

Ultra-Small, Low on Resistance Load Switch with Controlled Turn-on

Check for Samples: [TPS22913](#)

FEATURES

- Integrated Single Load Switch
- Ultra Small CSP-4 Package 0.9mm × 0.9mm, 0.5mm Pitch
- Input Voltage Range: 1.4-V to 5.5-V
- Low ON-Resistance
 - $r_{ON} = 60\text{-m}\Omega$ at $V_{IN} = 5\text{-V}$
 - $r_{ON} = 61\text{-m}\Omega$ at $V_{IN} = 3.3\text{-V}$
 - $r_{ON} = 74\text{-m}\Omega$ at $V_{IN} = 1.8\text{-V}$
 - $r_{ON} = 84\text{-m}\Omega$ at $V_{IN} = 1.5\text{-V}$
- 2-A Maximum Continuous Switch Current
- Low Threshold Control Input
- Controlled Slew-rate Options
- Under-Voltage Lock Out
- Quick Output Discharge Transistor
- Reverse Current Protection

APPLICATIONS

- Portable Industrial Equipment
- Portable Medical Equipment
- Portable Media Players
- Point Of Sales Terminal
- GPS Devices
- Digital Cameras
- Portable Instrumentation
- Smartphones

DESCRIPTION

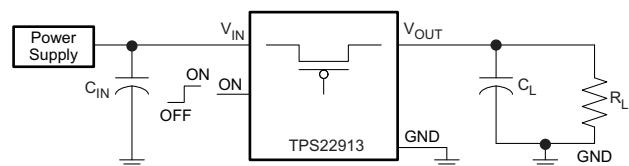
The TPS22913 is a small, low r_{ON} load switch with controlled turn on. The device contains a P-channel MOSFET that can operate over an input voltage range of 1.4 V to 5.5 V. The switch is controlled by an on/off input (ON), which is capable of interfacing directly with low-voltage control signals. The TPS22913 is active high enable.

The TPS22913 contains a 150- Ω on-chip load resistor for quick output discharge when the switch is turned off. The rise time of the device is internally controlled in order to avoid inrush current. The TPS22913 family has various slew rate options (see [Table 1](#)).

The TPS22913 device provides circuit breaker functionality by latching off the power-switch during reverse voltage situations. An internal reverse voltage comparator disables the power-switch when the output voltage is driven higher than the input (V_{IN}) to quickly (10 μ s typ) stop the flow of current towards the input side of the switch. The reverse current protection is active when the power switch is enabled (ON). Additionally, during under-voltage lockout (UVLO), or when the switch is disabled, no reverse current can flow as the switch body diode is not engaged.

The TPS22913 is available in an ultra-small, space-saving 4-pin CSP package and is characterized for operation over the free-air temperature range of -40°C to 85°C .

TYPICAL APPLICATION



Please be aware that an important notice concerning availability, standard warranty, and use in critical applications of Texas Instruments semiconductor products and disclaimers thereto appears at the end of this data sheet.

TPS22913

SLVSB20 – SEPTEMBER 2011

www.ti.com



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.

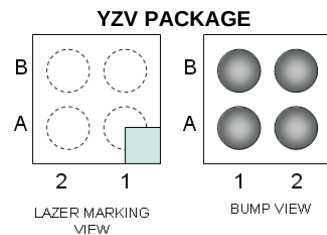
ORDERING INFORMATION

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	TPS22913CZVR	____ 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



TERMINALS ASSIGNMENTS

B	ON	GND
A	V _{IN}	V _{OUT}
	2	1

PIN FUNCTIONS

TPS22913	PIN NAME	DESCRIPTION
YZV		
B1	GND	Ground
B2	ON	Switch control input, active high. Do not leave floating
A1	V _{OUT}	Switch output
A2	V _{IN}	Switch input, bypass this input with a ceramic capacitor to ground

BLOCK DIAGRAM

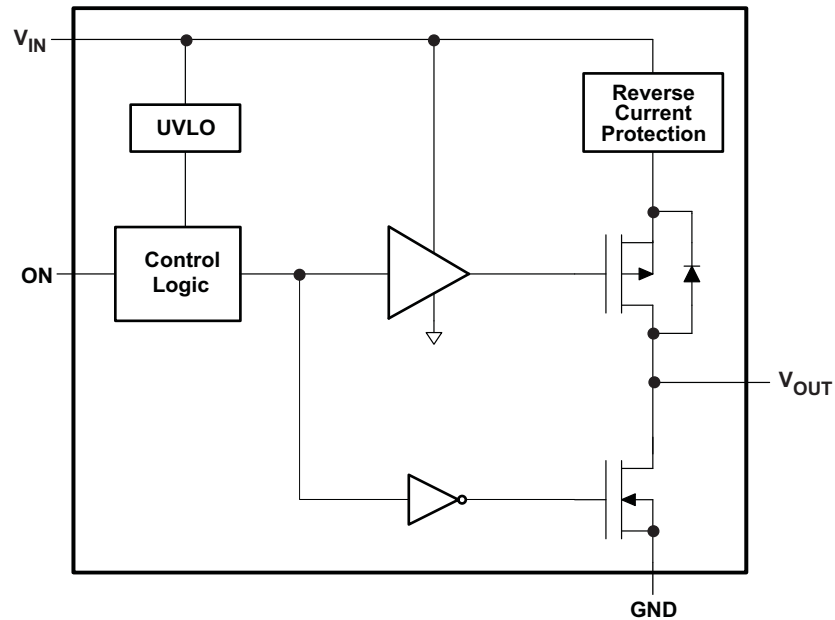


Table 2. FUNCTION TABLE

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	V _{IN} + 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
		Charged-Device Model (CDM) (VIN, VOUT, ON, GND pins)	1000

TPS22913

SLVSB20 – SEPTEMBER 2011

www.ti.com

THERMAL INFORMATION

THERMAL METRIC ⁽¹⁾		TPS22913	UNITS
		CSP	
		(4) PINS	
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_{JCbott}	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			V_{IN}	
V_{IH}	High-level input voltage, ON	$V_{IN} = 3.61\text{ V to }5.5\text{ V}$	1.1	5.5	V
		$V_{IN} = 1.4\text{ V to }3.6\text{ V}$	1.1	5.5	V
V_{IL}	Low-level input voltage, ON	$V_{IN} = 3.61\text{ V to }5.5\text{ V}$		0.6	V
		$V_{IN} = 1.4\text{ V to }3.6\text{ V}$		0.4	V
C_{IN}	Input Capacitor		1 ⁽¹⁾		μF

(1) Refer to the application section.

ELECTRICAL CHARACTERISTICS

V_{IN} = 1.4 V to 5.5 V, T_A = –40°C to 85°C (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

TPS22913

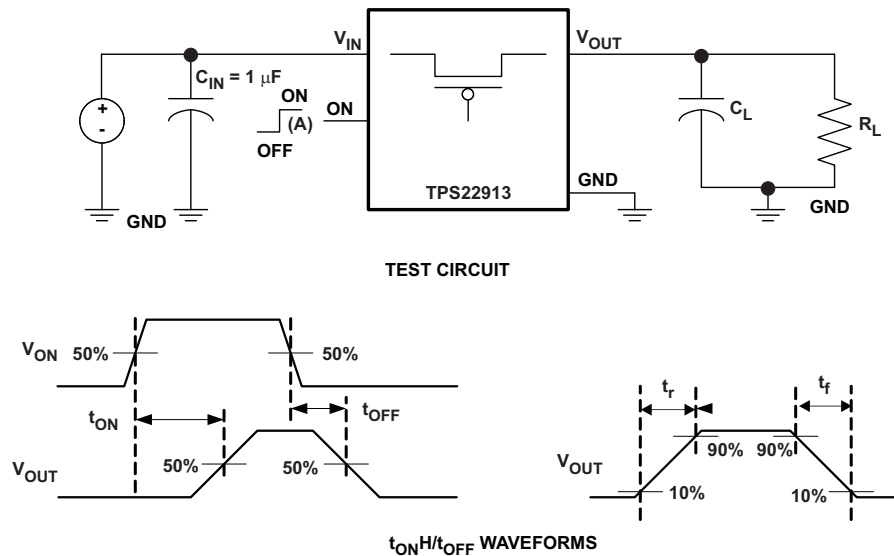
SLVSB20 – SEPTEMBER 2011

www.ti.com

SWITCHING CHARACTERISTICS

PARAMETER		TEST CONDITION	TPS22913 B	TPS22913 C	UNIT
			TYP	TYP	
VIN = 5 V, TA = 25°C (unless otherwise noted)					
tON	Turn-ON time	RL = 10 Ω, CL = 0.1 μF	76	770	μs
tOFF	Turn-OFF time	RL = 10 Ω, CL = 0.1 μF	6.6	6.6	
tR	VOUT rise time	RL = 10 Ω, CL = 0.1 μF	82	838	
tF	VOUT fall time	RL = 10 Ω, CL = 0.1 μF	3	3	
VIN = 3.3 V, TA = 25°C (unless otherwise noted)					
tON	Turn-ON time	RL = 10 Ω, CL = 0.1 μF	102	1048	μs
tOFF	Turn-OFF time	RL = 10 Ω, CL = 0.1 μF	8.5	8.6	
tR	VOUT rise time	RL = 10 Ω, CL = 0.1 μF	97	980	
tF	VOUT fall time	RL = 10 Ω, CL = 0.1 μF	3	3	
VIN = 1.5 V, TA = 25°C (unless otherwise noted)					
tON	Turn-ON time	RL = 10 Ω, CL = 0.1 μF	234	2344	μs
tOFF	Turn-OFF time	RL = 10 Ω, CL = 0.1 μF	17	18	
tR	VOUT rise time	RL = 10 Ω, CL = 0.1 μF	244	1823	
tF	VOUT fall time	RL = 10 Ω, CL = 0.1 μF	6.5	6.5	

PARAMETRIC MEASUREMENT INFORMATION



(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

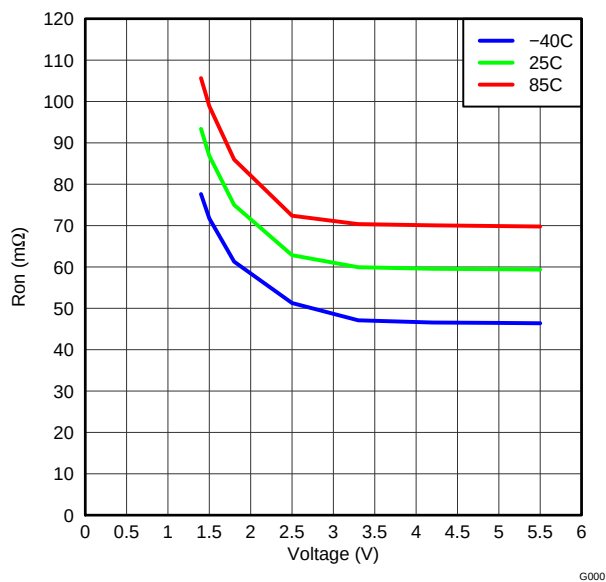


Figure 2.

ON INPUT THRESHOLD

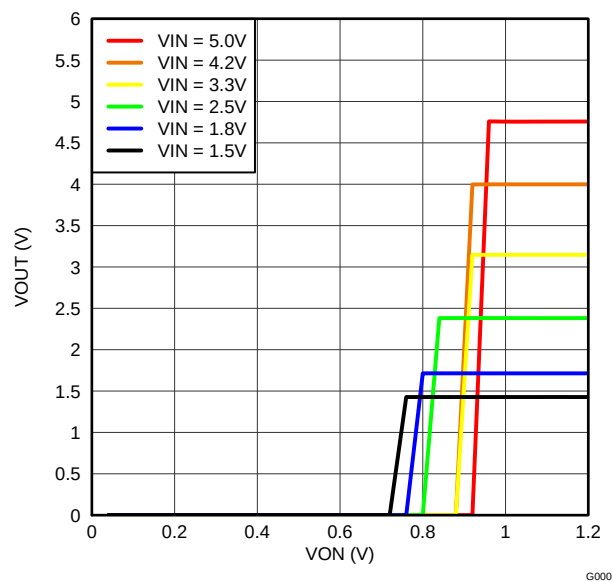


Figure 3.

INPUT CURRENT, QUIESCENT
vs
INPUT VOLTAGE

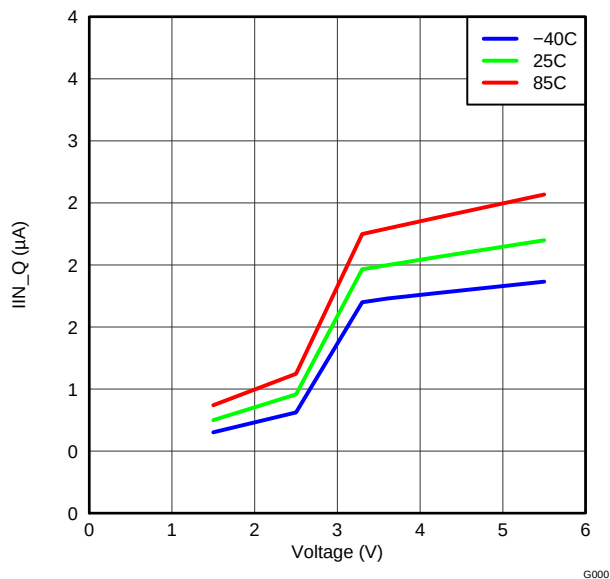


Figure 4.

INPUT CURRENT, LEAK
vs
INPUT VOLTAGE

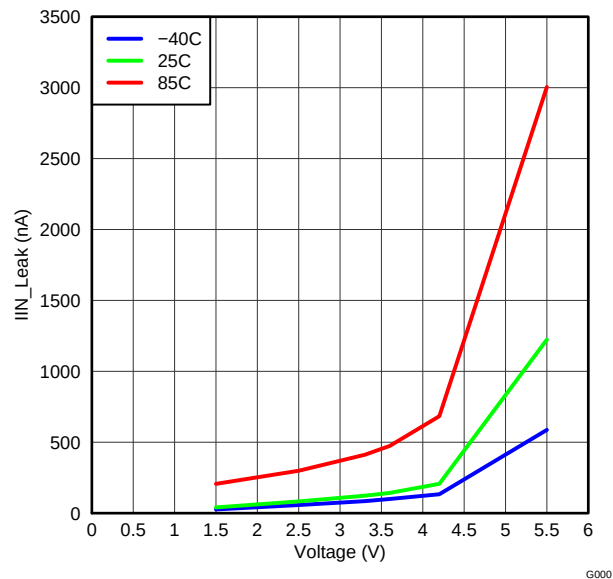


Figure 5.

TYPICAL CHARACTERISTICS (continued)

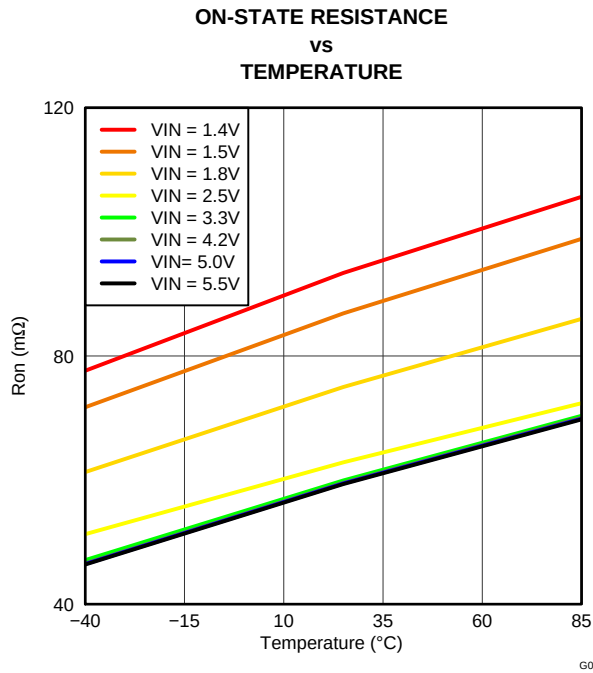


Figure 6.

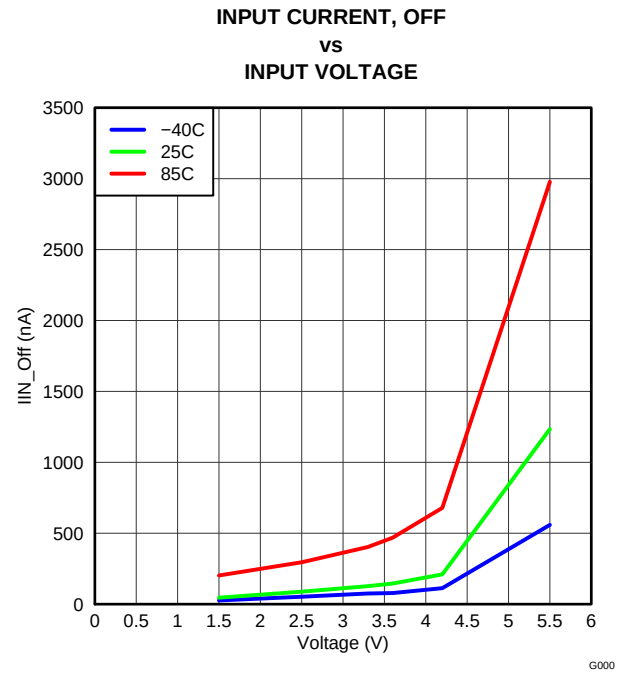


Figure 7.

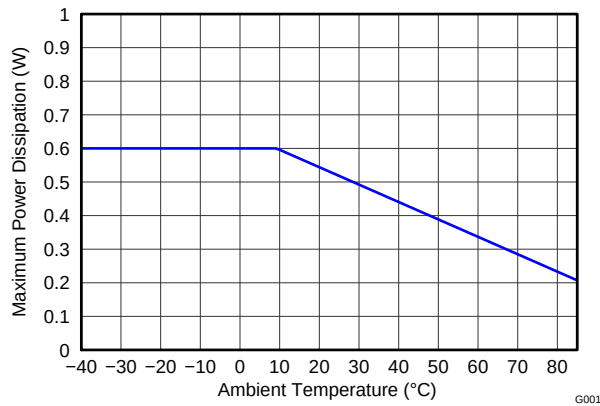


Figure 8. Allowable Power Dissipation

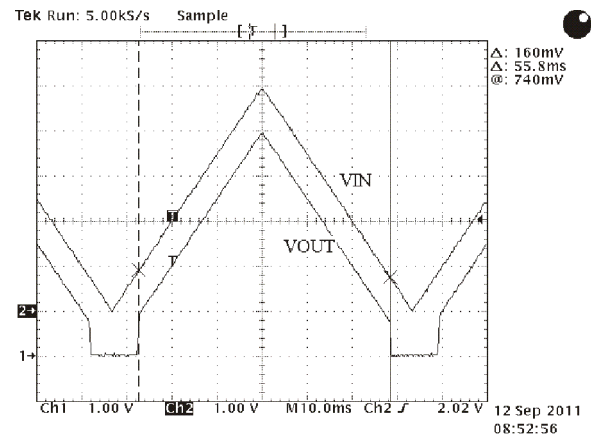


Figure 9. ULVO Response $I_{OUT} = -100\text{mA}$

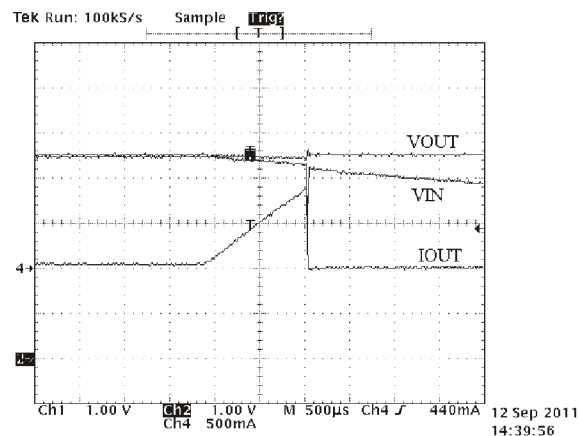


Figure 10. Reverse Current Protection $V_{OUT} = 3.3\text{V}$, $V_{IN} = 3.3\text{V}$ Decreasing to 0V

TYPICAL CHARACTERISTICS (continued) **TYPICAL AC CHARACTERISTICS FOR TPS22913B**

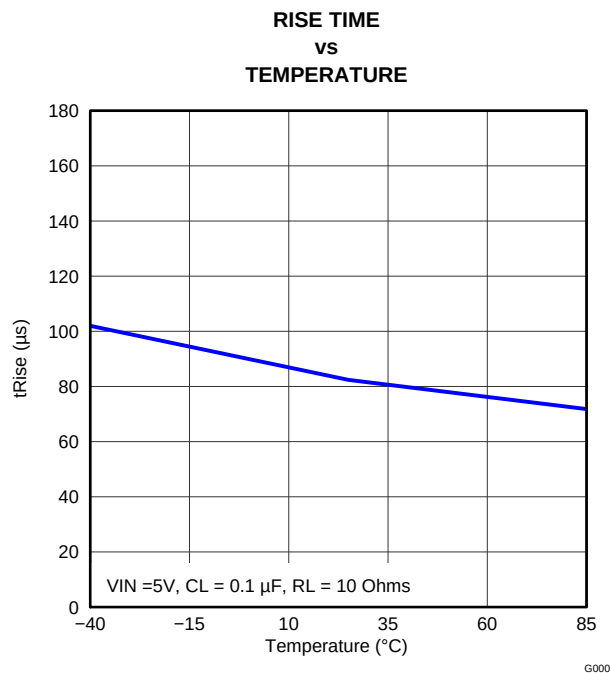


Figure 11.

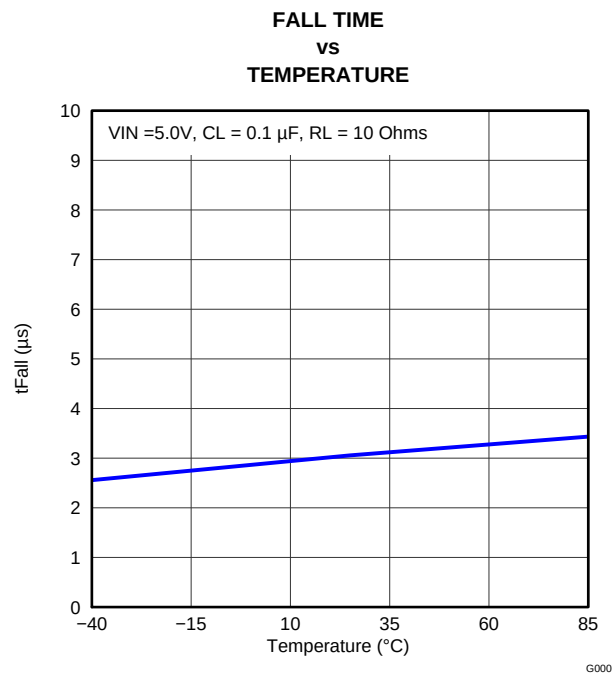


Figure 12.

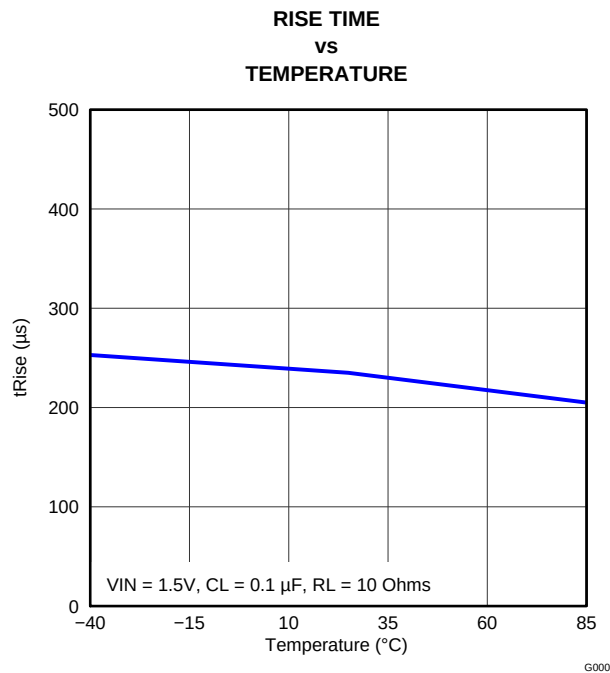


Figure 13.

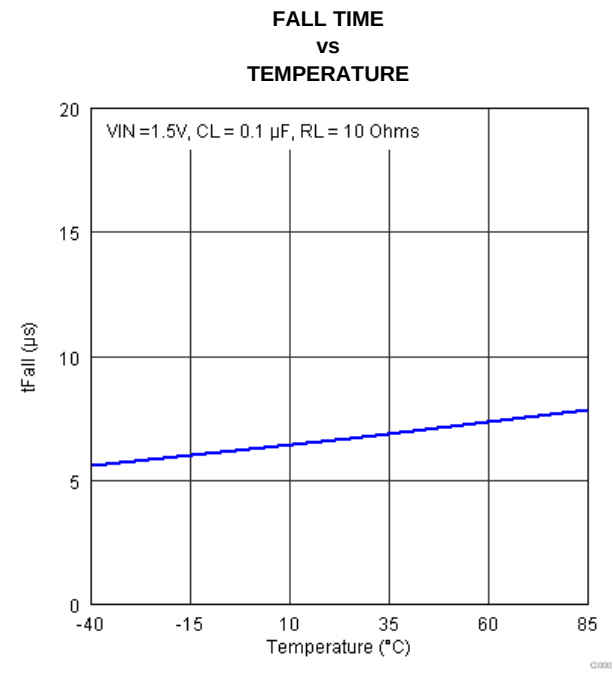
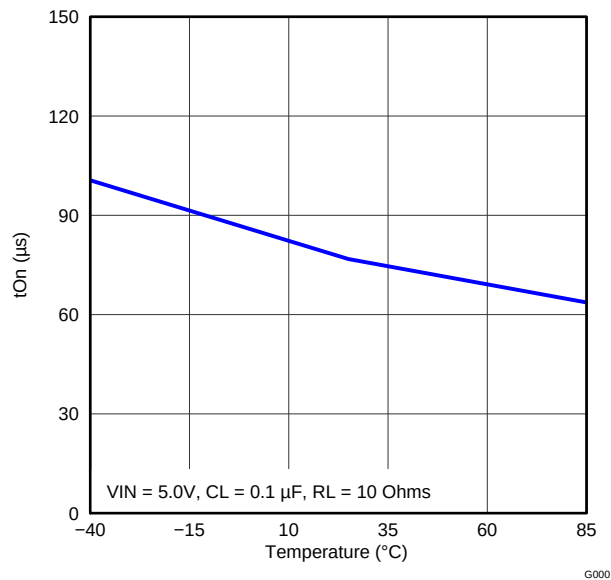
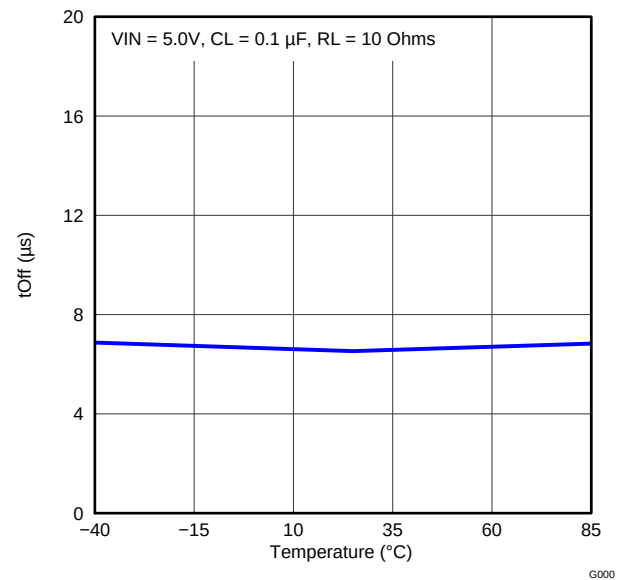
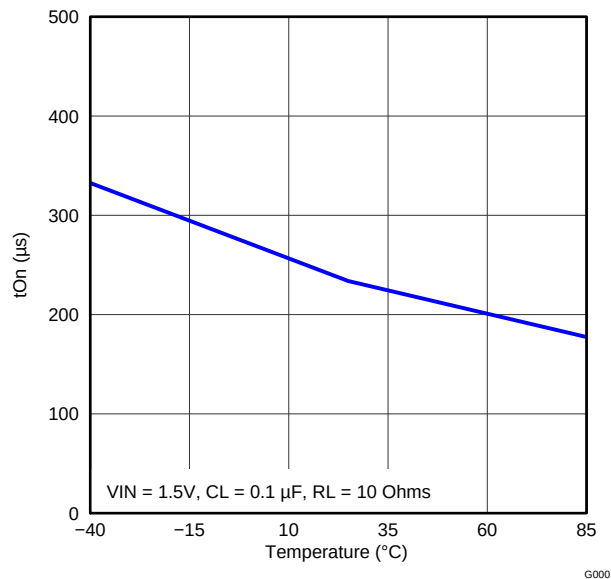
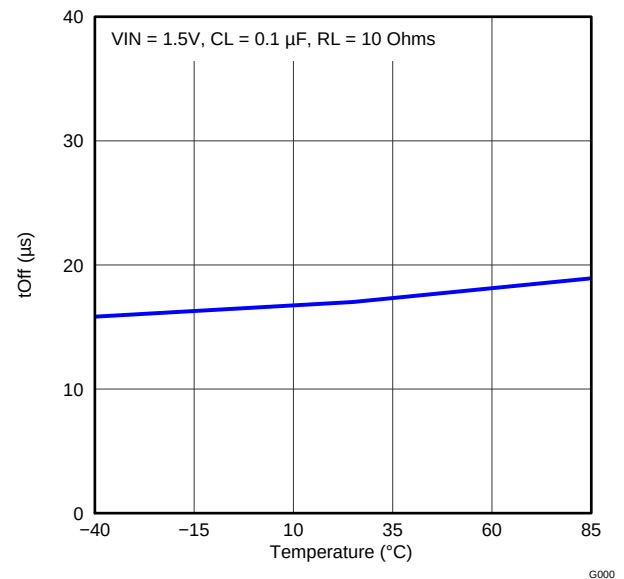


Figure 14.

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)

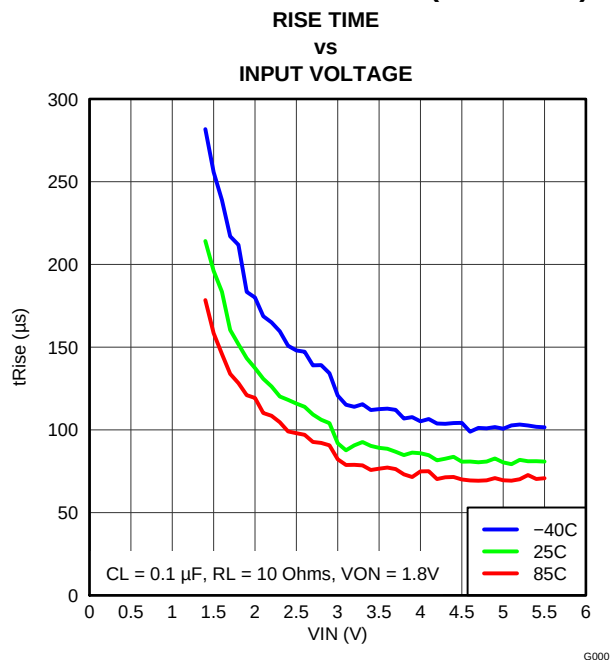


Figure 19.

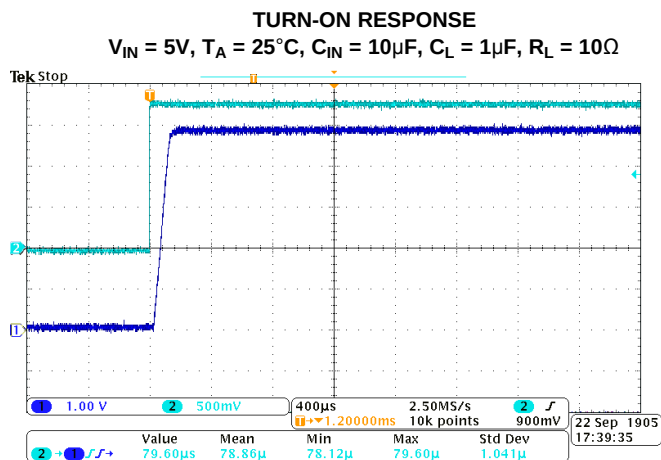


Figure 20.

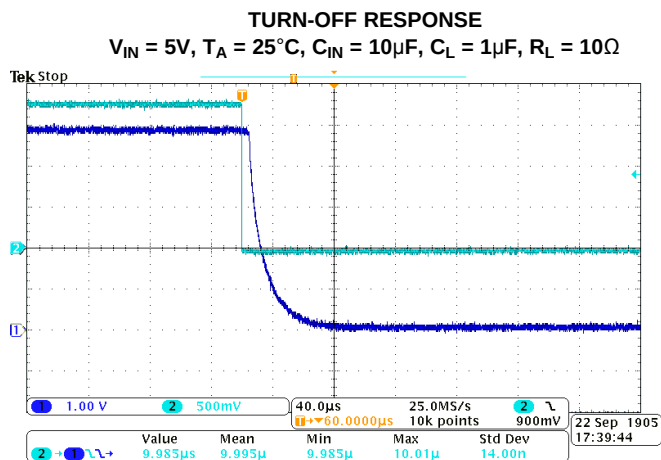


Figure 21.

TYPICAL CHARACTERISTICS (continued)

TURN-ON RESPONSE TIME

$V_{IN} = 5V$, $T_A = 25^\circ C$, $C_{IN} = 1\mu F$, $C_L = 0.1\mu F$, $R_L = 10\Omega$

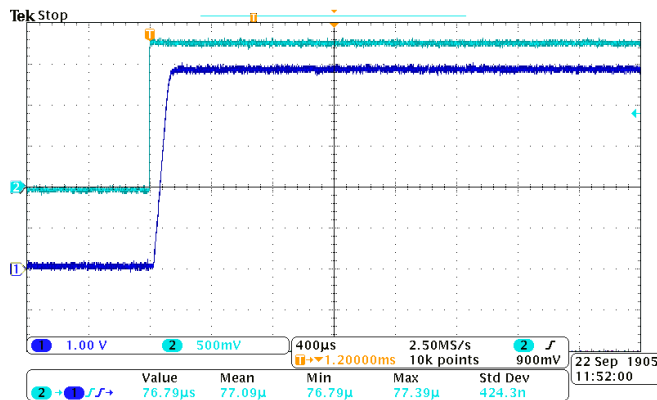


Figure 22.

TURN-OFF RESPONSE TIME

$V_{IN} = 5V$, $T_A = 25^\circ C$, $C_{IN} = 1\mu F$, $C_L = 0.1\mu F$, $R_L = 10\Omega$

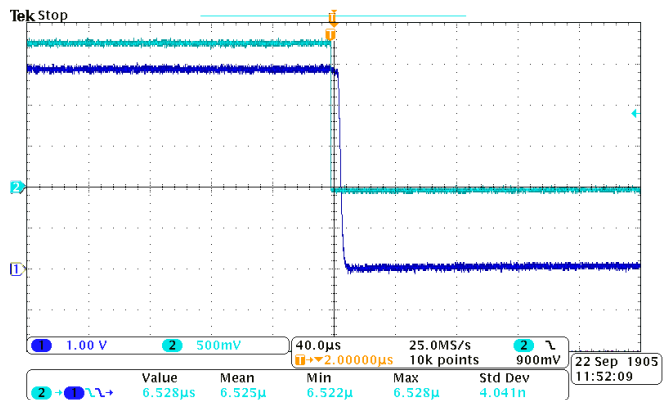


Figure 23.

TURN-Of RESPONSE TIME

$V_{IN} = 1.5V$, $T_A = 25^\circ C$, $C_{IN} = 10\mu F$, $C_L = 1\mu F$, $R_L = 10\Omega$

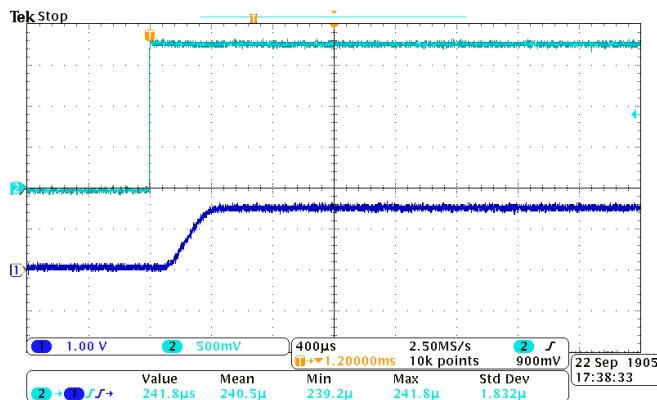


Figure 24.

TURN-Of RESPONSE TIME

$V_{IN} = 1.5V$, $T_A = 25^\circ C$, $C_{IN} = 10\mu F$, $C_L = 1\mu F$, $R_L = 10\Omega$

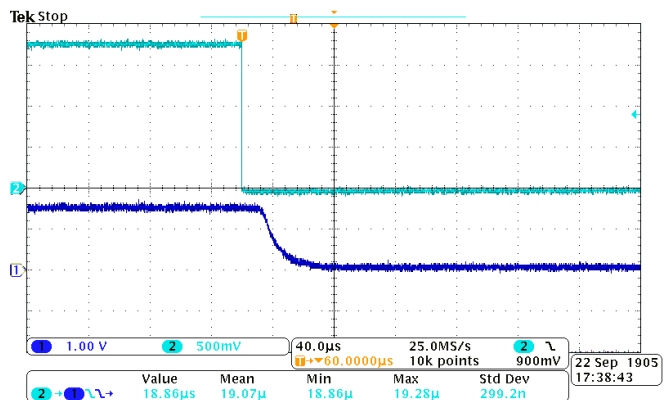


Figure 25.

TURN-Of RESPONSE TIME

$V_{IN} = 1.5V$, $T_A = 25^\circ C$, $C_{IN} = 1\mu F$, $C_L = 0.1\mu F$, $R_L = 10\Omega$

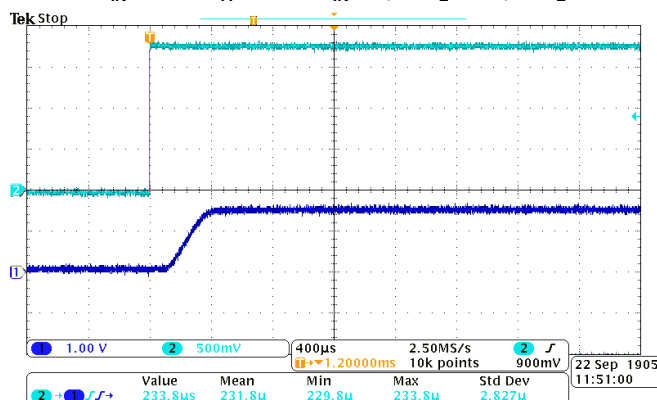


Figure 26.

TURN-Of RESPONSE TIME

$V_{IN} = 1.5V$, $T_A = 25^\circ C$, $C_{IN} = 1\mu F$, $C_L = 0.1\mu F$, $R_L = 10\Omega$

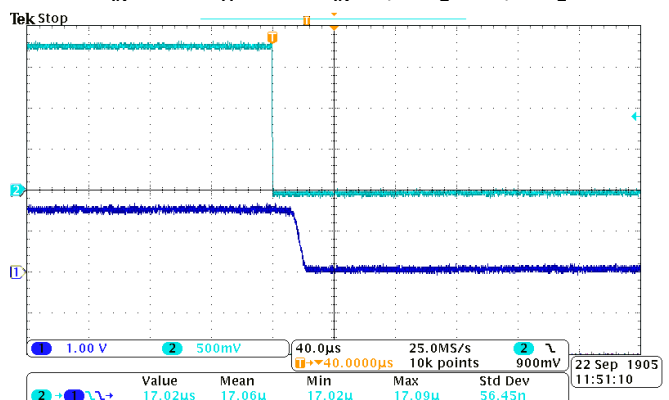


Figure 27.

TYPICAL CHARACTERISTICS (continued) TYPICAL AC CHARACTERISTICS FOR TPS22913C

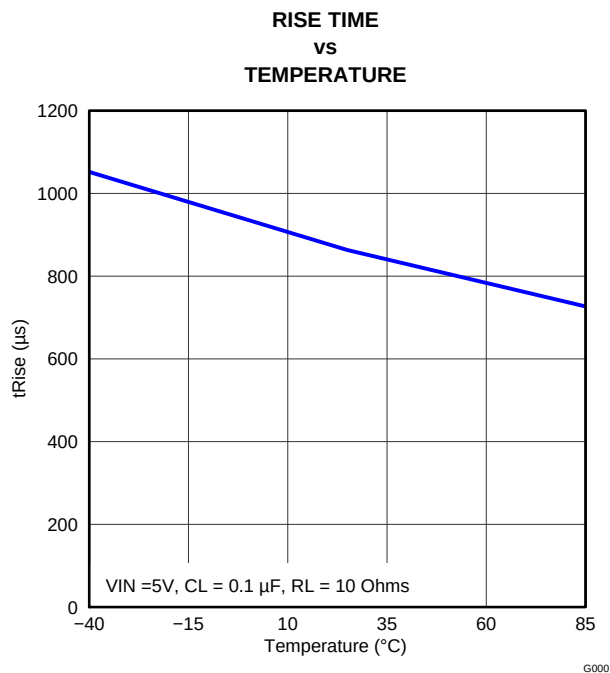


Figure 28.

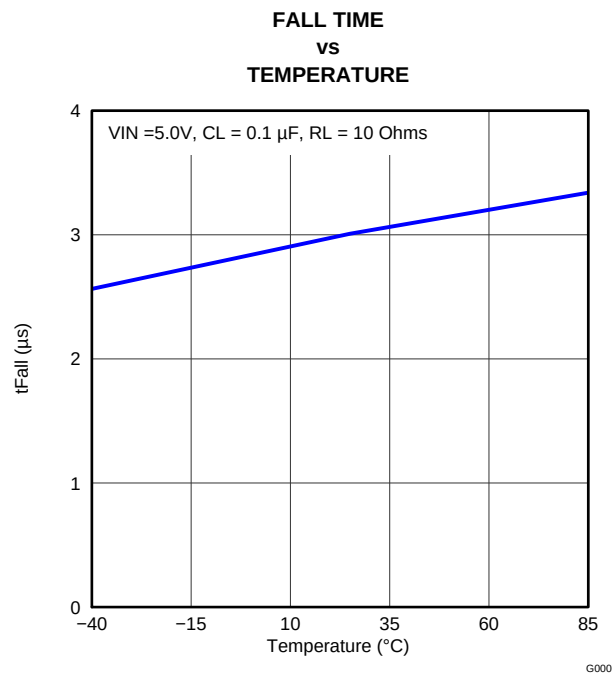


Figure 29.

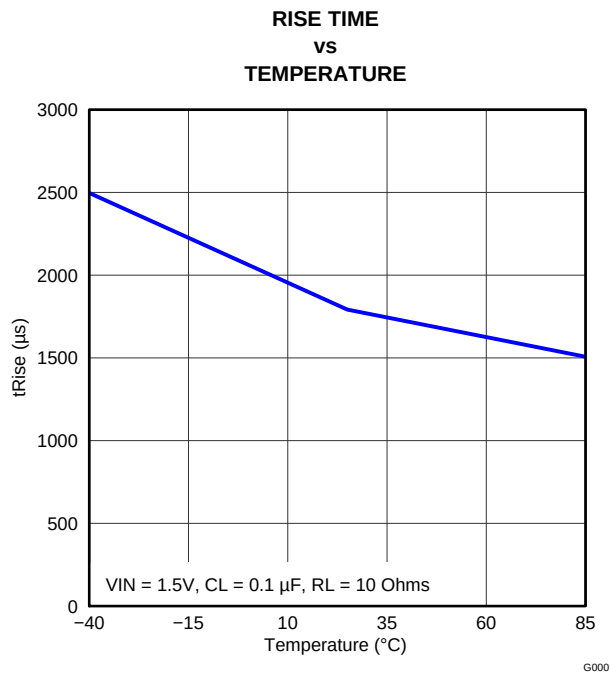


Figure 30.

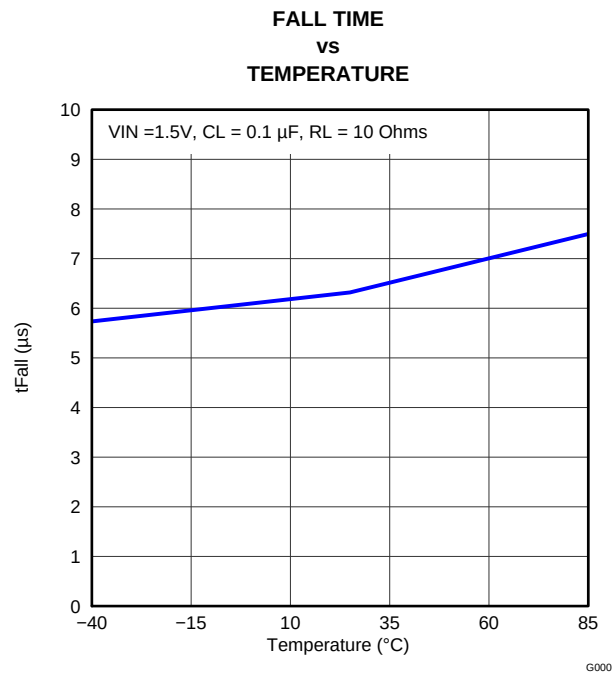


Figure 31.

TYPICAL CHARACTERISTICS (continued)

**TURN-ON TIME
vs
TEMPERATURE**

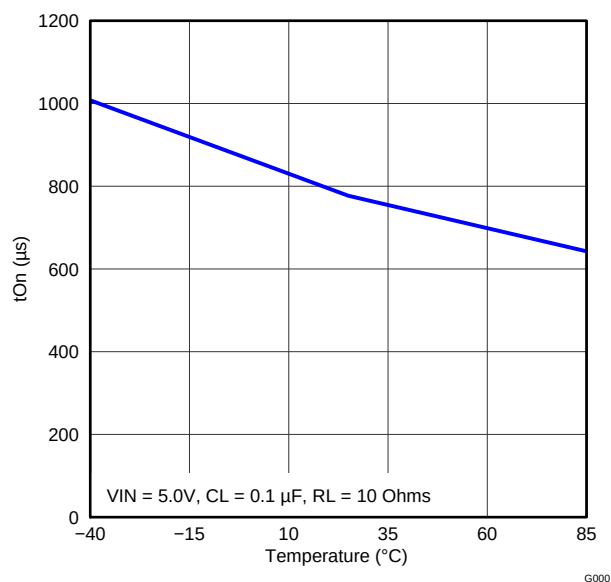


Figure 32.

**TURN-OFF TIME
vs
TEMPERATURE**

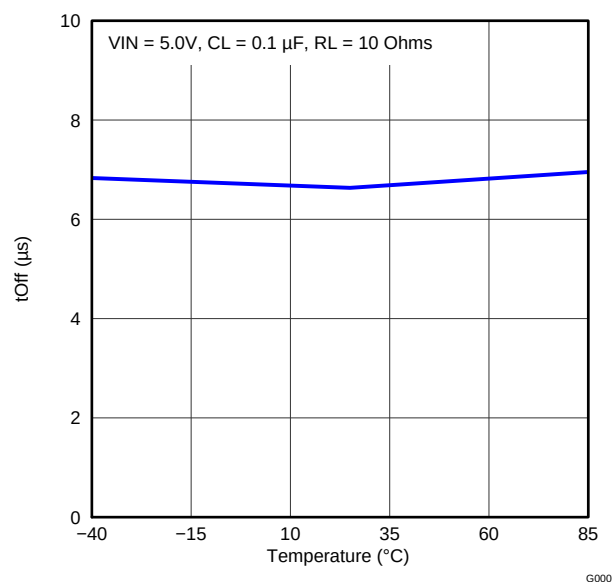


Figure 33.

**TURN-ON TIME
vs
TEMPERATURE**

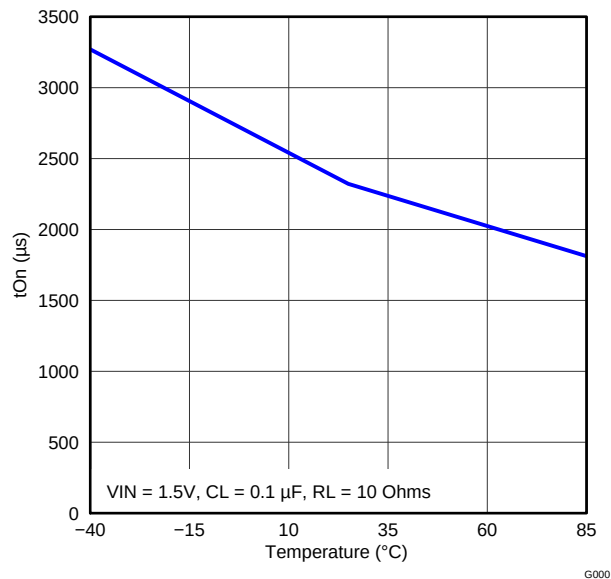


Figure 34.

**TURN-OFF TIME
vs
TEMPERATURE**

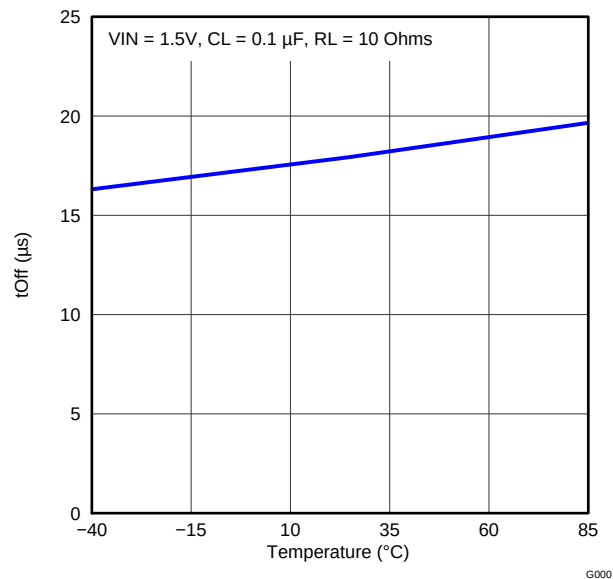


Figure 35.

TYPICAL CHARACTERISTICS (continued)

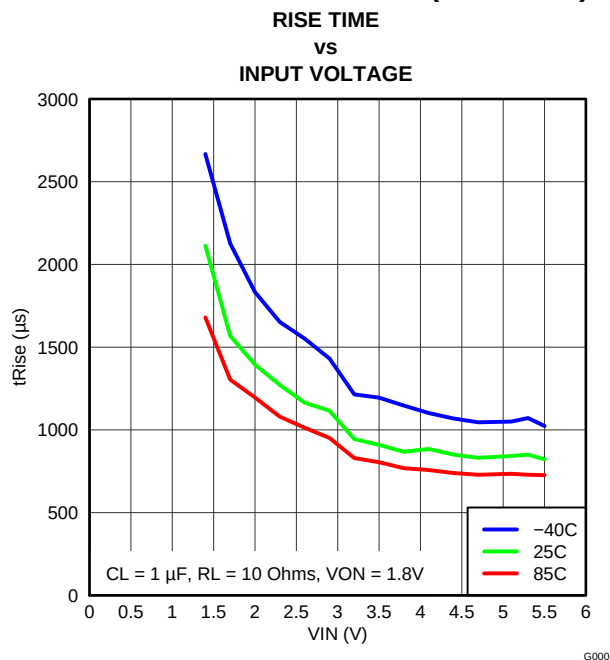


Figure 36.

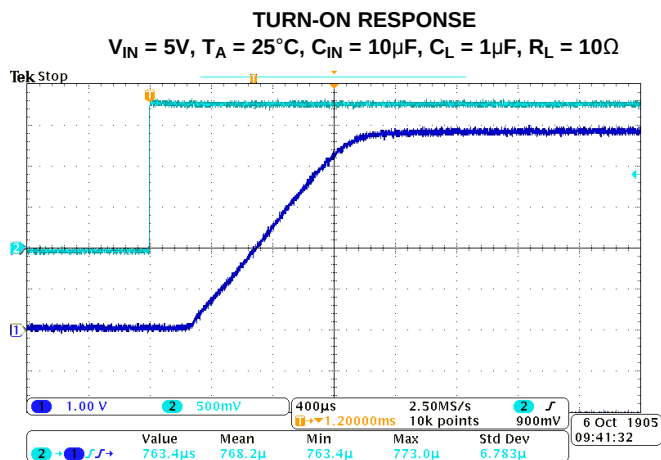


Figure 37.

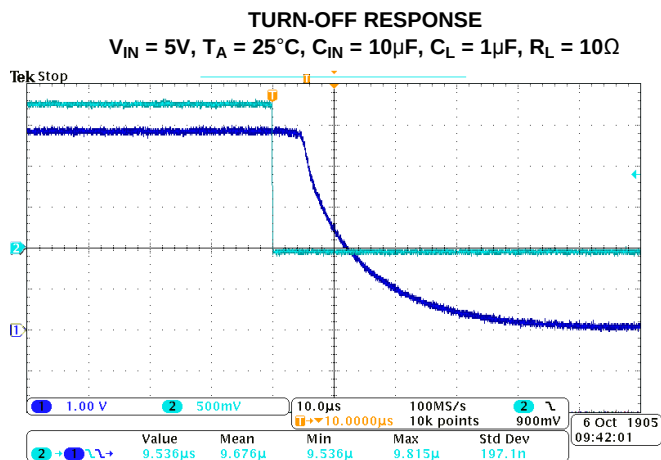


Figure 38.

TYPICAL CHARACTERISTICS (continued)

TURN-ON RESPONSE TIME

$V_{IN} = 5V$, $T_A = 25^\circ C$, $C_{IN} = 1\mu F$, $C_L = 0.1\mu F$, $R_L = 10\Omega$

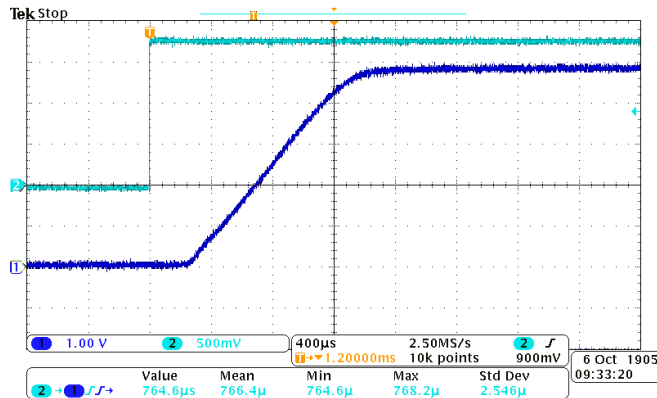


Figure 39.

TURN-OFF RESPONSE TIME

$V_{IN} = 5V$, $T_A = 25^\circ C$, $C_{IN} = 1\mu F$, $C_L = 0.1\mu F$, $R_L = 10\Omega$

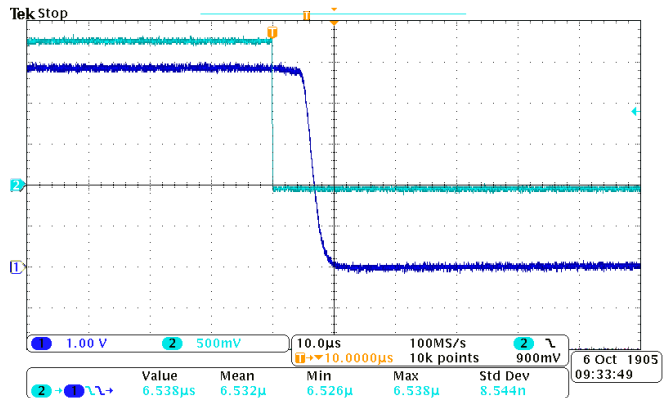


Figure 40.

TURN-Of RESPONSE TIME

$V_{IN} = 1.5V$, $T_A = 25^\circ C$, $C_{IN} = 10\mu F$, $C_L = 1\mu F$, $R_L = 10\Omega$

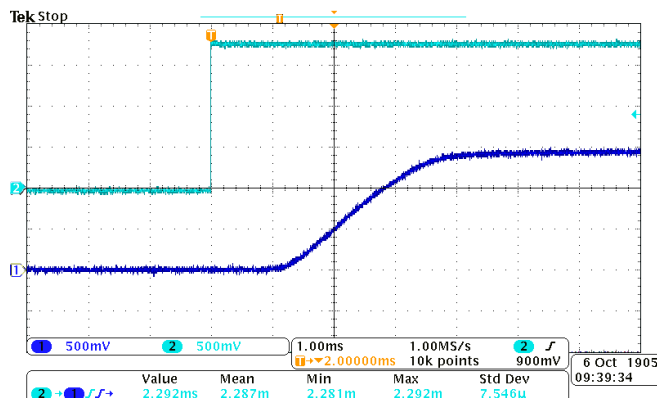


Figure 41.

TURN-Of RESPONSE TIME

$V_{IN} = 1.5V$, $T_A = 25^\circ C$, $C_{IN} = 10\mu F$, $C_L = 1\mu F$, $R_L = 10\Omega$

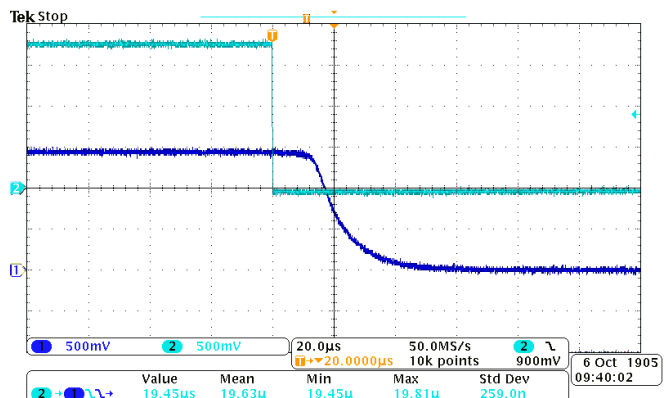


Figure 42.

TURN-Of RESPONSE TIME

$V_{IN} = 1.5V$, $T_A = 25^\circ C$, $C_{IN} = 1\mu F$, $C_L = 0.1\mu F$, $R_L = 10\Omega$

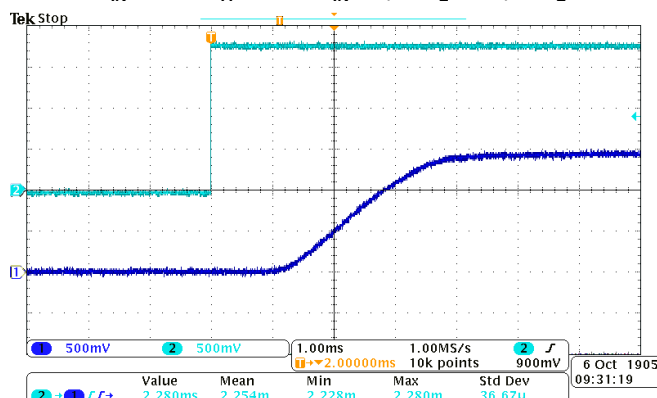


Figure 43.

TURN-Of RESPONSE TIME

$V_{IN} = 1.5V$, $T_A = 25^\circ C$, $C_{IN} = 1\mu F$, $C_L = 0.1\mu F$, $R_L = 10\Omega$

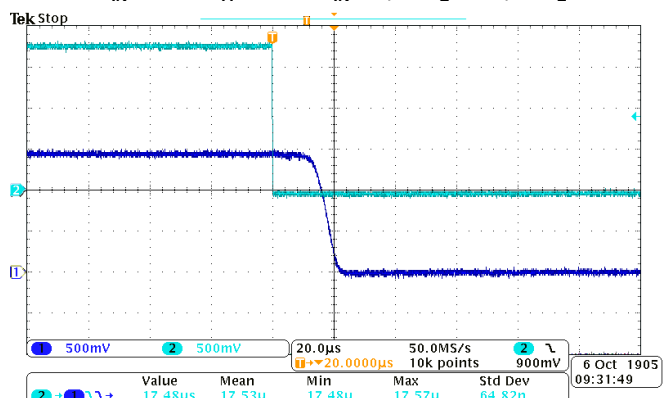


Figure 44.

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)	Op Temp (°C)	Top-Side Markings (4)	Samples
TPS22913BYZVR	ACTIVE	DSBGA	YZV	4	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	64	Samples
TPS22913BYZVT	ACTIVE	DSBGA	YZV	4	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	64	Samples
TPS22913CYZVR	ACTIVE	DSBGA	YZV	4	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	76	Samples
TPS22913CYZVT	ACTIVE	DSBGA	YZV	4	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	76	Samples

(1) The marketing status values are defined as follows:

ACTIVE: Product device recommended for new designs.

LIFEBUY: TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

NRND: Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

PREVIEW: Device has been announced but is not in production. Samples may or may not be available.

OBsolete: TI has discontinued the production of the device.

(2) 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.

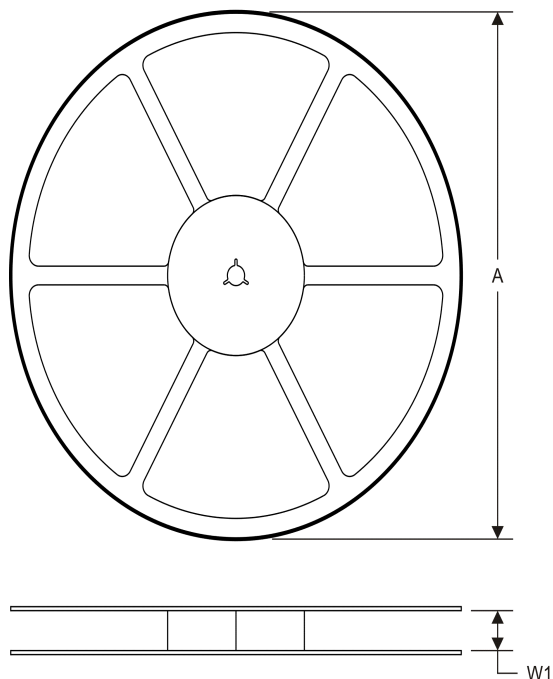
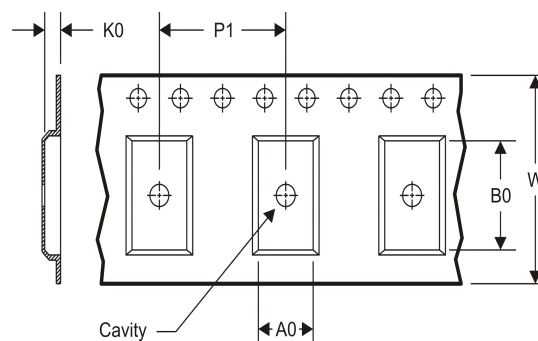
Green (RoHS & no Sb/Br): TI defines "Green" to mean Pb-Free (RoHS compatible), and free of Bromine (Br) and Antimony (Sb) based flame retardants (Br or Sb do not exceed 0.1% by weight in homogeneous material)

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

(4) Multiple Top-Side Markings will be inside parentheses. Only one Top-Side Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Top-Side 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.

TAPE AND REEL INFORMATION
REEL DIMENSIONS

TAPE DIMENSIONS


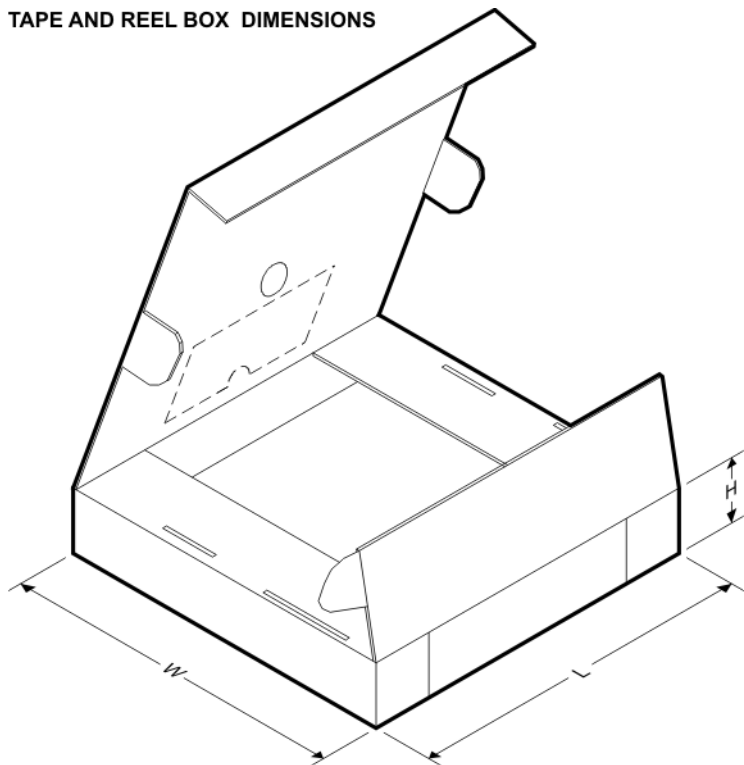
A0	Dimension designed to accommodate the component width
B0	Dimension designed to accommodate the component length
K0	Dimension designed to accommodate the component thickness
W	Overall width of the carrier tape
P1	Pitch between successive cavity centers

TAPE AND REEL INFORMATION

*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS22913BYZVR	DSBGA	YZV	4	3000	178.0	9.2	1.0	1.0	0.63	4.0	8.0	Q1
TPS22913BYZVT	DSBGA	YZV	4	250	178.0	9.2	1.0	1.0	0.63	4.0	8.0	Q1
TPS22913CYZVR	DSBGA	YZV	4	3000	178.0	9.2	1.0	1.0	0.63	4.0	8.0	Q1
TPS22913CYZVT	DSBGA	YZV	4	250	178.0	9.2	1.0	1.0	0.63	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS

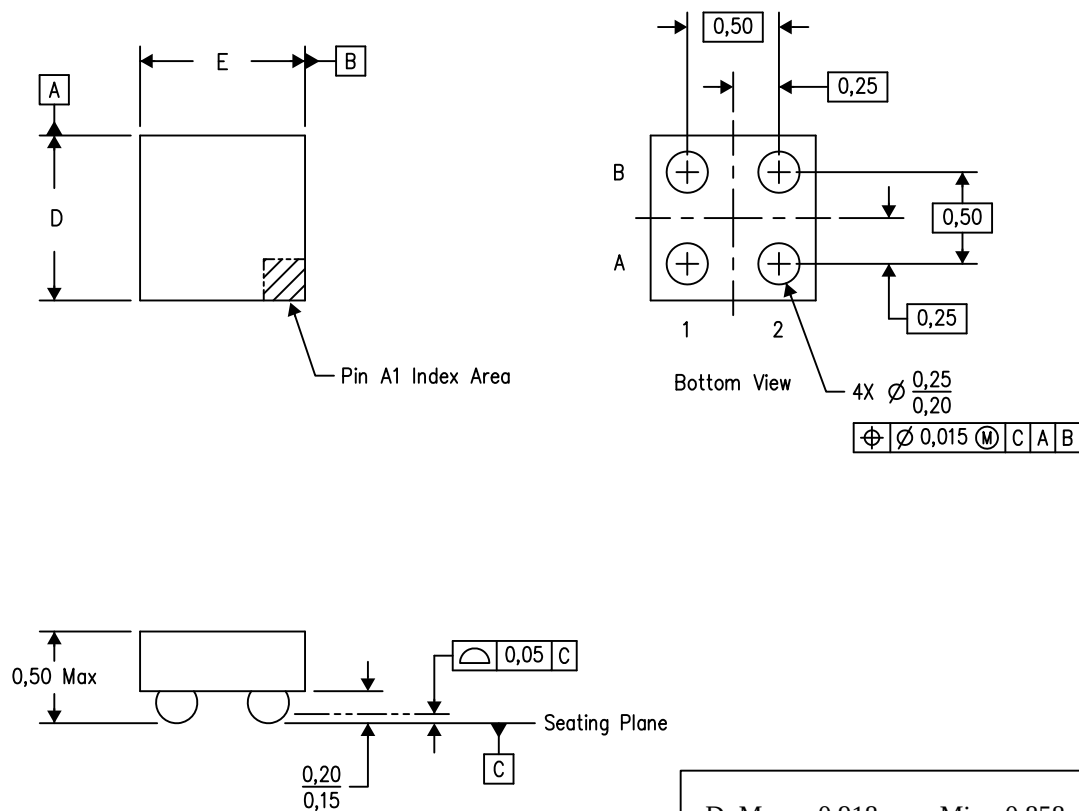


*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS22913BYZVR	DSBGA	YZV	4	3000	220.0	220.0	35.0
TPS22913BYZVT	DSBGA	YZV	4	250	220.0	220.0	35.0
TPS22913CYZVR	DSBGA	YZV	4	3000	220.0	220.0	35.0
TPS22913CYZVT	DSBGA	YZV	4	250	220.0	220.0	35.0

YZV (S-XBGA-N4)

DIE-SIZE BALL GRID ARRAY



D: Max = 0.918 mm, Min = 0.858 mm

E: Max = 0.918 mm, Min = 0.858 mm

4206083/C 07/13

- 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.

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, enhancements, improvements and other changes to its semiconductor products and services per JESD46, latest issue, and to discontinue any product or service per JESD48, latest issue. Buyers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All semiconductor products (also referred to herein as "components") are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its components to the specifications applicable at the time of sale, in accordance with the warranty in TI's terms and conditions of sale of semiconductor products. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by applicable law, testing of all parameters of each component is not necessarily performed.

TI assumes no liability for applications assistance or the design of Buyers' products. Buyers are responsible for their products and applications using TI components. To minimize the risks associated with Buyers' products and applications, Buyers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, machine, or process in which TI components or services are used. Information published by TI regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of significant portions of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI components or services with statements different from or beyond the parameters stated by TI for that component or service voids all express and any implied warranties for the associated TI component or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Buyer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of TI components in its applications, notwithstanding any applications-related information or support that may be provided by TI. Buyer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences, lessen the likelihood of failures that might cause harm and take appropriate remedial actions. Buyer will fully indemnify TI and its representatives against any damages arising out of the use of any TI components in safety-critical applications.

In some cases, TI components may be promoted specifically to facilitate safety-related applications. With such components, TI's goal is to help enable customers to design and create their own end-product solutions that meet applicable functional safety standards and requirements. Nonetheless, such components are subject to these terms.

No TI components are authorized for use in FDA Class III (or similar life-critical medical equipment) unless authorized officers of the parties have executed a special agreement specifically governing such use.

Only those TI components which TI has specifically designated as military grade or "enhanced plastic" are designed and intended for use in military/aerospace applications or environments. Buyer acknowledges and agrees that any military or aerospace use of TI components which have **not** been so designated is solely at the Buyer's risk, and that Buyer is solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI has specifically designated certain components as meeting ISO/TS16949 requirements, mainly for automotive use. In any case of use of non-designated products, TI will not be responsible for any failure to meet ISO/TS16949.

Products

Audio	www.ti.com/audio
Amplifiers	amplifier.ti.com
Data Converters	dataconverter.ti.com
DLP® Products	www.dlp.com
DSP	dsp.ti.com
Clocks and Timers	www.ti.com/clocks
Interface	interface.ti.com
Logic	logic.ti.com
Power Mgmt	power.ti.com
Microcontrollers	microcontroller.ti.com
RFID	www.ti-rfid.com
OMAP Applications Processors	www.ti.com/omap
Wireless Connectivity	www.ti.com/wirelessconnectivity

Applications

Automotive and Transportation	www.ti.com/automotive
Communications and Telecom	www.ti.com/communications
Computers and Peripherals	www.ti.com/computers
Consumer Electronics	www.ti.com/consumer-apps
Energy and Lighting	www.ti.com/energy
Industrial	www.ti.com/industrial
Medical	www.ti.com/medical
Security	www.ti.com/security
Space, Avionics and Defense	www.ti.com/space-avionics-defense
Video and Imaging	www.ti.com/video

TI E2E Community

e2e.ti.com