具有可控接通功能的超小型、低导通电阻负载开关

查询样品: TPS22912

特性

- 集成单负载开关
- **0.9mm x 0.9mm**，锡球/焊盘间距 **0.5mm**，超小型晶片比例 **(CSP)-4** 封装
- 输入电压范围：**1.4V** 至 **5.5V**
- 低导通电阻
  - 在输入电压**(VIN) = 5V**时，r_{ON} **= 60mΩ**
  - 在输入电压**(VIN) = 3.3V**时，r_{ON} **= 61mΩ**
  - 在输入电压**(VIN) = 1.8V**时，r_{ON} **= 74mΩ**
  - 在输入电压**(VIN) = 1.5V**时，r_{ON} **= 84mΩ**
- **2A** 最大持续开关电流
- 低阈值控制输入
- 可控转换率选项
- 欠压闭锁
- 反向电流保护

应用范围

- 便携式工业/医疗设备
- 便携式媒体播放器
- **POS** 机终端
- 全球卫星定位系统 **(GPS)** 导航器件
- 数码摄像机
- 便携式仪表
- 智能电话 / 无线手持终端

说明

TPS22912 是一款具有可控接通功能的小型、低 r_{ON} 负载开关，此开关包含一个可在 1.4V 至 5.5V 的输入电压范围内运行的 P 通道金属氧化物半导体场效应晶体管 (MOSFET)。此开关由一个高电平输入 (ON) 控制，此输入能够与低压控制信号直接接口相连。

为了避免涌入电流，此器件的转换率由内部控制。TPS22912 系列产品有多重上升时间选项并且工作态高电平启用。（参见表 1）

TPS22912 通过在反向电压情况期间锁存电源开关来提供电路断路器功能。 一个内部反向电压比较器在输出电压 (V_{OUT}) 高于输入电压 (V_{IN}) 时禁用此电源开关。 这一过程能够快速（典型值为 10µs）阻止流向开关输入端的电流。 反向电流保护一直有效，即便当器件被禁用时也是如此。 此外，如果此输入电压过低，欠压闭锁 (UVLO) 保护会将此开关关闭。

TPS22912 采用超小型、节省空间的 4 引脚 CSP 封装并可在 –40°C 至85°C 的大气环境温度范围内运行。

典型应用

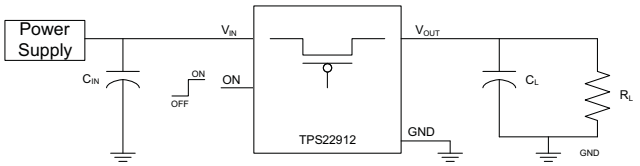


表 **1.** 特性列表

器件	**3.3V** 时的 r_{ON}（典型值）	**3.3V**（典型值）时的上升时间	快速输出放电 (1)	最大输出电压	使能
TPS22912A (2)	61mΩ	1µs	否	2A	高定平有效
TPS22912B (2)	61mΩ	100µs	否	2A	高定平有效
TPS22912C	61mΩ	1000µs	否	2A	高定平有效
TPS22912D (2)	61mΩ	4500µs	否	2A	高电平有效

(1) 此特性可通过一个 150Ω 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。
(2) 请向当地销售商/分销商或者厂家查询产品供货信息。

These devices have limited built-in ESD protection. The leads should be shorted together or the device placed in conductive foam during storage or handling to prevent electrostatic damage to the MOS gates.

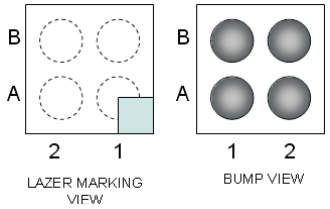
ORDERING INFORMATION

T_A	PACKAGE(1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING/ STATUS(2)
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22912AYZVR	Contact factory for availability
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22912BYZVR	Contact factory for availability
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22912CYZVR	_ _ _ _ 78
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22912DYZVR	Contact factory for availability

(1) Package drawings, standard packing quantities, thermal data, symbolization, and PCB design guidelines are available at www.ti.com/sc/package.
(2) Contact factory for details and availability for PREVIEW devices, minimum order quantities may apply.

DEVICE INFORMATION

YZV PACKAGE



TERMINAL ASSIGNMENTS

B	ON	GND
A	V_{IN}	V_{OUT}
	2	**1**

PIN FUNCTIONS

TPS22912 YZV	PIN NAME	DESCRIPTION
B1	GND	Ground
B2	ON	Switch control input, active high. Do not leave floating
A1	VOUT	Switch output
A2	VIN	Switch input. Use ceramic capacitor to GND for bypass.

BLOCK DIAGRAM

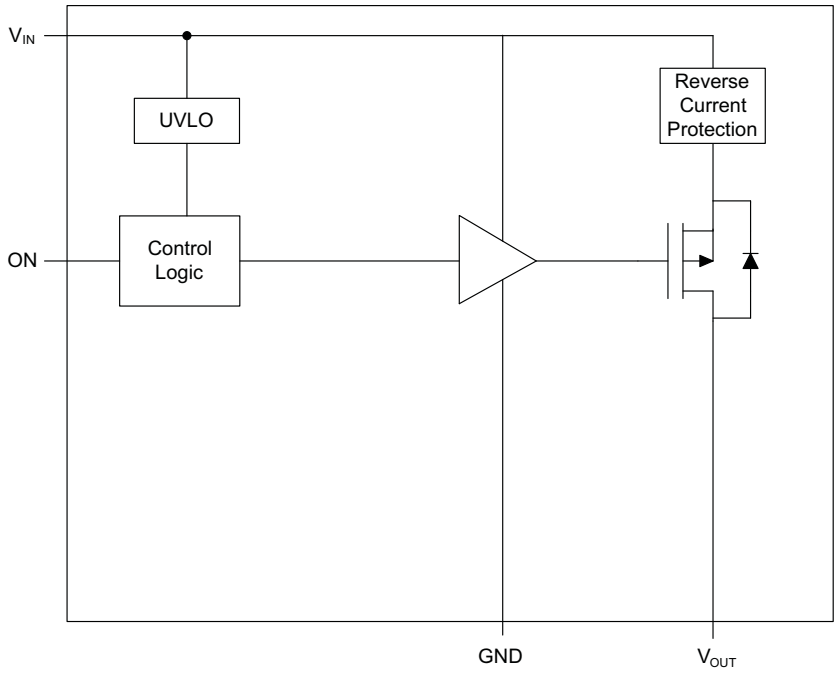


Table 2. FUNCTION TABLE

ON	VIN to VOUT
L	OFF
H	ON

ABSOLUTE MAXIMUM RATINGS

			VALUE	UNIT
V_{IN}	Input voltage range		–0.3 to 6	V
V_{OUT}	Output voltage range		–0.3 to 6	V
V_{ON}	Input voltage range		–0.3 to 6	V
I_{MAX}	Maximum continuous switch current		2	A
I_{PLS}	Maximum pulsed switch current, pulse ≤500 ms, 50% duty cycle		3	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) (VIN, VOUT, GND pins)	2000	V
		Charged-Device Model (CDM) (VIN, VOUT, ON, GND pins)	1000	

THERMAL INFORMATION

THERMAL METRIC(1)		TPS22912 CSP 4 PINS	UNITS
θ_{JA}	Junction-to-ambient thermal resistance	189.1	°C/W
θ_{JCtop}	Junction-to-case (top) thermal resistance	1.9	
θ_{JB}	Junction-to-board thermal resistance	36.8	
ψ_{JT}	Junction-to-top characterization parameter	11.3	
ψ_{JB}	Junction-to-board characterization parameter	36.8	
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}	Input voltage range		1.4	5.5	V
V_{ON}	ON voltage range		0	5.5	V
V_{OUT}	Output voltage range (Note: V_{OUT} greater than V_{IN} will cause the reverse current protection of this device to trigger. See application section.)			V_{IN} (1)	
V_{IH}	High-level input voltage, ON	VIN = 3.61 V to 5.5 V	1.1	5.5	V
		VIN = 1.4 V to 3.6 V	1.1	5.5	V
V_{IL}	Low-level input voltage, ON	VIN = 3.61 V to 5.5 V		0.6	V
		VIN = 1.4 V to 3. 6V		0.4	V
C_{IN}	Input Capacitor		1 (1)		µF

(1) Refer to the application section.

ELECTRICAL CHARACTERISTICS

VIN = 1.4 V to 5.5 V, T_A = –40ºC to 85ºC (unless otherwise noted)

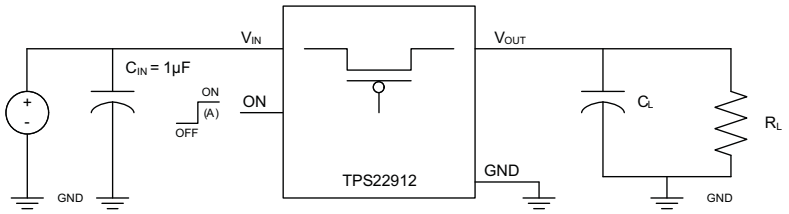
PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
I_{IN}	Quiescent current	I_{OUT} = 0, V_{ON} = V_{IN} = 5.25 V	Full		2	10	µA
		I_{OUT} = 0, V_{ON} = V_{IN} = 4.2 V			2	7.0	
		I_{OUT} = 0, V_{ON} = V_{IN} = 3.6 V			2	7.0	
		I_{OUT} = 0, V_{ON} = V_{IN} = 2.5 V			0.9	5	
		I_{OUT} = 0, V_{ON} = V_{IN} = 1.5 V			0.7	5	
$I_{IN(off)}$ (1)	Off supply current	R_L = 1 MΩ, V_{IN} = 5.25 V, V_{ON} = GND	Full		1.2	10	µA
		R_L = 1 MΩ, V_{IN} = 4.2 V, V_{ON} = GND			0.2	7.0	
		R_L = 1 MΩ, V_{IN} = 3.6 V, V_{ON} = GND			0.1	7.0	
		R_L = 1 MΩ, V_{IN} = 2.5 V, V_{ON} = GND			0.1	5	
		R_L = 1 MΩ, V_{IN} = 1.5 V, V_{ON} = GND			0.1	5	
$I_{IN(Leakage)}$	Leakage current	V_{OUT} = 0, V_{IN} = 5.25 V, V_{ON} = GND	Full		1.2	10	µA
		V_{OUT} = 0, V_{IN} = 4.2 V, V_{ON} = GND			0.2	7.0	
		V_{OUT} = 0, V_{IN} = 3.6 V, V_{ON} = GND			0.1	7.0	
		V_{OUT} = 0, V_{IN} = 2.5 V, V_{ON} = GND			0.1	5	
		V_{OUT} = 0, V_{IN} = 1.5 V, V_{ON} = GND			0.1	5	
r_{ON}	On-resistance	V_{IN} = 5.25 V, I_{OUT} = –200 mA	25°C		60	80	mΩ
			Full			110	
		V_{IN} = 5.0 V, I_{OUT} = –200 mA	25°C		60	80	
			Full			110	
		V_{IN} = 4.2 V, I_{OUT} = –200 mA	25°C		60	80	
			Full			110	
		V_{IN} = 3.3 V, I_{OUT} = –200 mA	25°C		60.7	80	
			Full			110	
		V_{IN} = 2.5 V, I_{OUT} = –200 mA	25°C		63.4	90	
			Full			120	
		V_{IN} = 1.8 V, I_{OUT} = –200 mA	25°C		74.2	100	
			Full			130	
		V_{IN} = 1.5 V, I_{OUT} = –200 mA	25°C		83.9	120	
			Full			150	
UVLO	Under voltage lockout	V_{IN} increasing, V_{ON} = 3.6 V, I_{OUT} = –100 mA	Full			1.2	V
		V_{IN} decreasing, V_{ON} = 3.6 V, I_{OUT} = –100 mA		0.50			
I_{ON}	ON input leakage current	V_{ON} = 1.4 V to 5.25 V or GND	Full			1	µA
V_{RCP}	Reverse Current Voltage Threshold	V_{OUT} > V_{IN}	25°C		54		mV
I_{RCP}(leak)	Reverse Current Protection Leakage after Reverse Current event	V_{OUT} – V_{IN} > V_{RCP}	25°C		0.3		µA
t_{DELAY}	Reverse Current Response Delay	V_{IN} = 5V			10		µs

(1) Verified by characterization, not production tested.

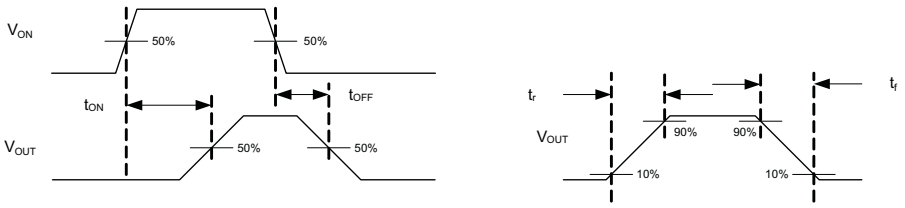
SWITCHING CHARACTERISTICS

PARAMETER		TEST CONDITION	TPS22912 TYP	UNIT
VIN = 5 V, T_A = 25ºC (unless otherwise noted)				
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 µF	840	µs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 µF	6.6	
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 µF	912	
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 µF	3	
VIN = 3.3 V, T_A = 25ºC (unless otherwise noted)				
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 µF	1147	µs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 µF	8.6	
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 µF	1030	
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 µF	3	
VIN = 1.5 V, T_A = 25ºC (unless otherwise noted)				
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 µF	2513	µs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 µF	17.4	
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 µF	1970	
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 µF	6.5	

PARAMETRIC MEASUREMENT INFORMATION



TEST CIRCUIT



t_{ON}/t_{OFF} WAVEFORMS

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

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

Figure 1. Test Circuit and t_{ON}/t_{OFF} Waveforms

TYPICAL CHARACTERISTICS

ON-STATE RESISTANCE vs INPUT VOLTAGE

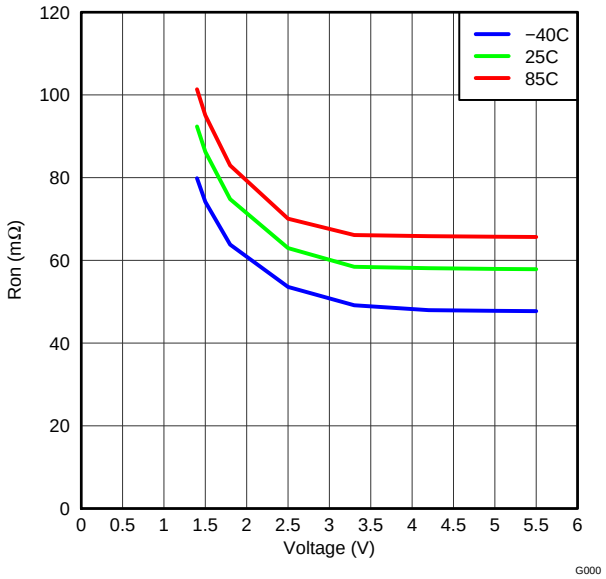


Figure 2.

ON INPUT THRESHOLD

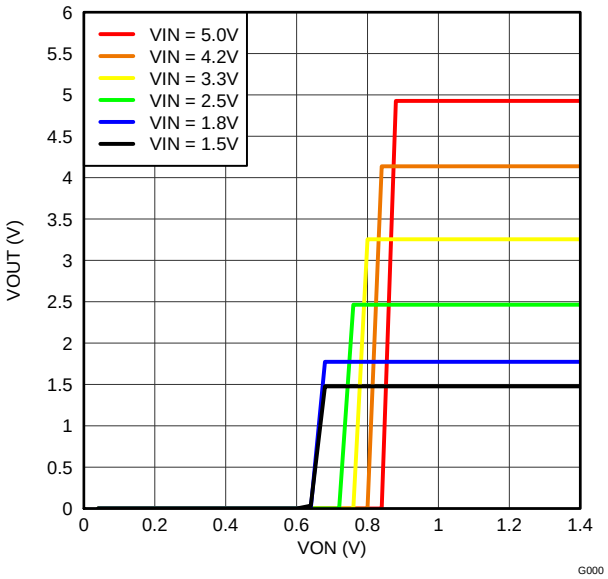


Figure 3.

INPUT CURRENT, QUIESCENT vs INPUT VOLTAGE

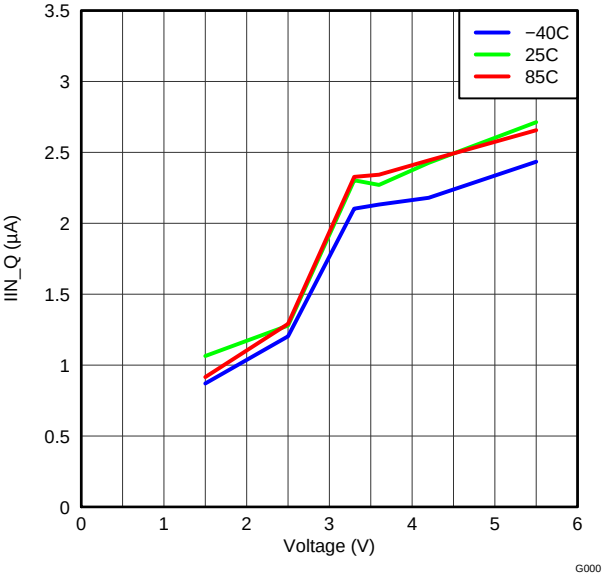


Figure 4.

INPUT CURRENT, LEAK vs INPUT VOLTAGE

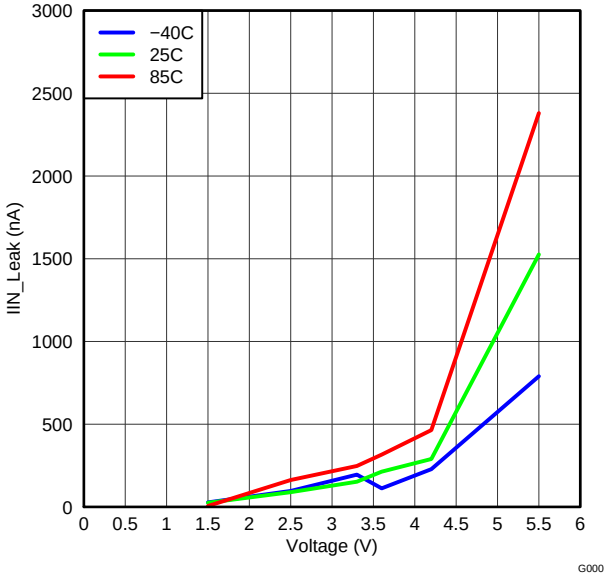


Figure 5.

TYPICAL CHARACTERISTICS (continued)

ON-STATE RESISTANCE vs TEMPERATURE

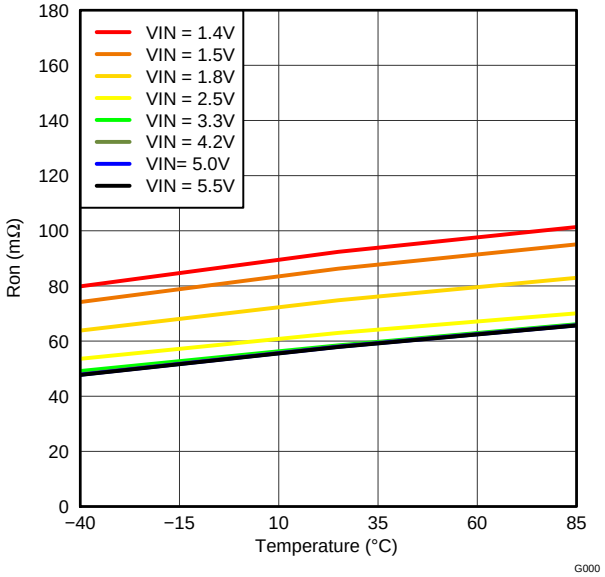


Figure 6.

INPUT CURRENT, OFF vs INPUT VOLTAGE

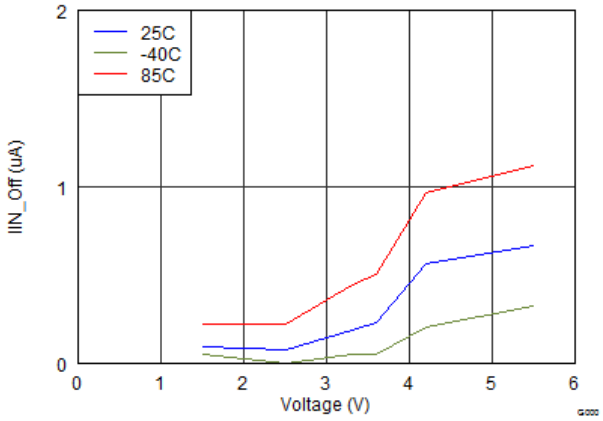


Figure 7.

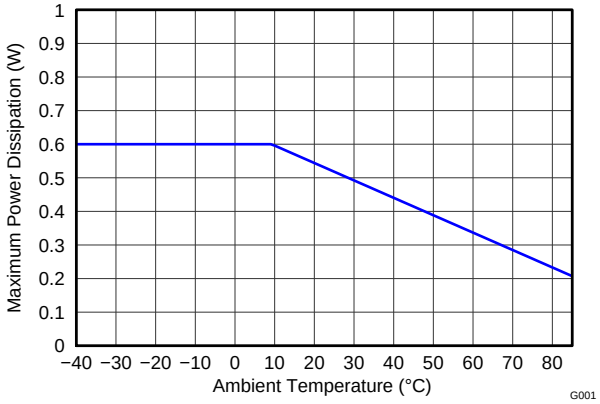


Figure 8. Allowable Power Dissipation

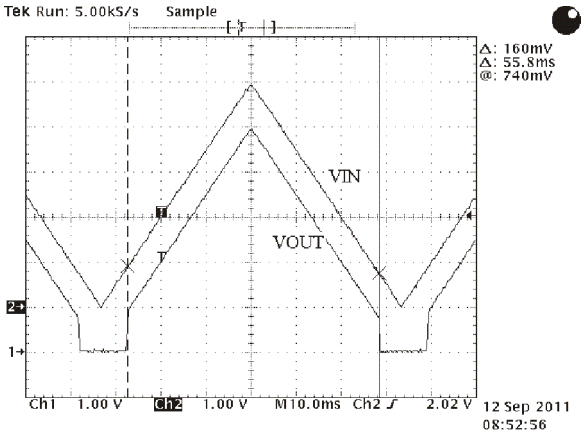


Figure 9. ULVO Response I_{OUT} = -100mA

TYPICAL CHARACTERISTICS (continued)

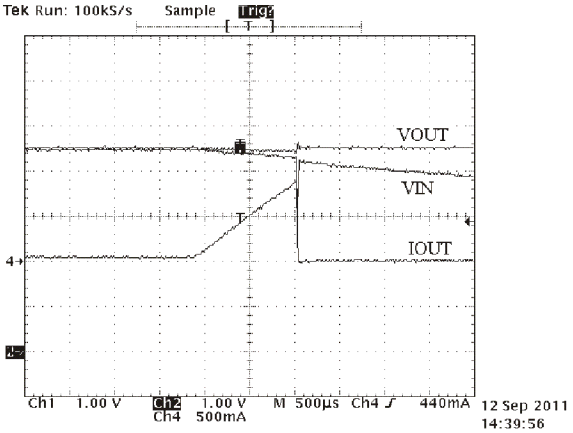


Figure 10. Reverse Current Protection V_{OUT} = 3.3V, V_{IN} = 3.3V Decreasing to 0V

TYPICAL AC CHARACTERISTICS FOR TPS22912C

RISE TIME vs TEMPERATURE

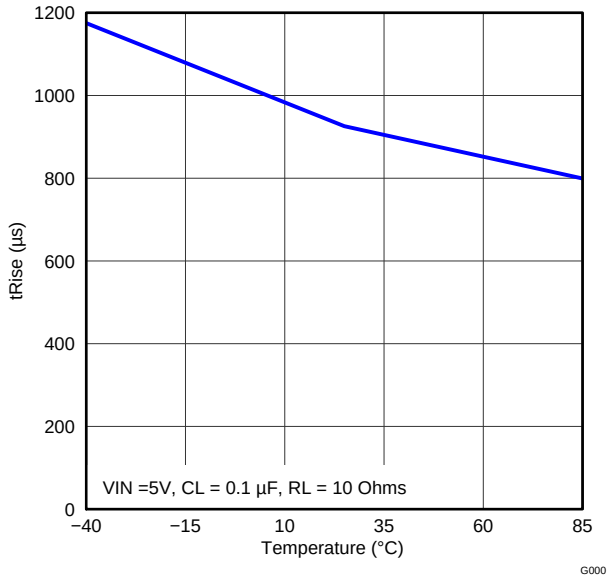


Figure 11.

FALL TIME vs TEMPERATURE

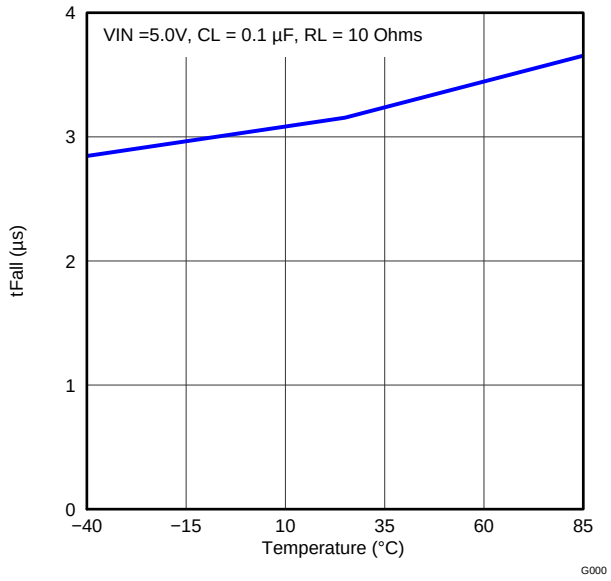


Figure 12.

TYPICAL CHARACTERISTICS (continued)

RISE TIME vs TEMPERATURE

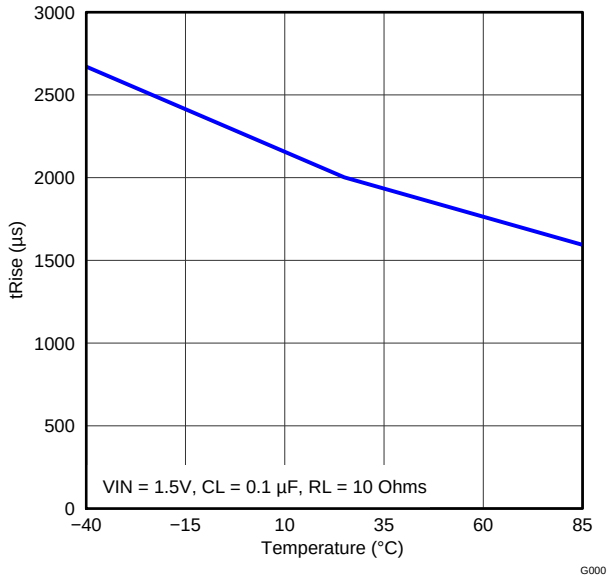


Figure 13.

FALL TIME vs TEMPERATURE

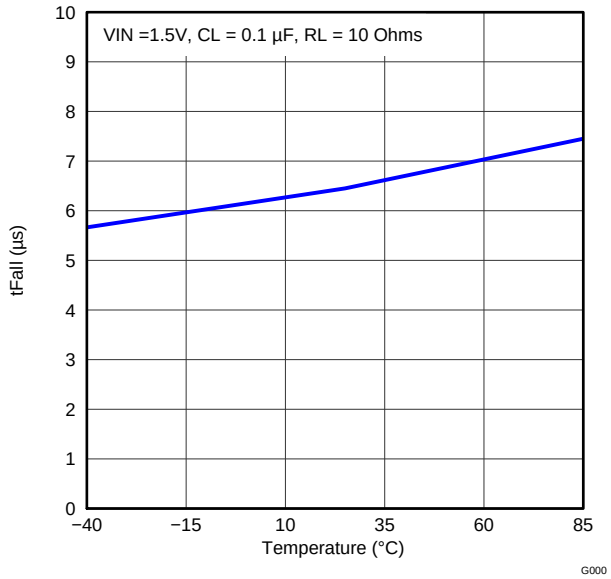


Figure 14.

TURN-ON TIME vs TEMPERATURE

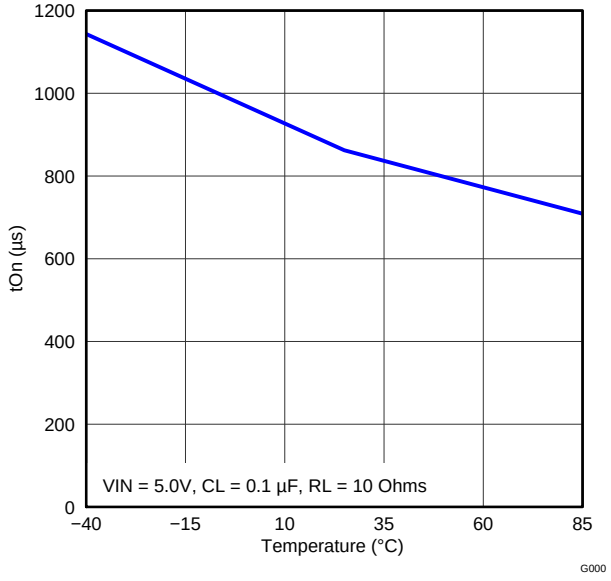


Figure 15.

TURN-OFF TIME vs TEMPERATURE

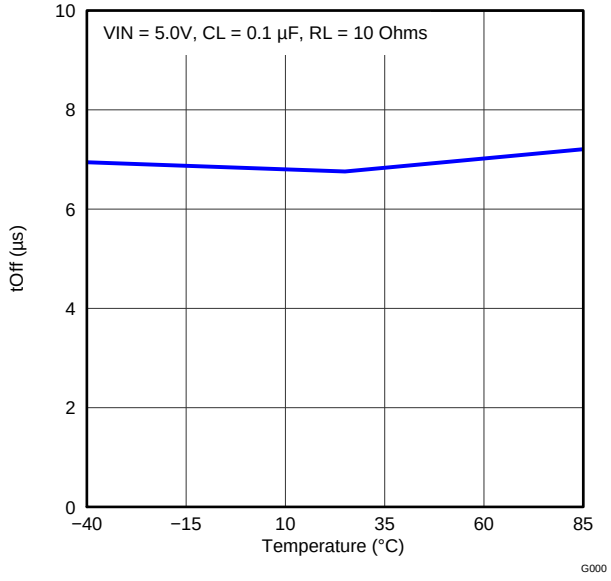


Figure 16.

TYPICAL CHARACTERISTICS (continued)

TURN-ON TIME vs TEMPERATURE

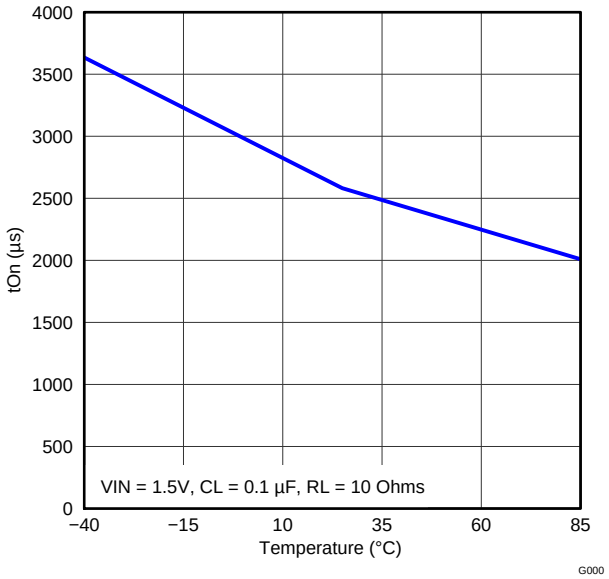


Figure 17.

TURN-OFF TIME vs TEMPERATURE

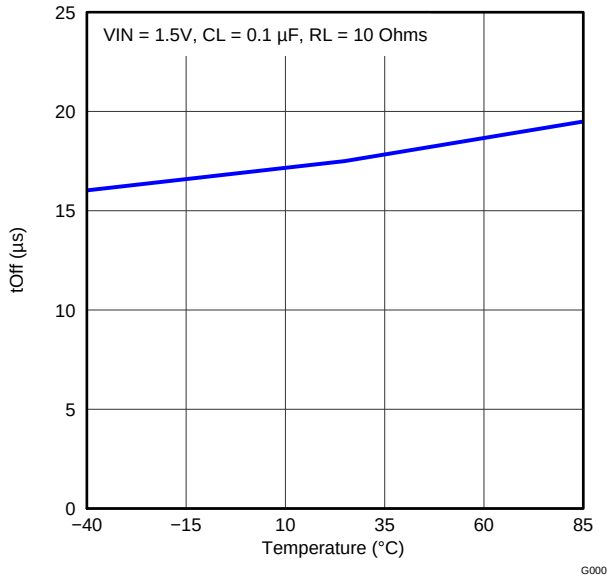


Figure 18.

RISE TIME vs INPUT VOLTAGE

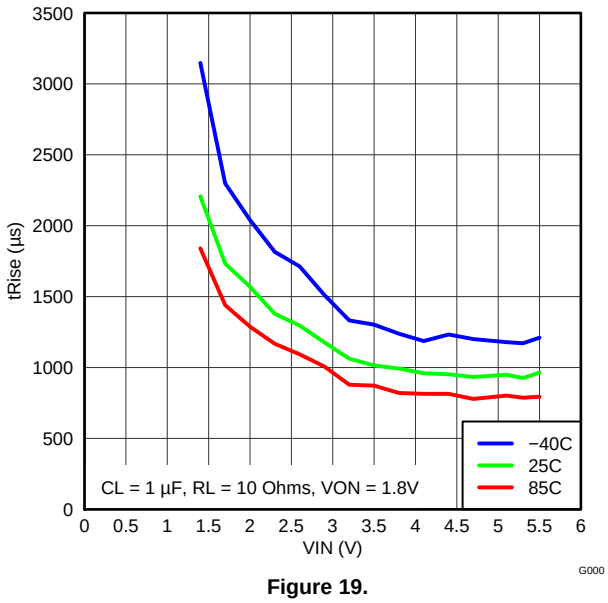


Figure 19.

TYPICAL CHARACTERISTICS (continued)

TURN-ON RESPONSE
V_{IN} = 5V, T_A = 25°C, C_{IN} = 1µF, C_L = 0.1µF, R_L = 10Ω

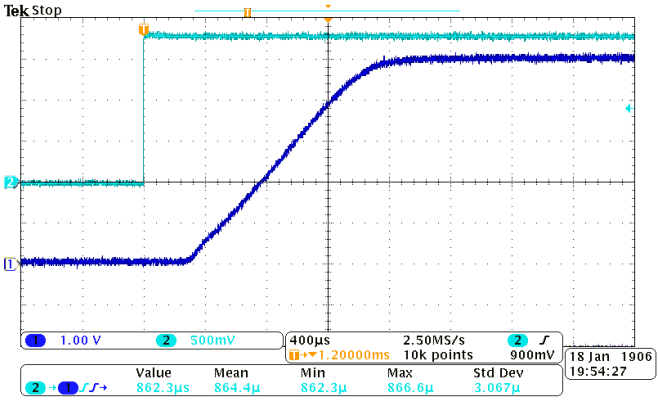


Figure 20.

TURN-OFF RESPONSE
V_{IN} = 5V, T_A = 25°C, C_{IN} = 1µF, C_L = 0.1µF, R_L = 10Ω

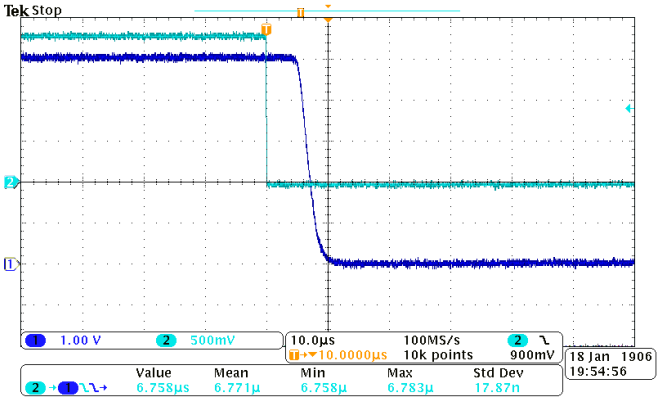


Figure 21.

TURN-ON RESPONSE TIME
V_{IN} = 5V, T_A = 25°C, C_{IN} =10µF, C_L = 1µF, R_L = 10Ω

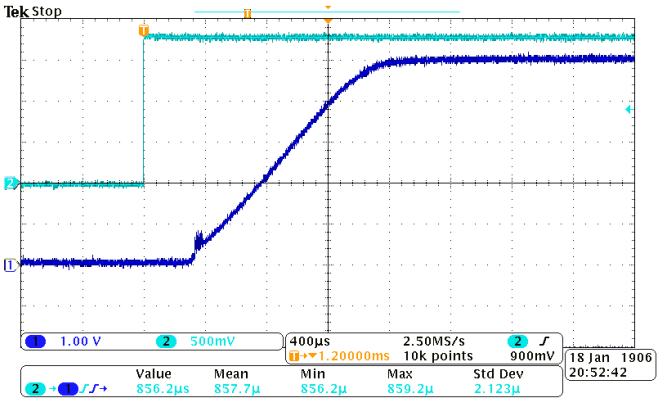


Figure 22.

TURN-OFF RESPONSE TIME
V_{IN} = 5V, T_A = 25°C, C_{IN} = 10µF, C_L = 1µF, R_L = 10Ω

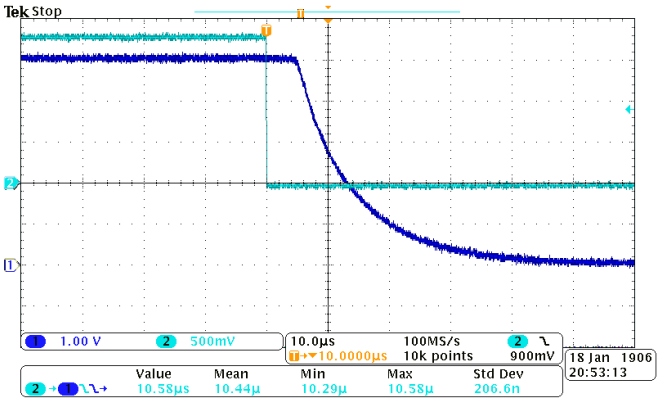


Figure 23.

TURN-ON RESPONSE TIME
V_{IN} = 1.5V, T_A = 25°C, C_{IN} = 1µF, C_L = 0.1µF, R_L = 10Ω

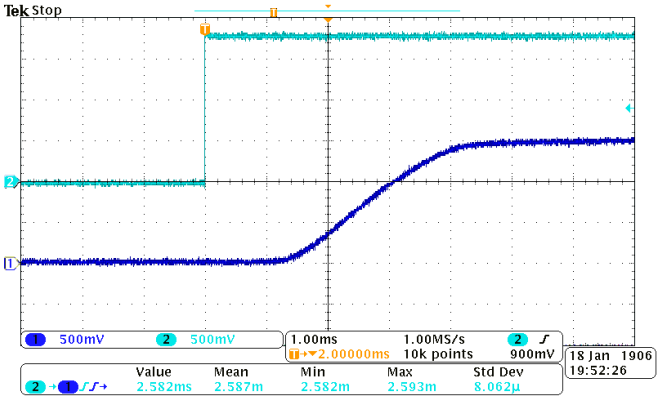


Figure 24.

TURN-OFF RESPONSE TIME
V_{IN} = 1.5V, T_A = 25°C, C_{IN} = 1µF, C_L = 0.1µF, R_L = 10Ω

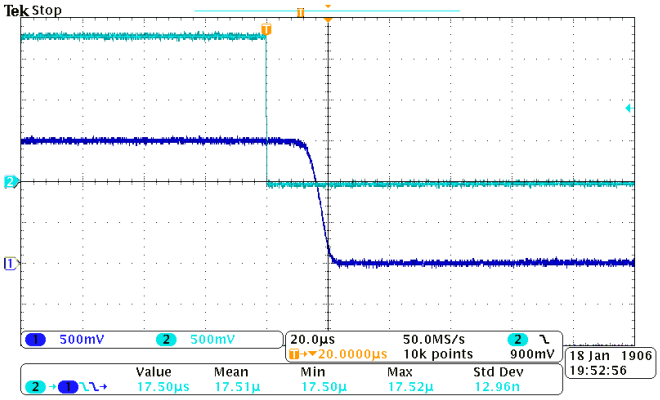


Figure 25.

TYPICAL CHARACTERISTICS (continued)

TURN-ON RESPONSE TIME

V_{IN} = 1.5V, T_A = 25°C, C_{IN} = 10µF, C_L = 1µF, R_L = 10Ω

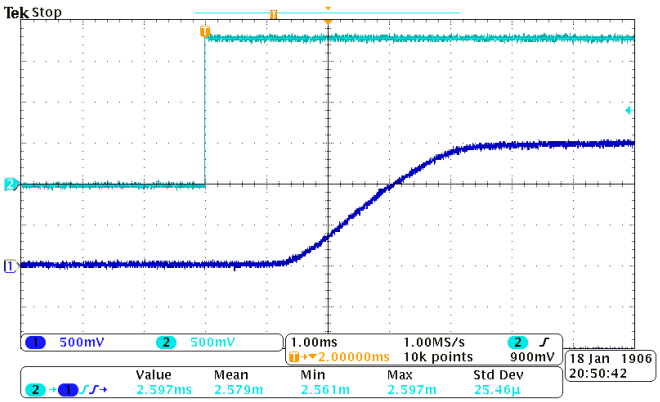


Figure 26.

TURN-OFF RESPONSE TIME

V_{IN} = 1.5V, T_A = 25°C, C_{IN} = 10µF, C_L = 1µF, R_L = 10Ω

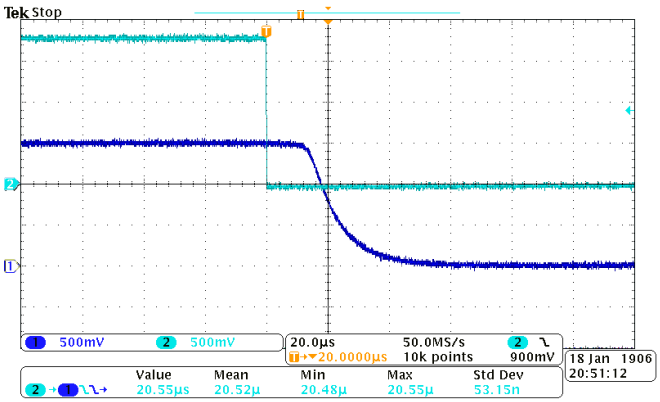


Figure 27.

APPLICATION INFORMATION

On/Off Control

The ON pin controls the state of the switch. Asserting ON high enables the switch. ON is active high and has a low threshold, making the pin 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 GPIO.

Input Capacitor

To limit the voltage drop on the input supply caused by transient inrush currents, a capacitor needs to be placed between VIN 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

A C_{IN} to C_L ratio of 10 to 1 is recommended for minimizing V_{IN} dip caused by inrush currents during startup. Devices with faster rise times may require a larger ratio to minimize V_{IN} dip.

Under-Voltage Lockout

Under-voltage lockout protection turns off the switch if the input voltage is below the under-voltage lockout threshold. During under-voltage lockout (UVLO), if the voltage level at V_{OUT} exceeds the voltage level at V_{IN} by the Reverse Current Voltage Threshold (V_{RVP}), the body diode will be disengaged to prevent any current flow to V_{IN}. With the ON pin active, the input voltage rising above the under-voltage lockout threshold will cause a controlled turn-on of the switch to limit current over-shoot.

Reverse Current Protection

In a scenario where V_{OUT} is greater than V_{IN}, there is potential for reverse current to flow through the pass FET or the body diode. The TPS22912 monitors V_{IN} and V_{OUT} voltage levels. When the reverse current voltage threshold (V_{RCP}) is exceeded, the switch is disabled (within 10µs typ). Additionally, the body diode is disengaged so as to prevent any reverse current flow to V_{IN}. The FET, and the output (V_{OUT}), will resume normal operation when the reverse current scenario is no longer present. The peak instantaneous reverse current is the current it takes to trip the reverse current protection. After the reverse current protection has tripped due to the peak instantaneous reverse current, the DC (off-state) leakage current from V_{OUT} and V_{IN} is referred to as I_{RCP}(leak) (see figure below).

Use the following formula to calculate the amount of peak instantaneous reverse current for a particular application:

$$I_{RC} = \frac{V_{RCP}}{R_{ON(VIN)}}$$

Where,

I_{RC} is the amount of reverse current,

$R_{ON(VIN)}$ is the on-resistance at the VIN of the reverse current condition.

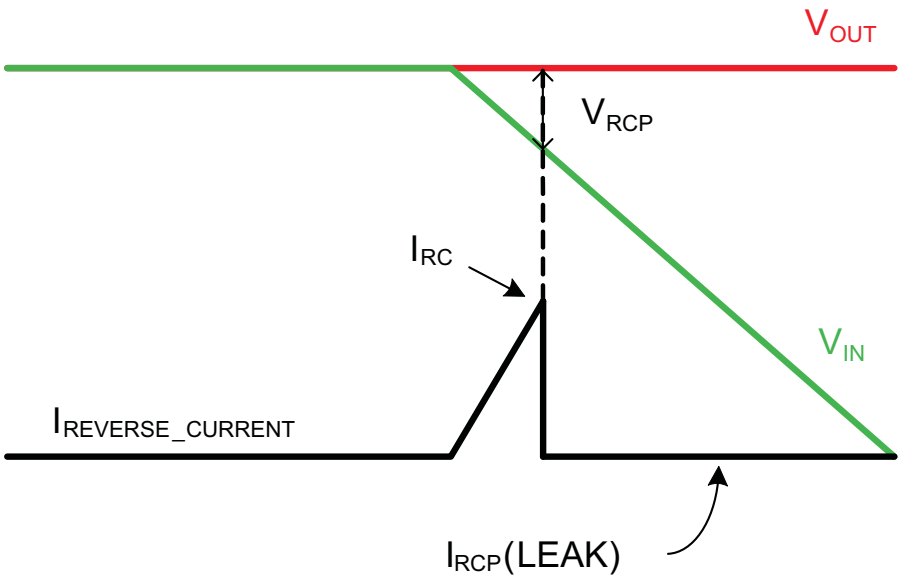


Figure 28. Reverse Current

Board Layout

For best performance, all traces should be as short as possible. 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.

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)
TPS22912CYZVR	Active	Production	DSBGA (YZV) | 4	3000 | LARGE T&R	Yes	SAC396	Level-1-260C-UNLIM	-40 to 85	78
TPS22912CYZVT	Active	Production	DSBGA (YZV) | 4	250 | SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 85	78

(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.

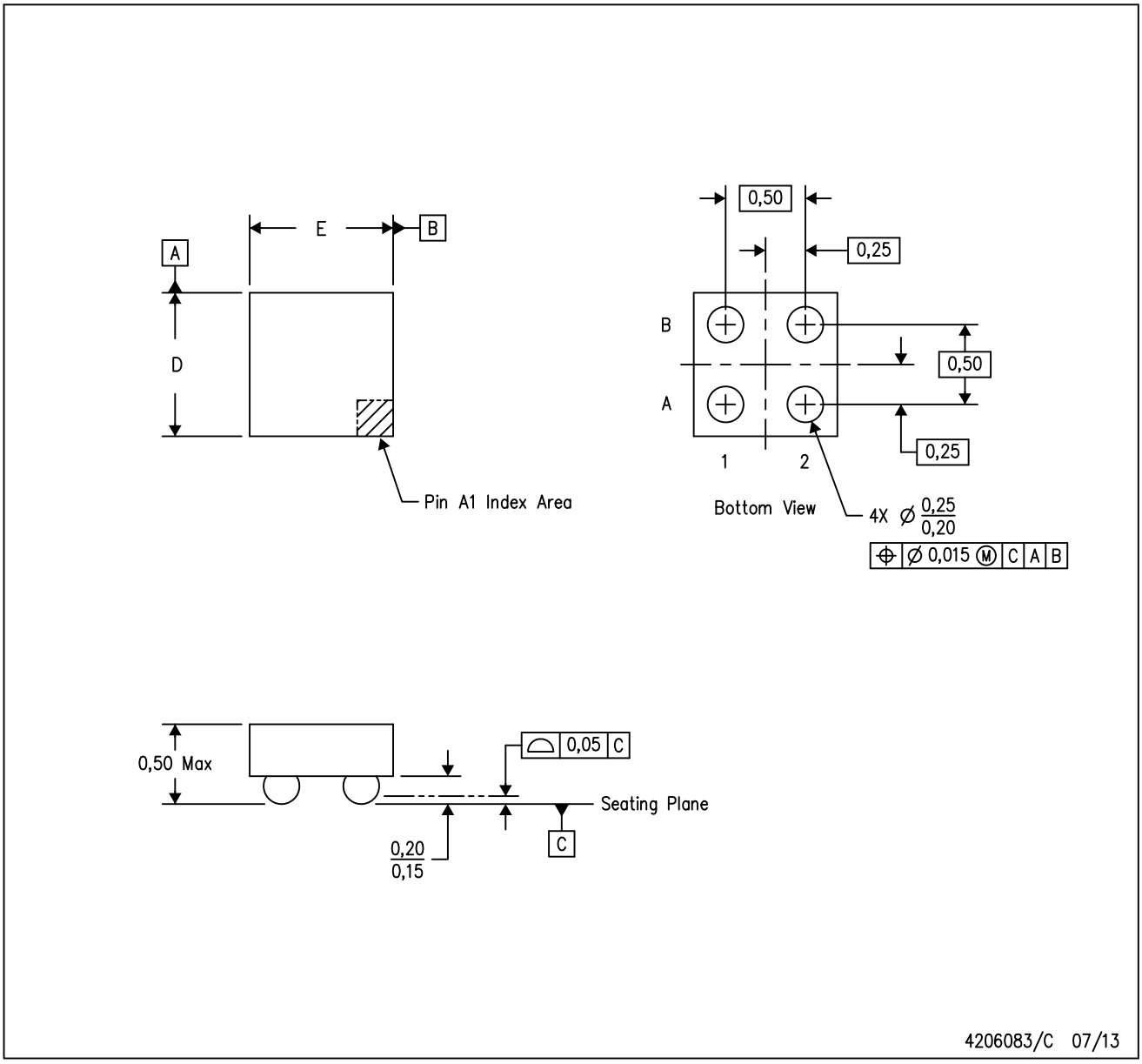
(4) **Lead finish/Ball material:** Parts may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

(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.

YZV (S–XBGA–N4) DIE–SIZE BALL GRID ARRAY



NOTES:
A. All linear dimensions are in millimeters. Dimensioning and tolerancing per ASME Y14.5M–1994.
B. This drawing is subject to change without notice.
C. NanoFree™ package configuration.

NanoFree is a trademark of Texas Instruments.

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