

LP8778x-Q1 Three Buck Converters, One Linear Regulator and One Boost/ Load Switch for mmWave Radar Sensors

1 Features

- AEC-Q100 qualified with the following results:
 - Device temperature grade 1: –40°C to +125°C ambient operating temperature
- Functional safety-compliant device
 - Developed for functional safety applications
 - Documentation that aids ISO 26262 functional safety system design up to ASIL-B
 - BUCK, BOOST or load-switch and LDO output and input supply overvoltage and undervoltage monitoring
 - Q&A Watchdog
 - Level or PWM error signal monitor (ESM)
 - ABIST and CRC
- Input voltage: 3.3V nominal (3.0V to 4.0V range)
- 3 high-efficiency, low noise, high frequency step-down DC/DC converters:
 - Output voltage: 0.6V to 1.9V with 10mV output voltage steps
 - Maximum output current: 3.5A (Buck1: 4.5A under certain conditions)
 - Scalable switching frequency: 3.67MHz to 17.6MHz
- 300mA high frequency step-up DC/DC converter/ 400mA load switch (VOUT_BST/LSW_OUT)
 - Options with LSW or boost available for Ethernet and CAN support
 - Input voltage, boost mode: 3.0V to 4.0V
 - Output voltage, boost mode: 5.0V
 - Input/output voltage, LSW mode: 0.8V to 3.4V
- 500mA linear regulator with bypass mode (VOUT_LDO)
 - Input voltage, LDO mode: 1.0V to 4.0V
 - Output voltage: 0.5V to 3.4V with 50mV output voltage steps
 - Input voltage, bypass mode: 0.8V to 3.4V
- Output current limit and overload protection
- Regulator output dynamic voltage scaling (DVS) through I2C interface
- Input overvoltage protection (OVP) and undervoltage lockout (UVLO)
- Overtemperature warning and protection
- I2C interface supporting standard, fast mode, fast-mode+ and high speed mode

2 Applications

- Satellite radar
- Short and medium range corner radar
- Ultra-short range radar
- Long range front radar
- Low ripple, low noise applications

3 Description

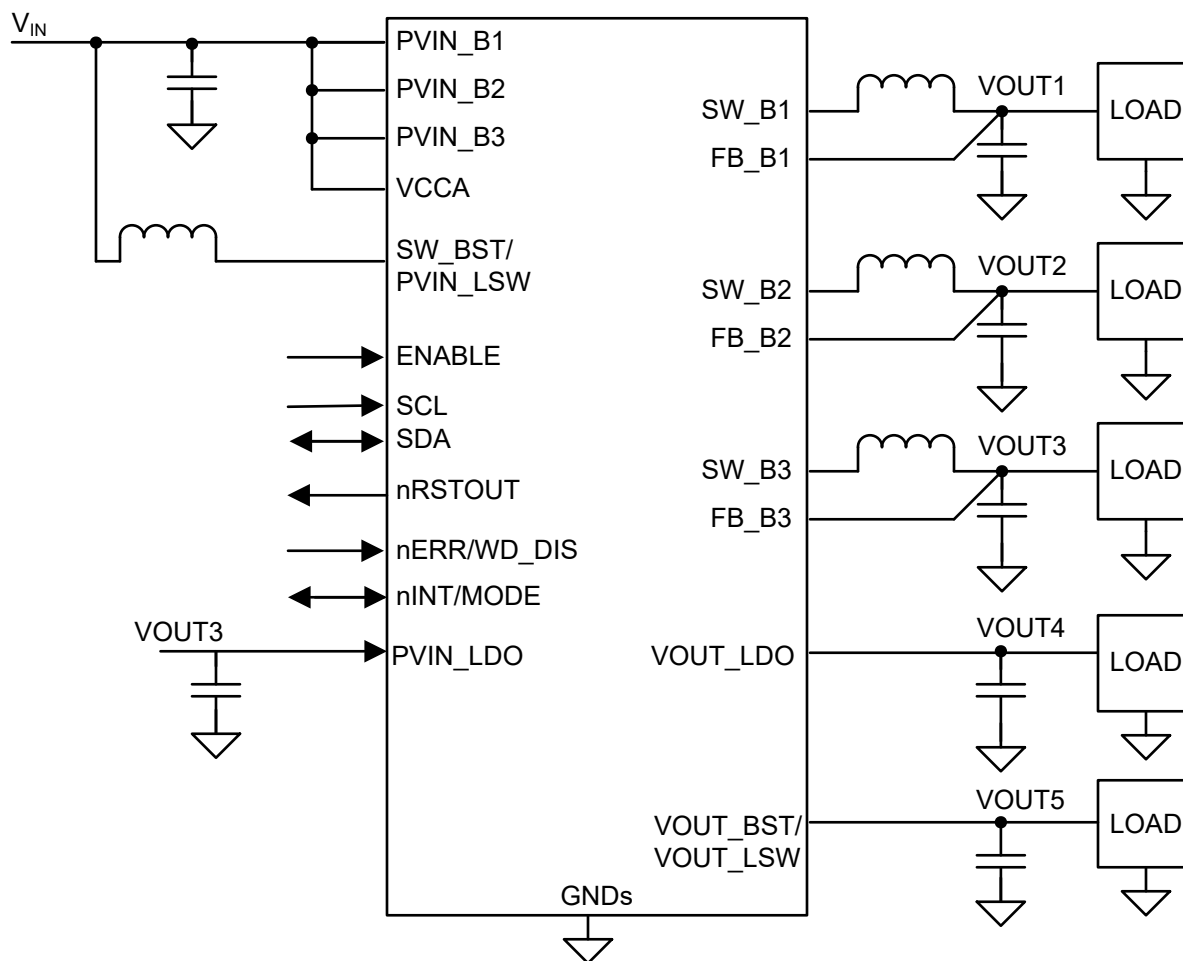
The LP8778x-Q1 devices meet the power management requirements of the AWR, IWR, and other MMICs in various automotive and industrial radar applications. The device has three step-down DC/DC converters, one step-up DC/DC converter and an LDO regulator. Depending on the orderable part-number, the device further has either a step-up converter or a load switch. The LDO supports bypass mode. These options allow the use with Ethernet- or CAN-transceivers. The LDO has an independent supply pin for minimizing the drop-out and is intended for supplying Ethernet device or any other device in the system. The step-up converter is intended to supply the CAN transceiver. The load switch is intended to cut off the 3.3 VIO supply during the sensor sleep mode. The MCU controls the device by I2C communication interface and optionally by enable signal. The low noise step-down DC/DC converters support factory programmed scalable switching frequency of 3.67MHz to 17.6MHz. High switching frequency and low noise across wide frequency range, enables LDO-free power tree which helps to reduce the application cost and improve thermal performance. The device forces the switching clock to PWM mode for excellent RF performance or allows auto-PFM mode for power efficiency. The LP8778x-Q1 device supports remote voltage sensing to compensate for IR drop between the regulator output and the point-of-load (POL) which improves the accuracy of the output voltage.



Package Information

PART NUMBER	PACKAGE ¹⁾	PACKAGE SIZE ²⁾
LP8778x-Q1	PKI (VQFN-HRL, 24)	4.00mm × 4.00mm

- (1) For all available packages, see the orderable addendum at the end of the datasheet.
- (2) The package size (length × width) is a nominal value and includes pins, where applicable.



Simplified Application

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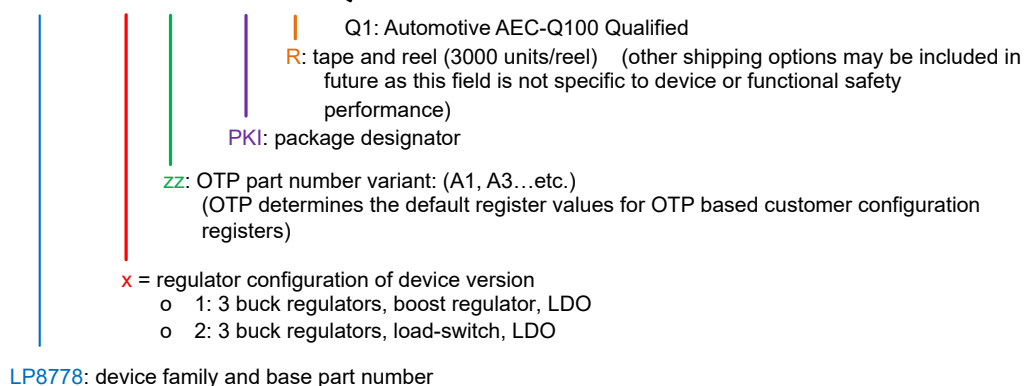
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4 Description (continued)

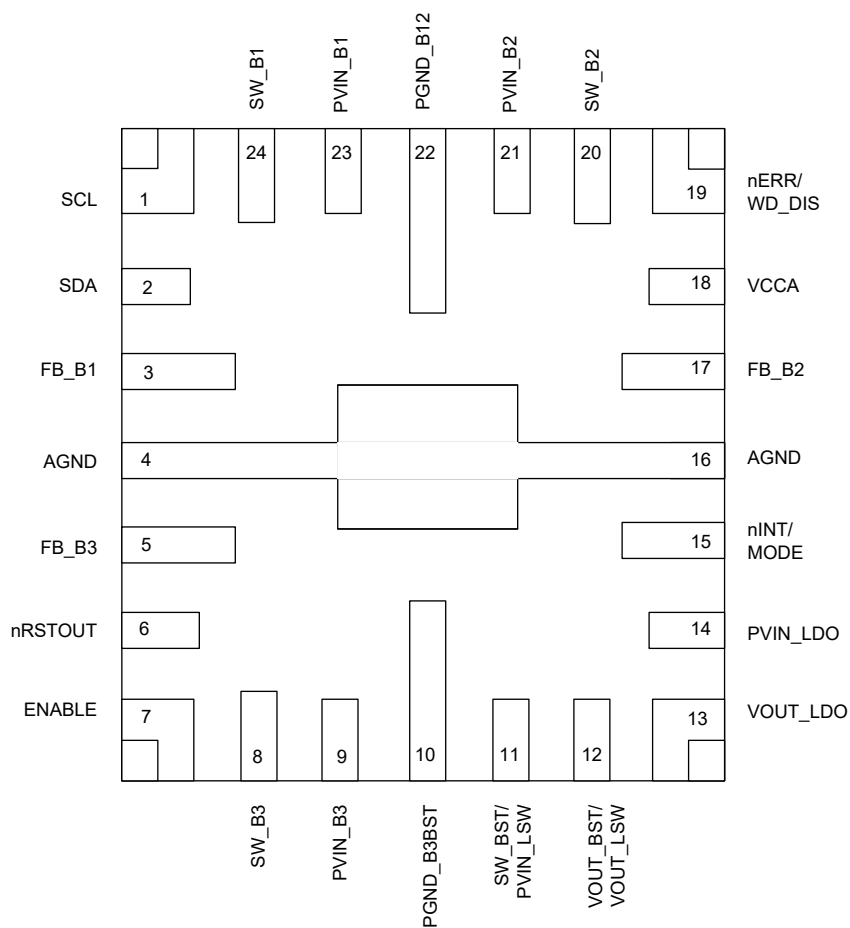
The LP8778x-Q1 device supports programmable start-up and shutdown delays and sequences which are synchronized to the ENABLE signal. TI programs the default settings into nonvolatile memory (NVM) / one time programmable (OTP) memory at the factory and the user cannot change the device default NVM / OTP settings. The device controls the output slew rate to minimize output voltage overshoot and in-rush current during device start-up.

LP8778x-Q1 family devices follow the **LP8778xyzzPKIRQ1** orderable part number scheme, where:

LP8778xzzPKIRQ1



5 Pin Configuration and Functions



For exact drawing please refer to the Package and Orderable Addendum

Figure 5-1. LP8778x-Q1 PKI Package, 24-Pin VQFN-HRL (Top View)

ADVANCE INFORMATION

Table 5-1. Pin Functions

PIN		I/O	TYPE	DESCRIPTION	CONNECTION IF NOT USED
NO.	NAME				
1	SCL	I	Digital	I2C interface serial clock (external pull up)	VCCA
2	SDA	I / O	Digital	I2C interface bidirectional serial data (external pull up)	VCCA
3	FB_B1	—	Analog	Output voltage feedback for BUCK1	Ground
		—	Analog	Alternative programmable function: Voltage monitoring input	Ground
4	AGND	—	Ground	Ground	Ground
5	FB_B3	—	Analog	Output voltage feedback for BUCK3	Ground
		—	Analog	Alternative programmable function: Voltage monitoring input	Ground
6	nRSTOUT	O	Digital	Reset output	Floating
7	ENABLE	I	Digital	Programmable ENABLE signal	Not applicable
8	SW_B3	—	Power	BUCK3 switch node	Floating
9	PVIN_B3	—	Power	Power input for BUCK3. The separate power pins PVIN_Bxx are not connected together internally – PVIN_Bxx and VCCA pins must be connected together in the application and be locally bypassed.	System supply
10	PGND_B3BS T	—	Ground	Power ground for BUCK3 and BOOST	Ground
11	SW_BST/ PVIN_LSW	—	Power	BOOST switch node	Ground
		—	Power	Input supply for Load Switch	Ground
12	VOUT_BST/ VOUT_LSW	—	Power	Output voltage of BOOST or Load Switch	Floating
		—	Analog	Alternative programmable function: Voltage monitoring input	Ground
13	VOUT_LDO	—	Power	Output voltage of LDO	Floating
		—	Analog	Alternative programmable function: Voltage monitoring input	Ground
14	PVIN_LDO	—	Power	Input supply for LDO	System supply
15	nINT/MODE	O	Digital	Primary function: Interrupt output for System MCU	Floating
		I	Digital	Alternative programmable function (input): Input to select Low Power Mode (PFM for selected converters)	Floating
16	AGND	—	Ground	Ground.	Ground
17	FB_B2	—	Analog	Output voltage feedback for BUCK2	Ground
		—	Analog	Alternative programmable function: Voltage monitoring input	Ground
18	VCCA	—	Power	VCCA and PVIN_Bxx pins must be connected together in the application and be locally bypassed.	System supply
19	nERR/ WD_DIS	I	Digital	Primary function: System MCU Error Monitoring Input	Ground
		I	Digital	Alternative programmable function: Watchdog Disable Input	Ground
20	SW_B2	—	Power	BUCK2 switch node	Floating
21	PVIN_B2	—	Power	Power input for BUCK2. The separate power pins PVIN_Bxx are not connected together internally – PVIN_Bxx and VCCA pins must be connected together in the application and be locally bypassed.	System supply
22	PGND_B12	—	Ground	Power ground for BUCK1 and BUCK2.	Ground
23	PVIN_B1	—	Power	Power input for BUCK1. The separate power pins PVIN_Bxx are not connected together internally – PVIN_Bxx and VCCA pins must be connected together in the application and be locally bypassed.	System supply
24	SW_B1	—	Power	BUCK1 switch node.	Floating

5.1 Digital Signal Descriptions

Table 5-2. Input Signal Descriptions

PIN NAME	POWER DOMAIN (recommended max)	INTERNAL PU/PD	DEGLITCH TIME
nERR/WD_DIS (nERR)	VCCA	10kΩ PU to VCCA	Configurable: 0μs or 4μs
nERR/WD_DIS (WD_DIS)	VCCA	8.4kΩ PD to GND during WD_DIS detection	30μs
SCL	VCCA	-	-
SDA	VCCA	-	-
ENABLE	VCCA	400kΩ PD to GND during power-up, optional 400kΩ PD to GND after NVM-load (turn off for precision enable)	Configurable: 0μs to 60ms
nINT/MODE (MODE)	VCCA	400kΩ PD to GND	8μs

ENABLE input is always functional when VCCA is at the valid level. Other input buffers are disabled until the valid VCCA supply is present and the device startup has progressed to a certain state. The input buffers are enabled after the OTP is read.

Table 5-3. Output Signal Descriptions

PIN NAME	POWER DOMAIN	PIN MODE	OUTPUT TYPE	INTERNAL PU/PD
SDA	VCCA	-		-
nRSTOUT	VCCA	-	Open-drain or Open-drain with internal 10k PU to VCCA	10kΩ programmable PU to VCCA when output driven high. PU disabled when output is driven low.
nINT/MODE (nINT)	VCCA	-	Open-drain or Open-drain with internal 10k PU to VCCA	10kΩ programmable PU to VCCA when output driven high. PU disabled when output is driven low.

6 Device and Documentation Support

6.1 Documentation Support

6.2 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](https://www.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.

6.3 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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6.4 Trademarks

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6.5 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.

6.6 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

7 Revision History

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

DATE	REVISION	NOTES
August 2026	*	Advance Information

8 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

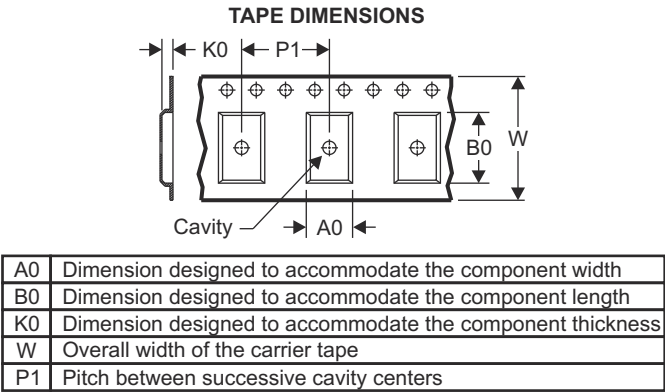
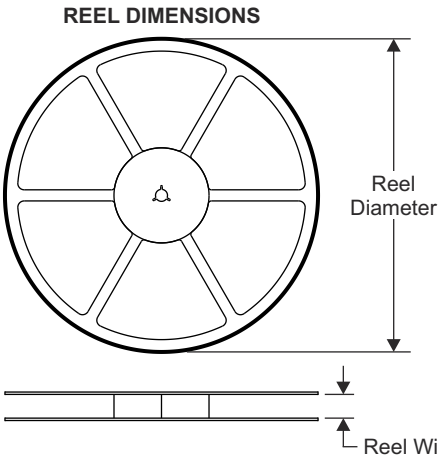
Orderable part number	Status ⁽¹⁾	Material type ⁽²⁾	Package Pins	Package qty Carrier	RoHS ⁽³⁾	Lead finish/ Ball material ⁽⁴⁾	MSL rating/Peak reflow ⁽⁵⁾	Op temp (°C)	Part marking ⁽⁶⁾
P8778101PKIRQ1	Preview	Preproduction	VQFN-HR 24	3000	Green (RoHS & no Sb/Br)	SN	Level-2-260C-UNLIM	-40 to 125	P87781X X-Q1

- (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.

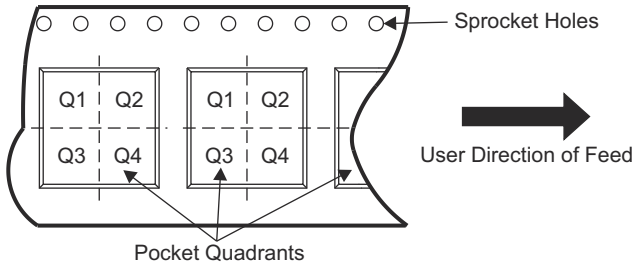
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Tape and Reel Information

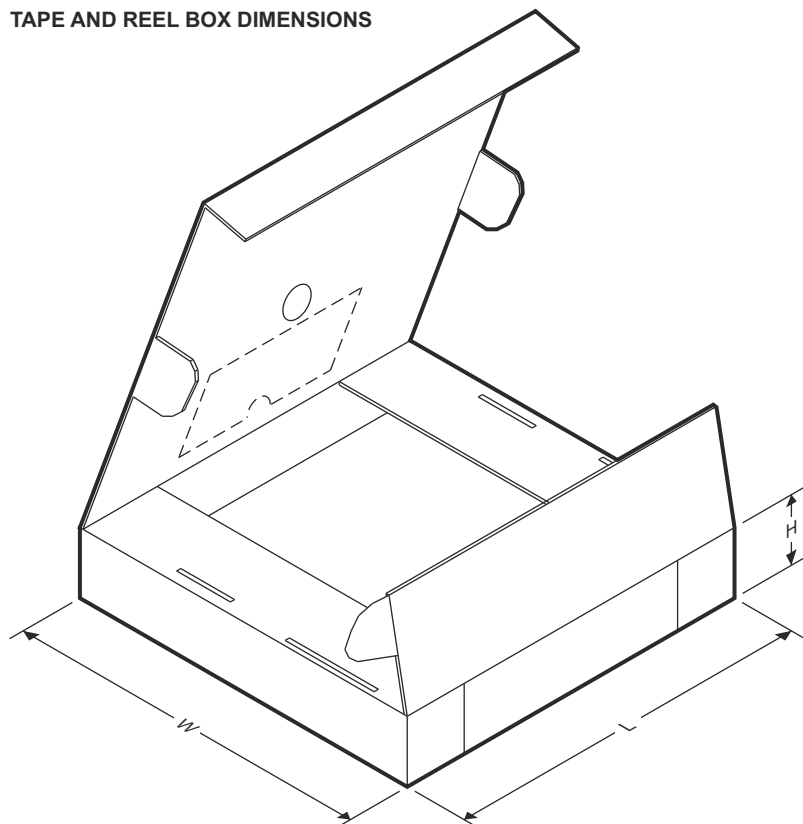


QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



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
P8778101PKIRQ1	VQFN-HR	PKI	24	3000	330	12.4	4.25	4.25	1.15	8.0	12.0	Q1

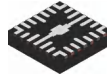
TAPE AND REEL BOX DIMENSIONS



Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
P8778101PKIRQ1	VQFN-HR	PKI	24	3000	367	367	35

ADVANCE INFORMATION

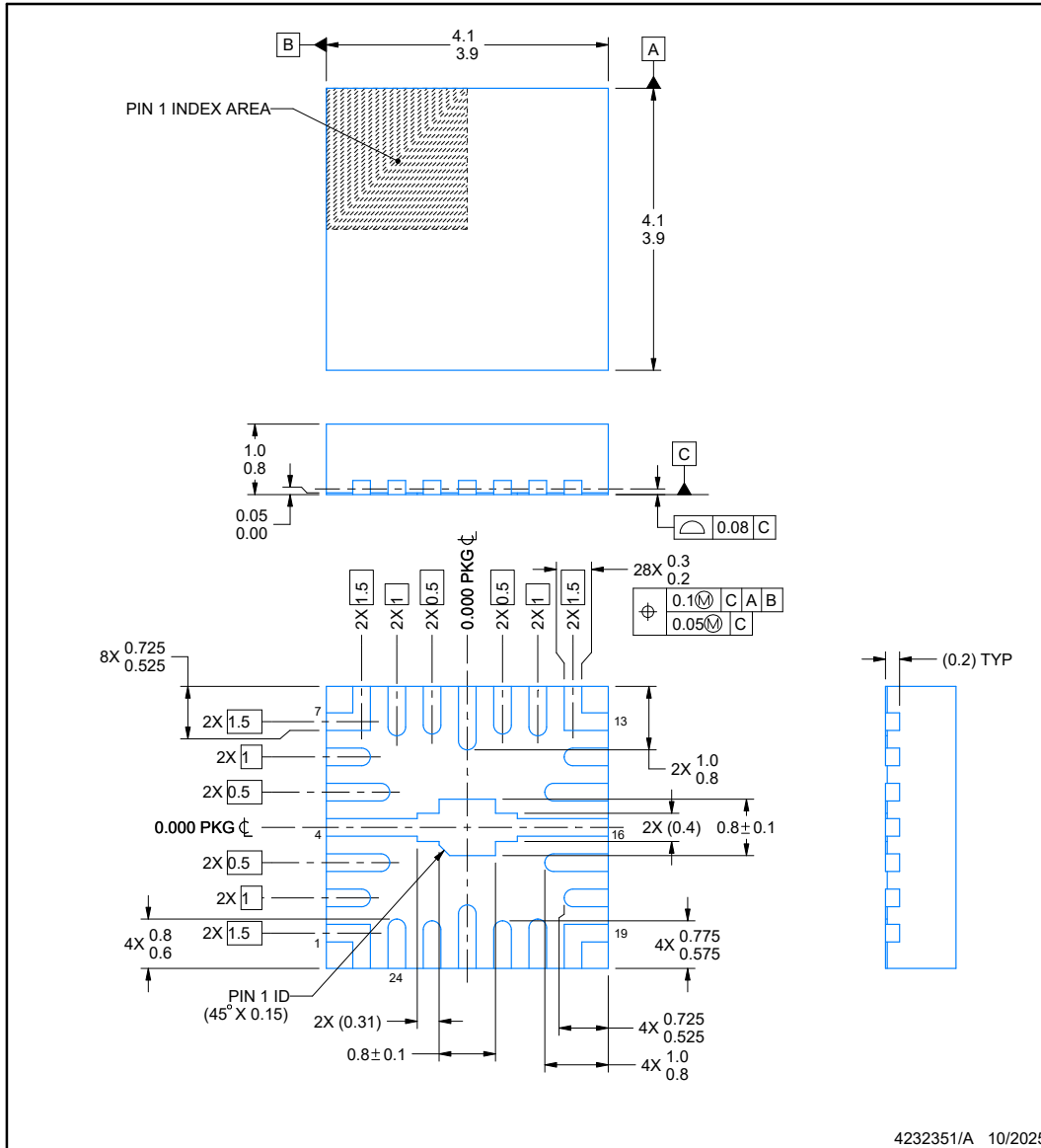
PKI0024A



PACKAGE OUTLINE

VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES:

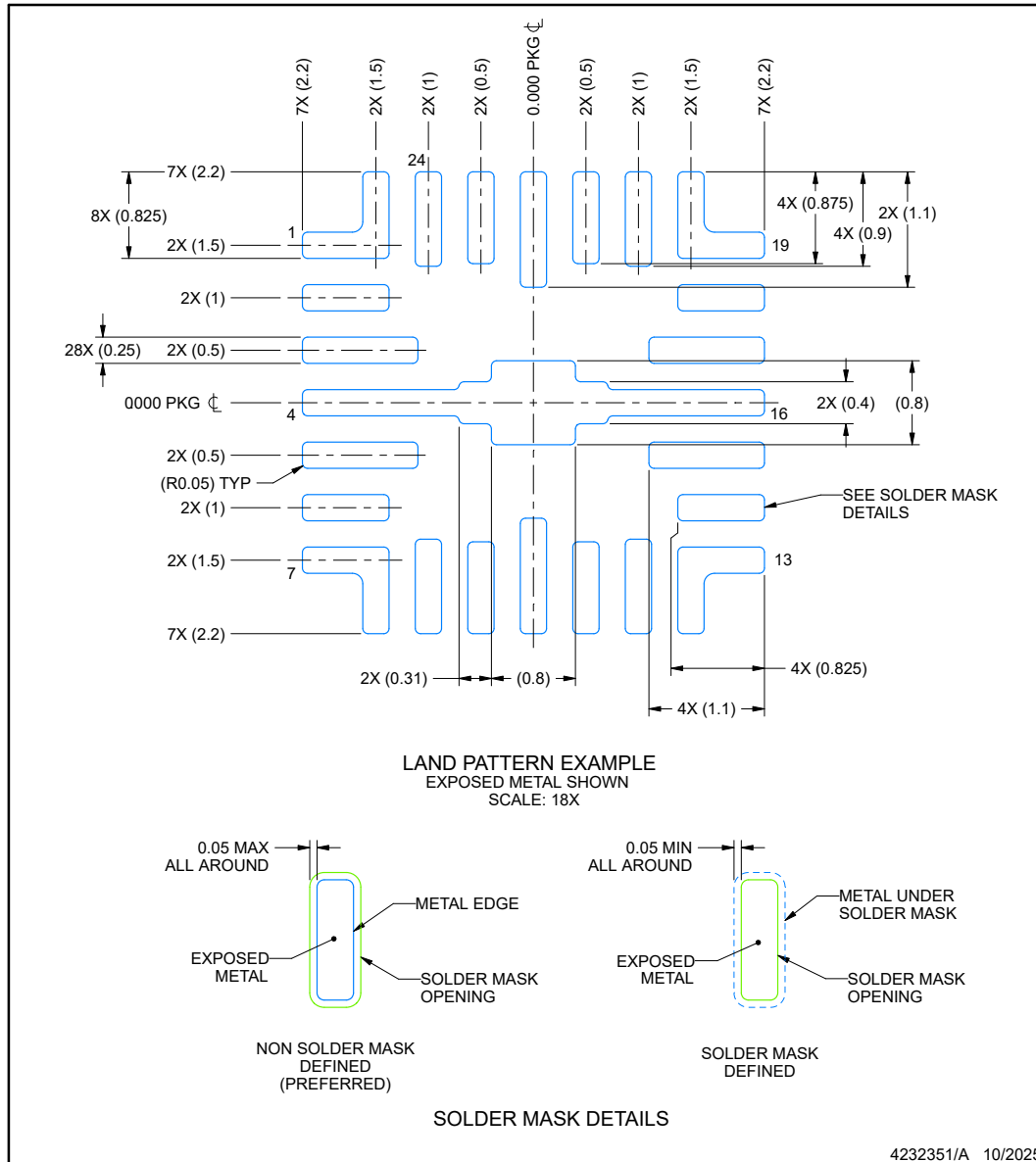
1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.

EXAMPLE BOARD LAYOUT

PKI0024A

VQFN-HR - 1 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



NOTES: (continued)

3. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).

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