PGA400-Q1 Pressure-Sensor Signal Conditioner

1 Features

- Analog features
  - Analog front-end for resistive bridge sensors
  - Self-oscillating demodulator for capacitive sensors
  - On-chip temperature sensor
  - Programmable gain
  - 16-bit, 1-MHz sigma-delta analog-to-digital converter for signal channel
  - 10-bit sigma-delta analog-to-digital converter for temperature channel
  - Two 12-bit digital-to-analog outputs
- Digital features
  - Microcontroller core
    - 10-MHz 8051 WARP core
    - 2 clocks per instruction cycle
  - On-chip oscillator
  - Memory
    - 8KB of OTP memory
    - 89 bytes of EEPROM
    - 256 bytes data SRAM
- Peripheral features
  - Serial peripheral interface (SPI)
  - Inter-integrated circuit (I²C)
  - One-wire interface (OWI)
  - Two input capture ports
  - Two output compare ports
  - Software watchdog timer
  - Oscillator watchdog
  - Power management control
  - Analog low-voltage detect
- General features
  - AEC-Q100 qualified with the following results:
    - Device temperature grade 1: −40°C to +125°C ambient operating temperature
    - Device HBM ESD classification level 2
    - Device HBM ESD classification level C3B
    - Power supply: 4.5-V to 5.5-V operational, −5.5-V to 16-V absolute maximum

2 Applications

- Pressure sensor-signal conditioning
- Level sensor-signal conditioning
- Humidity sensor-signal conditioning

3 Description

The PGA400-Q1 is an interface device for piezoresistive, strain gauge, and capacitive-sense elements. The device incorporates the analog front end (AFE) that directly connects to the sense element and has voltage regulators and an oscillator. The device also includes a sigma-delta analog-to-digital converter (ADC), 8051 WARP core microprocessor, and OTP memory. Sensor compensation algorithms can be implemented in software. The PGA400-Q1 also includes two digital-to-analog converter (DAC) outputs.

Device Information

<table>
<thead>
<tr>
<th>PART NUMBER</th>
<th>PACKAGE</th>
<th>BODY SIZE (NOM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGA400QRHHQ1</td>
<td>VQFN (36)</td>
<td>6.00 mm × 6.00 mm</td>
</tr>
<tr>
<td>PGA400QYRQ1</td>
<td>WCSP (36)</td>
<td>3.65 mm × 3.65 mm</td>
</tr>
</tbody>
</table>

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

Simplified Schematic
4 Device and Documentation Support

4.1 Documentation Support

4.1.1 Related Documentation
For related documentation see the following:
• Texas Instruments, PGA400-Q1 EVM user guide
• Texas Instruments, PGA400-Q1 errata
• Texas Instruments, Shelf-Life Evaluation of Lead-Free Component Finishes application report

4.2 Receiving Notification of Documentation Updates
To receive notification of documentation updates, navigate to the device product folder on ti.com. In the upper right corner, click on Alert me to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

4.3 Community Resources
The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's Terms of Use.

TI E2ETM Online Community TI's Engineer-to-Engineer (E2E) Community. Created to foster collaboration among engineers. At e2e.ti.com, you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

Design Support TI's Design Support Quickly find helpful E2E forums along with design support tools and contact information for technical support.

4.4 Trademarks
E2E is a trademark of Texas Instruments.
All other trademarks are the property of their respective owners.

4.5 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.

4.6 Glossary

SLYZ022 — Ti Glossary.
This glossary lists and explains terms, acronyms, and definitions.

5 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

<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/Ball Finish</th>
<th>MSL Peak Temp</th>
<th>Op Temp (°C)</th>
<th>Device Marking</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGA400QRH4RQ1</td>
<td>ACTIVE</td>
<td>VQFN</td>
<td>RHH</td>
<td>36</td>
<td>2500</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>CU NIPDAU</td>
<td>Level-3-260C-168 HR</td>
<td>-40 to 125</td>
<td>PGA400Q RHH-Q100</td>
<td>Samples</td>
</tr>
<tr>
<td>PGA400QY2SRQ2</td>
<td>ACTIVE</td>
<td>DSBGA</td>
<td>YZS</td>
<td>36</td>
<td>1500</td>
<td>Green (RoHS &amp; no Sb/Br)</td>
<td>SNAGCU</td>
<td>Level-1-260C-UNLIM</td>
<td>-40 to 125</td>
<td>PGA400</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/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 PGA400-Q1:

- Enhanced Product: PGA400-EP

NOTE: Qualified Version Definitions:

- Enhanced Product - Supports Defense, Aerospace and Medical Applications
### TAPE AND REEL INFORMATION

<table>
<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>Pin 1 Quadrant</th>
</tr>
</thead>
<tbody>
<tr>
<td>PGA400QRHRQ1</td>
<td>VQFN</td>
<td>RHH</td>
<td>36</td>
<td>2500</td>
<td>330.0</td>
<td>16.4</td>
<td>6.3</td>
<td>6.3</td>
<td>1.1</td>
<td>12.0</td>
<td>16.0</td>
<td>Q2</td>
</tr>
<tr>
<td>PGA400QYZSRQ1</td>
<td>DSBGA</td>
<td>YZS</td>
<td>36</td>
<td>1500</td>
<td>180.0</td>
<td>12.4</td>
<td>3.79</td>
<td>3.79</td>
<td>0.71</td>
<td>8.0</td>
<td>12.0</td>
<td>Q1</td>
</tr>
</tbody>
</table>

*All dimensions are nominal.*

- **Device**: The type of device.
- **Package Type**: The type of package.
- **Package Drawing**: The drawing reference for the package.
- **Pins**: The number of pins on the device.
- **SPQ**: The specific quantity of the device.
- **Reel Diameter**: The diameter of the reel.
- **Reel Width**: The width of the tape reel.
- **A0**: The dimension designed to accommodate the component width.
- **B0**: The dimension designed to accommodate the component length.
- **K0**: The dimension designed to accommodate the component thickness.
- **P1**: The pitch between successive cavity centers.
- **W**: The overall width of the carrier tape.

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## 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>
<th>Height (mm)</th>
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</thead>
<tbody>
<tr>
<td>PGA400QRRHHRQ1</td>
<td>VQFN</td>
<td>RHH</td>
<td>36</td>
<td>2500</td>
<td>367.0</td>
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<td>38.0</td>
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<tr>
<td>PGA400QYISRQ1</td>
<td>DSBGA</td>
<td>YZS</td>
<td>36</td>
<td>1500</td>
<td>210.0</td>
<td>185.0</td>
<td>35.0</td>
</tr>
</tbody>
</table>
This image is a representation of the package family, actual package may vary. Refer to the product data sheet for package details.
NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.
NOTES: (continued)

4. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/slua271).

5. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.
NOTES: (continued)

6. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. See Texas Instruments Literature No. SNVA009 (www.ti.com/lit/snva009).
NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.
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