TPS22991I 5.5V, 2.7A, 28mΩ Load Switch Device With Small Plastic Package

1 Features

- Integrated single channel load switch
- Input voltage range: 1V to 5.5V
- Maximum continuous switch current: 2.7A
- Typical ON-resistance: 28mΩ
- Low quiescent current:
  - I_Q at 3.3V V_{IN} = 6µA (typical)
- Ultra-low shutdown current:
  - I_{SD} at 3.3V V_{IN} = 200nA (maximum)
- Controlled slew rate:
  - Version B, BN: rise time (t_R) at 3.3V V_{IN} = 141µs
  - Version C, CN: rise time (t_R) at 3.3V V_{IN} = 662µs
- Quick output discharge (QOD): 150Ω
- Thermal shutdown protection
- UQFN package: 0.85 × 0.75mm, 0.4mm pitch

2 Applications

- PC and notebooks
- Wearables
- Solid state drive (SSD)
- Industrial PC

3 Description

The TPS22991I is a small, low R_{ON}, single channel load switch with controlled slew rate. The device contains an N-channel MOSFET that operates over an input voltage range of 1.0V to 5.5V and supports a maximum continuous current of 3A. The switch is controlled by an on and off input, which is capable of interfacing directly with low-voltage control signals.

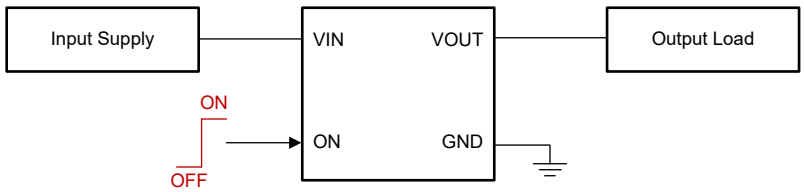
For space constrained, battery powered applications, the device is suitable due to its small size and low R_{ON}. The wide input voltage range of the switch applies to many different voltage rails. The controlled rise time of the device greatly reduces inrush current caused by large bulk load capacitances, thereby reducing or eliminating power supply droop. The TPS22991I further reduces the total solution size by integrating a 150Ω pulldown resistor for quick output discharge (QOD) when the switch is turned off.

The TPS22991I is available in a small, space saving 0.85mm × 0.75mm, 0.4mm pitch, 4-pin UQFN package. The device is characterized for operation over the free-air temperature range of –55°C to +125°C.

Package Information

PART NUMBER	PACKAGE(1)	PACKAGE SIZE(2)
TPS22991I	RAA (UQFN, 4)	0.85mm × 0.75mm

(1) For all available packages, see Section 12.
(2) The package size (length × width) is a nominal value and includes pins, where applicable.



TPS22991I Typical Application

An IMPORTANT NOTICE at the end of this data sheet addresses availability, warranty, changes, use in safety-critical applications, intellectual property matters and other important disclaimers. PRODUCTION DATA.

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4 Device Comparison Table

Table 4-1. Functionality Comparison

PART NUMBER	QUICK OUTPUT DISCHARGE (QOD)	TURN ON TIME
TPS22991IB	Yes	Fast
TPS22991IBN	No	Fast
TPS22991IC	Yes	Slow
TPS22991ICN	No	Slow

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5 Pin Configuration and Functions

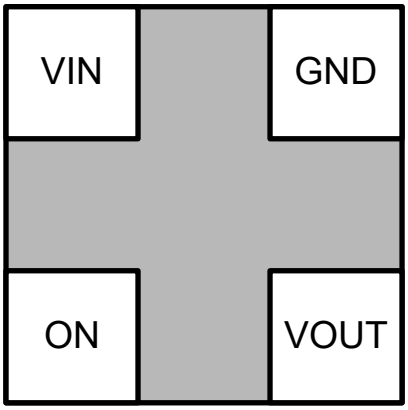

Figure 5-1. TPS22991 RAA Package, 4-Pin UQFN (Top View)

Table 5-1. Pin Functions

PIN		I/O	DESCRIPTION
NAME	NO.		
VIN	1	I	Switch input.
ON	2	I	Active high switch control input.
VOUT	3	O	Switch output.
GND	4	—	Device ground.

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6 Specifications

6.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)(1)

		MIN	MAX	UNIT
V_{IN}	Maximum input voltage range	–0.3	6	V
V_{OUT}	Maximum output voltage range	–0.3	6	V
V_{ON}	Maximum ON pin voltage range	–0.3	6	V
I_{MAX}	Maximum continuous current		3	A
I_{PLS}	Maximum pulsed current (2ms, 2% duty cycle)		4	A
T_J	Junction temperature	–55	150	°C
T_{STG}	Storage temperature	–65	150	°C
T_{LEAD}	Maximum lead temperature (10s soldering time)		300	°C

(1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. *Absolute Maximum Ratings* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.

6.2 ESD Ratings

			VALUE	UNIT
$V_{(ESD)}$	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins(1)	±1750	V
		Charged device model (CDM), per JEDEC specificationJESD22-C101, all pins(2)	±1000	

(1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
(2) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process. Manufacturing with less is possible with the necessary precautions. Pins listed may actually have higher performance.

6.3 Recommended Operating Conditions

over operating free-air temperature range (unless otherwise noted)

		MIN	TYP	MAX	UNIT
V_{IN}	Input voltage range	1.0		5.5	V
V_{OUT}	Output voltage range	0		5.5	V
V_{IH}	ON pin high voltage Range	0.8		5.5	V
V_{IL}	ON pin low voltage range	0		0.35	V
T_A	Ambient temperature	–55		125	°C

6.4 Thermal Information

THERMAL METRIC(1)		TPS22991 4 PINS RAA	UNIT
$R_{\theta JA}$	Junction-to-ambient thermal resistance	225.3	°C/W
$R_{\theta JC(top)}$	Junction-to-case (top) thermal resistance	214.5	°C/W
$R_{\theta JB}$	Junction-to-board thermal resistance	83.6	°C/W
Ψ_{JT}	Junction-to-top characterization parameter	13.1	°C/W
Ψ_{JB}	Junction-to-board characterization parameter	83	°C/W

(1) For more information about traditional and new thermal metrics, see the *Semiconductor and IC Package Thermal Metrics* application note.

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6.5 Electrical Characteristics

Typical values at VIN = 3.3V unless otherwise specified

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP	MAX	UNIT
INPUT SUPPLY (VIN)								
$I_{Q, VIN}$	VIN quiescent current	$V_{ON} \geq V_{IH}$, VOUT = Open		25°C		6		µA
				–40°C to 85°C			12	µA
				–55°C to 125°C			14	µA
$I_{SD, VIN}$	VIN shutdown current	$V_{ON} \leq V_{IL}$, VOUT = Open		25°C		9		nA
				–40°C to 85°C			0.3	µA
				–55°C to 125°C			1.2	µA
$I_{SD, VIN}$	VIN shutdown current	$V_{ON} \leq V_{IL}$, VOUT = GND	$V_{ON} \leq V_{IL}$, VOUT = GND	25°C		9		nA
				–40°C to 85°C			0.3	µA
				–55°C to 125°C			1.2	µA
ON-RESISTANCE (RON)								
R_{ON}	ON-state resistance	I_{OUT} = –200mA	V_{IN} = 5V	25°C		25		mΩ
				–40°C to 85°C			35	mΩ
				–40°C to 105°C			38	mΩ
				–55°C to 125°C			40	mΩ
			V_{IN} = 3.3V	25°C		25		mΩ
				–40°C to 85°C			35	mΩ
				–40°C to 105°C			38	mΩ
				–55°C to 125°C			40	mΩ
			V_{IN} = 1.8V	25°C		25		mΩ
				–40°C to 85°C			35	mΩ
				–40°C to 105°C			38	mΩ
				–55°C to 125°C			40	mΩ
			V_{IN} = 1V	25°C		42		mΩ
				–40°C to 85°C			64	mΩ
				–40°C to 105°C			66	mΩ
				–55°C to 125°C			73	mΩ
THERMAL SHUTDOWN (TSD)								
$T_{SD,R}$	Thermal shutdown			Rising		170		℃
$T_{SD,F}$	Thermal shutdown			Falling		150		℃
ENABLE PIN (ON)								
I_{ON}	ON pin leakage	$V_{ON} \geq V_{IH}$		–55°C to 125°C			100	nA
$R_{PD, ON}$	Smart pull down resistance	$V_{ON} \leq V_{IL}$		–55°C to 125°C		500		kΩ
$V_{IH,ON}$	ON pin threshold (VIH rising)			–55°C to 125°C			0.8	V
$V_{Hys,ON}$	ON pin threshold (hysteresis)			–55°C to 125°C		0.07		V
$V_{IL,ON}$	ON pin threshold (VIL falling)			–55°C to 125°C	0.35			V
QUICK OUTPUT DISCHARGE (QOD)								
R_{QOD}	QOD pin internal discharge resistance (Version B, C)	$V_{ON} \leq V_{IL}$	V_{IN} = 1V	–55°C to 125°C		190		Ω
			V_{IN} = 3.3V	–55°C to 125°C		150		Ω
			V_{IN} = 5V	–55°C to 125°C		140		Ω

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6.6 Switching Characteristics (Version C, CN)

Unless otherwise noted, the typical characteristics in the following table apply to an input voltage of 3.3V, an ambient temperature of 25°C, and a load of CL = 0.1µF, RL = 10Ω. Timing parameter measurement details are shown in the timing diagram in the data sheet. Parameter not tested in production

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{ON}	Turn ON time	VIN = 5.0V		1119		µs
		VIN = 3.3V		996		µs
		VIN = 1.8V		853		µs
		VIN = 1.0V		774		µs
t_R	Output rise time	VIN = 5.0V		794		µs
		VIN = 3.3V		662		µs
		VIN = 1.8V		514		µs
		VIN = 1.0V		397		µs
t_D	Delay time	VIN = 5.0V		332		µs
		VIN = 3.3V		341		µs
		VIN = 1.8V		346		µs
		VIN = 1.0V		383		µs
t_{OFF}	Turn OFF time	VIN = 5.0V		6		µs
		VIN = 3.3V		4		µs
		VIN = 1.8V		2		µs
		VIN = 1.0V		4		µs
t_F	Output Fall time	VIN = 5.0V		5		µs
		VIN = 3.3V		5		µs
		VIN = 1.8V		5		µs
		VIN = 1.0V		5		µs

6.7 Switching Characteristics (Version B, BN)

Unless otherwise noted, the typical characteristics in the following table apply to an input voltage of 3.3V, an ambient temperature of 25°C, and a load of CL = 0.1µF, RL = 10Ω. Timing parameter measurement details are shown in the timing diagram in the data sheet. Parameter not tested in production

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{ON}	Turn ON time	VIN = 5.0V		302		µs
		VIN = 3.3V		259		µs
		VIN = 1.8V		216		µs
		VIN = 1.0V		198		µs
t_R	Output rise time	VIN = 5.0V		173		µs
		VIN = 3.3V		141		µs
		VIN = 1.8V		107		µs
		VIN = 1.0V		90		µs
t_D	Delay time	VIN = 5.0V		127		µs
		VIN = 3.3V		117		µs
		VIN = 1.8V		109		µs
		VIN = 1.0V		116		µs
t_{OFF}	Turn OFF time	VIN = 5.0V		6		µs
		VIN = 3.3V		4		µs
		VIN = 1.8V		2		µs
		VIN = 1.0V		4		µs

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6.7 Switching Characteristics (Version B, BN) (continued)

Unless otherwise noted, the typical characteristics in the following table apply to an input voltage of 3.3V, an ambient temperature of 25°C, and a load of CL = 0.1µF, RL = 10Ω. Timing parameter measurement details are shown in the timing diagram in the data sheet. Parameter not tested in production

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_F	Output fall time	VIN = 5.0V		5		µs
		VIN = 3.3V		5		µs
		VIN = 1.8V		5		µs
		VIN = 1.0V		5		µs

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6.8 Typical Characteristics

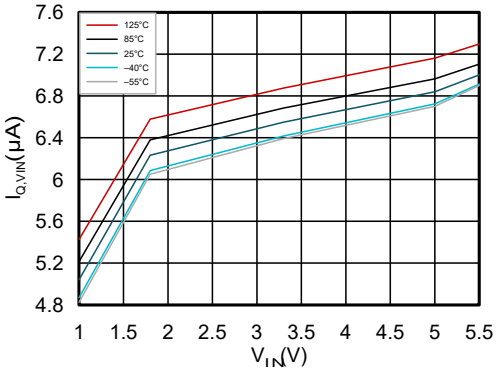
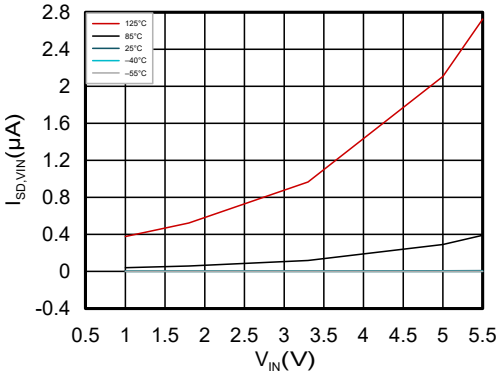
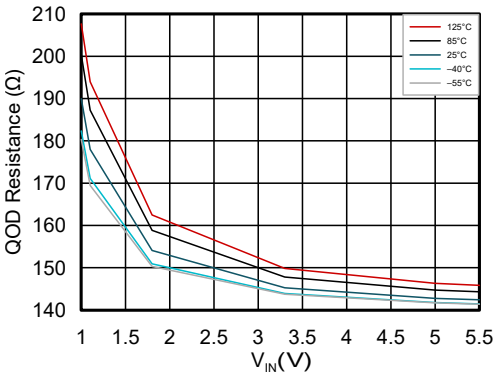


Figure 6-1. V_{IN} Quiescent Current vs Input Voltage



TPS22991B, TPS22991C

Figure 6-2. V_{IN} Shutdown Current vs Input Voltage



TPS22991B, TPS22991C

Figure 6-3. QOD Resistance vs Input Voltage

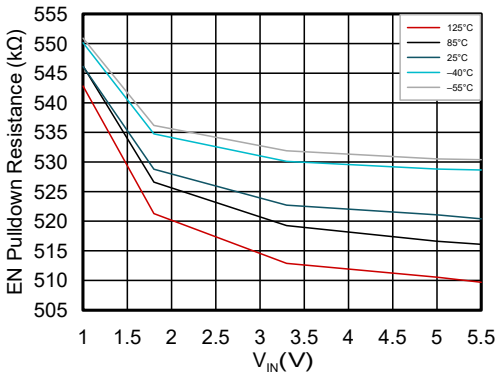


Figure 6-4. ON Pin Resistance $R_{PD,ON}$ vs Input Voltage

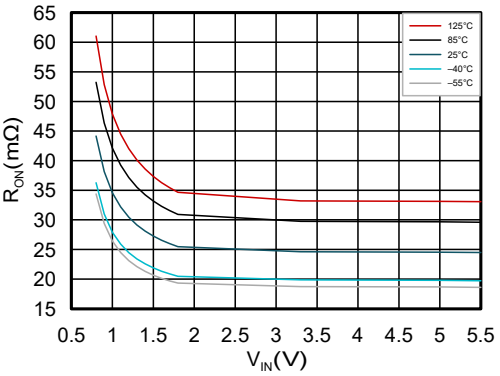
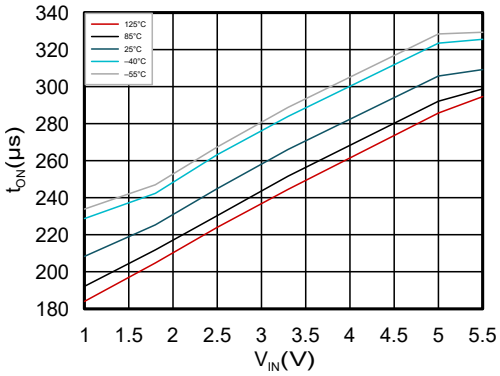


Figure 6-5. R_{ON} vs Input Voltage



C_L = 0.1µF R_L = 10Ω TPS22991B, TPS22991BN

Figure 6-6. Turn ON Time vs Input Voltage

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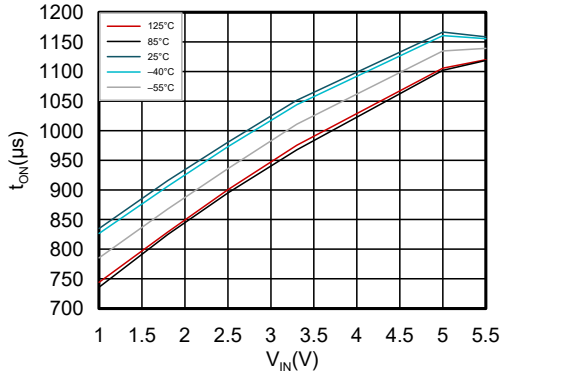
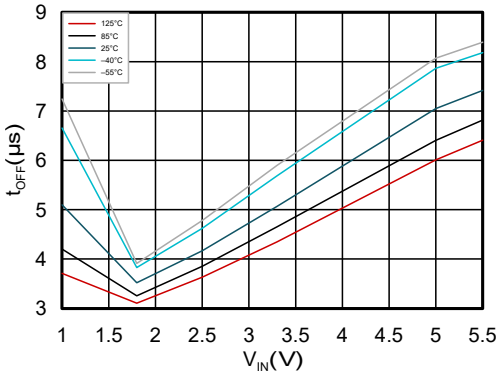
6.8 Typical Characteristics (continued)



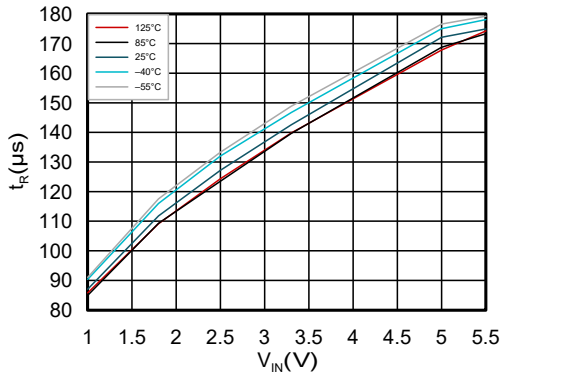
C_L = 0.1µF R_L = 10Ω TPS22991C, TPS22991CN

Figure 6-7. Turn ON Time vs Input Voltage



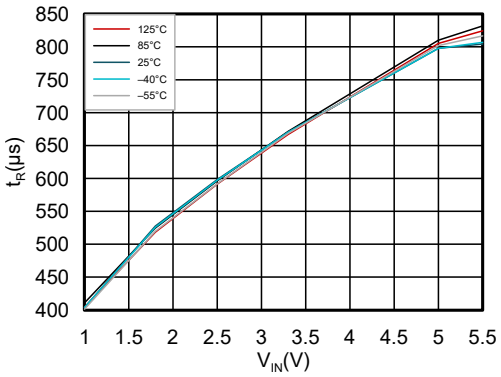
C_L = 0.1µF R_L = 10Ω

Figure 6-8. Turn OFF Time vs Input Voltage



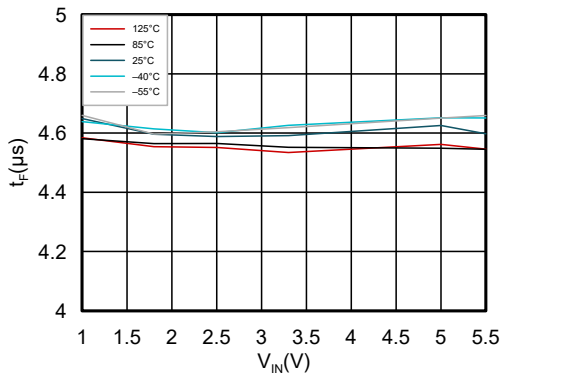
C_L = 0.1µF R_L = 10Ω TPS22991B, TPS22991BN

Figure 6-9. Rise Time vs Input Voltage



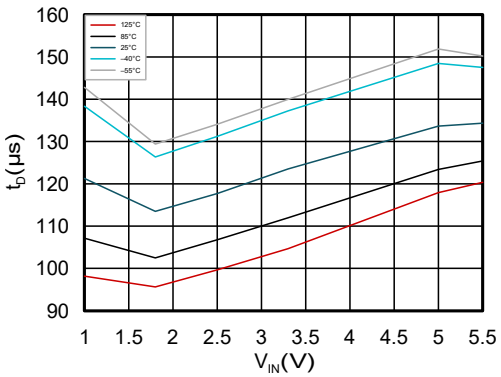
C_L = 0.1µF R_L = 10Ω TPS22991C, TPS22991CN

Figure 6-10. Rise Time vs Input Voltage



C_L = 0.1µF R_L = 10Ω

Figure 6-11. Fall Time vs Input Voltage



C_L = 0.1µF R_L = 10Ω TPS22991B, TPS22991BN

Figure 6-12. Delay Time vs Input Voltage

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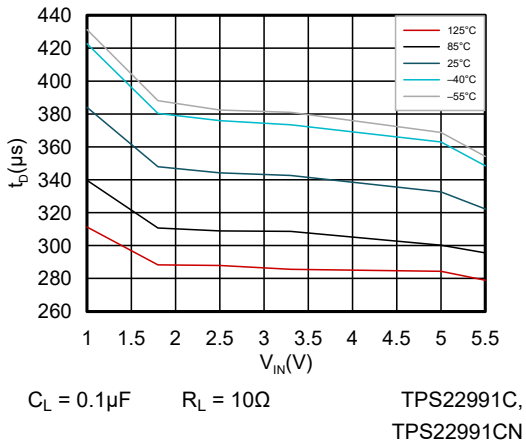
6.8 Typical Characteristics (continued)



C_L = 0.1µF R_L = 10Ω TPS22991C, TPS22991CN

Figure 6-13. Delay Time vs Input Voltage

7 Parameter Measurement Information

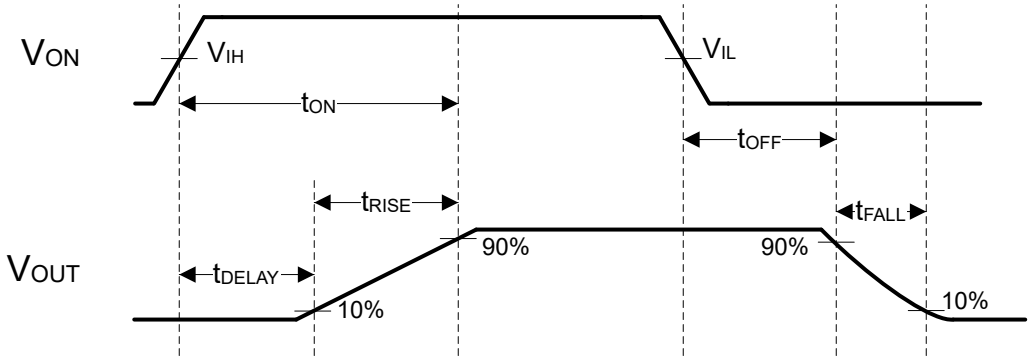


Figure 7-1. Timing Parameter Measurement Information

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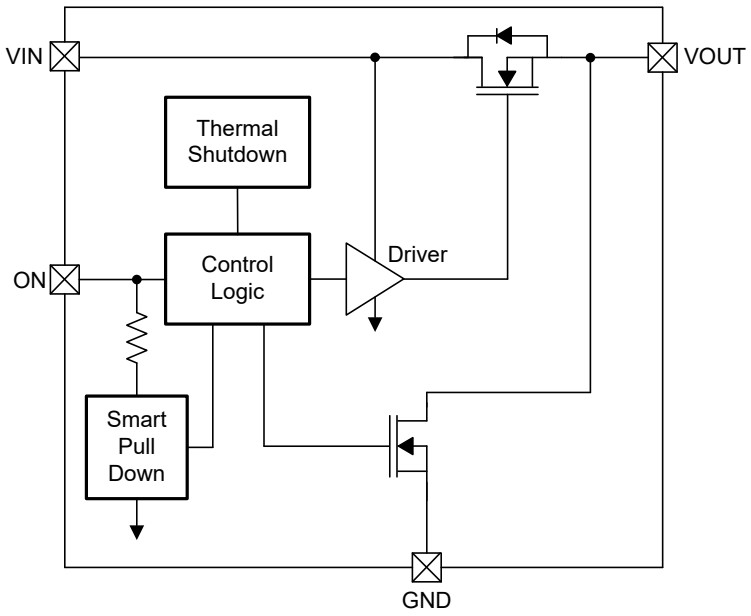
8 Detailed Description

8.1 Overview

The TPS22991I is a small, low R_{ON}, single channel load switch with a controlled slew rate. The device contains an N-channel MOSFET that operates over an input voltage range of 1V to 5.5V and supports a maximum continuous current of 2.7A. The switch is controlled by an on and off input, which interfaces directly with low-voltage control signals.

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 On and Off Control

The ON pin controls the state of the switch. The ON pin is compatible with standard GPIO logic threshold and is used in a wide variety of applications. When power is first applied to V_{IN}, a smart pulldown keeps the ON pin from floating until the system sequencing is complete. After the ON pin is deliberately driven high (≥ V_{IH}), the smart pulldown disconnects to prevent unnecessary power loss. See Table 8-1 when the ON pin smart pulldown is active.

Table 8-1. On Pin Control

ON PIN VOLTAGE	ON PIN SMART PULLDOWN STATUS
≤ V_{IL}	Smart pulldown resistance active
≥ V_{IH}	Smart pulldown disconnected

8.3.2 Quick Output Discharge

TPS22991IB and TPS22991IC integrates quick output discharge. When the switch is disabled, a discharge resistor is connected between VOUT and GND. This resistor has a typical value of 150Ω when V_{IN} = 3.3V, and prevents the output from floating while the switch is disabled.

8.3.3 Thermal Shutdown

When the device temperature reaches $T_{SD,\ R}$, the device shuts off to prevent thermal damage. After the device cools off to $T_{SD,F}$, the device turns back on. If the device is kept in a thermally stressful environment, then the device oscillates between the off and on states until the device temperature remains below the thermal shutdown point.

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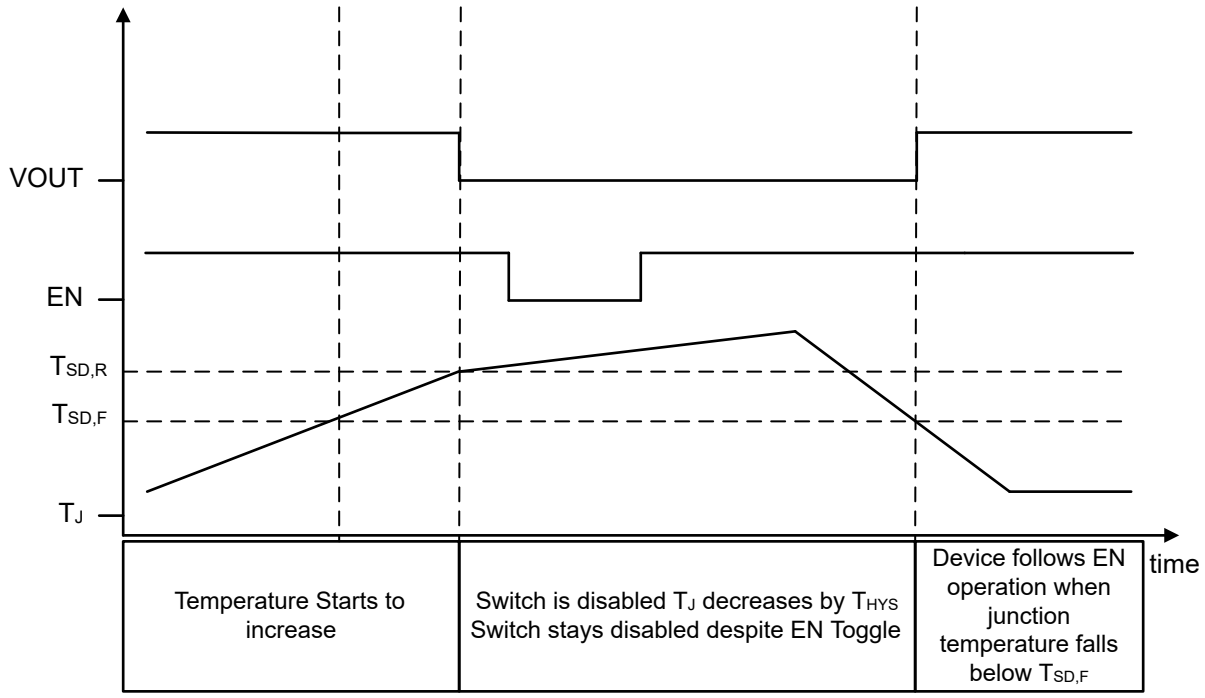

8.3.4 Input Capacitor (C_{IN})

To limit the voltage drop on the input supply caused by transient in-rush currents when the switch turns on into a discharged load capacitor or short-circuit, a capacitor needs to be placed between VIN and GND. A 1µF ceramic capacitor, C_{IN}, placed close to the pins, is usually sufficient. Higher values of C_{IN} can be used to further reduce the voltage drop during high-current application. When switching heavy loads, it is recommended to have an input capacitor about 10 times higher than the output capacitor to avoid excessive voltage drop.

8.3.5 Output Capacitor (C_L)

Due to the integrated body diode in the MOSFET, a C_{IN} greater than C_L is highly recommended. A C_L greater than C_{IN} can cause V_{OUT} to exceed V_{IN} when the system supply is removed, resulting in current flow through the body diode from V_{OUT} to V_{IN}. A C_{IN} to C_L ratio of 10 to 1 is recommended for minimizing V_{IN} dip caused by inrush currents during start-up.

8.4 Device Functional Modes

The table below describes the connection of the VOUT pin depending on the state of the ON pin.

Table 8-2. VOUT Pin State Due to ON Pin Status

ON	FAULT CONDITION	VOUT STATE
L	N/A	• Hi-Z for BN, CN • GND through QOD resistor for B, C
H	None	V_{IN} through R_{ON}
X	Thermal shutdown	• Hi-Z for BN, CN • GND through QOD resistor for B, C

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9 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

9.1 Application Information

The TPS22991I is capable of driving loads up to 2.7A, and the integrated slew rate control helps with charging load capacitance. Calculate the voltage drop to estimate the power dissipation across the device. Use the slew rate control setting to estimate the inrush current during turn on.

9.2 Typical Application

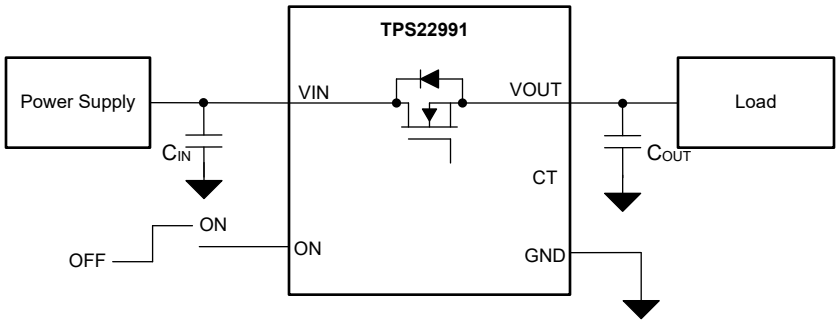

Figure 9-1. Typical Application Diagram

Table 9-1. Recommended External Components

COMPONENT	TYPICAL VALUE	PURPOSE
C_{IN}	1µF	Filtering voltage transients
C_{OUT}	100nF	Filtering voltage transients

9.2.1 Design Requirements

For this design example, use the input parameters shown in Table 9-2.

Table 9-2. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
V_{IN}	5V
Load current	2A
Load capacitance	10µF

9.2.2 Detailed Design Procedure

The input to output voltage drop in the device is determined by the R_{ON} of the device and the load current. The R_{ON} of the device depends upon the V_{IN} condition of the device. After the R_{ON} of the device is determined based upon the V_{IN} condition, use the below equation to calculate the input to output voltage drop.

$$\Delta V = I_{LOAD} \times R_{ON} \quad (1)$$

where

- ΔV is the voltage drop from V_{IN} to V_{OUT}
- I_{LOAD} is the load current

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- R_{ON} is the on-resistance of the device for a specific VIN and VBIAS

An appropriate I_{LOAD} must be chosen such that the I_{MAX} specification of the device is not violated.

To determine how much inrush current is caused by the load capacitance, use Equation 2.

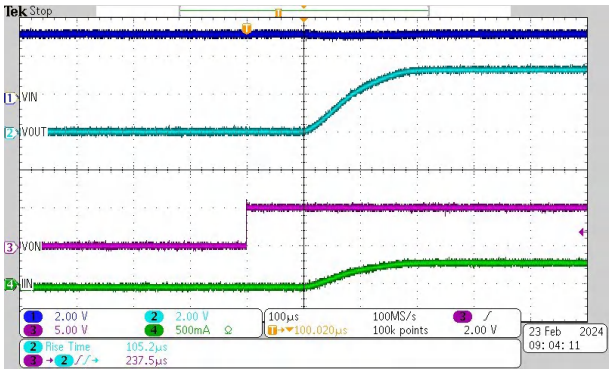
$$I_{INRUSH} = C_L \times dV_{OUT} \div dt \quad (2)$$

where

- I_{INRUSH} is amount of inrush current caused by C_L
- C_L is the load capacitance on V_{OUT}
- dt is the rise time for V_{OUT} when the device is enabled
- dV_{OUT} is change in the V_{OUT} voltage after the device is enabled

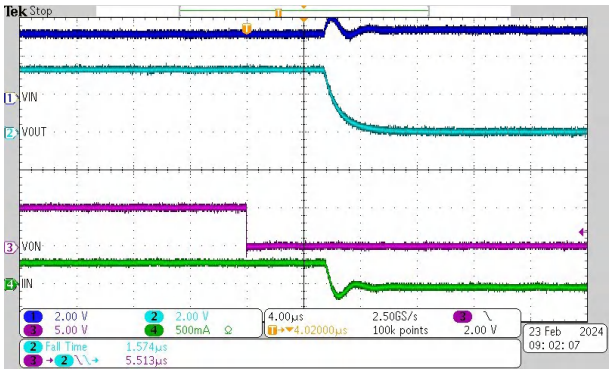
The slew rate of the device dV_{OUT}/dt at a given V_{IN} voltage can be found in the electrical characteristic table for a given version. I_{INRUSH} has to be within the I_{MAX} and I_{PLS} limits.

9.2.3 Application Curves



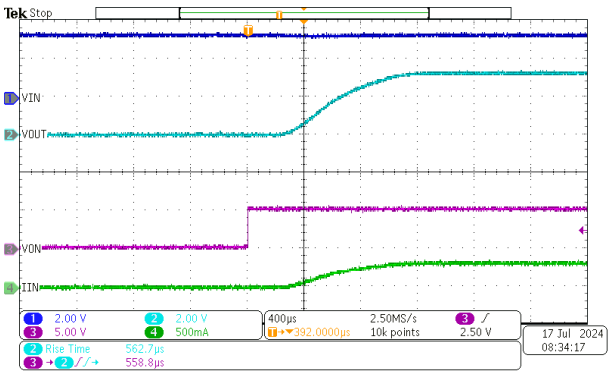
C_L = 0.1µF R_L = 10Ω V_{IN} = 3.3V

Figure 9-2. Typical Turn On for TPS22991B



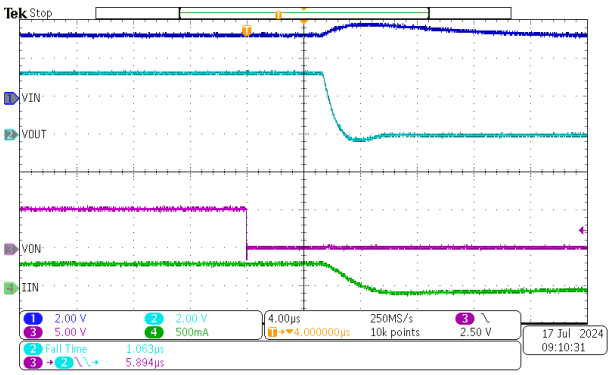
C_L = 0.1µF R_L = 10Ω V_{IN} = 3.3V

Figure 9-3. Typical Turn Off for TPS22991B



C_L = 0.1µF R_L = 10Ω V_{IN} = 3.3V

Figure 9-4. Typical Turn On for TPS22991C



C_L = 0.1µF R_L = 10Ω V_{IN} = 3.3V

Figure 9-5. Typical Turn Off for TPS22991C

9.3 Power Supply Recommendations

The TPS22991I device is designed to operate with a V_{IN} range of 1V to 5.5V. Regulate the V_{IN} power supply well and place as close to the device terminal as possible. The power supply must be able to withstand all transient load current steps. In most situations, using an input capacitance (C_{IN}) of 1µF is sufficient to prevent the supply voltage from dipping when the switch is turned on. In cases where the power supply is slow to respond to a large transient current or large load current step, additional bulk capacitance can be required on the input.

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9.4 Layout

9.4.1 Layout Guidelines

For best performance, all traces must be as short as possible. To be most effective, place the input and output capacitors close to the device to minimize the effects that parasitic trace inductances can have on normal operation. Using wide traces for VIN, VOUT, and GND helps minimize the parasitic electrical effects.

9.4.2 Layout Example

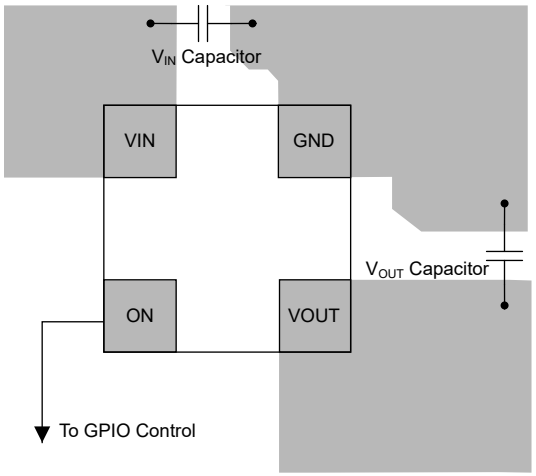

Figure 9-6. TPS22991I Layout

10 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.

10.1 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.

10.2 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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10.3 Trademarks

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10.4 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.

10.5 Glossary

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

11 Revision History

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

Changes from Revision * (June 2025) to Revision A (July 2025)	Page
• Changed the document status from *Advance Information* to *Production Data*	1
• Updated *Application Information* section	15

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12 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.

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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)
TPS22991IBNRAAR	Active	Production	UQFN-HR (RAA) | 4	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-55 to 125	4
TPS22991IBRAAR	Active	Production	UQFN-HR (RAA) | 4	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-55 to 125	S
TPS22991ICNRAAR	Active	Production	UQFN-HR (RAA) | 4	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-55 to 125	5
TPS22991ICRAAR	Active	Production	UQFN-HR (RAA) | 4	3000 | LARGE T&R	Yes	SN	Level-1-260C-UNLIM	-55 to 125	T

(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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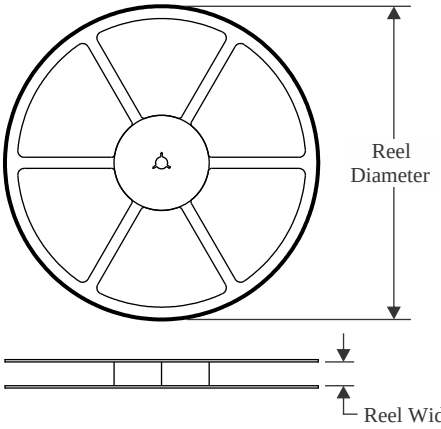
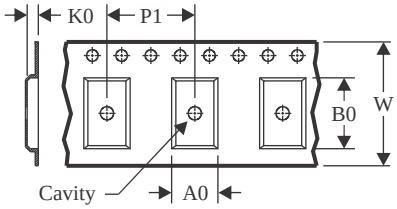
In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

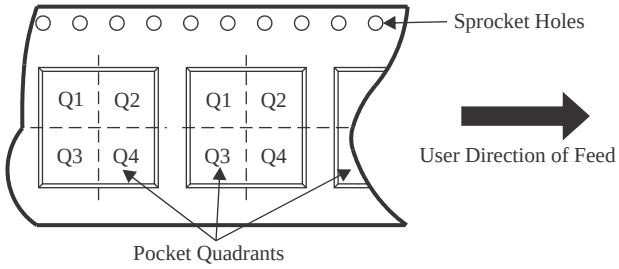


TAPE DIMENSIONS



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

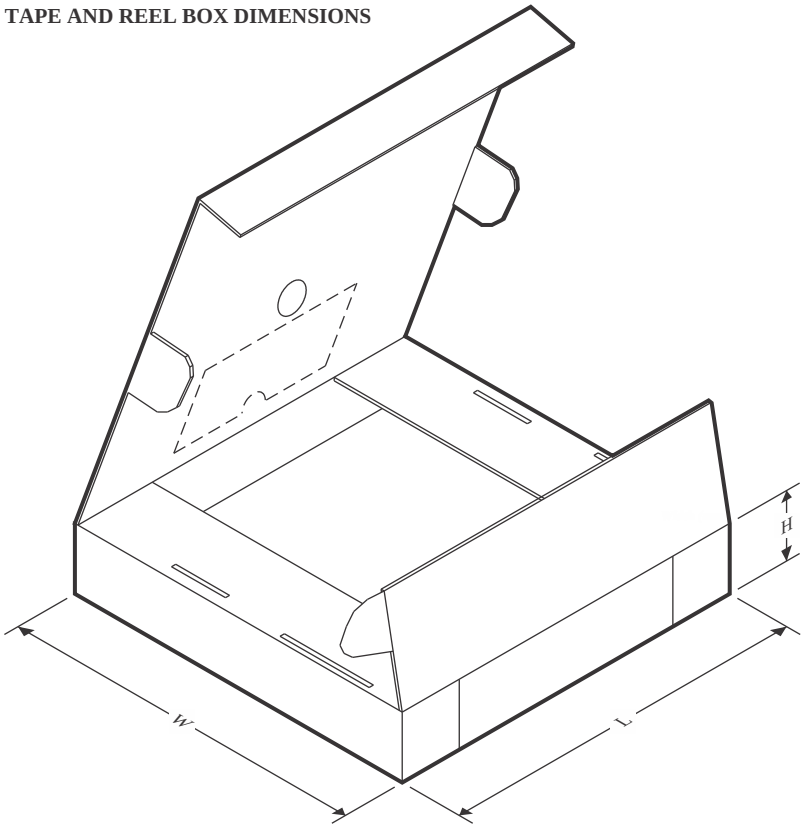
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*All dimensions are nominal

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
TPS22991IBNRAAR	UQFN-HR	RAA	4	3000	180.0	8.4	0.9	1.0	0.66	2.0	8.0	Q1
TPS22991IBRAAR	UQFN-HR	RAA	4	3000	180.0	8.4	0.9	1.0	0.66	2.0	8.0	Q1
TPS22991ICNRAAR	UQFN-HR	RAA	4	3000	180.0	8.4	0.9	1.0	0.66	2.0	8.0	Q1
TPS22991ICRAAR	UQFN-HR	RAA	4	3000	180.0	8.4	0.9	1.0	0.66	2.0	8.0	Q1

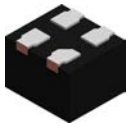
TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS22991IBNRAAR	UQFN-HR	RAA	4	3000	210.0	185.0	35.0
TPS22991IBRAAR	UQFN-HR	RAA	4	3000	210.0	185.0	35.0
TPS22991ICNRAAR	UQFN-HR	RAA	4	3000	210.0	185.0	35.0
TPS22991ICRAAR	UQFN-HR	RAA	4	3000	210.0	185.0	35.0

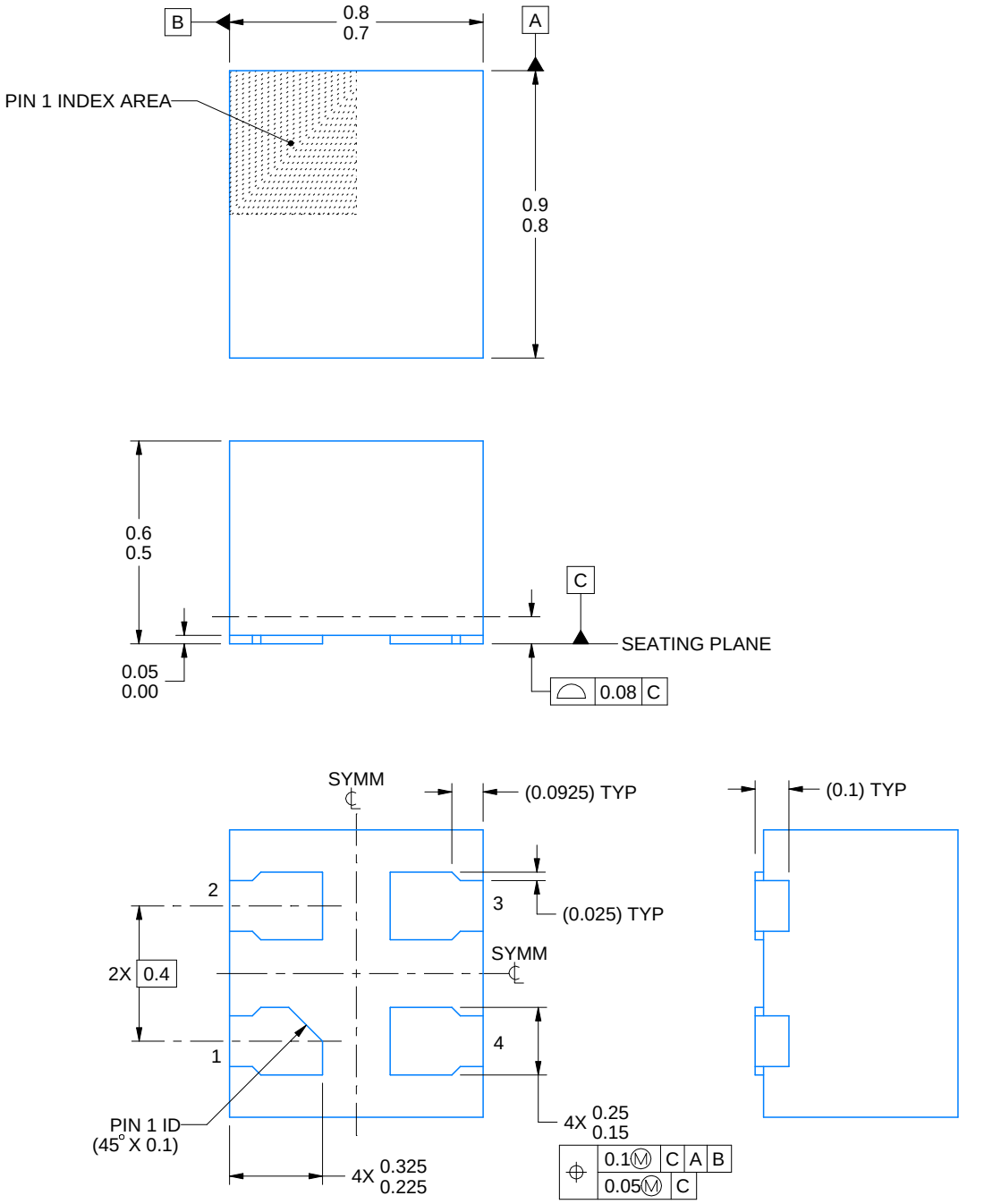
RAA0004A



PACKAGE OUTLINE

UQFN-HR - 0.6 mm max height

PLASTIC QUAD FLATPACK - NO LEAD



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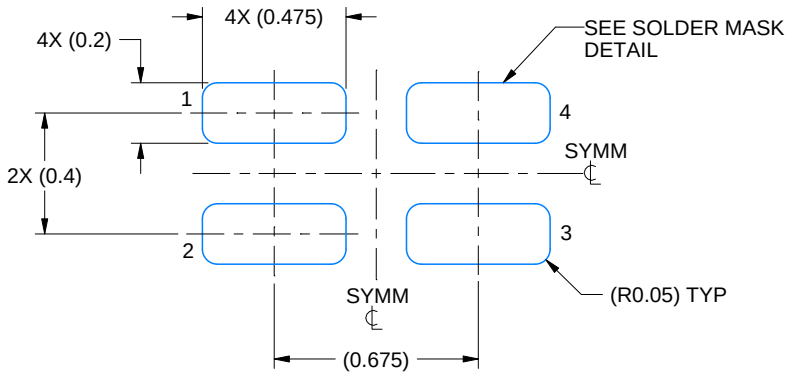
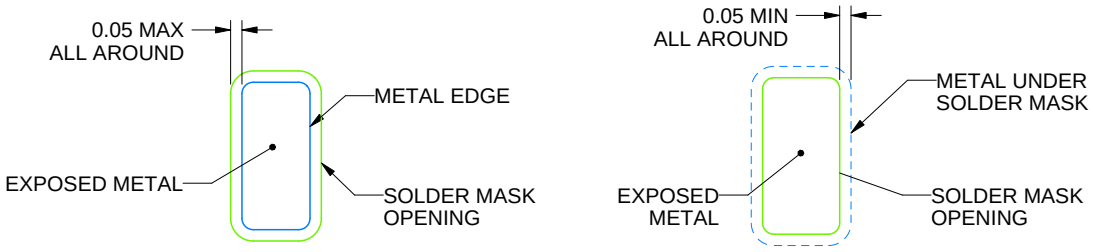
NOTES:

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.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE: 40X



NON SOLDER MASK
DEFINED
(PREFERRED)

SOLDER MASK DEFINED

SOLDER MASK DETAILS

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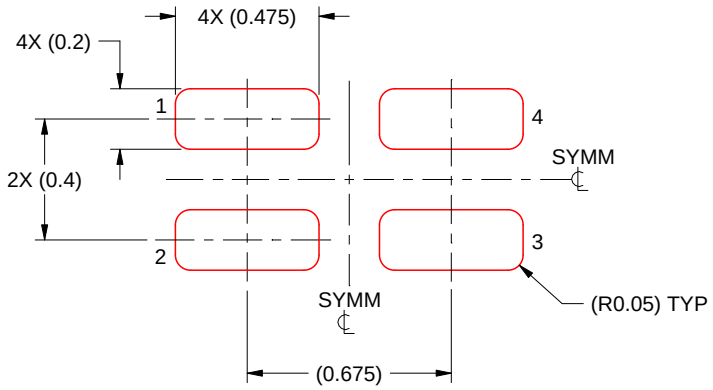
NOTES: (continued)

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.



SOLDER PASTE EXAMPLE
BASED ON 0.1 MM THICK STENCIL
SCALE: 40X

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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.

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