具有可控开启功能的超小型低导通电阻负载开关

查询样品: **TPS22910**

特性

- 集成单负载开关
- 超小型 **0.9mm × 0.9mm, 0.5mm** 脚距 **CSP-4** 封装
- 输入电压范围**: 1.4-V** 至 **5.5-V**
- 低导通电阻
  - 在 **VIN = 5-V**时，r_{ON} **= 60-mΩ**
  - 在 **VIN = 3.3-V**时，r_{ON} **= 61-mΩ**
  - 在 **VIN = 1.8-V**时，r_{ON} **= 74-mΩ**
  - 在 **VIN = 1.5-V**时，r_{ON} **= 84-mΩ**
- **2-A** 最大持续开关电流
- 低阀值控制输入
- 可控的转换率选项
- 欠压闭锁
- 快速输出放电晶体管
- 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
- 销售点终端机
- **GPS** 导航设备
- 数码相机
- 便携式仪器
- 智能手机 **/** 无线手持电话

说明

TPS22910 是一款具有可控开启功能的小型低 r_{ON} 负载的开关。 此器件包含一个 P-通道 MOSFET，此MOSFET可在输入电压 1.4 V 至 5.5 V区间内工作。 此开关由一个开/关输入(ON)控制并能与低电压控制信号直接连接。 TPS22910 低电平有效。

为了避免突入电流，此器件的转换率由内部控制。 TPS22910 系列产品具有不同的上升时间选项 (参看 表 1)。

在反向电压的情况下，通过锁住电源开关，TPS22910 提供电路断路器功能。 当输出电压(V_{IN})被驱动至高于输入电压 (V_{IN}) 以快速(典型值10μs)停止电流流向开关的输入端时，一个内部反向电压比较器使电源开关失效。 反向电流保护功能一直有效，甚至当电源开关无效的时候也是如此。 此外，如果输入电压过低的话，欠压闭锁(UVLO) 保护功能会将开关关闭。

TPS22910 采用超小型，节约空间的 4-引脚 CSP 封装，其可在外部环境温度为 –40°C 至 85°C的区间内正常工作。

典型应用

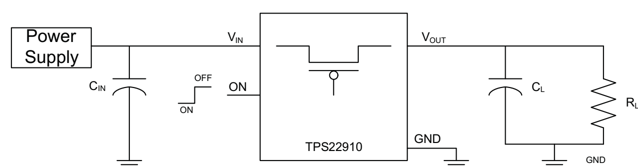


表 **1.** 特性列表

器件	在 **3.3 V**时，r_{ON} **(**典型值**)**	在 **3.3V**时，上升时间 **(**典型值**)**	快速输出放电[(1)]	最大输出电流	使能
TPS22910A	63 mΩ	1 µs	否	2-A	低电平有效
TPS22910B[(2)]	63 mΩ	100 µs	否	2-A	低电平有效
TPS22910C[(2)]	63 mΩ	1000 µs	否	2-A	低电平有效
TPS22910D[(2)]	63 mΩ	4500 µs	否	2-A	低电平有效

(1) 此特性通过一个 150-Ω 电阻器将开关输出放电至接地水平以防止输出浮动。
(2) 要获得产品可用性信息，请与当地销售商/分销商或者厂家联系。

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.

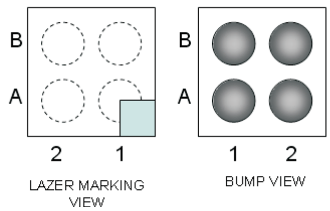
ORDERING INFORMATION

T_A	PACKAGE(1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING/ STATUS(2)
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22910AYZVR	_ _ _ _ 75
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22910BYZVR	Contact factory for availability
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22910CYZVR	Contact factory for availability
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22910DYZVR	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

TPS22910	PIN NAME	DESCRIPTION
YZV		
B1	GND	Ground
B2	ON	Switch control input, active high. Do not leave floating
A1	VOUT	Switch output
A2	VIN	Switch input, bypass this input with a ceramic capacitor to ground

BLOCK DIAGRAM

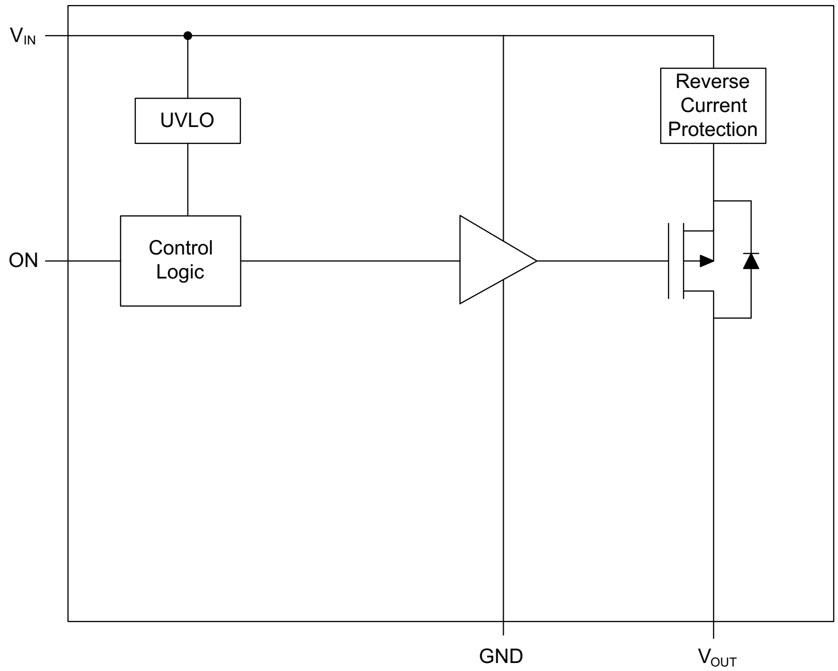


Table 2. FUNCTION TABLE

ON	VIN to VOUT
L	ON
H	OFF

ABSOLUTE MAXIMUM RATINGS

			VALUE	UNIT
V_{IN}	Input voltage range		–0.3 to 6	V
V_{OUT}	Output voltage range		VIN + 0.3	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 <300 µS, 2% duty cycle		2.5	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)		TPS22910 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) 有关传统和新的热度量的更多信息，请参阅 *IC* 封装热度量 应用报告 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			V_{IN}	
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

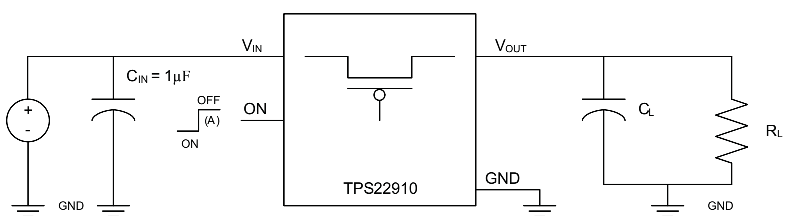
VIN = 1.4 V to 5.5 V, T_A = –40ºC to 85ºC (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
I_{IN}	Quiescent current	I_{OUT} = 0, V_{IN} = 5.25 V, V_{ON} = 0 V	Full		2	10	µA
		I_{OUT} = 0, V_{IN} = 4.2 V, V_{ON} = 0 V			2	7.0	
		I_{OUT} = 0, V_{IN} = 3.6 V, V_{ON} = 0 V			2	7.0	
		I_{OUT} = 0, V_{IN} = 2.5 V, V_{ON} = 0 V			0.9	5	
		I_{OUT} = 0, V_{IN} = 1.5 V, V_{ON} = 0 V			0.7	5	
$I_{IN(off)}$	Off supply current	V_{OUT} = Open, V_{IN} = V_{ON} = 5.25 V	Full		1.2	10	µA
		V_{OUT} = Open, V_{IN} = V_{ON} = 4.2 V			0.2	7.0	
		V_{OUT} = Open, V_{IN} = V_{ON} = 3.6 V			0.1	7.0	
		V_{OUT} = Open, V_{IN} = V_{ON} = 2.5 V			0.1	5	
		V_{OUT} = Open, V_{IN} = V_{ON} = 1.5 V			0.1	5	
$I_{IN(Leakage)}$	Leakage current	V_{OUT} = 0 V, V_{IN} = V_{ON} = 5.25 V	Full		1.2	10	µA
		V_{OUT} = 0 V, V_{IN} = V_{ON} = 4.2 V			0.2	7.0	
		V_{OUT} = 0 V, V_{IN} = V_{ON} = 3.6 V			0.1	7.0	
		V_{OUT} = 0 V, V_{IN} = V_{ON} = 2.5 V			0.1	5	
		V_{OUT} = 0 V, V_{IN} = V_{ON} = 1.5 V			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} = 0 V, I_{OUT} = –100 mA	Full			1.2	V
		V_{IN} decreasing, V_{ON} 3.6 V, R_L = 10 Ω		0.50			
I_{ON}	ON input leakage current	V_{ON} = 1.4 V to 5.25 V or GND	Full			1	µA
V_{RVP}	Reverse Current Voltage Threshold				44		mV
t_{DELAY}	Reverse Current Response Delay	V_{IN} = 5V			10		µs

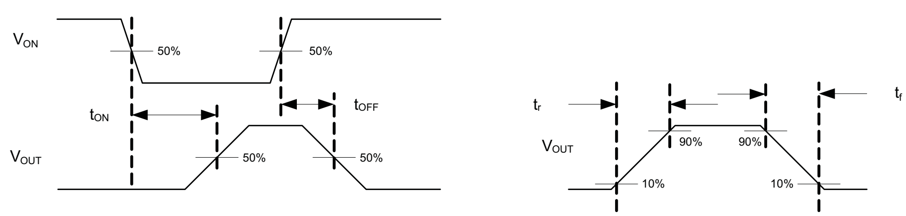
SWITCHING CHARACTERISTICS

PARAMETER		TEST CONDITION	TPS22910A	UNIT
			TYP	
VIN = 5 V, T_A = 25°C (unless otherwise noted)				
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 μF	2	μs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 μF	5.5	
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 μF	1	
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 μF	3	
VIN = 3.3 V, T_A = 25°C (unless otherwise noted)				
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 μF	2.5	μs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 μF	7	
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 μF	1	
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 μF	3.5	
VIN = 1.5 V, T_A = 25°C (unless otherwise noted)				
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 μF	4.5	μs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 μF	16.5	
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 μF	2	
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 μF	7	

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 is 100 ns.

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

TYPICAL CHARACTERISTICS

ON-STATE RESISTANCE vs INPUT VOLTAGE

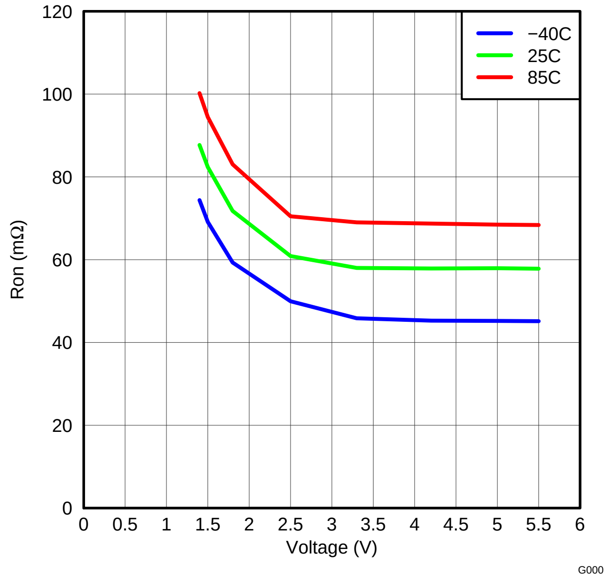


Figure 2.

ON INPUT THRESHOLD

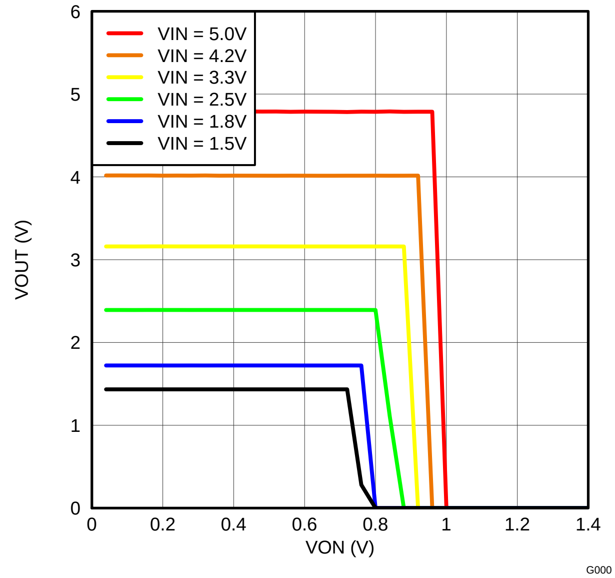


Figure 3.

INPUT CURRENT, QUIESCENT vs INPUT VOLTAGE

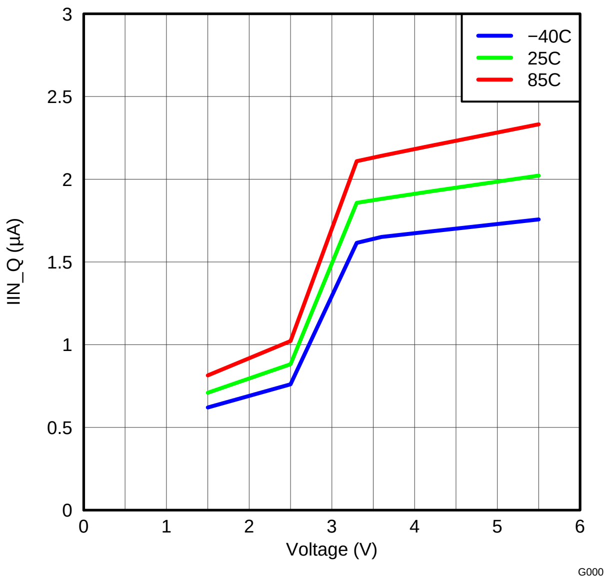


Figure 4.

INPUT CURRENT, LEAK vs INPUT VOLTAGE

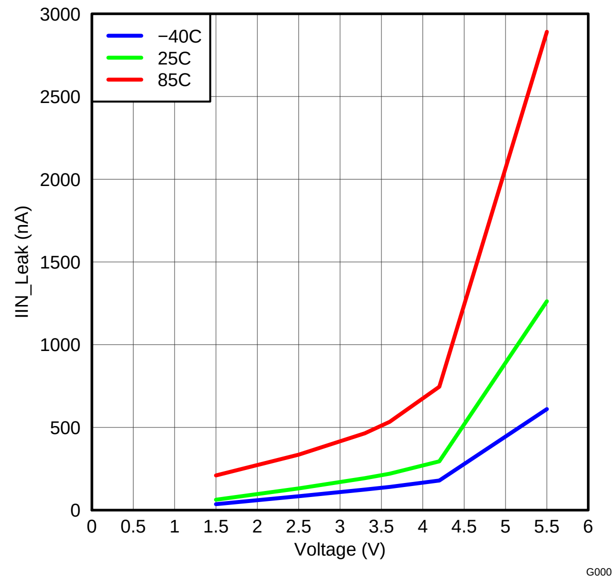


Figure 5.

TYPICAL CHARACTERISTICS (continued)

ON-STATE RESISTANCE vs TEMPERATURE

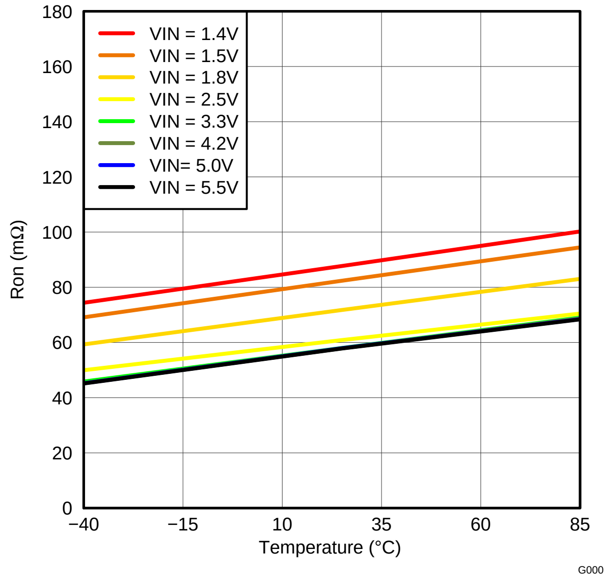


Figure 6.

INPUT CURRENT, OFF vs INPUT VOLTAGE

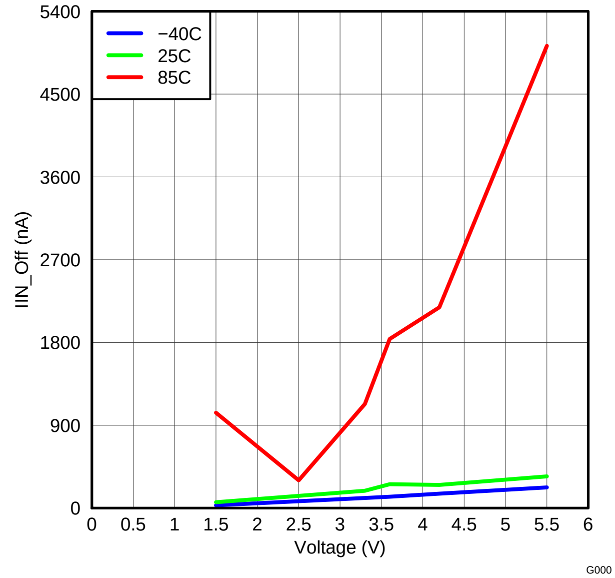


Figure 7.

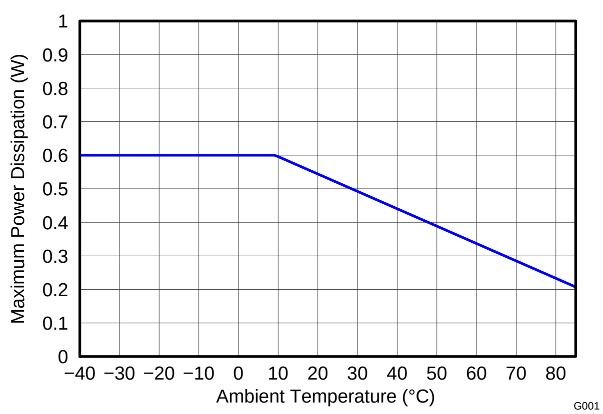


Figure 8. Allowable Power Dissipation

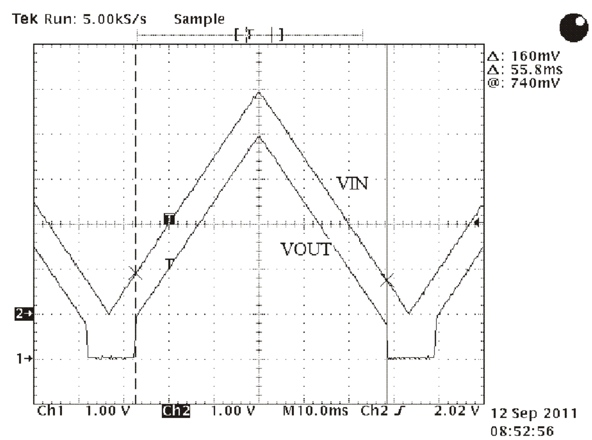


Figure 9. ULVO Response I_{OUT} = -100mA

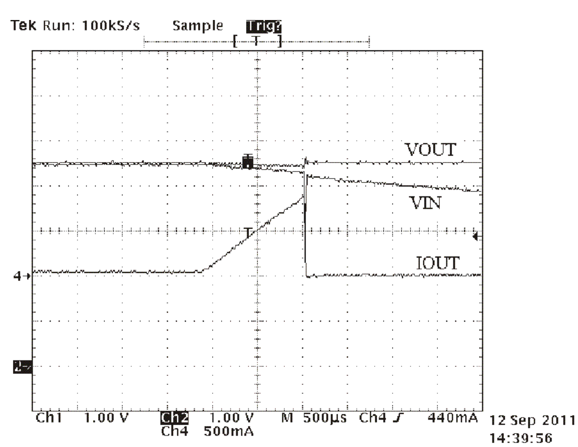


Figure 10. Reverse Current Protection V_{OUT} = 3.3V, V_{IN} = 3.3V Decreasing to 0V

TYPICAL CHARACTERISTICS (continued)

TYPICAL AC CHARACTERISTICS FOR TPS22910A

RISE TIME vs TEMPERATURE

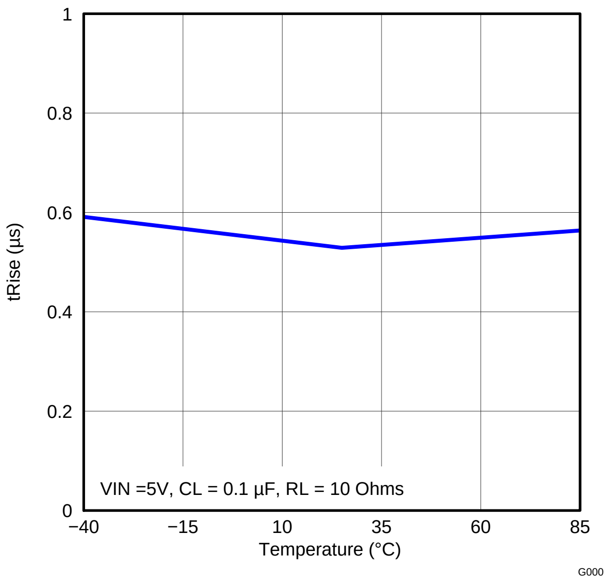


Figure 11.

FALL TIME vs TEMPERATURE

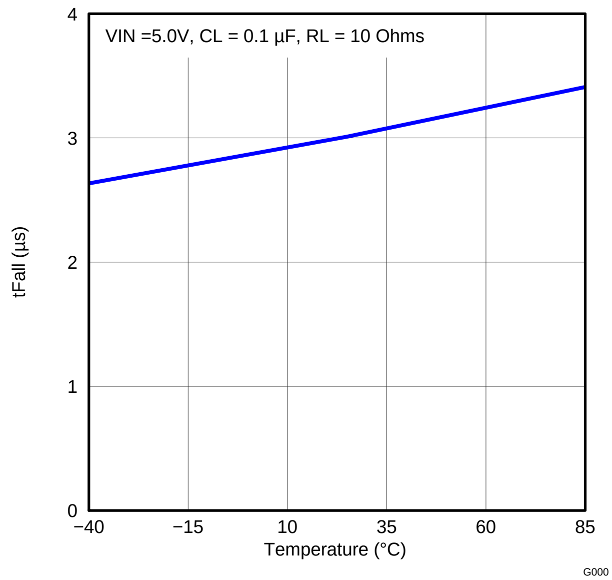


Figure 12.

RISE TIME vs TEMPERATURE

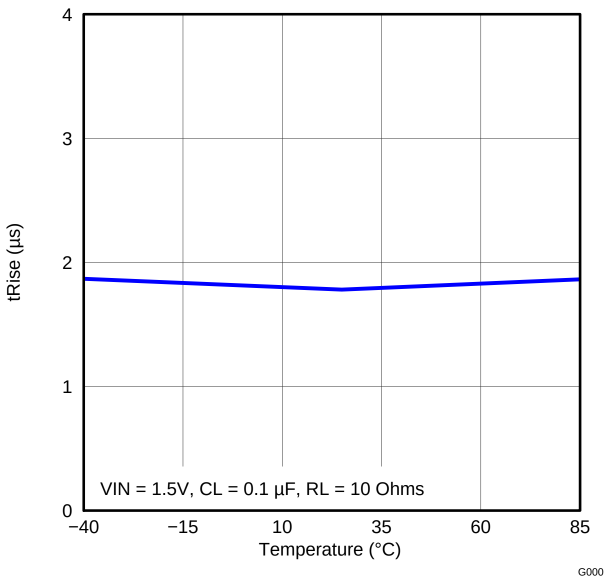


Figure 13.

FALL TIME vs TEMPERATURE

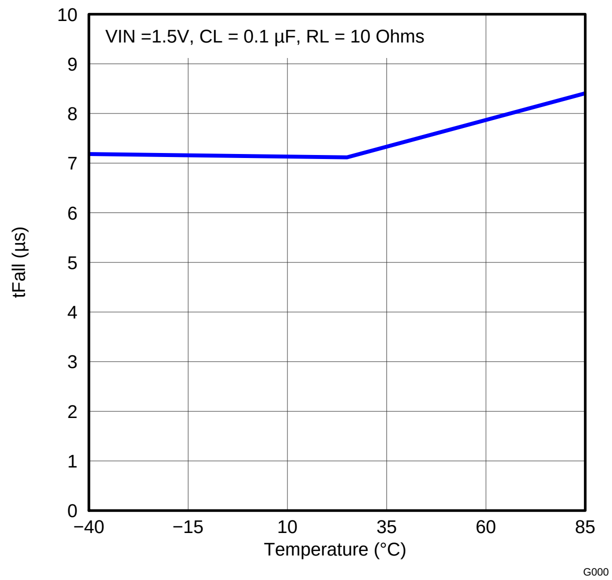


Figure 14.

TYPICAL CHARACTERISTICS (continued)

TURN-ON TIME
vs
TEMPERATURE

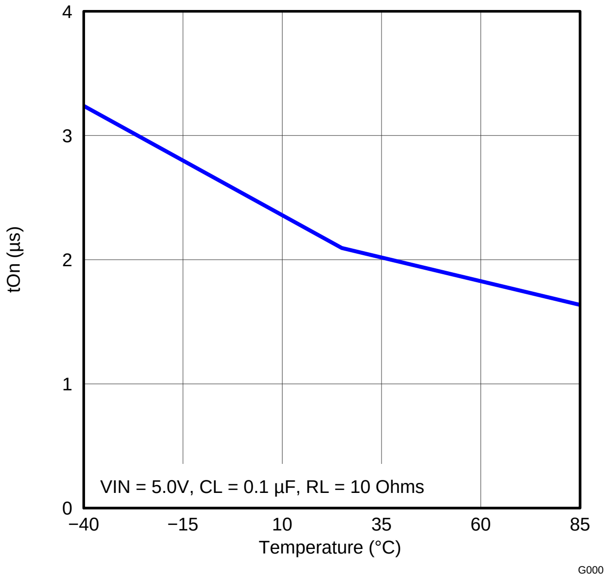


Figure 15.

TURN-OFF TIME
vs
TEMPERATURE

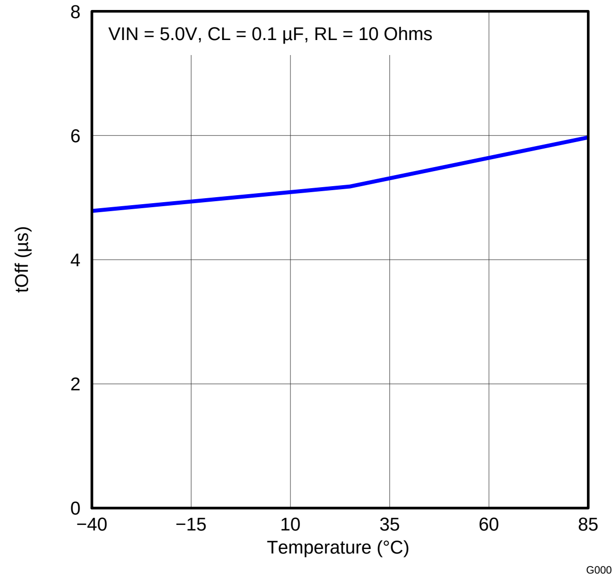


Figure 16.

TURN-ON TIME
vs
TEMPERATURE

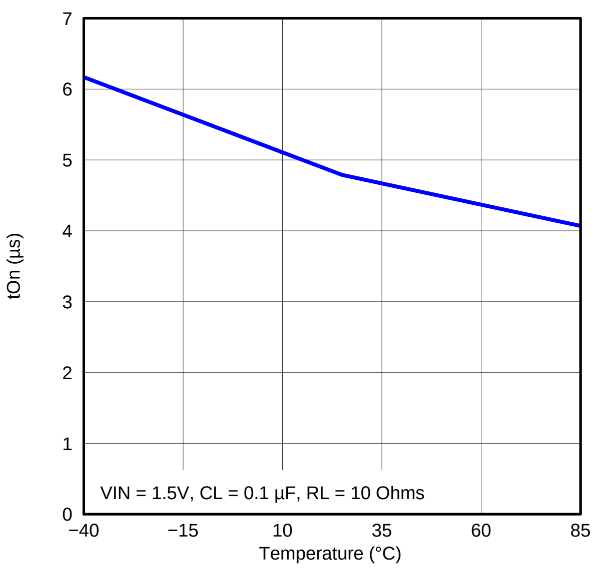


Figure 17.

TURN-OFF TIME
vs
TEMPERATURE

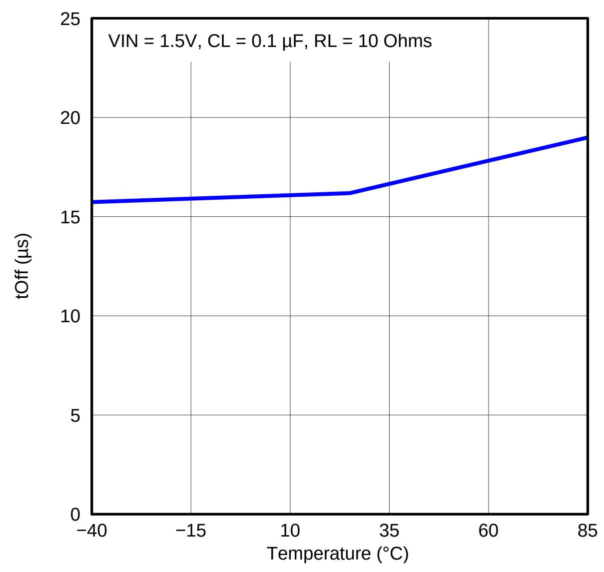


Figure 18.

TYPICAL CHARACTERISTICS (continued)

RISE TIME
vs
INPUT VOLTAGE

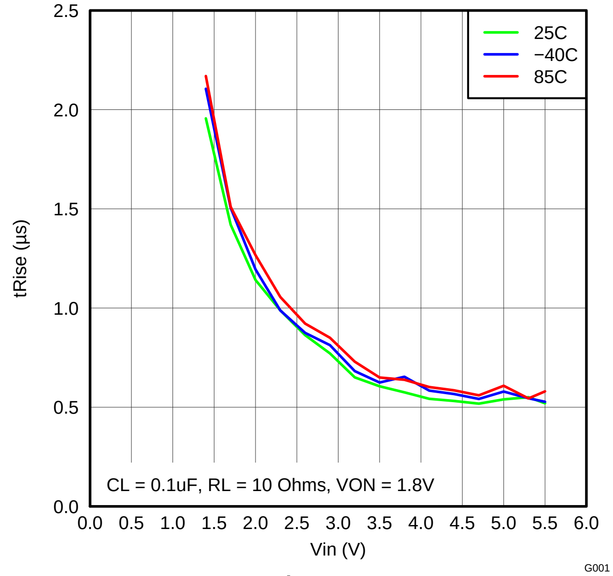


Figure 19.

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

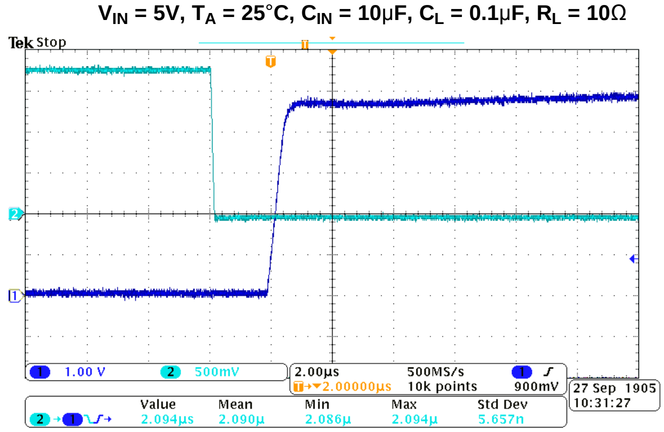


Figure 20.

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

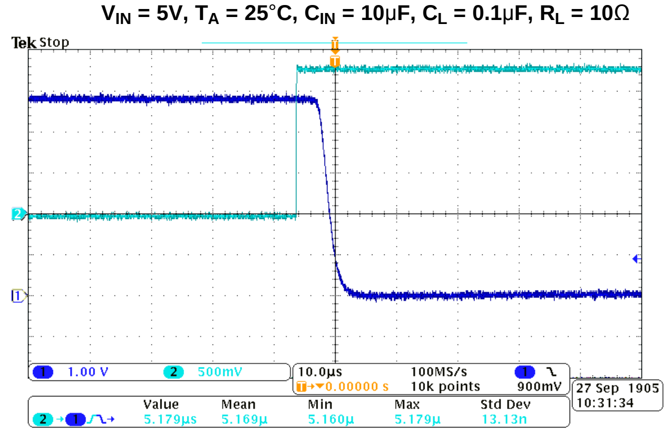


Figure 21.

TYPICAL CHARACTERISTICS (continued)

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

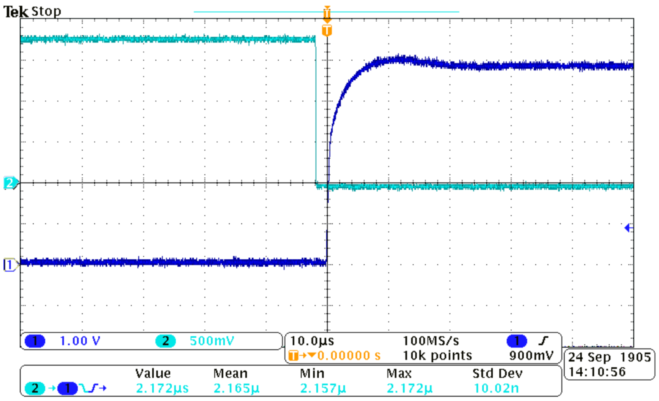


Figure 22.

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

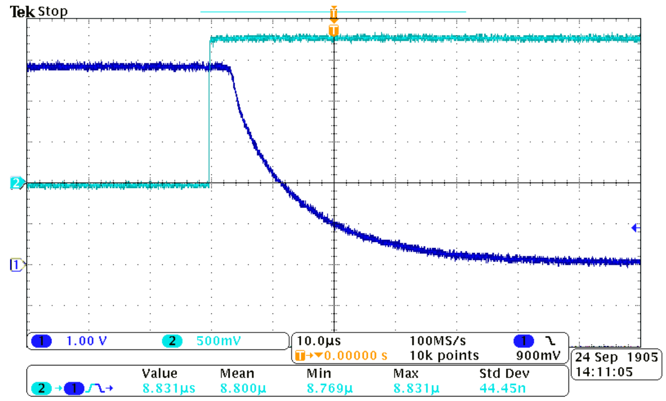


Figure 23.

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

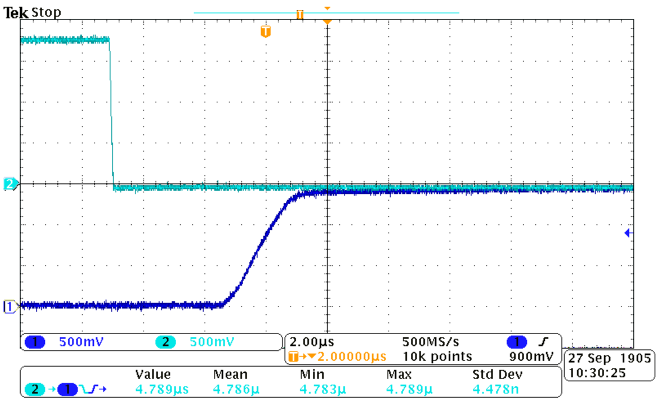


Figure 24.

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

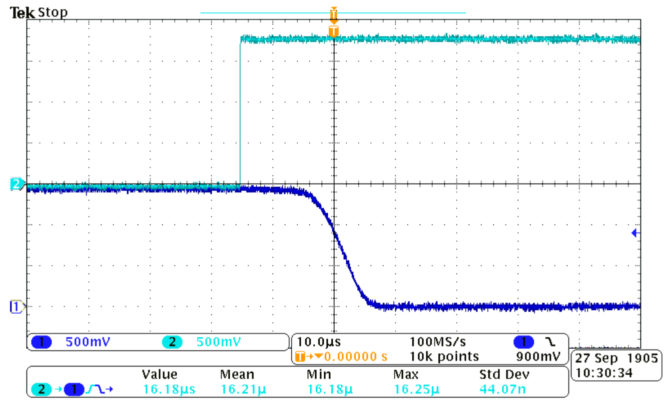


Figure 25.

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

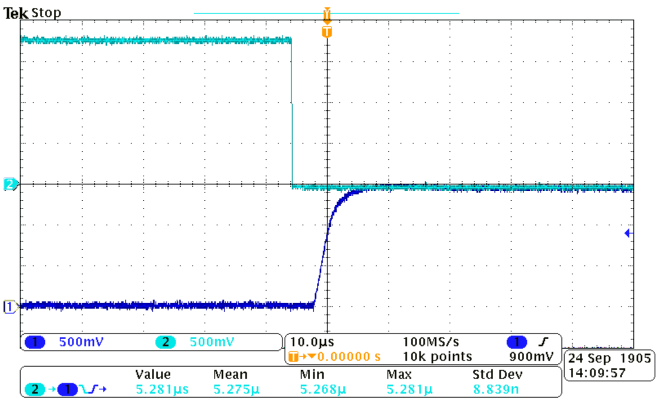


Figure 26.

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

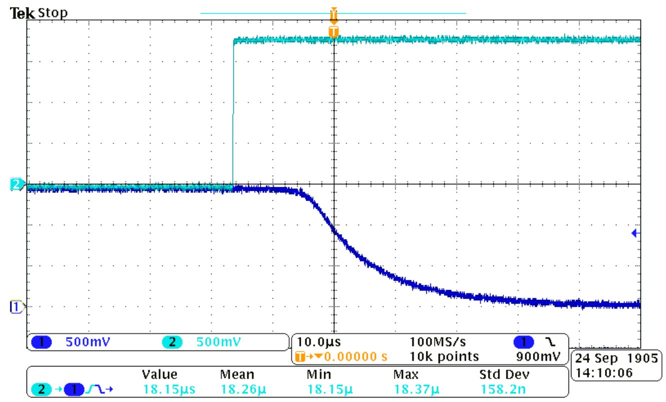


Figure 27.

APPLICATION INFORMATION

On/Off Control

The ON pin controls the state of the switch. Asserting ON 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 GPIO.

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 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 drops 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 TPS22910 monitors V_{IN} and V_{OUT} voltage levels. When the reverse current voltage threshold (V_{RVP}) 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.

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

$$I_{RC} = \frac{0.044V}{R_{ON(VIN)}}$$

Where,

I_{RC} is the amount of reverse current,

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

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.

TEXAS INSTRUMENTS

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12-Nov-2011

PACKAGING INFORMATION

Orderable Device	Status [1]	Package Type	Package Drawing	Pins	Package Qty	Eco Plan [2]	Lead/ Ball Finish	MSL Peak Temp [3]	Samples (Requires Login)
TPS22910AYZVR	ACTIVE	DSBGA	YZV	4	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	
TPS22910AYZVT	ACTIVE	DSBGA	YZV	4	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	

[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] Eco Plan - The planned eco-friendly classification: Pb-Free (RoHS), Pb-Free (RoHS Exempt), or Green (RoHS & no Sb/Br) - please check http://www.ti.com/productcontent for the latest availability information and additional product content details.
TBD: The Pb-Free/Green conversion plan has not been defined.
Pb-Free (RoHS): TI's terms "Lead-Free" or "Pb-Free" mean semiconductor products that are compatible with the current RoHS requirements for all 6 substances, including the requirement that lead not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, TI Pb-Free products are suitable for use in specified lead-free processes.
Pb-Free (RoHS Exempt): This component has a RoHS exemption for either 1) lead-based flip-chip solder bumps used between the die and package, or 2) lead-based die adhesive used between the die and leadframe. The component is otherwise considered Pb-Free (RoHS compatible) as defined above.
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

[3] MSL, Peak Temp. -- The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

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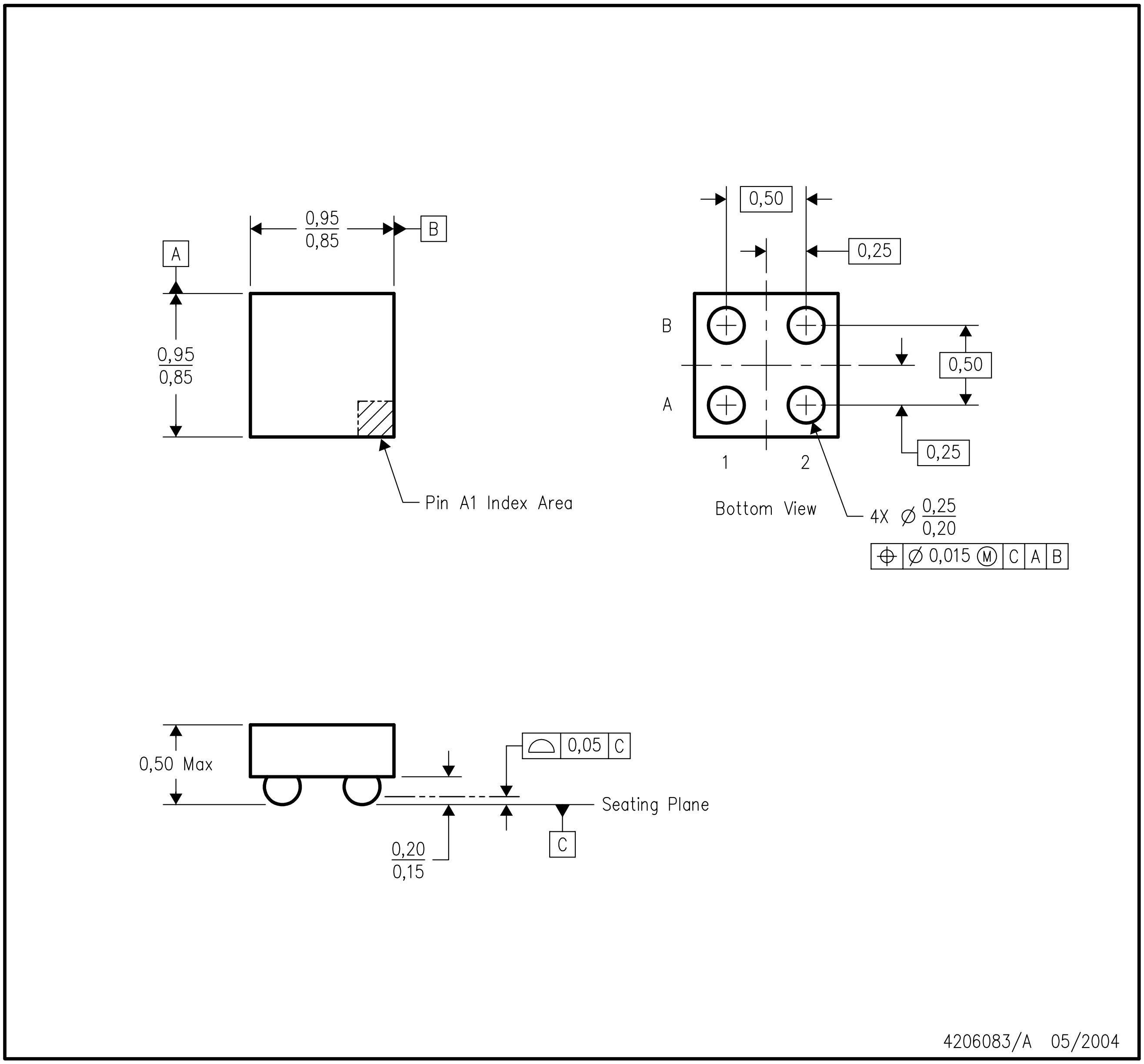
YZV (S–XBGA–N4) DIE–SIZE BALL GRID ARRAY



NOTES:
- A. All linear dimensions are in millimeters.
- B. This drawing is subject to change without notice.
- C. NanoFree™ package configuration.
- D. This package contains lead–free balls. Refer to the 4 YEV package (drawing 4206082) for tin–lead (SnPb) balls.

NanoFree is a trademark of Texas Instruments.

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