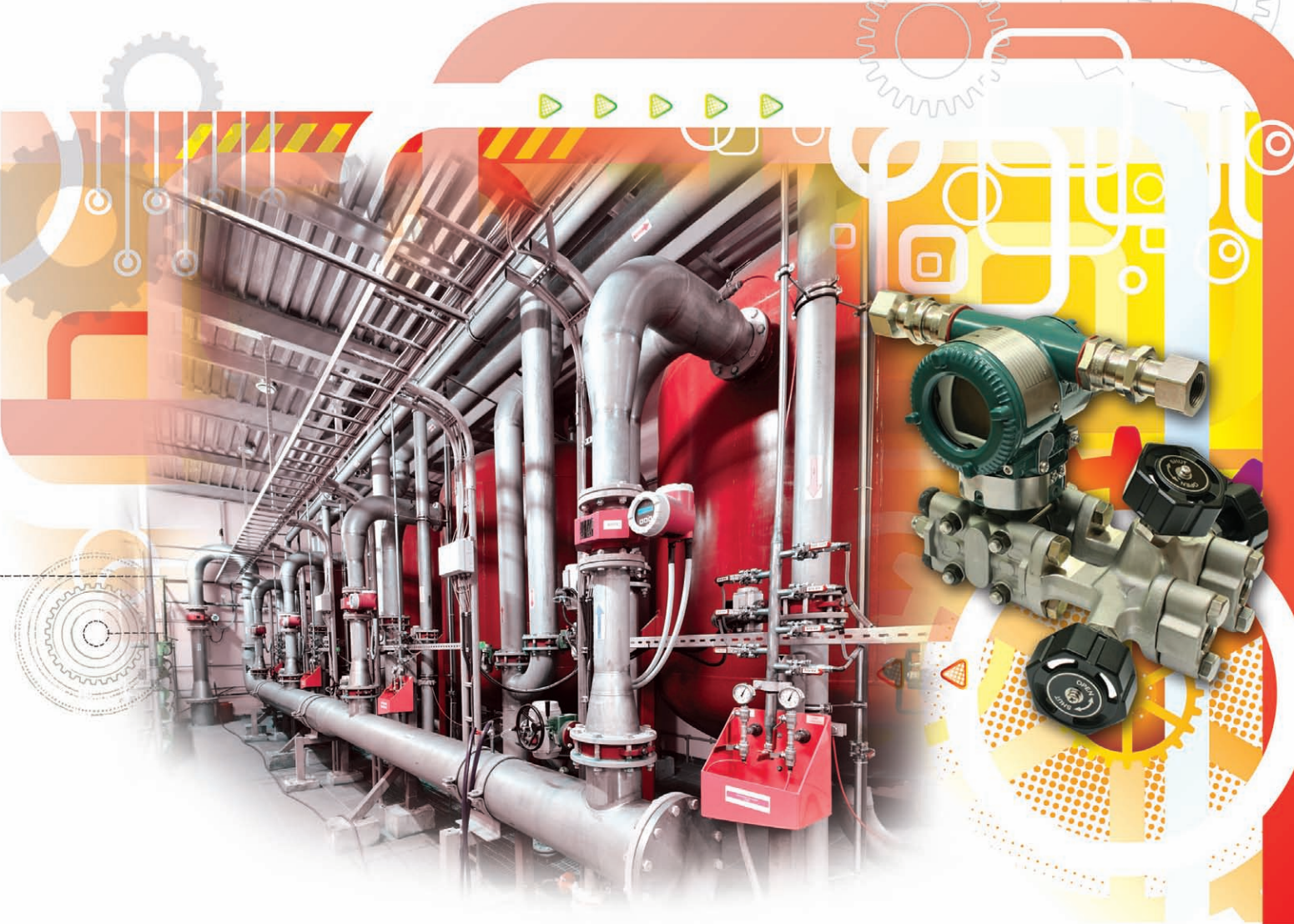


Field Transmitters and Process Instrumentation Solutions Guide



Industrial Automation Solutions



Field Transmitters & Process Instrumentation Solutions Guide

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Introduction

Monitoring and maintaining process variables at the appropriate levels is extremely critical in industrial automation and process control. A sensor in the industrial environment is either continuously or periodically measuring vital parameters such as temperature, pressure, flow, etc. The primary challenge of sensing in industrial environments is conditioning low signal levels in the presence of high noise and high-surge voltage.

Texas Instruments (TI) has a broad portfolio of products catering to industrial sensing, ranging from best-in-class precision amplifiers and data converters to interface products, power products, and high performance microprocessors. TI's cutting-edge semiconductor manufacturing processes provide industrial designers with products that meet the highest standards and that are optimized for industrial environments and extend product life cycles.

TI offers a wide range of Enhanced Products for Industrial systems that must perform in harsh environments.

To learn more, please visit:
www.ti.com/extendedtemp

TI has automotive grade, wide input voltage power management products with features suitable for safety applications.

To learn more, please visit:
www.ti.com/automotive

TI has expanded packaging options with the additional availability to bare die.

To learn more, please visit:
www.ti.com/die

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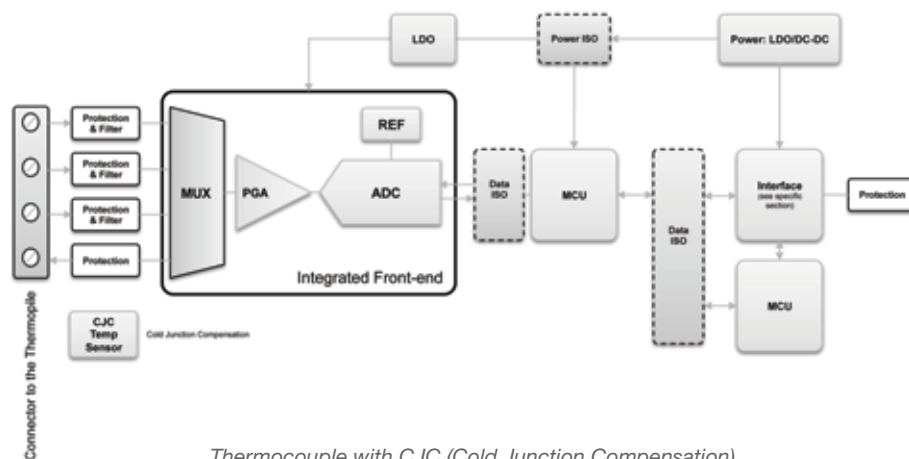
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Sensor Signal Conditioning

Temperature Transmitters

Temperature transmitters, most commonly made by using resistance temperature detectors (RTD) or thermocouples, have a wide range of uses in industrial automation. A constant and linear excitation source is a critical aspect of RTD sensing, while cold junction compensation is the key to a good temperature measurement with thermocouples. TI offers a variety of high integration, high accuracy, and excellent resolution analog front end devices to address these sensors.



Temperature Transmitter Signal Conditioning

Device	Resolution (bits)	Sample Rate (SPS)	Input Channels	Interface	Supply Voltage (V)	Features	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
Delta-Sigma ADCs (Thermocouple)										
ADS1018	12	3300	4	Serial SPI	2 to 5.5	Temp. sensor (0.5°C accurate)	ADS1118EVM	-40 to 125	10VSSOP, 10X2QFN	1.15
ADS1118	16	860	4	Serial SPI	2 to 5.5	Temp. sensor (0.5°C accurate)	ADS1118EVM	-40 to 125	10VSSOP, 10X2QFN	2.30
Delta-Sigma ADCs (RTD and Thermocouples)/ Analog Front Ends (AFE)										
ADS1148	16	2000	7	Serial SPI	2.7 to 5.25	Single cycle settling, GPIOs, True bipolar, Temp. sensor	ADS1148EVM	-40 to 105	28TSSOP, 32VQFN	3.95
ADS1248	24	2000	7	Serial SPI	2.7 to 5.25	Single cycle settling, GPIOs, True bipolar, Temp. sensor	ADS1248EVM-PDK	-40 to 105	28TSSOP	4.95
ADS1120	16	2000	4	Serial SPI	2.3 to 5.5	Single cycle settling, sensor, IDACs	ADS1120EVM	-40 to 125	16TSSOP	3.15
ADS1220	24	2000	4	Serial SPI	2.3 to 5.5	Single cycle settling, sensor, IDACs	ADS1220EVM	-40 to 125	16TSSOP, 16VQFN	3.95
LMP90080/79/78/77	16	214	7/4	Serial SPI	2.85 to 5.5	Continuous background calibration, Current sources	LMP90100EB	-40 to 125	28HTSSOP	2.33
LMP90100/99/98/97	24	214	7/4	Serial SPI	2.85 to 5.5	Continuous background calibration, Current sources	LMP90100EB	-40 to 125	28HTSSOP	2.86

Device	Vs (Min) (V)	Vs (Max) (V)	Number of Channels	GBW (Typ) (MHz)	Slew Rate (Typ) (V/μs)	CMRR (Typ) (dB)	Iq per ch. (Max) (mA)	Offset Voltage (Max) (mV)	Offset Drift (Typ) (μV/°C)	Operating Temp. Range (°C)	Pin/Package	Price*
Amplifiers												
OPA320	1.8	5.5	1	20	10	114	1.75	0.15	1.5	-40 to 125	5SOT-23, 6SOT-23	0.80
OPA188	4	36	1	2	0.8	146	0.51	0.025	0.03	-40 to 125	5SOT-23, 8SOIC, 8VSSOP	0.80
OPA376	2.2	5.5	1	5.5	2	90	0.95	0.005	0.26	-40 to 125	5SC70, 5SOT-23, 8SOIC	0.65
LMP2011	2.7	5	1	3	4	130	1.2	0.06	0.015	-40 to 125	5SOT-23, 8SOIC	0.90

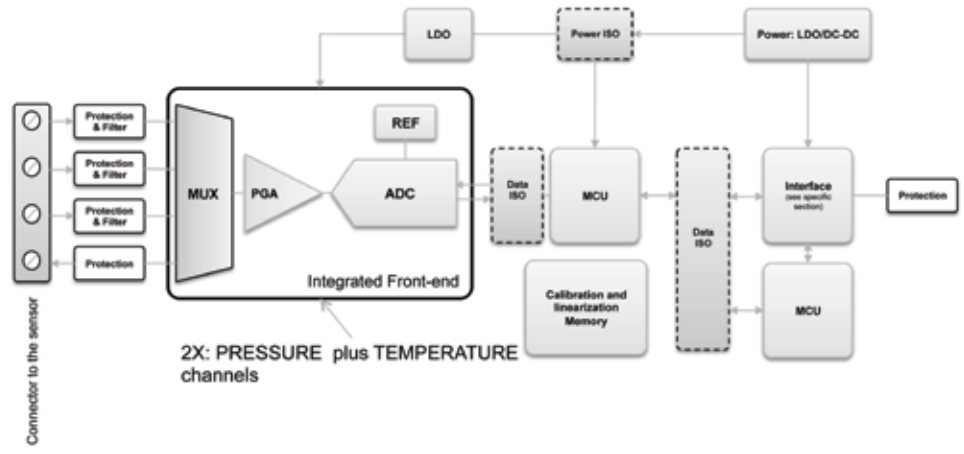
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New products are listed in bold red.

Sensor Signal Conditioning

Pressure Transmitters

Pressure transmitters, most commonly built from strain gauges, are essential in many process control applications such as weight, level, force, or flow. The primary challenges of pressure transmitters are nonlinearity, temperature dependent, a large offset, and a large offset drift. Texas Instruments offers several high precision analog front end devices that address these design challenges.



Pressure Transmitter Signal Conditioning

Device	Vs (Min) (V)	Vs (Max) (V)	GBW (Typ) (MHz)	Features	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
Programmable Analog Signal Conditioners								
PGA281	10	36	6	Zero-drift, input range from 1/8 V/V to 128V/V	PGA281EVM	-40 to 125	16TSSOP	2.55
PGA309	2.7	5.5	2	PGA308 plus temp. compensation	PGA309EVM-USB	-40 to 125	16TSSOP	2.95
PGA400-EP	-5.5	16	—	Sensor signal conditioning w/MCU	PGA400Q1EVM	-40 to 125	36VQFN	4.50
PGA300	-28	33	—	Resistive bridge sensor signal conditioner	—	-40 to 150	36VQFN, 36DSBGA	4.50

Device	Resolution (bits)	Sample Rate (SPS)	Input Channels	Interface	Supply Voltage (V)	Power (Typ) (mW)	50/60Hz Reject	Features	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
Delta-Sigma ADCs/Analog Front Ends (AFE)												
ADS1131	18	80	1	Serial	2.7 to 5.3	5	Yes	Low side bridge switch, Pin control, Input EMI filter	ADS1131REF	-40 to 85	20TSSOP	5.60
ADS1231/2/4	24	80	1/2/4	Serial SPI	2.7 to 5.3	5/4.3/4.3	Yes	Pin control (no registers), offset calibration	ADS1231REF	-40 to 85	16SOIC	2.50
ADS1220	24	2000	4	Serial SPI	2.3 to 5.5	0.4	Yes	Single cycle settling, Temp. sensor	ADS1220EVM	-40 to 125	16TSSOP, 16VQFN	3.95
LMP90080/79/78/77	16	214	7/4	Serial SPI	2.85 to 5.5	—	—	Continuous background calibration, Current sources	LMP90100EB	-40 to 125	28HTSSOP	2.33
LMP90100/99/98/97	24	214	7/4	Serial SPI	2.85 to 5.5	—	—	Continuous background calibration, Current sources	LMP90100EB	-40 to 125	28HTSSOP	2.86

Device	Vs (Min) (V)	Vs (Max) (V)	Number of Channels	GBW (Typ) (MHz)	Slew Rate (Typ) (V/μs)	CMRR (Typ) (dB)	Iq per ch. (Max) (mA)	Offset Voltage (Max) (mV)	Offset Drift (Typ) (μV/°C)	Operating Temp. Range (°C)	Pin/Package	Price*
Amplifiers												
OPA333	1.8	5.5	1	0.35	0.16	130	0.025	0.01	0.02	-40 to 125	5SOT-23, 5SC70, 8SOIC	0.95
OPA180	4	36	1	2	0.8	114	0.525	0.075	0.1	-40 to 125	5SOT-23, 8SOIC, 8VSSOP	0.69
OPA317	1.8	5.5	1	0.3	0.15	108	0.035	0.1	0.05	-40 to 125	5SC70, 5SOT-23, 8SOIC	0.55
INA333	1.8	5.5	1	0.15	0.16	100	0.05	0.025	0.1	-40 to 125	8SON, 8VSSOP	1.80
OPA378	2.2	5.5	1	0.9	0.4	112	0.15	0.05	0.1	-40 to 125	5SC70, 5SOT-23	0.70
LMP2021	2.2	5.5	1	5	2.6	139	1.1	0.005	0.004	-40 to 125	5SOT-23, 8SOIC	1.00

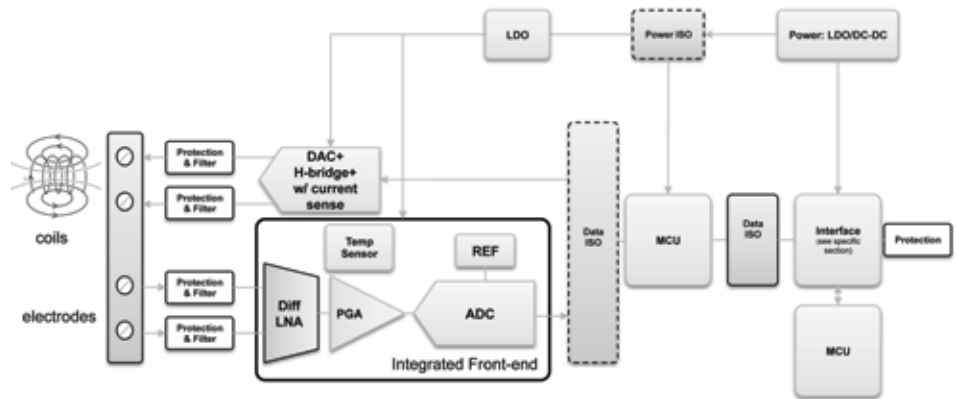
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Sensor Signal Conditioning

Flow Transmitters

Flow meters, consisting of many different architectures such as electromagnetic and Coriolis, are critical measuring instruments used to measure liquid or gas flow in an industrial automation plant. Some of the design challenges for flow meters are low noise, high speed, and temperature compensation. Texas Instruments offers a variety of highly integrated simultaneous sampling or delta-sigma converters to meet your analog front end needs.



Electromagnetic (MID) Flow Transmitter

Flow Transmitter Signal Conditioning

Device	Resolution (bits)	Sample Rate (kSPS)	Input Channels	Interface	Supply Voltage (V)	Power (Typ) (mW)	Input	Supports Daisy Chain	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
SAR ADCs												
ADS7253/7853/8353	12/14/16	1000/1000/700	2	Serial SPI	4.75 to 5.25	45	Single ended and pseudo-differential	No	ADS8353EVM-PDK	-40 to 125	16QFN, 16TSSOP	3.50
ADS7254/7854/8354	12/14/16	1000/1000/700	2	Serial SPI	4.75 to 5.25	45	Differential	No	ADS8354EVM-PDK	-40 to 125	16QFN, 16TSSOP	4.00
ADS8860/2/4/6	16	1000/680/400/100	1	Serial SPI	2.7 to 3.6	5.5/4.2/2.6/0.7	Pseudo-differential	Yes	ADS8860EVM-PDK	-40 to 85	10VSSOP, 10SON	5.00
ADS8861/3/5/7	16	1000/680/400/100	1	Serial SPI	2.7 to 3.6	5.5/4.2/2.6/0.7	Truly-differential	Yes	ADS8861EVM-PDK	-40 to 85	10VSSOP, 10SON	5.50
ADS8881/3/5/7	18	1000/680/400/100	1	Serial SPI	2.7 to 3.6	5.5/4.2/2.6/0.7	Truly-differential	Yes	ADS8881EVM-PDK	-40 to 85	10VSSOP, 10SON	7.95

Device	Resolution (bits)	Sample Rate (kSPS)	Input Channels	Interface	Supply Voltage (V)	Power (Typ) (mW)	SNR (dB)	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
Delta-Sigma ADCs											
ADS1255	24	30	2	Serial SPI	4.75 to 5.25	38	—	—	-40 to 85	20SSOP	6.96
ADS1247	24	2	3	Serial SPI	2.7 to 5.25	2.3	—	ADS1247EVM-PDK	-40 to 105	20TSSOP	5.99
ADS131E04/6/8	24	64	4/6/8	Serial SPI	2.7 to 5.25	8/12/16	107	ADS131E08EVM-PDK	-40 to 105	64TQFP	3.95
ADS1274	24	144	4	Serial SPI	5	275	111	ADS1274EVM-PDK	-40 to 125	64HTQFP	14.65
ADS7040/7041/7042/7043/7044	8/10/12/12/12	1000	1	Serial SPI	1.8 to 3.6	0.555/0.6/0.69/0.78/0.9	49/61/70/70/71	ADS7042EVM-PDK	-40 to 125	8QFN, 8VSSOP	2.10

Device	Vs (Min) (V)	Vs (Max) (V)	Number of Channels	GBW (Typ) (MHz)	Slew Rate (Typ) (V/μs)	CMRR (Typ) (dB)	Iq per ch. (Max) (mA)	Offset Voltage (Max) (mV)	Offset Drift (Typ) (μV/°C)	Operating Temp. Range (°C)	Pin/Package	Price*
Amplifiers												
OPA333	1.8	5.5	1	0.35	0.16	130	0.025	0.01	0.02	-40 to 125	5SOT-23, 5SC70, 8SOIC	0.95
INA826	2.7	36	1	1	1	115	0.25	0.15	2	-40 to 125	8SOIC, 8SON, 8VSSOP	1.10
THS4532	2.5	5.5	1	36	220	116	0.25	0.4	3	-40 to 125	16TSSOP/10QFN, 8SOIC, 8VSSOP	1.45
OPA320	1.8	5.5	1	20	10	114	1.75	0.15	1.5	-40 to 125	5SOT-23, 6SOT-23	0.80
OPA140	4.5	36	1	11	20	140	2	0.12	0.35	-40 to 125	8SOT-23, 8SOIC, 8VSSOP	1.55

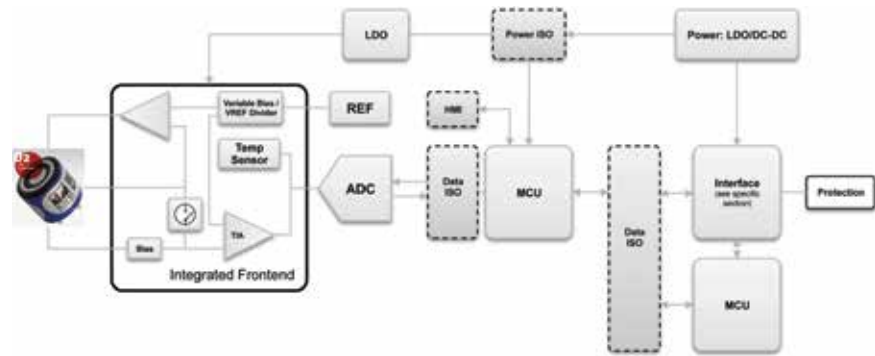
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Sensor Signal Conditioning

Process Analytics

Gas sensing is a critical component of monitoring safety and process performance in a multitude of applications ranging from building automation, oil and gas process industries, portable toxic gas detectors, etc. One common mechanism used to measure gas is a 3 lead electrochemical cell. Texas Instruments offers several analog front end devices that support a wide variety of gases including CO₂, H₂S, CO, and O₂.



Gas Detection

Process Analytics Signal Conditioning

Device	Gas Sensitivity Range	Input Channels	Interface	Supply Voltage (V)	Application	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
Analog Front Ends (AFE)									
LMP91000/2	0.5 to 9500 nA/ppm	1	Serial I ² C	2.7 to 5.25	Configurable AFE potentiostat for electrochemical gas sensing	LMP91000EVM	-40 to 85	14WS0N	1.80
LMP91050/1	167 to 7986 V/V programmable gain	1/2	Serial SPI	2.7 to 5.5	Configurable AFE for nondispersive infrared (NDIR) sensing	LMP90150SDEVAL	-40 to 85	10VSSOP/14TSSOP	1.25

Device	Resolution (bits)	Sample Rate (kSPS)	Input Channels	Interface	Supply Voltage (V)	Power (Typ) (mW)	Features	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
Delta-Sigma ADCs											
ADS1118/15	16	0.86	4	Serial SPI/ Serial I ² C	2 to 5.5	0.3	Temp. sensor	ADS1115EVM-PDK	-40 to 125	10VSSOP, 10X2QFN	2.30
ADS1220	24	2	4	Serial SPI	2.3 to 5.5	0.4	Single cycle settling, temp. sensor; iDACs	ADS1220EVM	-40 to 125	16TSSOP, 16VQFN	3.95
ADS1259	24	14.4	1	Serial SPI	5	13	Single cycle settling	ADS1259EVM-PDK	-40 to 105	20TSSOP	5.60

Device	V _s (Min) (V)	V _s (Max) (V)	I _b (Max) (pA)	Number of Channels	GBW (Typ) (MHz)	Slew Rate (Typ) (V/μs)	CMRR (Typ) (dB)	I _q per ch. (Max) (mA)	Offset Voltage (Max) (mV)	Offset Drift (Typ) (μV/°C)	Operating Temp. Range (°C)	Pin/Package	Price*
Amplifiers													
OPA314	1.8	5.5	10	1	3	1.5	96	0.21	0.5	1	-40 to 125	5SC70, 5SOT-23	0.30
OPA376	2.2	5.5	10	1	5.5	2	90	0.95	0.025	0.26	-40 to 125	5SC70, 5SOT-23	0.65
OPA140	4.5	36	10	1	11	20	140	2	0.12	0.35	-40 to 125	8SOIC, 5SOT-23, 8VSSOP	1.55
OPA320	1.8	5.5	0.9	1	20	10	114	1.75	0.15	1.5	-40 to 125	5SOT-23, 6SOT-23	0.80
LMP2011	2.7	5	5	1	3	4	130	1.2	0.06	0.015	-40 to 125	5SOT-23, 8SOIC	0.90

Integrated Solution (Humidity Sensor)

Device	Size (mm)	Package	V _{DD} (V)	Resolution (Max) (%RH)	I _{supply} @ 1/s (Hum + Temp) 11-bit res (μA)	Accuracy (%RH)	Temp Acc (°C)	Operating Range (%RH)	Interface	Operating Range (°C)	Functional Range (°C)
Integrated Sensing Solution											
HDC1000	1.59 x 2.04	WCSP-8	3 + 5	140-bit	1.2	±3	±0.2	0 to 100	I ² C	-20 to 85	-40 to 125

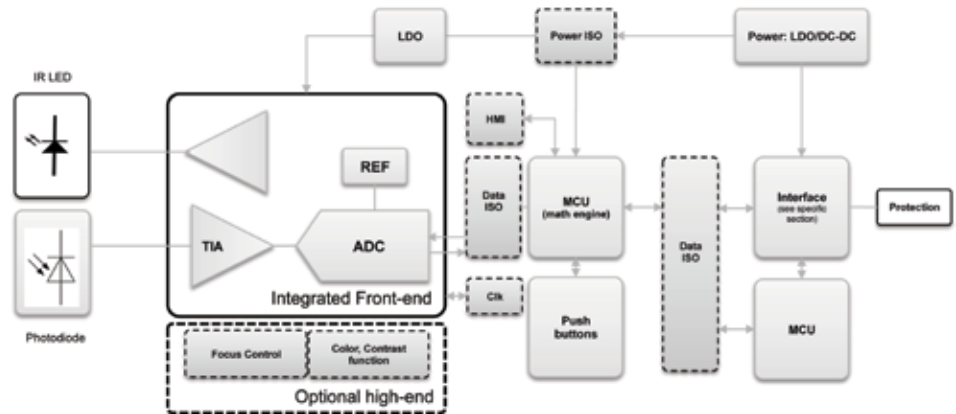
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Sensor Signal Conditioning

Photoelectric Sensors

Photoelectric sensors are used in many industrial applications including detecting objects, distinguishing changes in a surface, and acting as an alarm for abnormalities in a process control environment. The primary design challenges are Transimpedance gain, bandwidth, and noise. Texas Instruments offers a variety of high precision Transimpedance amplifiers that address these design challenges.



Learn more about the WEBENCH® Photodiode Sensor Designer at: www.ti.com/WEBENCH.

Optical (Time of Flight ToF) Sensor

Photoelectric Sensor Signal Conditioning

Device	Resolution (bits)	Sample Rate (kSPS)	Input Channels	Interface	Supply Voltage (V)	Power (Typ) (mW)	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
SAR ADCs										
ADC122S101	12	1000	2	Serial SPI, QSPI, Serial I/O	2.7 to 5.25	4.3	SP1202S03RB-PCB	-40 to 85	8VSSOP	1.94
ADS7253/7853/8353	12/14/16	1000/1000/700	2	Serial SPI	4.75 to 5.25	45	ADS8353EVM-PDK	-40 to 125	16QFN, 16TSSOP	3.50
ADS7254/7854/8354	12/14/16	1000/1000/700	2	Serial SPI	4.75 to 5.25	45	ADS8354EVM-PDK	-40 to 125	16QFN, 16TSSOP	4.00
ADS7945	14	2000	2	Serial SPI	2.7 to 5.5	10.5	ADS7945EVM-PDK	-40 to 85	16WQFN	3.95
ADS8881/3/5/7	18	1000/680/400/100	1	Serial SPI	2.7 to 3.6	5.5/4.2/2.6/0.7	ADS8881EVM-PDK	-40 to 85	10VSSOP, 10SON	7.95

Device	Resolution (bits)	Sample Rate (kSPS)	Input Channels	Interface	Supply Voltage (V)	Power (Typ) (mW)	SNR (dB)	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
Delta-Sigma ADCs											
ADS7040/7041/7042/7043/7044	8/10/12/12/12	1000	1	Serial SPI	1.8 to 3.6	0.555/0.6/0.69/0.78/0.9	49/61/70/70/71	ADS7042EVM-PDK	-40 to 125	8QFN, 8VSSOP	2.10

Device	Vs (Min) (V)	Vs (Max) (V)	Offset Voltage @ 25°C (Max) (mV)	Bias Current (Max) (pA)	GBW (Typ) (MHz)	Offset Drift (Typ) (µV/°C)	Slew Rate (Typ) (V/µs)	Iq per ch. (Max) (mA)	Operating Temp. Range (°C)	Pin/Package	Price*
Amplifiers											
LMP7721	1.8	5.5	0.15	0.02	17	1.5	10.5	1.7	-40 to 125	8SOIC	4.70
LMV791	1.8	5	1.35	1	17	1	9.5	1.75	-40 to 125	6SOT	0.60
LMV861	2.7	5.5	1	0.1	31	0.7	18	2.84	-40 to 125	5SC70	0.65
LMV793	1.8	5	1.65	0.1	88	-1	24	1.15	-40 to 125	5SOT-23, 8SOIC	0.45
OPA320	1.8	5.5	0.15	0.2	20	1.5	10	1.45	-40 to 125	5SOT-23, 6SOT-23	0.80
OPA657	8	12	2.6	2 (Typ)	1600	12	700	16.3	-40 to 85	5SOT-23, 8SOIC	7.14
OPA381	2.7	5.5	0.025	3	18	0.03	12	1	-40 to 125	8SON, 8VSSOP	0.75
OPA314	1.8	5.5	2.5	10	3	1	1.5	0.21	-40 to 125	5SC70, 5SOT-23	0.30
LMV601/2/4	2.7	5.5	4	200	1	1.7	1	0.17	-40 to 125	6SC70/8SOIC/14SOIC	0.20
OPA847	10	12	0.1	—	3900	1.5	950	18.9	-40 to 85	8SOIC, 6SOT-23	2.00
OPA140 (High voltage)	4.5	36	0.12	10	11	0.35	20	2	-40 to 85	8SOIC, 5SOT-23, 8VSSOP	1.55

Device	Vs (Min) (V)	Vs (Max) (V)	Iq (Typ) (µA)	IR Rejection (%)	Human Eye Response	Interface	Auto Ranging	Lux Range (Nom) (k)	Operating Temp. Range (°C)	Pin/Package	Price*
Integrated Sensing Solution											
OPT3001	1.6	3.6	2	99	Yes	I ² C	Yes	0.01 to 83	-40 to 85	USON (6)	—

*Quantities of 1,000 begin at this suggested resale price in U.S. dollars.

New products are listed in bold red. Preview products are listed in bold teal

Sensor Signal Conditioning & Integrated Sensing Solutions

Analog Switches

Device	Configuration	r _{on} (Typ) (ohms)	r _{on} Flatness (Typ) (ohms)	v ₊ (v) min	v ₊ (v) max	HBM ESD Protection (kV)	ON Time (Typ) (ns)	OFF Time (Typ) (ns)	Operating Temp. Range (°C)	Pin/Package	Price*
TS5A3166	SPST	0.9	0.15	1.65	5.5	2	4.5	9	-40 to 85	5SC70, 5SOT-23, 5DSBGA	0.22
TS5A3357	SP3T	2.5	6	1.65	5.5	2	6.5	3.7	-40 to 85	8US8, 8WCSP	0.59
TS5A4596	SPST	8	1.5	2.7	5.5	2	12	9	-40 to 85	5SC70, SOT-23	0.20

Current Shunt Monitors

Device	V _s (Min) (V)	V _s (Max) (V)	I _q (Max) (mA)	CMRR (Min) (dB)	Common Mode Range	Offset Voltage (Max) (mV)	Offset Drift (Typ) (µV/°C)	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
INA226	2.7	5.5	0.33	126	0 to 36	0.01	0.02	INA226EVM	-40 to 125	10VSSOP	1.40
INA282	2.7	18	0.9	120	-14 to 80	0.07	0.3	INA282-286EVM	-40 to 125	8SOIC	1.25
LMP92064	4.5	5.5	—	110	-0.2 to 2	0.06	0.28	LMP92064EVM	-40 to 105	16WSOON	1.99

Temperature Sensor ICs

Device	Type	V _s (Min) (V)	V _s (Max) (V)	Temp. Range (°C)	Local Sensor Accuracy (Max) (± °C)	Sensor Gain (mV/°C)	Interface	Feature	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
ADS1018	ADC	2	5.5	-40 to 125	1	—	SPI	PGA, ADC	ADS1118EVM	-40 to 125	10VSSOP, 10X2QFN	1.15
LMT87	Analog	2.7	5.5	-50 to 150	2.7	-13.6	—	Thermistor alternative	LMT84-7EVM	-50 to 150	5SC70	0.20
LM57	Switch	2.4	5.5	-50 to 150	1.5	-5.16 to 12.92	—	Temp. sensor and switch	LM57B10EB	-50 to 150	8WSOON	0.65
TMP102	Digital	2.7	5.5	-25 to 85	2	—	I ² C, SMBus	Fault queue	TMP102EVM	-40 to 125	6SOT	0.60

*Quantities of 1,000 begin at this suggested resale price in U.S. dollars.

New products are listed in bold red.

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Sensor Signal Conditioning & Integrated Sensing Solutions

Inductive Sensing

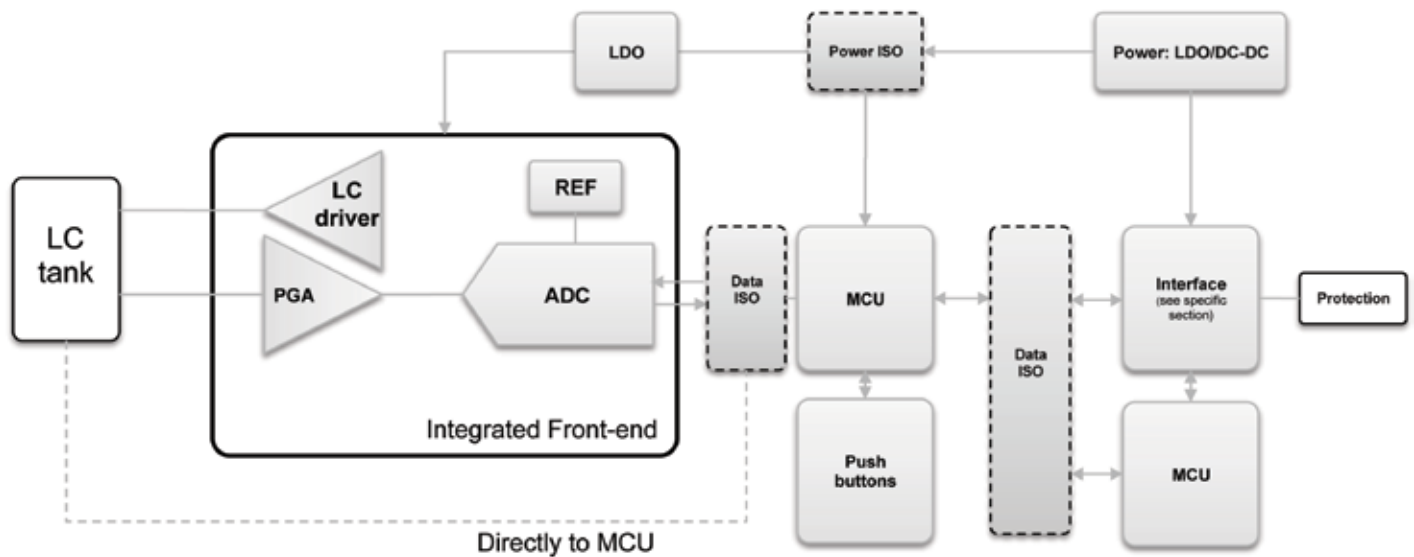
Inductive Sensing

Inductive Sensing is a contact-less, short-range sensing technology that enables low-cost, high-resolution sensing of conductive targets in the presence of dust, dirt, oil, and moisture, making it extremely reliable in hostile environments. Using a coil which can be created on a PCB as a sensing element, the LDC1000 enables ultra-low cost system solutions.

Inductive sensing technology enables precise measurement of linear/angular position, displacement, motion, compression, vibration, metal composition, and many other applications in markets including automotive, consumer, computer, industrial, medical, and communications. Inductive sensing offers better performance and reliability at lower cost than other, competitive solutions.

Key Features

- Gate driver with 8-60 V supply voltage Magnet-Free Operation
- Sub-Micron Precision
- Adjustable Sensing Range (via Coil Design)
- Lower System Cost
- Remote Sensor Placement (Decoupling the LDC from Harsh Environments)
- High Durability (by Virtue of Contact-Less Operation)
- Insensitivity to Environmental Interference (such as Dirt, Dust, Water, Oil)



Inductive Displacement Sensor

Inductive Sensing

Device	L Resolution (bits)	RP Resolution (bits)	Sensor Frequency Range	Input Channels	Interface	Supply Voltage (V)	Supply Current (Active) (mA)	Supply Current (Sleep) (µA)	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
LDC1000	24	16	5kHz – 5MHz	1	SPI	5	1.7 (Without LC tank)	250	LDC1000EVM	–40 to 125	16WSON	2.95
LDC1041	24	8	5kHz – 5MHz	1	SPI	5	1.7 (Without LC tank)	250	LDC1041EVM	–40 to 125	16WSON	2.50
LDC1051	—	8	5kHz – 5MHz	1	SPI	5	1.7 (Without LC tank)	250	LDC1051EVM	–40 to 125	16WSON	1.92
LMP91300	—	16	5kHz – 5MHz	1	SWIF	6.5 to 40	3	—	LMP91300EVM (Order through product line)	–40 to 125	24WQFN, 20DSBGA	2.12

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

New products are listed in bold red.

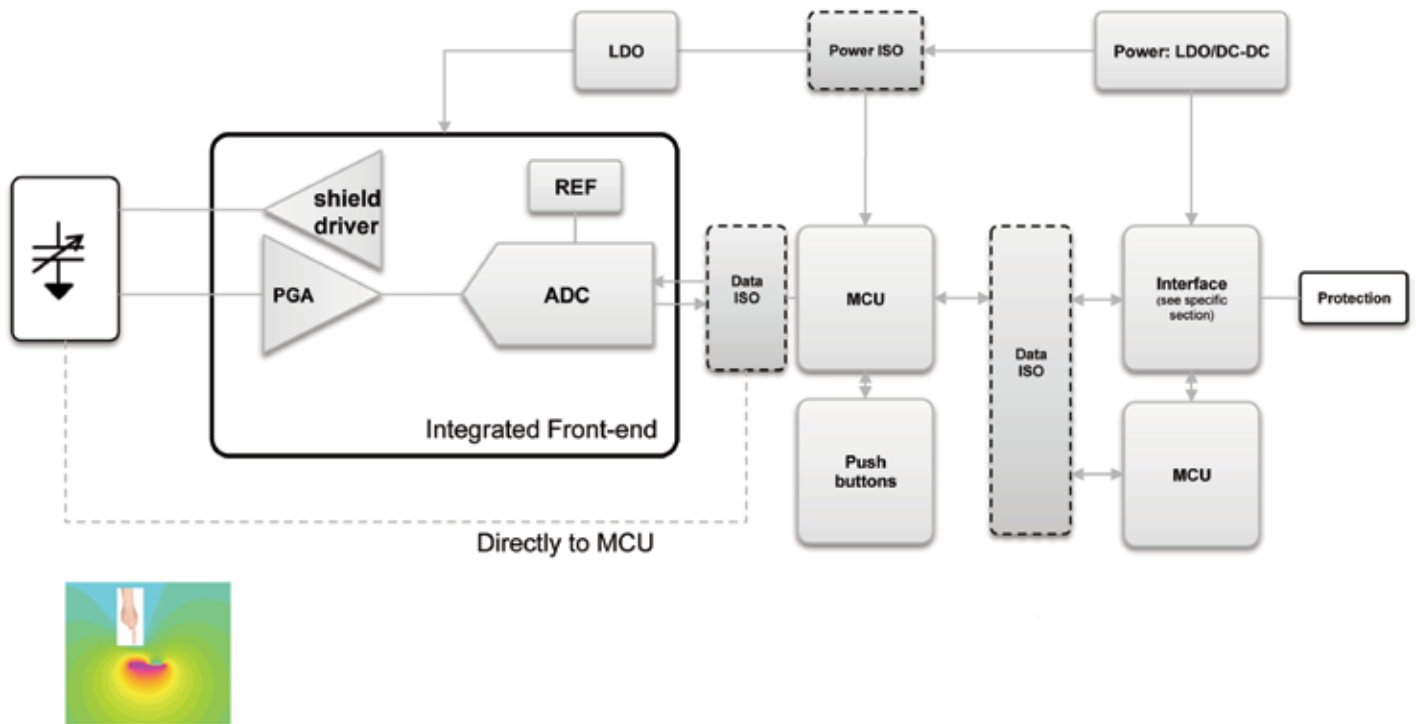
Sensor Signal Conditioning & Integrated Sensing Solutions

Capacitive Sensing

Capacitive Sensing

Capacitive sensing with grounded capacitor sensors is a very low-power, low-cost, high-resolution contactless sensing technique that can be applied to a variety of applications ranging from proximity detection and gesture sensing to

material analysis and remote liquid level sensing. The sensor in a capacitive sensing system is any metal or conductor, allowing for low cost and highly flexible system design.



Capacitive Displacement Sensor

Capacitive Sensing

Device	Description	# Input Channels	Input Range (pF)	Input Common Mode (pF)	Resolution (fF)	Shield Drive Capability (pF)	Supply Voltage (V)	Supply Current (Active) (uA)	Standby Current (uA)	Interface	Programmable Sampling Rate (°C)	Operating Temperature Range (°C)	Pin/Package	Price*
FDC1004	4-Channel capacitance-to-digital converter for capacitive sensing solutions	4	±15	100	0.5	400	3.3	750	29	I ² C	100/200/400	-40 to 85	10-pin WSON	2.50

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

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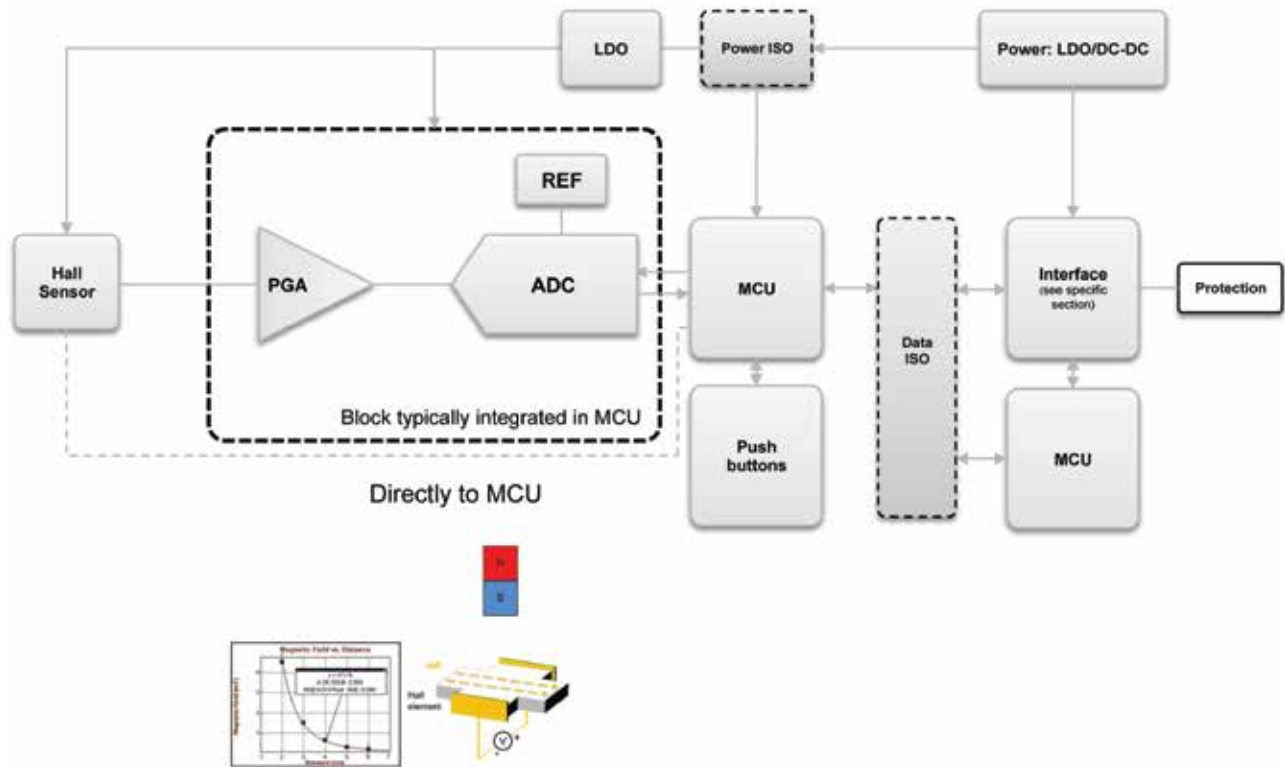
Sensor Signal Conditioning & Integrated Sensing Solutions

Hall Sensors and Z-Domain Sensing

DRV5000 Hall Effect Sensors

The Hall effect is a sensing technology that detects and can measure the strength of the magnetic field as an indicator of distance or position without physical contact. Hall effect sensors are commonly used in detecting position, speed, or acceleration of an object by sensing the magnetic field generated by the object.

Modern day silicon-based Hall effect sensors for commutation in sensored-brushless DC motors as well as object recognition, index counting, open and close door applications and more in a wide range of industrial and automotive applications. TI's DRV5000 Hall sensors are rugged and fully-protected with digital latch, digital switch, and analog bipolar outputs to suit a diverse range of applications.



Magnetic Hall Effect Displacement Sensor

Hall Sensors

Device	Description	Supply Voltage (V _{CC}) (Min)(V)	Supply Voltage (V _{CC}) (Max)(V)	Output	Type	Operating Temperature Range (°C)	Package	Price*
DRV5013	2.5V to 38V Digital latch hall effect sensor	2.5	38	Open drain	Latch	-40 to 125	SOT-23, T0-92	0.26
DRV5023	2.5V to 38V Digital switch hall effect sensor	2.5	38	Open drain	Switch	-40 to 125	SOT-23, T0-92	0.26
DRV5033	2.5V to 38V Digital omnipolar-switch hall effect sensor	2.5	38	Open drain	Omnipolar switch	-40 to 125	SOT-23, T0-92	0.26
DRV5053	2.5V to 38V Analog bipolar hall effect sensor	2.5	38	0.2V to 1.8V	Analog bipolar	-40 to 125	SOT-23, T0-92	0.31

Z-Domain Sensing

Device	ADC Resolution	DAC Resolution	Sample Rate (SPS)	Channels	Control Interface	Digital Audio Interface	Additional Features	Supply Voltage (V)	EVM	Operational Temp Range (°C)	Pin/Package	Price*
TLV320AIC3262	24 bits	24 bits	192k	2 ADC/2 DAC	I ² C, SPI	I2S, TDM, DSP, L&R, PCM	MiniDSP (processing engine)	1.8, 3.3	TLV320AIC3262EVM-U	-40 to 85	81DSBGA	4.95

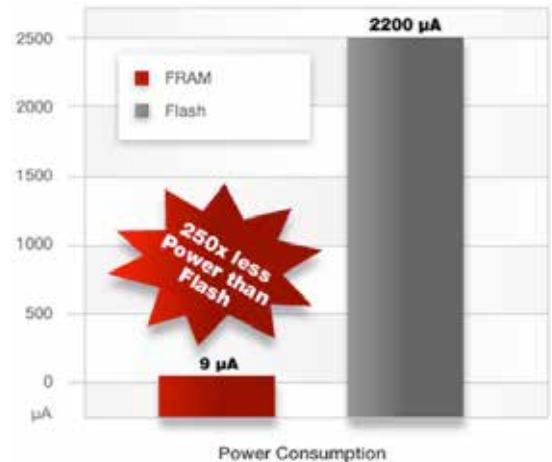
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Embedded Processing

Microcontrollers and processors from Texas Instruments offer a broad range of performance and power consumption options. Whether your system needs the MSP430 MCU with ultra-low power consumption; the C5000™ DSP platform with superior signal processing, an FFT accelerator core, and low power architecture; the Sitara™ AM335x ARM® Cortex™-A8 family with integrated multi-protocol industrial communications support to connect various kinds of sensors in real-time for better automation; TI is tailored to meet your design challenges.

The MSP430™ MCU Value Line brings 16-bit performance, up to 16 MHz operation, integrated intelligent peripherals, and ultra-low power at low-cost 8-bit MCU prices to cost sensitive applications. Learn more at www.ti.com/430value.



MSP430 Ultra Low Power MCU

Device	SAR ADC	Sigma Delta ADC	Sample Rate (Ksps)	NVM Memory (KB)	SRAM (KB)	Op Amp	PWM	Comparator	Temp. Sensor	Operating Temp. Range (°C)	Pin/Package	Price*
Integrated MCU Solutions												
MSP430F2274	10-bit	—	200	32 (FLASH)	1	2	Yes	Yes	Yes	−40 to 85	38TSSOP, 40VQFN, 49DSBGA	2.50
MSP430i2040	—	24 bit	2	16 (FLASH)	—	—	Yes	—	Yes	−40 to 85	28TSSOP, 32VQFN	1.70
MSP430FR5739	10-bit	—	200	16(FRAM)	1	—	Yes	Yes	Yes	−40 to 85	38TSSOP, 40VQFN	2.45
MSP430FR5969	12-bit	—	200	64(FRAM)	2	—	Yes	Yes	Yes	−40 to 85	48VQFN	2.35
MSP430F6736	10-bit	24 bit	200	128(FLASH)	8	—	Yes	—	Yes	−40 to 85	100LQFP, 80LQFP	3.25
MSP430FR6989	12-bit	—	200	128(FRAM)	2	—	Yes	Yes	Yes	−40 to 85	100LQFP, 80LQFP	4.50
Integrated MCU Flow Metering Solutions												
MSP430FR6989	12-bit	—	200	128(FRAM)	2	—	Yes	Yes	Yes	−40 to 85	100LQFP, 80LQFP	4.50
MSP430FW429	—	—	—	64(FLASH)	2	—	Yes	Yes	—	−40 to 85	64LQFP	3.55

Device	Sigma Delta ADC	NVM Memory (KB)	SRAM (KB)	Timers	Brown Out	Watch-dog	RTC	USCI_A	USCI_B	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
MSP430i2040	4, 24 bit ΣΔ ADC with PGA	32KB (Flash)	2	2	Yes	Yes	Yes	1	1	EVM430-I2040S	−40 to 85	28TSSOP, 32VQFN	1.70

ARM Processors

Device	ARM CPU	Frequency (MHz) (Max)	ARM MIPS (Max)	Interfaces Supported	IO Supply (V)	EVM	Pin/Package	Price*
TM4C1231C3PM	ARM Cortex-M4	80	100 DMIPS	—	1.2, 3.3	EK-TM4C123GXL	64LQFP	2.30
AM1810	ARM9	375, 456	375, 456	PROFIBUS®	1.8, 3.3	MityARM-1810	361NFBGA	15.53
AM3356/3357/3359	ARM Cortex-A8	300, 600, 800	600, 1200, 1600	PROFIBUS®, EtherCAT®, PROFINET®, PowerLink	1.8, 3.3	TMDSICE3359	324NFBGA	12.40

Safety Processors

Device	ARM CPU	Frequency (MHz) (Max)	Flash (KB)	Data Flash (KB)	RAM (KB)	IO Supply (V)	Core Supply (V)	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
RM42L432	ARM Cortex R4F	100	384	16	32	3.3	1.2	TMDXRM42HDK	−40 to 105	100LQFP	5.81
RM46L450	ARM Cortex R4F	200	1024	64	128	3.3	1.2	TMDXRM46HDK	−40 to 105	144LQFP	15.29
RM48L952	ARM Cortex R4F	220	3072	64	256	3.3	1.2	TMDXRM48HDK	−40 to 105	144LQFP	24.20

Digital Signal Processing (DSP)

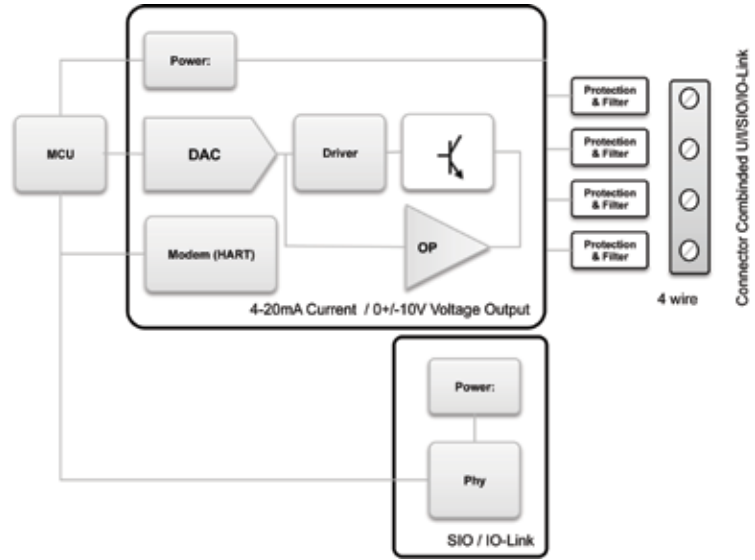
Device	DSP	DSP Instruction Type	Frequency (MHz) (Max)	DSP Peak MMACS	Hardware Acceleration	EVM	Pin/Package	Price*
TMS320C5515	C55x	Fixed Point	100, 120	200, 240	FFT Coprocessor	TMDX5515EZDSP	196NFBGA	9.10
TMS320C6747	C674x	Fixed/Floating-Point	375, 456	3000, 3648	—	TMDSOSKL137	256PBGA	11.73

*Quantities of 1,000 begin at this suggested resale price in U.S. dollars.

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Interface

Texas Instruments offers a comprehensive interface portfolio enabling system connectivity. With a variety of interface standards such as the traditional analog (4-20 mA) interface, HART®, RS-485, IO-Link, and CAN, TI delivers a variety of options for your interface needs.



Combined (U/I/SIO/IO-Link) Terminal

Integrated DAC and 4mA to 20mA Transmitters

Device	Resolution (bits)	DAC: Channels	Interface	Output Type	Supply Voltage (V)	Power (Typ) (mW)	Tx Type	HART compatible input	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
DAC161S997/P997	16	1	SPI/SWI	Current	2.7 to 3.6	0.33/0.5	2-wire	Yes	DAC161S997EVM	-40 to 105	16WQFN	1.75
DAC8750/7750	16/12	1	SPI	Current	10 to 36	105	3-wire	Yes	DAC8760EVM	-40 to 125	24HTSSOP, 40VQFN	—
DAC8760/7760	16/12	1	SPI	Current and voltage	10 to 36	105	3-wire	Yes	DAC8760EVM	-40 to 125	24HTSSOP, 40VQFN	—

DAC

Device	Resolution (bits)	DAC: Channels	Interface	Output Type	Supply Voltage (V)	Power (Typ) (mW)	Settling Time (µs)	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
DAC7311/8311/8411	12/14/16	1	Serial SPI	Voltage	2 to 5.5	0.14	6	DAC7311EVM	-40 to 125	6SC70	0.95
DAC7551	12	1	Serial SPI	Voltage	2.7 to 5.5	0.27	5	—	-40 to 105	12USON	1.40
DAC121C081	12	1	Serial I ² C	Voltage	2.7 to 5.5	0.38	8.5	—	-40 to 125	6SOT, 6WSON	1.15
DAC121S101	12	1	Serial SPI	Voltage	2.7 to 5.5	0.64	8	DAC121S101EVAL	-40 to 105	6SOT, 8VSSOP	1.15

Interface Amplifiers

Device	Vs (Min) (V)	Vs (Max) (V)	GBW (Typ) (MHz)	Slew Rate (Typ) (V/µs)	CMRR (Typ) (dB)	Iq per ch. (Max) (mA)	Offset Voltage (Max) (mV)	Offset Drift (Typ) (µV/°C)	Operating Temp. Range (°C)	Pin/Package	Price*
OPA333	1.8	5.5	0.35	0.16	130	0.025	0.01	0.02	-40 to 125	5SOT-23, 5SC70, 8SOIC	0.95
OPA330	1.8	5.5	0.35	0.16	115	0.035	0.05	0.02	-40 to 125	5DSBGA, 5SC70, 5SOT-23, 8SOIC	0.70
OPA317	1.8	5.5	0.3	0.15	108	0.035	0.1	0.05	-40 to 125	5SC70, 5SOT-23, 8SOIC	0.55 0.75
OPA348	2.1	5.5	1	0.5	82	0.065	5	4	-40 to 125	5SC70, 5SOT-23, 8SOIC	0.20
OPA170	2.7	36	1.2	0.5	120	0.145	1.8	0.3	-40 to 125	5SOT, 5SOT-23, 8SOIC	0.40
OPA188	4	36	2	0.8	146	0.51	0.025	0.03	-40 to 125	5SOT-23, 8SOIC, 8VSSOP	0.80
OPA171	2.7	36	3	1.5	104	0.595	1.8	0.3	-40 to 125	5SC70, 5SOT-23, 8SOIC	0.40
OPA277	4	36	1	0.8	140	0.825	0.02	0.1	-40 to 85	8SOIC, 8VSON	1.05

IO-Link

Device	Vs (min) (V)	Vs (Max) (V)	Peak Isolation Rating (Vpk)	Indicators	Protection	Internal Reference	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
SN65HVD101/2	9	36	50	Current limit, Power-good, Remote wake-up	OVP, OCP, OTP, Reverse polarity	Yes/No	SN65HVD101EVM	-40 to 105	20VQFN	2.50

*Quantities of 1,000 begin at this suggested resale price in U.S. dollars.

New products are listed in bold red.

Interface

4mA to 20mA Transmitters

	Vs (Min) (V)	Vs (Max) (V)	Full Scale Input Range (μA)	Non-Linearity (Max) (%)	Output Zero Error (Max) (μA)	Span Error (Max) (%)	Offset Voltage (Max) (mV)	Offset Drift (Typ) (μV/°C)	Operating Temp. Range (°C)	Pin/Package	Price*
4-20mA Transmitter											
XTR115/6	7.5	36	200	0.01	25	0.2	0.25	6	-55 to 125	8SOIC	1.25
XTR117	7.5	40	250	0.02	50	0.4	0.5	6	-40 to 125	8SON, 8VSSOP	0.90
XTR111	8	40	—	0.02	—	0.1	1.5	1.5	-55 to 125	10SON	0.65
XTR300	10	40	—	0.1	—	0.12	1.9	6	-55 to 125	20VQFN	1.90

Device	Application	Vs (Min) (V)	Vs (Max) (V)	Full Scale Input Range (V)	Non-Linearity (Max) (%)	Output Zero Error (Max) (μA)	Span Error (Max) (%)	Offset Voltage (Max) (mV)	Offset Drift (Typ) (μV/°C)	Sensor Excitation	Operating Temp. Range (°C)	Pin/Package	Price*
Analog Signal Conditioning and 4-20mA Transmitters													
XTR108	RTD	7.5	24	0.005 to 0.32	0.01	50 (Typ)	1 (Typ)	0.05	0.1	Two 500μA	-55 to 125	24SSOP	3.35
XTR105/12/14	RTD	7.5	36	0.005 to 1	0.01	25	0.2	0.025	1.5	Two 800μA/250μA/100μA	-40 to 85	14SOIC	4.00
XTR106	Strain gauge	7.5	36	0.005 to 1	0.01	25	0.2	0.025	1.5	2.5V or 5V Reference	-55 to 125	14SOIC	4.00

RS-485

Device	# of TX/RX	Isolated Rating (kVrms)	Integrated Transformer Driver	Number of Nodes	Duplex	Signaling Rate (Max) (Mbps)	ESD (kV)	Fail Safe	I _{cc} (Max) (mA)	Supply Voltage (V)	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
RS-485 (Profibus)														
SN65HVD1176	1/1	—	—	160	Half	40	10	Idle, Open, Short	6	5	—	-40 to 85	8SOIC	1.55
ISO1176	1/1	2.5	No	256	Half	40	16	Idle, Open, Short	10	3.15 to 5.5	ISO1176EVM	-40 to 85	16SOIC	3.00
ISO1176T	1/1	2.5	Yes	256	Half	40	10	Idle, Open, Short	18	3 to 5.5	ISO1176TEVM	-40 to 85	16SOIC	3.30

Device	# of TX/RX	Isolated	Common Mode Range	Number of Nodes	Duplex	Signaling Rate (Max) (Mbps)	ESD (kV)	Fail Safe	I _{cc} (Max) (mA)	Supply Voltage (V)	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
RS-485														
SN65HVD72/75/78	1/1	No	-7 to 12	200	Half	0.25/20/50	16	Idle, Open, Short	0.95	3.3	SN65HVD72EVM	-40 to 125	8SOIC, 8SON, 8VSSOP	0.70
SN65HVD82	1/1	No	-7 to 12	256	Half	0.25	16	Idle, Open, Short	0.9	5	RS-485 HD EVM	-40 to 85	8SOIC	1.00
SN65HVD888	1/1	No	-7 to 12	256	Half	0.25	16	No	0.9	5	RS485-HF-DPLX-EVM	-40 to 85	8SOIC	1.10
SN65HVD3080E	1/1	No	-7 to 12	256	Full	20	16	Idle, Open, Short	0.75	5	—	-40 to 85	10VSSOP	1.20

CAN

Device	I/O and V _{CC} Levels (V)	Short-Circuit Protection (V)	HBM ESD Protection (kV)	Supply Current (Typ) (mA)	Features	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
SN65HVD255	5	-27 to 40	12	10	"Turbo" CAN, "Ideal Passive", V _{RXD} Level Shift	SN65HVD255EVM	-40 to 125	8SOIC	0.50
ISO1050	5	-27 to 40	4	10.3	Isolated CAN (2.5kVRMS and 5kVRMS)	ISO1050EVM	-55 to 105	16SOIC, 8SOP	1.55
SN65HVD252	5	-27 to 40	12	13	DeviceNet CAN, with VREF	—	-40 to 85	8SOIC	0.80

*Quantities of 1,000 begin at this suggested resale price in U.S. dollars.

New products are listed in bold red.

Interface

Ethernet PHY

Part Number	Interface	Cable Length (m)	LED (#)	Supply Voltage (V)	Datarate (Mbps)	JTAG IEEE 1149.1	Port Count	Special Features	Operating Temperature Range (°C)	Pin/Package	Price*
DP83620	MII, RMII	150	3	3.3	10/100	Yes	Single	FX support, Cable diagnostics	-40 to 85	WQFN	1.52
DP83630	MII, RMII	150	3	3.3	10/100	Yes	Single	IEEE 1588 PTP, FX support, Cable diagnostics, P2P upgrade from the DP83620	-40 to 85	WQFN	4.78
DP83640	MII, RMII	150	3	3.3	10/100	Yes	Single	IEEE 1588 PTP, FX support, Cable diagnostics	-40 to 85	LQFP	4.98
DP83848I	MII, RMII, SNI	150	3	3.3	10/100	Yes	Single	Deterministic delay	-40 to 85	LQFP	2.20
DP83848K	MII, RMII	137	2	3.3	10/100	No	Single	Deterministic delay	-40 to 85	WQFN	0.95
DP83849F	MII, RMII, SNI	137	6	3.3	10/100	Yes	Dual	FX support, Cable diagnostics, Flexible port management	-40 to 85	TQFP	4.75

Power over Ethernet (PoE)

Device	PD Power Level (W)	Duty Cycle (%)	Switching Frequency	UVLO	rDS(on) per FET (Typ) (mOhms)	Driven/Active Clamp	PoE Current Limit (Min) (mA)	PoE Inrush Limit (Typ) (mA)	PoE Standards Supported	Fault Response	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
TPS2378	25	—	—	—	420	No	850	140	802.3 at type 2	Auto retry	TPS2378EVM-105	-40 to 85	8SO PowerPad	1.00
TPS23754	25	78	Programmable synchronizable	Unified	430	Yes	850	140	802.3 at type 1, 2	Auto retry	TPS23754EVM-420	-40 to 125	20HTSSOP	1.25
TPS23751	25	85	Programmable	Yes	450	No	850	140	802.3 at type 1, 2	Auto retry	TPS23751EVM-104	-40 to 85	16HTSSOP	1.10

Wireless Connectivity

Device	Device Type	Frequency Range (GHz)	Data Rate (Max) (kbps)	Operating Voltage (V)	Rx Current (Min) (mA)	Tx Power (Max) (dBm)	Modulation Techniques	Sensitivity (Best) (dBm)	Additional Features	Antenna Connection	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
CC1120	Transceiver	sub1-GHz	200	2 to 3.6	17	16	2-FSK, 2-GFSK 4-FSK, 4-GFSK MSK, ASK, OOK	-123	—	Differential	CC1120EMK-420-470 CC1120EMK-169, CC1120EMK-868-915 CC1120EMK-998	-40 to 85	5 × 5 mm QFN 32	2.20
CC2530	SoC	2.4	250	2 to 3.6	20.5	4.5	DSSS	-97	MCU/ADC	Differential	CC2530DK	-40 to 125	40QFN	3.20
CC2541	SoC	2.4	1000	2 to 3.6	17.9	0	GFSK	-93	MCU/ADC	Differential	CC2541EMK	-40 to 85	40VQFN	2.00
CC3000 MOD	Network Processor	2.4	7000	2.7 to 4.8	92	18.3	DSSS, CCK, OFDM	-97.5	Embedded TCP/IP stack	Single ended	CC3000EM CC3000BOOST	-20 to 70	Module	9.99
TRF7970A	Transceiver	13.56	848	2.7 to 5.5	10	23	ASK/PSK/FSK, ISO14443A/B, ISO15693	—	—	Single ended	TRF7970AEVM, TRF7970ATB	-40 to 110	QFN32	3.10
RF430CL330H	Dual Interface Transponder	13.56	848	0 (RF field powered) to 3.6	0	0	PSK, ISO14443B	—	—	Single ended	RF430CL330HTB	-40 to 85	TSSOP14, QFN16	0.85

*Quantities of 1,000 begin at this suggested resale price in U.S. dollars.

New products are listed in bold red.

Interface

Isolation

Device	Isolation Rating (Vrms)	Peak Isolation Rating (Vpk)	Working Voltage (Vpk)	Forward/Reverse Channels	Speed (Max) (Mbps)	Supply Voltage (V)	Default Output	Propagation Delay (Typ) (ns)	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
ISO7842	5700	8061	2121	2/2	100	2.25 to 5.5	High	11	ISO7842-EVM	-55 to 125	16SOIC	3.49
ISO7342C	3000	4242	1414	2/2	25	3 to 5.5	High / Low (F)	31	ISO7342CEVM	-40 to 125	16SOIC	1.80
ISO7140/1(F)CC ISO7142CC	2500	4242	560	4/0, 3/1, 2/2	50	2.7 to 5	High / Low (F)	23	ISO71XXDBQ-EVM	-40 to 125	16SSOP	1.90
ISO7131CC	2500	4242	560	2/1	50	2.7 to 5	High	23	ISO71XXDBQ-EVM	-40 to 125	16SSOP	1.60

ESD/EMI Protection

Device	Application	IEC 61000-4-2 Contact (± kV)	IEC 61000-4-2 Air-Gap (± kV)	Number of Channels	IO Capacitance (Typ) (pF)	Breakdown Voltage (Min) (V)	IO Leakage Current (nA)	Operating Temp. Range (°C)	Pin/Package	Price*
ESD Protection										
TPD1E10B09	Interface	20	20	1	10	9.5	100	-40 to 125	2X2SON	0.04
TPD2E007	Interface, Wheatstone bridge	8	15	2	15	14	50	-40 to 85	3SC70, 4DSLGA	0.20
TPD4E1U06	Ethernet, Profinet, LED, LCD	15	15	4	0.8	6.5	10	-40 to 125	SOT-23, SC70	0.08
TPD6F002	LCD	20	30	6	34	6	20	-40 to 85	SON	0.21
TPD2E007	RS-232/485, Profibus, CAN	8	15	2	10	±14	50	-40 to 85	SC70, DSLGA	0.2
TPD1E10B09	Keypad, General purpose	20	20	1	10	±9.5	100	-40 to 125	X1SON	0.05

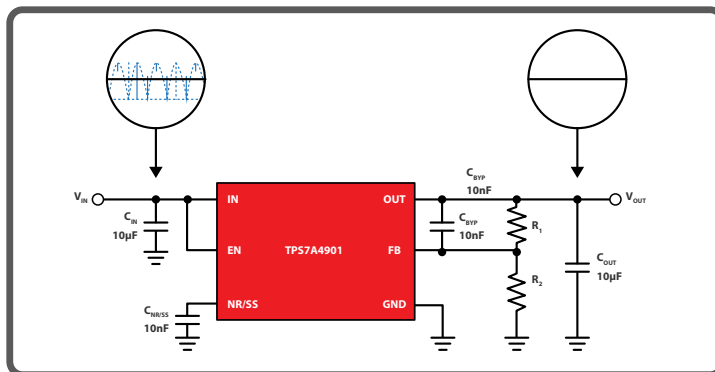
Device	Application	IEC 61000-4-2 Contact (± kV)	IEC 61000-4-2 Air-Gap (± kV)	Number of Channels	Breakdown Voltage (Min) (V)	Ctotal (Typ) (pF)	Rline (Typ) (ohms)	fc (MHz)	Operating Temp. Range (°C)	Pin/Package	Price*
EMI Protection											
TPD4F202	Keypad, LCD	25	25	4	6	30	100	108	-40 to 85	10DSBGA	0.17
TPD6F202	Keypad, LCD	25	25	6	6	30	100	108	-40 to 85	15DSBGA	0.21
TPD6F002	Keypad, LCD	20	30	6	6	34	100	100	-40 to 85	12SON	0.21
TPD8F003	Keypad	12	20	8	6	17	100	200	-40 to 85	16WSON	0.25

*Quantities of 1,000 begin at this suggested resale price in U.S. dollars.

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

Power Management Solutions

Texas Instruments (TI) offers a complete line of high-performance power management products designed for industrial applications. The devices shown are well-suited for powering sensors that may require low noise and high efficiency in both line- and loop-powered (4-20 mA) topologies.



Linear Regulators

	V _{IN} (Min) (V)	V _{IN} (Max) (V)	V _{OUT} (Min) (V)	V _{OUT} (Max) (V)	I _{OUT} (Max) (A)	I _q (Typ) (mA)	Accuracy (%)	Output Options	Pin/Package	Price*
Wide V_{IN} Linear Regulators (V_{IN} ≥ 24V)										
TPS7A4001	7	100	1.2	90	0.05	0.02	2.5	Adjustable	8MSOP-PowerPAD	1.05
LM2936	5.5	60	3	5	0.05	0.015	2	Fixed	3TO, 4SOT, 8SOIC, 8VSSOP	0.62
TPS7A1601	3	60	1.2	18.5	0.1	0.005	2	Adjustable or fixed	8 MSOP-PowerPAD, 8SON	1.40
TPS7A4101	7	50	1.2	48	0.05	0.02	2.5	Adjustable	8MSOP-PowerPAD	0.35
TPS7A4901	3	36	1.2	33	0.15	0.06	1.5	Adjustable	8MSOP-PowerPAD	1.10
TPS70933/50	2.7	30	3.3/5	3.3/5	0.15	0.001	2	Fixed	5SOT-23, 6SON	0.39
LP2951	2	30	1.2	29	0.1	0.075	1.4	Adjustable	8SOIC	0.27
Linear Regulators (V_{IN} < 24V)										
LP2985-N	2.5	16	2.5	6.1	0.15	0.065	—	Fixed	5DSBGA, 5SOT-23	0.24
LP3878-ADJ	2.5	16	1	5.5	0.8	0.18	—	Adjustable	8SO PowerPAD, 8WSO	0.80
LP38798	3	20	1.2	11.8	0.8	1.4	2	Fixed	12WSO	1.30
TPS71701/717xx	2.5	6.5	0.9	6.2	0.15	0.045	3	Adjustable/Fixed	5SC70, 6SON, 6WSO	0.36
LP5907	2.2	5.5	1.2	4.5	0.25	0.012	2	Fixed	5SOT-23, 4DSBGA, 4X2SON	0.14

Voltage References

	V _{IN} (Min) (V)	V _{IN} (Max) (V)	V _{OUT} (V)	I _{OUT} /I _Z (Max) (mA)	I _q (Typ) (µA)	Drift @ 0°C to 125°C (Max) (ppm/°C)	Drift @ -40°C to 125°C (Max) (ppm/°C)	Initial Accuracy (%)	Pin/Package	Price*
REF5030	3.2	18	3	10	800	3	3	0.05	8SOIC, 8VSSOP	1.35
REF3230	3.05	5.5	3	10	100	7	26	0.2	6SOT-23	1.70
LM4132	2.2	5.5	1.8 to 4.1	20	60	—	20	0.05	5SOT-23	0.78
REF3330	3.2	5.5	3	5	3.9	—	30	0.15	3SC70, 3SOT-23	0.85
REF3030	3	5.5	3	25	42	50	75	0.2	3SOT-23	0.60
LM4030	2.5/4.1	6	2.5/4.1	30	120	—	20	0.05	5SOT-23	0.45

System Timer

	V _{IN} (Min) (V)	V _{IN} (Max) (V)	Supply Current (µA)	Programmable Timer Interval (s)	Interrupt Pulsewidth (s)	Timekeeping Accuracy (Max) (%)	MOSFET driver	Watchdog Function	Operating Temp. Range (°C)	Pin/Package	Price*
Ultra-Low Power System Timer											
TPL5000	1.8	5.5	0.03	1 to 64	0.031	±10	No	Yes	-40 to 125	MSOP-10	0.60
TPL5100	1.8	5.5	0.03	16 to 1024	0.031	±10	Yes	Yes	-40 to 125	MSOP-10	0.60

Charge Pump

	V _{IN} (Min) (V)	V _{IN} (Max) (V)	V _{OUT} (V)	I _{OUT} (Max) (A)	I _q (Typ) (mA)	Efficiency (Typ) (%)	Special Features	EVM	Operating Temp. Range (°C)	Pin/Package	Price*
Fully Integrated DC/DC Buck Modules											
LM7705	3	5.25	-0.232	0.026	0.078	98	Enables True-Zero Amp Outputs	LM7705MMEVAL	-40 to 125	8VSSOP	0.19

*Quantities of 1,000 begin at this suggested resale price in U.S. dollars.

Power Management Solutions

Switching Regulators

	V _{IN} (Min) (V)	V _{IN} (Max) (V)	V _{OUT} (Min) (V)	V _{OUT} (Max) (V)	I _{OUT} (Max) (A)	Switching Frequency (Max) (kHz)	Topology	Switch Current Limit (Typ) (A)	I _q (Typ) (mA)	Duty Cycle (Max) (%)	Special Features	Pin/Package	Price*
Wide V_{IN} DC/DC Converters (V_{IN} ≥ 24V)													
LM5017/18/19	7.5	100	1.25	90	0.6/0.3/0.1	1000	Synch buck	1.3/0.7/0.3	1.75	90	—	8SO PowerPAD, 8WSON	1.57
TPS54061/2	4.7	60	0.8	58	0.2/0.05	1100/400	Inverting buck-boost, Synch buck	0.35/0.13	0.09	98	Enable, Freq. synch, Light load efficiency	8SON, 8VSSOP	0.88
LM25007	9	42	2.5	37	0.5	800	Buck	0.725	0.5	99	—	8VSSOP, 8WSON	1.05
LMR24210	4.5	42	0.8	24	1	1000	Synch buck	1.8	0.7	94	Enable	28DSBGA	1.50
LM34919	8	40	2.5	35	0.6	2000	Buck	0.64	0.5	—	—	10DSBGA	1.20
LM46000	3.5	60	1	28	0.5	2200	Synch buck	1.35	0.024	99	Enable, Freq. synch, Light load efficiency, Power good	16HTSSOP	1.65
DC/DC Converters (V_{IN} < 24V)													
TPS62125	3	17	1.2	10	0.3	1000	Synch buck	0.71	0.013	100	Enable, Light load efficiency,	8WSON	0.85
TPS62231	2.05	6	1.8	1.8	0.5	2000	Synch buck	0.84	0.022	100	Enable, Light load efficiency	6SON	0.50
TPS560200	4.5	17	0.8	6.5	0.5	600	Synch buck	1.35	0.06	—	Enable, Light load efficiency, Power good	SOT23-5	0.50
TPS62740	2.2	5.5	1.8	3.6	300	2000	Synch buck	0.6	0.00036	100	4-pin Voltage select Integr. load switch	6SON	1.15
TPS61291	0.9	5	2.5	3.3	200	—	Synch Boost	1	0.006	—	Voltage select bypass function	6SON	0.68

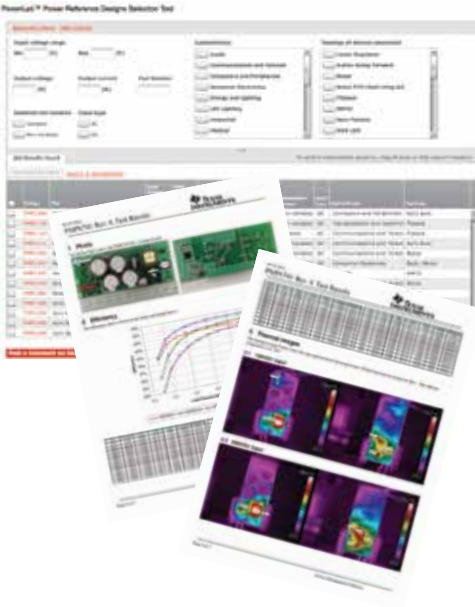
	V _{IN} (Min) (V)	V _{IN} (Max) (V)	V _{OUT} (Min) (V)	V _{OUT} (Max) (V)	I _{OUT} (Max) (A)	Topology	Special Features	Pin/Package	Price*
Isolated DC/DC Converters									
LM5017/18/19	7.5	100	—	—	0.4	Fly-buck	—	8SO PowerPAD, 8WSON	1.57
TPS55010	2.95	6	3.3	20	0.4	Fly-buck	Enable, Synch rectification, Power good, Freq synch	16WQFN	0.99
SN6501	3	5.5	0	11	0.25	Push-pull	Enable, Isolated	5SOT-23	0.90
DCR010503/5	4.5	5.5	3.3/5	3.3/5	0.3/0.2	—	1W, 1kV Isolation, regulated single output	12SOP	5.95
TPS60402	1.8	5.25	—	—	0.06	Half-bridge	see TIDA-00167 (Isolated, ultra-low power DC/DC)	5SOT-23	0.36

	V _{IN} (Min) (V)	V _{IN} (Max) (V)	V _{OUT} (Min) (V)	V _{OUT} (Max) (V)	I _{OUT} (Max) (A)	Switching Frequency (Max) (kHz)	Topology	EVM	Special Features	Pin/Package	Price*
Fully Integrated DC/DC Buck Modules											
LMZ21701	3	17	0.9	6	—	2500	Buck	LMZ21701EVM	Power good, Soft-start, Light load efficiency, EMI tested	8SIL	6.25
LMZ14201	6	42	6	42	—	1000	Synch buck	LMZ14201EVAL	Enable, Tracking, EMI tested	7PFM	5.85
TPS82740	2.2	5.5	1.8	3.3	0.2	2000	Synch buck	TPS82740AEVM-617 TPS82740BEVM-61	3-pin Voltage select 360nA quiescent current integrated load switch	41B1QFN	1.55

*Quantities of 1,000 begin at this suggested resale price in U.S. dollars.

New products are listed in bold red. Preview products are listed in bold teal.

Power Management Solutions



PowerLab™ Power Reference Design Library

The PowerLab library includes an interactive and powerful search engine for design engineers looking for a proven and tested solution to their power-supply requirements. This interactive search tool allows engineers to find designs by application, topology, input type, input voltage or output voltage.

Features

- Extensive collection of tested power management reference designs.
- Hundreds of power-management designs for a wide range of applications and power-conversion topologies.
- Reference designs include both isolated and non-isolated designs for lighting, telecommunication, computing, consumer electronics and more.

Get more information: www.ti.com/powerlab

4-20mA Current Loop 2-wire Sensor Power Supply

PowerLabs Design – PMP6938

Key Features

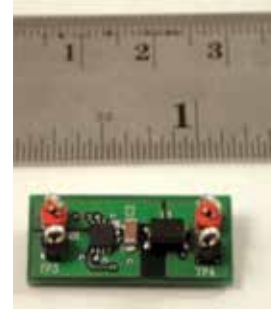
- Small form factor that fits 7mm x 15.5mm x 0.8mm
- Input voltage withstands line transients up to 60V
- Configured to deliver 3.3V/30mA at 400kHz
- Efficiency peaks at 70% at 20mA from 12V_{IN} to 3.3V_{OUT}

Reference Design Includes

Schematic and PCB layout
Bill of Materials
Test Results

TI Device: TPS54062

Get more information:
www.ti.com/tool/PMP6938



When you need a trusted reference design resource, look no further than **TI Designs** – a comprehensive reference design library spanning and complementing the breadth of TI's product portfolio. From embedded processors to power management to signal chain designs, TI Designs provides the information you need to quickly evaluate and customize a system and accelerate your time-to-market.



Turnkey IO-Link Sensor Transmitter Reference Design – TIDA-00188

Key Features

- IO-LINK v1.1 connectivity out of the box (TMG stack, PHY and M12 connector)
- Easy connection of in-house sensor to the PCB
- RTD performance: maximum measured error: 0.17°C (-200°C to 850°C)
- Designed to meet IEC 61000-4-2, IEC 61000-4-4, IEC 61000-4-5 and IEC 60255-5 standards



Reference Design Includes

- Bill of Materials
- User Guides
- Design Files

Get more information:

www.ti.com/tool/TIDA-00188

Small Form Factor, 2-wire 4mA to 20mA Current Loop RTD Temperature Transmitter Reference Design

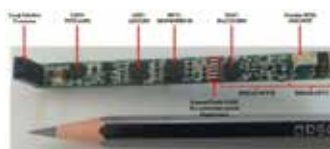
Reference Design – TIDA-00165

Key Features

- Small form factor (L x W): 71.12mm x 6mm
- Sensor input compatible with 2-, 3- or 4-wire RTD probes
- Connects to any RTD from PT100 to PT1000
- Maximum measured error: 0.2°C
- Output resolution: 0.76µA
- Input power supply range: 10V to 33V DC
- Designed to meet IEC-61000-4-5 (1KV Surge DM) requirement

Reference Design Includes

- Bill of Materials
- User Guides
- Design Files
- Software
- Applications



Get more information:

www.ti.com/tool/TIDA-00165

RTD Temperature Transmitter for 2-wire, 4-mA to 20-mA Current Loop Systems

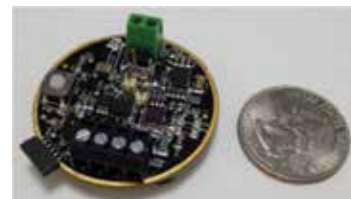
Reference Design – TIDA-00095

Key Features

- Input Compatible with 2-, 3-, and 4-wire RTD probes
- Low power consumption of 1.4mA (with RTD biasing currents) makes it ideal for loop powered systems
- 4mA to 20mA current-loop signal output with 0.25µA resolution
- Maximum measured error: 0.11°C (-200°C to 200°C), 0.17°C (-200°C to 850°C)
- IEC61000-4-2: ESD: Air Discharge: ±8kV Class A, Contact Discharge ±4kV Class A
- IEC61000-4-4: EFT: ±2kV Class A

Reference Design Includes

- Bill of Materials
- User Guides
- Design Files
- Software
- Applications



Get more information:

www.ti.com/tool/TIDA-00095

Isolated Loop Powered Thermocouple Transmitter

Reference Design – TIDA-00189

Key Features

- Sensor input compatible with k-Type Thermocouple probes (-200°C to +1375°C)
- Operating temperature of the circuit -40°C to +85°C
- Implements cold junction compensation (RTD based)
- Front End accuracy < 0.5°C (-200°C to +270°C) and < 0.15% (270°C to +1375°C)
- 4mA to 20mA current loop output signal
- Design to meet IEC 61000-4-5

Reference Design Includes

- Bill of Materials
- User Guides
- Design Files
- Software



Get more information:

www.ti.com/tool/TIDA-00189

TI Designs (continued)

Hall-Effect Proximity Sensor with PNP or NPN Output

Reference Design – TIDA-00244

Key Features

- Hall-effect latch sensor with SIO transmitter interface
- Offers superior stability of the proximity detection
- Size and form factor of sensors are perfectly suited to SIO transmitter interfaces
- MSP430 based solution for easy IO-Link upgrade (see TIDA-00188)

Reference Design Includes

- Bill of Materials
- User Guides
- Design Files
- Software
- Applications



Get more information:

www.ti.com/tool/TIDA-00244

Isolated Ultra-Low Power Design for 4mA to 20mA Loop Powered Transmitters

Reference Design – TIDA-00167

Key Features

- Input Power: 8V to 33V/<3.3mA
- Outputs: isolated and non-isolated 3.3V rails
 - Selectable between low Iq LDOs and high PSRR LDOs as post regulators
- Highly efficient isolated DC/DC converter
 - >70% @ 5mW to 8mW output power
 - Functional isolation: 1500V_{AC}
- Contains input surge protection (EN 61000-4-5: ±1kV), reverse protection, current limiters for hot-plug and surge, load switch and protects a transmitters loop current sense circuit
- On-board ripple filter to address conducted EMI requirements (EN 55011) and decoupling from loop current
- Fully functional board which can easily be tested, modified and optimized



Reference Design Includes

- Bill of Materials
- User Guides
- Design Files

Get more information:

www.ti.com/tool/TIDA-00167

NFC Configuration & Logging Interface (Dual Port FRAM: NFC <-> FRAM <-> Serial)

Reference Design – TIDA-00230

Key Features

- ISO14443B interface (RF430CL330): Android NFC standard
- 64kB FRAM (MSP430FR5969)
- Up to 8Mb/s throughput to/from FRAM over serial
- 800kb/s throughput to/from FRAM over NFC
- Powered over NFC
- Power ORing is provided between the main system and the NFC daughter card to demonstrate that the NFC card can be woken up when the main system is down

Reference Design Includes

- Bill of Materials
- User Guides
- Design Files
- Software
- Applications



Get more information:

www.ti.com/tool/TIDA-00230

Combined Voltage and Current Output Terminal for Analog Outputs (AO) in Industrial Applications

Reference Design – TIPD119

Key Features

- Single terminal, standard voltage or current output for a universal analog output module
- 16-bit Resolution
- <0.1% TUE (%FSR) 0mA to 24mA current output precision
- <0.1% TUE (%FSR) ±10V voltage output precision
- 4kV Digital galvanic isolation using ISO7641FC

Reference Design Includes

- Bill of Materials
- User Guides
- Design Files
- Software
- Applications



Get more information:

www.ti.com/tool/TIPD119

TI Designs (continued)

Variable Threshold Hall Proximity Sensor with PNP/NPN

Reference Design – TIDA-00286

Key Features

- Magnetic field proximity sensor
- Switched output (PNP/NPN)
- Configurable threshold (via on-board button)
- MSP430 based solution for easy IO-Link upgrade (see TIDA-00188)

Reference Design Includes

- User Guides
- Design Files
- Software



Get more information:

www.ti.com/tool/TIDA-00286

Simple Thermocouple Measurement Solution Reference Design, <math><1^\circ\text{C}</math> Accurate

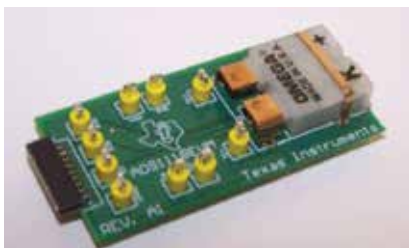
Reference Design – TIPD109

Key Features

- Measures K-type thermocouple temperature
- Accuracy <math><1^\circ\text{C}</math>
- Precision/repeatability 0.2°C
- Includes cold junction compensation
- Includes software algorithm
- Uses ADS1118 16-bit ADC with PGA

Reference Design Includes

- Theory
- Component Selection
- TINA-TI Simulation
- Schematics and PCB Layout
- Verification and Measured Performance
- Modification Options
- Bill of Materials
- User Guides
- Design Files
- Software



Get more information:

www.ti.com/tool/TIPD109

Bridge Sensor Signal Conditioner with Current Loop Output, EMC Protection

Reference Design – TIPD126

Key Features

- EMC tested according to IEC 61000-4 and FCC standards
- Digitally calibrated 4mA to 20mA output
- 0.1% accuracy

Reference Design Includes

- Theory
- Component Selection and Calculation
- TINA-TI Simulation
- Schematics and PCB Layout
- Measurement Results
- EMC Test Results
- Bill of Materials
- User Guides
- Design Files



Get more information:

www.ti.com/tool/TIPD126

Gas Sensor Platform with Bluetooth Low Energy

Reference Design – TIDA-00056

Key Features

- Monitors wide range of gases
- Carbon monoxide, oxygen, ammonia, fluorine, chlorine dioxide...and more
- Supports 2- and 3-lead electrochemical gas sensors
- Complies with FCC and IC regulatory standards
- Coin cell battery operation
- Easily monitor gas concentrations via TI's gas sensor iOS mobile app

Reference Design Includes

- Bill of Materials
- User Guides
- Design Files
- Software
- Applications



Get more information:

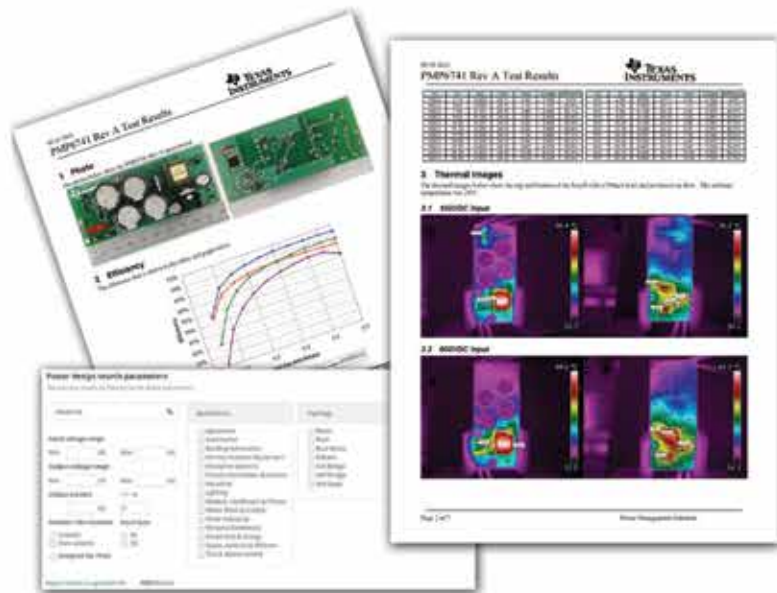
www.ti.com/tool/TIDA-00056



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Korea	080-551-2804
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