

# LOW INPUT VOLTAGE, ULTRA-LOW $r_{ON}$ LOAD SWITCH WITH CONFIGURABLE ENABLE LOGIC AND CONTROLLED SLEW-RATE

Check for Samples: [TPS22932B](#)

## FEATURES

- **Input Voltage: 1.1 V to 3.6 V**
- **Ultra-Low ON Resistance**
  - $r_{ON} = 55\text{ m}\Omega$  at  $V_{IN} = 3.6\text{ V}$
  - $r_{ON} = 65\text{ m}\Omega$  at  $V_{IN} = 2.5\text{ V}$
  - $r_{ON} = 75\text{ m}\Omega$  at  $V_{IN} = 1.8\text{ V}$
  - $r_{ON} = 115\text{ m}\Omega$  at  $V_{IN} = 1.2\text{ V}$
- **500-mA Maximum Continuous Switch Current**
- **Quiescent Current < 1  $\mu$ A**
- **Shutdown Current < 1  $\mu$ A**
- **Low Control Threshold Allows Use of 1.2-V/1.8-V/2.5-V/3.3-V Logic**
- **Configurable Enable Logic**
- **Controlled Slew Rate to Avoid Inrush Currents: 165  $\mu$ s at 1.8 V**
- **ESD Performance Tested Per JESD 22**
  - **2000-V Human-Body Model (A114-B, Class II)**
  - **1000-V Charged-Device Model (C101)**
- **Six-Terminal Wafer Chip Scale Package (DSBGA)**
  - **0.8 mm  $\times$  1.2 mm, 0.4-mm Pitch, 0.5-mm Height**

## APPLICATIONS

- PDAs
- Cell Phones
- GPS Devices
- MP3 Players
- Digital Cameras
- Peripheral Ports
- Portable Instrumentation

## DESCRIPTION

TPS22932B is a low  $r_{ON}$  load switch with controlled turn on. It contains an ultra-low  $r_{ON}$  P-channel MOSFET that can operate over an input voltage range of 1.1 V to 3.6 V.

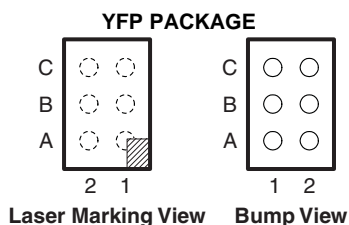
The switch is controlled by eight patterns of 3-bit input. The user can choose the logic functions MUX, AND, OR, NAND, NOR, inverter, and non-inverter. All inputs can be connected to  $V_{IN}$  or GND. The control pins can be connected to low voltage GPIOs allowing it to be controlled by whatever 1.2-V, 1.8-V, 2.5-V, or 3.3-V logic signals while keeping extremely low quiescent current.

A 120- $\Omega$  on-chip load resistor is available for output quick discharge when the switch is turned off. The rise time (slew rate) of the device is internally controlled to avoid inrush current: the rise time of TPS22932B is 165  $\mu$ s.

TPS22932B is available in a space-saving 6-terminal DSBGA (YFP with 0.4-mm pitch). The device is characterized for operation over the free-air temperature range of  $-40^{\circ}\text{C}$  to  $85^{\circ}\text{C}$ .

DEVICE	$r_{ON}$ AT 1.8 V (TYP)	SLEW RATE (TYP AT 3.3 V)	QUICK OUTPUT DISCHARGE <sup>(1)</sup>	MAX OUTPUT CURRENT	ENABLE
TPS22932B	75 m $\Omega$	165 $\mu$ s	Yes	500 mA	Active high

(1) This feature discharges the output of the switch to ground through a 120- $\Omega$  resistor, preventing the output from floating.



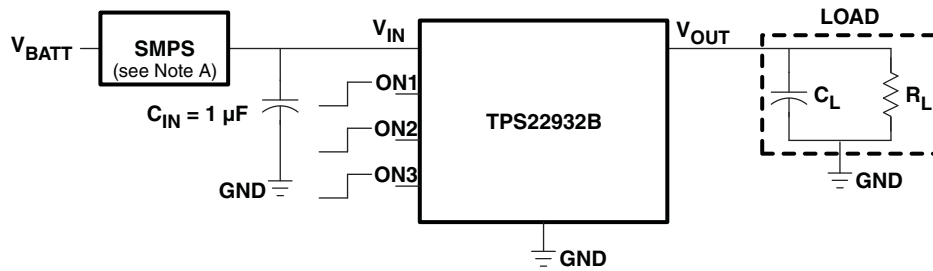
**Table 1. TERMINAL ASSIGNMENTS**

<b>C</b>	ON2	ON3
<b>B</b>	ON1	GND
<b>A</b>	$V_{IN}$	$V_{OUT}$
	<b>2</b>	<b>1</b>



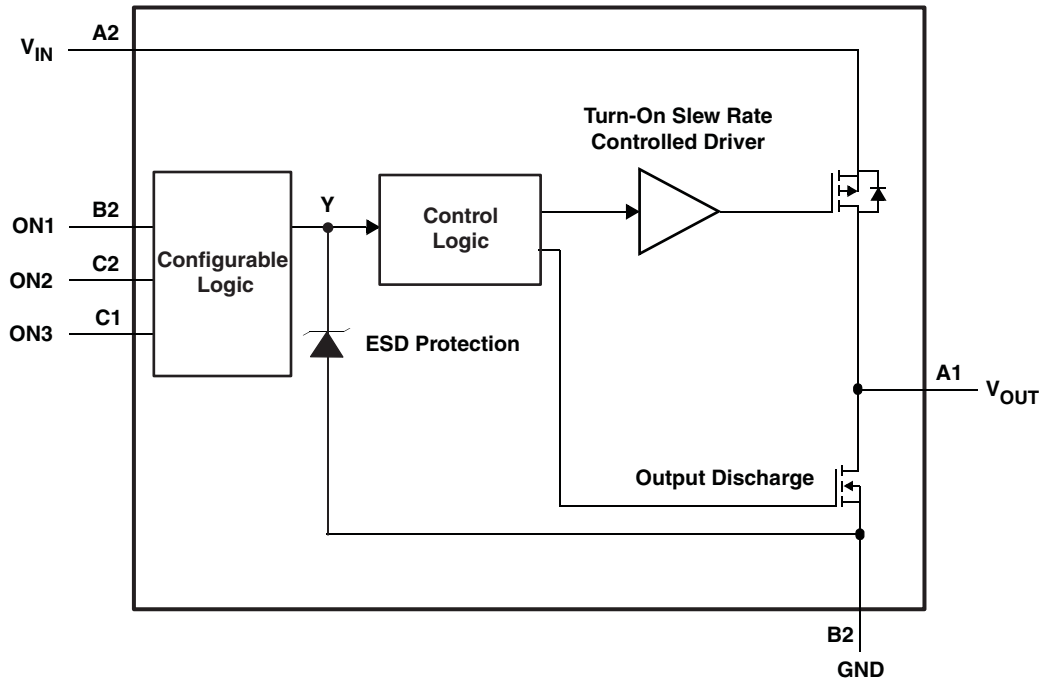
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TYPICAL APPLICATION



A. Switched mode power supply

APPLICATION BLOCK DIAGRAM



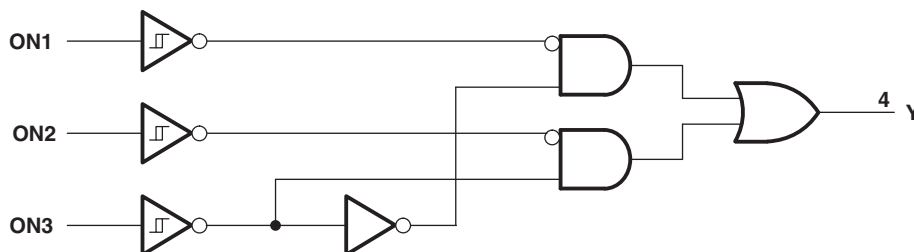
**Table 2. CONFIGURABLE LOGIC FUNCTION TABLE**

INPUTS			SWITCH CONTROL
ON3	ON2	ON1	Y
L	L	L	OFF
L	L	H	OFF
L	H	L	ON
L	H	H	ON
H	L	L	OFF
H	L	H	ON
H	H	L	OFF
H	H	H	ON

**TERMINAL FUNCTIONS**

TERMINAL		DESCRIPTION
NO.	NAME	
A1	V <sub>OUT</sub>	Switch output
A2	V <sub>IN</sub>	Switch input, bypass this input with a ceramic capacitor to ground
B1	GND	Ground
B2, C2, C1	ON1, ON2, ON3	Switch control input, active high - Do not leave floating

**LOGIC DIAGRAM (POSITIVE LOGIC)**



**Table 3. FUNCTION SELECTION TABLE**

LOGIC FUNCTION	FIGURE NO.
2-to-1 data selector	<a href="#">Figure 1</a>
2-input AND gate	<a href="#">Figure 2</a>
2-input OR gate with one inverted input	<a href="#">Figure 3</a>
2-input NAND gate with one inverted input	<a href="#">Figure 3</a>
2-input AND gate with one inverted input	<a href="#">Figure 4</a>
2-input NOR gate with one inverted input	<a href="#">Figure 4</a>
2-input OR gate	<a href="#">Figure 5</a>
Inverter	<a href="#">Figure 6</a>
Noninverted buffer	<a href="#">Figure 7</a>

LOGIC CONFIGURATIONS

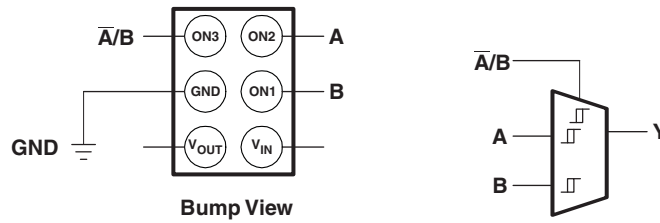


Figure 1. 2-to-1 Data Selector

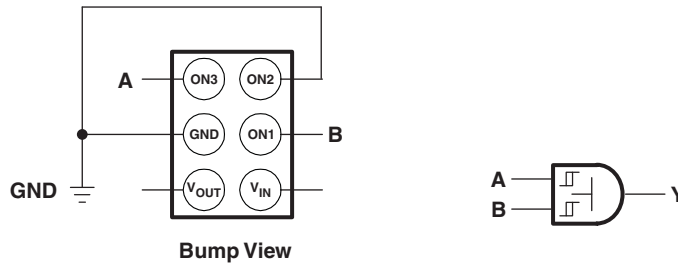


Figure 2. 2-Input AND Gate

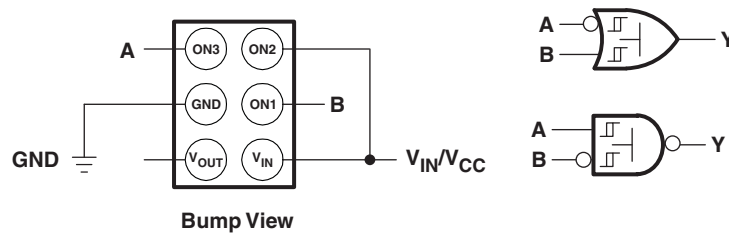


Figure 3. 2-Input OR Gate With One Inverted Input  
2-Input NAND Gate With One Inverted Input

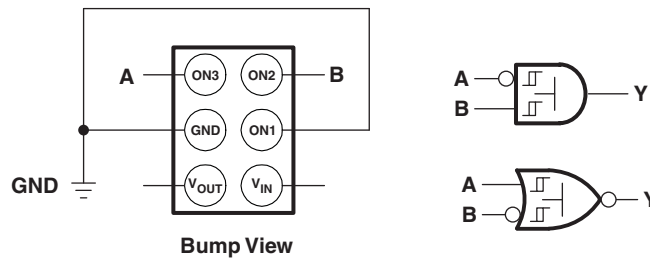


Figure 4. 2-Input AND Gate With One Inverted Input  
2-Input NOR Gate With One Inverted Input

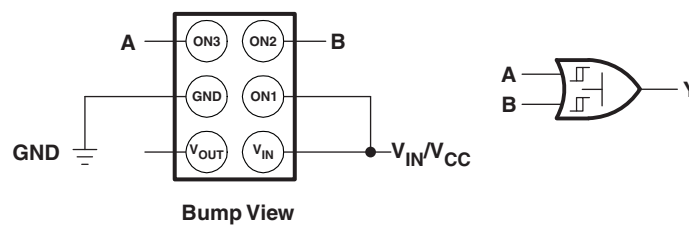


Figure 5. 2-Input OR Gate

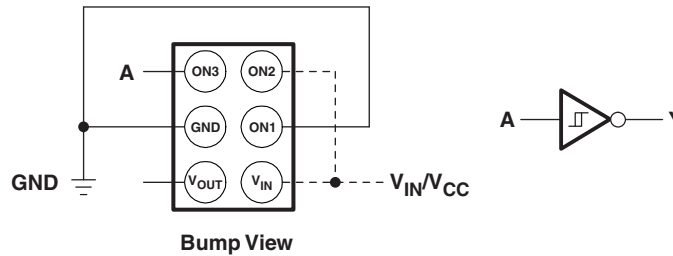


Figure 6. Inverter

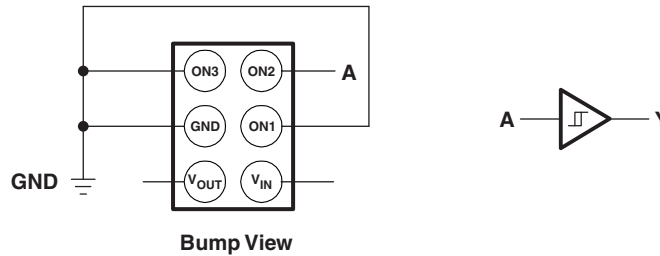


Figure 7. Noninverted Buffer

**ABSOLUTE MAXIMUM RATINGS<sup>(1)</sup>**

		MIN	MAX	UNIT
V <sub>IN</sub>	Input voltage range	-0.3	4	V
V <sub>OUT</sub>	Output voltage range		V <sub>IN</sub> + 0.3	V
P	Power dissipation at T <sub>A</sub> = 25°C		0.8	W
I <sub>MAX</sub>	Maximum continuous switch current		500	mA
T <sub>A</sub>	Operating free-air temperature range	-40	85	°C
T <sub>stg</sub>	Storage temperature range	-65	150	°C
T <sub>lead</sub>	Maximum lead temperature (10-s soldering time)		300	°C
ESD	Electrostatic discharge protection	Human-Body Model (HBM)		V
		Charged Device Model (CDM)		

(1) Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions* is not implied. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

**THERMAL IMPEDANCE RATINGS**

			TYP	UNIT
θ <sub>JA</sub>	Package thermal impedance <sup>(1)</sup>	YFP package	155	°C/W

(1) The package thermal impedance is calculated in accordance with JESD 51-7.

**RECOMMENDED OPERATING CONDITIONS**

		MIN	MAX	UNIT
I <sub>OUT</sub>	Output current		500	mA
V <sub>IN</sub>	Input voltage range	1.1	3.6	V
V <sub>OUT</sub>	Output voltage range		V <sub>IN</sub>	
C <sub>IN</sub>	Input capacitor	1 <sup>(1)</sup>		µF

(1) See *Application Information*.

**ELECTRICAL CHARACTERISTICS**
 $V_{IN} = 1.1\text{ V to }3.6\text{ V}$ ,  $T_A = -40^\circ\text{C to }85^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS		$T_A$	MIN	TYP <sup>(1)</sup>	MAX	UNIT
$I_{IN}$	Quiescent current	$I_{OUT} = 0$	$V_{IN} = 1.1\text{ V}$	Full		140	275	nA
			$V_{IN} = 1.8\text{ V}$			280	500	
			$V_{IN} = 3.6\text{ V}$			860	920	
$I_{IN(OFF)}$	OFF-state supply current	$V_{ON} = \text{GND}$ , $\text{OUT} = \text{Open}$	$V_{IN} = 1.1\text{ V}$	Full		80	225	nA
			$V_{IN} = 1.8\text{ V}$			125	300	
			$V_{IN} = 3.6\text{ V}$			340	650	
$I_{IN(LEAKAGE)}$	OFF-state switch current	$V_{ON} = \text{GND}$ , $V_{OUT} = 0$	$V_{IN} = 1.1\text{ V}$	Full		80	225	nA
			$V_{IN} = 1.8\text{ V}$			125	300	
			$V_{IN} = 3.6\text{ V}$			340	650	
$r_{ON}$	ON-state resistance	$I_{OUT} = -200\text{ mA}$	$V_{IN} = 3.6\text{ V}$	25°C		55	70	mΩ
				Full			85	
			$V_{IN} = 2.5\text{ V}$	25°C		65	80	
				Full			100	
			$V_{IN} = 1.8\text{ V}$	25°C		75	90	
				Full			110	
			$V_{IN} = 1.2\text{ V}$	25°C		115	130	
				Full			155	
			$V_{IN} = 1.1\text{ V}$	25°C		135	150	
				Full			170	
$r_{PD}$	Output pulldown resistance	$V_{IN} = 3.3\text{ V}$ , $V_{ON} = 0$ , $I_{OUT} = 30\text{ mA}$		25°C		75	120	Ω
$I_{ON}$	ON-state input leakage current	$V_{ON} = 1.1\text{ V to }3.6\text{ V or GND}$		Full			1	μA
<b>Control Inputs (ON1, ON2, ON3)</b>								
	Input leakage current	$V_{IN} = 1.1\text{ V to }3.6\text{ V or GND}$		Full			1	μA
$V_{ON}$	Control input voltage			Full			3.6	V
$V_{T+}$	Positive-going input voltage threshold	$V_{IN} = 1.1\text{ V to }1.8\text{ V}$	Full		0.5	0.8	V	
		$V_{IN} = 1.8\text{ V to }3.6\text{ V}$			0.6	0.9		
$V_{T-}$	Negative-going input voltage threshold	$V_{IN} = 1.1\text{ V to }1.8\text{ V}$	Full		0.2	0.6	V	
		$V_{IN} = 1.8\text{ V to }3.6\text{ V}$			0.3	0.7		
$\Delta V_T$	Hysteresis ( $V_{T+} - V_{T-}$ )	$V_{IN} = 1.1\text{ V to }3.6\text{ V}$		Full	0.2	0.6	V	

(1) Typical values are at the specified  $V_{IN}$  and  $T_A = 25^\circ\text{C}$ .

**SWITCHING CHARACTERISTICS**
 $V_{IN} = 1.2\text{ V}$ ,  $R_{L\_CHIP} = 120\ \Omega$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{ON}$	Turn-ON time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	350		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	390		
			$C_L = 3\ \mu\text{F}$	450		
$t_{OFF}$	Turn-OFF time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	30		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	70		
			$C_L = 3\ \mu\text{F}$	160		
$t_r$	$V_{OUT}$ rise time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	240		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	240		
			$C_L = 3\ \mu\text{F}$	260		
$t_f$	$V_{OUT}$ fall time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	20		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	150		
			$C_L = 3\ \mu\text{F}$	450		

**SWITCHING CHARACTERISTICS**
 $V_{IN} = 1.5\text{ V}$ ,  $R_{L\_CHIP} = 120\ \Omega$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{ON}$	Turn-ON time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	290		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	320		
			$C_L = 3\ \mu\text{F}$	350		
$t_{OFF}$	Turn-OFF time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	30		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	70		
			$C_L = 3\ \mu\text{F}$	150		
$t_r$	$V_{OUT}$ rise time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	205		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	205		
			$C_L = 3\ \mu\text{F}$	220		
$t_f$	$V_{OUT}$ fall time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	18		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	145		
			$C_L = 3\ \mu\text{F}$	445		

**SWITCHING CHARACTERISTICS**
 $V_{IN} = 1.8\text{ V}$ ,  $R_{L\_CHIP} = 120\ \Omega$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{ON}$	Turn-ON time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$		215		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$		240		
			$C_L = 3\ \mu\text{F}$		260		
$t_{OFF}$	Turn-OFF time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$		24		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$		60		
			$C_L = 3\ \mu\text{F}$		142		
$t_r$	$V_{OUT}$ rise time	$R_L = 500$	$C_L = 0.1\ \mu\text{F}$		165		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$		165		
			$C_L = 3\ \mu\text{F}$		175		
$t_f$	$V_{OUT}$ fall time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$		18		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$		145		
			$C_L = 3\ \mu\text{F}$		440		

**SWITCHING CHARACTERISTICS**
 $V_{IN} = 2.5\text{ V}$ ,  $R_{L\_CHIP} = 120\ \Omega$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS		MIN	TYP	MAX	UNIT
$t_{ON}$	Turn-ON time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$		185		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$		205		
			$C_L = 3\ \mu\text{F}$		225		
$t_{OFF}$	Turn-OFF time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$		2		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$		60		
			$C_L = 3\ \mu\text{F}$		140		
$t_r$	$V_{OUT}$ rise time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$		145		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$		150		
			$C_L = 3\ \mu\text{F}$		160		
$t_f$	$V_{OUT}$ fall time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$		18		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$		147		
			$C_L = 3\ \mu\text{F}$		445		



## SWITCHING CHARACTERISTICS

 $V_{IN} = 3\text{ V}$ ,  $R_{L\_CHIP} = 120\ \Omega$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{ON}$	Turn-ON time		$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	170	
		$C_L = 1\ \mu\text{F}$		190		
		$C_L = 3\ \mu\text{F}$		210		
$t_{OFF}$	Turn-OFF time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	2		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	60		
			$C_L = 3\ \mu\text{F}$	140		
$t_r$	$V_{OUT}$ rise time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	140		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	140		
			$C_L = 3\ \mu\text{F}$	150		
$t_f$	$V_{OUT}$ fall time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	17		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	148		
			$C_L = 3\ \mu\text{F}$	450		

## SWITCHING CHARACTERISTICS

 $V_{IN} = 3.3\text{ V}$ ,  $R_{L\_CHIP} = 120\ \Omega$ ,  $T_A = 25^\circ\text{C}$  (unless otherwise noted)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_{ON}$	Turn-ON time		$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	160	
		$C_L = 1\ \mu\text{F}$		175		
		$C_L = 3\ \mu\text{F}$		195		
$t_{OFF}$	Turn-OFF time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	20		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	55		
			$C_L = 3\ \mu\text{F}$	135		
$t_r$	$V_{OUT}$ rise time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	135		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	135		
			$C_L = 3\ \mu\text{F}$	145		
$t_f$	$V_{OUT}$ fall time	$R_L = 500\ \Omega$	$C_L = 0.1\ \mu\text{F}$	17		$\mu\text{s}$
			$C_L = 1\ \mu\text{F}$	148		
			$C_L = 3\ \mu\text{F}$	450		

TYPICAL CHARACTERISTICS

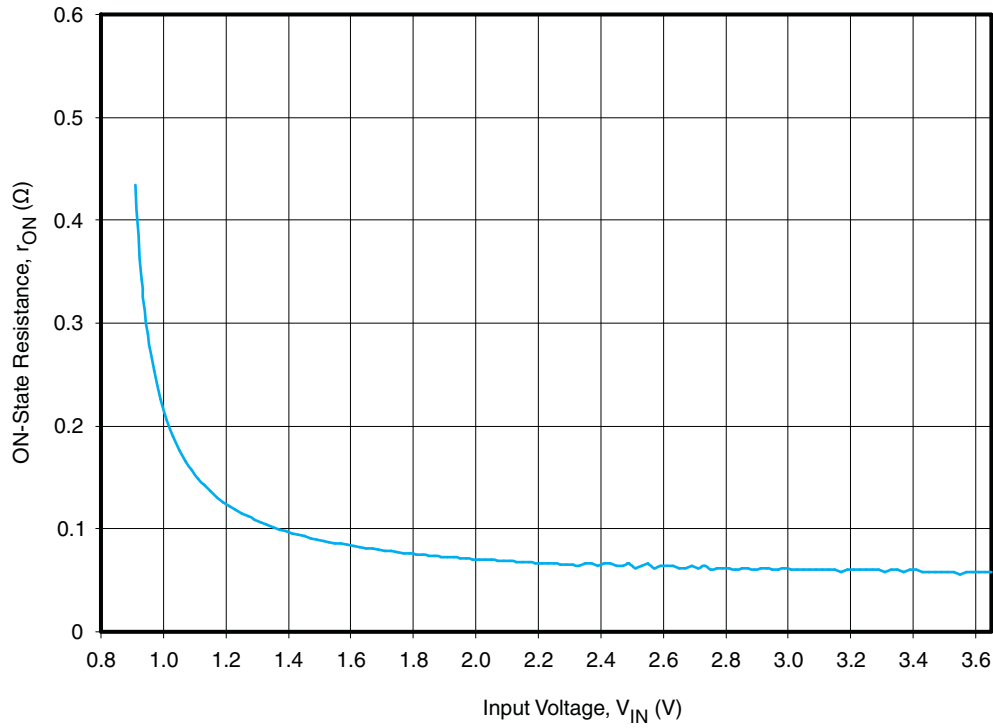


Figure 8.  $r_{ON}$  vs  $V_{IN}$

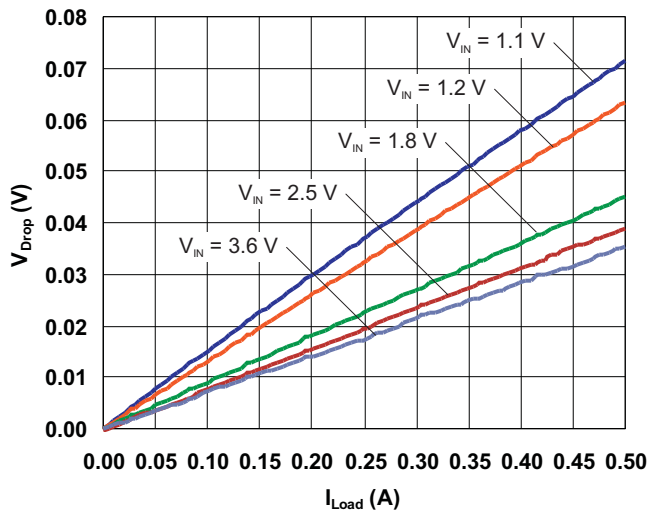


Figure 9. Voltage Drop vs Load Current

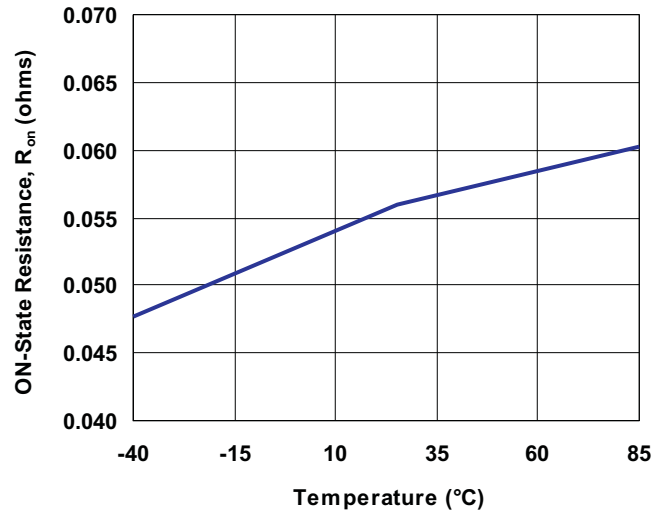


Figure 10.  $r_{ON}$  vs  $T_A$  ( $V_{IN} = 3.3$  V)

TYPICAL CHARACTERISTICS (continued)

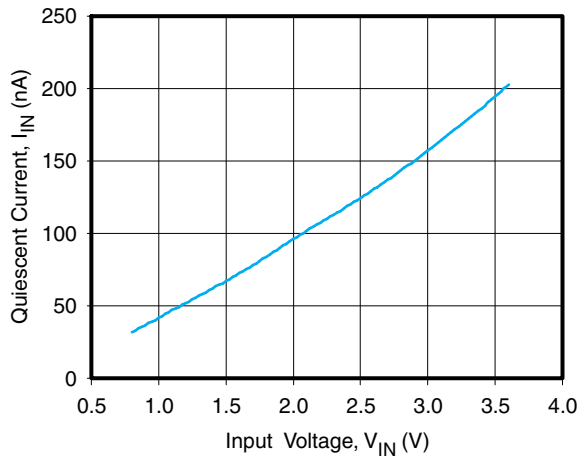


Figure 11. Quiescent Current vs  $V_{IN}$   
( $ON2 = V_{IN}$ ,  $ON1-ON3 = 0 V$ ,  $I_{out} = 0$ )

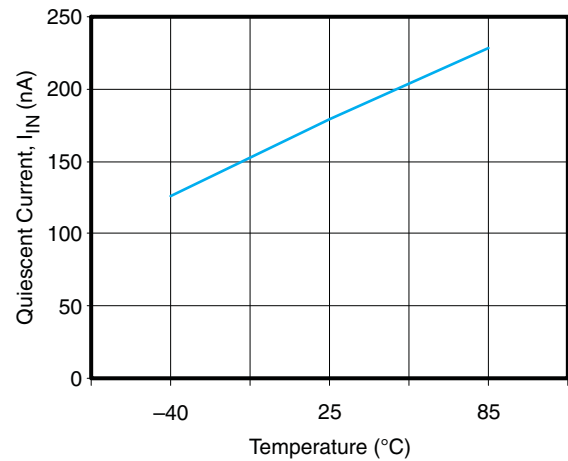


Figure 12. Quiescent Current vs  $T_A$   
( $V_{IN} = 3.3 V$ ,  $ON2 = V_{IN}$ ,  $ON1-ON3 = 0 V$ ,  $I_{out} = 0$ )

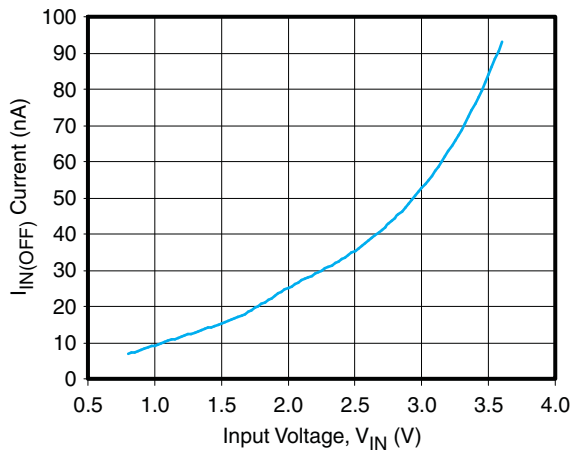


Figure 13.  $I_{IN(OFF)}$  vs  $V_{IN}$   
( $ON1-ON2-ON3 = 0 V$ )

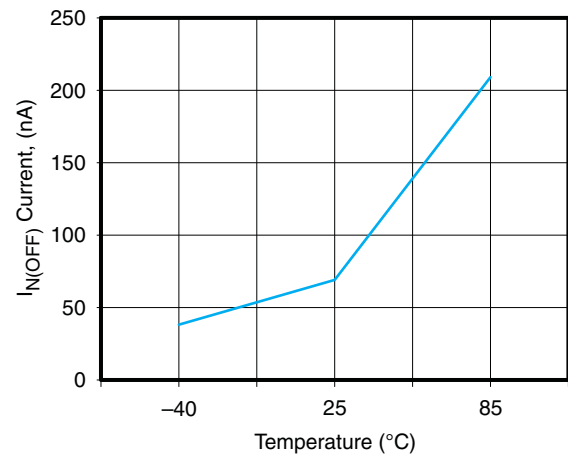


Figure 14.  $I_{IN(OFF)}$  vs Temperature  
( $V_{IN} = 3.3 V$ ,  $ON1-ON2-ON3 = 0 V$ )

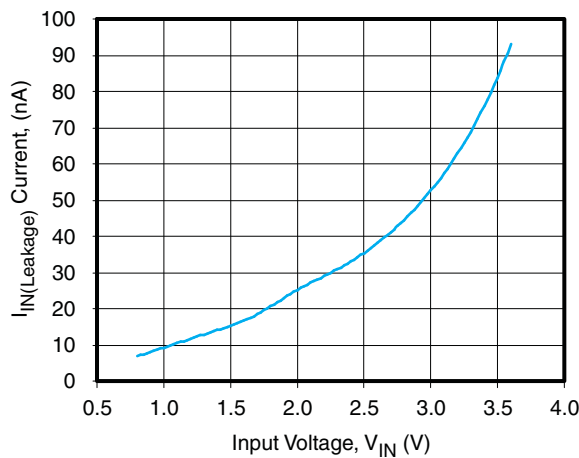


Figure 15.  $I_{IN(Leakage)}$  vs  $V_{IN}$   
( $ON1-ON2-ON3 = 0 V$ ,  $V_{out} = 0$ )

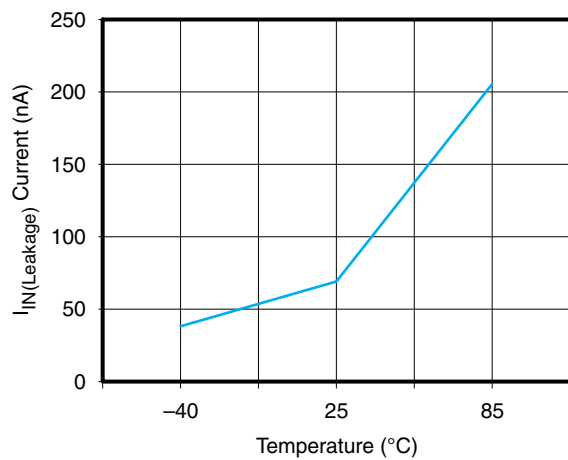
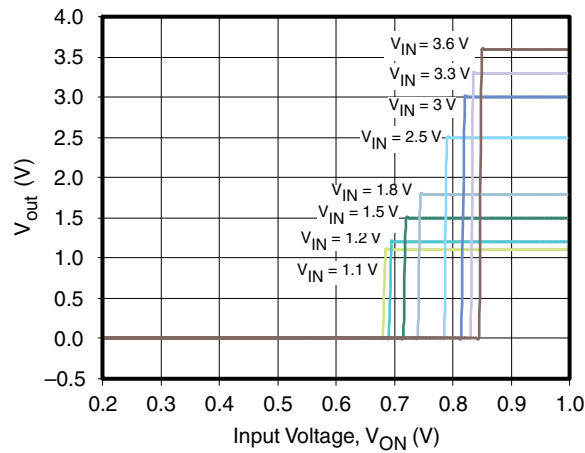
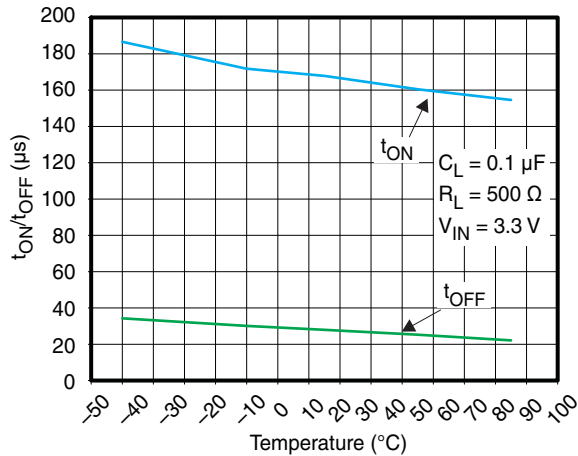


Figure 16.  $I_{IN(Leakage)}$  vs Temperature  
( $V_{IN} = 3.3 V$ ,  $ON1-ON2-ON3 = 0 V$ )

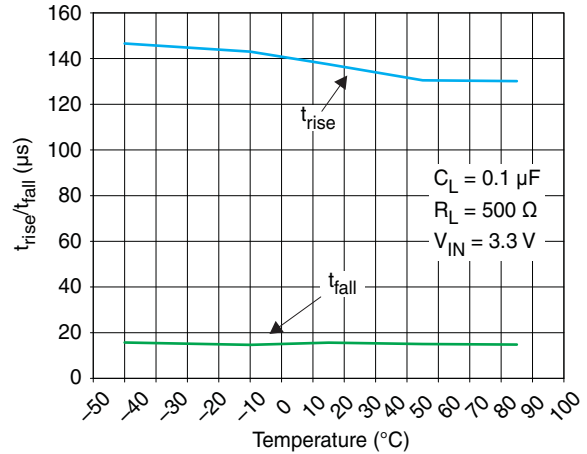
**TYPICAL CHARACTERISTICS (continued)**



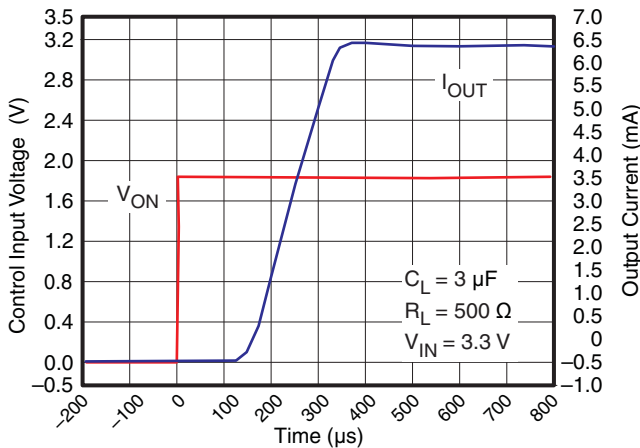
**Figure 17. ON-Input Threshold**



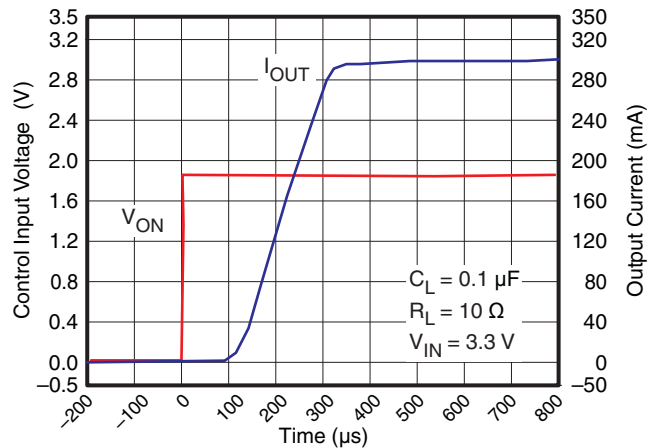
**Figure 18.  $t_{ON}/t_{OFF}$  vs Temperature**



**Figure 19.  $t_{rise}/t_{fall}$  vs Temperature**



**Figure 20.  $t_{ON}$  Response**



**Figure 21.  $t_{ON}$  Response**

TYPICAL CHARACTERISTICS (continued)

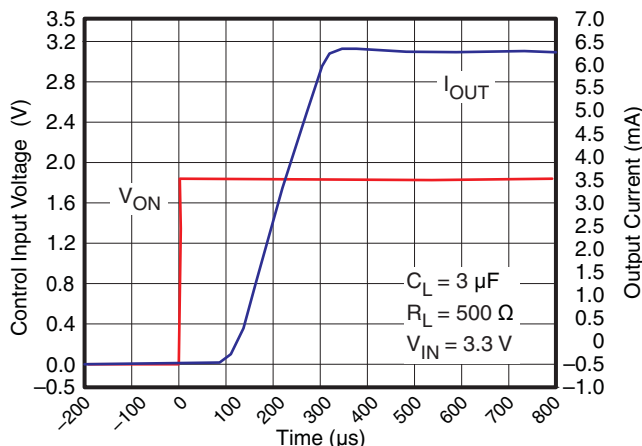


Figure 22.  $t_{\text{ON}}$  Response

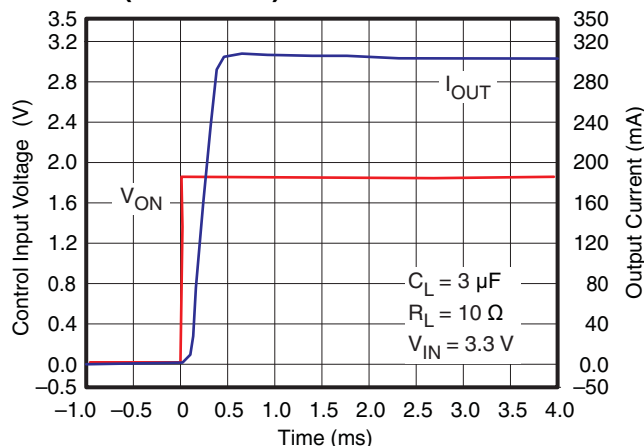


Figure 23.  $t_{\text{ON}}$  Response

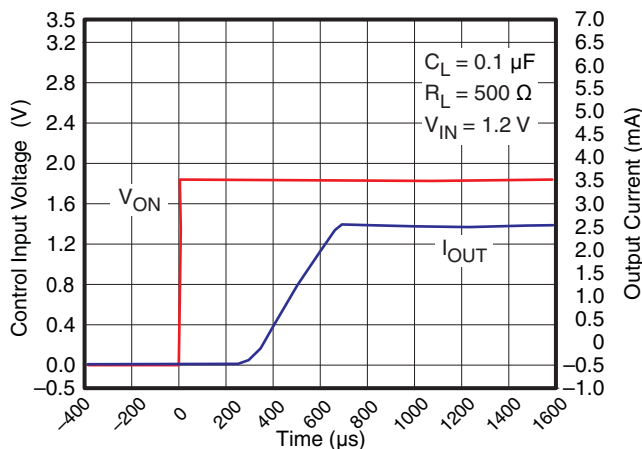


Figure 24.  $t_{\text{ON}}$  Response

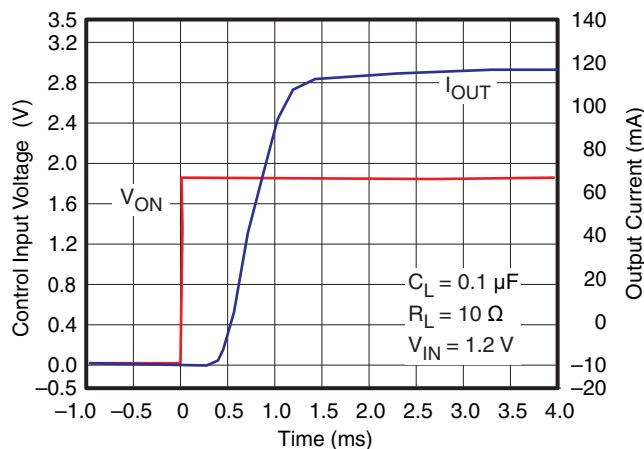


Figure 25.  $t_{\text{ON}}$  Response

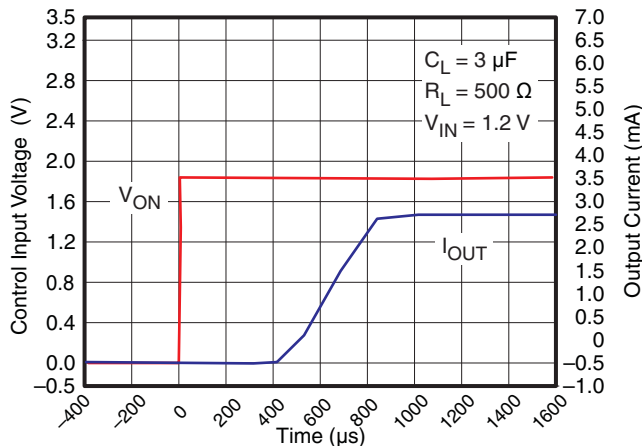


Figure 26.  $t_{\text{ON}}$  Response

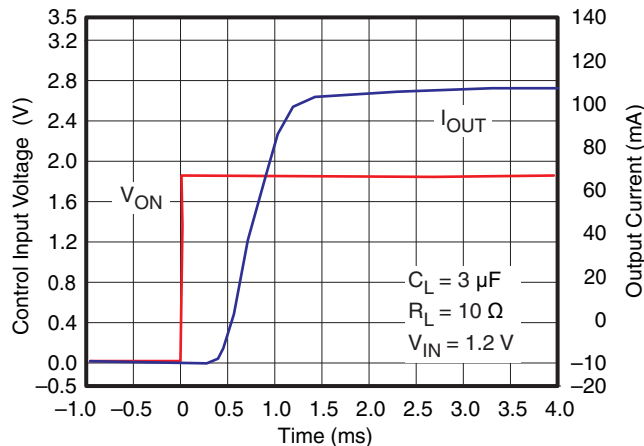


Figure 27.  $t_{\text{ON}}$  Response

TYPICAL CHARACTERISTICS (continued)

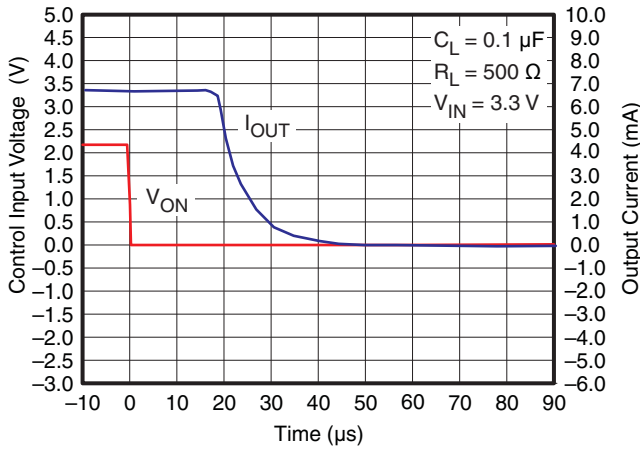


Figure 28.  $t_{OFF}$  Response

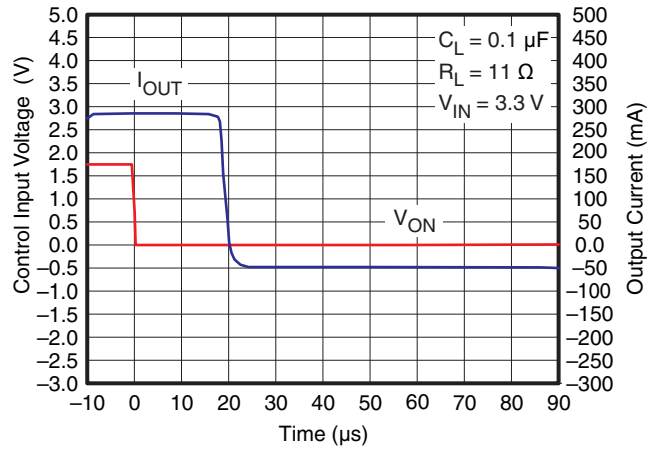


Figure 29.  $t_{OFF}$  Response

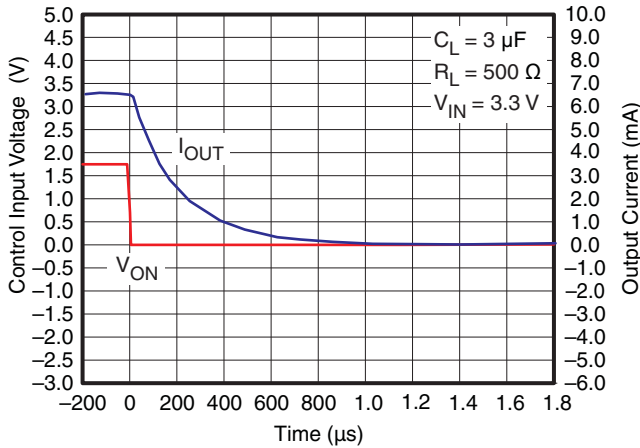


Figure 30.  $t_{OFF}$  Response

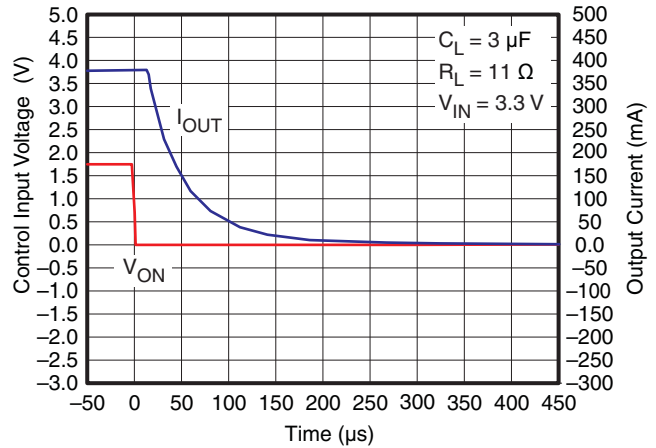


Figure 31.  $t_{OFF}$  Response

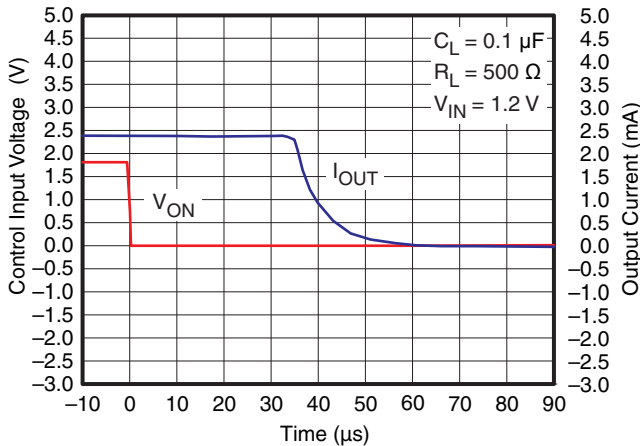


Figure 32.  $t_{OFF}$  Response

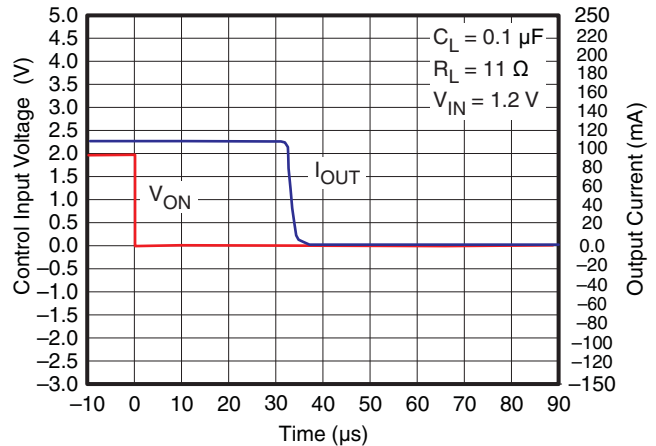


Figure 33.  $t_{OFF}$  Response

TYPICAL CHARACTERISTICS (continued)

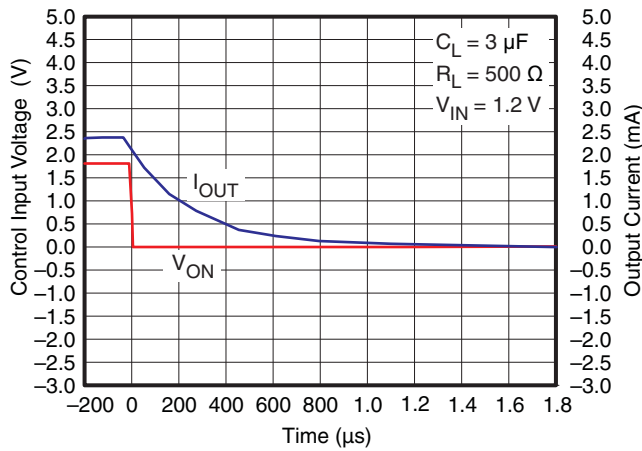


Figure 34.  $t_{OFF}$  Response

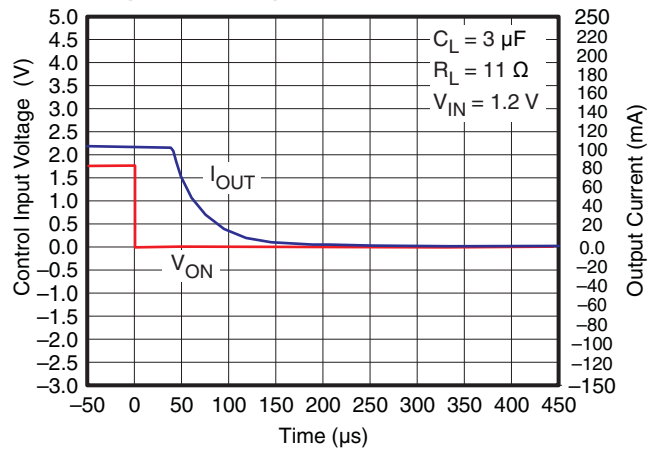
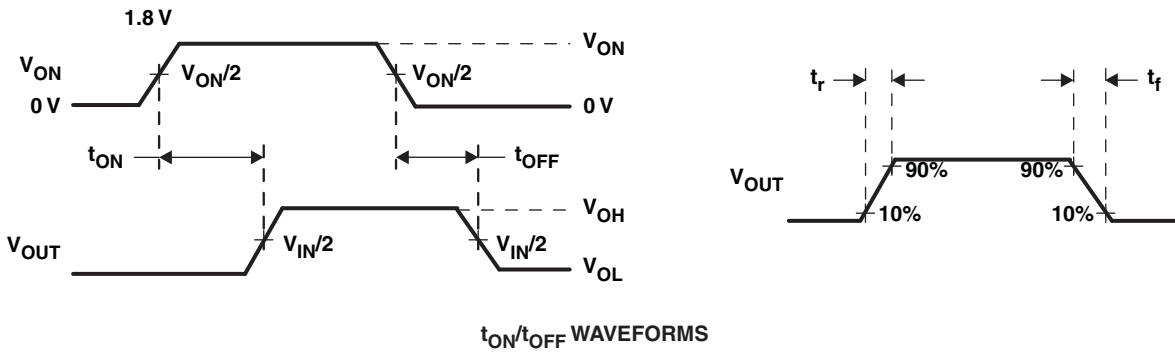
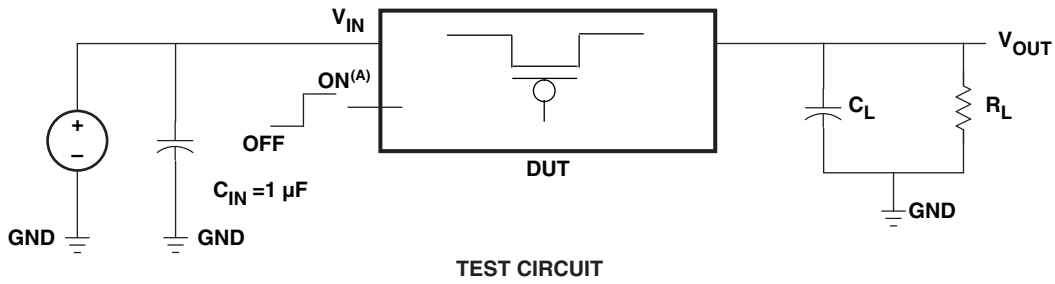


Figure 35.  $t_{OFF}$  Response

PARAMETER MEASUREMENT INFORMATION



A.  $t_{rise}$  and  $t_{fall}$  of the control signal is 100 ns.

Figure 36. Test Circuit and  $t_{ON}/t_{OFF}$  Waveforms



## APPLICATION INFORMATION

### ON/OFF Control

The ON pin controls the state of the switch. Activating ON continuously holds the switch in the on state so long as there is no fault. ON is active HI and has a low threshold making it capable of interfacing with low voltage signals. The ON pin is compatible with standard GPIO logic threshold. It can be used with any microcontroller with 1.2-V, 1.8-V, 2.5-V or 3.3-V GPIOs.

### Input Capacitor

To limit the voltage drop on the input supply caused by transient in-rush currents when the switch turns on into a discharged load capacitor or short-circuit, a capacitor must be placed between  $V_{IN}$  and GND. A 1- $\mu$ F 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 during higher current application. When switching a heavy load, it is recommended to have an input capacitor about 10 or more times higher than the output capacitor in order to avoid any supply drop.

### Output Capacitor

Due to the integral body diode in the PMOS switch, a  $C_{IN}$  greater than  $C_L$  is highly recommended. A  $C_L$  greater than  $C_{IN}$  can cause  $V_{OUT}$  to exceed  $V_{IN}$  when the system supply is removed. This could result in current flow through the body diode from  $V_{OUT}$  to  $V_{IN}$ .

### Board Layout

For best performance, all traces should be as short as possible. To be most effective, the input and output capacitors should be placed close to the device to minimize the effects that parasitic trace inductances may have on normal and short-circuit operation. Using wide traces for  $V_{IN}$ ,  $V_{OUT}$ , and GND will help minimize the parasitic electrical effects along with minimizing the case to ambient thermal impedance.

## REVISION HISTORY

Changes from Revision A (November 2009) to Revision B	Page
• Aligned package description throughout datasheet. ....	1

**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)	Device Marking (4/5)	Samples
TPS22932BYFPR	ACTIVE	DSBGA	YFP	6	3000	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	483	<a href="#">Samples</a>
TPS22932BYFPT	ACTIVE	DSBGA	YFP	6	250	Green (RoHS & no Sb/Br)	SNAGCU	Level-1-260C-UNLIM	-40 to 85	483	<a href="#">Samples</a>

(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) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device 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 Device Marking for that device.

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## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*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
TPS22932BYFPR	DSBGA	YFP	6	3000	180.0	8.4	0.89	1.29	0.62	4.0	8.0	Q1
TPS22932BYFPT	DSBGA	YFP	6	250	180.0	8.4	0.89	1.29	0.62	4.0	8.0	Q1

**TAPE AND REEL BOX DIMENSIONS**

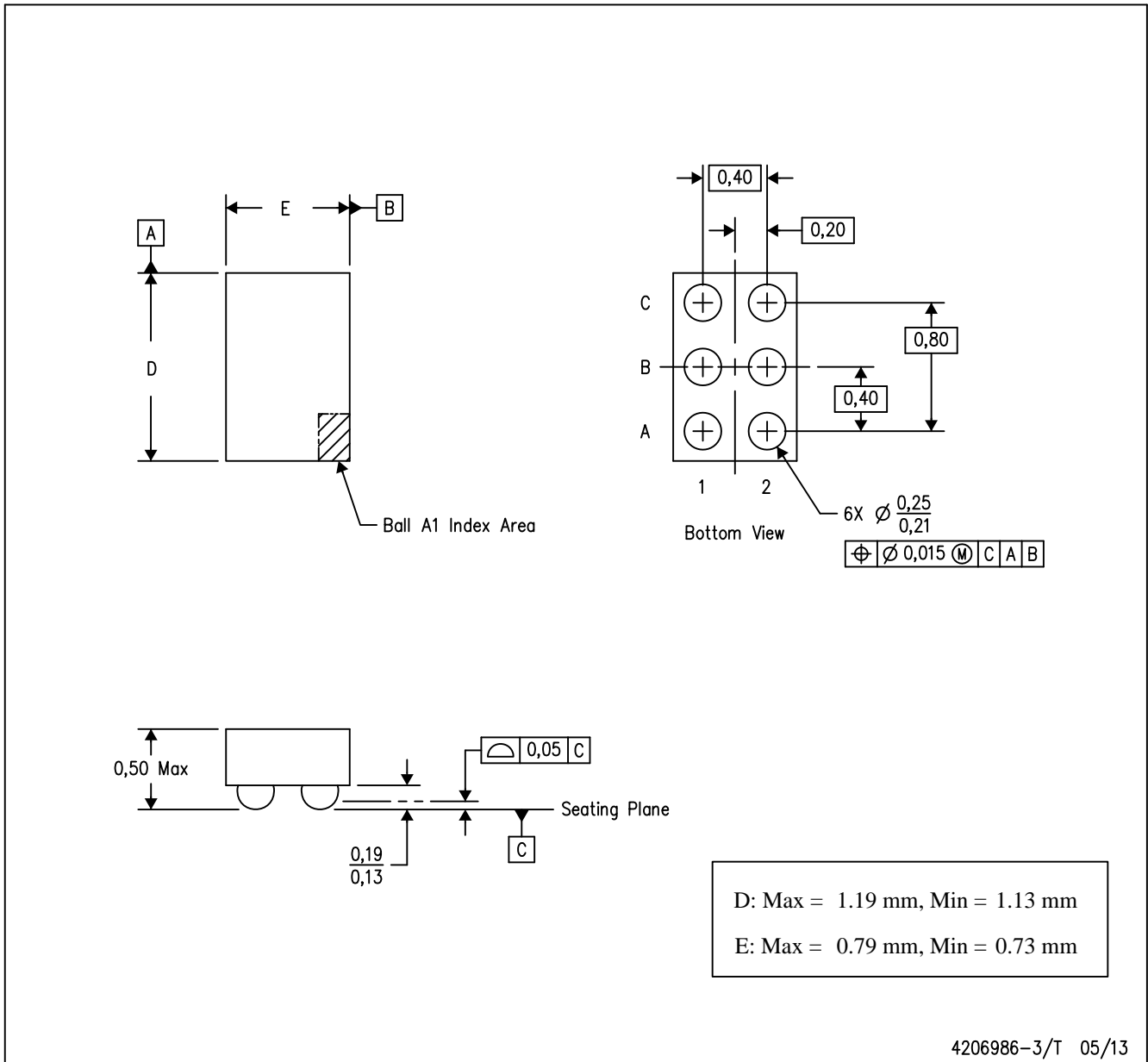

\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS22932BYFPR	DSBGA	YFP	6	3000	220.0	220.0	34.0
TPS22932BYFPT	DSBGA	YFP	6	250	220.0	220.0	34.0

# MECHANICAL DATA

YFP (R-XBGA-N6)

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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