

# Multi-Sensor High Accuracy Digital Temperature Measurement Systems



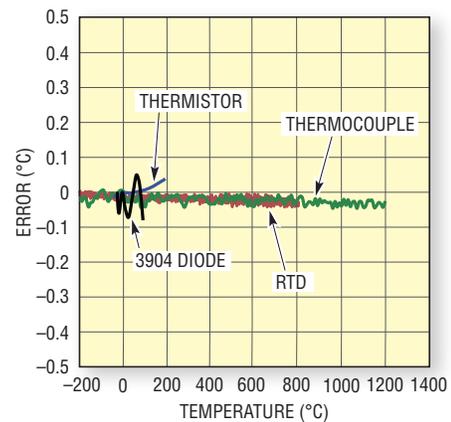
## Any Temperature Sensor In. Benchtop Accuracy Out.

The LTC<sup>®</sup>2983, LTC2984, and LTC2986 are high accuracy digital temperature measurement systems that integrate all of the necessary components to excite, calibrate, measure and digitize diodes, thermistors, thermocouples and RTDs (resistance temperature detectors). Any combination of sensors connect directly to the ICs, with no other active components required. An SPI interface provides readout of temperature in °C or °F and simple configuration of features such as automatic cold junction compensation, linearization coefficients and fault detection. The LTC2984 and LTC2986-1 include EEPROM for storing channel configuration data and custom coefficients.

### Features

- Directly Digitizes 2-, 3-, 4-Wire RTDs, Thermocouples, Thermistors and Diodes
- On-Chip EEPROM Stores Channel Configuration Data and Custom Coefficients (LTC2984 and LTC2986-1)
- 3V to 5V Supply Range
- Up to 20 Flexible Inputs Allow Interchanging Sensors without Hardware Modifications
- Measures Negative Voltages and Ground-Referenced Sensors without the Need of an Extra Supply or Level Shift Circuitry
- Buffered Inputs Allow External Protection and Filtering without Droop Errors
- Includes 15ppm/°C (Max) Reference, Switching Networks, Current Sources, Three 24-Bit  $\Delta\Sigma$ ADCs, RAM, ROM, and Sensor Linearization Circuitry
- Built-In Standard or Programmable Coefficients
- Simultaneous 50Hz/60Hz Rejection
- Sleep Mode to Reduce Current Consumption to 25 $\mu$ A
- Automatic Burn Out, Short-Circuit and Fault Detection

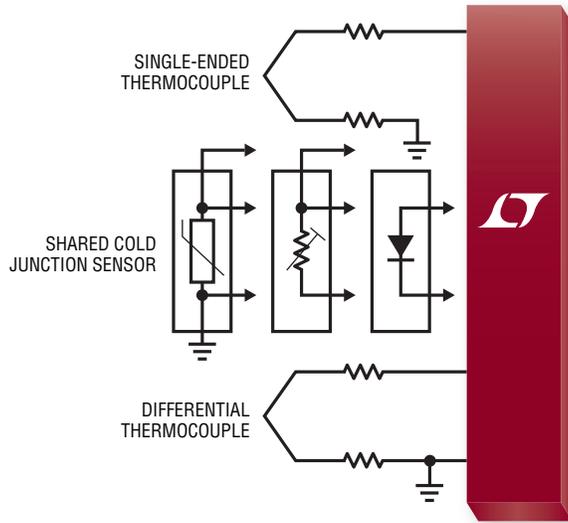
### Error Contribution



	Product Selection			
	LTC2983	LTC2984	LTC2986	LTC2986-1
Channel Count	20	20	10	10
EEPROM		•		•
Package	7mm x 7mm LQFP-48			

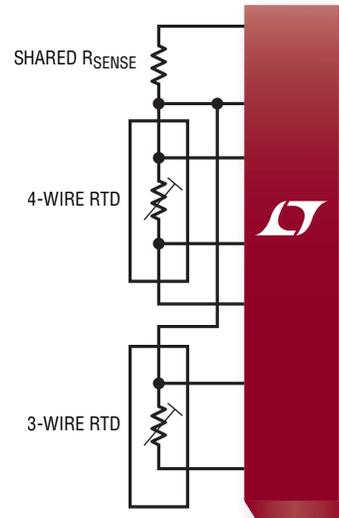
# Sensor Specific Features

## Thermocouples



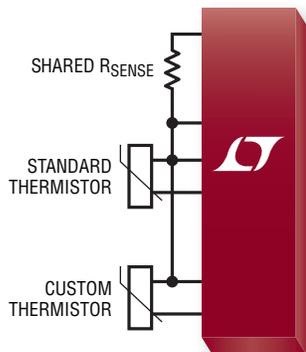
- Single-Ended or Differential Measurements
- Built-In Linearization NIST Coefficients for Types J, K, E, N, R, S, T and B
- Programmable Custom Coefficients Support
- Automatic Cold Junction Compensation (CJC) Using Shareable Diode, RTD or Thermistor

## RTDs



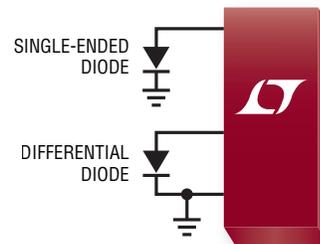
- 2-Wire Support for Simple Setups
- 3-Wire Support for Balanced Lead Resistance Error Cancellation
- 4-Wire Support for Unbalanced Lead Resistance Error Cancellation; Automatic Rotation of RTD for Removal of Thermocouple Effects
- Shareable Sense Resistor for Multiple RTDs or Thermistors
- Built-In Linearization Coefficients for Types PT-10, PT-50, PT-100, PT-200, PT-500, PT-1000 and NI-120 with Selectable Common Standards (385, 392, etc.)
- Programmable Custom Coefficients Support
- Programmable Excitation Current: 5 $\mu$ A – 1mA
- Hi-Z Sensor and Sense Resistor Input

## Thermistors



- Single-Ended or Differential Measurements
- Shareable Sense Resistor for Multiple Thermistors or RTDs
- Automatic Rotation of Thermistor for Removal of Thermocouple Effects
- Built-In Linearization Coefficients for Types 44004/44033, 44005/44030, 44006/44031, 44007/44034, 44008/44032, and YSI-400
- Programmable Custom Steinhart-Hart or Custom Coefficients Support
- Auto Range Current Sources for High Accuracy
- Thermistor Resistance Can Be Orders of Magnitude Larger Than Sense Resistor
- Hi-Z Sensor and Sense Resistor Input

## Diodes

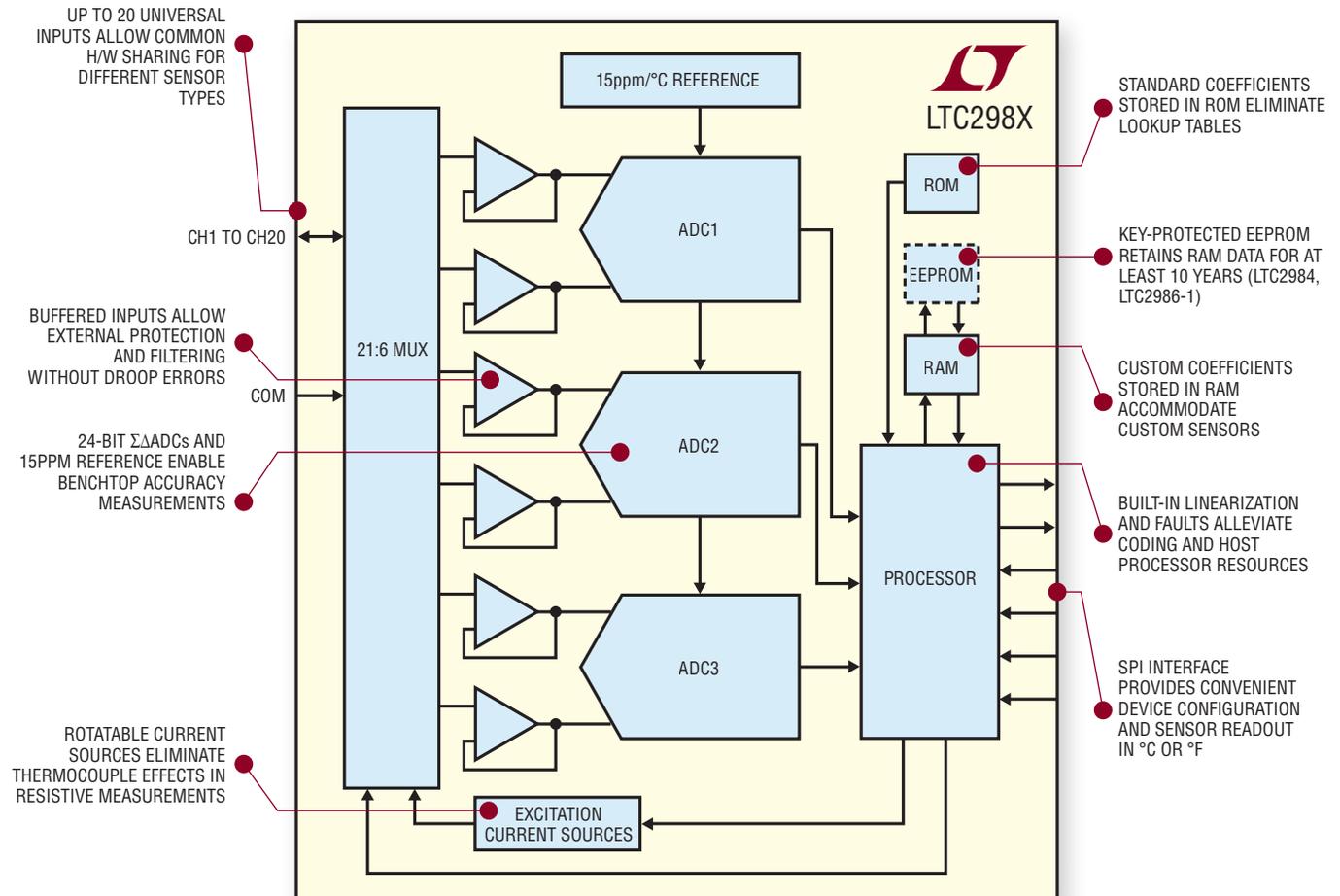


- Single-Ended or Differential Measurements
- Series Resistance Error Cancellation
- Noise Reduction When Used as CJC Sensor
- Programmable Excitation Current: 10 $\mu$ A – 640 $\mu$ A
- Programmable Ideality Factor ( $\eta$ )

## Error Contribution and Peak Noise Errors

SENSOR TYPE	TEMPERATURE RANGE	SYSTEM ACCURACY	PEAK-TO-PEAK NOISE
Type K Thermocouple	-200°C to 0°C 0°C to 1372°C	$\pm(\text{Temperature} \cdot 0.23\% + 0.05)^\circ\text{C}$ $\pm(\text{Temperature} \cdot 0.12\% + 0.05)^\circ\text{C}$	$\pm 0.08^\circ\text{C}$
Type J Thermocouple	-210°C to 0°C 0°C to 1200°C	$\pm(\text{Temperature} \cdot 0.23\% + 0.05)^\circ\text{C}$ $\pm(\text{Temperature} \cdot 0.10\% + 0.05)^\circ\text{C}$	$\pm 0.07^\circ\text{C}$
Type E Thermocouple	-200°C to 0°C 0°C to 1000°C	$\pm(\text{Temperature} \cdot 0.18\% + 0.05)^\circ\text{C}$ $\pm(\text{Temperature} \cdot 0.10\% + 0.05)^\circ\text{C}$	$\pm 0.06^\circ\text{C}$
Type N Thermocouple	-200°C to 0°C 0°C to 1300°C	$\pm(\text{Temperature} \cdot 0.27\% + 0.08)^\circ\text{C}$ $\pm(\text{Temperature} \cdot 0.10\% + 0.08)^\circ\text{C}$	$\pm 0.13^\circ\text{C}$
Type R Thermocouple	0°C to 1768°C	$\pm(\text{Temperature} \cdot 0.10\% + 0.4)^\circ\text{C}$	$\pm 0.62^\circ\text{C}$
Type S Thermocouple	0°C to 1768°C	$\pm(\text{Temperature} \cdot 0.10\% + 0.4)^\circ\text{C}$	$\pm 0.62^\circ\text{C}$
Type B Thermocouple	400°C to 1820°C	$\pm(\text{Temperature} \cdot 0.10\%)^\circ\text{C}$	$\pm 0.83^\circ\text{C}$
Type T Thermocouple	-250°C to 0°C 0°C to 400°C	$\pm(\text{Temperature} \cdot 0.15\% + 0.05)^\circ\text{C}$ $\pm(\text{Temperature} \cdot 0.10\% + 0.05)^\circ\text{C}$	$\pm 0.09^\circ\text{C}$
External Diode (2 Reading)	-40°C to 85°C	$\pm 0.25^\circ\text{C}$	$\pm 0.05^\circ\text{C}$
External Diode (3 Reading)	-40°C to 85°C	$\pm 0.25^\circ\text{C}$	$\pm 0.2^\circ\text{C}$
Platinum RTD – PT-10, $R_{\text{SENSE}} = 1\text{k}\Omega$	-200°C to 800°C	$\pm 0.1^\circ\text{C}$	$\pm 0.05^\circ\text{C}$
Platinum RTD – PT-100, $R_{\text{SENSE}} = 2\text{k}\Omega$	-200°C to 800°C	$\pm 0.1^\circ\text{C}$	$\pm 0.05^\circ\text{C}$
Platinum RTD – PT-500, $R_{\text{SENSE}} = 2\text{k}\Omega$	-200°C to 800°C	$\pm 0.1^\circ\text{C}$	$\pm 0.02^\circ\text{C}$
Platinum RTD – PT-1000, $R_{\text{SENSE}} = 2\text{k}\Omega$	-200°C to 800°C	$\pm 0.1^\circ\text{C}$	$\pm 0.01^\circ\text{C}$
Thermistor, $R_{\text{SENSE}} = 10\text{k}\Omega$	-40°C to 85°C	$\pm 0.1^\circ\text{C}$	$\pm 0.01^\circ\text{C}$

## System Benefits



# Hardware and Software Development

**Evaluation**  
 QuikEval™ GUI  
 Software

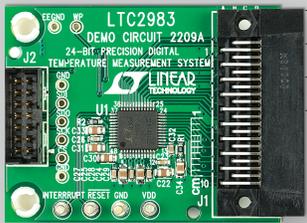


**Code Development**  
 Arduino IDE  
 (C Coding Environment with  
 Libraries & Examples)

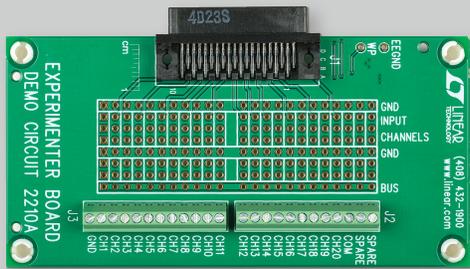


Linduino® ONE DC2026

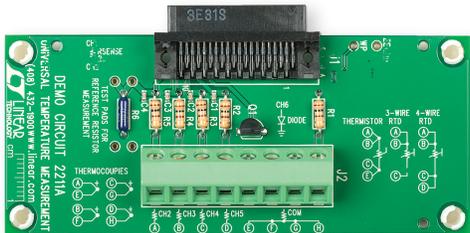
DC2296 (LTC2983), DC2420 (LTC2984), DC2531 (LTC2986)  
 OR DC2608 (LTC2986-1) DEMO KIT



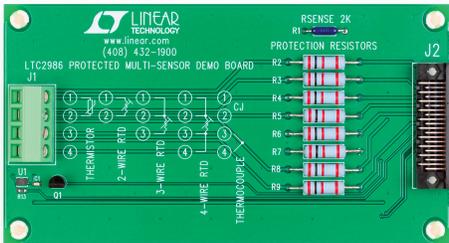
MOTHERBOARD



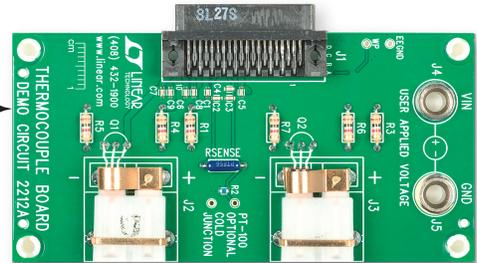
20-INPUT BREAKOUT BOARD



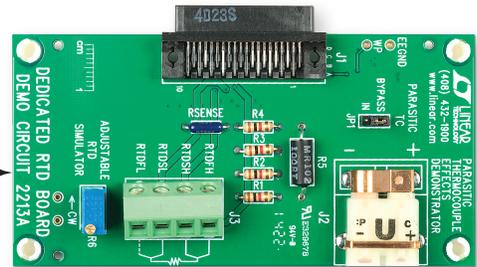
UNIVERSAL 4-INPUT BOARD DC2211



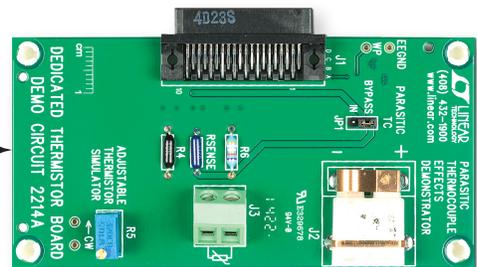
UNIVERSAL PROTECTED BOARD DC2507 (LTC2986)



THERMOCOUPLE BOARD DC2212



RTD BOARD DC2213



THERMISTOR BOARD DC2214