

TPS2291xx, 5.5V, 2A, 37mΩ On-Resistance Load Switch

1 Features

- Integrated Single Channel Load Switch
- Input Voltage Range: 1.05V to 5.5V
- Low On-Resistance (R_{ON})
 - $R_{ON} = 37m\Omega$ (Typical) at $V_{IN} = 5V$
 - $R_{ON} = 38m\Omega$ (Typical) at $V_{IN} = 3.3V$
 - $R_{ON} = 43m\Omega$ (Typical) at $V_{IN} = 1.8V$
- 2A Maximum Continuous Switch Current
- Low Quiescent Current
 - $7.7\mu A$ (Typical) at $V_{IN} = 3.3V$
- Low Control Input Threshold Enables Use of 1V or Higher GPIO
- Controlled Slew Rate
 - $t_R(TPS22914B/15B) = 64\mu s$ at $V_{IN} = 3.3V$
 - $t_R(TPS22914C/15C) = 913\mu s$ at $V_{IN} = 3.3V$
- Quick Output Discharge (TPS22915 only)
- Ultra-Small Wafer-Chip-Scale Package
 - 0.74mm × 0.74mm, 0.4mm Pitch, 0.5mm Height (YFP)
- ESD Performance Tested per JESD 22
 - 2kV HBM and 1kV CDM

2 Applications

- [Smartphones, Mobile Phones](#)
- [Ultrathin, Ultrabook™ / Notebook PC](#)
- [Tablet PC](#)
- [Wearable Technology](#)
- [Solid State Drives](#)
- [Digital Cameras](#)

3 Description

The TPS22914/15 is a small, low R_{ON} , single channel load switch with controlled slew rate. The device contains an N-channel MOSFET that can operate over an input voltage range of 1.05V to 5.5V and can support a maximum continuous current of 2A. The switch is controlled by an on and off input, which is capable of interfacing directly with low-voltage control signals.

The small size and low R_{ON} makes the device designed for being use in space-constrained, battery-powered applications. The wide input voltage range of the switch makes the device a versatile design for many different voltage rails. The controlled rise time of the device greatly reduces inrush current caused by large bulk load capacitances, thereby reducing or eliminating power supply droop. The TPS22915 further reduces the total solution size by integrating a 143Ω pulldown resistor for quick output discharge (QOD) when the switch is turned off.

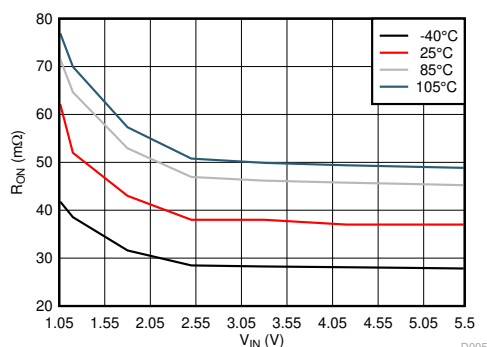
The TPS22914/15 is available in a small, space-saving 0.74mm × 0.74mm, 0.4mm pitch, 0.5mm height 4-pin Wafer-Chip-Scale (WCSP) package (YFP). The device is characterized for operation over the free-air temperature range of $-40^{\circ}C$ to $+105^{\circ}C$.

Package Information

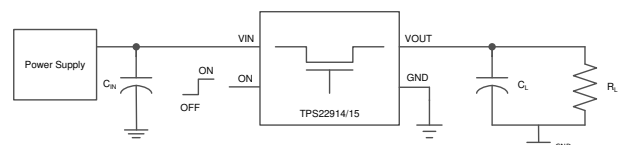
PART NUMBER	PACKAGE ⁽¹⁾	PACKAGE SIZE ⁽²⁾
TPS22914B	DSBGA (4)	0.74mm × 0.74mm
TPS22914C		
TPS22915B		
TPS22915C		

(1) For more information, see [Section 12](#).

(2) The package size (length × width) is a nominal value and includes pins, where applicable.



R_{ON} vs V_{IN} ($I_{OUT} = -200mA$)



Simplified Schematic



Table of Contents

1 Features	1	8.3 Feature Description.....	16
2 Applications	1	8.4 Device Functional Modes.....	17
3 Description	1	9 Application and Implementation	18
4 Device Comparison Table	3	9.1 Application Information.....	18
5 Pin Configuration and Functions	3	9.2 Typical Application.....	18
6 Specifications	4	9.3 Power Supply Recommendations.....	20
6.1 Absolute Maximum Ratings.....	4	9.4 Layout.....	20
6.2 ESD Ratings.....	4	10 Device and Documentation Support	22
6.3 Recommended Operating Conditions.....	4	10.1 Documentation Support.....	22
6.4 Thermal Information.....	4	10.2 Related Links.....	22
6.5 Electrical Characteristics.....	5	10.3 Receiving Notification of Documentation Updates.....	22
6.6 Switching Characteristics.....	8	10.4 Support Resources.....	22
6.7 Typical DC Characteristics.....	9	10.5 Trademarks.....	22
6.8 Typical AC Characteristics (TPS22914B/15B).....	11	10.6 Electrostatic Discharge Caution.....	22
6.9 Typical AC Characteristics (TPS22914C/15C).....	13	10.7 Glossary.....	22
7 Parameter Measurement Information	15	11 Revision History	22
8 Detailed Description	16	12 Mechanical, Packaging, and Orderable Information	23
8.1 Overview.....	16		
8.2 Functional Block Diagram.....	16		

4 Device Comparison Table

DEVICE	R _{ON} at 3.3V (TYPICAL)	t _R at 3.3V (TYPICAL)	QUICK OUTPUT DISCHARGE	MAXIMUM OUTPUT CURRENT	ENABLE
TPS22914B	38mΩ	64μs	No	2A	Active High
TPS22914C	38mΩ	913μs	No	2A	Active High
TPS22915B	38mΩ	64μs	Yes	2A	Active High
TPS22915C	38mΩ	913μs	Yes	2A	Active High

5 Pin Configuration and Functions

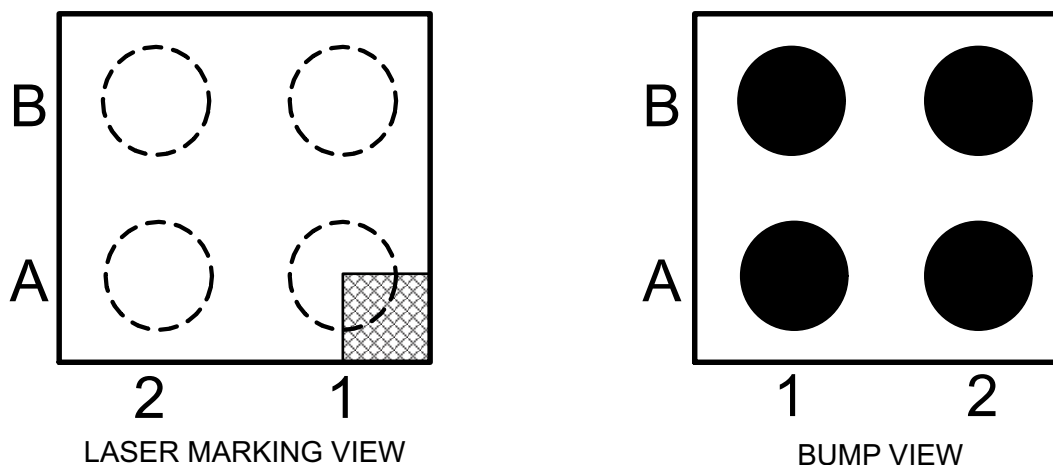


Figure 5-1. YFP PACKAGE 4 PIN DSBGA TOP VIEW

Table 5-1. Pin Description

B	ON	GND
A	VIN	VOUT
	2	1

Table 5-2. Pin Functions

PIN		TYPE ⁽¹⁾	DESCRIPTION
NO.	NAME		
A1	VOUT	O	Switch output. Place ceramic bypass capacitors between this pin and GND. See the Detailed Description section for more information
A2	VIN	I	Switch input. Place ceramic bypass capacitors between this pin and GND. See the Detailed Description section for more information
B1	GND	—	Device ground
B2	ON	I	Active high switch control input. Do not leave floating

(1) I = Input; O = Output.

6 Specifications

6.1 Absolute Maximum Ratings

Over operating free-air temperature range (unless otherwise noted)^{(1) (2)}

		MIN	MAX	UNIT
V _{IN}	Input voltage	−0.3	6	V
V _{OUT}	Output voltage	−0.3	6	V
V _{ON}	ON voltage	−0.3	6	V
I _{MAX}	Maximum continuous switch current		2	A
I _{PLS}	Maximum pulsed switch current, pulse < 300μs, 2% duty cycle		2.5	A
T _J	Maximum junction temperature		125	°C
T _{STG}	Storage temperature	−65	150	°C

- (1) Operation outside the *Absolute Maximum Ratings* may cause permanent device damage. *Absolute Maximum Ratings* do not imply functional operation of the device at these or any other conditions beyond those listed under *Recommended Operating Conditions*. If used outside the *Recommended Operating Conditions* but within the *Absolute Maximum Ratings*, the device may not be fully functional, and this may affect device reliability, functionality, performance, and shorten the device lifetime.
- (2) All voltage values are with respect to network ground terminal.

6.2 ESD Ratings

		VALUE	UNIT
V _(ESD)	Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±2000
		Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾	±1000

- (1) JEDEC document JEP155 states that 500V HBM allows safe manufacturing with a standard ESD control process.
- (2) JEDEC document JEP157 states that 250V CDM allows safe manufacturing with a standard ESD control process.

6.3 Recommended Operating Conditions

Over operating free-air temperature range (unless otherwise noted)

			MIN	MAX	UNIT
V _{IN}	Input voltage		1.05	5.5	V
V _{ON}	ON voltage		0	5.5	V
V _{OUT}	Output voltage			V _{IN}	V
V _{IH, ON}	High-level input voltage, ON	V _{IN} = 1.05V to 5.5V	1	5.5	V
V _{IL, ON}	Low-level input voltage, ON	V _{IN} = 1.05V to 5.5V	0	0.5	V
T _A	Operating free-air temperature range ⁽¹⁾		−40	105	°C
C _{IN}	Input Capacitor		1 ⁽²⁾		μF

- (1) In applications where high power dissipation or poor package thermal resistance is present, the maximum ambient temperature may have to be derated. Maximum ambient temperature [T_{A(MAX)}] is dependent on the maximum operating junction temperature [T_{J(MAX)}], the maximum power dissipation of the device in the application [P_{D(MAX)}], and the junction-to-ambient thermal resistance of the part/package in the application (θ_{JA}), as given by the following equation: T_{A(MAX)} = T_{J(MAX)} − (θ_{JA} × P_{D(MAX)}).
- (2) Refer to the [Detailed Description](#) section.

6.4 Thermal Information

THERMAL METRIC ⁽¹⁾		TPS2291x	UNIT
		YFP (DSBGA)	
		4 PINS	
R _{θJA}	Junction-to-ambient thermal resistance	193	°C/W
R _{θJC(top)}	Junction-to-case (top) thermal resistance	2.3	°C/W
R _{θJB}	Junction-to-board thermal resistance	36	°C/W
ψ _{JT}	Junction-to-top characterization parameter	12	°C/W

6.4 Thermal Information (continued)

THERMAL METRIC ⁽¹⁾	TPS2291x	UNIT
	YFP (DSBGA)	
	4 PINS	
Ψ_{JB} Junction-to-board characterization parameter	36	°C/W

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application note.

6.5 Electrical Characteristics

Unless otherwise noted, the specification in the following table applies over the operating ambient temperature $-40^{\circ}\text{C} \leq T_A \leq +105^{\circ}\text{C}$. **Typical values are for $T_A = 25^{\circ}\text{C}$.**

PARAMETER		TEST CONDITION		T_A	MIN	TYP	MAX	UNIT
$I_{Q, VIN}$	Quiescent current (TPS22914B/15B)	$V_{ON} = 5V, I_{OUT} = 0A$	$V_{IN} = 5.5V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	7.7	10.8		μA
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		12.1		
			$V_{IN} = 5V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	7.6	9.6		
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		11.9		
			$V_{IN} = 3.3V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	7.7	9.6		
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		12		
			$V_{IN} = 1.8V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	8.4	11		
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		13.5		
			$V_{IN} = 1.2V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	7.4	10.4		
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		13.9		
	Quiescent current (TPS22914C/15C)	$V_{ON} = 5V, I_{OUT} = 0A$	$V_{IN} = 1.05V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	6.7	10.9		μA
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		11.7		
			$V_{IN} = 5.5V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	7.7	11.5		
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		14.1		
			$V_{IN} = 5V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	7.6	11.1		
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		13.7		
			$V_{IN} = 3.3V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	7.7	10.7		
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		13.3		
			$V_{IN} = 1.8V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	8.4	11.7		
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		13.4		
			$V_{IN} = 1.2V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	7.4	11		
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		12.8		
			$V_{IN} = 1.05V$	$-40^{\circ}\text{C to } +85^{\circ}\text{C}$	6.7	10.9		
				$-40^{\circ}\text{C to } +105^{\circ}\text{C}$		10.9		

6.5 Electrical Characteristics (continued)

Unless otherwise noted, the specification in the following table applies over the operating ambient temperature $-40^{\circ}\text{C} \leq T_A \leq +105^{\circ}\text{C}$. **Typical values are for $T_A = 25^{\circ}\text{C}$.**

PARAMETER	TEST CONDITION	T_A	MIN	TYP	MAX	UNIT
$I_{SD, VIN}$ Shutdown current	$V_{ON} = 0\text{V}, V_{OUT} = 0\text{V}$	$V_{IN} = 5.5\text{V}$	-40°C to $+85^{\circ}\text{C}$	0.5	2	μA
			-40°C to $+105^{\circ}\text{C}$		3	
		$V_{IN} = 5.0\text{V}$	-40°C to $+85^{\circ}\text{C}$	0.5	2	
			-40°C to $+105^{\circ}\text{C}$		3	
		$V_{IN} = 3.3\text{V}$	-40°C to $+85^{\circ}\text{C}$	0.5	2	
			-40°C to $+105^{\circ}\text{C}$		3	
		$V_{IN} = 1.8\text{V}$	-40°C to $+85^{\circ}\text{C}$	0.5	2	
			-40°C to $+105^{\circ}\text{C}$		3	
		$V_{IN} = 1.2\text{V}$	-40°C to $+85^{\circ}\text{C}$	0.4	2	
			-40°C to $+105^{\circ}\text{C}$		3	
		$V_{IN} = 1.05\text{V}$	-40°C to $+85^{\circ}\text{C}$	0.4	2	
			-40°C to $+105^{\circ}\text{C}$		3	
I_{ON} ON pin input leakage current	$V_{IN} = 5.5\text{V}, I_{OUT} = 0\text{A}$	-40°C to $+105^{\circ}\text{C}$			0.1	μA
R_{ON} On-resistance	$V_{IN} = 5.5\text{V}, I_{OUT} = -200\text{mA}$	25°C		37	40	$\text{m}\Omega$
		-40°C to $+85^{\circ}\text{C}$			51	
		-40°C to $+105^{\circ}\text{C}$			57	
	$V_{IN} = 5\text{V}, I_{OUT} = -200\text{mA}$	25°C		37	41	$\text{m}\Omega$
		-40°C to $+85^{\circ}\text{C}$			51	
		-40°C to $+105^{\circ}\text{C}$			57	
	$V_{IN} = 4.2\text{V}, I_{OUT} = -200\text{mA}$	25°C		37	41	$\text{m}\Omega$
		-40°C to $+85^{\circ}\text{C}$			52	
		-40°C to $+105^{\circ}\text{C}$			58	
	$V_{IN} = 3.3\text{V}, I_{OUT} = -200\text{mA}$	25°C		38	41	$\text{m}\Omega$
		-40°C to $+85^{\circ}\text{C}$			52	
		-40°C to $+105^{\circ}\text{C}$			59	
	$V_{IN} = 2.5\text{V}, I_{OUT} = -200\text{mA}$	25°C		38	42	$\text{m}\Omega$
		-40°C to $+85^{\circ}\text{C}$			53	
		-40°C to $+105^{\circ}\text{C}$			58	
	$V_{IN} = 1.8\text{V}, I_{OUT} = -200\text{mA}$	25°C		43	48	$\text{m}\Omega$
		-40°C to $+85^{\circ}\text{C}$			59	
		-40°C to $+105^{\circ}\text{C}$			66	
	$V_{IN} = 1.2\text{V}, I_{OUT} = -200\text{mA}$	25°C		52	61	$\text{m}\Omega$
		-40°C to $+85^{\circ}\text{C}$			73	
		-40°C to $+105^{\circ}\text{C}$			85	
	$V_{IN} = 1.05\text{V}, I_{OUT} = -200\text{mA}$	25°C		63	96	$\text{m}\Omega$
		-40°C to $+85^{\circ}\text{C}$			102	
		-40°C to $+105^{\circ}\text{C}$			107	

6.5 Electrical Characteristics (continued)

Unless otherwise noted, the specification in the following table applies over the operating ambient temperature $-40^{\circ}\text{C} \leq T_A \leq +105^{\circ}\text{C}$. **Typical values are for $T_A = 25^{\circ}\text{C}$.**

PARAMETER	TEST CONDITION	T_A	MIN	TYP	MAX	UNIT
V_{HYS} ON pin hysteresis	$V_{\text{IN}} = 5.5\text{V}$	25°C		102		mV
	$V_{\text{IN}} = 5\text{V}$			100		
	$V_{\text{IN}} = 3.3\text{V}$			98		
	$V_{\text{IN}} = 2.5\text{V}$			96		
	$V_{\text{IN}} = 1.8\text{V}$			96		
	$V_{\text{IN}} = 1.2\text{V}$			94		
	$V_{\text{IN}} = 1.05\text{V}$			92		
R_{PD} ⁽¹⁾ Output pull down resistor	$V_{\text{IN}} = V_{\text{OUT}} = 3.3\text{V}, V_{\text{ON}} = 0\text{V}$	-40°C to $+105^{\circ}\text{C}$		143	200	Ω

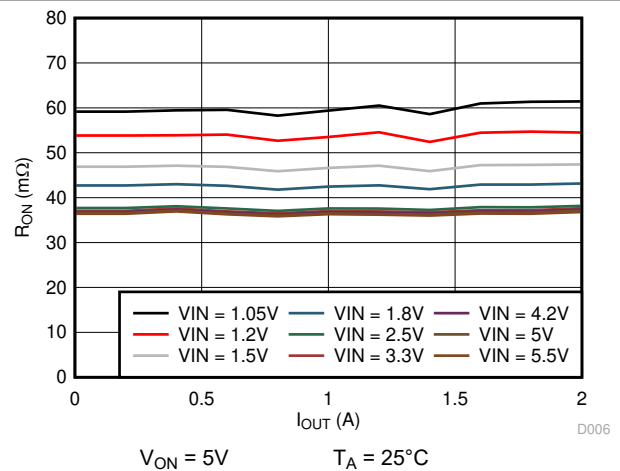
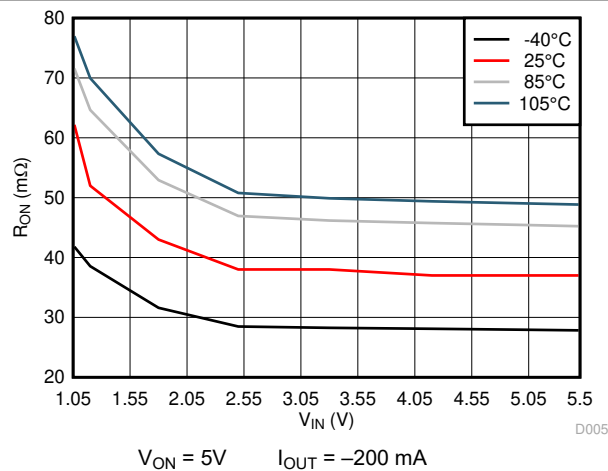
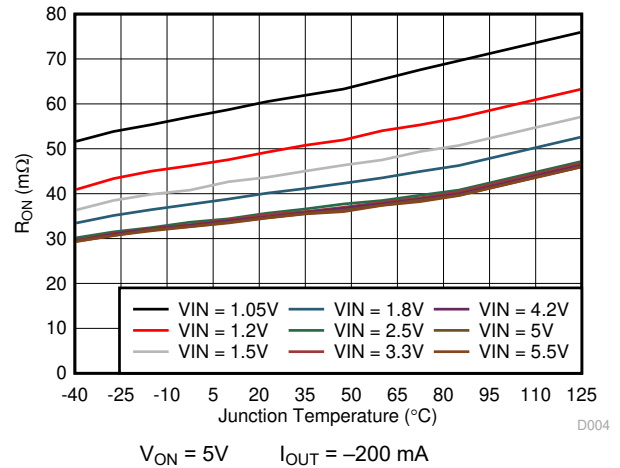
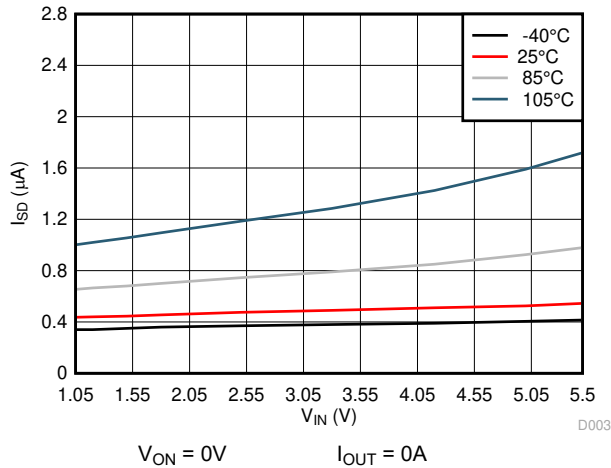
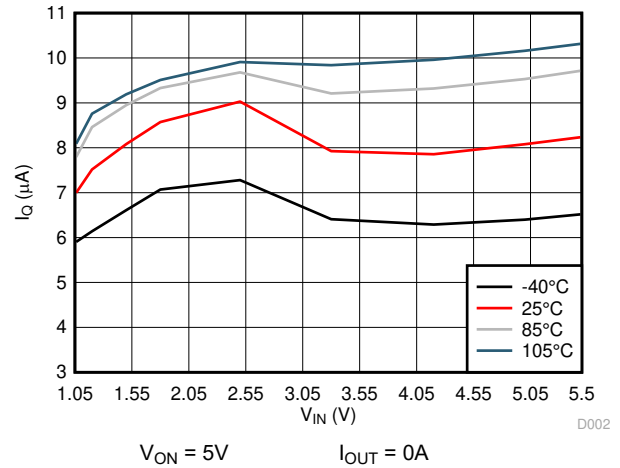
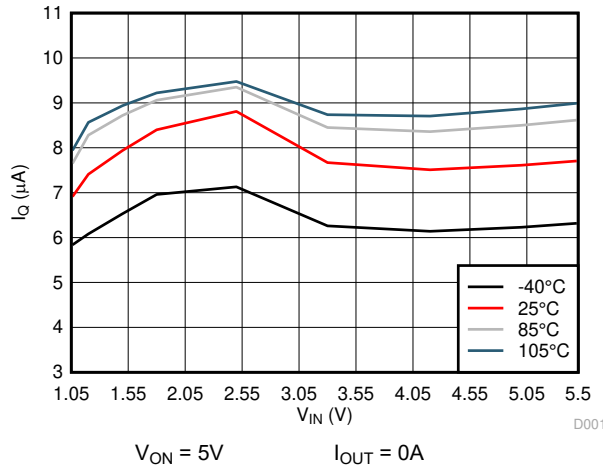
(1) TPS22915B/C only.

6.6 Switching Characteristics

Refer to the timing test circuit in [Figure 7-1](#) (unless otherwise noted) for references to external components used for the test condition in the switching characteristics table. Switching characteristics shown below are only valid for the power-up sequence where VIN is already in steady state condition before the ON pin is asserted high.

PARAMETER		TEST CONDITION	TYP (TPS22914B/15B)	TYP (TPS22914C/15C)	UNIT
V_{IN} = 5V, V_{ON} = 5V, T_A = 25°C (unless otherwise noted)					
t _{ON}	Turnon time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	104	1300	μs
t _{OFF}	Turnoff time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	2	2	μs
t _R	V _{OUT} rise time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	89	1277	μs
t _F	V _{OUT} fall time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	2	2	μs
t _D	Delay time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	59	663	μs
V_{IN} = 3.3V, V_{ON} = 5V, T_A = 25°C (unless otherwise noted)					
t _{ON}	Turnon time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	83	1077	μs
t _{OFF}	Turnoff time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	2	2	μs
t _R	V _{OUT} rise time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	64	913	μs
t _F	V _{OUT} fall time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	2	2	μs
t _D	Delay time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	52	622	μs
V_{IN} = 1.05V, V_{ON} = 5V, T_A = 25°C (unless otherwise noted)					
t _{ON}	Turnon time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	61	752	μs
t _{OFF}	Turnoff time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	3	3	μs
t _R	V _{OUT} rise time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	28	409	μs
t _F	V _{OUT} fall time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	2	2	μs
t _D	Delay time	R _L = 10Ω, C _{IN} = 1μF, C _{OUT} = 0.1μF	47	547	μs

6.7 Typical DC Characteristics



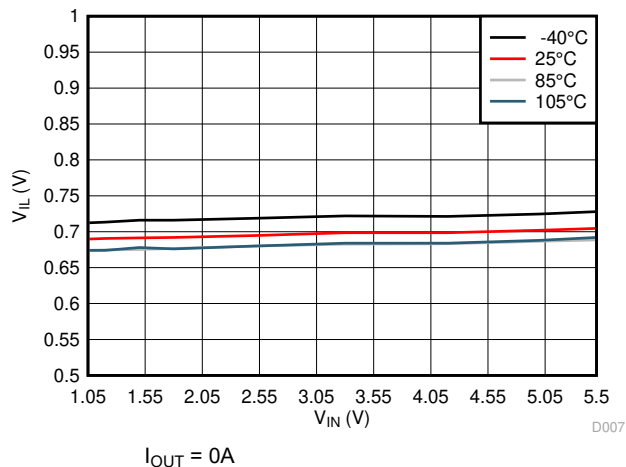


Figure 6-7. V_{IL} vs V_{IN}

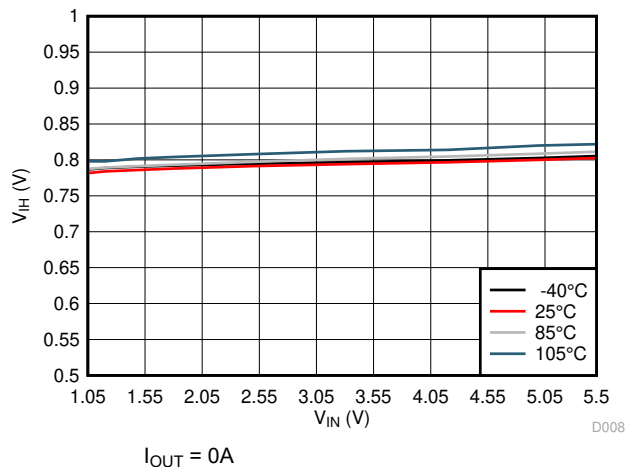


Figure 6-8. V_{IH} vs V_{IN}

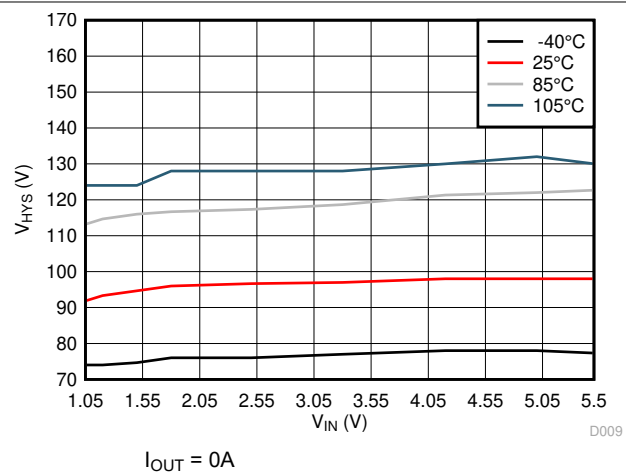


Figure 6-9. V_{HYS} vs V_{IN}

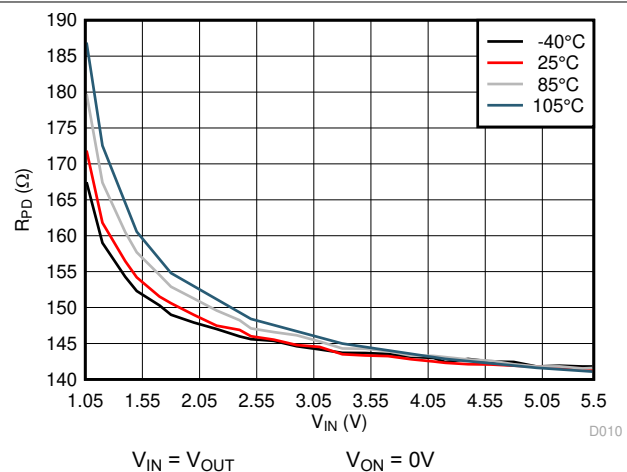


Figure 6-10. R_{PD} vs V_{IN}

6.8 Typical AC Characteristics (TPS22914B/15B)

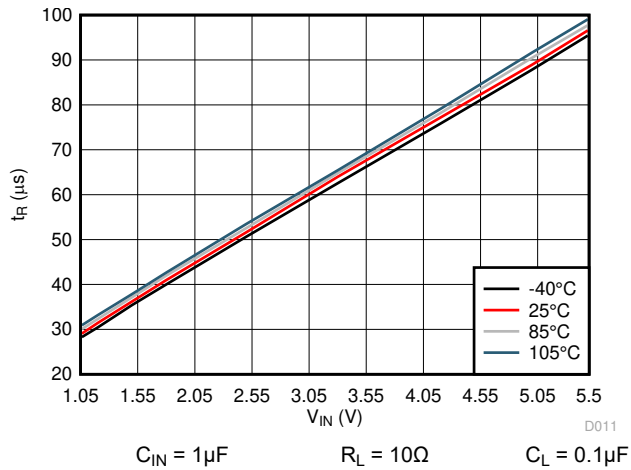


Figure 6-11. t_R vs V_{IN}

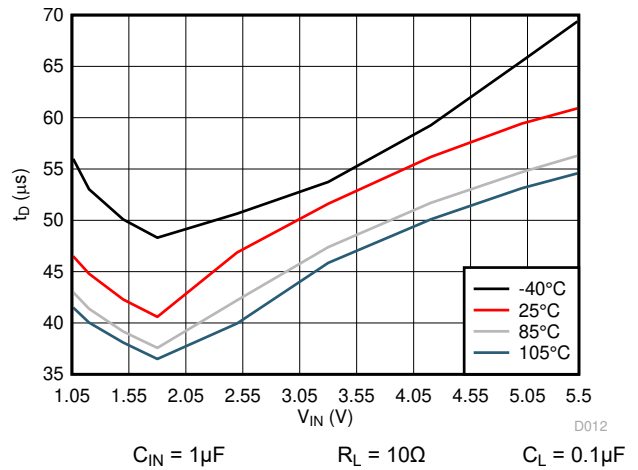


Figure 6-12. t_D vs V_{IN}

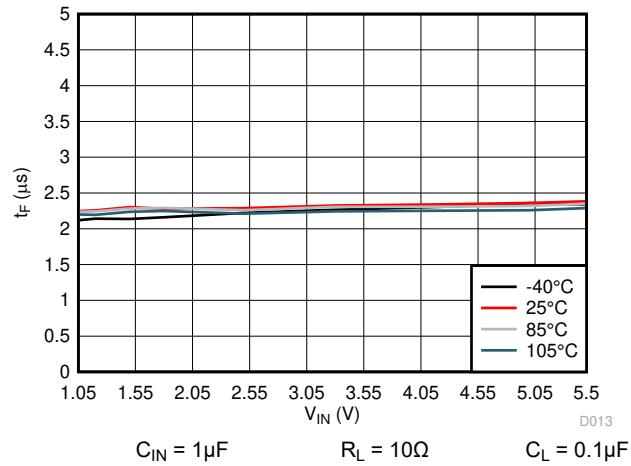


Figure 6-13. t_F vs V_{IN}

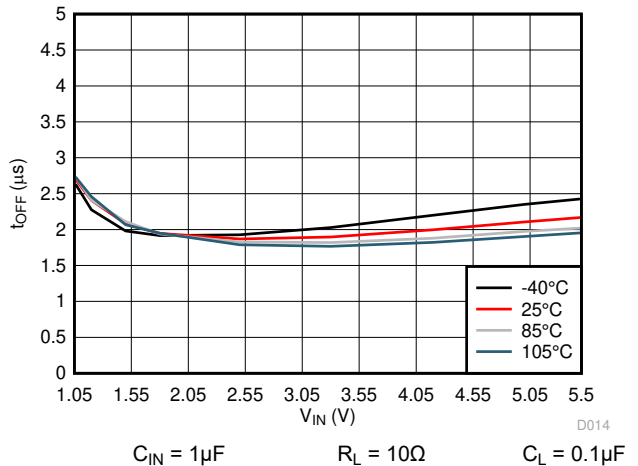


Figure 6-14. t_{OFF} vs V_{IN}

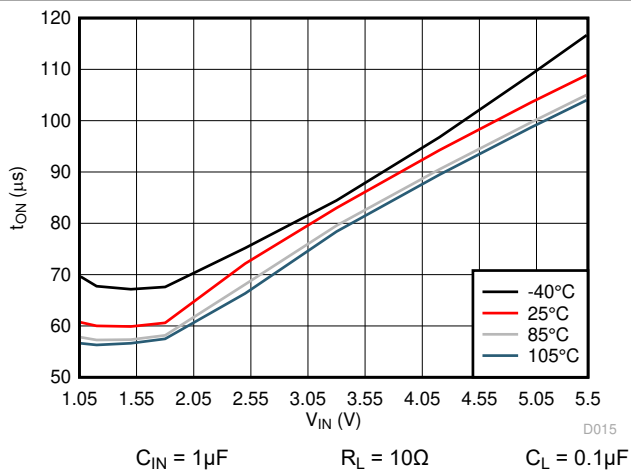


Figure 6-15. t_{ON} vs V_{IN}

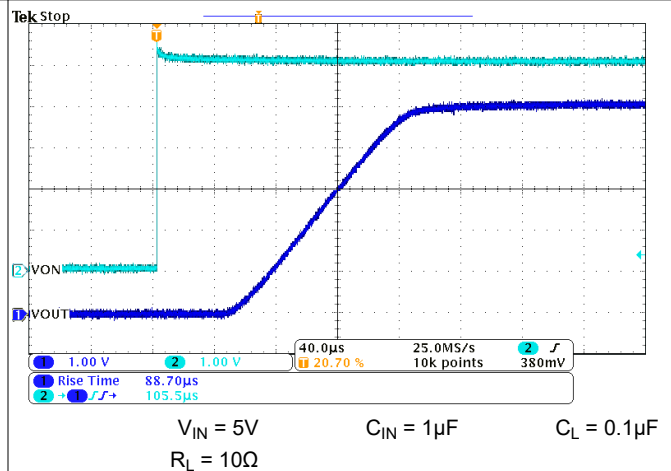


Figure 6-16. t_R at $V_{IN} = 5\text{V}$

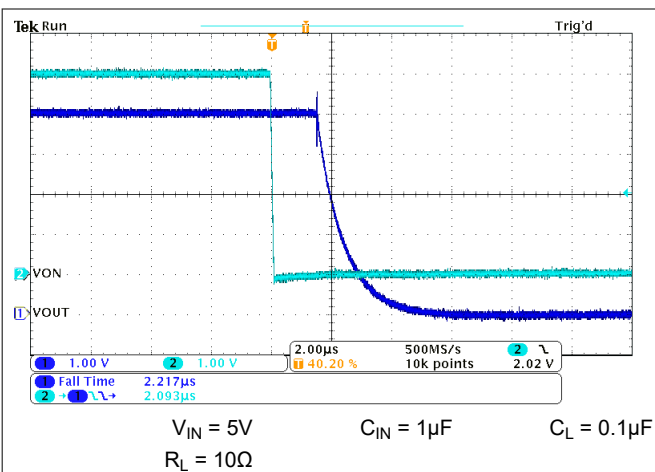


Figure 6-17. t_F at $V_{IN} = 5V$

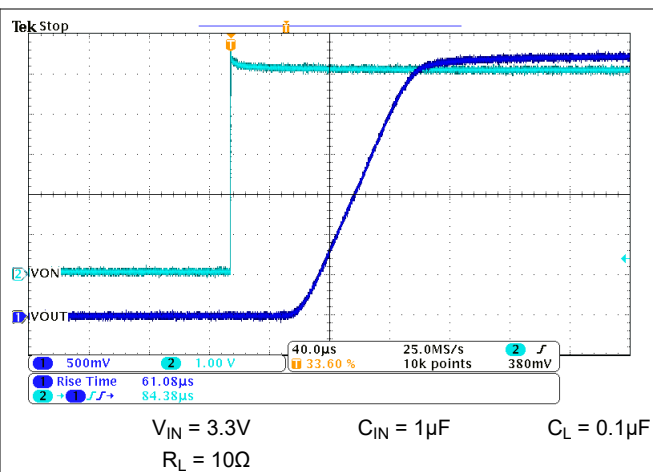


Figure 6-18. t_R at $V_{IN} = 3.3V$

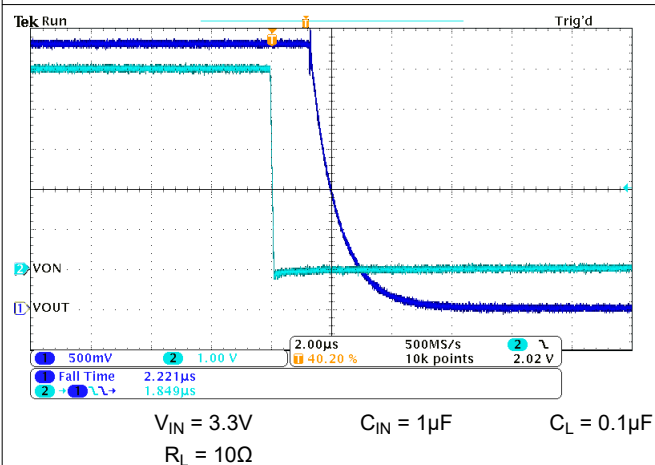


Figure 6-19. t_F at $V_{IN} = 3.3V$

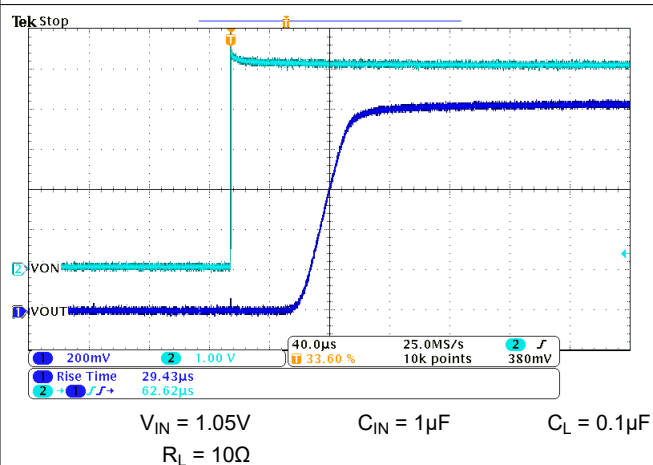


Figure 6-20. t_R at $V_{IN} = 1.05V$

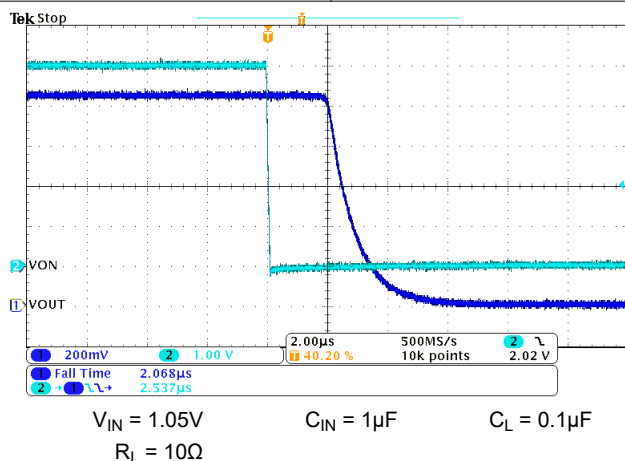


Figure 6-21. t_F at $V_{IN} = 1.05V$

6.9 Typical AC Characteristics (TPS22914C/15C)

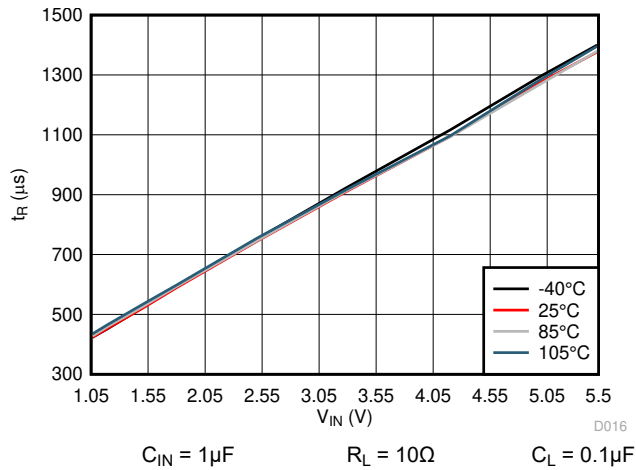


Figure 6-22. t_R vs V_{IN}

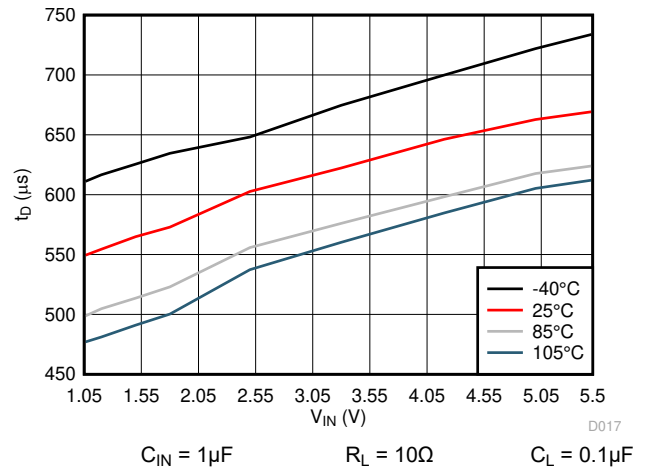


Figure 6-23. t_D vs V_{IN}

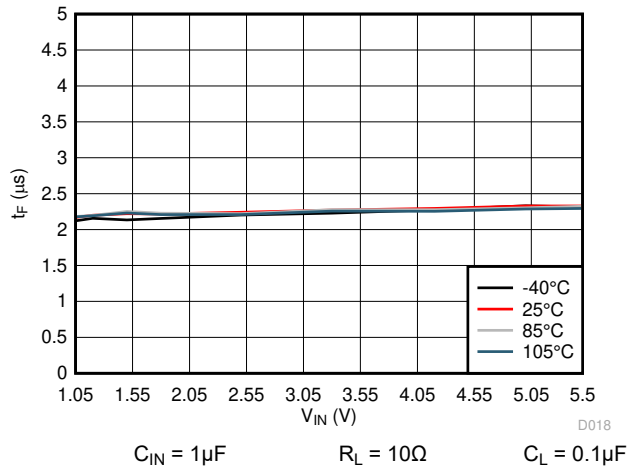


Figure 6-24. t_F vs V_{IN}

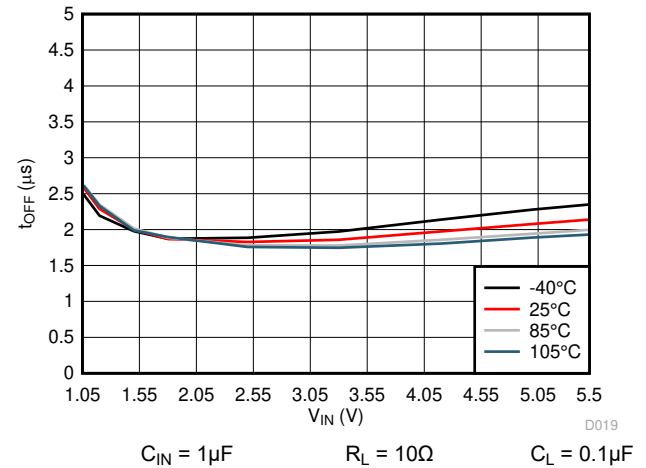


Figure 6-25. t_{OFF} vs V_{IN}

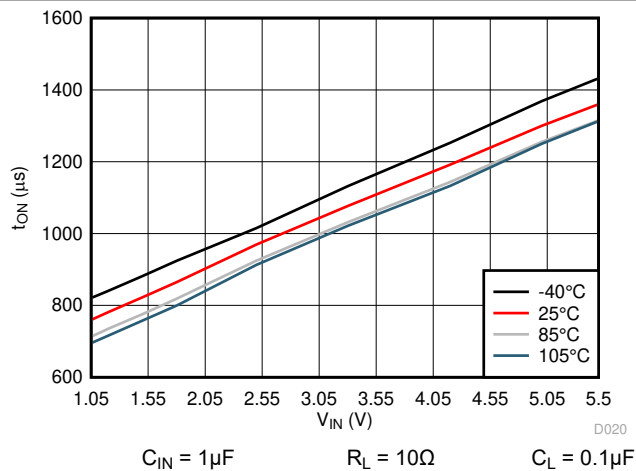


Figure 6-26. t_{ON} vs V_{IN}

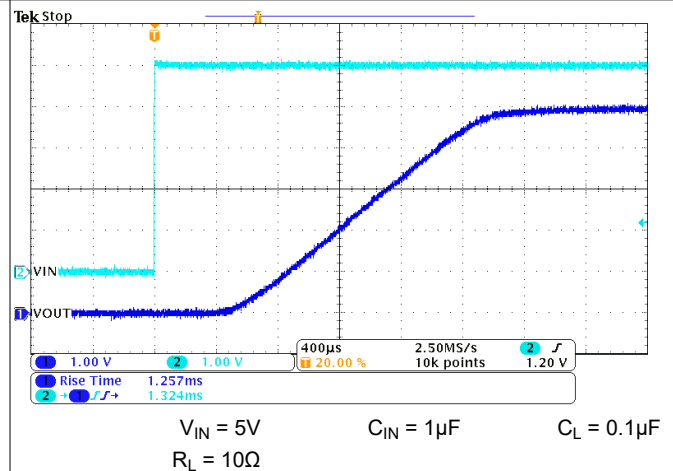


Figure 6-27. t_R at $V_{IN} = 5V$

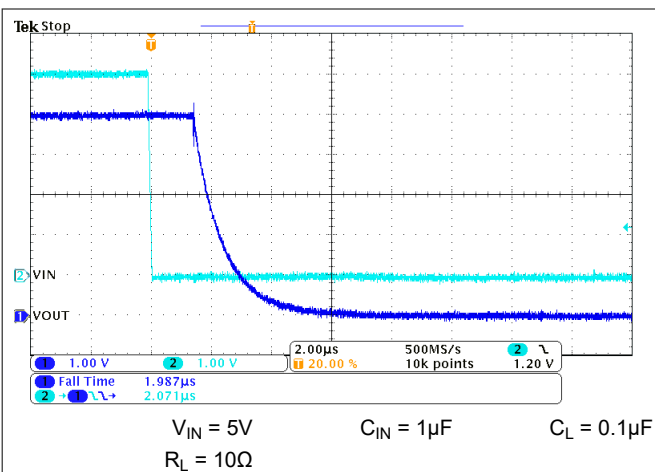


Figure 6-28. t_F at $V_{IN} = 5V$

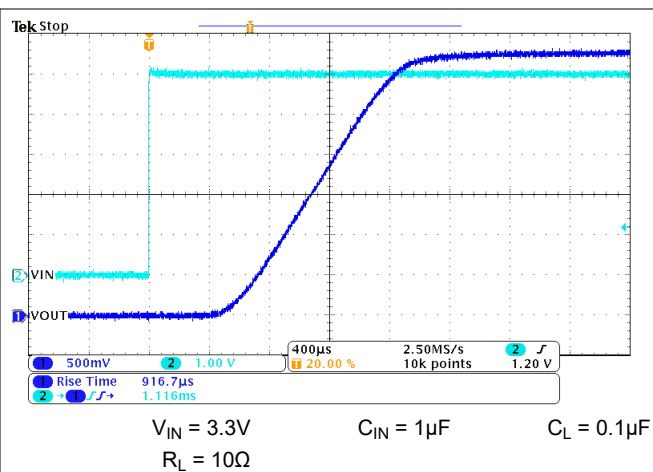


Figure 6-29. t_R at $V_{IN} = 3.3V$

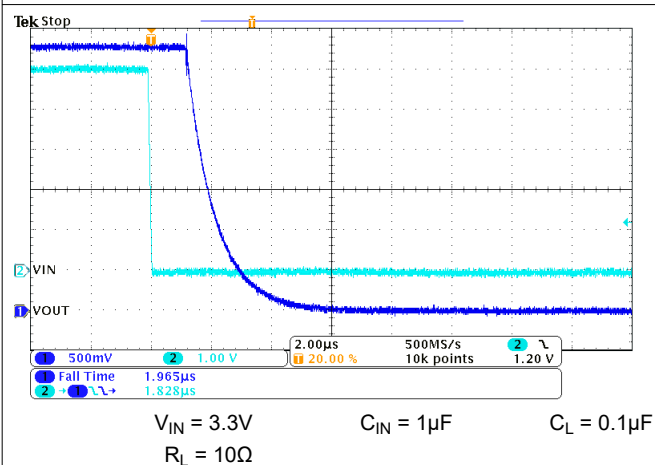


Figure 6-30. t_F at $V_{IN} = 3.3V$

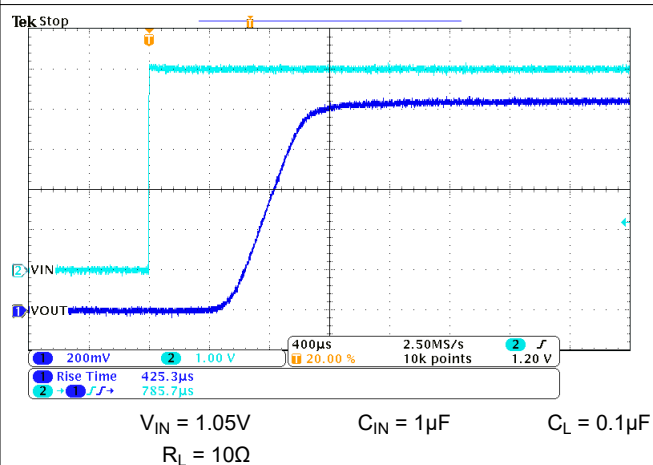


Figure 6-31. t_R at $V_{IN} = 1.05V$

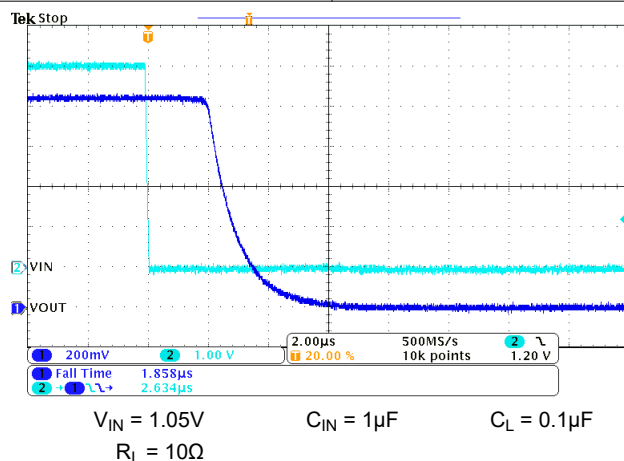
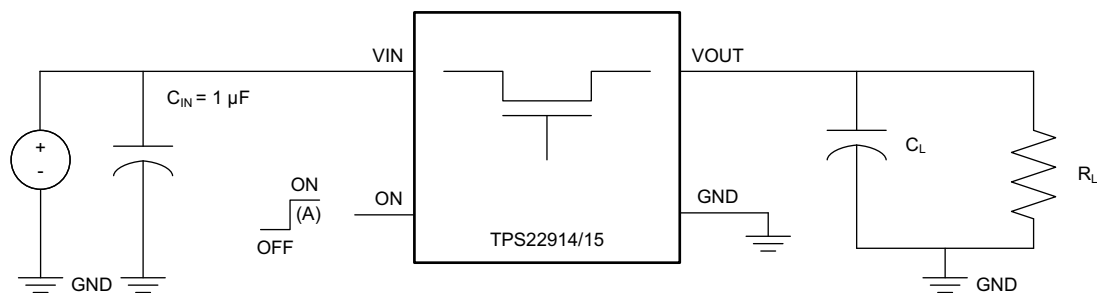


Figure 6-32. t_F at $V_{IN} = 1.05V$

7 Parameter Measurement Information



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

Figure 7-1. Test Circuit

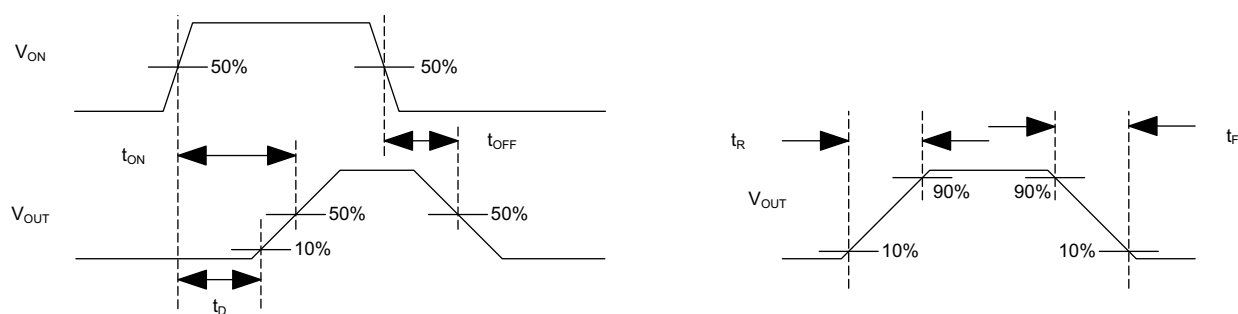


Figure 7-2. Timing Waveforms

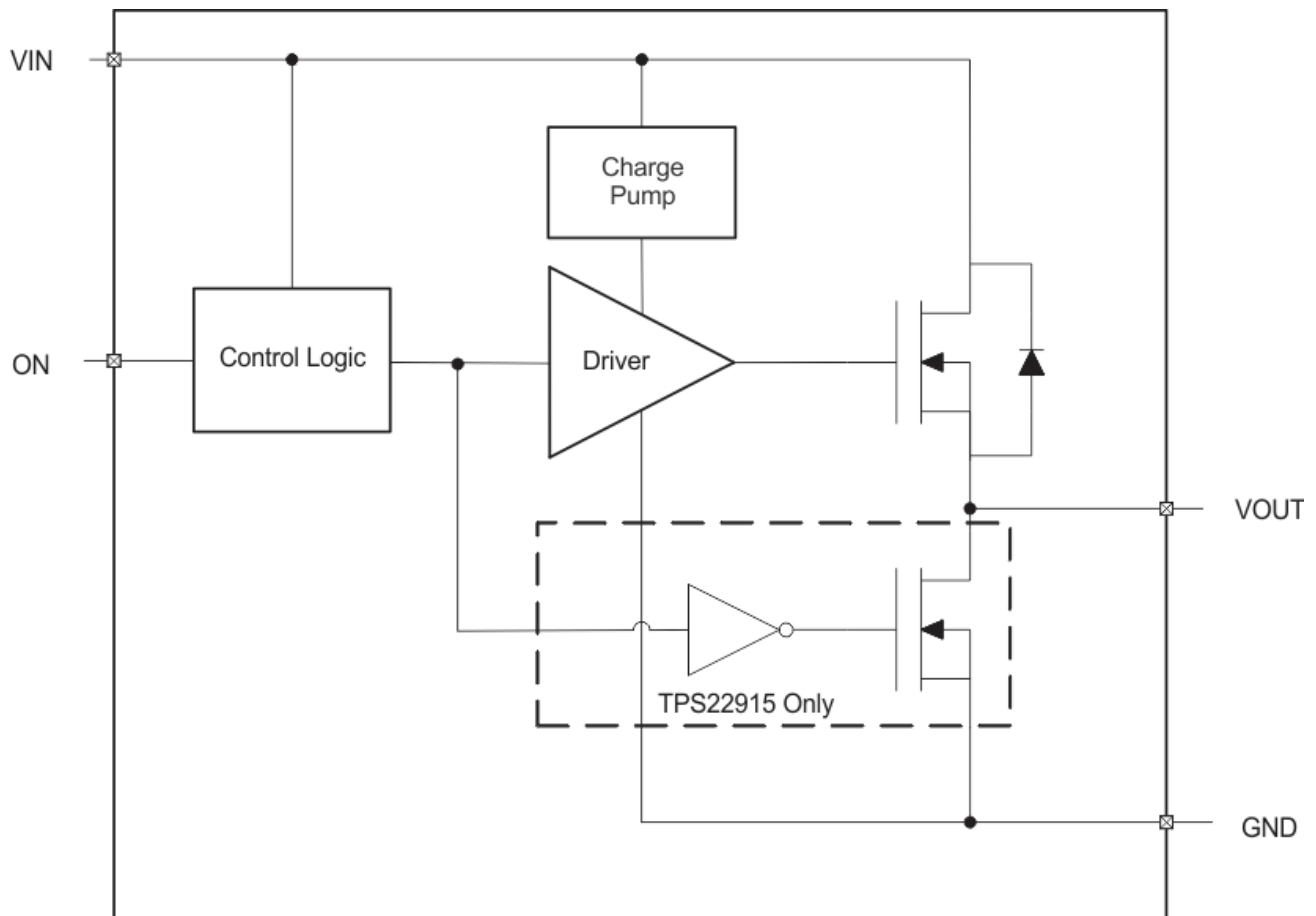
8 Detailed Description

8.1 Overview

The device is a 5.5V, 2A load switch in a 4-pin YFP package. To reduce voltage drop for low voltage and high current rails, the device implements an ultra-low resistance N-channel MOSFET which reduces the drop out voltage through the device.

The device has a controlled and fixed slew rate which helps reduce or eliminate power supply droop due to large inrush currents. During shutdown, the device has very low leakage currents, thereby reducing unnecessary leakages for downstream modules during standby. Integrated control logic, driver, charge pump, and output discharge FET eliminates the need for any external components, which reduces solution size and bill of materials (BOM) count.

8.2 Functional Block Diagram



8.3 Feature Description

8.3.1 On and Off Control

The ON pins control the state of the switch. Asserting ON high enables the switch. ON is active high and has a low threshold, making the device capable of interfacing with low-voltage signals. The ON pin is compatible with standard GPIO logic threshold. The device can be used with any microcontroller with 1V or higher GPIO voltage. This pin cannot be left floating and must be driven either high or low for proper functionality.

8.3.2 Input Capacitor (C_{IN})

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 needs to be placed between VIN and GND. A 1 μ F

ceramic capacitor, C_{IN} , placed close to the pins, is typically sufficient. Higher values of C_{IN} can be used to further reduce the voltage drop during high-current application. When switching heavy loads, use an input capacitor approximately 10 times higher than the output capacitor to avoid excessive voltage drop.

8.3.3 Output Capacitor (C_L)

Due to the integrated body diode in the MOSFET, 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 can result in current flow through the body diode from V_{OUT} to V_{IN} . A C_{IN} to C_L ratio of 10 to 1 is recommended for minimizing V_{IN} dip caused by inrush currents during startup.

8.4 Device Functional Modes

Table 8-1 describes the connection of the V_{OUT} pin depending on the state of the ON pin.

Table 8-1. V_{OUT} Connection

ON	TPS22914	TPS22915
L	Open	GND
H	VIN	VIN

9 Application and Implementation

Note

Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes, as well as validating and testing their design implementation to confirm system functionality.

9.1 Application Information

This section highlights some of the design considerations when implementing this device in various applications. A PSPICE model for this device is also available in the product page of this device.

9.2 Typical Application

This typical application demonstrates how the TPS22914 and TPS22915 can be used to power downstream modules.

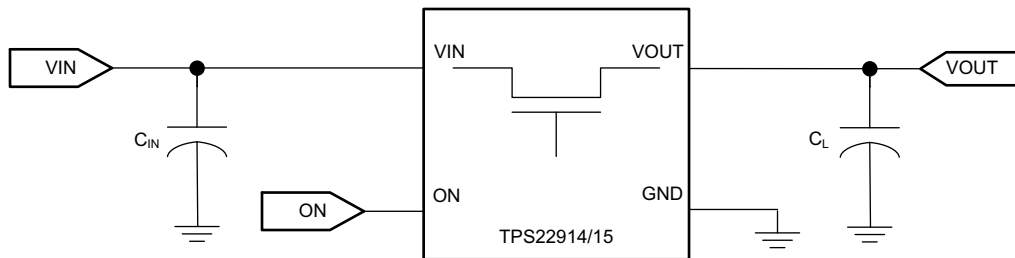


Figure 9-1. Typical Application Schematic

9.2.1 Design Requirements

For this design example, use the input parameters shown in [Table 9-1](#).

Table 9-1. Design Parameters

DESIGN PARAMETER	EXAMPLE VALUE
V_{IN}	5V
Load current	2A

9.2.2 Detailed Design Procedure

To begin the design process, the designer needs to know the following:

- V_{IN} voltage
- Load Current

9.2.2.1 VIN to VOUT Voltage Drop

The V_{IN} to V_{OUT} voltage drop in the device is determined by the R_{ON} of the device and the load current. The R_{ON} of the device depends upon the V_{IN} conditions of the device. Refer to the R_{ON} specification of the device in the [Electrical Characteristics](#) table of this data sheet. Once the R_{ON} of the device is determined based upon the V_{IN} conditions, use [Equation 1](#) to calculate the V_{IN} to V_{OUT} voltage drop.

$$\Delta V = I_{LOAD} \times R_{ON} \quad (1)$$

where

- ΔV = voltage drop from V_{IN} to V_{OUT}
- I_{LOAD} = load current
- R_{ON} = On-resistance of the device for a specific V_{IN}

An appropriate I_{LOAD} must be chosen such that the I_{MAX} specification of the device is not violated.

9.2.2.2 Inrush Current

To determine how much inrush current is caused by the C_L capacitor, use [Equation 2](#).

$$I_{INRUSH} = C_L \times \frac{dV_{OUT}}{dt} \quad (2)$$

where

- I_{INRUSH} = amount of inrush caused by C_L
- C_L = capacitance on V_{OUT}
- dt = rise time in V_{OUT} during the ramp up of V_{OUT} when the device is enabled
- dV_{OUT} = change in V_{OUT} during the ramp up of V_{OUT} when the device is enabled

An appropriate C_L value must be placed on V_{OUT} such that the I_{MAX} and I_{PLS} specifications of the device are not violated.

9.2.3 Application Curves

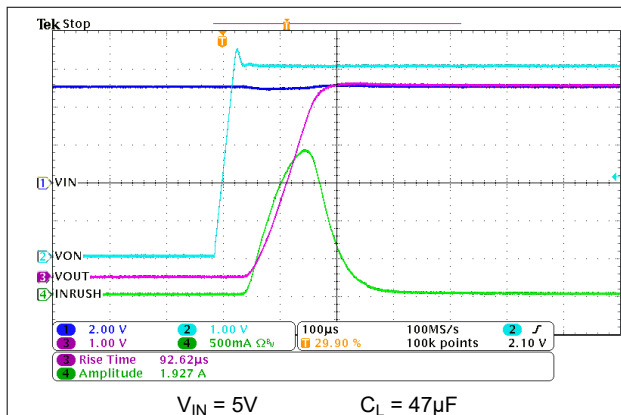


Figure 9-2. TPS22914B/15B Inrush Current

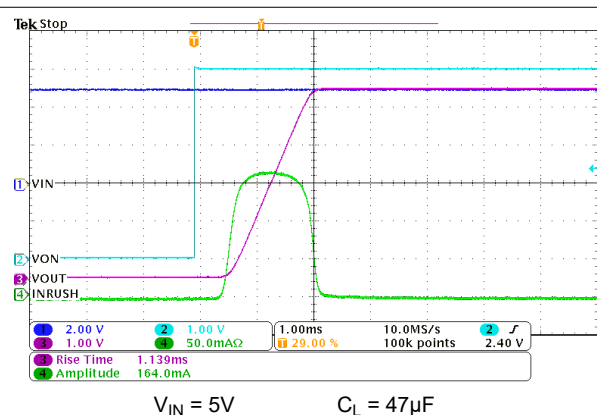


Figure 9-3. TPS22914C/15C Inrush Current

9.3 Power Supply Recommendations

The device is designed to operate from a VIN range of 1.05V to 5.5V. This supply must be well regulated and placed as close to the device terminal as possible with the recommended 1µF bypass capacitor. If the supply is located more than a few inches from the device terminals, additional bulk capacitance can be required in addition to the ceramic bypass capacitors. If additional bulk capacitance is required, an electrolytic, tantalum, or ceramic capacitor of 1µF can be sufficient.

9.4 Layout

9.4.1 Layout Guidelines

1. VIN and VOUT traces must be as short and wide as possible to accommodate for high current.
2. The VIN pin must be bypassed to ground with low ESR ceramic bypass capacitors. The typical recommended bypass capacitance is 1µF ceramic with X5R or X7R dielectric. This capacitor must be placed as close to the device pins as possible.
3. The VOUT pin must be bypassed to ground with low ESR ceramic bypass capacitors. The typical recommended bypass capacitance is one-tenth of the VIN bypass capacitor of X5R or X7R dielectric rating. This capacitor must be placed as close to the device pins as possible.

9.4.1.1 Thermal Considerations

For best performance, all traces must be as short as possible. To be most effective, the input and output capacitors must be placed close to the device to minimize the effects that parasitic trace inductances can have on normal and short-circuit operation. Using wide traces for VIN, VOUT, and GND helps minimize the parasitic electrical effects along with minimizing the case to ambient thermal impedance.

The maximum IC junction temperature must be restricted to 125°C under normal operating conditions. To calculate the maximum allowable dissipation, $P_{D(max)}$ for a given output current and ambient temperature, use [Equation 3](#).

$$P_{D(MAX)} = \frac{T_{J(MAX)} - T_A}{\theta_{JA}} \quad (3)$$

where

- $P_{D(MAX)}$ = maximum allowable power dissipation
- $T_{J(MAX)}$ = maximum allowable junction temperature (125°C for the TPS22914/15)
- T_A = ambient temperature of the device
- θ_{JA} = junction to air thermal impedance. Refer to the [Thermal Information](#) table. This parameter is highly dependent upon board layout.

9.4.2 Layout Example

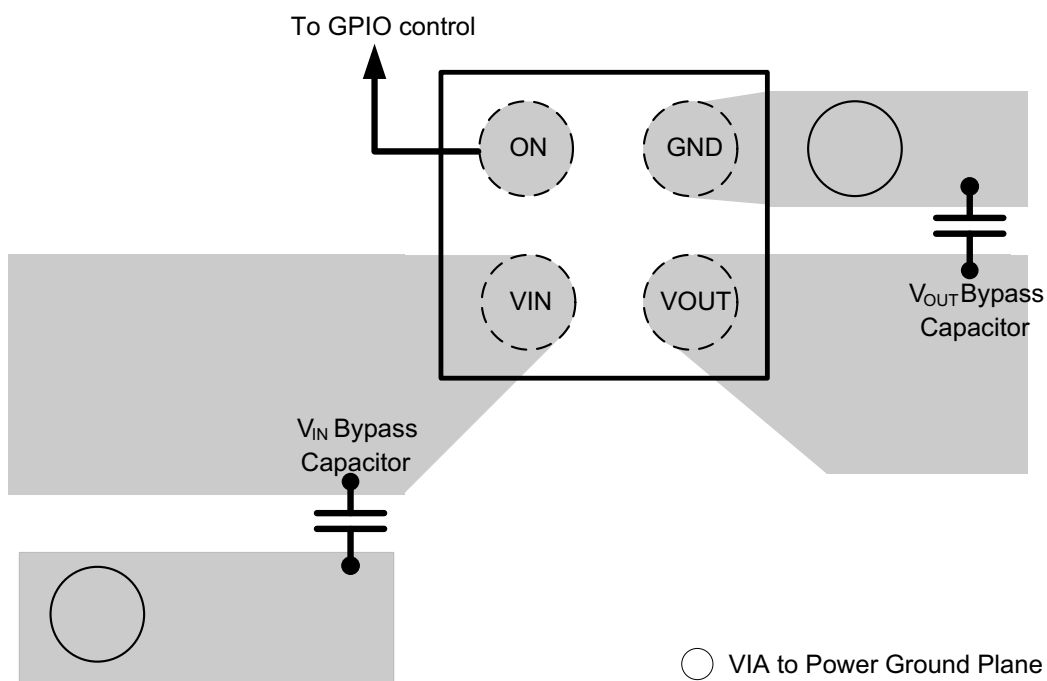


Figure 9-4. Recommended Board Layout

10 Device and Documentation Support

10.1 Documentation Support

10.1.1 Related Documentation

For related documentation see the following:

- [Basics of Load Switches](#)
- [Managing Inrush Current](#)
- [Load Switch Thermal Considerations](#)
- [Using the TPS22915BEVM-078 Single Channel Load Switch IC](#)
- [Implementing Ship Mode Using the TPS22915B Load Switches](#)

10.2 Related Links

The table below lists quick access links. Categories include technical documents, support and community resources, tools and software, and quick access to sample or buy.

Table 10-1. Related Links

PARTS	PRODUCT FOLDER	SAMPLE & BUY	TECHNICAL DOCUMENTS	TOOLS & SOFTWARE	SUPPORT & COMMUNITY
TPS22914B	Click here	Click here	Click here	Click here	Click here
TPS22914C	Click here	Click here	Click here	Click here	Click here
TPS22915B	Click here	Click here	Click here	Click here	Click here
TPS22915C	Click here	Click here	Click here	Click here	Click here

10.3 Receiving Notification of Documentation Updates

To receive notification of documentation updates, navigate to the device product folder on [ti.com](#). Click on *Notifications* to register and receive a weekly digest of any product information that has changed. For change details, review the revision history included in any revised document.

10.4 Support Resources

TI E2E™ [support forums](#) are an engineer's go-to source for fast, verified answers and design help — straight from the experts. Search existing answers or ask your own question to get the quick design help you need.

Linked content is provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

10.5 Trademarks

Ultrabook™ is a trademark of Intel.

TI E2E™ is a trademark of Texas Instruments.

All trademarks are the property of their respective owners.

10.6 Electrostatic Discharge Caution



This integrated circuit can be damaged by ESD. Texas Instruments recommends that all integrated circuits be handled with appropriate precautions. Failure to observe proper handling and installation procedures can cause damage.

ESD damage can range from subtle performance degradation to complete device failure. Precision integrated circuits may be more susceptible to damage because very small parametric changes could cause the device not to meet its published specifications.

10.7 Glossary

[TI Glossary](#) This glossary lists and explains terms, acronyms, and definitions.

11 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

Changes from Revision E (October 2020) to Revision F (July 2025)	Page
• Updated the size of the device	1
• Updated package size in the Description paragraph.....	1

Changes from Revision D (September 2016) to Revision E (October 2020)	Page
• Updated the numbering format for tables, figures and cross-references throughout the document.....	1
• Updated the body size in the Device Information table.....	1

12 Mechanical, Packaging, and Orderable Information

The following pages include mechanical, packaging, and orderable information. This information is the most current data available for the designated devices. This data is subject to change without notice and revision of this document. For browser-based versions of this data sheet, refer to the left-hand navigation.

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
TPS22914BYFPR	Active	Production	DSBGA (YFP) 4	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 105	S3
TPS22914BYFPR.A	Active	Production	null (null)	3000 LARGE T&R	-	SNAGCU	Level-1-260C-UNLIM	See TPS22914BYFPR	S3
TPS22914BYFPT	Active	Production	DSBGA (YFP) 4	250 SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 105	S3
TPS22914BYFPT.A	Active	Production	null (null)	250 SMALL T&R	-	SNAGCU	Level-1-260C-UNLIM	See TPS22914BYFPT	S3
TPS22914CYFPR	Active	Production	DSBGA (YFP) 4	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 105	S6
TPS22914CYFPR.A	Active	Production	null (null)	3000 LARGE T&R	-	SNAGCU	Level-1-260C-UNLIM	See TPS22914CYFPR	S6
TPS22914CYFPT	Active	Production	DSBGA (YFP) 4	250 SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 105	S6
TPS22914CYFPT.A	Active	Production	null (null)	250 SMALL T&R	-	SNAGCU	Level-1-260C-UNLIM	See TPS22914CYFPT	S6
TPS22915BYFPR	Active	Production	DSBGA (YFP) 4	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 105	S4
TPS22915BYFPR.A	Active	Production	null (null)	3000 LARGE T&R	-	SNAGCU	Level-1-260C-UNLIM	See TPS22915BYFPR	S4
TPS22915BYFPT	Active	Production	DSBGA (YFP) 4	250 SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 105	S4
TPS22915BYFPT.A	Active	Production	null (null)	250 SMALL T&R	-	SNAGCU	Level-1-260C-UNLIM	See TPS22915BYFPT	S4
TPS22915CYFPR	Active	Production	DSBGA (YFP) 4	3000 LARGE T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 105	S7
TPS22915CYFPR.A	Active	Production	null (null)	3000 LARGE T&R	-	SNAGCU	Level-1-260C-UNLIM	See TPS22915CYFPR	S7
TPS22915CYFPT	Active	Production	DSBGA (YFP) 4	250 SMALL T&R	Yes	SNAGCU	Level-1-260C-UNLIM	-40 to 105	S7
TPS22915CYFPT.A	Active	Production	null (null)	250 SMALL T&R	-	SNAGCU	Level-1-260C-UNLIM	See TPS22915CYFPT	S7

(1) **Status:** For more details on status, see our [product life cycle](#).

(2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.

(3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.

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

(5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.

(6) Part marking: There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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



*All dimensions are nominal

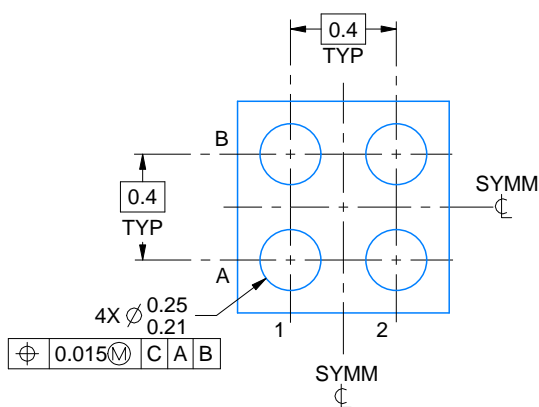
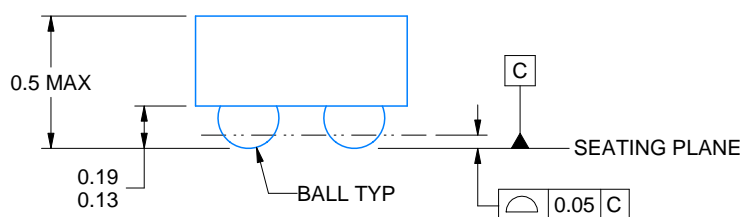
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
TPS22914BYFPR	DSBGA	YFP	4	3000	180.0	8.4	0.85	0.85	0.64	4.0	8.0	Q1
TPS22914BYFPT	DSBGA	YFP	4	250	180.0	8.4	0.85	0.85	0.64	4.0	8.0	Q1
TPS22914CYFPR	DSBGA	YFP	4	3000	180.0	8.4	0.85	0.85	0.64	4.0	8.0	Q1
TPS22914CYFPT	DSBGA	YFP	4	250	180.0	8.4	0.85	0.85	0.64	4.0	8.0	Q1
TPS22915BYFPR	DSBGA	YFP	4	3000	180.0	8.4	0.85	0.85	0.64	4.0	8.0	Q1
TPS22915BYFPT	DSBGA	YFP	4	250	180.0	8.4	0.85	0.85	0.64	4.0	8.0	Q1
TPS22915CYFPR	DSBGA	YFP	4	3000	180.0	8.4	0.85	0.85	0.64	4.0	8.0	Q1
TPS22915CYFPT	DSBGA	YFP	4	250	180.0	8.4	0.85	0.85	0.64	4.0	8.0	Q1

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

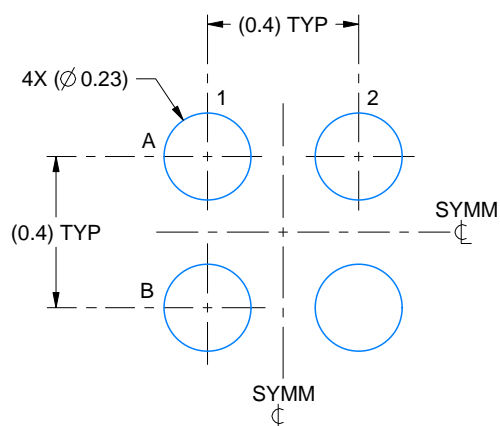
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS22914BYFPR	DSBGA	YFP	4	3000	182.0	182.0	20.0
TPS22914BYFPT	DSBGA	YFP	4	250	182.0	182.0	20.0
TPS22914CYFPR	DSBGA	YFP	4	3000	182.0	182.0	20.0
TPS22914CYFPT	DSBGA	YFP	4	250	182.0	182.0	20.0
TPS22915BYFPR	DSBGA	YFP	4	3000	182.0	182.0	20.0
TPS22915BYFPT	DSBGA	YFP	4	250	182.0	182.0	20.0
TPS22915CYFPR	DSBGA	YFP	4	3000	182.0	182.0	20.0
TPS22915CYFPT	DSBGA	YFP	4	250	182.0	182.0	20.0



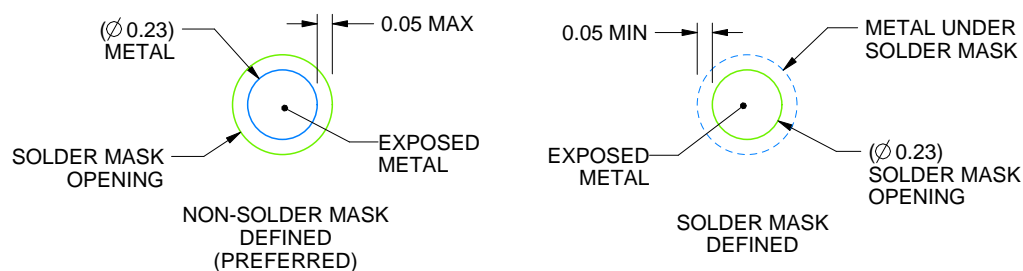
E: Max = 0.778 mm, Min = 0.718 mm

NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



LAND PATTERN EXAMPLE
EXPOSED METAL SHOWN
SCALE:50X



SOLDER MASK DETAILS
NOT TO SCALE

4223507/A 01/2017

NOTES: (continued)

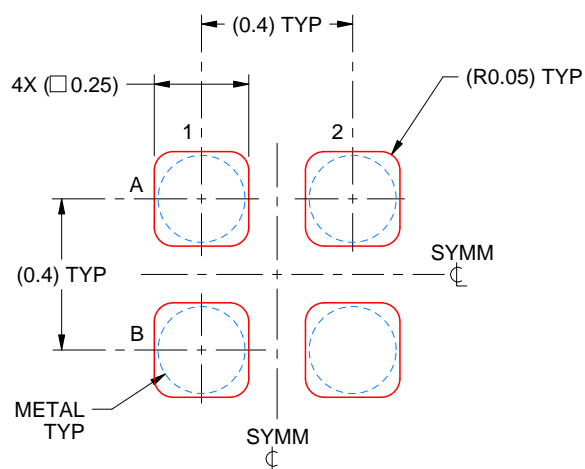
- Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. For more information, see Texas Instruments literature number SNVA009 (www.ti.com/lit/snva009).

EXAMPLE STENCIL DESIGN

YFP0004

DSBGA - 0.5 mm max height

DIE SIZE BALL GRID ARRAY



SOLDER PASTE EXAMPLE
BASED ON 0.1 mm THICK STENCIL
SCALE:50X

4223507/A 01/2017

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

IMPORTANT NOTICE AND DISCLAIMER

TI PROVIDES TECHNICAL AND RELIABILITY DATA (INCLUDING DATA SHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES "AS IS" AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS AND IMPLIED, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for skilled developers designing with TI products. You are solely responsible for (1) selecting the appropriate TI products for your application, (2) designing, validating and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, regulatory or other requirements.

These resources are subject to change without notice. TI grants you permission to use these resources only for development of an application that uses the TI products described in the resource. Other reproduction and display of these resources is prohibited. No license is granted to any other TI intellectual property right or to any third party intellectual property right. TI disclaims responsibility for, and you will fully indemnify TI and its representatives against, any claims, damages, costs, losses, and liabilities arising out of your use of these resources.

TI's products are provided subject to [TI's Terms of Sale](#) or other applicable terms available either on [ti.com](https://www.ti.com) or provided in conjunction with such TI products. TI's provision of these resources does not expand or otherwise alter TI's applicable warranties or warranty disclaimers for TI products.

TI objects to and rejects any additional or different terms you may have proposed.

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265
Copyright © 2025, Texas Instruments Incorporated