超小型，低输入电压低，低 $R_{导通}$负载开关

查询样品: **TPS22924D**

特性

- 集成单负载开关
- 输入电压：**0.75V** 至 **3.6V**
- 超低导通电阻
  - **$V_{输入}$= 3.6V** 时，**$r_{导通}$= 18.3mΩ**
  - **$V_{输入}$= 2.5V** 时，**$r_{导通}$= 18.5mΩ**
  - **$V_{输入}$= 1.8V** 时，**$r_{导通}$= 19.6mΩ**
  - **$V_{输入}$= 1.2V** 时，**$r_{导通}$= 19.4mΩ**
  - **$V_{输入}$= 1.0V** 时，**$r_{导通}$= 20.3mΩ**
  - **$V_{输入}$= 0.75V** 时，**$r_{导通}$= 22.7mΩ**
- **1.4mm x 0.9mm**，焊球间距 **0.5mm**，超小型芯片比例 **(CSP)-6** 封装
- **2A** 最大持续开关电流
- 低关断电流
- 低阈值控制输入
- 受控转换率以避免涌入电流
- 快速输出放电晶体管
- 静电放电 **(ESD)** 性能测试符合 **JESD 22** 标准
  - **5000V** 人体模型（**A114-B**，**II** 类）
  - **1000V** 充电器件模型 **(C101)**

应用范围

- 电池供电类设备
- 便携式工业设备
- 便携式医疗设备
- 便携式媒体播放器
- 销售点终端
- 全球卫星定位**(GPS)**设备
- 数码摄像机
- 笔记本**/**平板电脑**/**电子阅读器
- 智能电话

说明

TPS22924D 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 MOSFET，此 MOSFET 可运行在 0.75V 至 3.6V 的输入电压范围内。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。 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。

添加了一个 1250Ω 片载负载电阻器，以便在开关被关闭时实现输出快速放电。 此器件的上升时间受到内部控制以避免涌入电流。 电压为 3.6V 时，TPS22924D 特有一个 6200μs 的上升时间。

TPS22924D 采用超小型、节省空间的 6 引脚 CSP 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

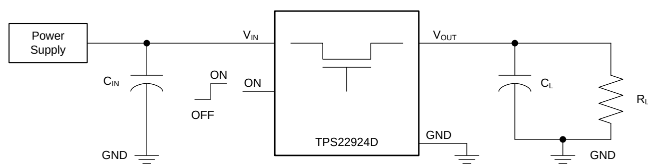


表 **1.** 特性列表

	3.6V 时的 **r**导通（典型值）	**3.6V** 时，转换率（典型值）	快速输出放电[(1)]	最大输出电压	使能
TPS22924D	18.3mΩ	6200μs	支持	2A	高电平有效

(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。 请参见应用信息中的*输出下拉*部分。

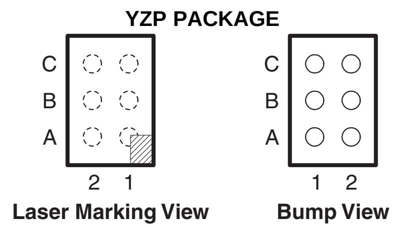
English Data Sheet: SLVSBT4

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



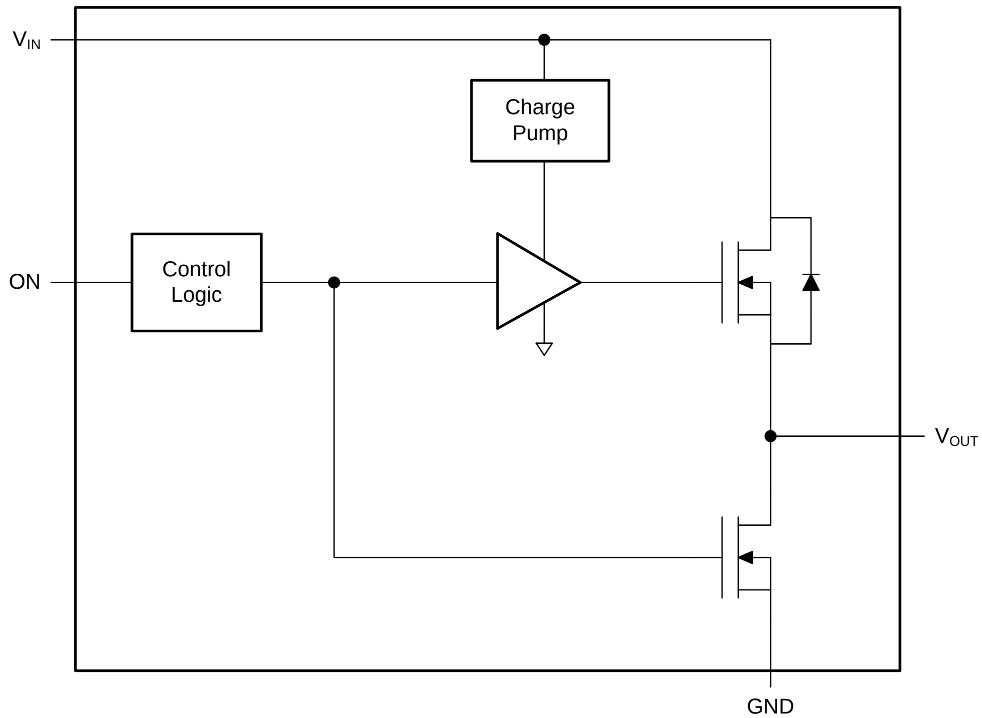
TERMINALS ASSIGNMENTS (YZP PACKAGE)

C	GND	ON
B	VOUT	VIN
A	VOUT	VIN
	1	2

TERMINAL FUNCTIONS

NO.	NAME	DESCRIPTION
C1	GND	Ground
C2	ON	Switch control input, active high. Do not leave floating
A1, B1	VOUT	Switch output
A2, B2	VIN	Switch input. Place a decoupling capacitor from VIN to GND. See Application Information section for details about input capacitors.

BLOCK DIAGRAM



FUNCTION TABLE

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

(1) See application section *Output Pulldown*.

ABSOLUTE MAXIMUM RATINGS[1]

			MIN	MAX	UNIT
V_{IN}	Input voltage range		–0.3	4	V
V_{OUT}	Output voltage range			V_{IN} + 0.3	V
V_{ON}	ON pin voltage range		–0.3	4	V
I_{MAX}	Maximum continuous switch current, T_A = -40°C to 85°C			2	A
I_{PLS}	Maximum pulsed switch current, 100-µs pulse, 2% duty cycle, T_A = -40°C to 85°C			4	A
T_A	Operating free-air temperature range		–40	85	°C
T_{stg}	Storage temperature range		–65	150	°C
ESD	Electrostatic discharge protection	Human-Body Model (HBM)		5000	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 ratings 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.

DISSIPATION RATINGS

BOARD	PACKAGE	$R_{\theta JC}$	$R_{\theta JA}$	DERATING FACTOR ABOVE T_A = 25°C	T_A < 25°C	T_A = 70°C	T_A = 85°C
High-K[1]	YZP	17.6°C/W	123.36°C/W	- 8.1063 mW/°C	810.63 mW	445.84 mW	324.25 mW

(1) The JEDEC high-K (2s2p) board used to derive this data was a 3- × 3-inch, multilayer board with 1-ounce internal power and ground planes and 2-ounce copper traces on top and bottom of the board.

RECOMMENDED OPERATING CONDITIONS

			MIN	MAX	UNIT
V_{IN}	Input voltage		0.75	3.6	V
V_{OUT}	Output voltage			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 2.5 V	0.9	3.6	
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	
C_{IN}	Input capacitance		1[1]		µF

(1) See the *Input Capacito*r 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	VOUT = open, V_{IN} = V_{ON}	V_{IN} = 3.6 V	Full		75	160	µA
			V_{IN} = 2.5 V			42	100	
			V_{IN} = 1.8 V			50	350	
			V_{IN} = 1.2 V			95	200	
			V_{IN} = 1.0 V			65	120	
			V_{IN} = 0.75 V			35	80	
$I_{SD, VIN}$	Shutdown current	V_{ON} = GND, VOUT = 0V		Full			4.0	µA
R_{ON}	ON-state resistance	I_{OUT} = -200 mA	V_{IN} = 3.6 V	25°C		18.3	22.8	mΩ
				Full			26.8	
			V_{IN} = 2.5 V	25°C		18.5	23.0	
				Full			27.2	
			V_{IN} = 1.8 V	25°C		19.6	24.1	
				Full			28.1	
			V_{IN} = 1.2 V	25°C		19.4	23.9	
				Full			28.0	
			V_{IN} = 1.0 V	25°C		20.3	24.8	
				Full			29.0	
			V_{IN} = 0.75 V	25°C		22.7	27.2	
				Full			34.8	
R_{PD}	Output pulldown resistance[(2)]	V_{IN} = 3.3 V, V_{ON} = 0, I_{OUT} = 1 mA		25°C	450		1400	Ω
I_{ON}	ON-pin 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)

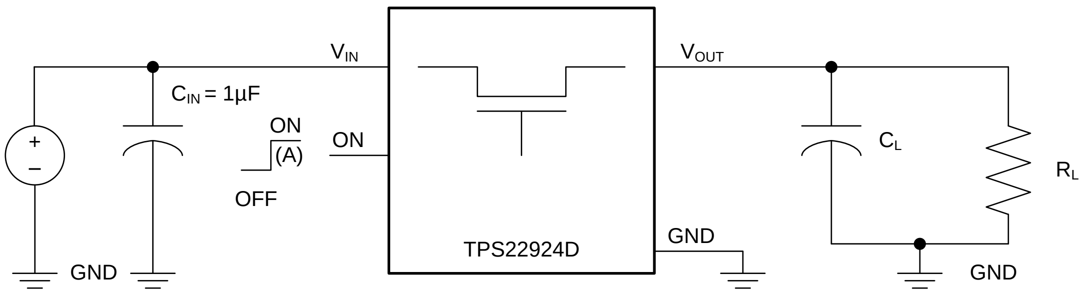
PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 3.6V		7400		µs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 3.6V		2.5		µs
t_r	V_{OUT} rise time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 3.6V		6200		µs
t_f	V_{OUT} fall time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 3.6V		2		µs

SWITCHING CHARACTERISTICS

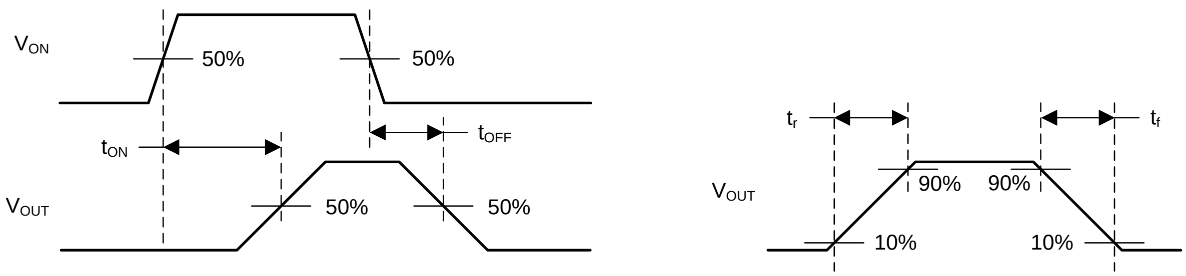
V_{IN} = 0.9 V, T_A = 25°C (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 0.9V		6300		µs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 0.9V		12		µs
t_r	V_{OUT} rise time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 0.9V		3200		µs
t_f	V_{OUT} fall time	R_L = 10 Ω, C_L = 0.1 µF, V_{IN} = 0.9V		3		µs

PARAMETRIC MEASUREMENT INFORMATION



TEST CIRCUIT



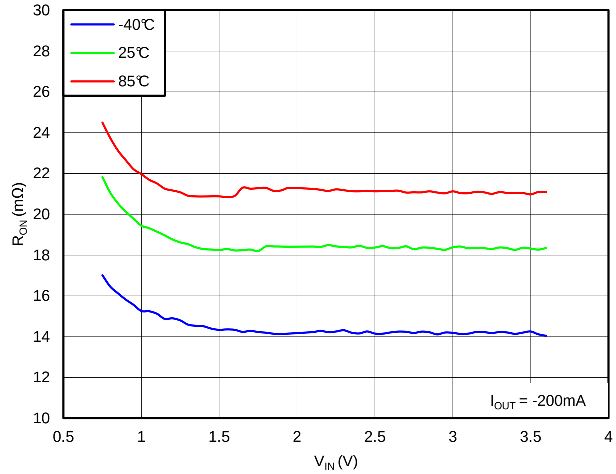
t_{ON}/t_{OFF} WAVEFORMS

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

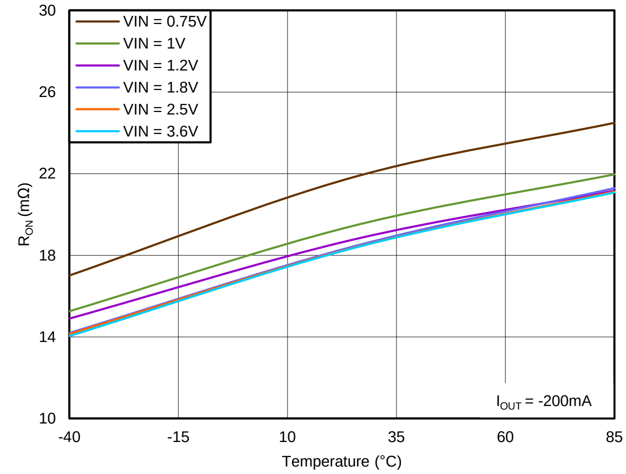
Figure 2. Test Circuit and t_{ON}/t_{OFF} Waveforms

TYPICAL CHARACTERISTICS

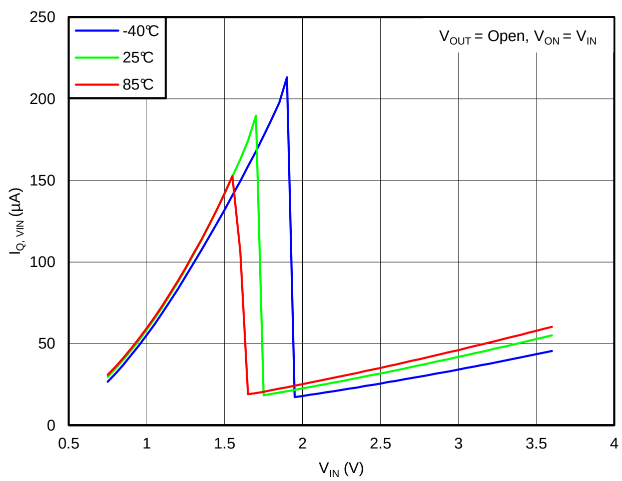
ON-STATE RESISTANCE vs INPUT VOLTAGE



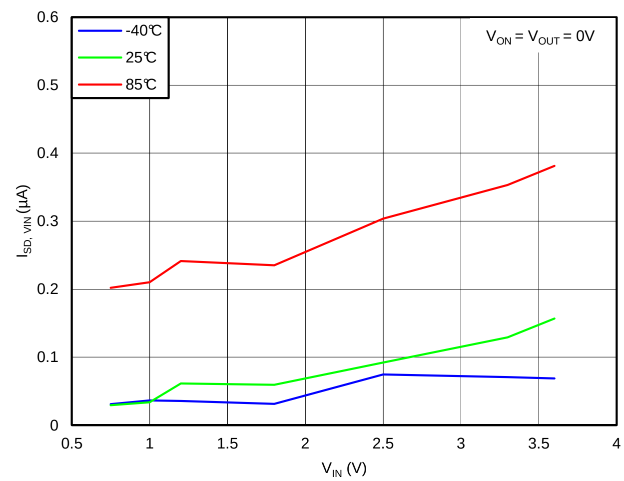
ON-STATE RESISTANCE vs TEMPERATURE



QUIESCENT CURRENT vs INPUT VOLTAGE

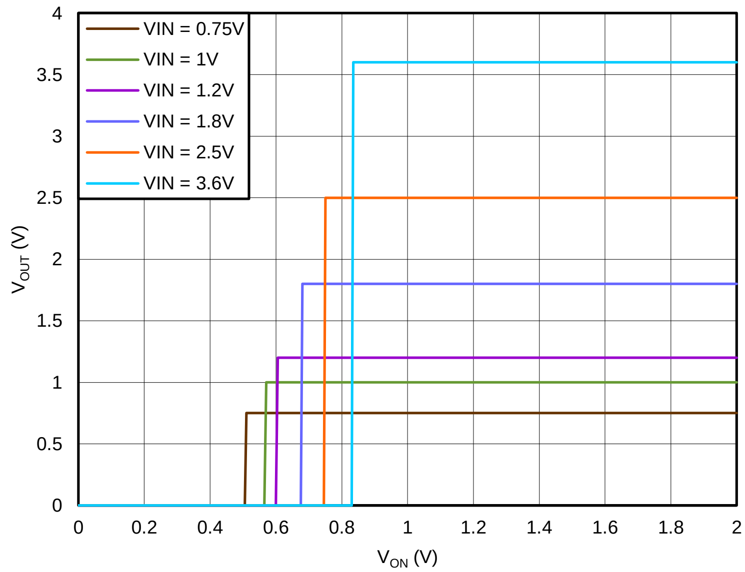


SHUTDOWN CURRENT vs INPUT VOLTAGE

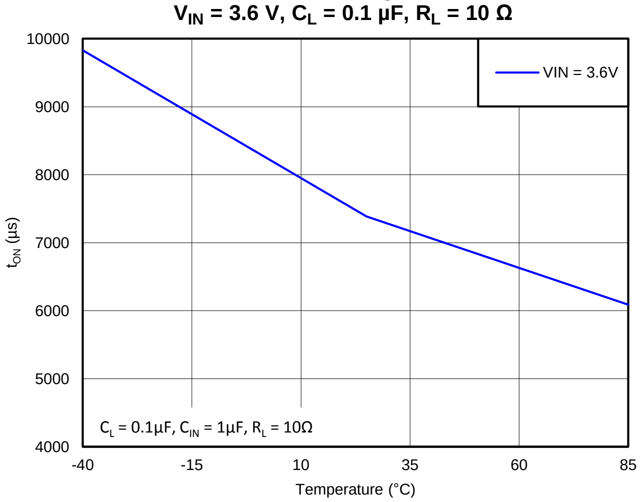


TYPICAL CHARACTERISTICS (continued)

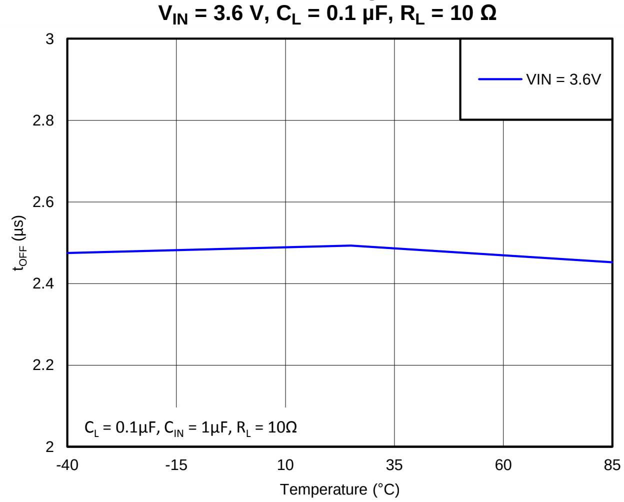
ON INPUT THRESHOLD



TURN-ON TIME vs TEMPERATURE V_{IN} = 3.6 V, C_L = 0.1 μF, R_L = 10 Ω

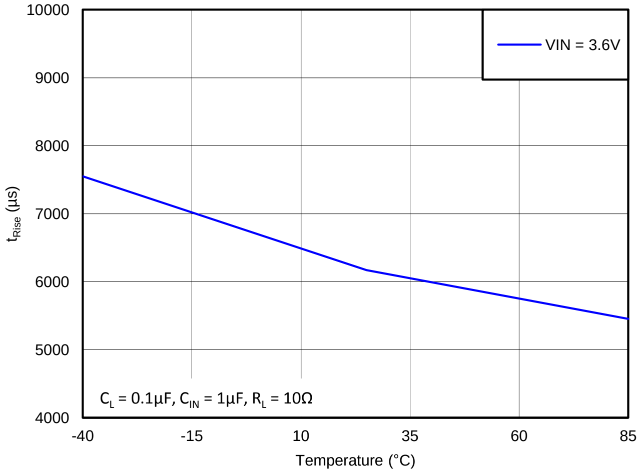


TURN-OFF TIME vs TEMPERATURE V_{IN} = 3.6 V, C_L = 0.1 μF, R_L = 10 Ω

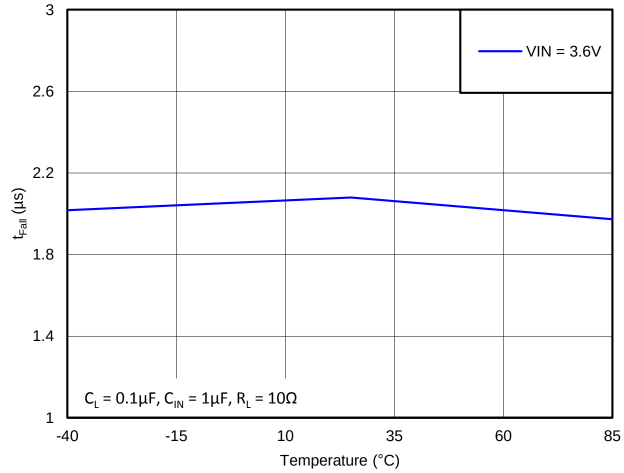


TYPICAL CHARACTERISTICS (continued)

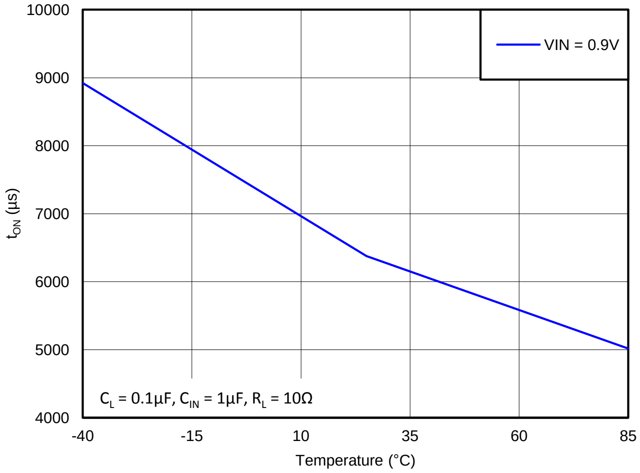
RISE TIME vs TEMPERATURE V_{IN} = 3.6 V, C_L = 0.1 μF, R_L = 10 Ω



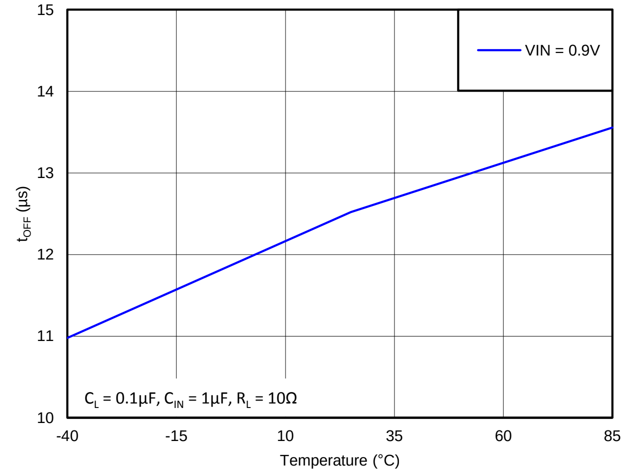
FALL TIME vs TEMPERATURE V_{IN} = 3.6 V, C_L = 0.1 μF, R_L = 10 Ω



TURN-ON TIME vs TEMPERATURE V_{IN} = 0.9 V, C_L = 0.1 μF, R_L = 10 Ω

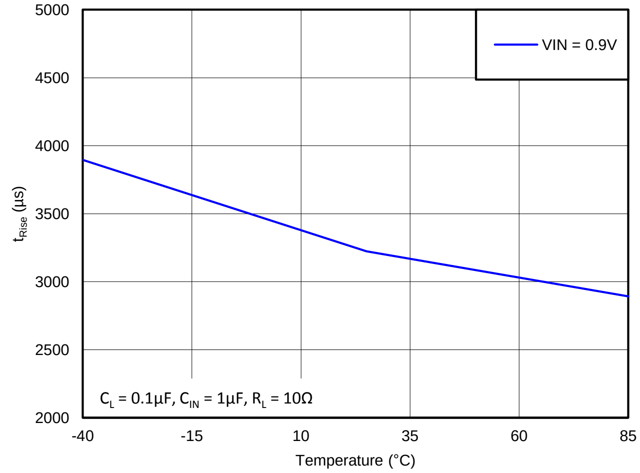


TURN-OFF TIME vs TEMPERATURE V_{IN} = 0.9 V, C_L = 0.1 μF, R_L = 10 Ω

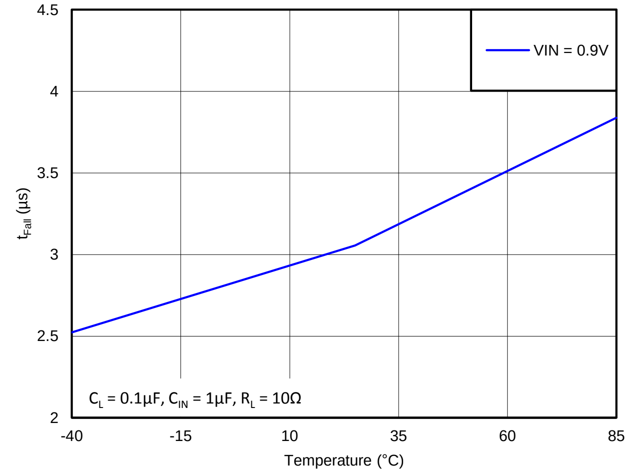


TYPICAL CHARACTERISTICS (continued)

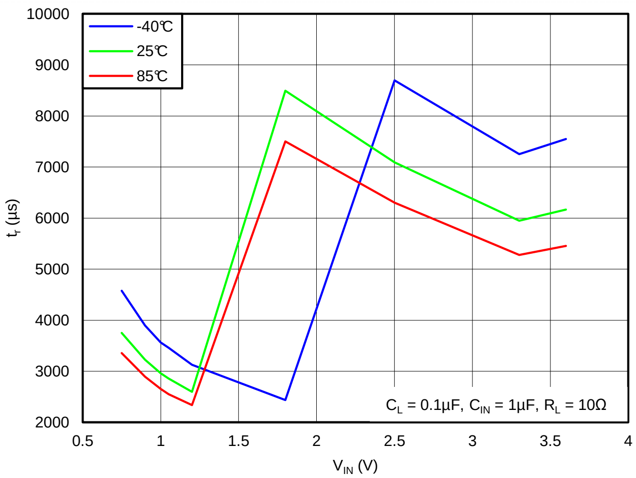
RISE TIME vs TEMPERATURE
V_{IN} = 0.9 V, C_L = 0.1 μF, R_L = 10 Ω



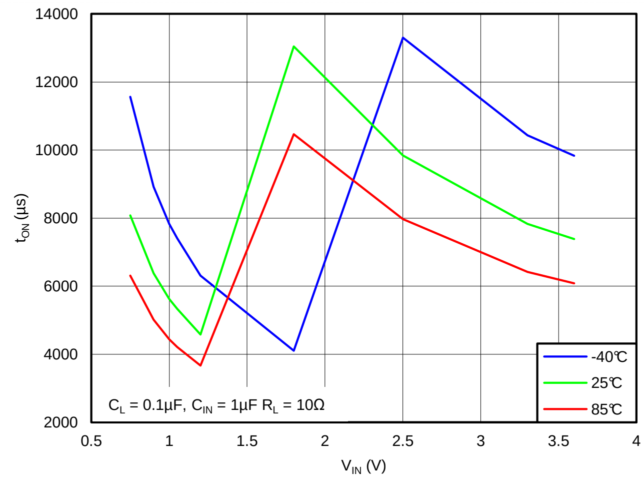
FALL TIME vs TEMPERATURE
V_{IN} = 0.9 V, C_L = 0.1 μF, R_L = 10 Ω



RISE TIME vs INPUT VOLTAGE
C_L = 0.1 μF, R_L = 10 Ω, V_{ON} = 1.8 V

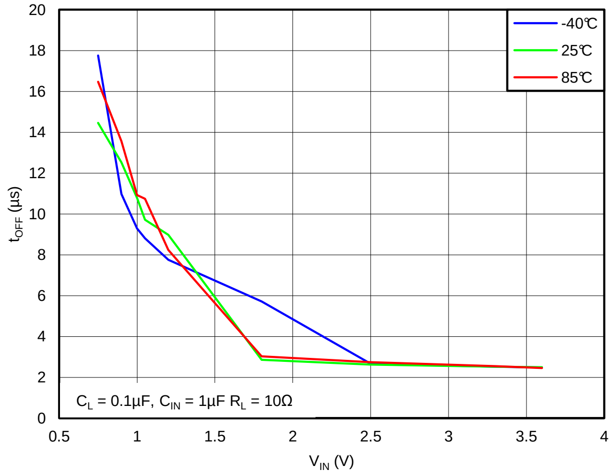


TURN-ON TIME vs INPUT VOLTAGE
C_L = 0.1 μF, R_L = 10 Ω, V_{ON} = 1.8 V

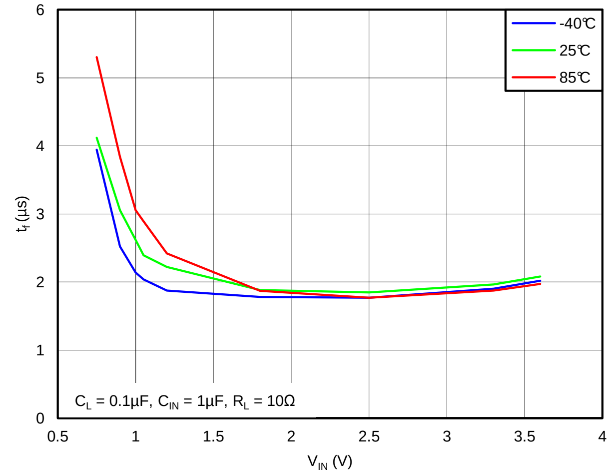


TYPICAL CHARACTERISTICS (continued)

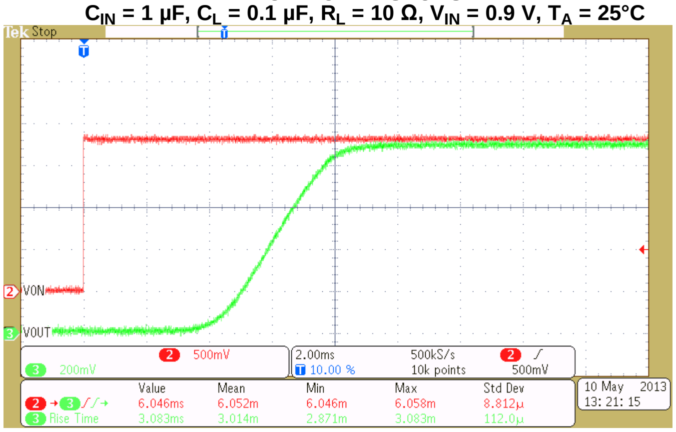
TURN-OFF TIME vs INPUT VOLTAGE
C_L = 0.1 µF, R_L = 10 Ω, V_{ON} = 1.8 V



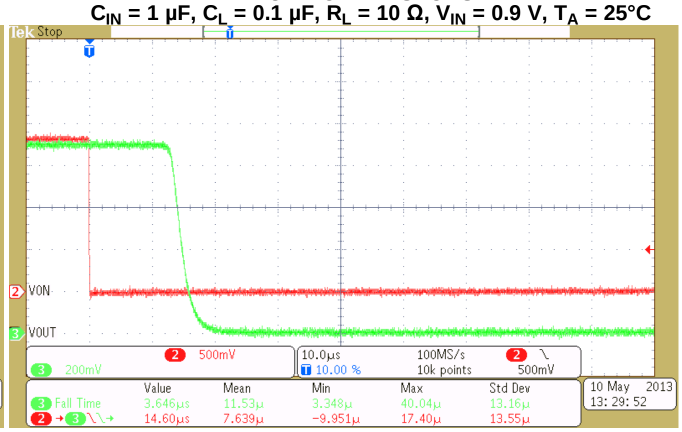
FALL TIME vs INPUT VOLTAGE
C_L = 0.1 µF, R_L = 10 Ω, V_{ON} = 1.8 V



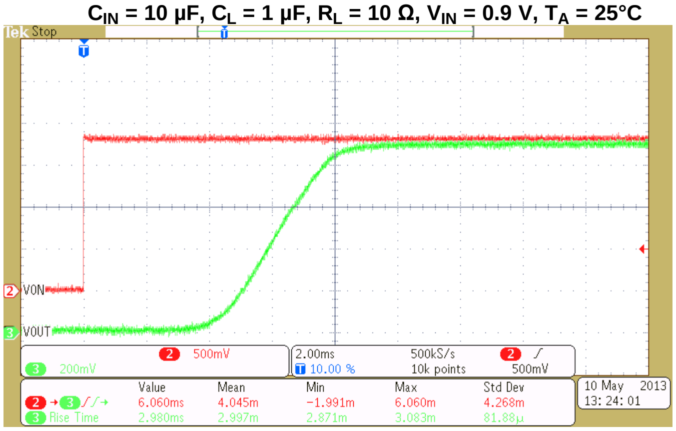
TURN-ON RESPONSE
C_{IN} = 1 µF, C_L = 0.1 µF, R_L = 10 Ω, V_{IN} = 0.9 V, T_A = 25°C



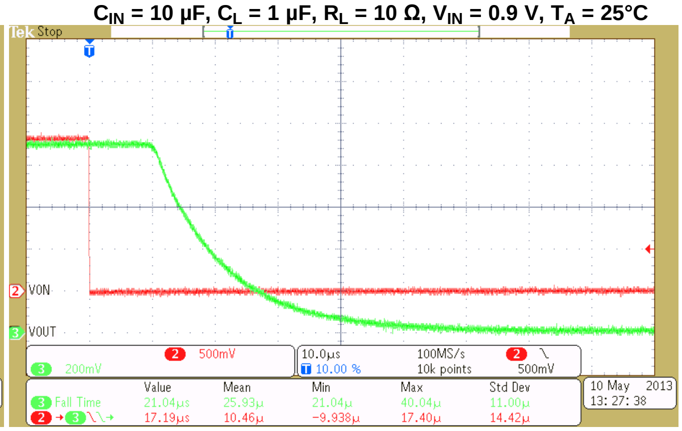
TURN-OFF RESPONSE
C_{IN} = 1 µF, C_L = 0.1 µF, R_L = 10 Ω, V_{IN} = 0.9 V, T_A = 25°C



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



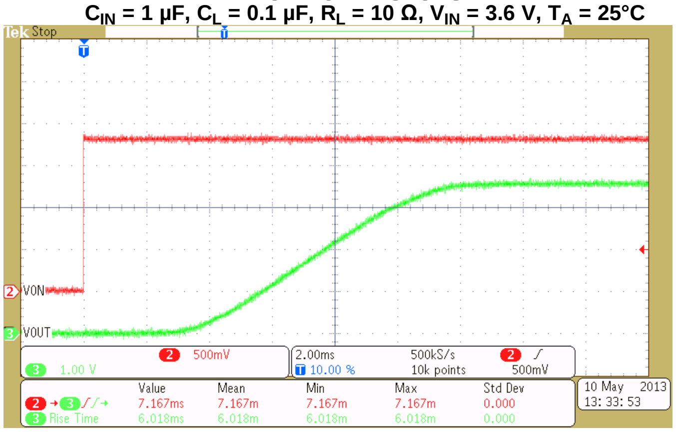
TURN-OFF RESPONSE
C_{IN} = 10 µF, C_L = 1 µF, R_L = 10 Ω, V_{IN} = 0.9 V, T_A = 25°C



TYPICAL CHARACTERISTICS (continued)

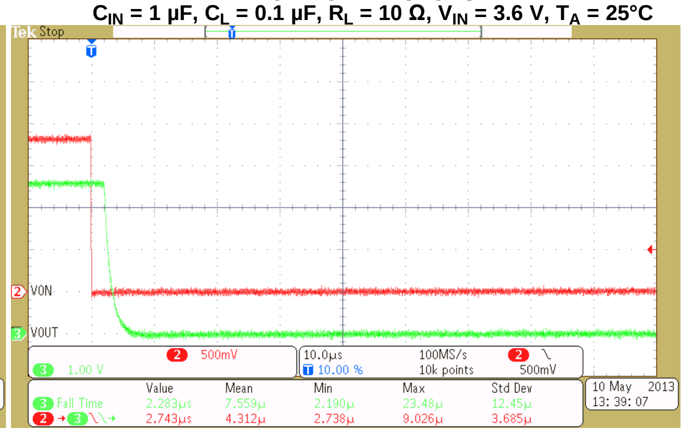
TURN-ON RESPONSE

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



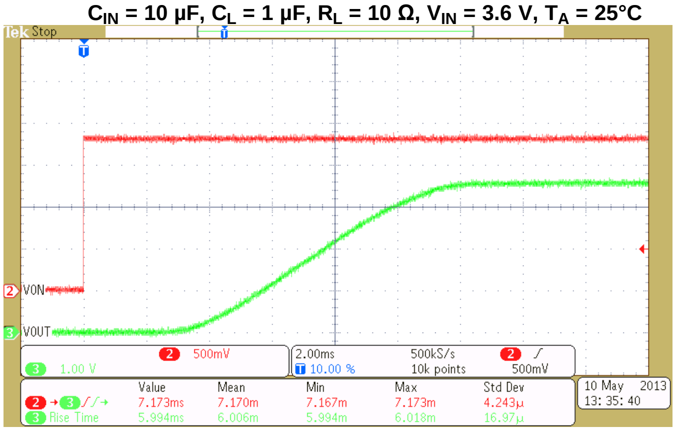
TURN-OFF RESPONSE

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



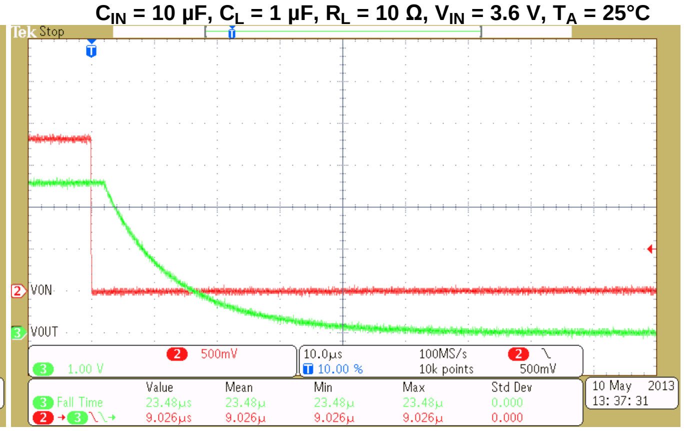
TURN-ON RESPONSE

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



TURN-OFF RESPONSE

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



APPLICATION INFORMATION

ON/OFF Control

The ON pin controls the state of the switch. Asserting ON high enables the switch. ON is active high 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

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

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 Pulldown

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, 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 and short-circuit 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.

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)
TPS22924DYZPR	Active	Production	DSBGA (YZP) | 6	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	DL
TPS22924DYZPR.B	Active	Production	DSBGA (YZP) | 6	3000 | LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	DL
TPS22924DYZPT	Active	Production	DSBGA (YZP) | 6	250 | SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	DL
TPS22924DYZPT.B	Active	Production	DSBGA (YZP) | 6	250 | SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	DL

(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.

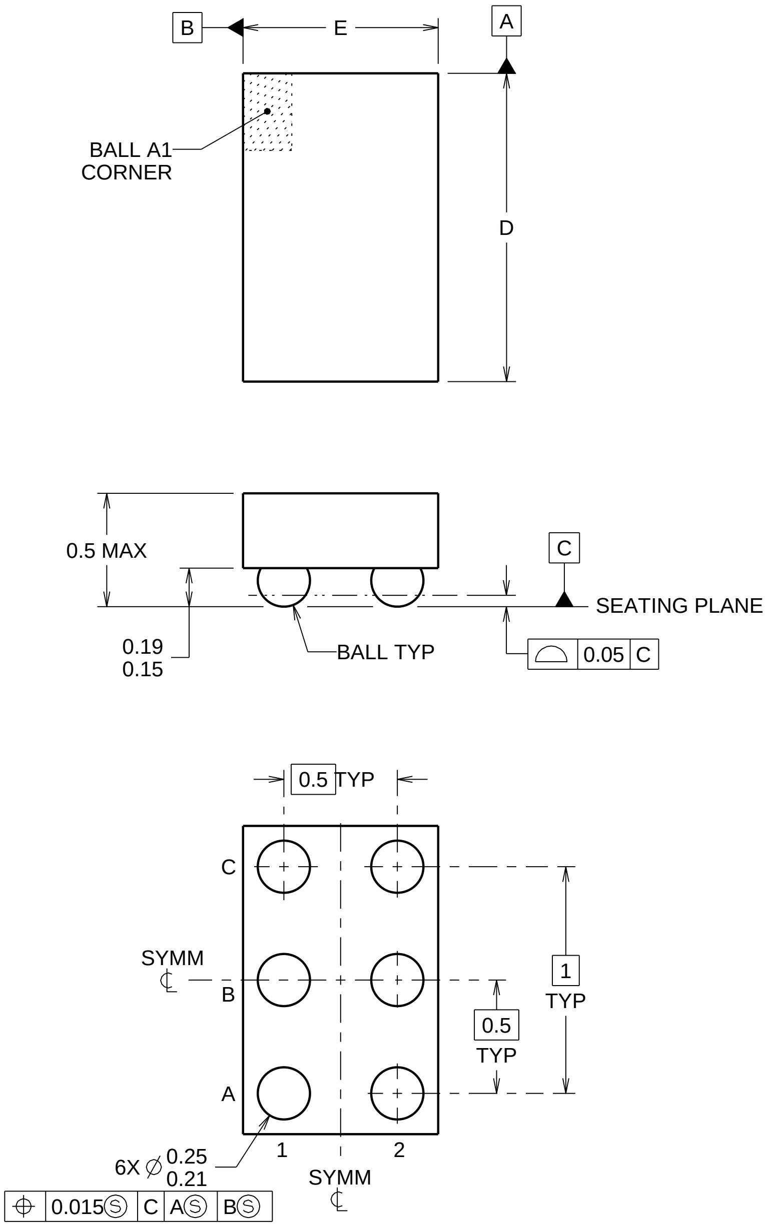
(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will 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.

Important Information and Disclaimer: The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

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.



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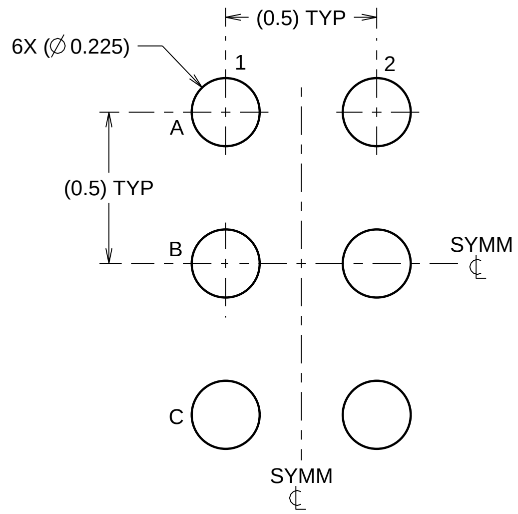
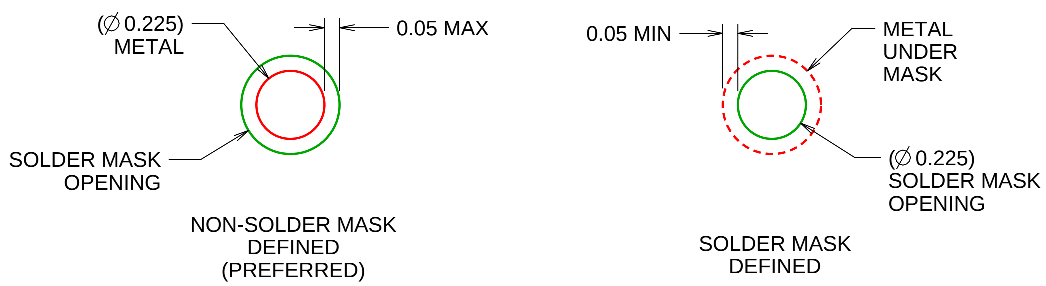
NOTES:

NanoFree Is a trademark of Texas Instruments.

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. NanoFree™ package configuration.



LAND PATTERN EXAMPLE
SCALE:40X



SOLDER MASK DETAILS
NOT TO SCALE

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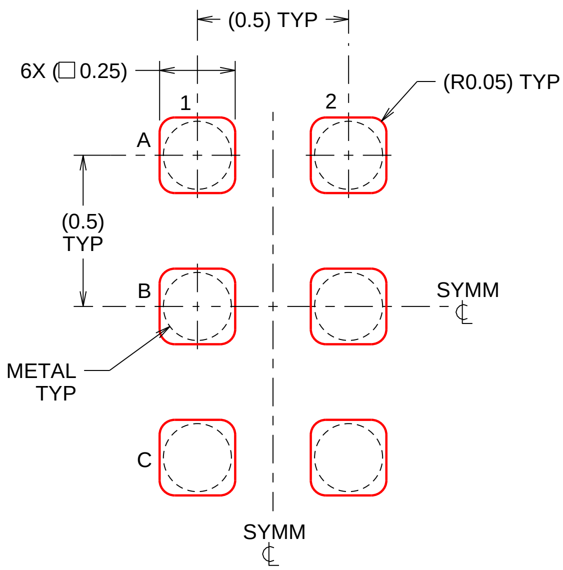
NOTES: (continued)

4. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SBVA017 (www.ti.com/lit/sbva017).



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

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NOTES: (continued)

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

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