Welcome!
Texas Instruments New Product Update

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- Phone lines will be muted
- Please post questions in the chat or contact your TI sales contact or field applications engineer

New Product Update:
Digital SPI temperature sensors

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November 11th, 2021

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Agenda

- TMP126 and TMP126-Q1
- TMP127-Q1
- Use cases
- Main takeaways

The world's first 0.3 °C digital temperature sensors to reach 175 °C in a plastic surface mount package

The smallest leaded SPI temperature sensors on the market

TMP126/-Q1

±0.3 °C SPI Temperature sensor with 175 °C operation, CRC, and slew rate alert

Features

- Supply range of 1.62 V to 5.5 V
- Operating temperature: -55 ˚C to 175 ˚C (up to 150 for **N** version)
- Automotive AEC-Q100 grade 0
- NIST Traceable
- 3-wire SPI interface up to 10 MHz
- Optional Cyclic Redundancy Check (CRC)
- ALERTs: Over/Under temperature limits, Slew rate alert
- Adjustable digital averaging and polling frequency
- Packages:
  - 6-pin SOT-23 DBV (2.9 mm x 1.6 mm) - Automotive device only
  - 6-pin SOT-SC70 DCK (1.25 mm x 2.0 mm) – Automotive and catalog

Device Accuracy:	-20 to 85˚C	-40 to 125˚C	-55 to 150˚C	-55 to 175˚C
TMP126	±0.3 ˚C	±0.4 ˚C	±0.5 ˚C	±1 ˚C
TMP126N	±0.8 ˚C	±0.8 ˚C	±0.8 ˚C	**N/A**
TMP126-Q1	±0.3 ˚C	±0.4 ˚C	±0.5 ˚C	±1 ˚C

Applications

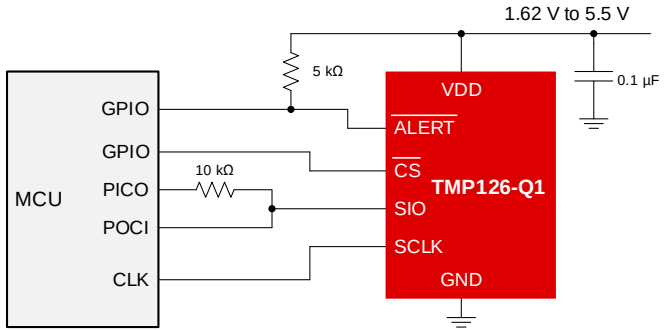
- Thermocouple cold junction compensation
- Medical
- Environmental monitoring and HVAC
- Building and Factory automation
- Instrumentation & Test
- Optical Networks
- Automotive: HEV/EV TCU

Benefits

- Ultra-high accuracy with excellent long term stability and reliability, no calibration needed.
- Accurately protect your system in noisy environments with CRC to ensure data integrity of the SPI communication.
- Automated Alerts reduce software overhead and allow for autonomous temperature monitoring
- Protect your system with a slew rate alert by detecting temperature spikes, a potential leading indicator of thermal issues.

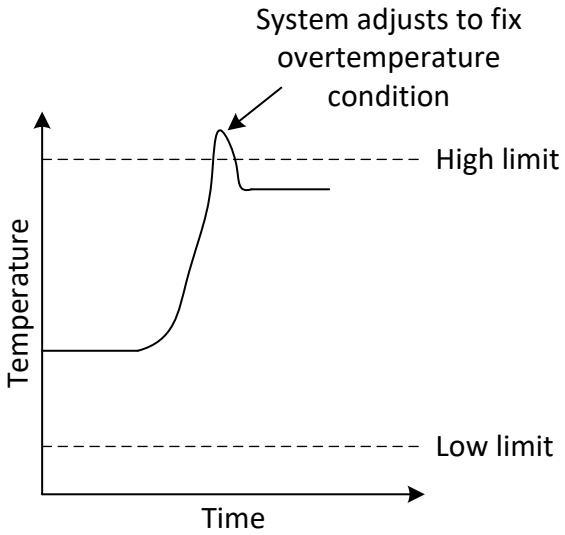
Tools/collateral

- TMP126-Q1 Datasheet
- TMP126EVM
- Automotive technical article



TMP126 Normal temperature threshold alert

Alerts are typically generated by absolute temperature readings indicating operation outside a desired range.



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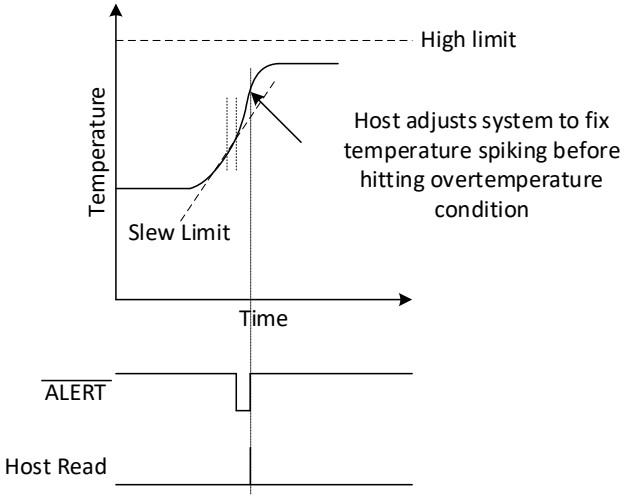
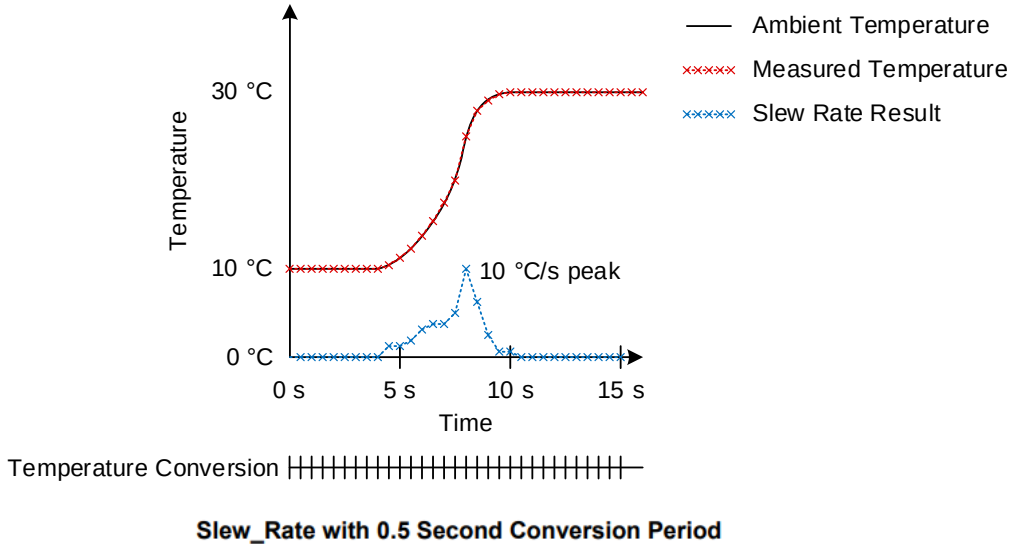
TMP126 Slew rate alert

Slew Rate alerts let your system take action before the operating temperature reaches that point.



Slew Rate Warning



Slew_Rate with 0.5 Second Conversion Period

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TMP127-Q1

±1 °C Accuracy, Digital Temperature Sensor with 175 °C Temperature support and 3-Wire SPI Compatible Interface

Features

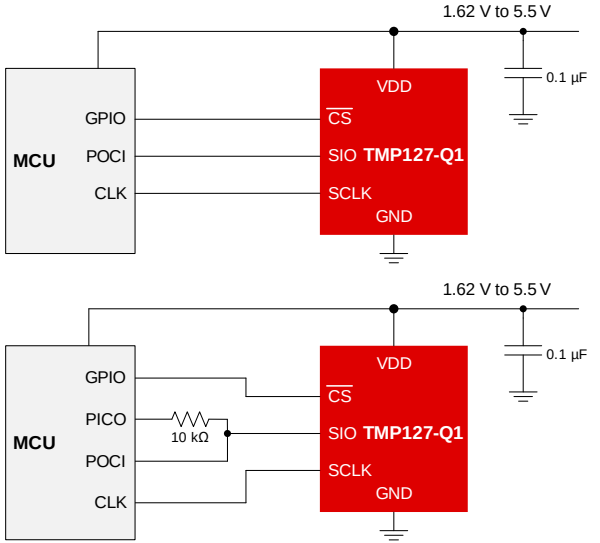
- Supply range of 1.62 V to 5.5 V
- Operating temperature -55 ˚C to 175 ˚C in SOT-23 package
- Automotive grade-0
- Accuracy:
  - ±0.8 ˚C from -55 ˚C to 150 ˚C
  - ±1 ˚C from -55 ˚C to 175 ˚C
- 3-wire SPI interface up to 10 MHz
  - Read only configuration
  - Read + write configuration
- Digital averaging
- 200 ms conversion cycle
- Package (Plastic only):
  - 6-pin SOT-23 DBV (2.9 mm x 1.6 mm)

Applications

- Thermocouple cold junction compensation
- Medical
- Environmental monitoring and HVAC
- Building and Factory automation
- Instrumentation & Test
- Optical Networks
- Automotive: HEV/EV TCU

Benefits

- Ultra-high Accuracy
  - NIST Traceable
  - No calibration needed
  - Excellent long term stability and reliability
- Simple SPI interface
  - Reduces software complexity



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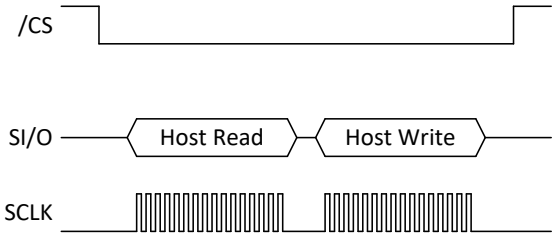
Interface differences

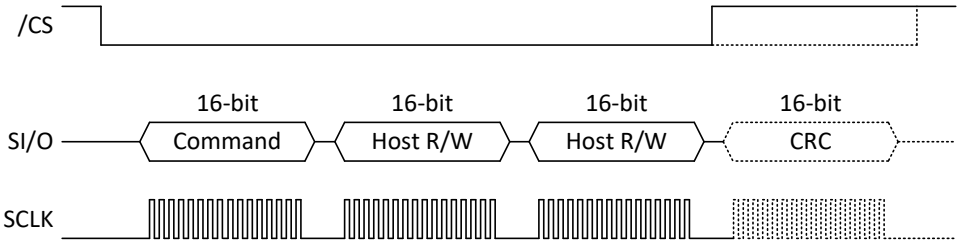
TMP127 interface

- Write is optional and always to configuration register
- Read is depends on mode
  - Continuous Mode → Temp value
  - Shutdown Mode → Device ID



TMP126 Interface

- 16-bit register based
  - Command byte first
  - Burst read and write capable
  - Optional CRC



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Use case #1: MCU Wake Up

Challenge:

Many MCUs operate from -40 °C to 125 °C, but the temperature profile is expected to be -55 °C to 125 °C.

Goal:

Put the MCU in standby mode when temperature is below -40 °C. Wake it back up when it reached -35 °C.

Requirement:

High accuracy for temperature since internal temp sense of MCU is inaccurate (7 °C+ error).

Solution:

Use TMP126 in comparator mode with Tlow_Limit set to -40 °C and Tlow_Hyst to 5 °C.

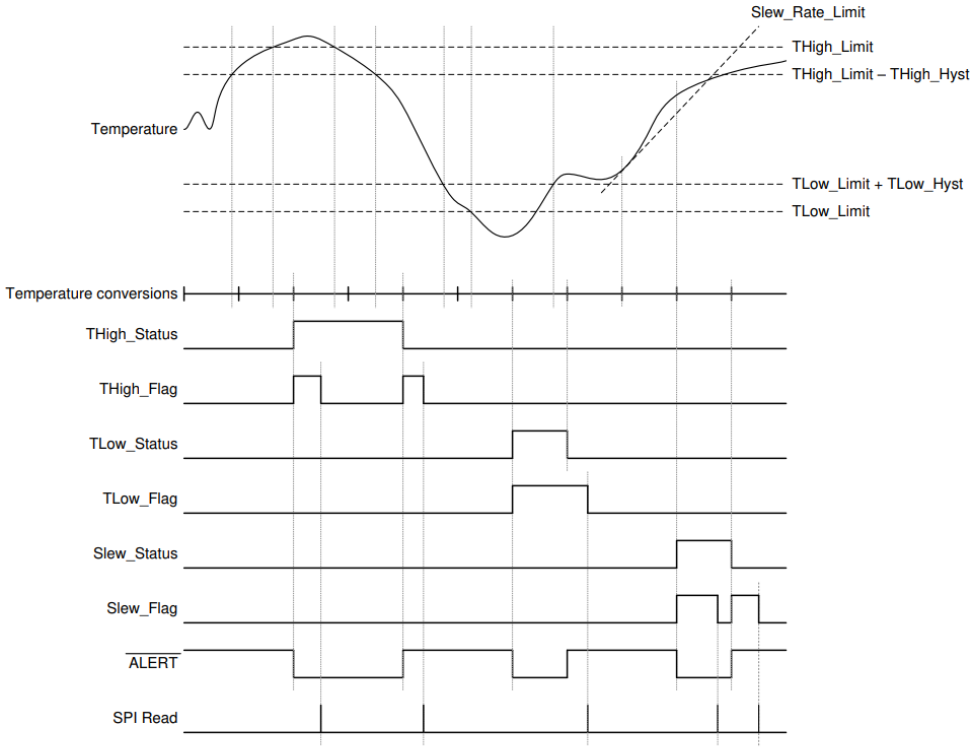

Figure 8-8. Comparator Mode Timing Diagram

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Use case #2: Reading across isolation barrier

Challenge:

Need to send accurate temperature readings and data from a SPI ADC across a uni-directional isolator without adding additional cost.

Goal:

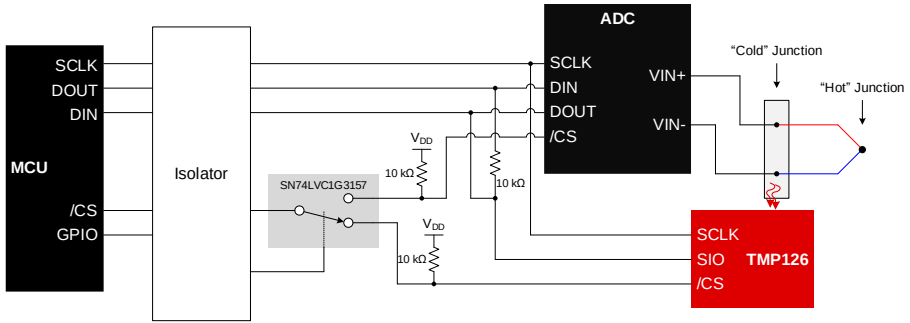
Share the uni-directional isolator with the SPI ADC.

Requirement:

High accuracy temperature measurement on the cold junction, fast (< 50 ms) conversion time, small size.

Solution:

The same uni-directional isolator for ADC SPI communication can be used for TMP126, reducing system cost compared to bi-directional isolator needed for I2C communication.



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TMP126/7 Value proposition

- **Reliable: Maintain safety and performance over time**
  - High accuracy proven over extended reliability testing, resulting in negligible drift vs discrete sensors such as RTDs and NTC thermistors.
  - Slew rate alerts help protect your components by detecting rapid temperature changes before they reach dangerous levels, allowing you to take action faster and help safeguard your system from thermal runaway.
  - 10MHz SPI communication
  - CRC data Integrity checks help accurately protect your system in noisy environments by verifying that your temperature sensor data has been transmitted correctly.

- **Accurate: Prevent false triggering and protect components more effectively**
  - High accuracy enables your system to operate closer to thermal limits and throttle/shut down only when truly needed.
  - ± 0.3 ˚C max error from -20 to 85˚C
  - NIST traceability

- **Flexible for your design**
  - Widest operating temperature (-55 C to 175 C) and supply voltage ranges, and the lowest power consumption in the SPI temperature sensor market.
  - Operating supply range: 1.62 V to 5.5 V
  - Quiescent current: 3.5 µA
  - Standby current: 0.5 µA

- **Smallest leaded SPI temperature sensor on the market**
  - 48% space savings over the next smallest option.
  - 4.2 mm^2 (Including package leads)

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