TDC7200 Time-to-Digital Converter for Water, Gas, Heat Flow Metering Applications

1 Features

- Resolution: 55 ps
- Standard Deviation: 35 ps
- Measurement Range:
  - Mode 1: 12 ns to 500 ns
  - Mode 2: 250 ns to 8 ms
- Low Power Consumption: 0.5 uA (2 SPS)
- Supports up to 5 STOP Signals
- Autonomous Multi-Cycle Averaging Mode for Low Power Consumption
- Supply Voltage: 2.0 V to 3.6 V
- Operating Temperature: –40°C to 85°C
- SPI Host Interface for Configuration and Register Access

2 Applications

- Flow Meter: Water Meter, Gas Meter, Heat Meter
- Heat Cost Allocators

3 Description

The TDC7200 is a Time to Digital Converter (TDC) for ultrasonic sensing measurements such as water flow meter, gas flow meter, and heat flow meter. When paired with the TDC1000 (ultrasonic analog-front-end), the TDC7200 can be a part of a complete TI ultrasonic sensing solution that includes the MSP430, power, wireless, and source code.

The Time to Digital Converter (TDC) performs the function of a stopwatch and measures the elapsed time (time-of-flight or TOF) between a START pulse and up to five STOP pulses. The ability to measure from START to multiple STOPs gives users the flexibility to select which STOP pulse yields the best echo performance.

The device has an internal self-calibrated time base which compensates for drift over time and temperature. Self-calibration enables time-to-digital conversion accuracy in the order of picoseconds. This accuracy makes the TDC7200 ideal for flow meter applications, where zero and low flow measurements require high accuracy.

When placed in the Autonomous Multi-Cycle Averaging Mode, the TDC7200 can be optimized for low system power consumption, making it ideal for battery powered flow meters. In this mode, the host can go to sleep to save power, and it can wake up when interrupted by the TDC upon completion of the measurement sequence.

Device Information(1)

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PACKAGE</th>
<th>BODY SIZE (NOM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDC7200</td>
<td>TSSOP (14)</td>
<td>5.00 mm × 4.40 mm</td>
</tr>
</tbody>
</table>

Companion Device

<table>
<thead>
<tr>
<th>PART NO.</th>
<th>TITLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDC1000</td>
<td>Ultrasonic Sensing Analog Front End for Level, Concentration, Flow &amp; Proximity Sensing</td>
</tr>
</tbody>
</table>

(1) For all available packages, see the orderable addendum at the end of the datasheet.
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4 Revision History

<table>
<thead>
<tr>
<th>DATE</th>
<th>REVISION</th>
<th>NOTES</th>
</tr>
</thead>
<tbody>
<tr>
<td>February 2015</td>
<td>*</td>
<td>Initial release.</td>
</tr>
</tbody>
</table>
5 Device and Documentation Support

5.1 Documentation Support

5.1.1 Related Documentation

- **TDC1000**: Ultrasonic Sensing Analog Front End for Level, Concentration, Flow & Proximity Sensing Applications

5.2 Trademarks

All trademarks are the property of their respective owners.

5.3 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.

5.4 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.
# PACKAGE OPTION ADDENDUM

## PACKAGING INFORMATION

<table>
<thead>
<tr>
<th>Orderable Device</th>
<th>Status</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>Package Qty</th>
<th>Eco Plan</th>
<th>Lead finish/Ball material</th>
<th>MSL Peak Temp</th>
<th>Op Temp (°C)</th>
<th>Device Marking (4/5)</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>TDC7200PW</td>
<td>ACTIVE</td>
<td>TSSOP</td>
<td>PW</td>
<td>14</td>
<td>90</td>
<td>RoHS &amp; Green</td>
<td>NIPDAU</td>
<td>Level-1-260C-UNLIM</td>
<td>-40 to 85</td>
<td>T7200</td>
<td></td>
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<tr>
<td>TDC7200PWR</td>
<td>ACTIVE</td>
<td>TSSOP</td>
<td>PW</td>
<td>14</td>
<td>2000</td>
<td>RoHS &amp; Green</td>
<td>NIPDAU</td>
<td>Level-1-260C-UNLIM</td>
<td>-40 to 85</td>
<td>T7200</td>
<td>Samples</td>
</tr>
</tbody>
</table>

(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) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

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

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Addendum-Page 1
TAPE AND REEL INFORMATION

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<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Reel Diameter (mm)</th>
<th>Reel Width W1 (mm)</th>
<th>A0 (mm)</th>
<th>B0 (mm)</th>
<th>K0 (mm)</th>
<th>P1 (mm)</th>
<th>W (mm)</th>
<th>Pin1 Quadrant</th>
</tr>
</thead>
<tbody>
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<td>TDC7200PWR</td>
<td>TSSOP</td>
<td>PW</td>
<td>14</td>
<td>2000</td>
<td>330.0</td>
<td>12.4</td>
<td>6.9</td>
<td>5.6</td>
<td>1.6</td>
<td>8.0</td>
<td>12.0</td>
<td>Q1</td>
</tr>
</tbody>
</table>

*All dimensions are nominal*

- A0: Dimension designed to accommodate the component width
- B0: Dimension designed to accommodate the component length
- K0: Dimension designed to accommodate the component thickness
- W: Overall width of the carrier tape
- P1: Pitch between successive cavity centers
## TAPE AND REEL BOX DIMENSIONS

*All dimensions are nominal

<table>
<thead>
<tr>
<th>Device</th>
<th>Package Type</th>
<th>Package Drawing</th>
<th>Pins</th>
<th>SPQ</th>
<th>Length (mm)</th>
<th>Width (mm)</th>
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</thead>
<tbody>
<tr>
<td>TDC7200PWR</td>
<td>TSSOP</td>
<td>PW</td>
<td>14</td>
<td>2000</td>
<td>350.0</td>
<td>350.0</td>
<td>43.0</td>
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</table>
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
NOTES:  
A. All linear dimensions are in millimeters.  
B. This drawing is subject to change without notice.  
C. Publication IPC-7351 is recommended for alternate designs.  
D. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC-7525 for other stencil recommendations.  
E. Customers should contact their board fabrication site for solder mask tolerances between and around signal pads.
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