TPS6288x-Q1 2.7V to 6V Input, 12A, 20A, 24A, and 30A Automotive, Fast Transient, Stackable, Dual-Phase Step-Down Converter With I²C Interface

ADVANCE INFORMATION

1 Features

- AEC-Q100 qualified for automotive applications
  - Temperature grade 1: –40°C to 125°C T_A
  - –40°C to 150°C junction temperature range
- Functional Safety-Compliant
  - Developed for functional safety applications
  - Documentation to aid ISO26262 functional safety system design target up to ASIL D planned
- Input voltage range: 2.7V to 6V
- Selectable output voltage ranges for AVS / DVS
  - 3 ranges; Vout from 0.4V to 1.2V
- Output voltage accuracy: ±0.5%
- 7mΩ and 4.5mΩ internal power MOSFETs
- External compensation
- Switching frequency options of 1.5MHz, 2.25MHz, 2.5MHz, or 3MHz
- Forced PWM or power save mode operation
- 3.4MHz I²C-compatible interface with CRC
- Output voltage selection by I²C i/f or VSELx pins
- Optional stacked operation
- Differential remote sense
- Input and output overvoltage protection
- Thermal pre-warning and thermal shutdown
- Output discharge
- Optional spread spectrum clocking
- Power-good output with window comparator with adjustable thresholds

2 Applications

- ADAS camera, ADAS sensor fusion
- Surround view ECU
- Hybrid and reconfigurable cluster
- Head unit, Telematics control unit

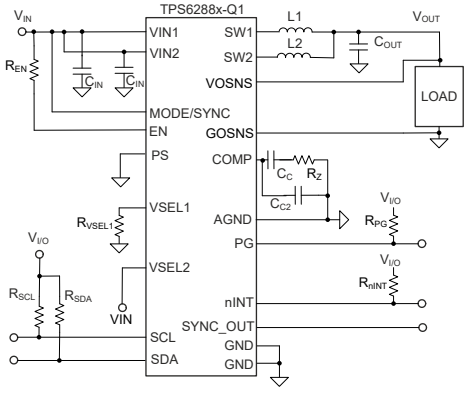
3 Description

The TPS62880-Q1, TPS62881-Q1 , TPS62882-Q1, and TPS62883-Q1 are a family of pin-to-pin 12A, 20A, 24A, and 30A synchronous, dual-phase, step-down DC/DC converters. The TPS6288x-Q1 implement an enhanced DCS-Control scheme that combines fast transient response with fixed frequency operation. Dual-phase operation reduces the input and output voltage ripple and also enables the use of smaller inductors per phase. At medium to heavy loads, the devices operate in Pulse Width Modulation (PWM) mode and automatically enter Discontinuous Conduction Mode at light load to maintain high efficiency over the entire load current range. The devices can also be forced into PWM mode operation for smallest output voltage ripple. The devices provide 0.5% DC output voltage accuracy across the recommended input voltage and temperature range. Differential remote sense allows for accurate voltage control directly at the load. The I²C compatible interface is operational as long as the supply voltage is above the UVLO threshold. The interface offers several control, monitoring, and warning features, such as voltage monitoring and temperature warnings. Dynamic voltage scaling allows the load power consumption to adapt to the performance needs of the application. The default start-up voltage is selectable by the VSELx pins. The switching frequency is factory programmed to 2.25MHz with options for 1.5MHz, 2.5MHz or 3MHz. The TPS6288x-Q1 can be synchronized to an external clock. Stacking allows to operate up to 5 devices in parallel to support a total output current of up to 150A. The PS pin along with the SYNC_OUT pin define a device as a primary or secondary device. The phase shift of the secondary devices is defined by the VSEL1 and VSEL2 pins to either 30°, 60°, 90° or 120°. See the *Device Options* table for details.

Device Information

PART NUMBER(2)	CURRENT RATING	BODY SIZE (NOM)
TPS62880-Q1(1)	12A	4mm × 5mm
TPS62881-Q1(1)	20A	
TPS62882-Q1(1)	24A	
TPS62883-Q1	30A	

(1) Preview information (not Advance Information).
(2) See the *Device Options* table.



Simplified Schematic

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ADVANCE INFORMATION

4 Device Options

DEVICE NUMBER	OUTPUT CURRENT	START-UP VOLTAGE and I²C DEVICE ADDRESS FOR PRIMARY DEVICE	I²C DEVICE ADDRESS / PHASE SHIFT FOR SECONDARY DEVICE(S)	SOFT-START TIME / DEFAULT SWITCHING FREQUENCY AND OTHER CONFIGURATION SETTINGS
TPS62880QFWRADRQ1(1)	12A	Vo1 = 0.850V; I2C1 = 0x38 Vo2 = 0.750V; I2C2 = 0x39 Vo3 = 0.875V; I2C3 = 0x3A Vo4 = 0.800V; I2C4 = 0x3B	I2C1 = 0x3C / 30° I2C2 = 0x3D / 60° I2C3 = 0x3E / 90° I2C4 = 0x3F / 120°	$td_{(Ramp)}$ = 1ms f_{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 1 PGTH = ±5%
TPS62881QFWRADRQ1(1)	20A	Vo1 = 0.850V; I2C1 = 0x38 Vo2 = 0.750V; I2C2 = 0x39 Vo3 = 0.875V; I2C3 = 0x3A Vo4 = 0.800V; I2C4 = 0x3B	I2C1 = 0x3C / 30° I2C2 = 0x3D / 60° I2C3 = 0x3E / 90° I2C4 = 0x3F / 120°	$td_{(Ramp)}$ = 1ms f_{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 1 PGTH = ±5%
TPS62882QFWRADRQ1(1)	24A	Vo1 = 0.850V; I2C1 = 0x38 Vo2 = 0.750V; I2C2 = 0x39 Vo3 = 0.875V; I2C3 = 0x3A Vo4 = 0.800V; I2C4 = 0x3B	I2C1 = 0x3C / 30° I2C2 = 0x3D / 60° I2C3 = 0x3E / 90° I2C4 = 0x3F / 120°	$td_{(Ramp)}$ = 1ms f_{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 1 PGTH = ±5%
TPS62883QFWRADRQ1	30A	Vo1 = 0.850V; I2C1 = 0x38 Vo2 = 0.750V; I2C2 = 0x39 Vo3 = 0.875V; I2C3 = 0x3A Vo4 = 0.800V; I2C4 = 0x3B	I2C1 = 0x3C / 30° I2C2 = 0x3D / 60° I2C3 = 0x3E / 90° I2C4 = 0x3F / 120°	$td_{(Ramp)}$ = 1ms f_{SW} = 2.25MHz SOFT_STOP_EN = 1 DROOPEN = 1 PGTH = ±5%

(1) Preview information (not Advance Information)

ADVANCE INFORMATION

5 Device and Documentation Support

5.1 Receiving Notification of Documentation Updates

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.

5.2 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.

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5.3 Trademarks

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5.4 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.

5.5 Glossary

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

6 Revision History

DATE	REVISION	NOTES
October 2024	*	Initial release.

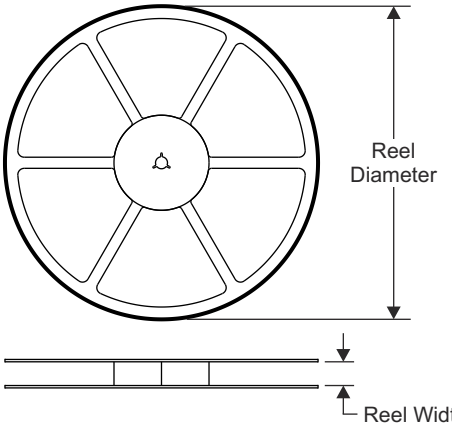
ADVANCE INFORMATION

7 Mechanical, Packaging, and Orderable Information

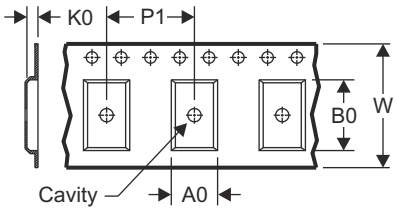
The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand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

7.1 Tape and Reel Information

REEL DIMENSIONS

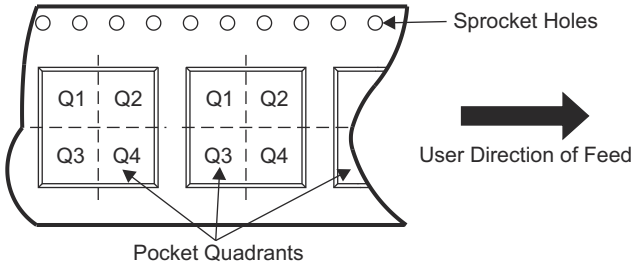


TAPE DIMENSIONS



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

QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE

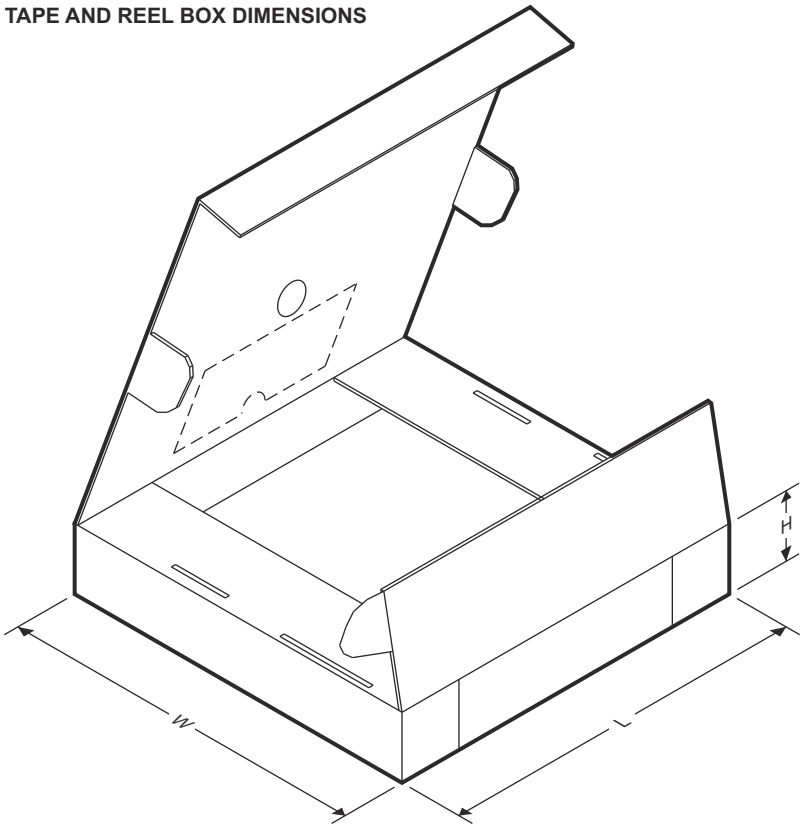


Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS62883QFWRADRQ1	VQFN-HR	RAD	25	3000	330.0	12.4	4.3	5.3	1.3	8.0	12	Q1

ADVANCE INFORMATION

ADVANCE INFORMATION

TAPE AND REEL BOX DIMENSIONS



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS62883QFWRADRQ1	VQFN-HR	RAD	25	3000	367	367	35

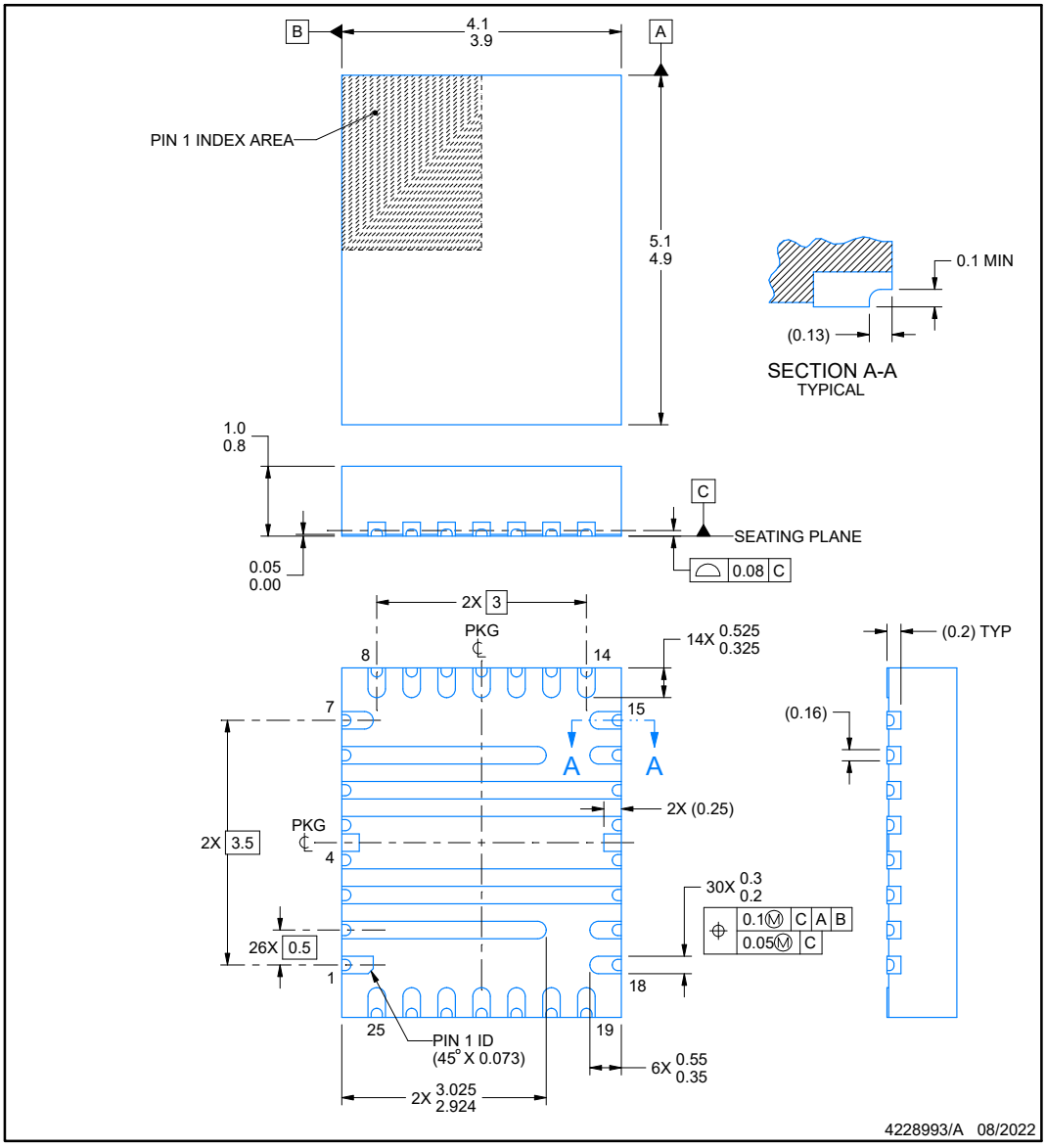
7.2 Mechanical Data

RAD0025A

PACKAGE OUTLINE

VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES:

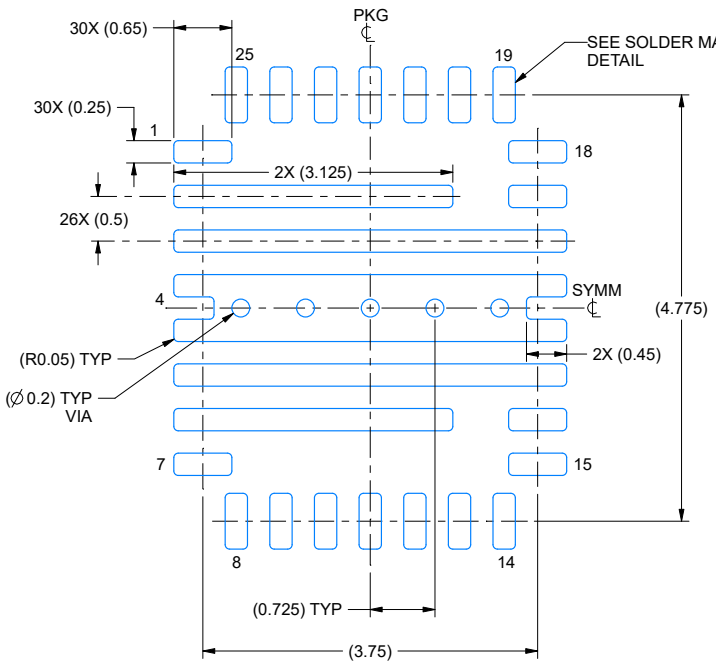
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.

ADVANCE INFORMATION

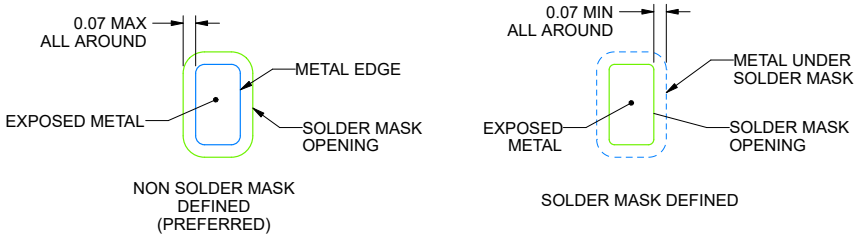
EXAMPLE BOARD LAYOUT

RAD0025A — **VQFN-HR - 1 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 15X



SOLDER MASK DETAILS

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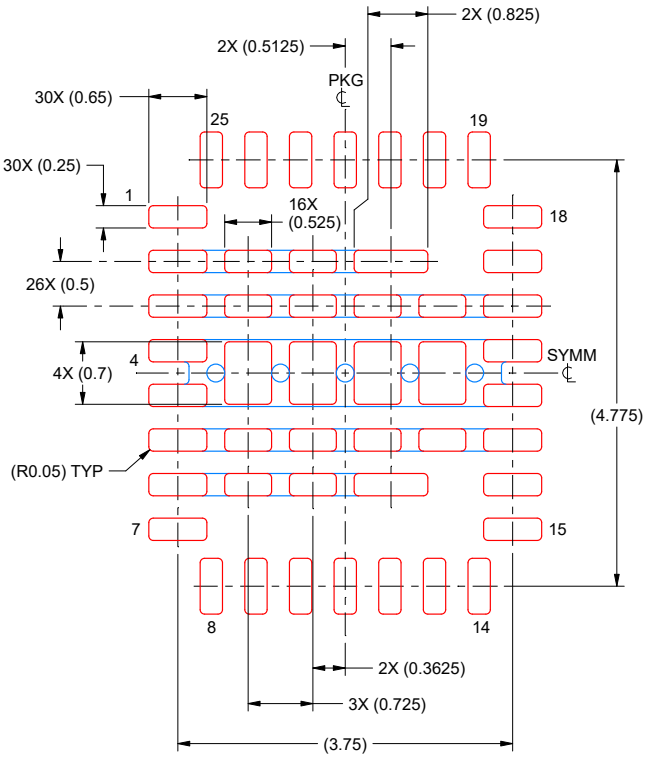
NOTES: (continued)

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.

EXAMPLE STENCIL DESIGN

RAD0025A — **VQFN-HR - 1 mm max height**

PLASTIC QUAD FLATPACK - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 MM THICK STENCIL
SCALE: 15X

PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
PADS 2 & 6: 80%
PADS 3 & 5: 77%
PAD 4: 69%

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NOTES: (continued)

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

PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
XTPS62883QFWRADRQ1	ACTIVE	VQFN-HR	RAD	25	3000	TBD	Call TI	Call TI	-40 to 125		Samples

(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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