# AFE1256 256-Channel, Analog Front-End for Digital X-Ray, Flat-Panel Detectors

## 1 Features

- 256 Channels
- On-Chip, 16-Bit ADC
- Photodiode Short Immunity
- Column Short Immunity
- High Performance:
  - Noise: 758 e-RMS with 28-pF Sensor Capacitor in 1.2-pC Range
  - Integral Nonlinearity: ±2 LSB with Internal 16-Bit ADC
  - Minimum Scan Time:
    - 37.9 µs in Normal Mode
    - 20 µs in 2x Binning Mode
- Integration:
  - Eight Selectable Full-Scale Ranges: 0.15 pC (Min) to 9.6 pC (Max)
  - Built-In Correlated Double Sampler
  - 2x Binning (Averages Charge of Two Adjacent Channels) for Faster Throughput
  - Pipelined Integrate and Read: Allows Data Read During Integration
- Flexibility:
  - Electron and Hole Integration
- Low Power:
  - 2.9 mW/Ch with ADC
  - 2.3 mW/Ch without ADC
  - 0.1 mW/Ch in Nap Mode
  - Total Power-Down Feature
- 22-mm × 5-mm Gold-Bump Die, Suitable for TCP and COF

## 2 Application

Flat-Panel, X-Ray Detector

## 3 Description

The AFE1256 is a 256-channel, analog front-end (AFE) designed to suit the requirements of flat-panel detectors (FPDs) based on digital X-ray systems. The device includes 256 integrators, a programmable gain amplifier (PGA) for full-scale, charge-level selection, a correlated double sampler (CDS) with dual banking, 256:4 analog multiplexers, and four 16-bit, successive-approximation register (SAR) analog-to-digital converters (ADCs) onboard. Serial data from the ADCs are available in SPI™ format.

Hardware-selectable integration polarity allows for the integration of positive or negative charge and provides more flexibility in system design. The Nap feature enables substantial power saving. This power savings is especially useful in battery-powered systems.

The device is available as a 22-mm × 5-mm gold-bumped die and a 38-mm × 28-mm, COF-314 TDS package in singulated forms.

To request a full data sheet or other design resources: request AFE1256

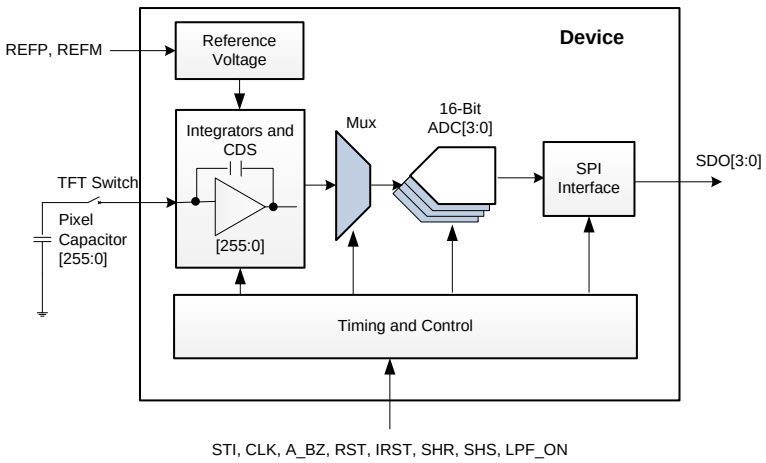
**Device Information(1)**

| ORDER NUMBER | PACKAGE | BODY SIZE |
|---|---|---|
| AFE1256GBTD | Gold-bump die (533) | 22 mm × 5 mm |
| AFE1256TDS | COF (314) | 38 mm × 28 mm |

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

(2) Product-preview device.

**AFE1256 Schematic**



## Table of Contents



## 4 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

**Changes from Revision C (August 2015) to Revision D** — **Page**

- Added link to request full data sheet ... 1

**Changes from Revision B (April 2014) to Revision C** — **Page**

- Changed document status from Mixed to Production Data ... 1
- Deleted TDQ package from document ... 1
- Changed last paragraph of *Description* section ... 1
- Deleted second row from *Device Information* table ... 1
- Changed *Tray Dimensions* section: deleted Figure 1 ... 4

**Changes from Revision A (March 2014) to Revision B** — **Page**

- Changed TDS package to Production Data ... 1

**Changes from Original (October 2013) to Revision A** — **Page**

- Made changes to product preview data sheet ... 1

# 5 Device and Documentation Support

## 5.1 Trademarks

SPI is a trademark of Motorola.
All other trademarks are the property of their respective owners.

## 5.2 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.

## 5.3 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.

## 6.1 Tray Dimensions

Tray dimensions for the TDS package is shown in Figure 1.

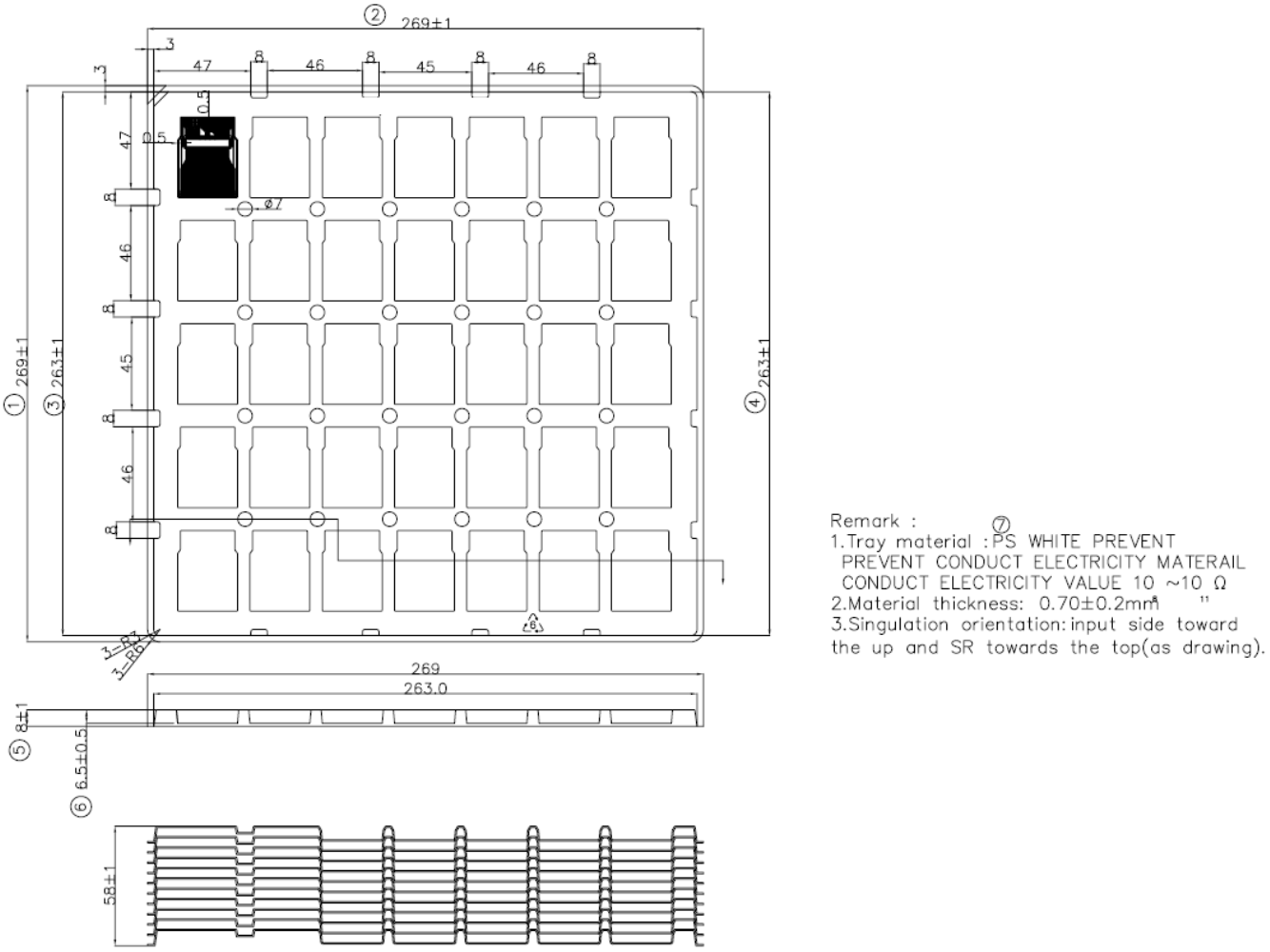



**Figure 1. TDS Tray Dimensions**

## 6.2 GBTD Die

Figure 2 does not take into account the scribe seal.

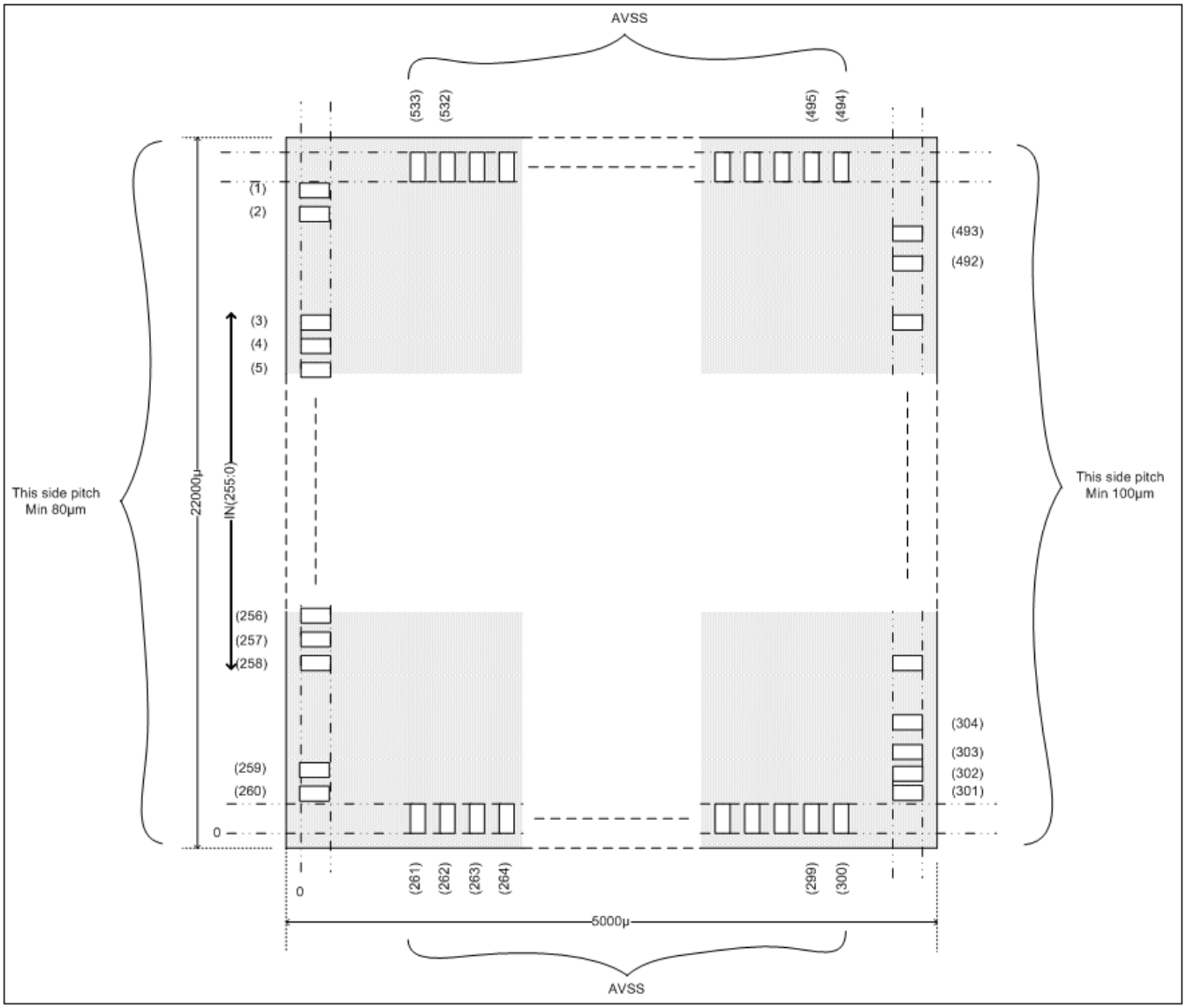



**Figure 2. GBTD Die Mechanical Data**

## GBTD Die (continued)

Figure 3 provides the tray dimensions for the GBTD die.

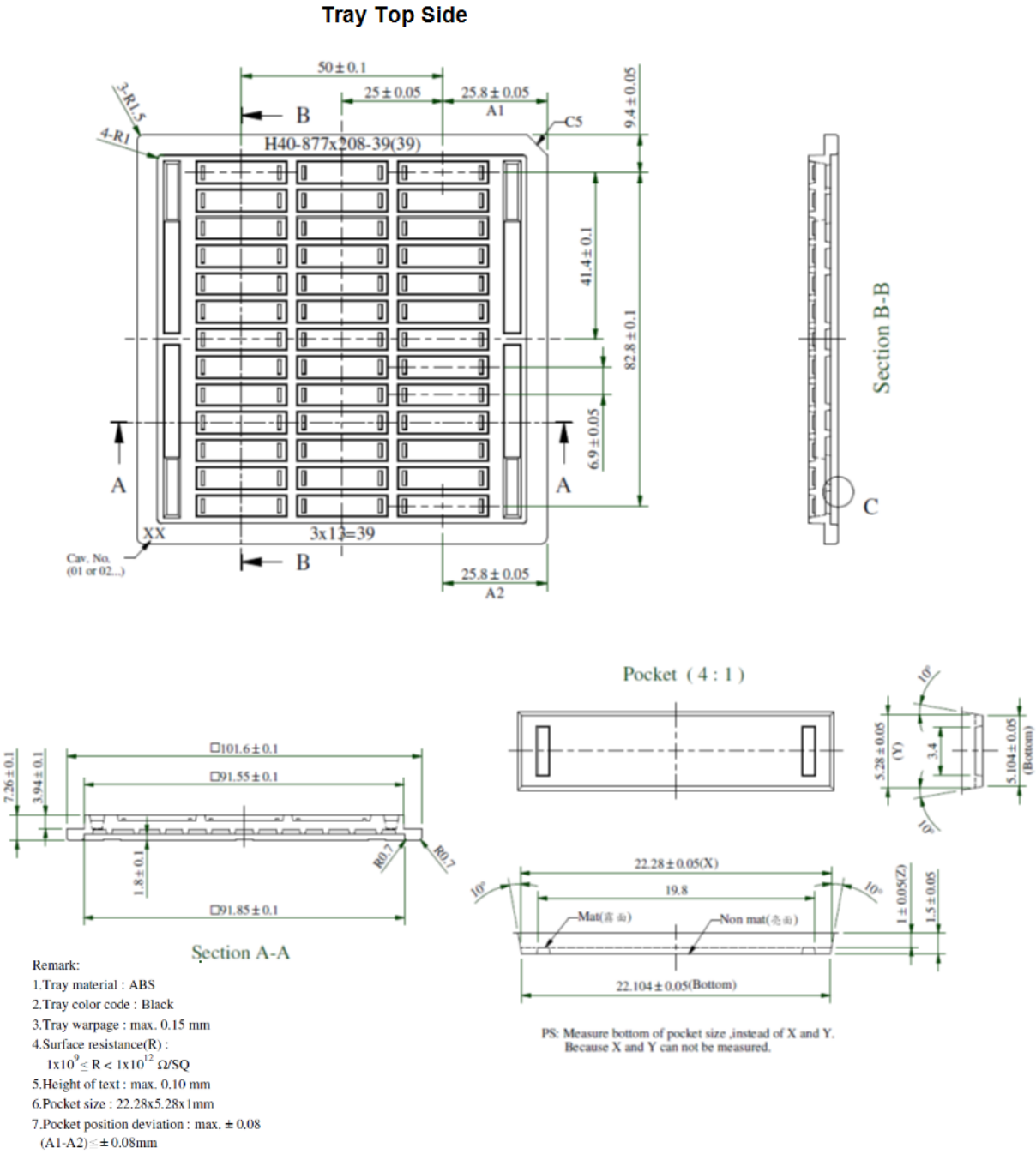



**Figure 3. GBTD Die Tray Dimension Details**

## GBTD Die (continued)

Dies are placed active side up (bumps up) into waffle pack. The waffle pack notch is at the upper right, as shown in Figure 4.

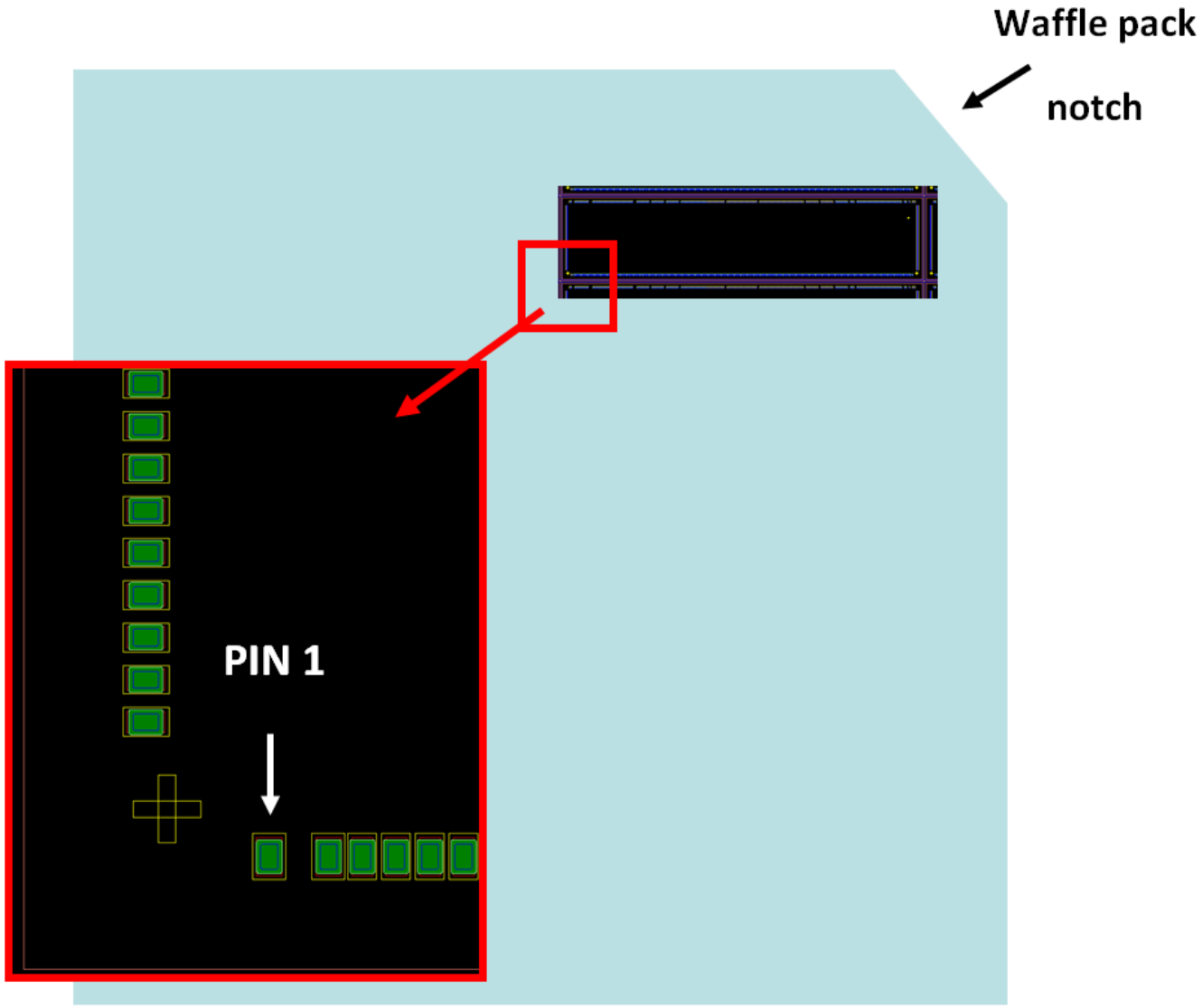



**Figure 4. GBTD Die, Pin 1 Location**

## PACKAGING INFORMATION

| Orderable part number | Status (1) | Material type (2) | Package \| Pins | Package qty \| Carrier | RoHS (3) | Lead finish/ Ball material (4) | MSL rating/ Peak reflow (5) | Op temp (°C) | Part marking (6) |
|---|---|---|---|---|---|---|---|---|---|
| AFE1256GBTD | Active | Production | null (null) \| 0 | 39 \| TUBE | Yes | Call TI | Call TI | 0 to 70 | AFE1256 |
| AFE1256GBTD.A | Active | Production | null (null) \| 0 | 39 \| TUBE | Yes | Call TI | Call TI | 0 to 70 | AFE1256 |
| AFE1256TDS | Active | Production | COF (TDS) \| 314 | 35 \| JEDEC TRAY (10+1) | Yes | AU | N/A for Pkg Type | 0 to 70 | AFE1256TDS |
| AFE1256TDS.A | Active | Production | COF (TDS) \| 314 | 35 \| JEDEC TRAY (10+1) | Yes | AU | N/A for Pkg Type | 0 to 70 | AFE1256TDS |

(1) **Status:** For more details on status, see our product life cycle.

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the TI RoHS Statement for additional information and value definition.

(4) **Lead finish/Ball material:** Parts 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.

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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Last updated 10/2025