

## TDC1000 Ultrasonic Analog Front-End (AFE)

### 1 Features

- Available in AEC-Q100 (TDC1000-Q1)
- Measurement Range: Up to 8ms
- Operating Current: 1.8  $\mu$ A (2 SPS)
- Transmitter Channels TX1/TX2:
  - Supports Single or Dual-Transducer Application
  - Programmable Excitation: 31.25 kHz to 4 MHz, Up to 31 Pulses
- Receiver Channels RX1/RX2:
  - STOP Cycle-to-Cycle Jitter: 50 ps<sub>RMS</sub>
  - Low-Noise and Programmable Gain Amplifiers
  - Access to Signal Chain for External Filter Design
  - Programmable Threshold Comparator for Echo Qualification
  - Automatic Channel Swapping for Differential Time-of-Flight (TOF) Measurement
  - Programmable Low Power Mode for Long TOF Measurements
- Temperature Measurement
  - Interface to Two PT1000/500 RTDs
  - RTD-to-RTD Matching Accuracy 0.05°C<sub>RMS</sub>
- Operating Temperature Range: -40°C to 125°C

### 2 Applications

- Measurements through tanks of varying materials:
  - Fluid Level
  - Fluid Identification / Concentration
- Flow Metering: Water, Gas, Heat, CPAP

- Distance/Proximity Sensing

### 3 Description

The TDC1000 is a fully integrated analog front-end (AFE) for ultrasonic sensing measurements of level, fluid identification/ concentration, flow, and proximity/ distance applications common in automotive, industrial, medical, and consumer markets. When paired with an MSP430/C2000 MCU, power, wireless, and source code, TI provides the complete ultrasonic sensing solution.

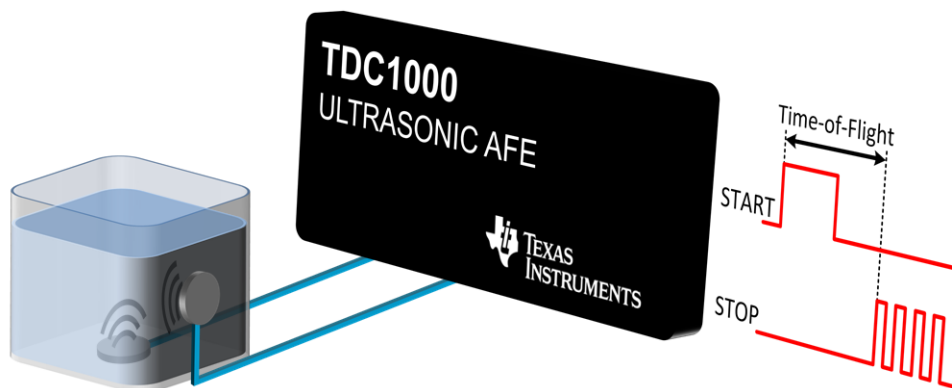
TI's Ultrasonic AFE offers programmability and flexibility to accommodate a wide-range of applications and end equipment. The TDC1000 can be configured for multiple transmit pulses and frequencies, gain, and signal thresholds for use with a wide-range of transducer frequencies (31.25kHz to 4MHz) and Q-factors. Similarly, the programmability of the receive path allows ultrasonic waves to be detected over a wider range of distances/tank sizes and through various mediums.

Selecting different modes of operation, the TDC1000 can be optimized for low power consumption making it ideal for battery powered flow meters, level instrumentation, and distance/ proximity measurements. The low noise amplifiers and comparators provide extremely low jitter, enabling picosecond resolution and accuracy for zero and low flow measurements.

Device Information<sup>(1)</sup>

PART NUMBER	PACKAGE	BODY SIZE (NOM)
TDC1000	TSSOP (28)	9.70 × 4.40 mm
TDC1000-Q1	TSSOP (28)	9.70 × 4.40 mm

(1) For all available packages, see the orderable addendum at the end of the data sheet.



## 4 Revision History

DATE	REVISION	NOTES
October 2014	*	Initial release.

## 5 Device and Documentation Support

### 5.1 Documentation Support

For related documentation see the following:

- TDC1000 Temperature Sensing Glitch, [SNAA218](#)

### 5.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

**Table 1. Related Links**

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
TDC1000	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>
TDC1000-Q1	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>	<a href="#">Click here</a>

### 5.3 Trademarks

### 5.4 Electrostatic Discharge Caution



These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

### 5.5 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 6 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TDC1000QPWQ1	PREVIEW	TSSOP	PW	28	48	TBD	Call TI	Call TI	-40 to 125		
TDC1000QPWRQ1	PREVIEW	TSSOP	PW	28	2500	TBD	Call TI	Call TI	-40 to 125		

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check <http://www.ti.com/productcontent> for the latest availability information and additional product content details.

**TBD:** The Pb-Free/Green conversion plan has not been defined.

**Pb-Free (RoHS):** TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.

**Pb-Free (RoHS Exempt):** This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.

**Green (RoHS & no Sb/Br):** TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead/Ball Finish - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead/Ball Finish values may wrap to two lines if the finish value exceeds the maximum column width.

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**OTHER QUALIFIED VERSIONS OF TDC1000, TDC1000-Q1 :**

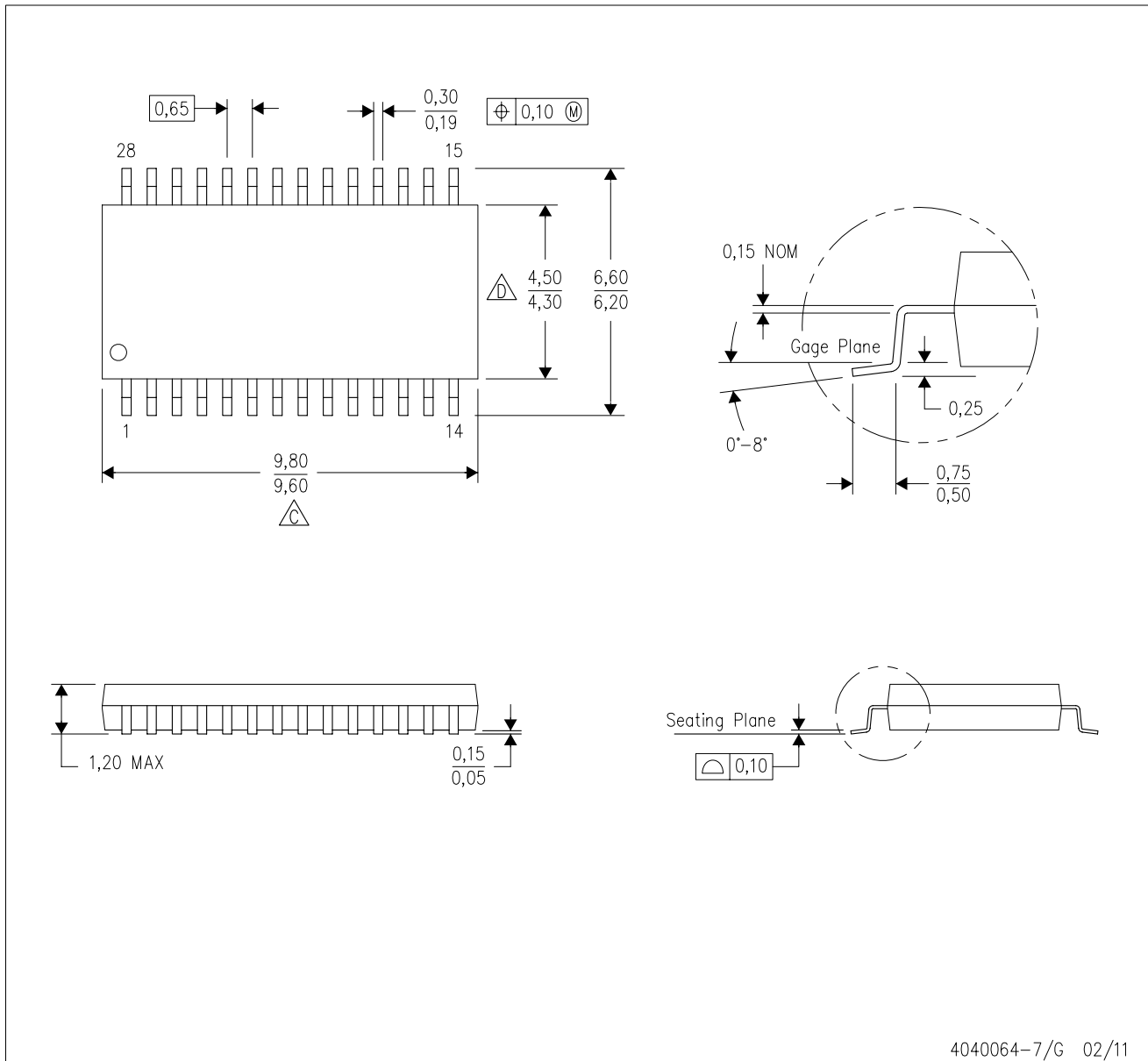
- Catalog: [TDC1000](#)
- Automotive: [TDC1000-Q1](#)

## NOTE: Qualified Version Definitions:

- Catalog - TI's standard catalog product
- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

PW (R-PDSO-G28)

PLASTIC SMALL OUTLINE



4040064-7/G 02/11

- NOTES:
- A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M-1994.
  - B. This drawing is subject to change without notice.
  - C. Body length does not include mold flash, protrusions, or gate burrs. Mold flash, protrusions, or gate burrs shall not exceed 0,15 each side.
  - D. Body width does not include interlead flash. Interlead flash shall not exceed 0,25 each side.
  - E. Falls within JEDEC MO-153

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TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

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Amplifiers	<a href="http://amplifier.ti.com">amplifier.ti.com</a>
Data Converters	<a href="http://dataconverter.ti.com">dataconverter.ti.com</a>
DLP® Products	<a href="http://www.dlp.com">www.dlp.com</a>
DSP	<a href="http://dsp.ti.com">dsp.ti.com</a>
Clocks and Timers	<a href="http://www.ti.com/clocks">www.ti.com/clocks</a>
Interface	<a href="http://interface.ti.com">interface.ti.com</a>
Logic	<a href="http://logic.ti.com">logic.ti.com</a>
Power Mgmt	<a href="http://power.ti.com">power.ti.com</a>
Microcontrollers	<a href="http://microcontroller.ti.com">microcontroller.ti.com</a>
RFID	<a href="http://www.ti-rfid.com">www.ti-rfid.com</a>
OMAP Applications Processors	<a href="http://www.ti.com/omap">www.ti.com/omap</a>
Wireless Connectivity	<a href="http://www.ti.com/wirelessconnectivity">www.ti.com/wirelessconnectivity</a>

### Applications

Automotive and Transportation	<a href="http://www.ti.com/automotive">www.ti.com/automotive</a>
Communications and Telecom	<a href="http://www.ti.com/communications">www.ti.com/communications</a>
Computers and Peripherals	<a href="http://www.ti.com/computers">www.ti.com/computers</a>
Consumer Electronics	<a href="http://www.ti.com/consumer-apps">www.ti.com/consumer-apps</a>
Energy and Lighting	<a href="http://www.ti.com/energy">www.ti.com/energy</a>
Industrial	<a href="http://www.ti.com/industrial">www.ti.com/industrial</a>
Medical	<a href="http://www.ti.com/medical">www.ti.com/medical</a>
Security	<a href="http://www.ti.com/security">www.ti.com/security</a>
Space, Avionics and Defense	<a href="http://www.ti.com/space-avionics-defense">www.ti.com/space-avionics-defense</a>
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