-232 Port	6	10	3.3, 5	0.02	—	SSOP, TSSOP	$4.32
SN752232	Dual RS-232 Port	6	10	5	±50	—	SSOP, TSSOP	$0.81
SN75C23243	3V to 5.5V Dual RS-232 Port	6	10	3.3, 5	0.02	—	SSOP, TSSOP	$3.42
UC5171	Octal Line Driver with TTL Mode Selection	8	0	±9 to ±15	42	—	PLCC	$6.33
UC5172	Octal Line Driver with Long Line Drive	8	0	±9 to ±15	25	—	PDIP, PLCC	$3.25

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

New products appear in ***bold red***.

Interface

1394b Media Summary

Device	Reach	s100	s200	s400	s800	s1600	s3200
UTP-5	100m	X	—	—	—	—	—
POF/HPCF	100m	X	X	X	X	X	—
50µm GOF	100m	—	—	X	X	X	X
STP (beta)	4.5m	—	—	X	X	X	X
STP (DS)	4.5m	X	X	X	—	—	—

Higher speeds and greater distances provide increased versatility for industrial and automated systems requiring high bandwidth real-time data.

1394 Link-Layer Controllers Selection Guide

Device	Supply Voltage (V)	Speed Max (Mbps)	FIFO (kb)	Pin/ Package	Description	Price[1]
TSB12C01A	5	100	2	100-LQFP	High-Performance 5V Link Layer with 32-Bit Host I/F, 2kb FIFOs	$11.75
TSB12LV01B	3.3	400	2	100-TQFP	High-Performance 1394 3.3V Link Layer for Telecom, Embedded & Industrial App., 32-Bit I/F, 2kb FIFO	$8.90
TSB12LV21B	3.3	400	4	176-LQFP	PCILynx™ - PCI to 1394 3.3V Link Layer with 32-Bit PCI I/F, 4kb FIFOs	$9.60
TSB12LV26	3.3	400	9	100-TQFP	OHCI-Lynx™ PCI-Based IEEE 1394 Host Controller	$3.95
TSB12LV32	3.3	400	4	100-LQFP	General-Purpose Link Layer Controller (GP2Lynx)	$5.15
TSB42AA4	3.3	400	8	128-TQFP	1394 Link Layer Controller with DTCP Content Protection for Consumer Electronics Applications	$9.20
TSB42AB4	3.3	400	8	128-TQFP	1394 Link Layer Controller for Consumer Electronics Applications – No Content Protection	$10.95
TSB42AC3	3.3	400	10	100-TQFP	High-Performance Link Layer with 32-Bit I/F. May Be Cycle Master; Has 10kb FIFO and JTAG Support. PHY-Link Timing Compliant with 1394a-2000 for Industrial and Bridge Applications.	$6.50
TSB82AA2	3.3	800	11	144-LQFP	High-Performance 1394b 3.3V OHCI 1.1+ Compliant Link Layer Controller	$7.80

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

1394 Integrated Devices Selection Guide

Device	Supply Voltage (V)	Speed Max (Mbps)	FIFO (kb)	Package(s)	Description	Price[1]
TSB43AA22	3.3	400	8	128-TQFP	1394a Serial Layer Controller +400Mbps, 2-Port Physical Layer	$7.20
TSB43AA82A	3.3	400	4.7	144-LQFP	2-Port High Performance Integrated Physical and Link Layer Chip for PC Peripherals	$8.30
TSB43AB21A	3.3	400	9	128-TQFP	OHCI 1.1, 1394a Link Layer Controller Integrated with 1394a, 400Mbps, 1-Port Physical Layer (PHY)	$4.35
TSB43AB22A	3.3	400	9	128-TQFP	OHCI 1.1, 1394a Link Layer Controller Integrated with 1394a, 400Mbps, 2-Port Physical Layer (PHY)	$4.55
TSB43AB23	3.3	400	9	144-LQFP, 128-TQFP	OHCI 1.1, 1394a Link Layer Controller Integrated with a 1394a, 400Mbps, 3-Port Physical Layer (PHY)	$4.90
TSB43CA42	3.3	400	16	176-LQFP	iceLynx Micro 2-port IEEE 1394a-2000 CES	$10.60
TSB43CA43A	3.3	400	16.5	176-LQFP	iceLynx Micro-5C with Streaming Audio and Content Protection	$12.60
TSB43CB43A	3.3	400	16.5	176-LQFP	iceLynx Micro with Streaming Audio	$11.40

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

1394 Physical-Layer Controllers Selection Guide

Device	Supply Voltage (V)	Speed Max (Mbps)	FIFO (kb)	Package(s)	Description	Price[1]
TSB14AA1A	3.3	100	1	48-TQFP	IEEE 1394-1995, 3.3V, 1-Port, 50/100Mbps, Backplane PHY	$5.90
TSB14C01A	5	100	1	64-LQFP	IEEE 1394-1995, 5V, 1-Port, 50/100Mbps Backplane Physical Layer Controller	$5.45
TSB17BA1	3.3	100	1	24-TSSOP	1394b-2002 Compliant Cat5 Cable Transceiver for up to 100 Meters	$2.50
TSB41AB1	3.3	400	1	48-HTQFP, 64-HTQFP	IEEE 1394a One-Port Cable Transceiver/Arbiter	$1.50
TSB41AB2	3.3	400	2	64-HTQFP	IEEE 1394a Two-Port Cable Transceiver/Arbiter	$1.85
TSB41AB3A	3.3	400	3	80-HTQFP	IEEE 1394a Three-Port Cable Transceiver/Arbiter	$3.00
TSB41BA3A	3.3	400	3	80-HTQFP	1394b-2002 3-Port Physical Layer Device	$6.50
TSB41LV04A	3.3	400	4	80-HTQFP	IEEE 1394a Four-Port Cable Transceiver/Arbiter	$6.50
TSB41LV06A	3.3	400	6	100-HTQFP	IEEE 1394a Six-Port Cable Transceiver/Arbiter	$6.40
TSB81BA3	1.8, 3.3	800	3	80-HTQFP	IEEE P1394b s800 Three-Port Cable Transceiver/Arbiter	$7.80

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

UARTs Selection Guide

Device	Channels	FIFOs (Bytes)	Baud Rate max (Mbps)	Voltage (V)	Package(s)	Description	Price[1]
TL16C450	1	0	0.256	5	40-PDIP, 44-PLCC	Single UART without FIFO	$1.50
TL16C451	1	0	0.256	5	68-PLCC	Single UART with Parallel Port and without FIFO	$2.50
TL16C452	2	0	0.256	5	68-PLCC	Dual UART with Parallel Port and without FIFO	$2.55
TL16C550C	1	16	1	5, 3.3	48-LQFP, 40-PDIP, 44-PLCC, 48-TQFP	Single UART with 16-Byte FIFOs and Auto Flow Control	$1.75
TL16C550D	1	16	1	5, 3.3, 2.5	48-LQFP, 48-TQFP, 32-QFN	Single UART with 16-Byte FIFOs and Auto Flow Control	$1.75
TL16C552/552A	2	16	1	5	68-PLCC	Dual UART with 16-Byte FIFOs and Parallel Port	$3.90 /$3.85
TL16C554/554A	4	16	1	5	80-LQFP, 68-PLCC	Quad UART with 16-Byte FIFOs	$6.05/$6.00
TL16C750	1	16 or 64	1	5, 3.3	64-LQFP, 44-PLCC	Single UART with 64-Byte FIFOs, Auto Flow Control, Low-Power Modes	$3.70
TL16C752B	2	64	3	3.3	48-LQFP	Dual UART with 64-Byte FIFO	$3.10
TL16C754B	4	64	5V-3, 3.3V-2	5, 3.3	80-LQFP, 68-PLCC	Quad UART with 64-Byte FIFO	$8.35
TL16PC564B/BLV	1	64	1	5, 3.3	100-BGA, 100-LQFP	Single UART with 64-Byte FIFOs, PCMCIA Interface	$5.90/$3.10
TL16PIR552	2	16	1	5	80-QFP	Dual UART with 16-Byte FIFOs, Selectable IR and 1284 Modes	$6.10
TIR1000	0	None	0.115	2.7 to 5.5	8-OP, 8-TSSOP	Standalone IrDA Encoder and Decoder	$1.15
TUSB3410	0	None	0.922	3.3	32-LQFP	RS232/IrDA Serial-to-USB Converter	$2.50

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

USB Hub Controllers Selection Guide

Device	Speed	Ports	I^2C	Voltage (V)	Package	Description	Price[1]
TUSB2036	Full (1.1)	2	No	3.3	32-LQFP	2/3-Port Hub for USB with Optional Serial EEPROM Interface	$1.15
TUSB2046B	Full (1.1)	4	No	3.3	32-LQFP	4-Port Hub for USB with Optional Serial EEPROM Interface Supporting Windows® 95/DOS Mode	$1.20
TUSB2077A	Full (1.1)	7	No	3.3	48-LQFP	7-Port USB Hub with Optional Serial EEPROM Interface	$1.95
TUSB2136	Full (1.1)	2	Yes	3.3	64-LQFP	2-Port Hub with Integrated General-Purpose Function Controller	$3.25
TUSB5052	Full (1.1)	5	Yes	3.3	100-LQFP	5-Port Hub with Integrated Bridge to Two Serial Ports	$5.10

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

USB Peripherals Selection Guide

Device	Speed	Voltage (V)	Remote Wakeup	Package	Description	Price[1]
TUSB3210	Full	3.3	Yes	64-LQFP	USB Full-Speed General-Purpose Device Controller	$2.50
TUSB3410	Full	3.3	Yes	32-LQFP	RS232/IrDA Serial-to-USB Converter	$2.25
TUSB6250	Full, high	3.3	Yes	80-TQFP	USB 2.0 High-Speed ATA/ATAPI Bridge Solution	$2.80

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

PCI Bridges Selection Guide

Device	Intel Compatible Part Number	Speed (MHz)	Expansion Interface (Bits)	Hot Swap	MicroStar BGA™ Packaging	Voltage(s) (V)	Package(s)	Description	Price[1]
HPC3130		33	32		No	3.3	128-LQFP, 120-QFP	Hot Plug Controller	$10.95
HPC3130A		66	64		No	3.3	128-LQFP, 144-LQFP, 120-QFP	Hot Plug Controller	$10.95
PCI2040				Friendly	Yes	3.3, 5	144-BGA, 144-LQFP	PCI-to-DSP Bridge Controller, Compliant to Compact PCI Hot Swap Specification 1.0	$10.55
PCI2060		66	32	Friendly	Yes	3.3, 5	257-BGA	Asynchronous 32-Bit, 66MHz PCI-to-PCI Bridge	$9.50
PCI2050B	21150bc	66	32	Friendly	Yes	3.3, 5	257-BGA, 208-LQFP, 208-QFP	PCI-to-PCI Bridge	$9.50
PCI2250	21152ab	33	32	Friendly	No	3.3, 5	176-LQFP, 160-QFP	32-Bit, 33MHz PCI-to-PCI Bridge, Compact PCI Hot-Swap Friendly, 4-Master	$6.10

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

Interface/Power and Control

PCI CardBus Controllers Selection Guide

Device	Voltage (V)	D3 Cold Wake	Integrated 1394	Integrated ZV	Package(s)	Description	Price[1]
PCI1510	3.3	Yes	No	No	144-BGA, 144-LQFP	Single Slot PC CardBus Controller	$3.60
PCI1520	3.3	Yes	No	No	209-BGA, 208-LQFP	PC Card Controller	$4.35
PCI1620	1.8, 3.3, 5	Yes	No	No	209-BGA, 208-LQFP	PC Card, Flash Media, and Smart Card Controller	$7.35
PCI4510	3.3	Yes	Yes	No	209-BGA, 208-LQFP	PC Card and Integrated 1394a-2000 OHCI Two-Port-PHY/Link-Layer Controller	$8.00
PCI4520	3.3	Yes	Yes	No	257-BGA	Two Slot PC Card and Integrated 1394a-2000 OHCI Two-Port-PHY/Link-Layer Controller	$9.15
PCI6420	3.3	Yes	No	No	288-BGA	Integrated 2-Slot PC Card and Dedicated Flash Media Controller	$9.50
PCI6620	3.3	Yes	No	No	288-BGA	Integrated 2-Slot PC Card with Smart Card and Dedicated Flash Media Controller	$10.50
PCI7410	3.3	Yes	Yes	No	209-BGA, 208-LQFP	PC Card, Flash Media, Integrated 1394a-2000 OHCI 2-Port PHY/Link-Layer Controller	$11.00
PCI7420	3.3	Yes	Yes	No	288-BGA	Integrated 2-Slot PC Card, Dedicated Flash Media Socket & 1394a-2000 OHCI 2-Port-PHY/Link-Layer Controller	$12.00
PCI7510	3.3	Yes	Yes	No	209-BGA, 208-LQFP	Integrated PC Card, Smart Card and 1394 Controller	$11.00
PCI7610	3.3	Yes	Yes	No	209-BGA, 208-LQFP	Integrated PC Card, Smart Card, Flash Media ,1394a-2000 OHCI 2-Port-PHY/ Link-Layer Controller	$12.00
PCI7620	3.3	Yes	Yes	No	288-BGA	Integrated 2-Slot PC Card with Smart C, Flash Media, 1394a-2000 OHCI 2-Port-PHY/Link-Layer Controller	$13.00

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

Power+ Logic™: 8-Bit Devices with Integrated Control Logic and FETs (T_C = –40°C to +125°C)

Device	Description	V_{DS} max (V)	I_{CC} typ (µA)	I_O (A)	I_{PEAK} (A)	$r_{DS(on)}$ typ (Ω)	E_{AS} max (mJ)	t_{PLH} typ (ns)	ESD max (kV)	Package(s)
TPIC6259	Addressable Latch	45	15	0.25	0.75	1.3	75	625	3	20/SOP (DW), DIP (N)
TPIC6273	D-Type Latch	45	15	0.25	0.75	1.3	75	625	3	20/SOP (DW), DIP (N)
TPIC6595	Shift Register	45	15	0.25	0.75	1.3	75	650	3	20/SOP (DW), DIP (N)
TPIC6596	Shift Register	45	15	0.25	0.75	1.3	75	650	3	20/SOP (DW), DIP (N)
TPIC6A259[1]	Addressable Latch	50	500	0.35	1.1	1	75	125	2.5	20/DIP (NE), 24/SOP (DW)
TPIC6A595[1]	Shift Register	50	500	0.35	1.1	1	75	125	2.5	20/DIP (NE), 24/SOP (DW)
TPIC6A596[1]	Shift Register	50	500	0.35	1.1	1	75	125	2.5	20/DIP (NE), 24/SOP (DW)
TPIC6B259[2]	Addressable Latch	50	20	0.15	0.5	5	30	150	2.5	20/SOP (DW), DIP (N)
TPIC6B273[2]	D-Type Latch	50	20	0.15	0.5	5	30	150	2.5	20/SOP (DW), DIP (N)
TPIC6B595[2]	Shift Register	50	20	0.15	0.5	5	30	150	2.5	20/SOP (DW), DIP (N)
TPIC6B596[2]	Shift Register	50	20	0.15	0.5	5	30	150	2.5	20/SOP (DW), DIP (N)
TPIC6C595[2]	Shift Register	33	20	0.1	0.25	7	30	80	2.5	16/SOP (D), DIP (N)
TPIC6C596[2]	Shift Register	33	20	0.1	0.25	7	30	80	2.5	16/SOP (D), DIP (N)

[1]Short-circuit and current-limit protection. [2]Current-limit capability.

PWM Power Supply Control (Single Output) Selection Guide

Device	Typical Power Level (W)	Max Practical Frequency	Start-Up Current	Operating Current	Supply Voltage (V)	UVLO: On/Off (V)	V_{REF} (V)	V_{REF} Tol. (%)	Max Duty Cycle (%)	E/A	Voltage Feed-Forward	Internal Drive (Sink/Source) (A)	Package(s)	Price[1]
Peak Current Mode Controllers														
UCC38C40	10 to 250	1MHz	50µA	2.3mA	6.6 to 20	7.0/6.6	5	2	100	Yes	Yes	1/1	SOIC-8, PDIP-8, MSOP-8	$0.95
UCC38C41	10 to 250	1MHz	50µA	2.3mA	6.6 to 20	7.0/6.6	5	2	50	Yes	Yes	1/1	SOIC-8, PDIP-8, MSOP-8	$0.95
UCC38C42	10 to 250	1MHz	50µA	2.3mA	9 to 20	14.5/9	5	2	100	Yes	Yes	1/1	SOIC-8, PDIP-8, MSOP-8	$0.95
UCC38C43	10 to 250	1MHz	50µA	2.3mA	7.6 to 20	8.4/7.6	5	2	100	Yes	Yes	1/1	SOIC-8, PDIP-8, MSOP-8	$0.95
UCC38C44	10 to 250	1MHz	50µA	2.3mA	9 to 20	14.5/9	5	2	50	Yes	Yes	1/1	SOIC-8, PDIP-8, MSOP-8	$0.95
UCC38C45	10 to 250	1MHz	50µA	2.3mA	7.6 to 20	8.4/7.6	5	2	50	Yes	Yes	1/1	SOIC-8, PDIP-8, MSOP-8	$0.95

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

Switching DC/DC Controllers Selection Guide

Device	V_{IN} (V)	V_O (V) (max)	V_O (V) (min)	V_{REF} Tol (%)	Driver Current (A)	Output Current (A)[2]	Multiple Outputs	Frequency (kHz)	Protection[3] OPC	OVP	UVLO	PG	Application[4] Source Only	Source/ Sink	Prebias Operation	PGD	DDR	Light Load Efficient	Price[1]
General-Purpose DC/DC Controllers																			
TPS40007	2.25 to 5.5	4	0.7	1.5	1	15	No	300	✓	—	✓	—	—	✓	✓	✓	—	✓	$0.99
TPS40021	2.25 to 5.5	4	0.7	1	2	25	No	Program up to 1MHz	✓	—	✓	✓	—	✓	—	✓	—	✓	$1.15
TPS40057	8 to 40	35	0.7	1	1	20	No	Program up to 1MHz	✓	—	✓	—	—	—	✓	—	—	✓	$1.35
TPS40061	10 to 55	40	0.7	1	1	10	No	Program up to 1MHz	✓	—	✓	—	—	✓	—	—	—	—	$1.40
TPS40071	4.25 to 28	23	0.7	1	1	20	No	Program up to 1MHz	✓	—	✓	✓	—	✓	—	✓	—	—	$1.35
TPS51020	4.25 to 28	24	0.85	1	2	20	2	450	✓	✓	✓	✓	—	—	—	—	✓	✓	$3.15
DC/DC Controllers with Light Load Efficiency													**Comments**						
TPS51116	3 to 28	3.4	1.5	1	0.8	10	1 + 2	Up to 500	✓	✓	✓	✓	Sync Switcher w/3A Tracking LDO				✓	✓	$1.20
Other Topology DC/DC Controllers													**Comments**						
TPS6420x	1.8 to 6.5	6.5	1.2	—	—	3	No	—	✓	—	✓	—	Simple, Hysteretic High-Efficiency Controller in SOT-23						$0.55
UC3572	4.75 to 30	0	–48	2	0.5	5	No	300	✓	—	✓	—	Simple Inverting PWM Controller						$1.05

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]Current levels of this magnitude can be supported.
[3]OCP = over-current protection, OVP= over-voltage protection, UVLO = under-voltage lockout, PG = power good.
[4]The controller of choice for most applications will be the source/sink version, which has two-quadrant operation and will source or sink output current. PGD = Predictive Gate Drive™ technology included; DDR = supports DDR memory.

DC/DC Converter (Integrated FETs) Selection Guide

Device	V_{IN} (V)	Output Current (A)	V_{OUT} (V)	Package(s)	Price[1]
Buck (Step Down)					
TPS62200/1/2/3/4/5/6	2.5 to 6.0	0.3	Adj.,1.5, 1.8, 3.3, 1.6, 2.5, 2.6	SOT 23-5	$1.35
TPS62000/1/2/3/4/5/6/7/8	2.0 to 5.5	0.6	Adj., 0.9, 1.0,1.2, 1.5, 1.8, 2.5, 3.3, 1.9	MSOP-10	$1.60
TPS62051/2/3/4/5	2.7 to 10	0.8	Adj., 1.5, 1.8, 3.3	MSOP-10	$1.85
TPS62040/2/3/4/6	2.5 to 6.0	1.2	Adj. 1.5, 1.6, 1.8, 3.3	MSOP-10, QFN-10	$2.20
TPS62110/1/2	3.1 to 17	1.5	Adj., 3.3, 5	QFN-16	$2.50
TPS54310/1/2/3/4/5/6	3.0 to 6.0	3	Adj., 0.9, 1.2, 1.5, 1.8, 2.5, 3.3	HTSSOP-20	$2.95
TPS54610/1/2/3/4/5/6	3.0 to 6.0	6	Adj., 0.9, 1.2, 1.5, 1.8, 2.5, 3.3	HTSSOP-28	$3.90
TPS54810	4.0 to 6.0	8	Adj. to 0.9	HTSSOP-28	$4.20
TPS54910	3.0 to 4.0	9	Adj. to 0.9	HTSSOP-28	$4.40
TPS799xx	1.2 to 3.3	0.2	Adj tp 6.5	SOT23-5	0.35
Inverter					
TPS6755	2.7 to 9.0	0.2	Adj. from -1.25 to - 9.3	SOIC-8	$1.25
TL497A	4.5 to 12	0.5	Adj. from -1.2 to -25	TSSOP-14	$0.86

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

Power Management

Low Dropout Regulators (LDOs) Selection Guide

Device	I_O (mA)	V_{DO} @ I_O (mV)	I_q (µA)	Output Options: Voltage (V)	Output Options: Adj.	Min V_{IN}	Max V_{IN}	Accuracy (%)	Packages: SC70	SOT23	MSOP	SO8	SOT223	TO220	QFN	DDPAK	Features[2]	CO[3]	Comments	Price[1]
Positive Voltage, Single-Output Devices																				
TPS797xx	10	105	1.2	1.8, 3.0, 3.3	—	1.8	5.5	4	✓								PG	0.47µF C	MSP430; Lowest Iq	$0.34
TPS715xx/A	50	415	3.2	2.5, 3.0, 3.3, 5	1.2 – 15	2.5	24	4	✓						✓			0.47µF C	V_{IN} Up to 24V	$0.34
TPS722xx	50	50	80	1.5, 1.6, 1.8	1.2 – 2.5	1.8	5.5	3		✓							/EN, BP	0.1µF C	Low Noise, V_{IN} Down to 1.8V	$0.41
REG101	100	60	400	2.5, 2.8, 2.85, 3.0, 3.3, 5	2.5 – 5.5	2.6	10	1.5		✓		✓					EN, BP	No Cap	Low Noise	$0.95
TPS792xx	100	38	185	2.5, 2.8, 3.0	1.2 – 5.5	2.7	5.5	2		✓							EN	1µF C	RF Low Noise, High PSRR	$0.40
TPS731xx	150	30	400	1.5, 1.8, 2.5, 3.0, 3.3, 5.0, EEProm[4]	1.2 – 5.5	1.7	5.5	1		✓							EN, BP	No Cap	Reverse Leakage Protection	$0.45
TPS771xx	150	75	90	1.5, 1.8, 2.7, 2.8, 3.3, 5	1.5 – 5.5	2.7	10	2				✓					/EN, SVS	10µF C	Low Noise	$0.60
TPS732xx	250	40	400	1.5, 1.8, 2.5, 3.0 3.3, 5.0, EEProm[4]	1.2 – 5.5	1.7	5.5	1		✓			✓				EN, BP	No Cap	Reverse Leakage Protection	$0.65
TPS794xx	250	145	172	1.8, 2.5, 2.8, 3.0, 3.3	1.2 – 5.5	2.7	5.5	2			✓		✓				EN, BP	2.2µF C	RF Low Noise, High PSRR	$0.65
REG102	250	150	400	2.5, 2.8, 2.85, 3.0, 3.3, 5	2.5 – 5.5	1.8	10	2		✓		✓	✓				EN, BP	No Cap	Capacitor Free, DMOS	$1.05
TPS736xx	400	75	300	1.5, 1.8, 2.5, 3.0 3.3, EEProm[4]	1.2 – 5.5	1.7	5.5	1		✓			✓		✓		EN, BP	No Cap	Reverse Leakage Protection	$0.85
TPS795xx	500	105	265	1.6, 1.8, 2.5, 3.0, 3.3	1.2 – 5.5	2.7	5.5	3					✓				EN, BP	2.2µF C	RF Low Noise, High PSRR	$1.05
REG103	500	115	500	2.5, 2.7, 3.0, 3.3, 5	2.5 – 5.5	2.1	15	2				✓	✓			✓	EN, PG	No Cap	Capacitor Free, DMOS	$2.50
TPS777xx	750	260	85	1.5, 1.8, 2.5, 3.3	1.5 – 5.5	2.7	10	2			✓		✓				/EN,SVS	10µF T	Fast Transient Response	$1.05
TPS725xx	1000	170	75	1.5, 1.6, 1.8, 2.5	1.2 – 5.5	1.8	6	2				✓	✓			✓	EN, SVS	No Cap	V_{IN} Down to 1.8V, Low Noise	$1.10
TPS786xx	1500	390	310	1.8, 2.5, 2.8, 3.0, 3.3	1.2 – 5.5	2.7	5.5	3					✓			✓	EN, BP	1µF C	RF Low Noise, High PSRR	$1.35
UCCx83-x	3000	400	400	3.3, 5	1.2 – 8.5	1.8	9	2.5						✓		✓	EN	22µF T	Reverse Leakage Protection	$2.57
UCx85-x	5000	350	8mA	1.5, 2.1, 2.5	1.2 – 6	1.7	7.5	1						✓		✓		100µF T	Fast LDO with Reverse Leak	$3.00
Negative Voltage, Single-Output Devices																				
TPS723xx	200	280	130	–2.5	–1.2 to –9	–10	–2.7	2		✓							EN, BP	2.2µF C	Low Noise, High PSRR	$1.05
UCC384-x	500	150	200	–12.0, –5.0	–1.25 to –1	–15	–3.5	3				✓					/EN	4.7µF T	Duty Cycled Short	$1.86

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]PG = Power Good; EN = Active High Enable; /EN = Active Low Enable; SVS Supply Voltage Supervisor; BP = Bypass Pin for noise reduction capacitor. [3]C = Ceramic; T = Tantalum; No Cap = Capacitor Free LDO. [4]TI's TPS73xxx series of LDOs are EEProm programmable at the factory, allowing production of custom fixed voltages (as well as custom current limits), minimum quantities apply. Please contact TI.

Dual-Output LDOs Selection Guide

Device	I_{O1} (mA)	I_{O2} (mA)	V_{DO1} at I_{O1} (mV)	V_{DO2} at I_{O2} (mV)	I_Q at I_O (µA)	Output Options: Voltage (V)	Output Options: Adj.	Accuracy (%)	PWP Package	Min V_O	Max V_O	Features: /EN	PG	SVS	Seq	Low Noise	Min V_{IN}	Max V_{IN}	CO[2]	Description	Price[1]
TPS707xx	250	150	83	—	95	3.3/2.5, 3.3/1.8, 3.3/1.5, 3.3/1.2	✓	2	✓	1.2	5	✓	✓	✓	✓	✓	2.7	5.5	10µF T	Dual-Output LDO with Sequencing	$1.20
TPS708xx	250	150	83	—	95	3.3/2.5, 3.3/1.8, 3.3/1.5, 3.3/1.2	✓	2	✓	1.2	5	✓	✓	✓		✓	2.7	5.5	10µF T	Dual-Output LDO with Independent Enable	$1.20
TPS701xx	500	250	170	—	95	3.3/2.5, 3.3/1.8, 3.3/1.5, 3.3/1.2	✓	2	✓	1.2	5	✓	✓	✓	✓	✓	2.7	5.5	10µF T	Dual-Output LDO with Sequencing	$1.50
TPS702xx	500	250	170	—	95	3.3/2.5, 3.3/1.8, 3.3/1.5, 3.3/1.2	✓	2	✓	1.2	5	✓	✓	✓		✓	2.7	5.5	10µF T	Dual-Output LDO with Independent Enable	$1.50
TPS767D3xx	1000	1000	230	—	170	3.3/2.5 3.3/1.8	✓	2	✓	1.2	5	✓		✓			2.7	10	10µF T	Dual-Output FAST LDO with Integrated SVS	$2.00
TPPM0110	1500	300	1000	2500	1000	3.3/1.8		2		1.8	3.3						4.7	5.3	100µF T	Outputs Track within 2V	$1.60
TPPM0111	1500	300	1000	2800	1000	3.3/1.5		2		1.5	3.3						4.7	5.3	100µF T	Outputs Track within 2V	$1.60
TPS703xx	2000	1000	160	—	185	3.3/2.5, 3.3/1.8, 3.3/1.5, 3.3/1.2	✓	2	✓	1.2	5	✓	✓	✓	✓	✓	2.7	5.5	22µF T	Dual-Output LDO with Sequencing	$2.35
TPS704xx	2000	1000	160	—	185	3.3/2.5, 3.3/1.8, 3.3/1.5, 3.3/1.2	✓	2	✓	1.2	5	✓	✓	✓		✓	2.7	5.5	22µF T	Dual-Output LDO with Independent Enable	$2.35

[1]Suggested resale price in U.S. dollars in quantities of 1,000. [2]T = Tanalum.

Plug-In Power Solutions Selection Guide

Device	Input Bus Voltage (V)	Description	P_{OUT} or I_{OUT}	Isolated Outputs	V_O Range (V)	V_O Adjustable	Price[1]
Non-Isolated Single Positive Output							
PTH03010W	3.3	3.3V Input 15A POL with Auto-Track™ Sequencing	15A	No	0.8 to 2.5	Yes	$11.60
PTH03020W	3.3	3.3V Input 22A POL with Auto-Track Sequencing	22A	No	0.8 to 2.5	Yes	$18.15
PTH03030W	3.3	3.3V Input 30A POL with Auto-Track Sequencing	30A	No	0.8 to 2.5	Yes	$25.00
PTH03050W	3.3	3.3V Input 6A POL with Auto-Track Sequencing	6A	No	0.8 to 2.5	Yes	$6.90
PTH03060W	3.3	3.3V Input 10A POL with Auto-Track Sequencing	10A	No	0.7 to 2.5	Yes	$9.80
PTH04000W	3.3/5	3V to 5.5V Input 3A POL with Auto-Track Sequencing	3A	No	0.9 to 3.6	Yes	$4.50
PTH04040W	3.3/5	3V to 5.5V Input 60A POL with Auto-Track Sequencing	60A	No	0.8 to 3.6	Yes	$35.00
PTH05010W	5	5V Input 15A POL with Auto-Track Sequencing	15A	No	0.8 to 3.6	Yes	$11.60
PTH05020W	5	5V Input 22A POL with Auto-Track Sequencing	22A	No	0.8 to 3.6	Yes	$18.15
PTH05030W	5	5V Input 30A POL with Auto-Track Sequencing	30A	No	0.8 to 3.6	Yes	$25.00
PTH05050W	5	5V Input 6A POL with Auto-Track Sequencing	6A	No	0.8 to 3.6	Yes	$6.90
PTH05060W	5	5V Input 10A POL with Auto-Track Sequencing	10A	No	0.8 to 3.6	Yes	$9.80
PTH05T210W	5	5V Input, 30A T2 2nd Gen PTH POL with *TurboTrans*™	30A	No	0.7 to 3.6	Yes	$18.00
PTH08080W	5/12	5V to 18V Input, 2.25A POL	2.25A	No	0.9 to 5.5	Yes	$4.28
PTH08T210W	12	5.5 to 14V Input, 30A T2 2nd Gen PTH POL with *TurboTrans*	30A	No	0.7 to 3.6	Yes	$18.00
PTH08T220W	5/12	4.5 to 14V Input, 16A T2 2nd Gen PTH POL with *TurboTrans*	16A	No	0.7 to 5.5	Yes	$12.60
PTH08T230W	5/12	4.5 to 14V Input, 6A T2 2nd Gen PTH POL with *TurboTrans*	6A	No	0.7 to 5.5	Yes	$7.90
PTH08T240W	5/12	4.5 to 14V Input, 10A T2 2nd Gen PTH POL with *TurboTrans*	10A	No	0.7 to 5.5	Yes	$10.80
PTH12010L/W	12	12V Input 12A POL with Auto-Track Sequencing	12A	No	0.8 to 1.8/1.2 to 5.5	Yes	$11.60
PTH12020L/W	12	12V Input 18A POL with Auto-Track Sequencing	18A	No	0.8 to 1.8/1.2 to 5.5	Yes	$18.15
PTH12030L/W	12	12V Input 26A POL with Auto-Track Sequencing	26A	No	0.8 to 1.8/1.2 to 5.5	Yes	$25.00
PTH12040W	12	12V Input 50A POL with Auto-Track Sequencing	50A	No	0.8 to 5.5	Yes	$35.00
PTH12050L/W	12	12V Input 6A POL with Auto-Track Sequencing	6A	No	0.8 to 1.8/1.2 to 5.5	Yes	$6.90
PTH12060L/W	12	12V Input 10A POL with Auto-Track Sequencing	10A	No	0.8 to 1.8/1.2 to 5.5	Yes	$9.80
PTN04050C	3.3/5	3V/5V Input, 12W Output Step-Up (Boost) ISR	12W	No	5 to 15	Yes	$8.00
PTN78000W/H	V_O + 2 to 36	Wide-Input, Wide-Output 1.5A Positive Step-Down ISR	1.5A	No	2.5 to 12/12 to 22	Yes	$8.00
PTN78060W/H	V_O + 2 to 36	Wide-Input, Wide-Output 3A Positive Step-Down ISR	3A	No	2.5 to 12/12 to 22	Yes	$11.00
PTN78020W/H	V_O + 2 to 36	Wide-Input, Wide-Output 6A Positive Step-Down ISR	6A	No	2.5 to 12/12 to 22	Yes	$15.00
Non-Isolated Single Negative Output							
PT6910	3.3/5	3.3V/5V Input 12W Adjustable Plus-to-Minus Voltage Converter	12W	No	–1.2 to –6.5	Yes	$26.25
PTN04050A	3.3/5	3V to 5V Input, 6W Positive to Negative (Buck-Boost) ISR	6 W	No	–3.3 to –15	Yes	$8.00
PTN78000A	7 to 29	Wide-Input, Wide-Output 1.5A Positive to Negative (Buck-Boost) ISR	1.5A	No	–3 to –15	Yes	$8.00
PTN78060A	9 to 29	Wide-Input, Wide-Output 15W Positive to Negative (Buck-Boost) ISR	15W	No	–3 to –15	Yes	$11.00
PTN78020A	9 to 29	Wide-Input, Wide-Output 25W Positive to Negative (Buck-Boost) ISR	25W	No	–3 to –15	Yes	$15.00
Non-Isolated Multiple Output							
PT5060	5	5 to ±12/15V_{OUT} 9W Dual Output Adjustable ISR	9W	No	±8 to ±20	Yes	$10.80
PT6980	12	10A 12V Input Adjustable Dual Output ISR	10A	No	1.3 to 3.6	Yes	$27.40
Isolated Single Output							
DCP01_B	5, 24	1W Unregulated Isolated DC/DC Converter with Sychronization	1W	Yes	5, 12, 15	No	$5.35
DCP02	5, 12, 24	2W Unregulated Isolated DC/DC Converter with Sychronization	2W	Yes	3.3, 5, 7, 9, 12, 15	No	$6.95
DCR01	5, 12, 24	1W Regulated Isolated DC/DC Converter with Sychronization	1W	Yes	3.3, 5	No	$5.95
DCR02	12, 24	2W Regulated Isolated DC/DC Converter with Sychronization	2W	Yes	5	No	$7.30
DCV01	5, 24	1W Unregulated Isolated DC/DC Converter with 1500V Isolation	1W	Yes	5, 12, 15	No	$8.50
PT4140	24	20W, 24V Input Isolated DC/DC Converter	20W	Yes	1.7 to 16.5	Yes	$32.45
PT4240	24	10W, 24V Input Isolated DC/DC Converter	10W	Yes	1.5 to 12	Yes	$26.90
PTB78520W	18 to 60	20A, 18V to 60V Input Isolated POL Converter with Track I/O	65W	Yes	1.8 to 3.6	Yes	$62.00
PTB78560A/B/C	18 to 60	30W, 18V to 60V Input Isolated POL Converter with Track I/O	30W	Yes	3.3, 5, 12	Yes	$25.00
PTMA	48	10W, 48V Input Isolated DC/DC Converter - Industry Std Footprint	10W	Yes	3.3, 5, 12	Yes	$20.00
Isolated Multiple Output							
DCP01_DB	5, 15, 24	1W Unregulated Dual Isolated DC/DC Converter with Sychronization	1W	Yes	±5, ±12, ±15	No	$5.90
DCP02_D	5, 15, 24	2W Unregulated Dual Isolated DC/DC Converter with Sychronization	2W	Yes	±5, ±12, ±15	No	$6.95
DCV01_D	5, 15, 24	1W Unregulated Dual Isolated DC/DC Converter with 1500V Isolation	1W	Yes	±5, ±12, ±15	No	$9.05

[1]*Suggested resale price in U.S. dollars in quantities of 1,000.* *New products are listed in* ***bold red***.

Standard Linear and Logic Selection Guide

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LM258
LM2902K
LM2904
LM318
LM324K
LMV321
LMV324
LMV341
LMV342 (Preview)
LMV344 (Preview)
LMV358
LMV710
LMV711
LMV821
LMV822
LMV824
LMV931
LMV932
LMV934 (Preview)
LMV981
LMV982
LT1013DI
LT1014DI
MC33078
OP27
TL031I
TL032I
TL034I
TL051I
TL052I
TL054I
TL5580I
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TSM104WA
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MAX4594
MAX4595
MAX4596
MAX4597
TS5A23166
TS5A3159

I²C Interface
PCA8550
PCA9306
PCF8574
PCF8574A
PCF8575
PCF8575C
Power Management
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LM337
LM4040
LM4041
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LP2985
MC33063A
MC79L12
MC79L12A
MC79L15
MC79L15A
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TL2843
TL2844
TL2845
TL431B
TL432B
TL497A
TL594
TL750L10
TL750L12
TL751L10
TL751L12
TL780-12
TL780-15
TLV1117
TLVH431B
TLVH432B
UA723
UA7810
UA7812
UA7815
UA7824
UA78L09A
UA78L10A
UA78L12A
UA78M09
UA78M10
UA78M12

RS-232 Interface
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MAX208
MAX211
MAX211E
MAX222
MAX232
MAX3221
MAX3222
MAX3223
MAX3232
MAX3238
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MAX3243
MAX3243E
SN65C1154
SN65C1406
SN65C23243
SN65C3221
SN65C3222
SN65C3223
SN65C3232
SN65C3238
SN65C3243
RS-485 Interface
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SN65176B
SN65ALS176
SN65ALS180

Translation
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SN74AVC16T245
SN74AVC1T45
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SN74AVC24T245
SN74AVC2T45
SN74AVC32T245
SN74AVC4T245
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