The LTC®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 ΔΣADCs, RAM, ROM, and Sensor Linearization Circuitry
- Built-In Standard or Programmable Coefficients
- Simultaneous 50Hz/60Hz Rejection
- Sleep Mode to Reduce Current Consumption to 25µA
- Automatic Burn Out, Short-Circuit and Fault Detection

### Error Contribution

**Product Selection**

<table>
<thead>
<tr>
<th>Channel Count</th>
<th>LTC2983</th>
<th>LTC2984</th>
<th>LTC2986</th>
<th>LTC2986-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEPROM</td>
<td>20</td>
<td>20</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Package</td>
<td>7mm x 7mm LQFP-48</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**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: 5µA – 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: 10µA – 640µA
  - Programmable Ideality Factor ($\eta$)
### Error Contribution and Peak Noise Errors

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

### System Benefits

- Up to 20 universal inputs allow common H/W sharing for different sensor types.
- Buffered inputs allow external protection and filtering without droop errors.
- 24-bit ∑∆ADCs and 15ppm/°C reference enable benchtop accuracy measurements.
- Rotatable current sources eliminate thermocouple effects in resistive measurements.
- Standard coefficients stored in ROM eliminate lookup tables.
- Key-protected EEPROM retains RAM data for at least 10 years (LTC2984, LTC2986-1).
- Custom coefficients stored in RAM accommodate custom sensors.
- Built-in linearization and faults alleviate coding and host processor resources.
- SPI interface provides convenient device configuration and sensor readout in °C or °F.
Hardware and Software Development

Evaluation
QuikEval™ GUI
Software

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

UNIVERSAL 4-INPUT BOARD DC2211
UNIVERSAL PROTECTED BOARD DC2507 (LTC2986)
20-INPUT BREAKOUT BOARD
DC2296 (LTC2983), DC2420 (LTC2984), DC2531 (LTC2986)
OR DC2608 (LTC2986-1) DEMO KIT

RTD BOARD DC2213
MOTHERBOARD
QUICK EvaL™ GUI
SOFTWARE

Linduino® ONE DC2026

THERMOCOUPLE BOARD DC2212
THERMISTOR BOARD DC2214

Evaluation
QuikEval™ GUI
Software

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