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: TPS22913

特性

- 集成单负载开关
- 超小型 **0.9mm × 0.9mm, 0.5mm** 螺距 **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

- 便携式工业用设备
- 便携式医疗设备
- 便携式媒体播放器
- 销售点终端机
- **GPS**设备
- 数码摄像机
- 便携式仪器
- 智能电话

说明

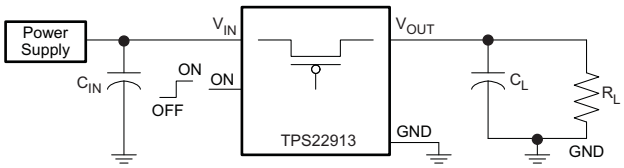
TPS22913 是一款具有可控开启功能的小型低 r_{ON} 负载的开关。 此器件包含一个 P-通道 MOSFET，此MOSFET可在输入电压 1.4 V 至 5.5 V区间内工作。此开关由一个开/关输入(ON)控制并能与低电压控制信号直接连接。 TPS22913 高电平有效。

TPS22913 包含一个 150-Ω 片载电阻器，此电阻器用于当开关关闭时的快速输出放电。 为了避免突入电流，此器件的上升时间由内部控制。 TPS22913 系列产品具有不同的转换速率选项 (参看 Table 1)。

在反向电压的情况下，通过锁住电源开关，TPS22913 提供电路断路器功能。 当输出电压被驱动至高于输入电压(V_{IN})以快速(10μs 典型值)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。当电源开关处于开启（ON）状态时，反向电流保护功能被激活。 除此之外，在欠压闭锁期间，或者在开关关闭期间，由于开关内的二极管没有工作，所以没有反向电流产生。

TPS22913 采用超小型，节约空间的 4-引脚 C无效SP 封装，其在自然环境中的额定工作温度范围为 –40°C 至 85°C。

典型应用



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.

Table 1. Feature List

DEVICE	r_{ON} (typ) at 3.3 V	SLEW RATE (typ)	QUICK OUTPUT DISCHARGE(1)	MAXIMUM OUTPUT CURRENT	ENABLE
TPS22913A(2)	63 mΩ	0.1 µs/V	Yes	2-A	Active High
TPS22913B	63 mΩ	20 µs/V	Yes	2-A	Active High
TPS22913C	63 mΩ	200 µs/V	Yes	2-A	Active High
TPS22913D(2)	63 mΩ	900 µs/V	Yes	2-A	Active High

(1) This feature discharges the output of the switch to ground through an 150-Ω resistor, preventing the output from floating.
(2) Contact local sales/distributor or factory for availability.

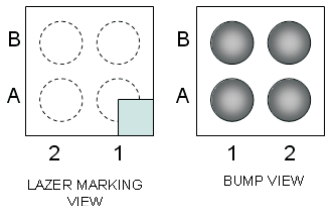
ORDERING INFORMATION

T_A	PACKAGE(1)		ORDERABLE PART NUMBER	TOP-SIDE MARKING/ STATUS(2)
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22913AYZVR	Contact factory for availability
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22913BYZVR	_ _ _ _ 64
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22913CYZVR	_ _ _ _ 76
–40°C to 85°C	YZV (0.5mm pitch)	Tape and Reel	TPS22913DYZVR	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



TERMINALS ASSIGNMENTS

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

PIN FUNCTIONS

TPS22913 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, bypass this input with a ceramic capacitor to ground

BLOCK DIAGRAM

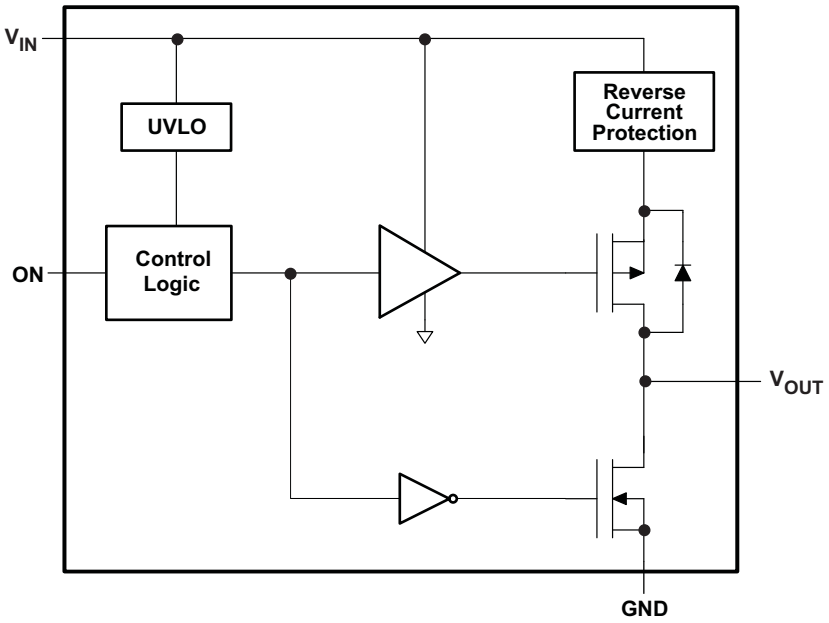


Table 2. FUNCTION TABLE

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

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

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)		TPS22913 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

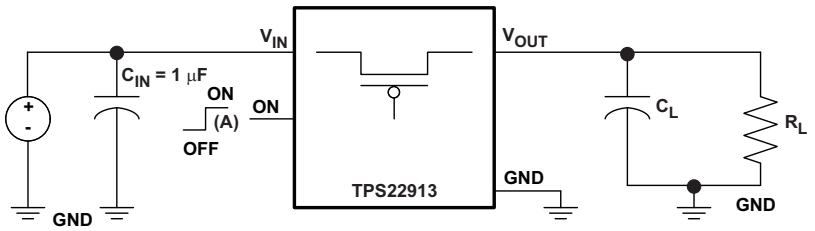
VIN = 1.4 V to 5.5 V, T_A = –40ºC to 85ºC (unless otherwise noted)

PARAMETER		TEST CONDITIONS	T_A	MIN	TYP	MAX	UNIT
I_{IN}	Quiescent current	I_{OUT} = 0, V_{IN} = V_{ON} = 5.25 V	Full		2	10	µA
		I_{OUT} = 0, V_{IN} = V_{ON} = 4.2 V			2	7.0	
		I_{OUT} = 0, V_{IN} = V_{ON} = 3.6 V			2	7.0	
		I_{OUT} = 0, V_{IN} = V_{ON} = 2.5 V			0.9	5	
		I_{OUT} = 0, V_{IN} = V_{ON} = 1.5 V			0.7	5	
$I_{IN(off)}$	Off supply current	V_{ON} = GND, V_{OUT} = Open, V_{IN} = 5.25 V	Full		1.2	10	µA
		V_{ON} = GND, V_{OUT} = Open, V_{IN} = 4.2 V			0.2	7.0	
		V_{ON} = GND, V_{OUT} = Open, V_{IN} = 3.6 V			0.1	7.0	
		V_{ON} = GND, V_{OUT} = Open, V_{IN} = 2.5 V			0.1	5	
		V_{ON} = GND, V_{OUT} = Open, V_{IN} = 1.5 V			0.1	5	
$I_{IN(Leakage)}$	Leakage current	V_{ON} = GND, V_{OUT} = 0, V_{IN} = 5.25 V	Full		1.2	10	µA
		V_{ON} = GND, V_{OUT} = 0, V_{IN} = 4.2 V			0.2	7.0	
		V_{ON} = GND, V_{OUT} = 0, V_{IN} = 3.6 V			0.1	7.0	
		V_{ON} = GND, V_{OUT} = 0, V_{IN} = 2.5 V			0.1	5	
		V_{ON} = GND, V_{OUT} = 0, V_{IN} = 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	
RPD	Output pull down resistance	V_{IN} = 3.3 V, V_{ON} = 0, I_{OUT} = 30 mA	25°C		153	200	Ω
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, 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

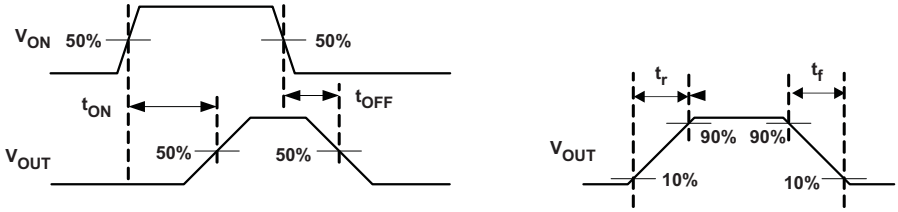
SWITCHING CHARACTERISTICS

PARAMETER		TEST CONDITION	TPS22913B TYP	TPS22913C TYP	UNIT
VIN = 5 V, T_A = 25°C (unless otherwise noted)					
t_{ON}	Turn-ON time	R_L = 10 Ω, C_L = 0.1 µF	76	770	µs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 µF	6.6	6.6	
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 µF	82	838	
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 µF	3	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	102	1048	µs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 µF	8.5	8.6	
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 µF	97	980	
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 µF	3	3	
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	234	2344	µs
t_{OFF}	Turn-OFF time	R_L = 10 Ω, C_L = 0.1 µF	17	18	
t_R	VOUT rise time	R_L = 10 Ω, C_L = 0.1 µF	244	1823	
t_F	VOUT fall time	R_L = 10 Ω, C_L = 0.1 µF	6.5	6.5	

PARAMETRIC MEASUREMENT INFORMATION



TEST CIRCUIT



$t_{ON}H/t_{OFF}$ WAVEFORMS

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

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

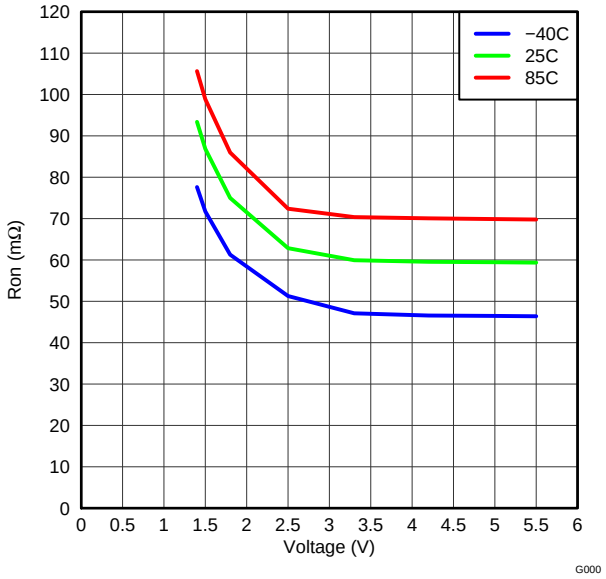


Figure 2.

ON INPUT THRESHOLD

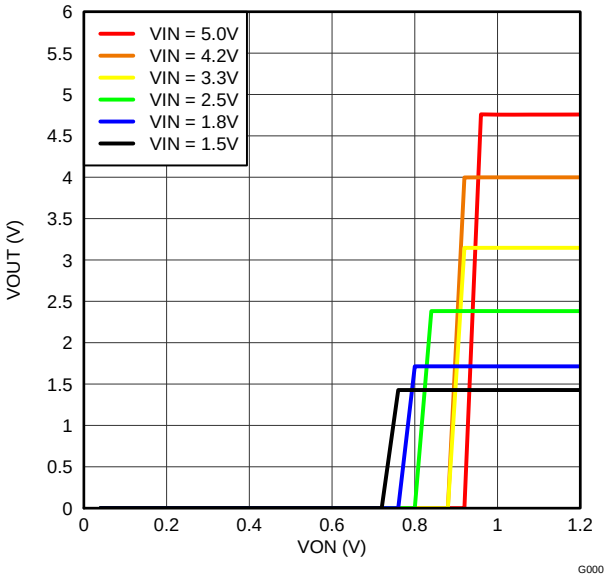


Figure 3.

INPUT CURRENT, QUIESCENT vs INPUT VOLTAGE

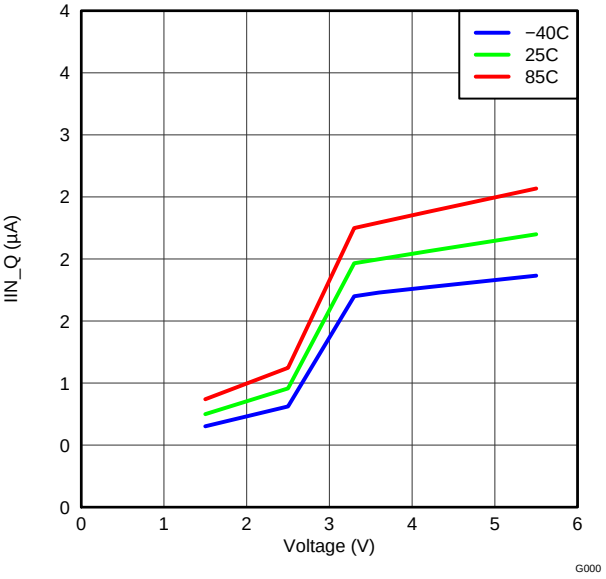


Figure 4.

INPUT CURRENT, LEAK vs INPUT VOLTAGE

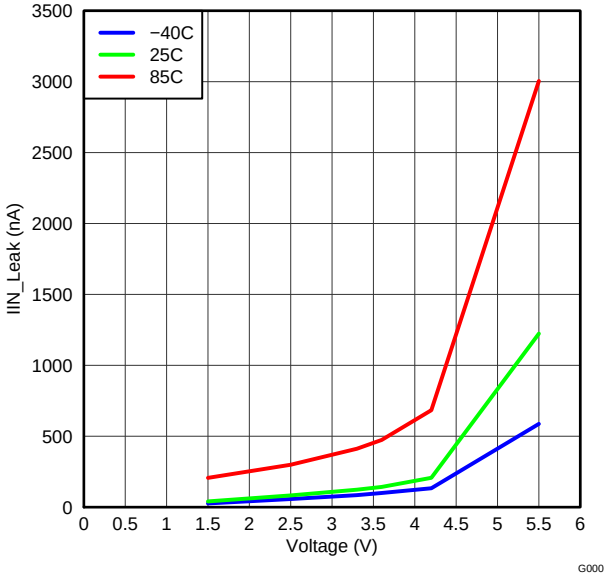


Figure 5.

TYPICAL CHARACTERISTICS (continued)

ON-STATE RESISTANCE vs TEMPERATURE

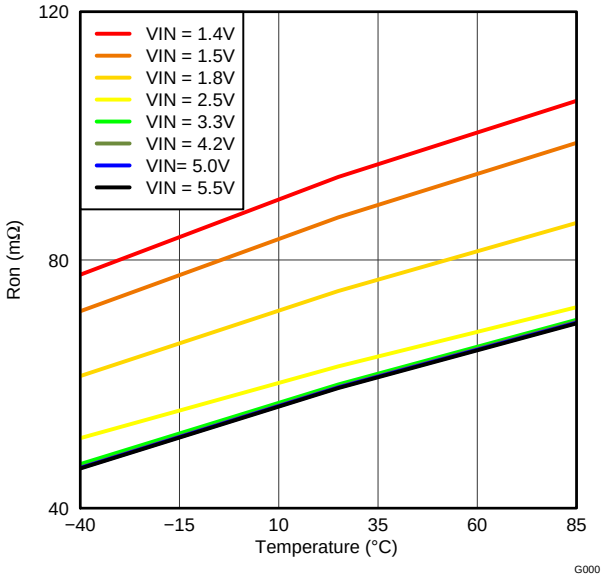


Figure 6.

INPUT CURRENT, OFF vs INPUT VOLTAGE

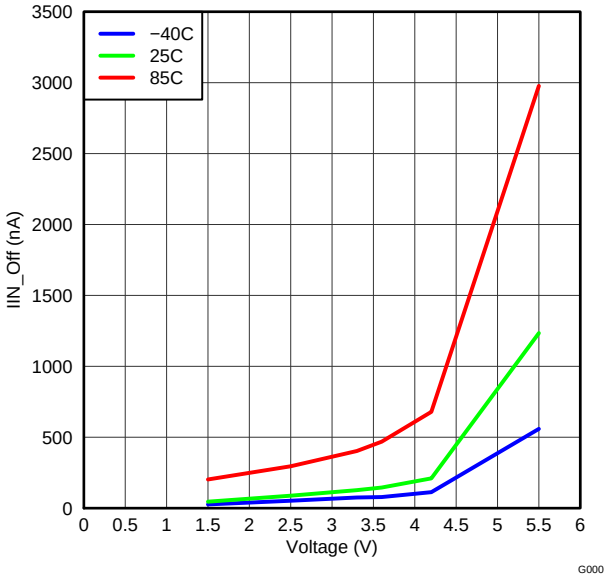


Figure 7.

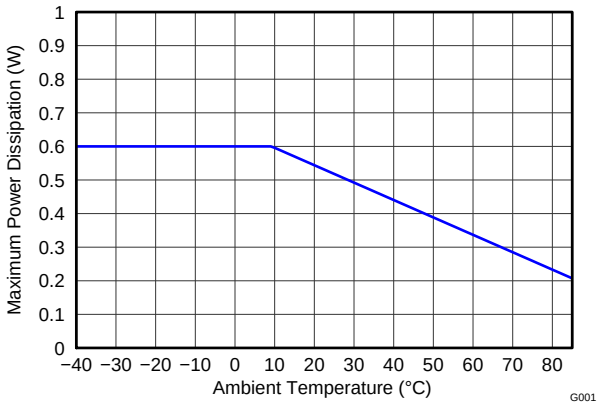


Figure 8. Allowable Power Dissipation

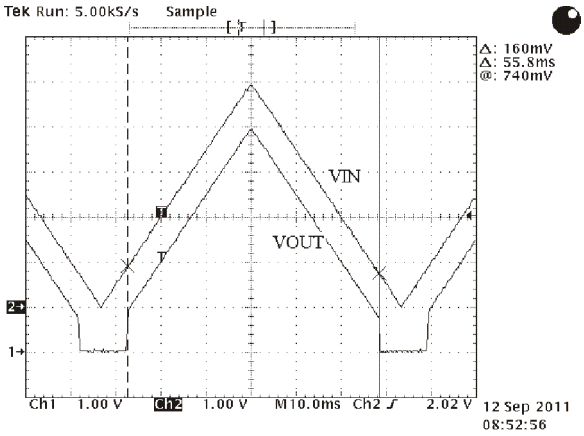


Figure 9. ULVO Response I_{OUT} = -100mA

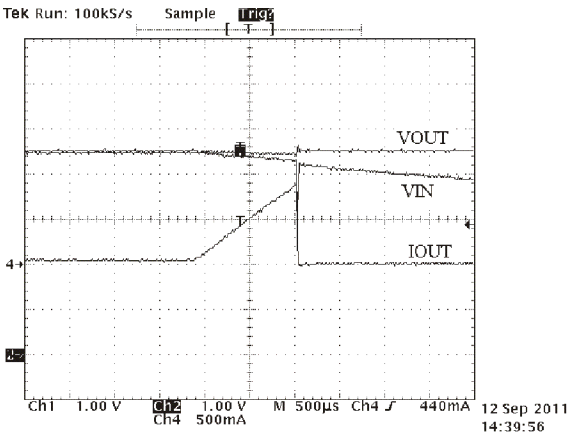


Figure 10. Reverse Current Protection V_{OUT} = 3.3V, V_{IN} = 3.3V Decreasing to 0V

TYPICAL CHARACTERISTICS (continued)

TYPICAL AC CHARACTERISTICS FOR TPS22913B

RISE TIME vs TEMPERATURE

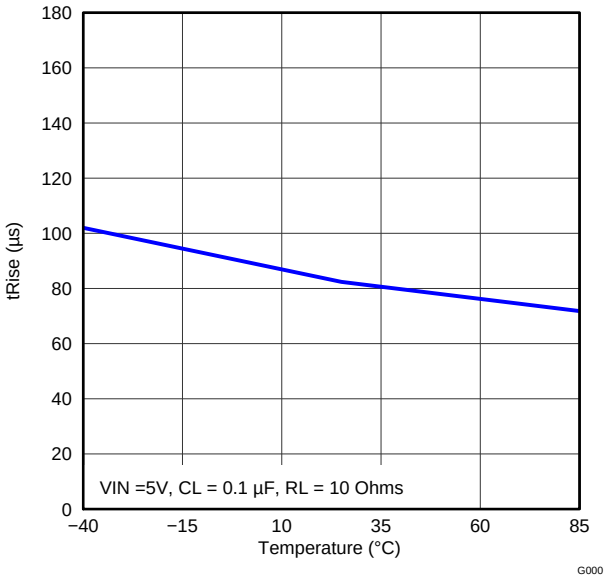


Figure 11.

FALL TIME vs TEMPERATURE

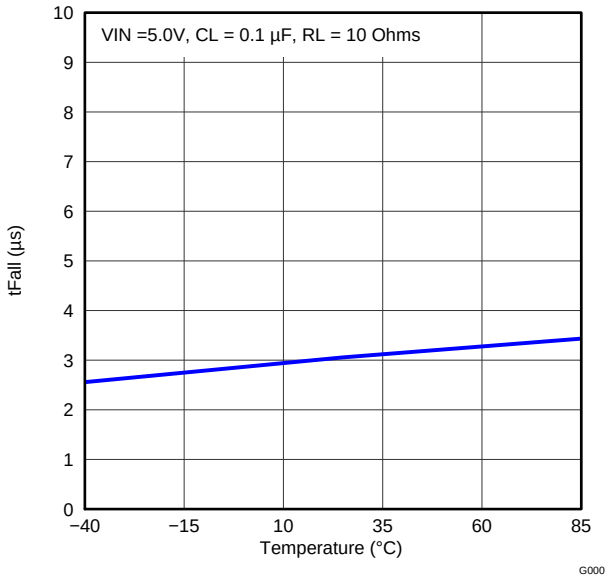


Figure 12.

RISE TIME vs TEMPERATURE

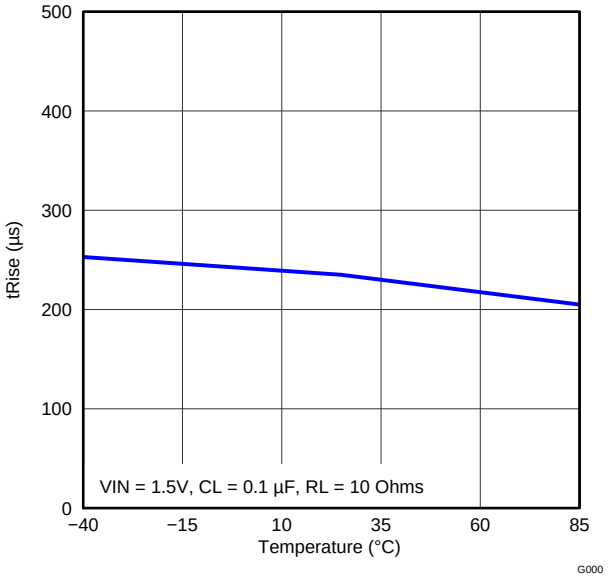


Figure 13.

FALL TIME vs TEMPERATURE

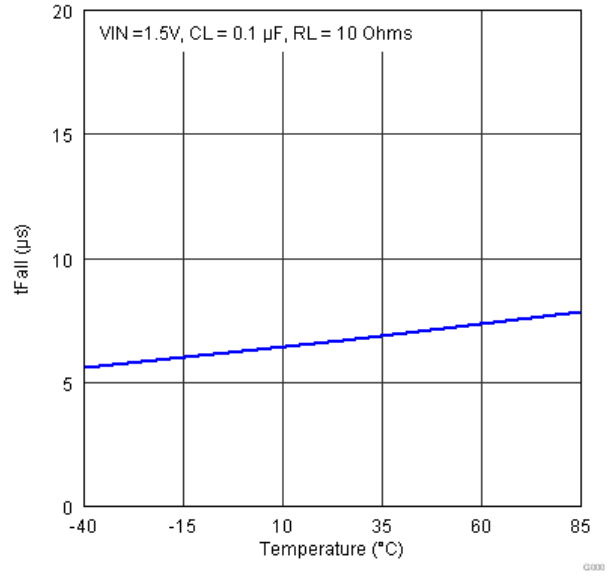


Figure 14.

TYPICAL CHARACTERISTICS (continued)

TURN-ON TIME vs TEMPERATURE

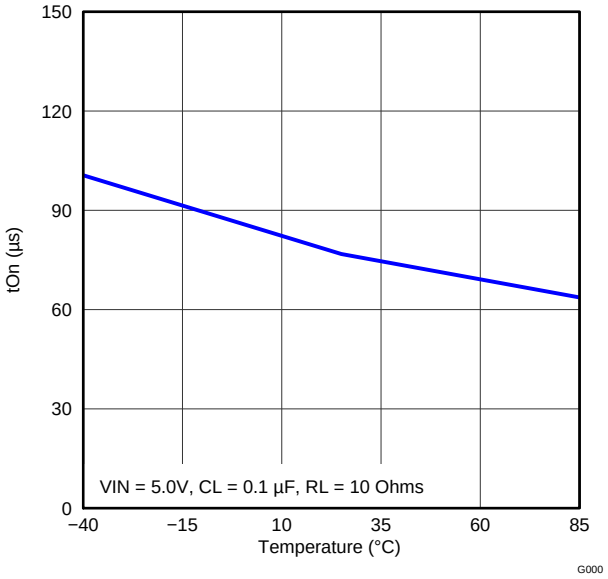


Figure 15.

TURN-OFF TIME vs TEMPERATURE

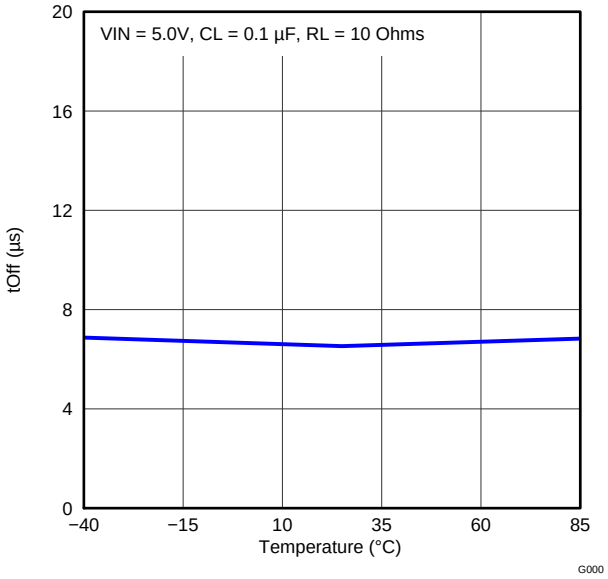


Figure 16.

TURN-ON TIME vs TEMPERATURE

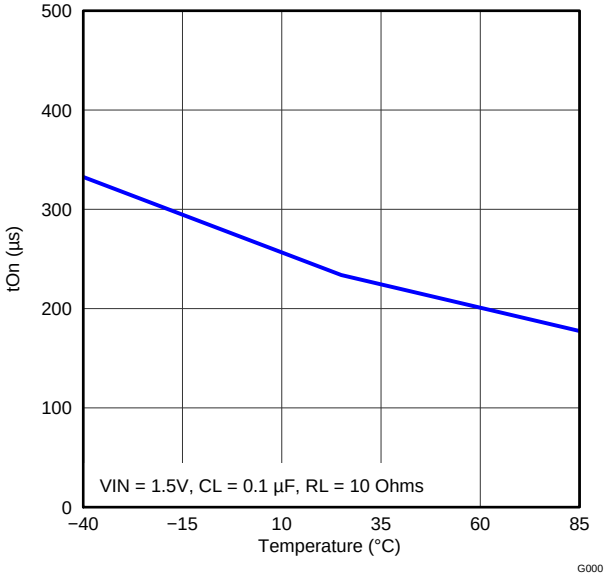


Figure 17.

TURN-OFF TIME vs TEMPERATURE

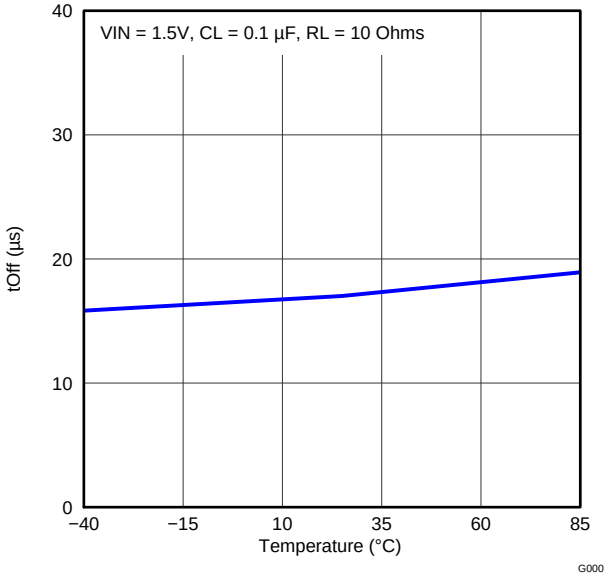


Figure 18.

TYPICAL CHARACTERISTICS (continued)

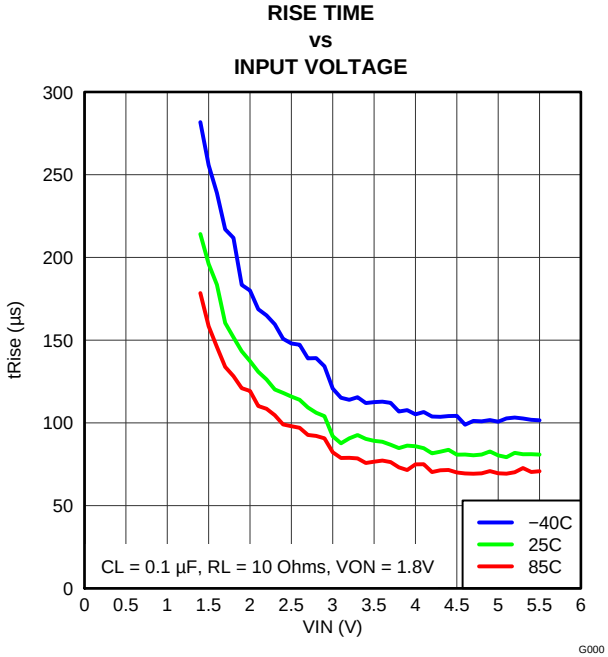


Figure 19.

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

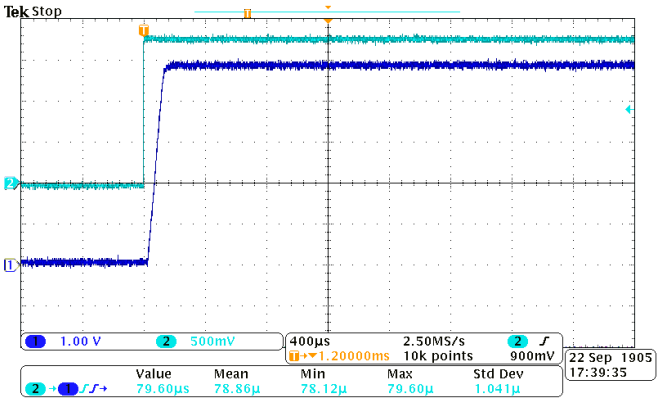


Figure 20.

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

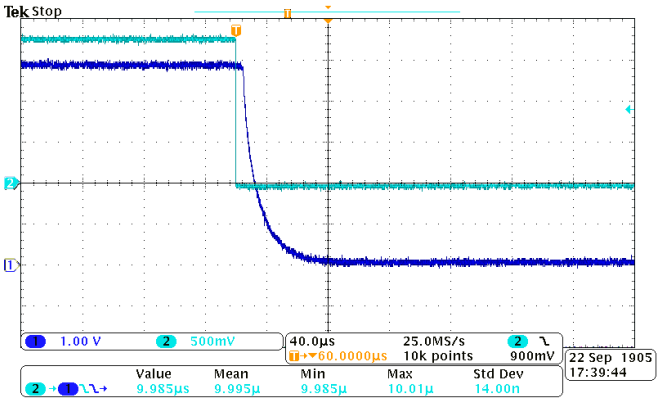


Figure 21.

TYPICAL CHARACTERISTICS (continued)

TURN-ON RESPONSE TIME

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

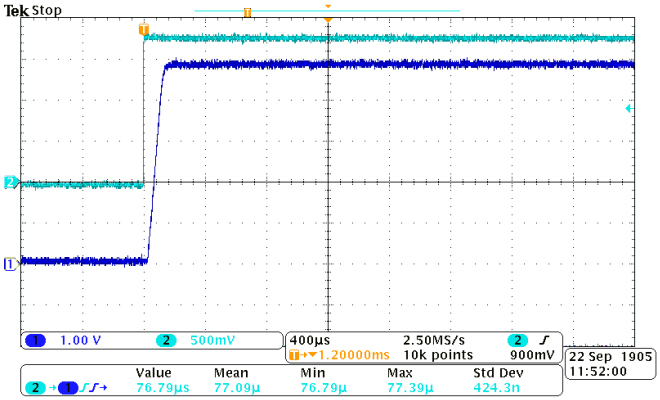


Figure 22.

TURN-OFF RESPONSE TIME

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

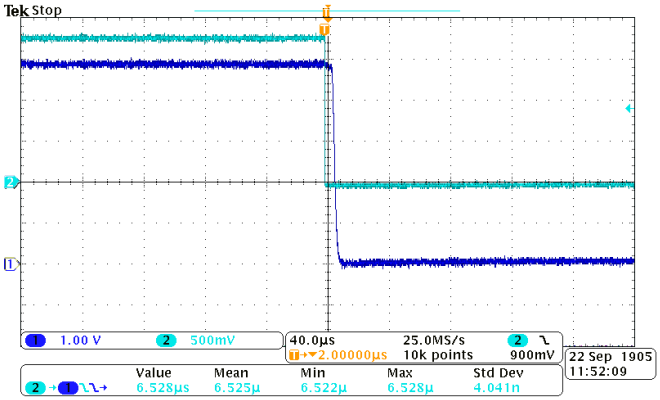


Figure 23.

TURN-Of RESPONSE TIME

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

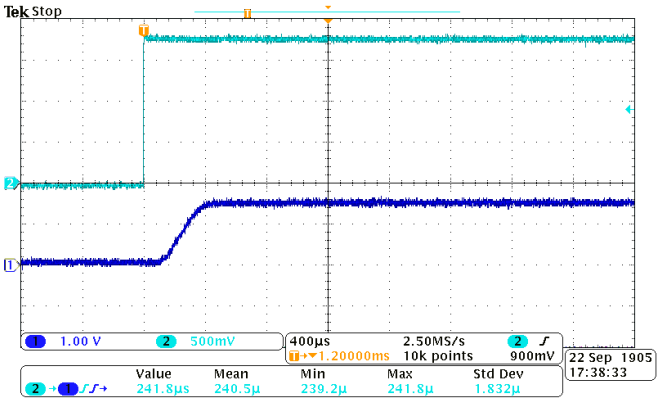


Figure 24.

TURN-Of RESPONSE TIME

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

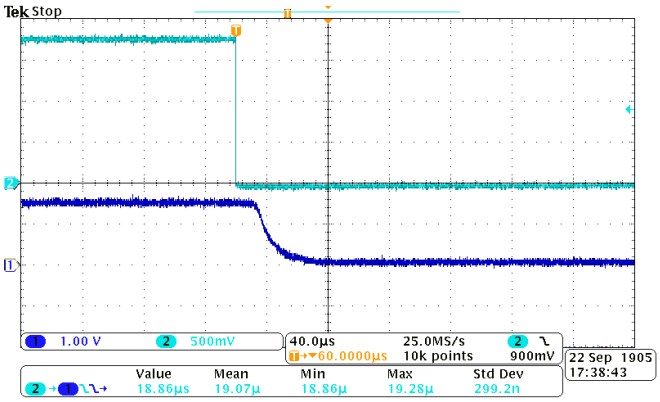


Figure 25.

TURN-Of RESPONSE TIME

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

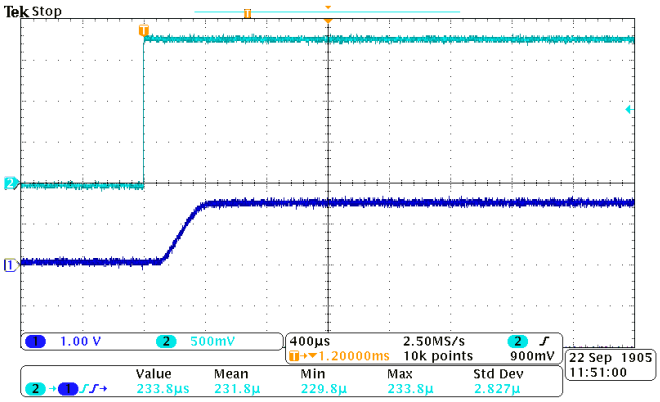


Figure 26.

TURN-Of RESPONSE TIME

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

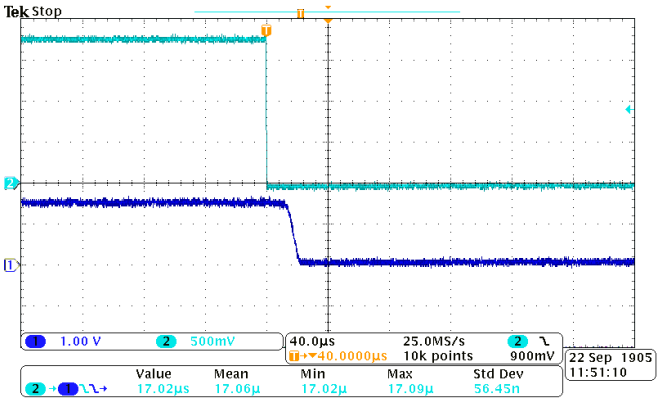


Figure 27.

TYPICAL CHARACTERISTICS (continued)

TYPICAL AC CHARACTERISTICS FOR TPS22913C

RISE TIME vs TEMPERATURE

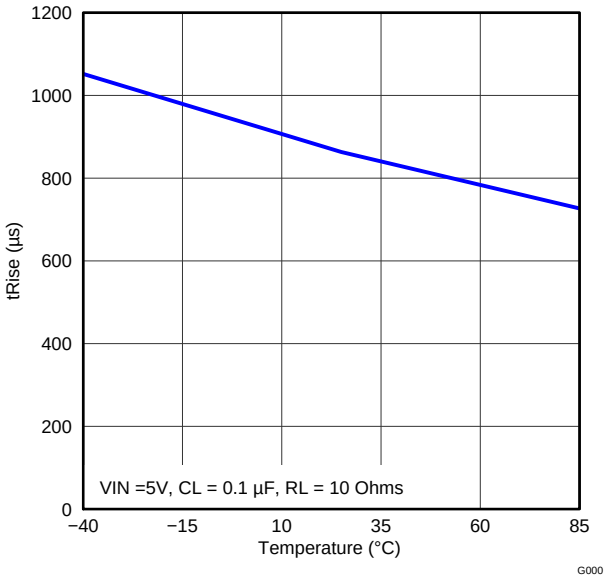


Figure 28.

FALL TIME vs TEMPERATURE

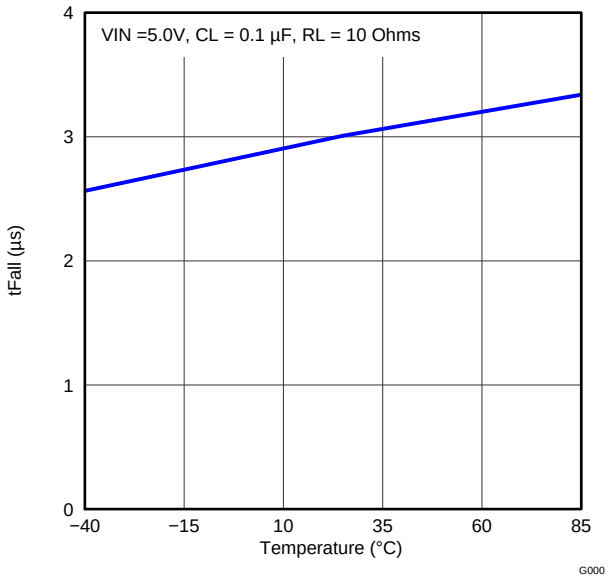


Figure 29.

RISE TIME vs TEMPERATURE

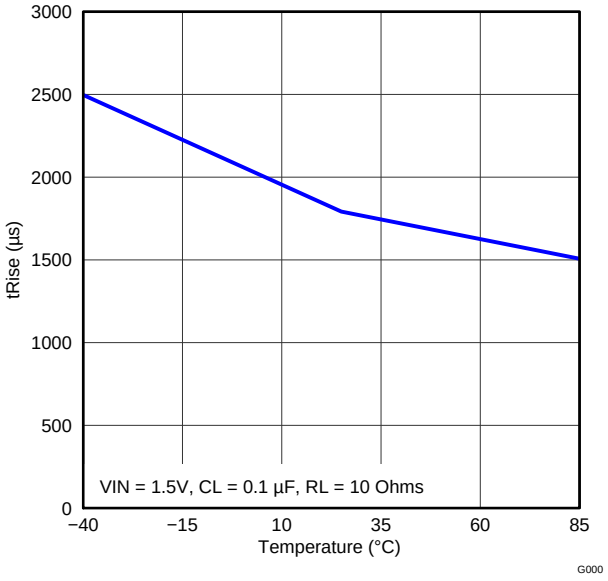


Figure 30.

FALL TIME vs TEMPERATURE

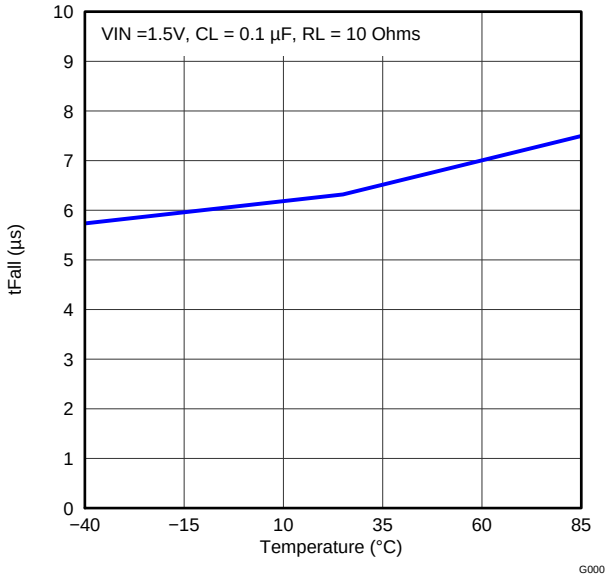


Figure 31.

TYPICAL CHARACTERISTICS (continued)

TURN-ON TIME vs TEMPERATURE

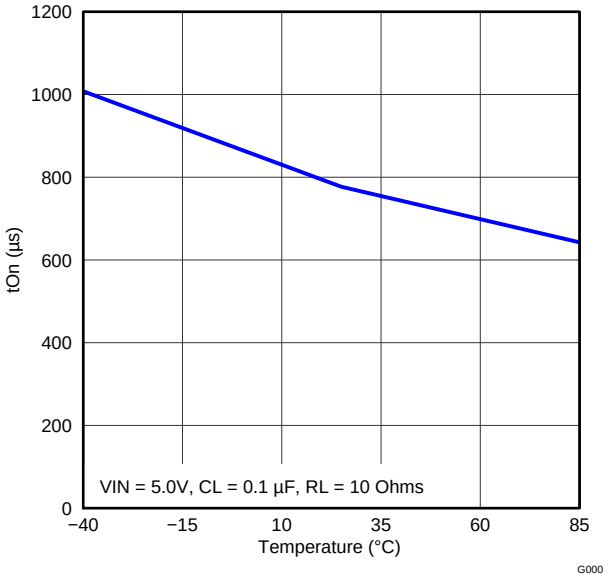


Figure 32.

TURN-OFF TIME vs TEMPERATURE

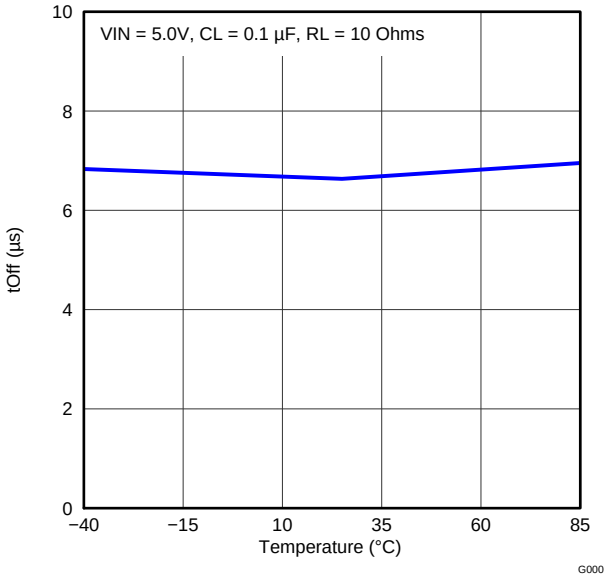


Figure 33.

TURN-ON TIME vs TEMPERATURE

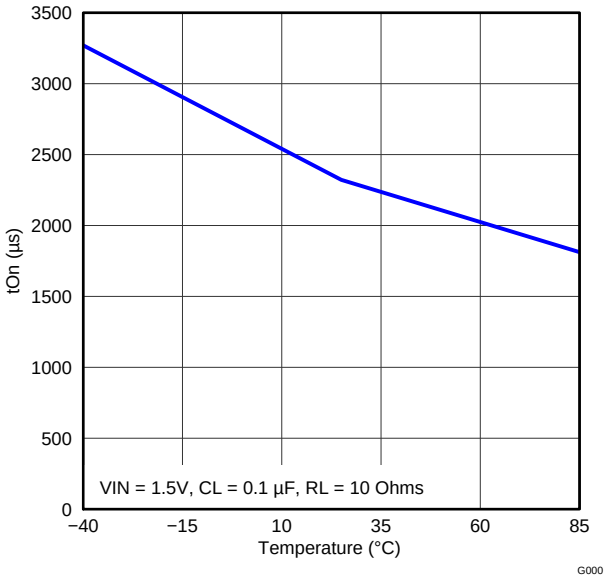


Figure 34.

TURN-OFF TIME vs TEMPERATURE

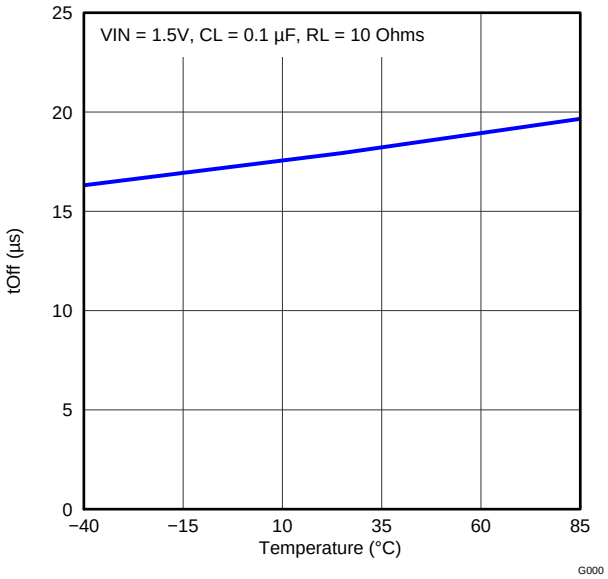


Figure 35.

TYPICAL CHARACTERISTICS (continued)

RISE TIME vs INPUT VOLTAGE

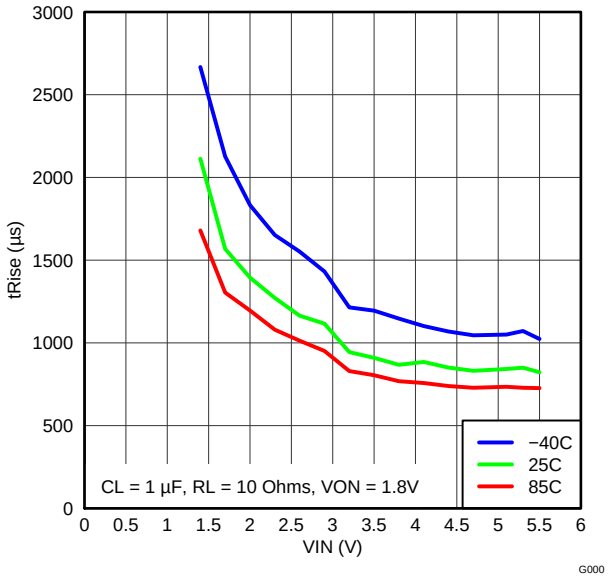


Figure 36.

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

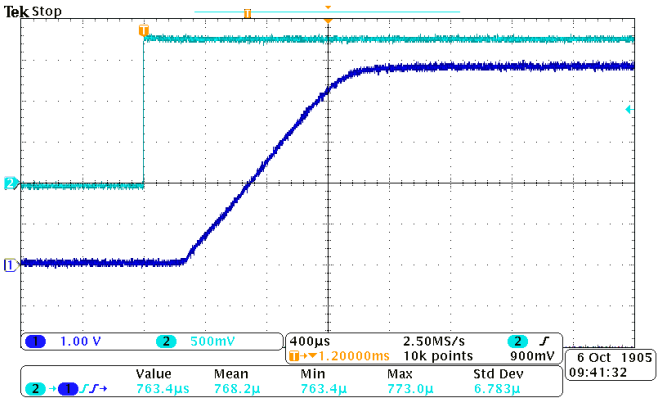


Figure 37.

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

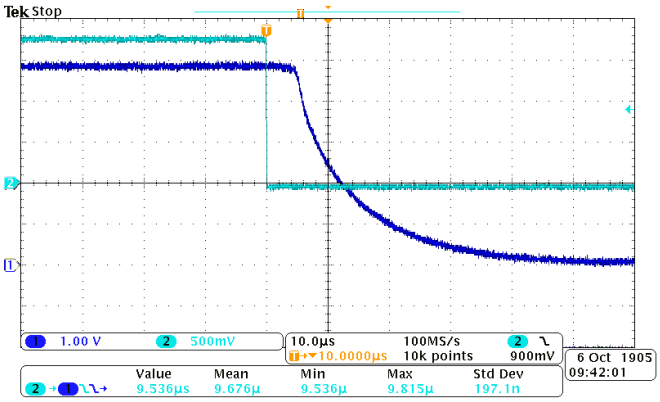


Figure 38.

TYPICAL CHARACTERISTICS (continued)

TURN-ON RESPONSE TIME

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

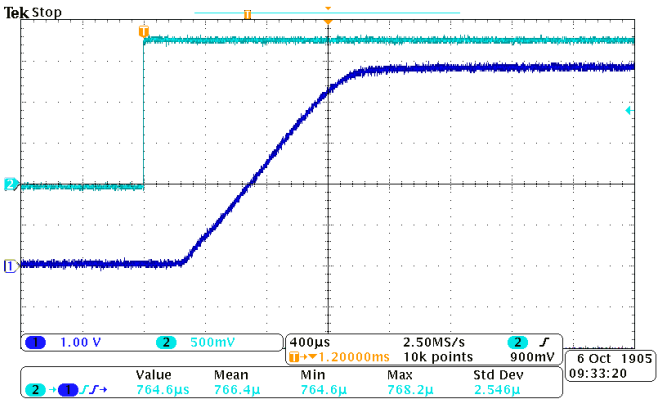


Figure 39.

TURN-OFF RESPONSE TIME

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

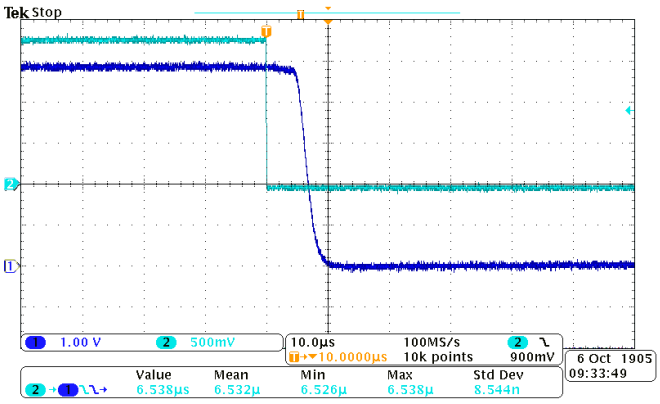


Figure 40.

TURN-Of RESPONSE TIME

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

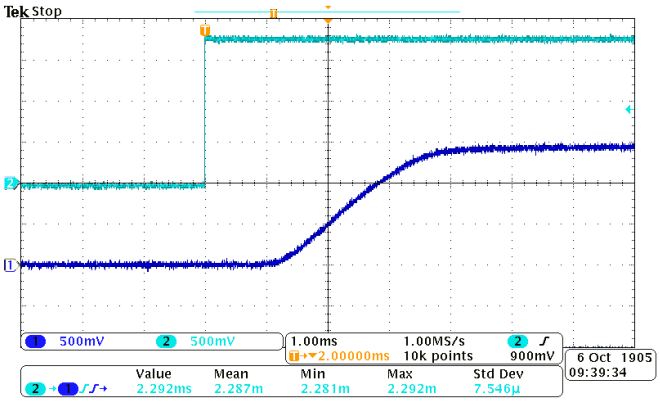


Figure 41.

TURN-Of RESPONSE TIME

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

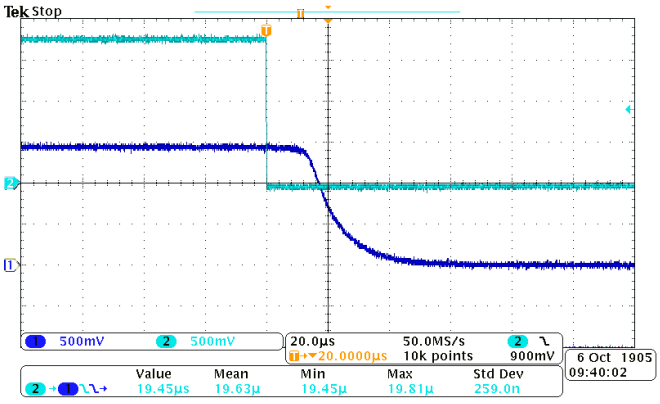


Figure 42.

TURN-Of RESPONSE TIME

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

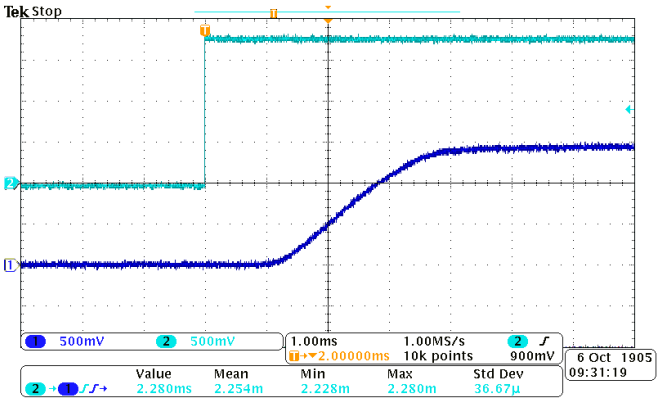


Figure 43.

TURN-Of RESPONSE TIME

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

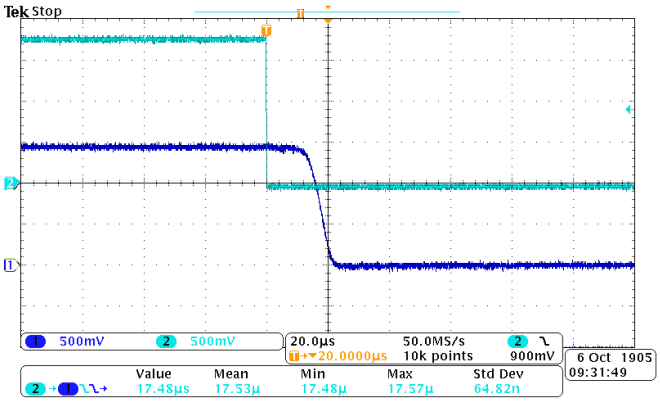


Figure 44.

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 1.8-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 VIN and GND. A 1-µF ceramic capacitor, CIN, placed close to the pins is usually sufficient. Higher values of CIN 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.

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.

Under-Voltage Lockout

The under-voltage lockout turns-off the switch if the input voltage drops below the under-voltage lockout threshold. With the ON pin active the input voltage rising above the under-voltage lockout threshold will cause a controlled turn-on of the switch which limits current over-shoots. During under-voltage lockout (UVLO), no reverse current can flow as the body diode is not engaged.

Reverse Current Protection

In a scenario where V_{OUT} is greater than V_{IN}, there could be reverse current through the body diode of the PMOS FET. The TPS22913 monitors the current through the FET and shuts off the FET when a reverse current is detected. The FET, and the output, resumes normal operation when the reverse current scenario is no longer present. When the reverse current protection (RCP) is active, no reverse current can flow as the body diode is not engaged. During under-voltage lockout (UVLO), or when the switch is disabled, no reverse current can flow as the body diode is not engaged.

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.

PACKAGING INFORMATION

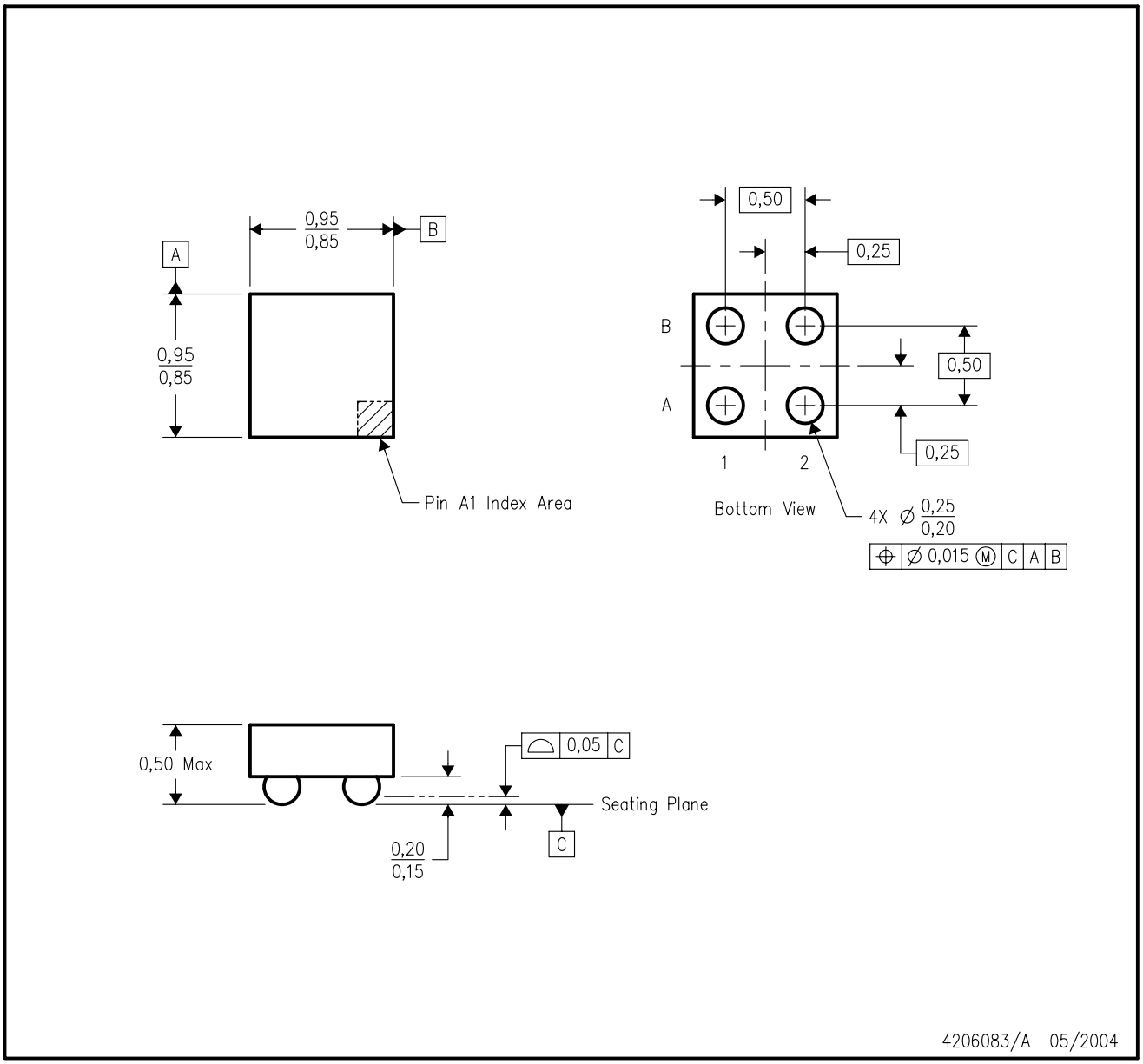
Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/ Ball Finish	MSL Peak Temp (3)	Samples (Requires Login)
TPS22913BYZVR	ACTIVE	DSBGA	YZV	4	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	
TPS22913BYZVT	ACTIVE	DSBGA	YZV	4	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	
TPS22913CYZVR	ACTIVE	DSBGA	YZV	4	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	
TPS22913CYZVT	PREVIEW	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.

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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