具有受控接通功能的超低导通电阻，4A 集成负载开关

查询样品: TPS22920L

特性

- 输入电压范围：0.75V 至 3.6V
- 集成导通场效应晶体管 (FET)
  R_{DSON}= 2mΩ（典型值），此时 $V_{输入}$= 3.6V
- 超低导通电阻
  - $V_{输入}$ = 3.6V 时，$r_{导通}$ = 5.3mΩ
  - $V_{输入}$ = 2.5V 时，$r_{导通}$ = 5.4mΩ
  - $V_{输入}$ = 1.8V 时，$r_{导通}$ = 5.5mΩ
  - $V_{输入}$ = 1.2V 时，$r_{导通}$ = 5.8mΩ
  - $V_{输入}$ = 1.05V 时，$r_{导通}$ = 6.1mΩ
  - $V_{输入}$ = 0.75V 时，$r_{导通}$ = 7.3mΩ
- 超小型 8 引脚芯片级封装（芯片级球栅阵列封装 (DSBGA)）0.9mm x 1.9mm，焊球间距 0.5mm
- 4A 最大持续开关电流
- 关断电流最大值 5.5μA
- 低阀值 (1.2V) 通用输入输出 (GPIO) 控制输入
- 受控转换率以避免涌入电流
- 快速输出放电 (QOD) 晶体管
- 静电放电 (ESD) 性能测试符合 JESD 22 标准
  - 4000V 人体模型（A114-B，II 类）
  - 1000V 充电器件模型 (C101)

应用范围

- Thunderbolt™
- 固态硬盘 (SSD)
- 笔记本/超薄
- 平板个人电脑
- 智能手机
- 便携式 GPS 器件
- MP3 播放器

说明

TPS22920L 是一款小型，超低 $R_{导通}$负载开关，此开关具有可控接通功能。 此器件包含一个 N 通道金属氧化物半导体场效应晶体管 (MOSFET)，此 MOSFET 可运行在 0.75V 至 3.6V 的输入电压范围内，并且开关电流高达 4A。一个集成的电荷泵把 NMOS 开关偏置，以实现一个最小的开关导通电阻（$R_{导通}$）。 此开关可由一个打开/关闭输入 (ON) 控制，此输入可与低压控制信号直接对接。

TPS22920L 包含一个 1250Ω 片上负载电阻器用于在此开关被关闭时进行快速输出放电。

TPS22920L 有一个内部受控上升时间来减少涌入电流。 电压为 3.6V 时，TPS22920L 特有一个 627μs 的上升时间。

TPS22920L 采用超小型、节省空间的 8 引脚芯片级封装并可在 -40°C 至 85°C 的自然通风温度范围内运行。

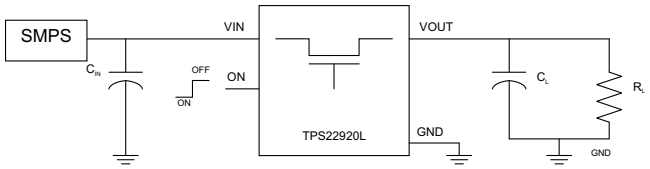


图 1. 典型应用

特性列表

	3.6V 时的 $r_{导通}$（典型值）	3.6V 时的上升时间（典型值）	快速输出放电(1)	最大输出电压	使能
TPS22920L	5.3mΩ	627μs	是	4A	低电平有效

(1) 此特性可通过一个 1250Ω 电阻器将开关的输出放电至接地水平，从而防止此输出悬空。 请见应用部分“输出下拉”

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.

ORDERING INFORMATION

For the most current package and ordering information, see the Package Option Addendum at the end of this document, or see the TI web site at www.ti.com

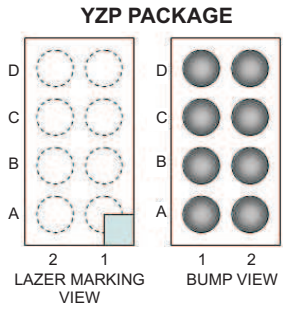


Figure 2. Bump Assignments

Bump Assignments (YZP Package)

D	GND	ON
C	VOUT	VIN
B	VOUT	VIN
A	VOUT	VIN
	1	**2**

Pin Description

TPS22920L YZP	PIN NAME	DESCRIPTION
D1	GND	Ground.
D2	ON	Switch control input, active low. Do not leave floating.
A1, B1, C1	VOUT	Switch output.
A2, B2, C2	VIN	Switch input. Place an optional decoupling capacitor between this pin and GND for reduce VIN dip during turn-on of the channel. See Application Information section for more information.

FUNCTIONAL BLOCK DIAGRAM

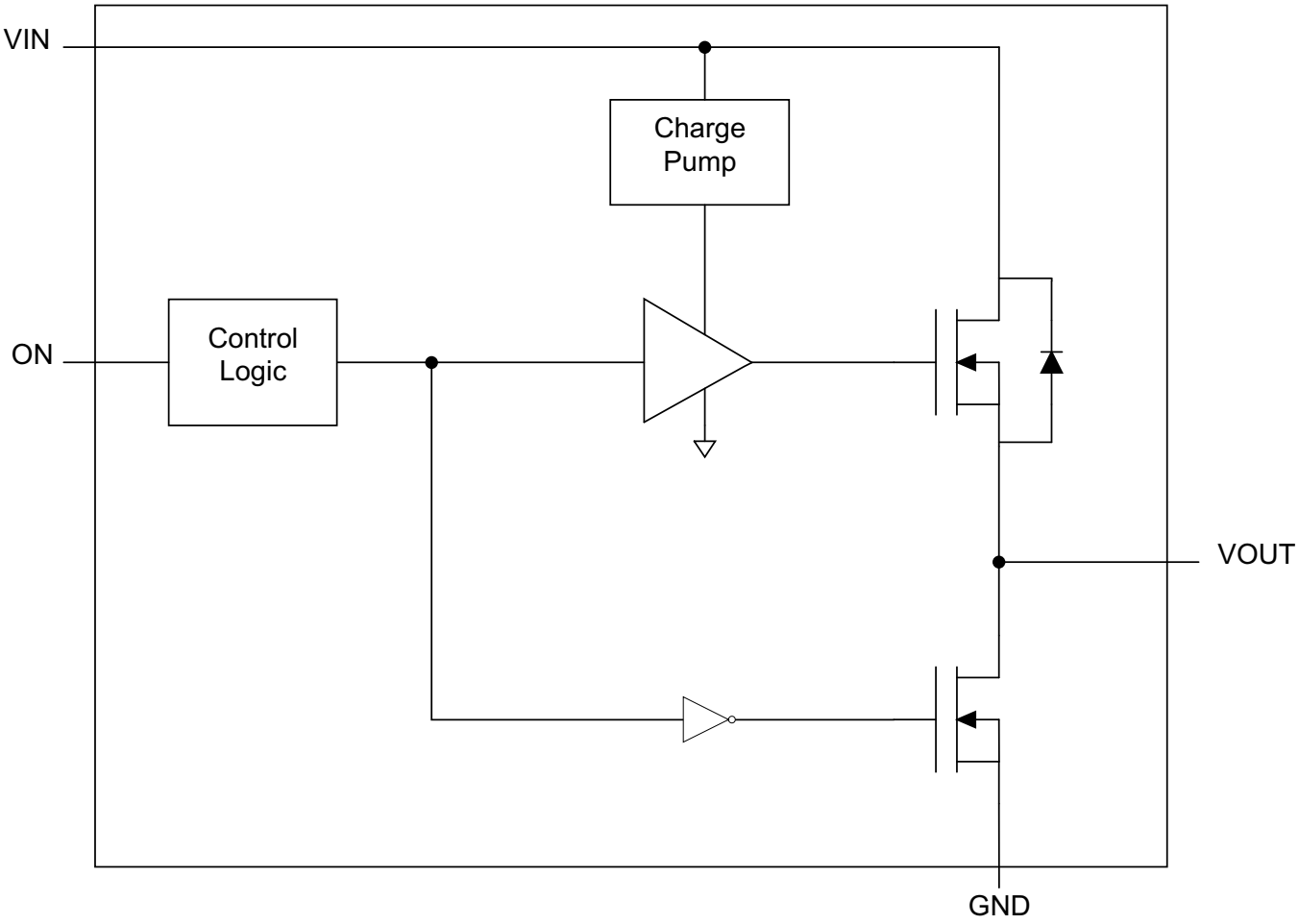


Figure 3. Functional block diagram of the TPS22920L

FUNCTION TABLE

ON	VIN to VOUT	VOUT to GND(1)
L	ON	OFF
H	OFF	ON

(1) See Application section 'Output Pull-Down'

ABSOLUTE MAXIMUM RATINGS(1)

			VALUE	UNIT
V_{IN}	VIN voltage range		–0.3 to 4	V
V_{OUT}	VOUT voltage range		VIN + 0.3	V
V_{ON}	ON-pin voltage range		–0.3 to 4	V
I_{MAX}	Maximum continuous switch current		4	A
I_{PLS}	Maximum pulsed switch current, pulse <300µS, 2% duty cycle		6	A
T_A	Operating free-air temperature range		–40 to 85	°C
T_J	Maximum junction temperature		125	°C
T_{STG}	Storage temperature range		–65 to 150	°C
T_{LEAD}	Maximum lead temperature (10-s soldering time)		300	°C
ESD	Electrostatic discharge protection	Human-Body Model (HBM)	4000	V
		Charged Device Model (CDM)	1000	

(1) Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress only, and functional operation of the device at these or any other conditions beyond those indicated under Recommended Operating Conditions is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

THERMAL INFORMATION

THERMAL METRIC(1)		TPS22920L CSP (8 PINS)	UNITS
θ_{JA}	Junction-to-ambient thermal resistance	130	°C/W
θ_{JCtop}	Junction-to-case (top) thermal resistance	54	
θ_{JB}	Junction-to-board thermal resistance	51	
ψ_{JT}	Junction-to-top characterization parameter	1	
ψ_{JB}	Junction-to-board characterization parameter	50	
θ_{JCbot}	Junction-to-case (bottom) thermal resistance	n/a	

(1) For more information about traditional and new thermal metrics, see the *IC Package Thermal Metrics* application report, SPRA953.

RECOMMENDED OPERATING CONDITIONS

			MIN	MAX	UNIT
V_{IN}	VIN voltage range		0.75	3.6	V
V_{OUT}	VOUT voltage range			V_{IN}	V
V_{IH}	High-level input voltage, ON	V_{IN} = 2.5-V to 3.6 V	1.2	3.6	V
		V_{IN} = 0.75-V to 2.49 V	0.9	3.6	V
V_{IL}	Low-level input voltage, ON	V_{IN} = 2.5-V to 3.6 V		0.6	V
		V_{IN} = 0.75-V to 2.49 V		0.4	V
C_{IN}	Input Capacitor		1(1)		µF

(1) See *Input Capacitor* section in Application Information.

ELECTRICAL CHARACTERISTICS

V_{IN} = 0.75 V to 3.6 V (unless otherwise noted)

PARAMETER		TEST CONDITIONS		T_A	MIN	TYP(1)	MAX	UNIT
$I_{Q,VIN}$	Quiescent current for VIN	I_{OUT} = 0 A, V_{ON} = 0V	V_{IN} = 3.6 V	Full		68	160	µA
			V_{IN} = 2.5 V			40	70	
			V_{IN} = 1.8 V			25	350	µA
			V_{IN} = 1.2 V			103	200	
			V_{IN} = 1.05 V			78	110	µA
			V_{IN} = 0.75 V			37	70	
$I_{SD,VIN}$	Shutdown current for VIN	V_{ON} = 3.6 V, V_{OUT} = 0 V		Full			5.5	µA
R_{ON}	On-Resistance	V_{IN} = 3.6 V, I_{OUT} = –200 mA		25°C		5.3	8.8	mΩ
				Full			9.8	
		V_{IN} = 2.5 V, I_{OUT} = –200 mA		25°C		5.4	8.9	mΩ
				Full			9.9	
		V_{IN} = 1.8 V, I_{OUT} = –200 mA		25°C		5.5	9.1	mΩ
				Full			10.1	
		V_{IN} = 1.2 V, I_{OUT} = –200 mA		25°C		5.8	9.4	mΩ
				Full			10.4	
		V_{IN} = 1.05 V, I_{OUT} = –200 mA		25°C		6.1	9.7	mΩ
				Full			10.8	
		V_{IN} = 0.75 V, I_{OUT} = –200 mA		25°C		7.3	11.0	mΩ
				Full			12.4	
R_{PD}	Output pull down resistance(2)	V_{IN} = 3.3 V, V_{ON} = 3.6 V, I_{OUT} = 3 mA		Full		1250	1500	Ω
I_{ON}	ON input leakage current	V_{ON} = 0.9 V to 3.6 V or GND		Full			0.1	µA

(1) Typical values are at V_{IN} = 3.3 V and T_A = 25°C.
(2) See Output Pulldown in *Application Information*.

SWITCHING CHARACTERISTICS

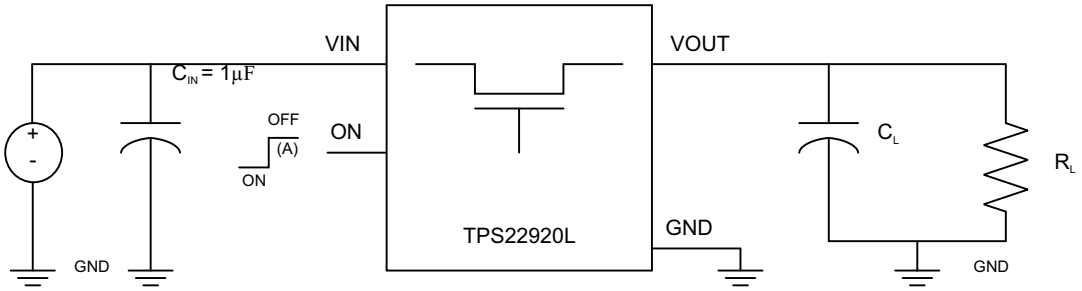
V_{IN} = 3.6 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 3.6 V		663		µs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 3.6 V		2		
t_R	VOUT Rise time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 3.6 V		627		
t_F	VOUT Fall time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 3.6 V		2		
t_D	ON delay time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 3.6 V		380		

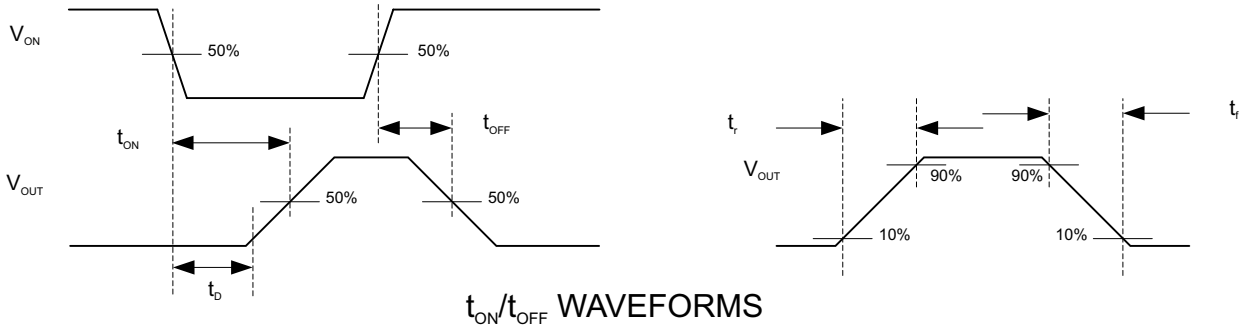
V_{IN} = 0.9 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITION	MIN	TYP	MAX	UNIT
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 0.9 V		840		µs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 0.9 V		12		
t_R	VOUT Rise time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 0.9 V		419		
t_F	VOUT Fall time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 0.9 V		3		
t_D	ON delay time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 0.9 V		611		

PARAMETRIC MEASUREMENT INFORMATION



TEST CIRCUIT

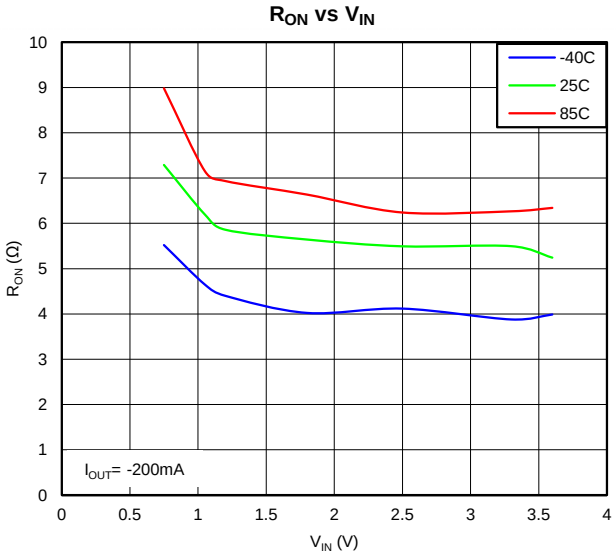


t_{ON}/t_{OFF} WAVEFORMS

A. Rise and fall times of the control signal is 100ns.

Figure 4. Test Circuit and t_{ON}/t_{OFF} Waveforms

TYPICAL CHARACTERISTICS



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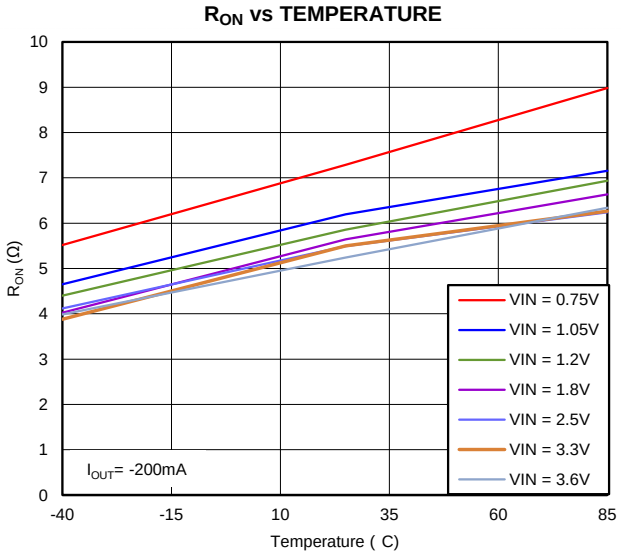
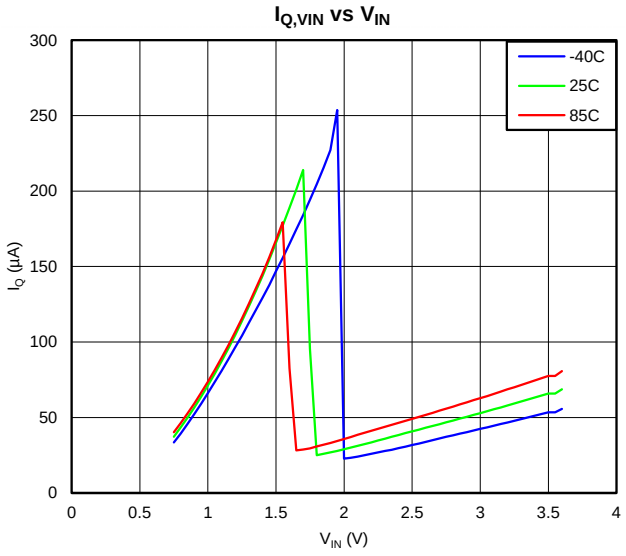


Figure 6.



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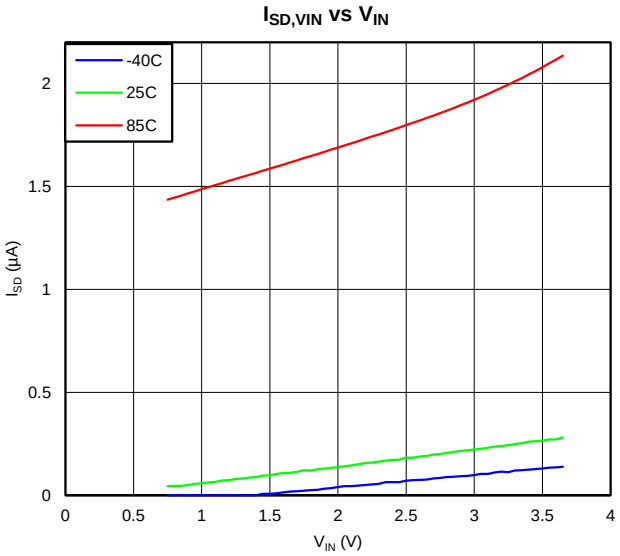


Figure 8.

TYPICAL CHARACTERISTICS (continued)

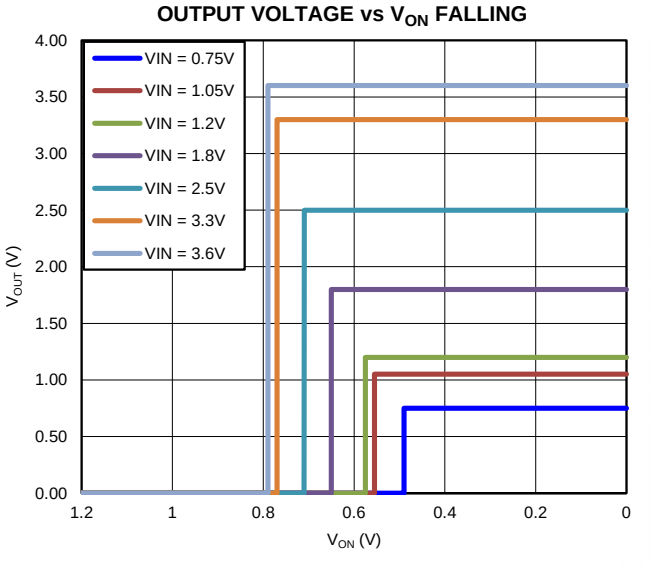


Figure 9.

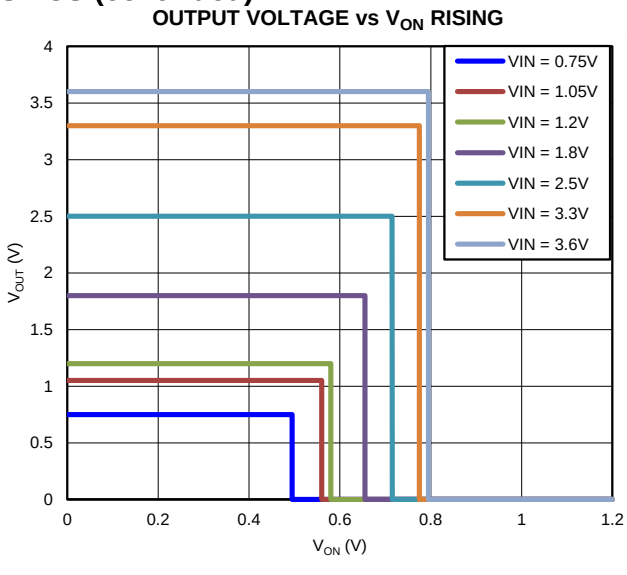


Figure 10.

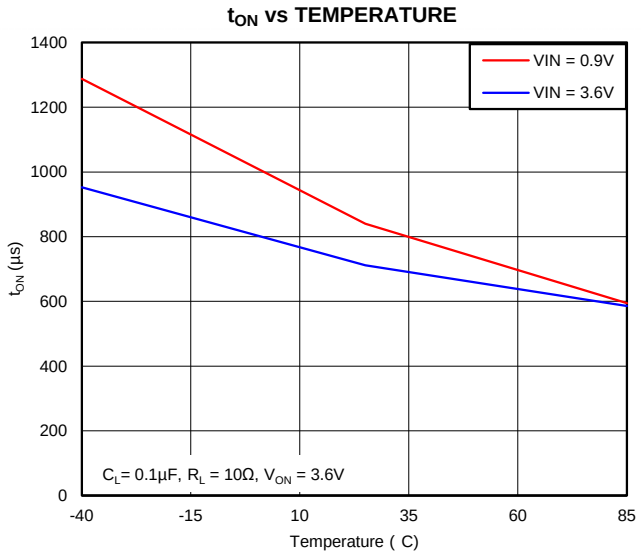


Figure 11.

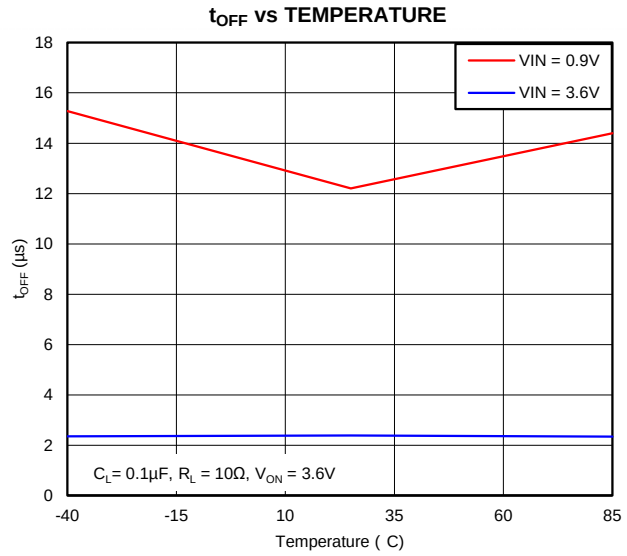


Figure 12.

TYPICAL CHARACTERISTICS (continued)

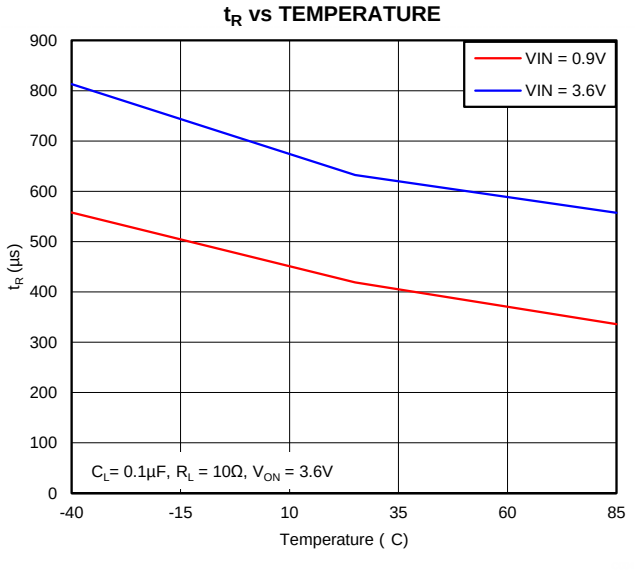
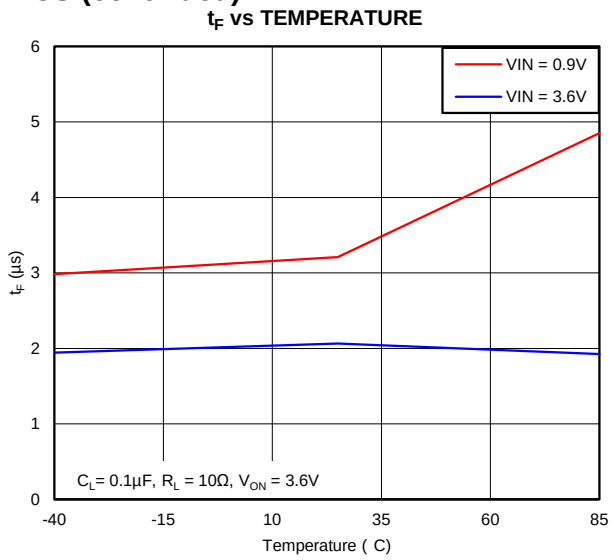


Figure 13.



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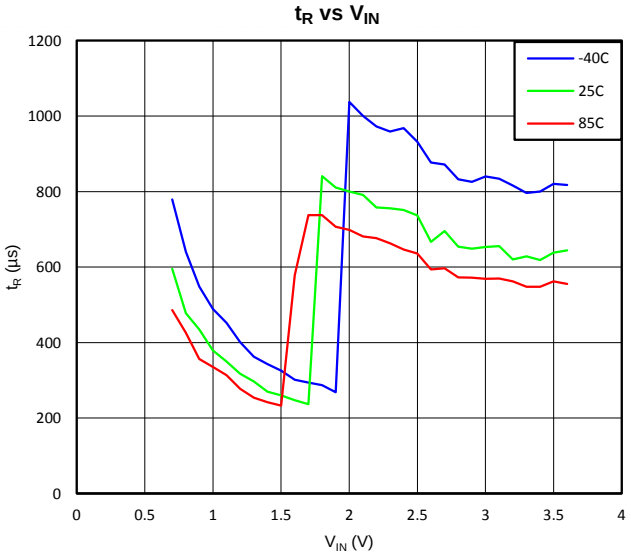

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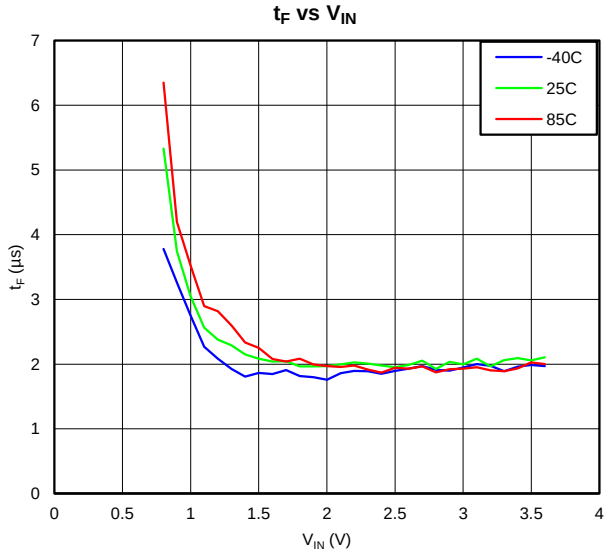
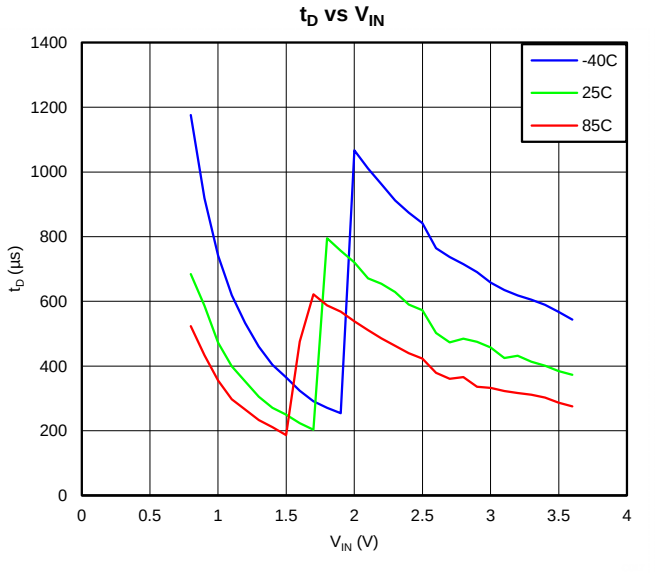


Figure 16.

TYPICAL CHARACTERISTICS (continued)



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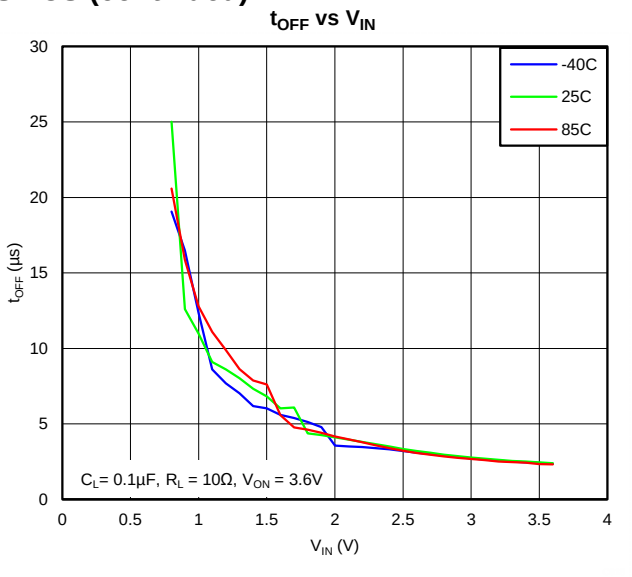

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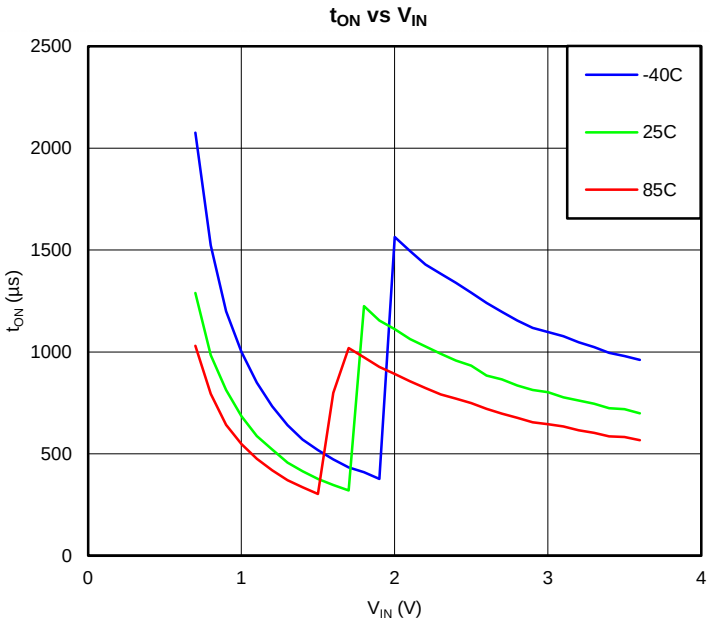


Figure 19.

TYPICAL CHARACTERISTICS (continued)

TURN-ON RESPONSE
V_{IN} = 0.9V, T_A = 25°C, C_{IN} = 1µF, C_L = 0.1µF, R_L = 10Ω

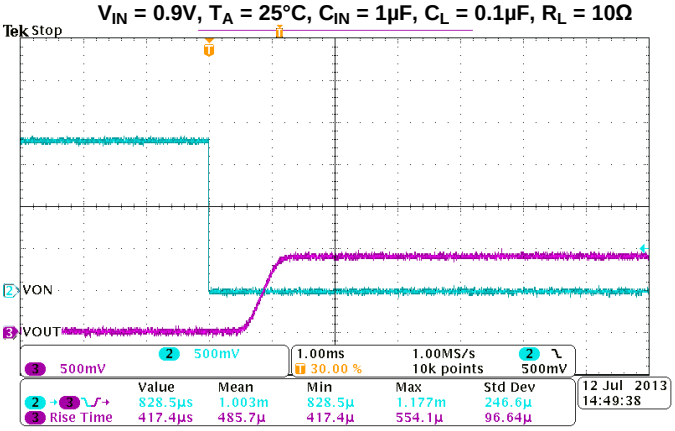


Figure 20.

TURN-OFF RESPONSE
V_{IN} = 0.9V, T_A = 25°C, C_{IN} = 1µF, C_L =0.1µF, R_L = 10Ω

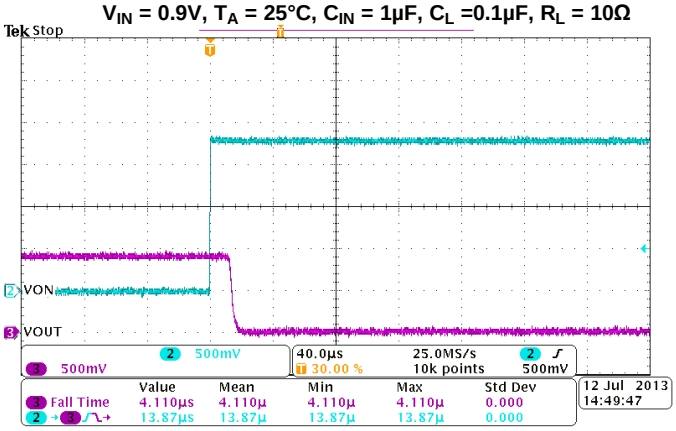


Figure 21.

TURN-ON RESPONSE
V_{IN} = 0.9V, T_A = 25°C, C_{IN} = 10µF, C_L = 1µF, R_L = 10Ω

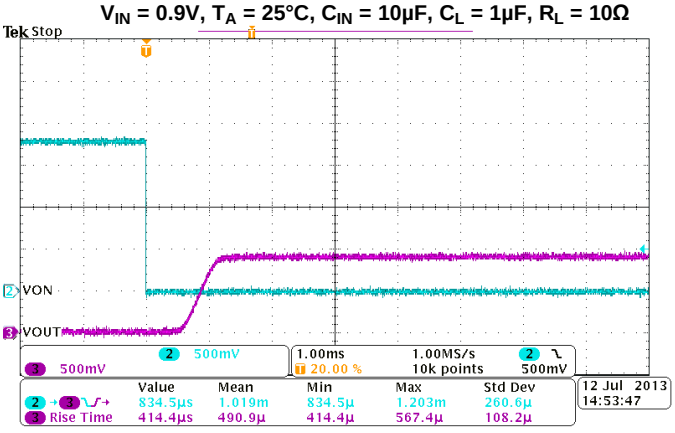


Figure 22.

TURN-OFF RESPONSE
V_{IN} = 0.9V, T_A = 25°C, C_{IN} = 10µF, C_L = 1µF, R_L = 10Ω

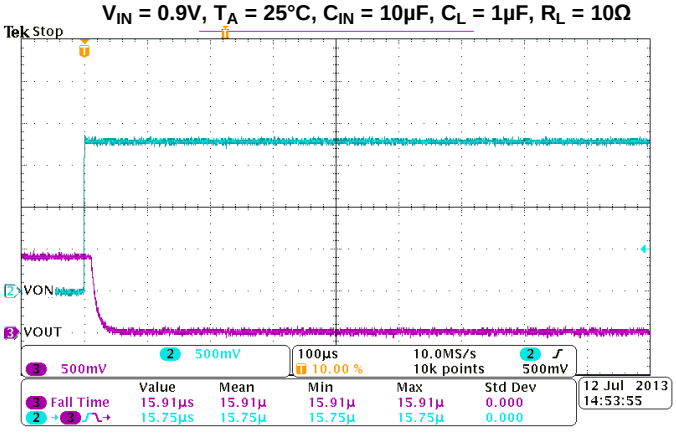


Figure 23.

TURN-ON RESPONSE
V_{IN} = 3.6V, T_A = 25°C, C_{IN} = 1µF, C_L =0.1µF, R_L = 10Ω

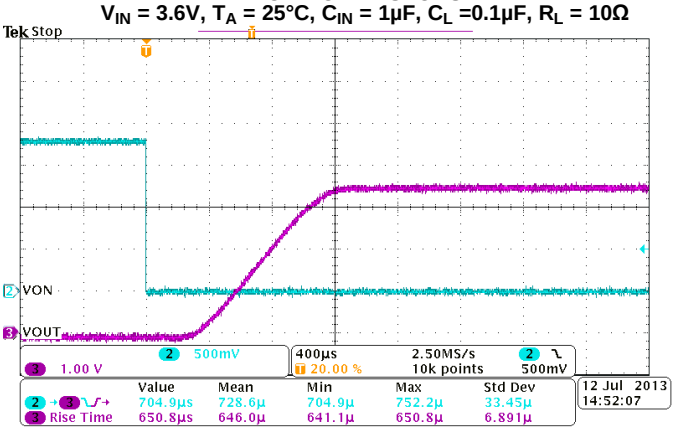


Figure 24.

TURN-OFF RESPONSE
V_{IN} = 3.6V, T_A = 25°C, C_{IN} = 1µF, C_L = 0.1µF, R_L = 10Ω

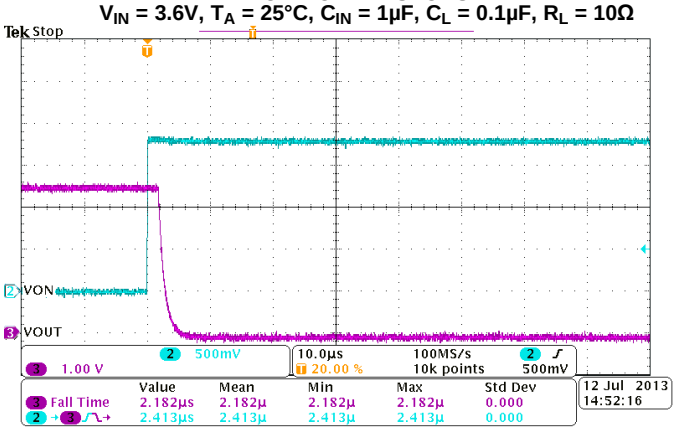


Figure 25.

TYPICAL CHARACTERISTICS (continued)

TURN-ON RESPONSE

V_{IN} = 3.6V, T_A = 25°C, C_{IN} = 10µF, C_L = 1µF, R_L = 10Ω

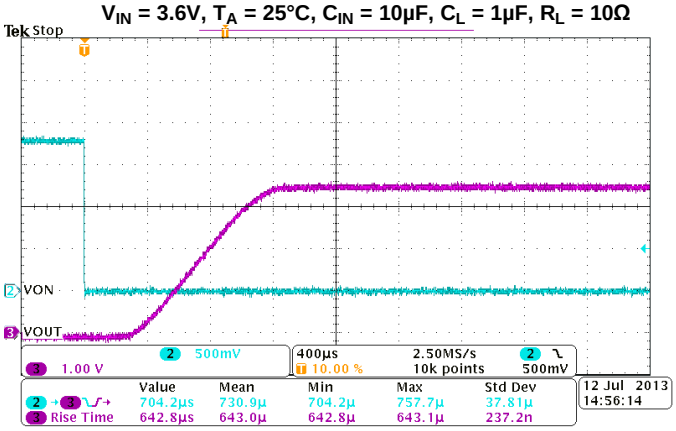


Figure 26.

TURN-OFF RESPONSE

V_{IN} = 3.6V, T_A = 25°C, C_{IN} = 10µF, C_L = 1µF, R_L = 10Ω

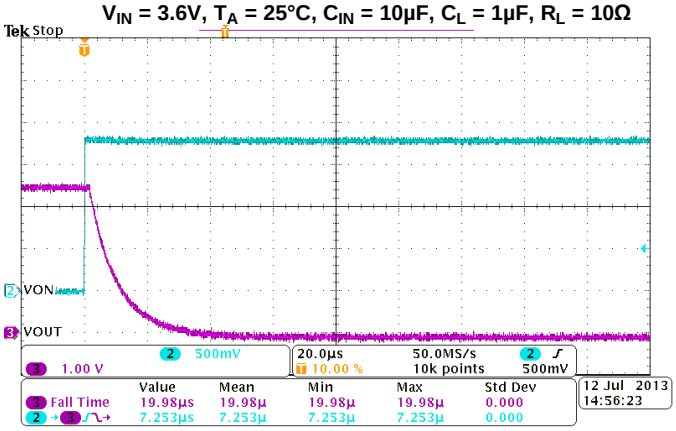


Figure 27.

APPLICATION INFORMATION

ON/OFF CONTROL

The ON pin controls the state of the switch. Asserting ON low enables the switch. ON is active low and has a low threshold, making it capable of interfacing with low-voltage signals. The ON pin is compatible with standard GPIO logic threshold. It can be used with any microcontroller with 1.2 V, 1.8 V, 2.5 V or 3.3 V GPIOs.

INPUT CAPACITOR (OPTIONAL)

To limit the voltage drop on the input supply caused by transient inrush currents when the switch turns on into a discharged load capacitor or short-circuit, a capacitor needs to be placed between V_{IN} and GND. A 1 µF 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.

OUTPUT CAPACITOR (OPTIONAL)

Due to the integrated body diode in the NMOS switch, 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. This could result 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 startup.

OUTPUT PULL-DOWN

The output pulldown is active when the user is turning off the main pass FET. The pulldown discharges the output rail to approximately 10% of the rail, and then the output pulldown is automatically disconnected to optimize the shutdown current.

BOARD LAYOUT

For best performance, all traces should be as short as possible. To be most effective, the input and output capacitors should be placed close to the device to minimize the effects that parasitic trace inductances may have on normal operation. Using wide traces for V_{IN}, V_{OUT}, and GND helps minimize the parasitic electrical effects along with minimizing the case to ambient thermal impedance.

REVISION HISTORY

Changes from Original (August 2013) to Revision A	Page
• 将预览文档更新为完全版本。	1

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
TPS22920LYZPR	ACTIVE	DSBGA	YZP	8	3000	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 85	DV	Samples
TPS22920LYZPT	ACTIVE	DSBGA	YZP	8	250	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 85	DV	Samples
TPS22920YZPR	ACTIVE	DSBGA	YZP	8	3000	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 85	6Z	Samples
TPS22920YZPRB	ACTIVE	DSBGA	YZP	8	3000	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 85	6Z	Samples
TPS22920YZPT	ACTIVE	DSBGA	YZP	8	250	RoHS & Green	SNAGCU	Level-1-260C-UNLIM	-40 to 85	6Z	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.

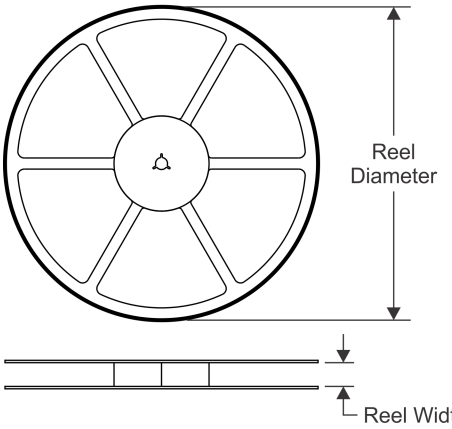
(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(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.

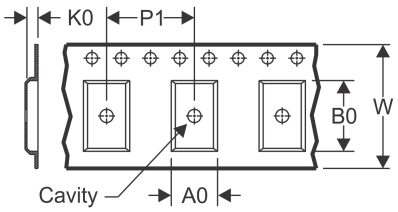
(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

TAPE AND REEL INFORMATION

REEL DIMENSIONS

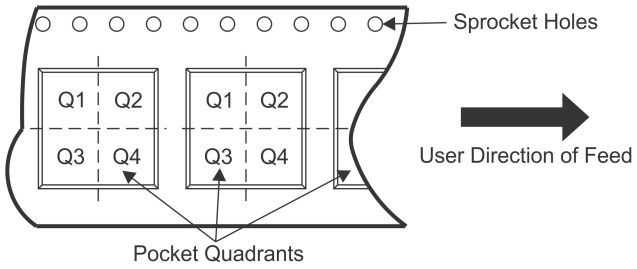


TAPE DIMENSIONS



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

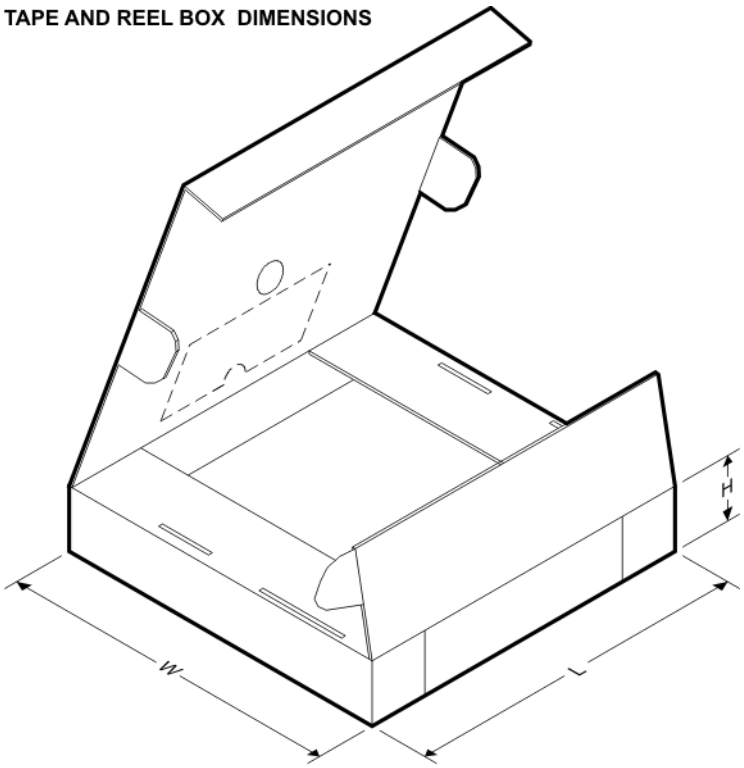
QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



*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
TPS22920LYZPR	DSBGA	YZP	8	3000	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1
TPS22920LYZPT	DSBGA	YZP	8	250	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1
TPS22920YZPR	DSBGA	YZP	8	3000	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1
TPS22920YZPR	DSBGA	YZP	8	3000	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1
TPS22920YZPRB	DSBGA	YZP	8	3000	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1
TPS22920YZPRB	DSBGA	YZP	8	3000	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1
TPS22920YZPT	DSBGA	YZP	8	250	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1
TPS22920YZPT	DSBGA	YZP	8	250	180.0	8.4	1.02	2.02	0.63	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

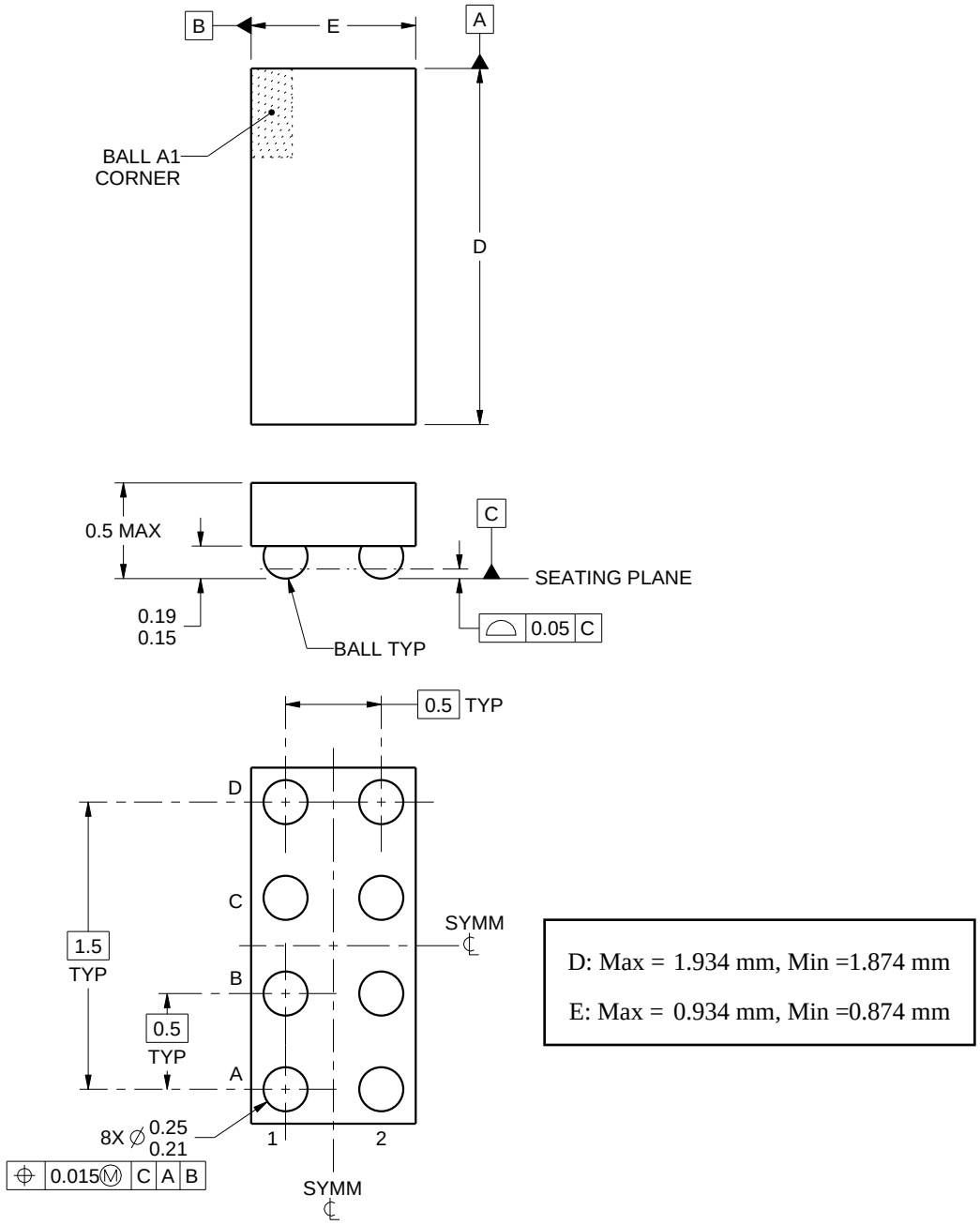
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS22920LYZPR	DSBGA	YZP	8	3000	182.0	182.0	20.0
TPS22920LYZPT	DSBGA	YZP	8	250	182.0	182.0	20.0
TPS22920YZPR	DSBGA	YZP	8	3000	182.0	182.0	20.0
TPS22920YZPR	DSBGA	YZP	8	3000	182.0	182.0	20.0
TPS22920YZPRB	DSBGA	YZP	8	3000	182.0	182.0	20.0
TPS22920YZPRB	DSBGA	YZP	8	3000	182.0	182.0	20.0
TPS22920YZPT	DSBGA	YZP	8	250	182.0	182.0	20.0
TPS22920YZPT	DSBGA	YZP	8	250	182.0	182.0	20.0

PACKAGE OUTLINE

YZP0008

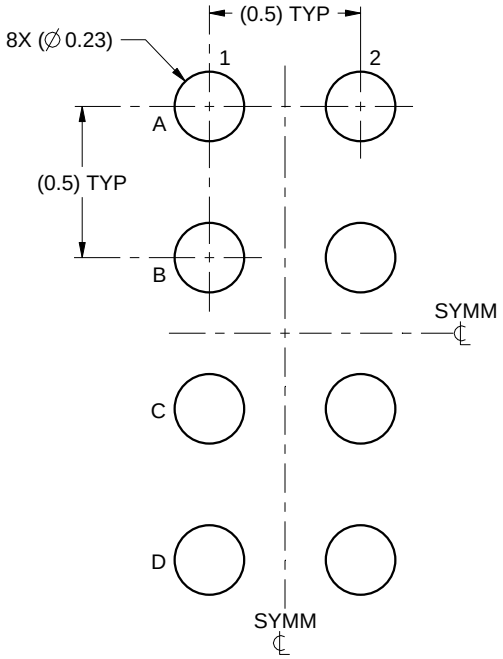
DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY

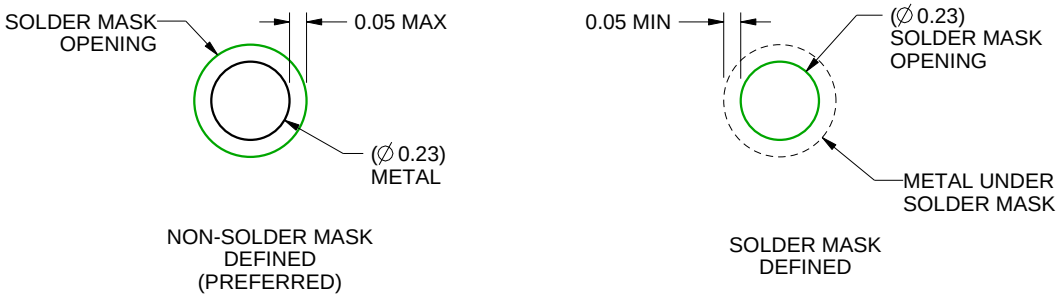


NOTES:

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.



LAND PATTERN EXAMPLE
SCALE:40X



SOLDER MASK DETAILS
NOT TO SCALE

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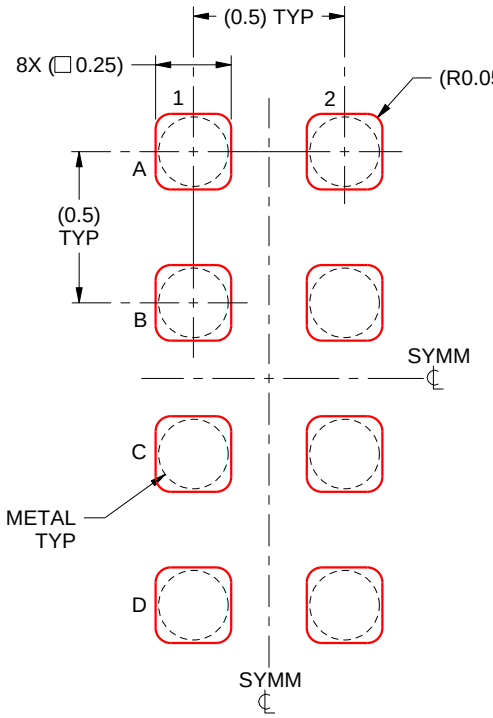
NOTES: (continued)

3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 (www.ti.com/lit/snva009).



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

4223082/A 07/2016

NOTES: (continued)

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

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