AWR2188 Single Chip 8x8 Cascadable 76-to-81 GHz Transceiver in LOP package

1 Features

- FMCW transceiver
  - Integrated PLL, transmitter, receiver, baseband, and ADC
  - 76-81GHz operation with up to 4.5GHz continuous chirp bandwidth
  - Eight receive channels
  - Eight transmit channels
  - Ultra-accurate chirp engine based on Fractional-N PLL
  - TX power: 13.5dBm
  - RX noise figure: 10dB
  - Best in class linearity enabling P1dB up to -5dBm while maintaining good noise figure
  - Industry leading 8 transmitter, 8 receiver radar front end with 2.8W power consumption
  - Minimum chirp idle time of 3 µs for excellent max velocity measurements
  - Maximum chirp slope of 266MHz/µs to enable rapid high-bandwidth measurements
  - ADC Sample rate up to 66.67 MSPS for exceptional instrumentation range distance
- Built-in calibration and self-test
  - Built-in firmware (ROM)
  - Self-calibrating system across process and temperature
- Host interface
  - Control interface with external processor over SPI or I2C interface
  - Data interface with external processor over MIPI D-PHY and CSI2 v1.2
  - Interrupts for Fault Reporting
- Functional Safety-Compliant targeted
  - Developed for functional safety applications
  - Documentation available to aid ISO 26262 functional safety system design
  - Systematic capability up to ASIL-D targeted
  - Hardware capability up to ASIL-B targeted
  - Safety-related certification
    - ISO 26262 certification by TUV planned
- AEC-Q100 Targeted
- AWR2188 advanced features
  - Embedded self-monitoring with limited Host processor involvement
  - Option of cascading multiple devices to increase channel count
  - Embedded interference detection capability
- Power management
  - Built-in LDO Network for enhanced PSRR
  - I/Os support dual voltage 3.3V/1.8V
- Clock source
  - Supports externally driven clock (square/sine) at 50 MHz or 40 MHz
  - Supports 50 MHz or 40 MHz crystal connection with load capacitors
- Easy hardware design
  - Production proven innovative Launch on Package (LOP) technology with easy to route launcher positions
  - 0.5mm pitch 14mm × 15mm FCCSP package for easy assembly and low-cost PCB design
  - Small solution size
- Operating Conditions
  - Junction temp range: –40°C to 140°C, and –40°C to 142°C in TX module

2 Applications

- Automated Highway Driving
- Automatic Emergency Braking
- Adaptive Cruise Control
- Imaging Radar using Cascading Configuration

ADVANCE INFORMATION

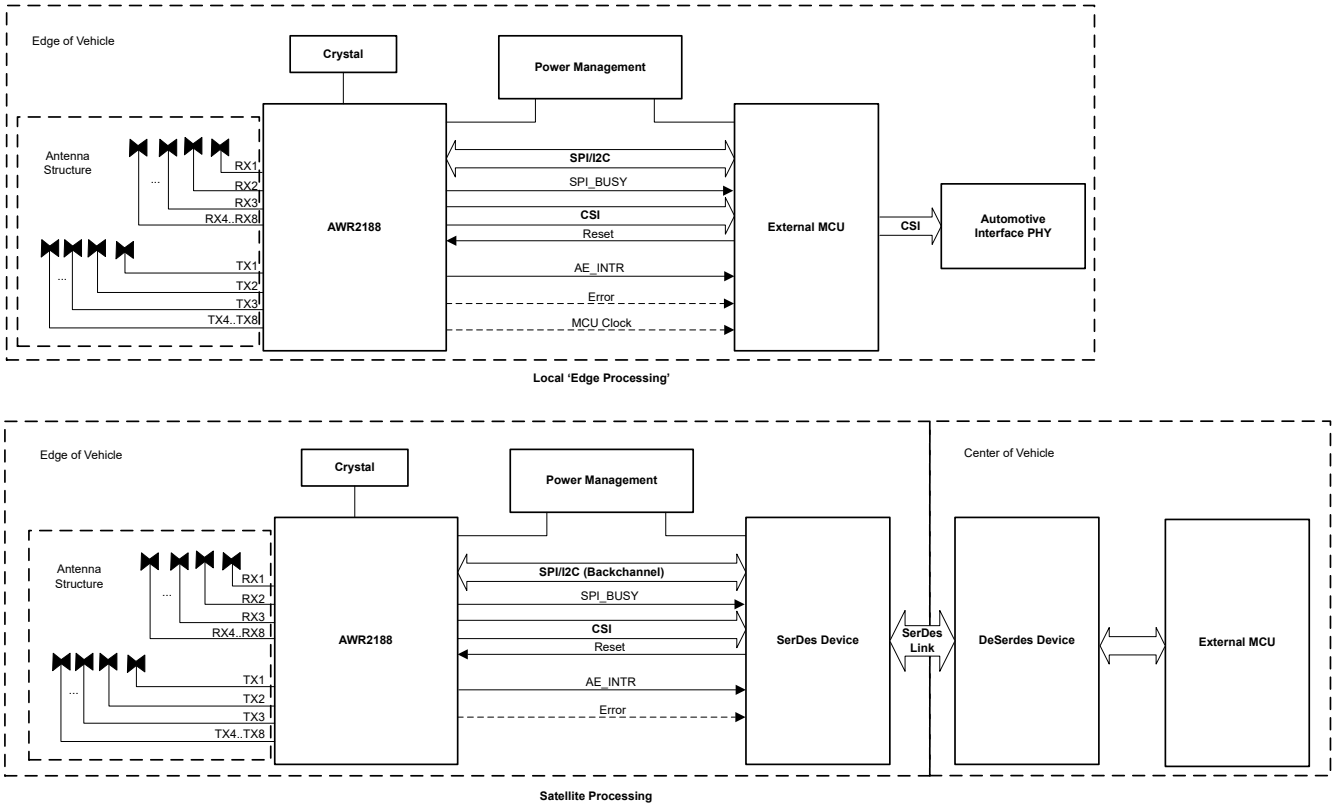


Figure 2-1. Radar Sensor for Automotive Applications

ADVANCE INFORMATION

3 Description

The AWR2188 device is an integrated single-chip FMCW transceiver capable of operation in the 76GHz to 81GHz band. The device enables unprecedented levels of integration in an extremely small form factor. AWR2188 is designed for low power, self-monitored, ultra-accurate radar systems in the automotive space.

The AWR2188 device is a self-contained FMCW transceiver single-chip device that simplifies the implementation of Automotive Radar sensors in the band of 76GHz to 81GHz. The device is built on TI's low-power 45nm RFCMOS process, which enables a monolithic implementation of a 8TX, 8RX system with built-in PLL and ADC converters. Simple programming model changes can enable a wide variety of sensor implementation (Short, Mid, Long) with the possibility of dynamic reconfiguration for implementing a multimode sensor. Additionally, the device is provided as a complete platform device including reference hardware design, software drivers, sample configurations, API guide, and user documentation.

Device Information

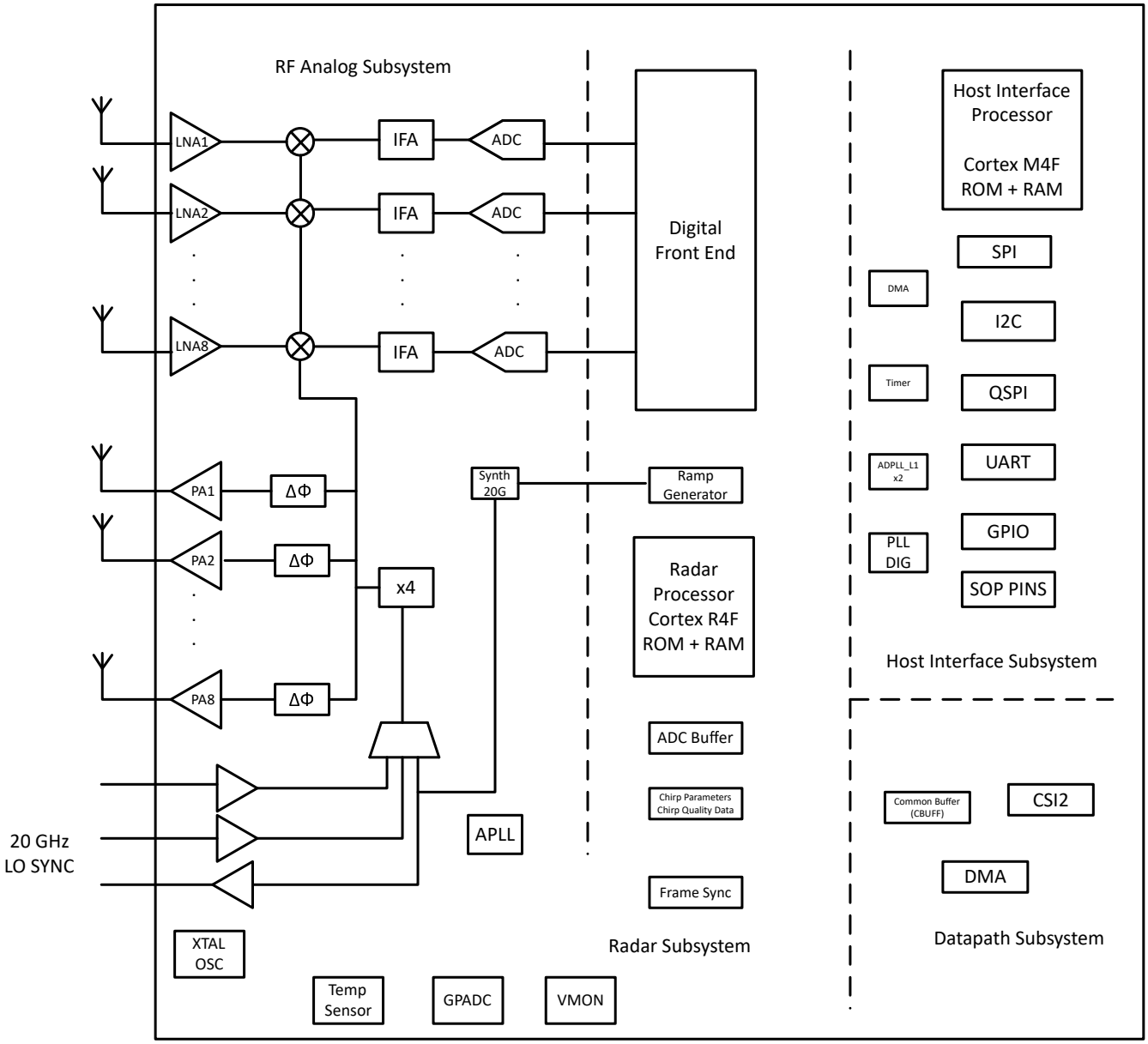
PART NUMBER(1)	PACKAGE	BODY SIZE
XA2188BGAPE (Tray)	APE (FCBGA, 573)	14mm x 15mm
XA2188BGAPER (Reel)	APE (FCBGA, 573)	14mm x 15mm

(1) For more information, see *Mechanical Packaging and Orderable Information*.

ADVANCE INFORMATION

ADVANCE INFORMATION

4 Functional Block Diagram



A. Multi-chip cascading feature is available in AWR2188
B. Internal temperature sensor accuracy is ± 3 °C.

5 Device and Documentation Support

TI offers an extensive line of development tools. Tools and software to evaluate the performance of the device, generate code, and develop solutions are listed below.

5.1 Device Nomenclature

To designate the stages in the product development cycle, TI assigns prefixes to the part numbers of all microprocessors (MPUs) and support tools. Each device has one of three prefixes: X, P, or null (no prefix) (for example, *XA2F44BDALL*). Texas Instruments recommends two of three possible prefix designators for its support tools: TMDX and TMDS. These prefixes represent evolutionary stages of product development from engineering prototypes (TMDX) through fully qualified production devices and tools (TMDS).

Device development evolutionary flow:

X Experimental device that is not necessarily representative of the final device's electrical specifications and may not use production assembly flow.

P Prototype device that is not necessarily the final silicon die and may not necessarily meet final electrical specifications.

null Production version of the silicon die that is fully qualified.

Support tool development evolutionary flow:

TMDX Development-support product that has not yet completed Texas Instruments internal qualification testing.

TMDS Fully-qualified development-support product.

X and P devices and TMDX development-support tools are shipped against the following disclaimer:

"Developmental product is intended for internal evaluation purposes."

Production devices and TMDS development-support tools have been characterized fully, and the quality and reliability of the device have been demonstrated fully. TI's standard warranty applies.

Predictions show that prototype devices (X or P) have a greater failure rate than the standard production devices. Texas Instruments recommends that these devices not be used in any production system because their expected end-use failure rate still is undefined. Only qualified production devices are to be used.

TI device nomenclature also includes a suffix with the device family name. This suffix indicates the package type (for example, *your package*), the temperature range (for example, blank is the default commercial temperature range), and the device speed range, in megahertz (for example, *your device speed range*). Figure x provides a legend for reading the complete device name for any *your device* device.

For orderable part numbers of *your device* devices in the *your package* package types, see the Package Option Addendum of this document, ti.com, or contact your TI sales representative.

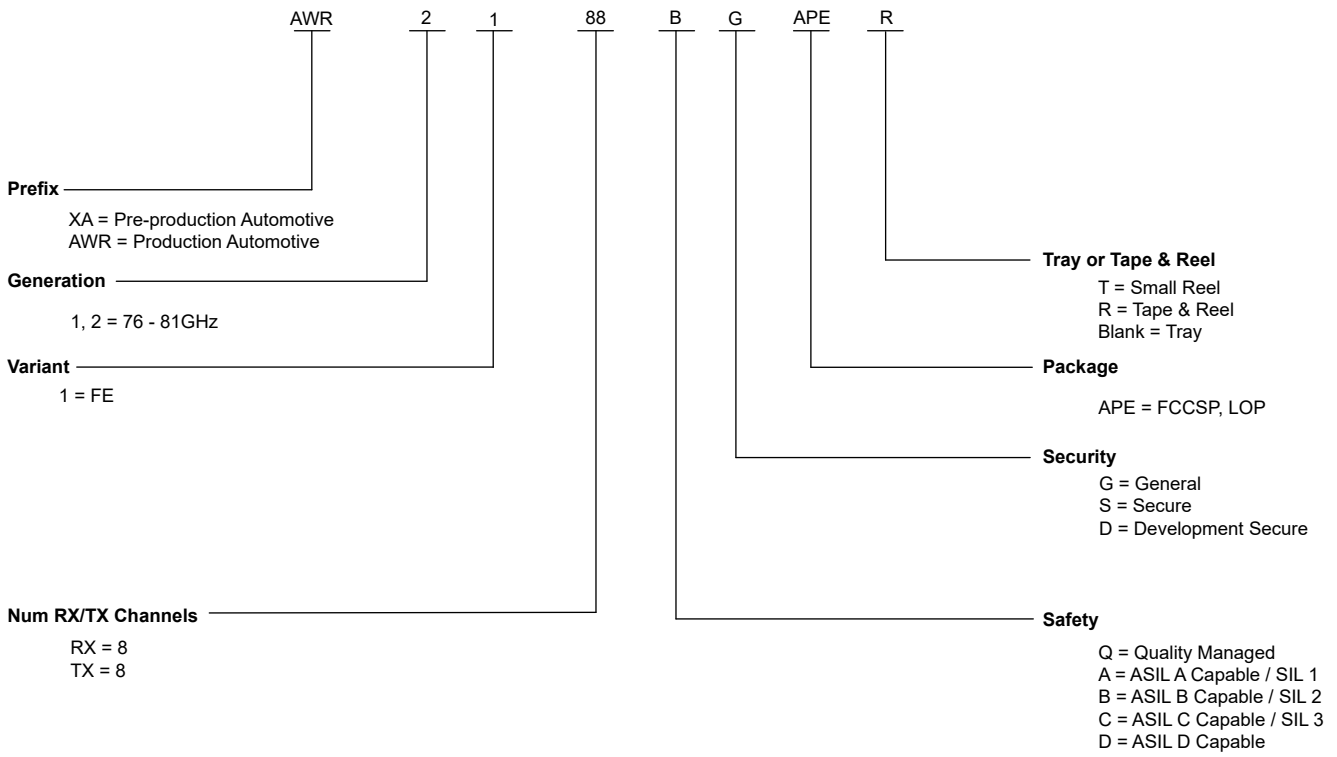


Figure 5-1. Device Nomenclature

5.2 Tools and Software

Boundary scan database of testable input and output pins for IEEE 1149.1 of the specific device can be obtained by contacting a TI representative.

IBIS model IO buffer information model for the IO buffers of the device can be obtained by contacting a TI representative. For simulation on a circuit board, see IBIS Open Forum.

5.3 Documentation support

To receive notification of documentation updates, navigate to the device product folder on ti.com. Click on *Notifications* 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.

The contents in this section will be updated in subsequent versions.

5.4 Support Resources

TI E2E™ support forums are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is 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.

5.5 Trademarks

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ADVANCE INFORMATION

5.6 Electrostatic Discharge Caution

This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

5.7 Glossary

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, see the left-hand navigation.

PACKAGING INFORMATION

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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)
XA2188BGAPE	Active	Preproduction	FCCSP (APE) | 573	96 | JEDEC TRAY (5+1)	-	Call TI	Call TI	-40 to 140	

(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.

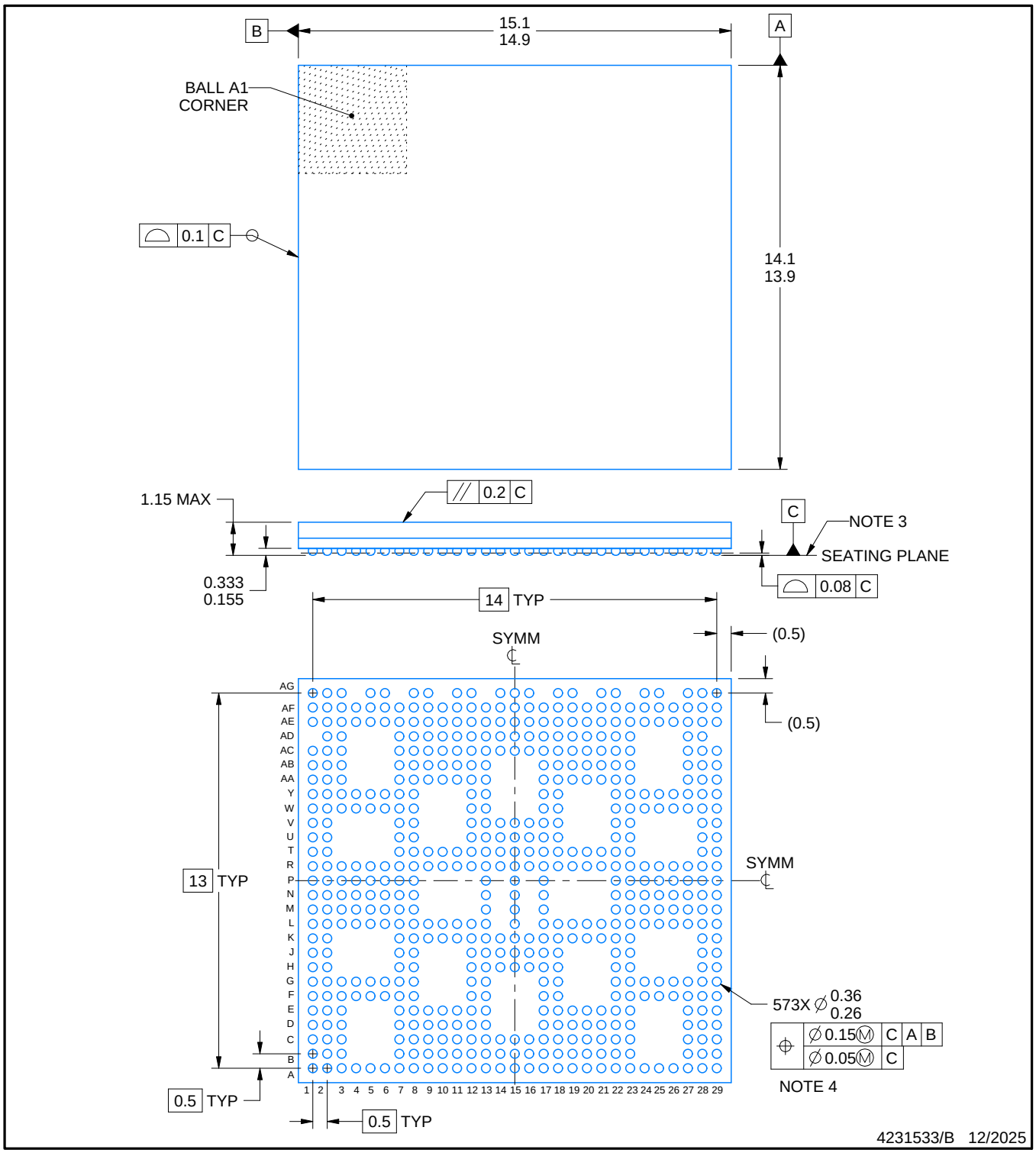
Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

PACKAGE OUTLINE

APE0573A

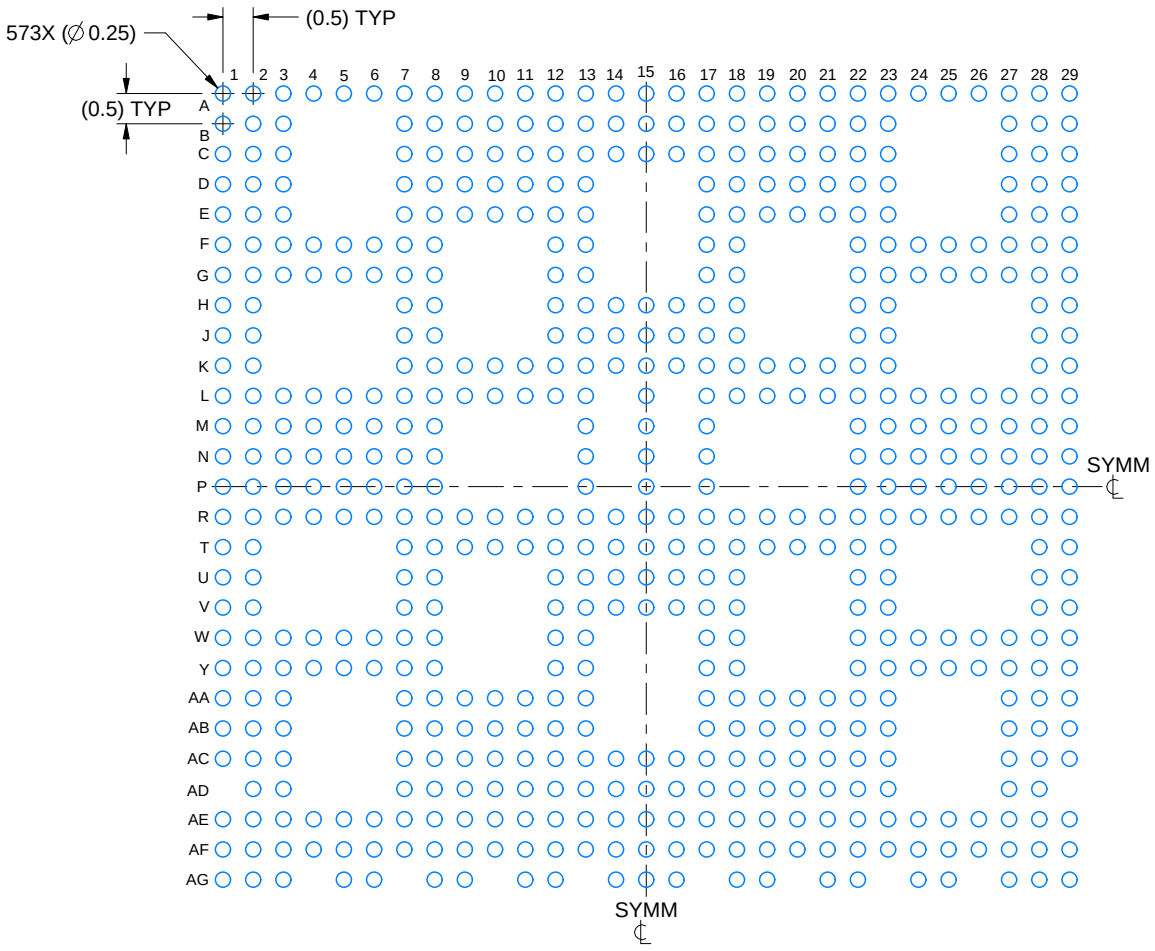
FCCSP - 1.15 mm max height

PLASTIC BALL GRID ARRAY

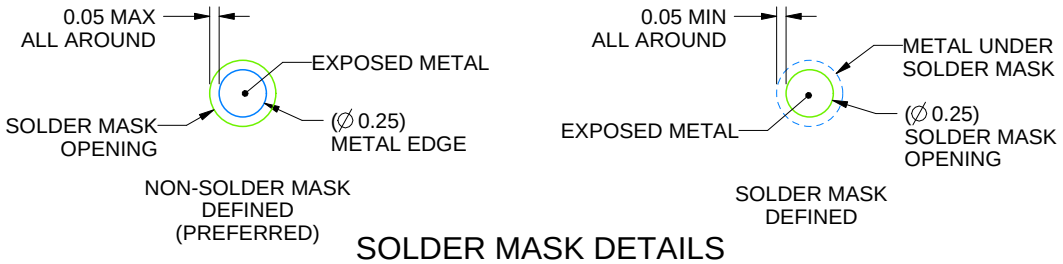


NOTES:

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. Primary datum C and seating plane are defined by the spherical crowns of the solder balls.
4. Dimension is measured at the maximum solder ball diameter, post reflow, parallel to primary datum C.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 8X



SOLDER MASK DETAILS
NOT TO SCALE

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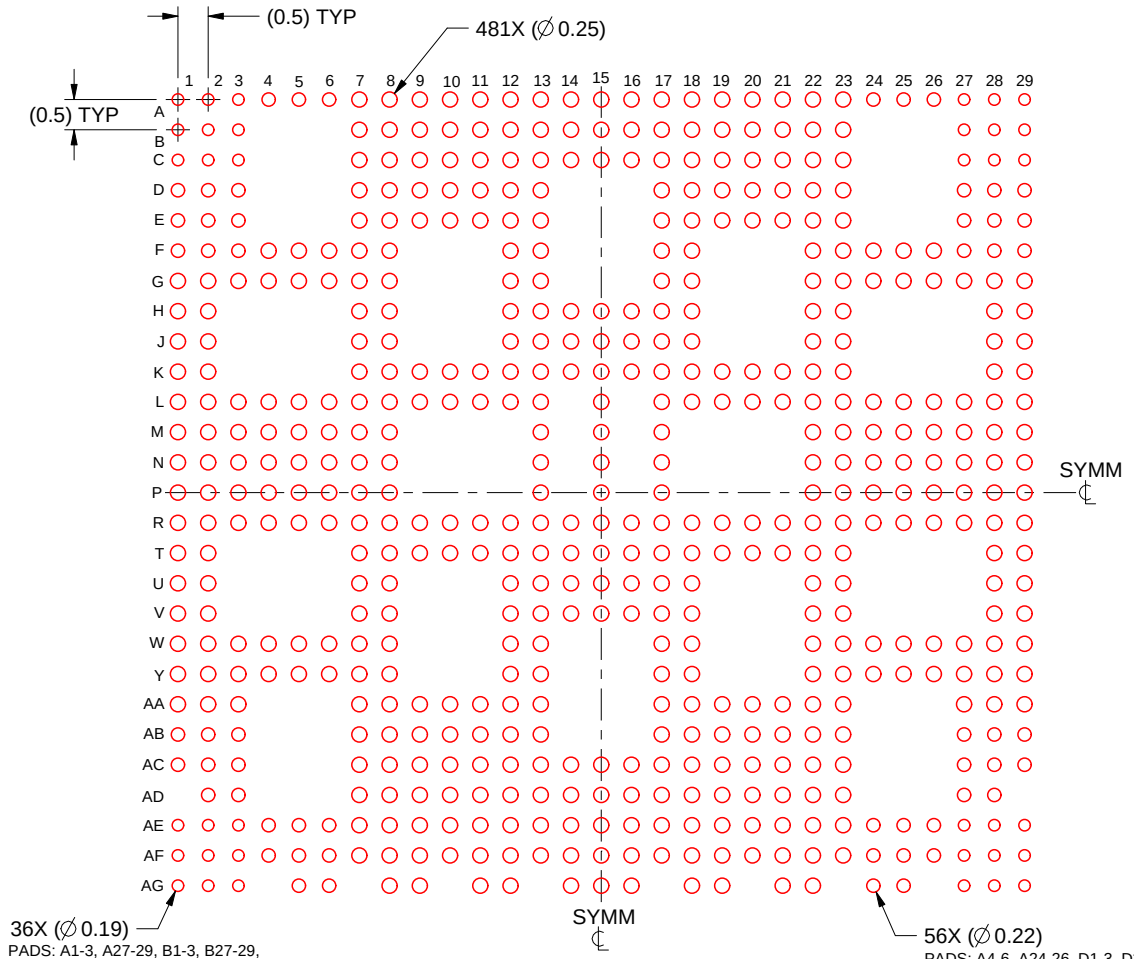
NOTES: (continued)

5. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints.
For information, see Texas Instruments literature number SPRAA99 (www.ti.com/lit/spraa99).



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL
SCALE: 8X

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NOTES: (continued)

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

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