

## AUTOSWITCHING POWER MUX

Check for Samples: [TPS2114A](#), [TPS2115A](#)

### FEATURES

- Two-Input, One-Output Power Multiplexer with Low  $r_{DS(on)}$  Switches:
  - 120 m $\Omega$  Typ (TPS2114A)
  - 84 m $\Omega$  Typ (TPS2115A)
- Reverse and Cross-Conduction Blocking
- Wide Operating Voltage Range: 2.8 V to 5.5 V
- Low Standby Current: 0.5- $\mu$ A Typ
- Low Operating Current: 55- $\mu$ A Typ
- Adjustable Current Limit
- Controlled Output Voltage Transition Times
- Limit Inrush Current and Minimize Output Voltage Hold-Up Capacitance
- CMOS- and TTL-Compatible Control Inputs
- Manual and Auto-Switching Operating Modes
- Thermal Shutdown
- Available in TSSOP-8 and 3-mm  $\times$  3-mm SON-8 Packages

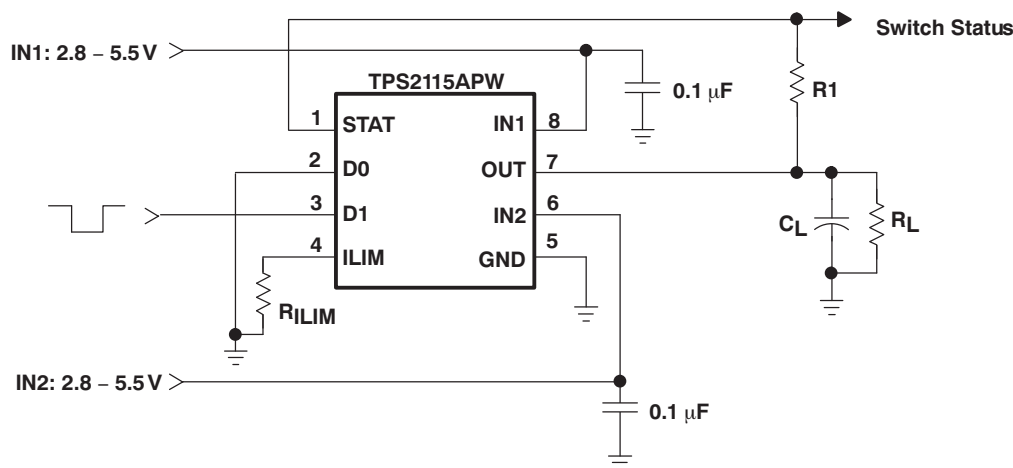
### APPLICATIONS

- PCs
- PDAs
- Digital Cameras
- Modems
- Cell Phones
- Digital Radios
- MP3 Players

### DESCRIPTION

The TPS211xA family of power multiplexers enables seamless transition between two power supplies (such as a battery and a wall adapter), each operating at 2.8 V to 5.5 V and delivering up to 2 A, depending on package. The TPS211xA family includes extensive protection circuitry, including user-programmable current limiting, thermal protection, inrush current control, seamless supply transition, cross-conduction blocking, and reverse-conduction blocking. These features greatly simplify designing power multiplexer applications.

### 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.

All trademarks are the property of their respective owners.



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.

### DEVICE INFORMATION<sup>(1)</sup>

T <sub>A</sub>	PACKAGE	I <sub>OUT</sub>	ORDERING NUMBER	MARKING
–40°C to 85°C	TSSOP-8 (PW)	0.75	TPS2114APW	2114A
		1.25	TPS2115APW	2115A
	SON-8 (DRB)	2	TPS2115ADRB	CGF

(1) For the most current package and ordering information see the Package Option Addendum at the end of this document, or visit the device product folder at [www.ti.com](http://www.ti.com).

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

Over recommended junction temperature range (unless otherwise noted).

		VALUE		UNIT
		MIN	MAX	
Voltage	IN1, IN2, D0, D1, ILIM <sup>(2)</sup>	–0.3	6	V
	V <sub>O(OUT)</sub> , V <sub>O(STAT)</sub> <sup>(2)</sup>	–0.3	6	V
Current	Output sink, I <sub>O(STAT)</sub>		5	mA
	Continuous output, I <sub>O</sub> (TPS2114APW)		0.9	A
	Continuous output, I <sub>O</sub> (TPS2115APW)		1.5	A
	Continuous output, I <sub>O</sub> (TPS2115ADRB), T <sub>J</sub> ≤ 105°C		2.5	A
Power dissipation	Continuous total	See <a href="#">Power Dissipation Ratings</a> table		
Temperature	Operating virtual junction, T <sub>J</sub>	–40	125	°C
ESD ratings	Human body model, HBM		2	kV
	Charge device model, CDM		500	V

(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 is not implied. Exposure to absolute-maximum rated conditions for extended periods may affect device reliability.

(2) All voltages are with respect to GND.

### AVAILABLE OPTIONS

FEATURE		TPS2114A	TPS2115A
Current limit adjustment range		0.31 A to 0.75 A	0.63 A to 2 A
Switching modes	Manual	Yes	Yes
	Automatic	Yes	Yes
Switch status output		Yes	Yes
Package	TSSOP-8		TSSOP-8
			SON-8

## PACKAGE DISSIPATION RATINGS

PACKAGE	DERATING FACTOR ABOVE $T_A = 25^{\circ}\text{C}$	$T_A \leq 25^{\circ}\text{C}$ POWER RATING	$T_A = 70^{\circ}\text{C}$ POWER RATING	$T_A = 85^{\circ}\text{C}$ POWER RATING
TSSOP-8 (PW)	3.9 mW/ $^{\circ}\text{C}$	387 mW	213 mW	155 mW
SON-8 (DRB)	25.0 mW/ $^{\circ}\text{C}$	2.50 W	1.38 W	1.0 W

## RECOMMENDED OPERATING CONDITIONS

		MIN	NOM	MAX	UNIT
Input voltage at IN1, $V_{I(IN1)}$	$V_{I(IN2)} \geq 2.8\text{ V}$	1.5		5.5	V
	$V_{I(IN2)} < 2.8\text{ V}$	2.8		5.5	V
Input voltage at IN2, $V_{I(IN2)}$	$V_{I(IN1)} \geq 2.8\text{ V}$	1.5		5.5	V
	$V_{I(IN1)} < 2.8\text{ V}$	2.8		5.5	V
Input voltage, $V_{I(DO)}$ , $V_{I(D1)}$		0		5.5	V
Nominal current limit adjustment range, $I_{O(OUT)}^{(1)}$	TPS2114APW	0.31		0.75	A
	TPS2115APW	0.63		1.25	A
	TPS2115ADRB, $T_J \leq 105^{\circ}\text{C}$	0.63		2	A
Operating virtual junction temperature, $T_J$		-40		125	$^{\circ}\text{C}$

(1) Minimum recommended current is based on accuracy considerations.

## ELECTRICAL CHARACTERISTICS: POWER SWITCH

Over recommended operating junction temperature range,  $V_{I(IN1)} = V_{I(IN2)} = 5.5\text{ V}$ , and  $R_{LIM} = 400\ \Omega$ , unless otherwise noted.

PARAMETER	TEST CONDITIONS	TPS2114A			TPS2115A			UNIT
		MIN	TYP	MAX	MIN	TYP	MAX	
$r_{DS(on)}^{(1)}$ Drain-source on-state resistance (INx-OUT)	$T_J = 25^{\circ}\text{C}$ , $I_L = 500\text{ mA}$ , $V_{I(IN1)} = V_{I(IN2)} = 5.0\text{ V}$		120	140		84	110	m $\Omega$
	$T_J = 25^{\circ}\text{C}$ , $I_L = 500\text{ mA}$ , $V_{I(IN1)} = V_{I(IN2)} = 3.3\text{ V}$		120	140		84	110	m $\Omega$
	$T_J = 25^{\circ}\text{C}$ , $I_L = 500\text{ mA}$ , $V_{I(IN1)} = V_{I(IN2)} = 2.8\text{ V}$		120	140		84	110	m $\Omega$
	$T_J = 125^{\circ}\text{C}$ , $I_L = 500\text{ mA}$ , $V_{I(IN1)} = V_{I(IN2)} = 5.0\text{ V}$			220			150	m $\Omega$
	$T_J = 125^{\circ}\text{C}$ , $I_L = 500\text{ mA}$ , $V_{I(IN1)} = V_{I(IN2)} = 3.3\text{ V}$			220			150	m $\Omega$
	$T_J = 125^{\circ}\text{C}$ , $I_L = 500\text{ mA}$ , $V_{I(IN1)} = V_{I(IN2)} = 2.8\text{ V}$			220			150	m $\Omega$

(1) The TPS211xA can switch a voltage as low as 1.5 V as long as there is a minimum of 2.8 V at one of the input power pins. In this specific case, the lower supply voltage has no effect on the IN1 and IN2 switch on-resistances.

**ELECTRICAL CHARACTERISTICS: GENERAL**

Over recommended operating junction temperature range,  $V_{I(IN1)} = V_{I(IN2)} = 5.5\text{ V}$ , and  $R_{ILIM} = 400\ \Omega$ , unless otherwise noted.

PARAMETER		TEST CONDITIONS	TPS2114A			UNIT	
			MIN	TYP	MAX		
LOGIC INPUTS (D0 AND D1)							
V <sub>IH</sub>	High-level input voltage		2			V	
V <sub>IL</sub>	Low-level input voltage					0.7	V
Input current at D0 or D1		D0 or D1 = high, sink current				1	μA
		D0 or D1 = low, source current	0.5	1.4	5	μA	
SUPPLY AND LEAKAGE CURRENTS							
Supply current from IN1 (operating)		D1 = high, D0 = low (IN1 active), V <sub>I(IN1)</sub> = 5.5 V, V <sub>I(IN2)</sub> = 3.3 V, I <sub>O(OUT)</sub> = 0 A		55	90	μA	
		D1 = high, D0 = low (IN1 active), V <sub>I(IN1)</sub> = 3.3 V, V <sub>I(IN2)</sub> = 5.5 V, I <sub>O(OUT)</sub> = 0 A		1	12	μA	
		D0 = D1 = low (IN2 active), V <sub>I(IN1)</sub> = 5.5 V, V <sub>I(IN2)</sub> = 3.3 V, I <sub>O(OUT)</sub> = 0 A			75	μA	
		D0 = D1 = low (IN2 active), V <sub>I(IN1)</sub> = 3.3 V, V <sub>I(IN2)</sub> = 5.5 V, I <sub>O(OUT)</sub> = 0 A			1	μA	
Supply current from IN2 (operating)		D1 = high, D0 = low (IN1 active), V <sub>I(IN1)</sub> = 5.5 V, V <sub>I(IN2)</sub> = 3.3 V, I <sub>O(OUT)</sub> = 0 A			1	μA	
		D1 = high, D0 = low (IN1 active), V <sub>I(IN1)</sub> = 3.3 V, V <sub>I(IN2)</sub> = 5.5 V, I <sub>O(OUT)</sub> = 0 A			75	μA	
		D0 = D1 = low (IN2 active), V <sub>I(IN1)</sub> = 5.5 V, V <sub>I(IN2)</sub> = 3.3 V, I <sub>O(OUT)</sub> = 0 A	1	12	μA		
		D0 = D1 = low (IN2 active), V <sub>I(IN1)</sub> = 3.3 V, V <sub>I(IN2)</sub> = 5.5 V, I <sub>O(OUT)</sub> = 0 A	55	90	μA		
Quiescent current from IN1 (STANDBY)		D0 = D1 = high (inactive), V <sub>I(IN1)</sub> = 5.5 V, V <sub>I(IN2)</sub> = 3.3 V, I <sub>O(OUT)</sub> = 0 A	0.5	2	μA		
		D0 = D1 = high (inactive), V <sub>I(IN1)</sub> = 3.3 V, V <sub>I(IN2)</sub> = 5.5 V, I <sub>O(OUT)</sub> = 0 A		1	μA		
Quiescent current from IN2 (STANDBY)		D0 = D1 = high (inactive), V <sub>I(IN1)</sub> = 5.5 V, V <sub>I(IN2)</sub> = 3.3 V, I <sub>O(OUT)</sub> = 0 A		1	μA		
		D0 = D1 = high (inactive), V <sub>I(IN1)</sub> = 3.3 V, V <sub>I(IN2)</sub> = 5.5 V, I <sub>O(OUT)</sub> = 0 A	0.5	2	μA		
Forward leakage current from IN1 (measured from OUT to GND)		D0 = D1 = high (inactive), V <sub>I(IN1)</sub> = 5.5 V, IN2 open, V <sub>O(OUT)</sub> = 0 V (shorted), T <sub>J</sub> = 25°C	0.1	5	μA		
Forward leakage current from IN2 (measured from OUT to GND)		D0 = D1 = high (inactive), V <sub>I(IN2)</sub> = 5.5 V, IN1 open, V <sub>O(OUT)</sub> = 0 V (shorted), T <sub>J</sub> = 25°C	0.1	5	μA		
Reverse leakage current to IN <sub>x</sub> (measured from IN <sub>x</sub> to GND)		D0 = D1 = high (inactive), V <sub>I(IN<sub>x</sub>)</sub> = 0 V, V <sub>O(OUT)</sub> = 5.5 V, T <sub>J</sub> = 25°C	0.3	5	μA		
CURRENT LIMIT CIRCUIT							
Current limit accuracy, TPS2114A		R <sub>ILIM</sub> = 400 Ω	0.51	0.63	0.80	A	
		R <sub>ILIM</sub> = 700 Ω	0.30	0.36	0.50	A	
Current limit accuracy, TPS2115A		R <sub>ILIM</sub> = 400 Ω	0.95	1.25	1.56	A	
		R <sub>ILIM</sub> = 700 Ω	0.47	0.71	0.99	A	
t <sub>d</sub>	Current limit settling time	Time for short-circuit output current to settle within 10% of its steady state value.	1			ms	
Input current at ILIM		V <sub>I(ILIM)</sub> = 0 V, I <sub>O(OUT)</sub> = 0 A	–15	0		μA	
UVLO							
IN1 and IN2 UVLO		Falling edge	1.15	1.25		V	
		Rising edge		1.30	1.35	V	
IN1 and IN2 UVLO hysteresis			30	57	65	mV	
Internal V <sub>DD</sub> UVLO (the higher of IN1 and IN2)		Falling edge	2.4	2.53		V	
		Rising edge		2.58	2.8	V	
Internal V <sub>DD</sub> UVLO hysteresis			30	50	75	mV	
UVLO deglitch for IN1, IN2		Falling edge		110		μs	

## ELECTRICAL CHARACTERISTICS: GENERAL (continued)

Over recommended operating junction temperature range,  $V_{I(IN1)} = V_{I(IN2)} = 5.5\text{ V}$ , and  $R_{ILIM} = 400\ \Omega$ , unless otherwise noted.

PARAMETER		TEST CONDITIONS	TPS2114A			UNIT
			MIN	TYP	MAX	
REVERSE CONDUCTION BLOCKING						
$\Delta V_{O(I\_block)}$	Minimum input-to-output voltage difference to block switching	D0 = D1 = high, $V_{I(INx)} = 3.3\text{ V}$ Connect OUT to a 5-V supply through a series 1-k $\Omega$ resistor. Let D0 = low. Slowly decrease the supply voltage until OUT connects to IN1.	80	100	120	mV
THERMAL SHUTDOWN						
	Thermal shutdown threshold	TPS211xA is in current limit	135			$^{\circ}\text{C}$
	Recovery from thermal shutdown	TPS211xA is in current limit	125			$^{\circ}\text{C}$
	Hysteresis			10		$^{\circ}\text{C}$
IN2-IN1 COMPARATORS						
	Hysteresis of IN2-IN1 comparator		0.1		0.2	V
	Deglintch of IN2-IN1 comparator (both $\uparrow\downarrow$ )		10	20	50	$\mu\text{s}$
STAT OUTPUT						
	Leakage current	$V_{O(STAT)} = 5.5\text{ V}$		0.01	1	$\mu\text{A}$
	Saturation voltage	$I_{I(STAT)} = 2\text{ mA}$ , IN1 switch is on		0.13	0.4	V
	Deglintch time (falling edge only)			150		$\mu\text{s}$

## SWITCHING CHARACTERISTICS

Over recommended operating junction temperature range,  $V_{I(IN1)} = V_{I(IN2)} = 5.5\text{ V}$ , and  $R_{ILIM} = 400\ \Omega$ , unless otherwise noted.

PARAMETER		TEST CONDITIONS	TPS2114A			TPS2115A			UNIT
			MIN	TYP	MAX	MIN	TYP	MAX	
POWER SWITCH									
t <sub>r</sub>	Output rise time from an enable	V <sub>I(IN1)</sub> = V <sub>I(IN2)</sub> = 5 V, T <sub>J</sub> = 25°C, C <sub>L</sub> = 1 μF, I <sub>L</sub> = 500 mA (see Figure 1a)	0.5	1.0	1.5	1	1.8	3	ms
t <sub>f</sub>	Output fall time from a disable	V <sub>I(IN1)</sub> = V <sub>I(IN2)</sub> = 5 V, T <sub>J</sub> = 25°C, C <sub>L</sub> = 1 μF, I <sub>L</sub> = 500 mA (see Figure 1a)	0.35	0.5	0.7	0.5	1	2	ms
t <sub>t</sub>	Transition time	IN1 to IN2 transition, V <sub>I(IN1)</sub> = 3.3 V, V <sub>I(IN2)</sub> = 5 V, T <sub>J</sub> = 125°C, C <sub>L</sub> = 10 μF, I <sub>L</sub> = 500 mA Measure transition time as 10–90% rise time or from 3.4 V to 4.8 V on V <sub>O(OUT)</sub> (see Figure 1b).		40	60		40	60	μs
		IN2 to IN1 transition, V <sub>I(IN1)</sub> = 5 V, V <sub>I(IN2)</sub> = 3.3 V, T <sub>J</sub> = 125°C, C <sub>L</sub> = 10 μF, I <sub>L</sub> = 500 mA Measure transition time as 10–90% rise time or from 3.4 V to 4.8 V on V <sub>O(OUT)</sub> (see Figure 1b).		40	60		40	60	μs
t <sub>PLH1</sub>	Turn-on propagation delay from enable	V <sub>I(IN1)</sub> = V <sub>I(IN2)</sub> = 5 V, measured from enable to 10% of V <sub>O(OUT)</sub> , T <sub>J</sub> = 25°C, C <sub>L</sub> = 10 μF, I <sub>L</sub> = 500 mA (see Figure 1a)		0.5			1		ms
t <sub>PHL1</sub>	Turn-off propagation delay from a disable	V <sub>I(IN1)</sub> = V <sub>I(IN2)</sub> = 5 V, measured from disable to 90% of V <sub>O(OUT)</sub> , T <sub>J</sub> = 25°C, C <sub>L</sub> = 10 μF, I <sub>L</sub> = 500 mA (see Figure 1a)		3			5		ms
t <sub>PLH2</sub>	Switch-over rising propagation delay	Logic 1 to Logic 0 transition on D1, V <sub>I(IN1)</sub> = 1.5 V, V <sub>I(IN2)</sub> = 5 V, V <sub>I(D0)</sub> = 0 V, measured from D1 to 10% of V <sub>O(OUT)</sub> , T <sub>J</sub> = 25°C, C <sub>L</sub> = 10 μF, I <sub>L</sub> = 500 mA (see Figure 1c)		40	100		40	100	μs
t <sub>PHL2</sub>	Switch-over falling propagation delay	Logic 0 to Logic 1 transition on D1, V <sub>I(IN1)</sub> = 1.5V, V <sub>I(IN2)</sub> = 5V, V <sub>I(D0)</sub> = 0 V, measured from D1 to 90% of V <sub>O(OUT)</sub> , T <sub>J</sub> = 25°C, C <sub>L</sub> = 10 μF, I <sub>L</sub> = 500 mA (see Figure 1c)	2	3	10	2	5	10	ms

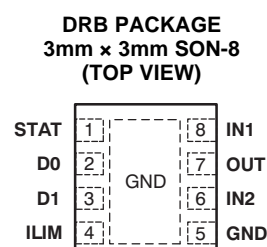
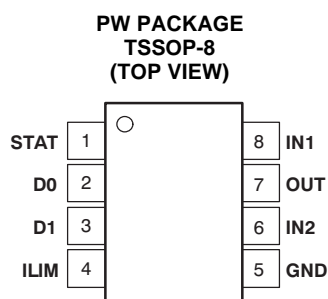
**Table 1. Truth Table**

D1	D0	$V_{I(IN2)} > V_{I(IN1)}$	STAT	OUT <sup>(1)</sup>
0	0	X <sup>(2)</sup>	Hi-Z	IN2
0	1	No	0	IN1
0	1	Yes	Hi-Z	IN2
1	0	X	0	IN1
1	1	X	0	Hi-Z

(1) The under-voltage lockout circuit causes the output OUT to go Hi-Z if the selected power supply does not exceed the IN1/IN2 UVLO, or if neither of the supplies exceeds the internal  $V_{DD}$  UVLO.

(2) X = Don't care.

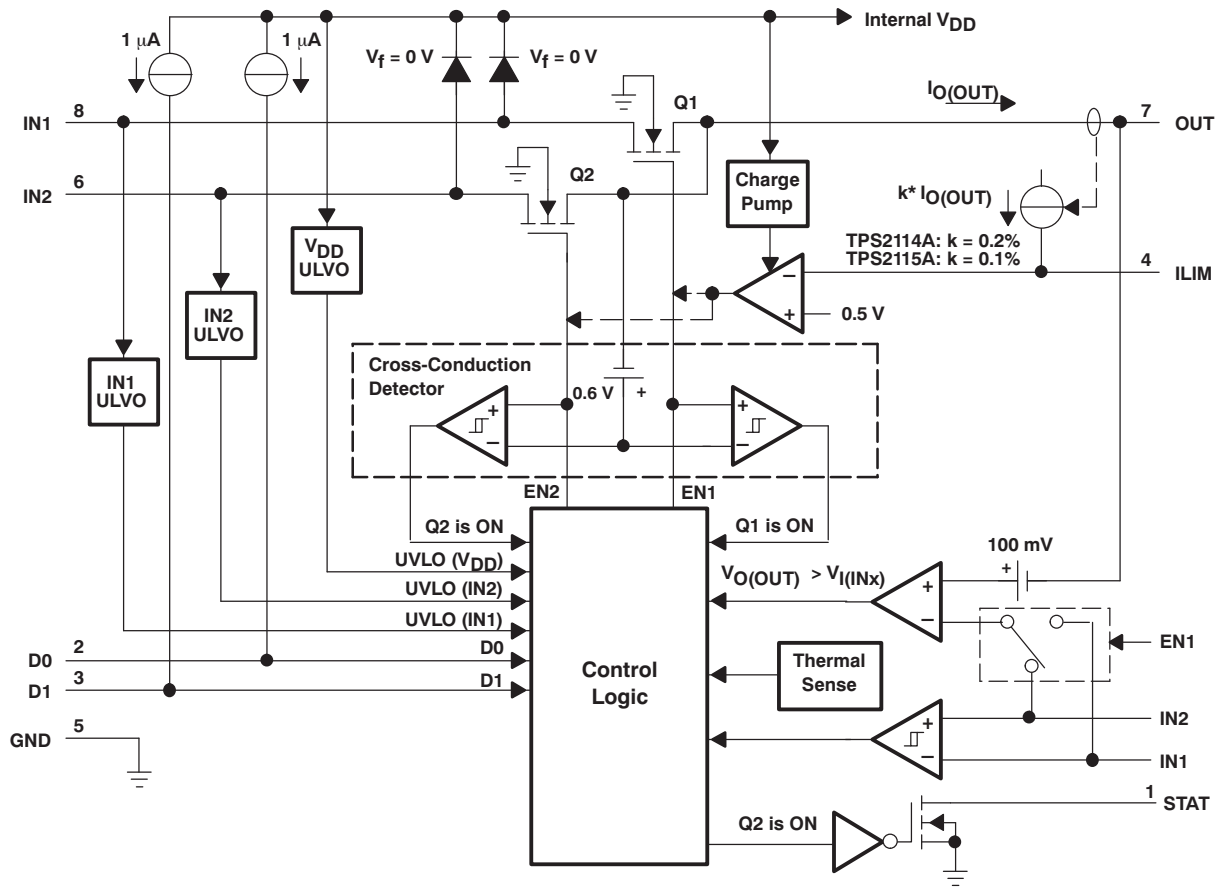
## PIN CONFIGURATIONS



## TERMINAL FUNCTIONS

TERMINAL		I/O	DESCRIPTION
NAME	NO.		
D0	2	I	TTL- and CMOS-compatible input pins. Each pin has a 1- $\mu$ A pull-up. <a href="#">Table 1</a> illustrates the functionality of D0 and D1.
D1	3	I	TTL- and CMOS-compatible input pins. Each pin has a 1- $\mu$ A pull-up. <a href="#">Table 1</a> illustrates the functionality of D0 and D1.
GND	5	I	Ground
IN1	8	I	Primary power switch input. The IN1 switch can be enabled only if the IN1 supply is above the UVLO threshold and at least one supply exceeds the internal $V_{DD}$ UVLO.
IN2	6	I	Secondary power switch input. The IN2 switch can be enabled only if the IN2 supply is above the UVLO threshold and at least one supply exceeds the internal $V_{DD}$ UVLO.
ILIM	4	I	A resistor $R_{ILIM}$ from ILIM to GND sets the current limit $I_L$ to $250/R_{ILIM}$ and $500/R_{ILIM}$ for the TPS2114A and TPS2115A, respectively.
OUT	7	O	Power switch output
STAT	1	O	STAT is an open-drain output that is Hi-Z if the IN2 switch is ON. STAT pulls low if the IN1 switch is ON or if OUT is Hi-Z (i.e., $\overline{EN}$ is equal to logic 0).
PAD	—	I	Tie to GND. Connect to internal planes for improved heatsinking with multiple vias.

# FUNCTIONAL BLOCK DIAGRAM



## PARAMETER MEASUREMENT INFORMATION

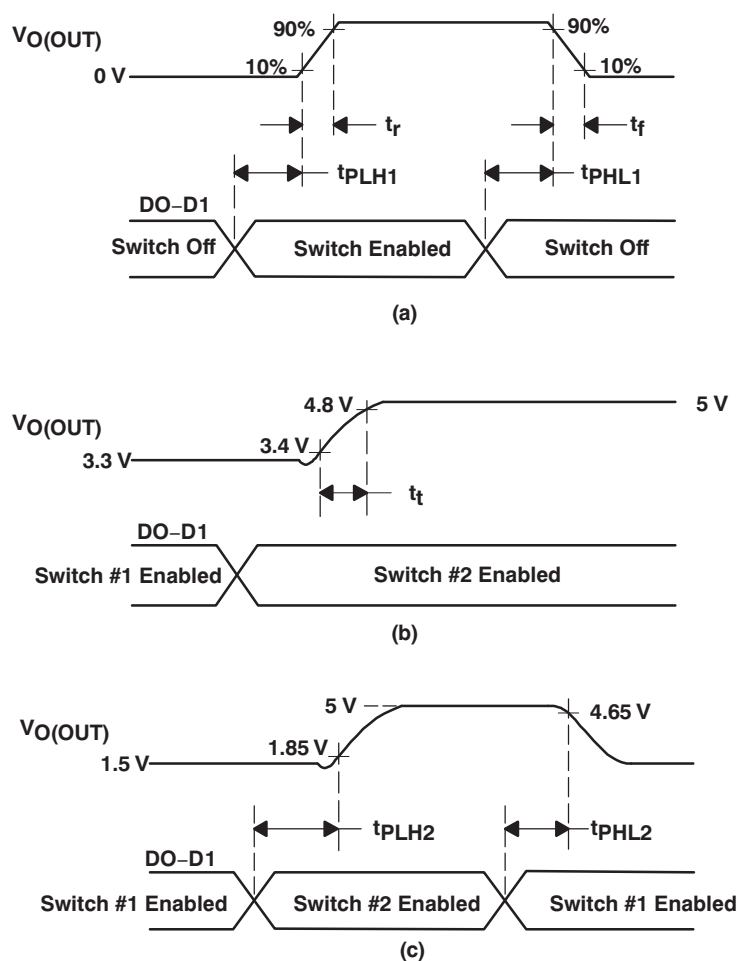
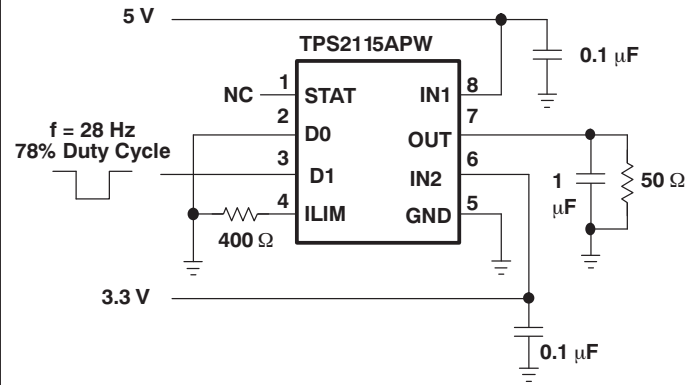
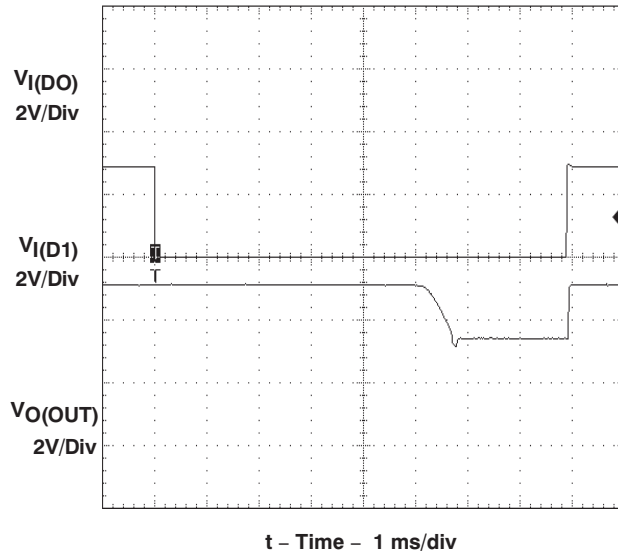


Figure 1. Propagation Delays and Transition Timing Waveforms



## TYPICAL CHARACTERISTICS

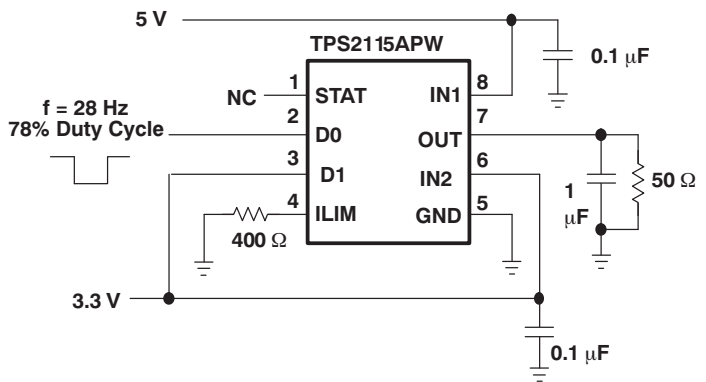
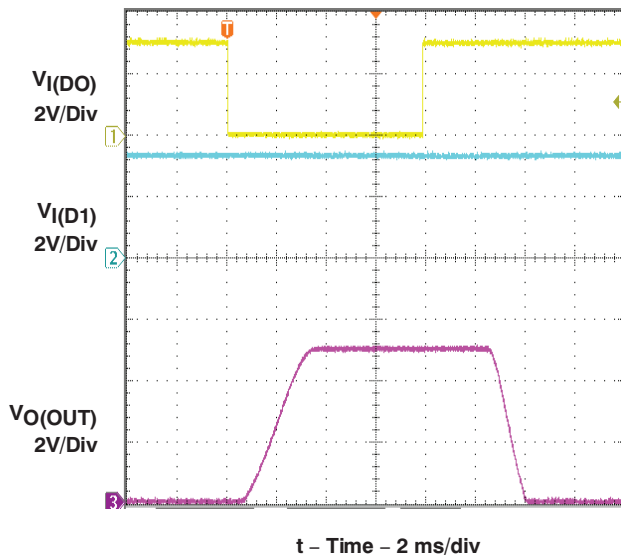
### OUTPUT SWITCHOVER RESPONSE



Output Switchover Response Test Circuit

Figure 2.

### OUTPUT TURN-ON RESPONSE

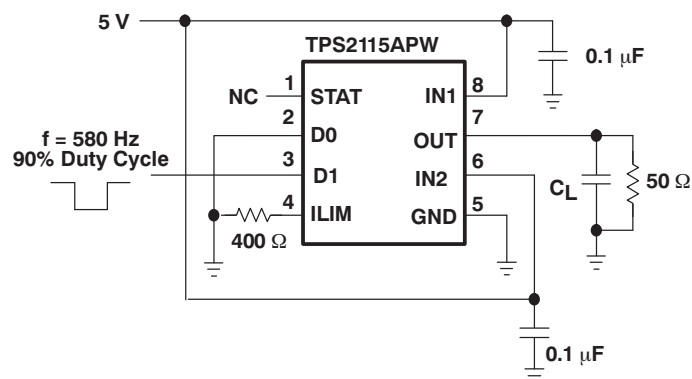
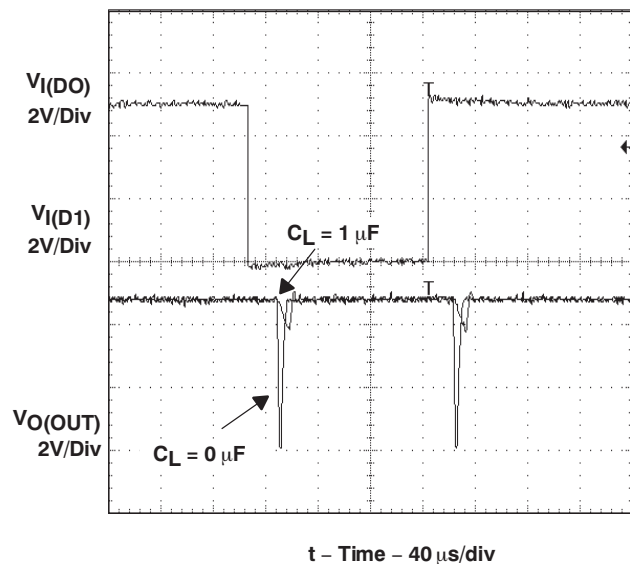


Output Turn-On Response Test Circuit

Figure 3.

## TYPICAL CHARACTERISTICS (continued)

### OUTPUT SWITCHOVER VOLTAGE DROOP

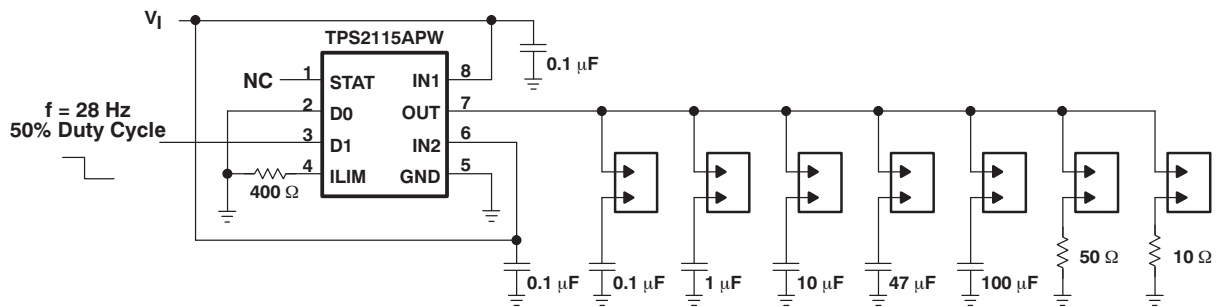
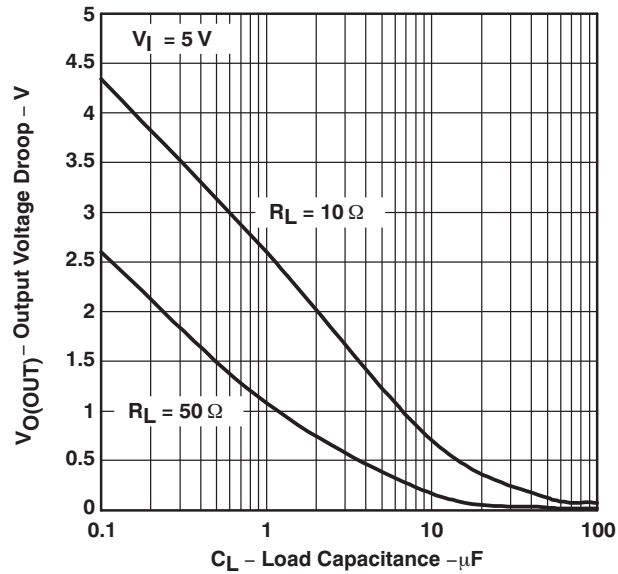


Output Switchover Voltage Droop Test Circuit

Figure 4.

## TYPICAL CHARACTERISTICS (continued)

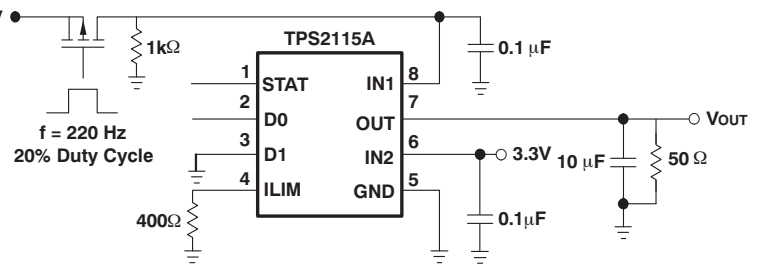
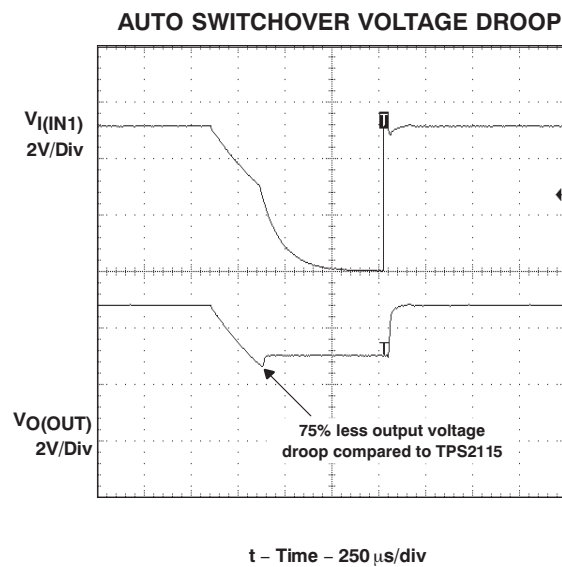
### OUTPUT SWITCHOVER VOLTAGE DROOP vs LOAD CAPACITANCE



Output Switchover Voltage Droop Test Circuit

Figure 5.

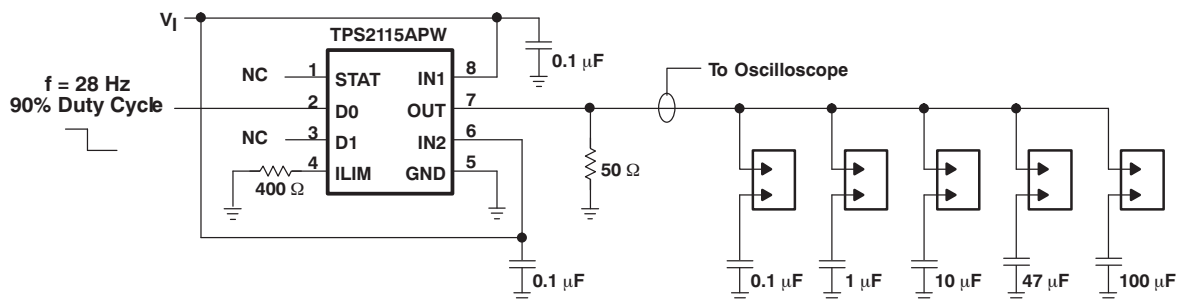
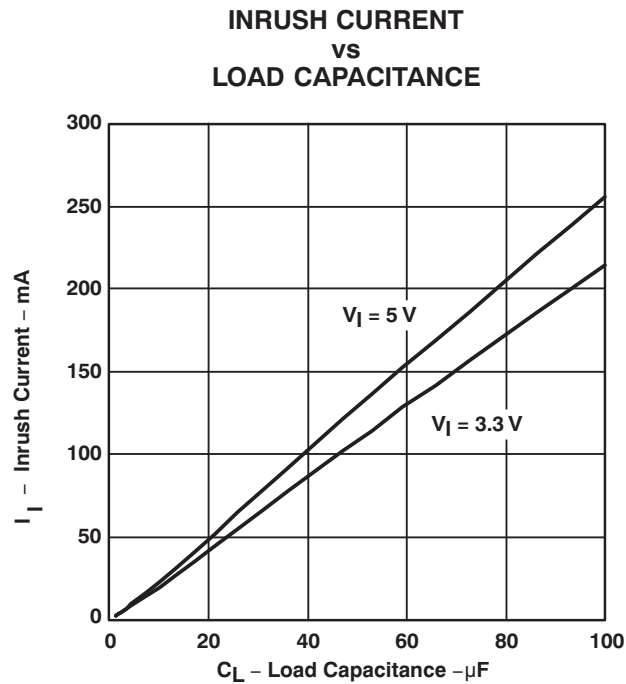
## TYPICAL CHARACTERISTICS (continued)



Auto Switchover Voltage Droop Test Circuit

Figure 6.

## TYPICAL CHARACTERISTICS (continued)



**Output Capacitor Inrush Current Test Circuit**

**Figure 7.**

## TYPICAL CHARACTERISTICS (continued)

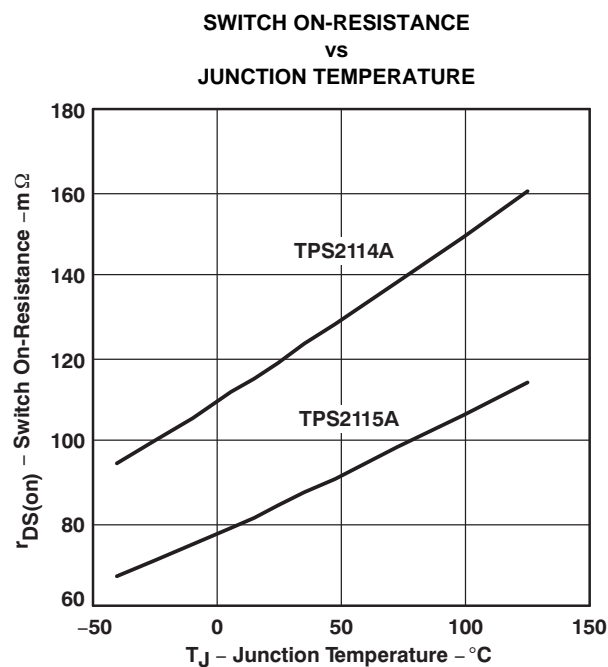


Figure 8.

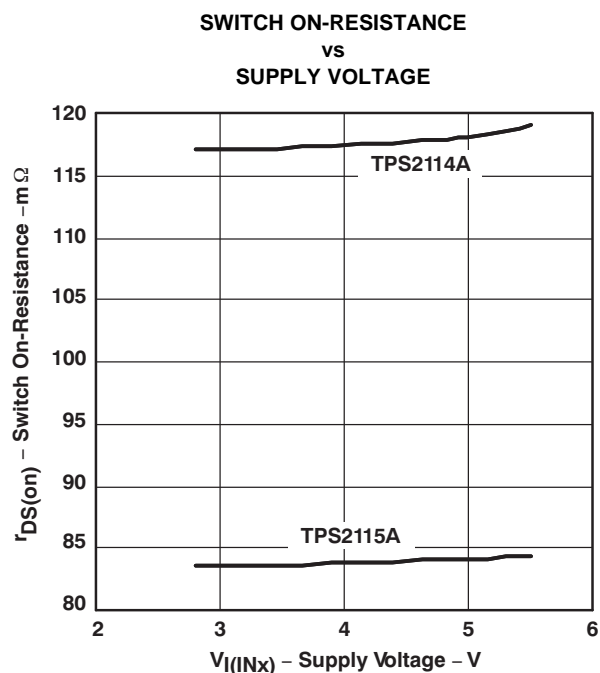


Figure 9.

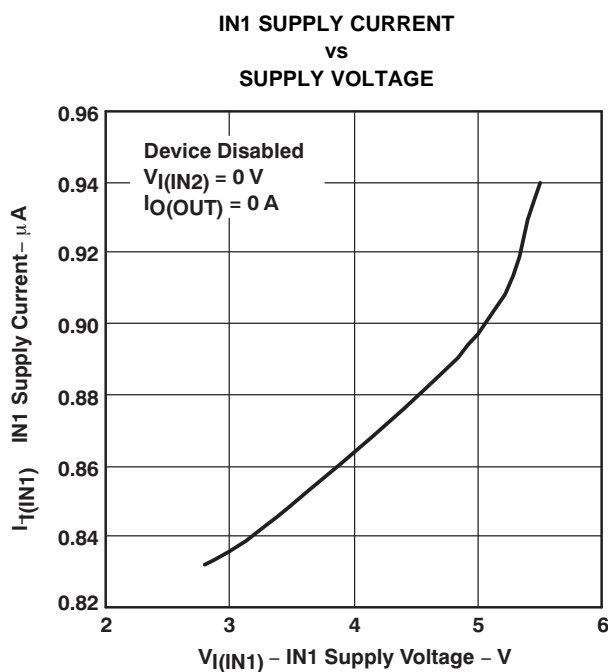


Figure 10.

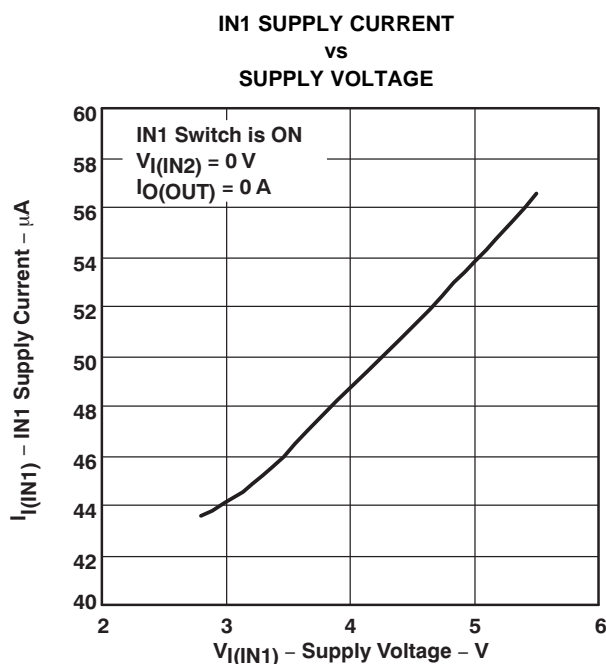
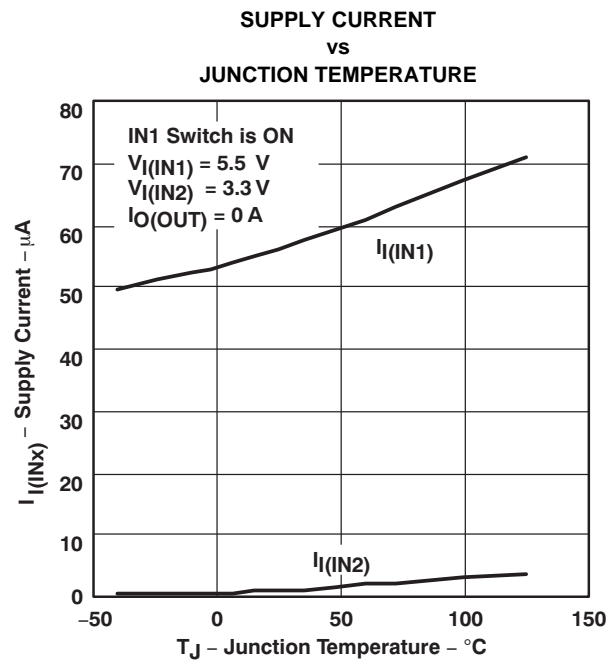
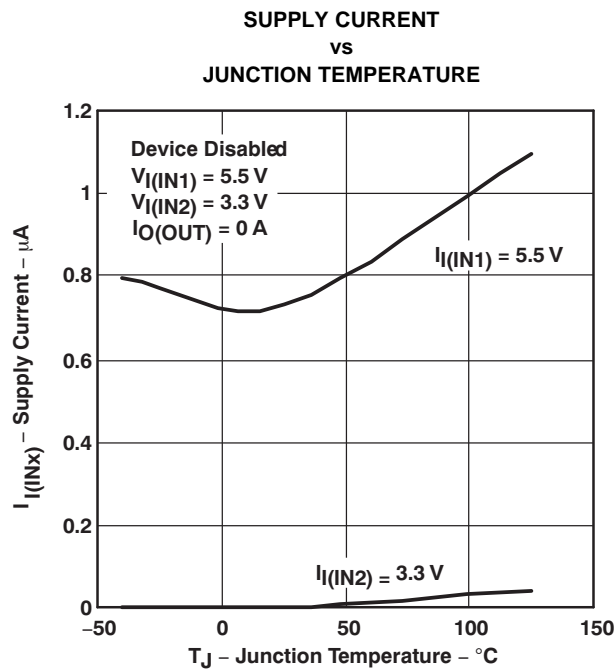


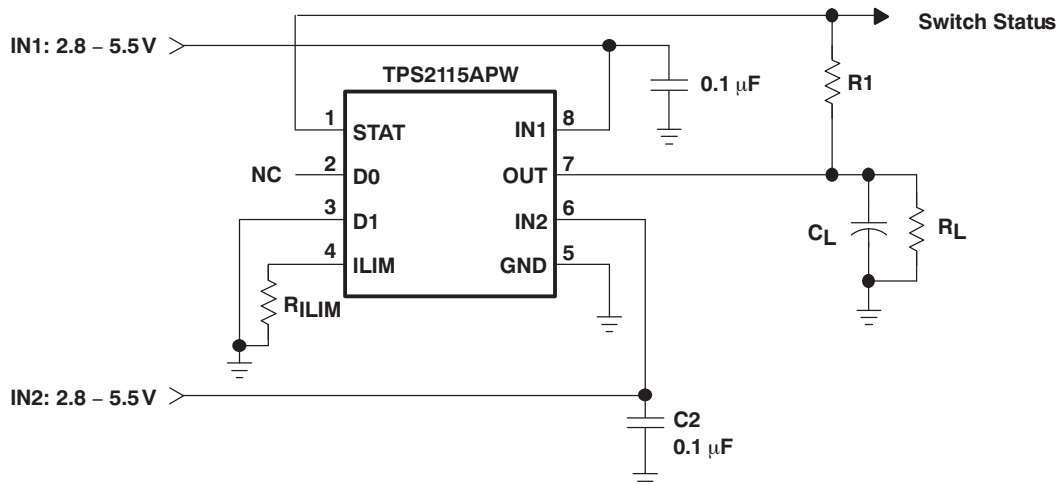
Figure 11.

## TYPICAL CHARACTERISTICS (continued)



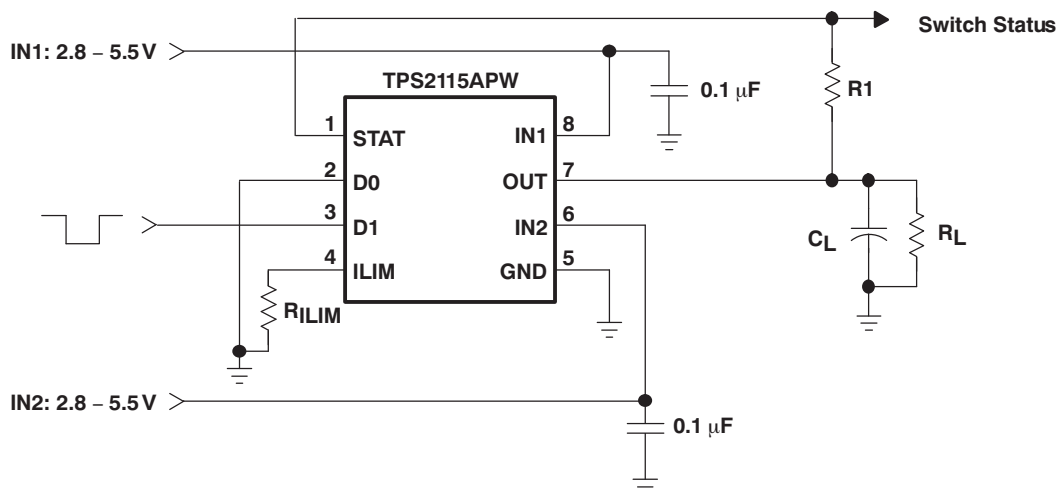
## APPLICATION INFORMATION

Some applications have two energy sources, one of which should be used in preference to another. [Figure 14](#) shows a circuit that will connect IN1 to OUT until the voltage at IN1 falls below a user-specified value. Once the voltage on IN1 falls below this value, the TPS2114A/5A will select the higher of the two supplies. This usually means that the TPS2114A/5A will swap to IN2.



**Figure 14. Auto-Selecting for a Dual Power Supply Application**

In [Figure 15](#), the multiplexer selects between two power supplies based upon the D1 logic signal. OUT connects to IN1 if D1 is logic 1; otherwise, OUT connects to IN2. The logic thresholds for the D1 terminal are compatible with both TTL and CMOS logic.



**Figure 15. Manually Switching Power Sources**



## DETAILED DESCRIPTION

### AUTO-SWITCHING MODE

D0 equal to logic 1 and D1 equal to logic 0 selects the auto-switching mode. In this mode, OUT connects to the higher of IN1 and IN2.

### MANUAL SWITCHING MODE

D0 equal to logic 0 selects the manual-switching mode. In this mode, OUT connects to IN1 if D1 is equal to logic 1, otherwise OUT connects to IN2.

### N-CHANNEL MOSFETs

Two internal high-side power MOSFETs implement a single-pole double-throw (SPDT) switch. Digital logic selects the IN1 switch, IN2 switch, or no switch (Hi-Z state). The MOSFETs have no parallel diodes so output-to-input current cannot flow when the FET is off. An integrated comparator prevents turn-on of a FET switch if the output voltage is greater than the input voltage.

### CROSS-CONDUCTION BLOCKING

The switching circuitry ensures that both power switches will never conduct at the same time. A comparator monitors the gate-to-source voltage of each power FET and allows a FET to turn on only if the gate-to-source voltage of the other FET is below the turn-on threshold voltage.

### REVERSE-CONDUCTION BLOCKING

When the TPS211xA switches from a higher-voltage supply to a lower-voltage supply, current can potentially flow back from the load capacitor into the lower-voltage supply. To minimize such reverse conduction, the TPS211xA will not connect a supply to the output until the output voltage has fallen to within 100 mV of the supply voltage. Once a supply has been connected to the output, it will remain connected regardless of output voltage.

### CHARGE PUMP

The higher of supplies IN1 and IN2 powers the internal charge pump. The charge pump provides power to the current limit amplifier and allows the output FET gate voltage to be higher than the IN1 and IN2 supply voltages. A gate voltage that is higher than the source voltage is necessary to turn on the N-channel FET.

### CURRENT LIMITING

A resistor  $R_{ILIM}$  from ILIM to GND sets the current limit to  $250/R_{ILIM}$  and  $500/R_{ILIM}$  for the TPS2114A and TPS2115A, respectively. Setting resistor  $R_{ILIM}$  equal to zero is not recommended as that disables current limiting.

### OUTPUT VOLTAGE SLEW-RATE CONTROL

The TPS2114A/5A slews the output voltage at a slow rate when OUT switches to IN1 or IN2 from the Hi-Z state (see [Table 1](#)). A slow slew rate limits the inrush current into the load capacitor. High inrush currents can glitch the voltage bus and cause a system to hang up or reset. It can also cause reliability issues—like pit the connector power contacts, when hot-plugging a load such as a PCI card. The TPS2114A/5A slews the output voltage at a much faster rate when OUT switches between IN1 and IN2. The fast rate minimizes the output voltage droop and reduces the output voltage hold-up capacitance requirement.

## REVISION HISTORY

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

Changes from Revision E (April 2011) to Revision F	Page
• Changed description of power supplies in <i>Description</i> section .....	1
• Added $I_{OUT}$ column to Device Information table .....	2
• Changed conditions of Absolute Maximum Ratings table .....	2
• Added PW to end of device name in first two continuous output rows in <i>Current</i> parameter of Absolute Maximum Ratings table .....	2
• Added last continuous output row to <i>Current</i> parameter in Absolute Maximum Ratings table .....	2
• Deleted storage temperature row from Absolute Maximum Ratings table .....	2
• Changed <i>Current limit adjustment range</i> parameter, TPS2115A specification in Available Options table .....	2
• Changed Nominal current limit adjustment range parameter in Recommended Operating Conditions table .....	3
• Added footnote 1 to Recommended Operating Conditions table .....	3

Changes from Revision D (July 2006) to Revision E	Page
• Updated document to current format .....	1
• Changed title, footnote, and CGF marking in Device Information table .....	2
• Deleted footnote 1 (not tested in production) from Electrical Characteristics: General table .....	4
• Deleted footnote 1 (not tested in production) from Switching Characteristics table .....	5
• Added PAD row to Terminal Functions table .....	6

## PACKAGING INFORMATION

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead/Ball Finish (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
TPS2114APW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2114A	<a href="#">Samples</a>
TPS2114APWG4	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2114A	<a href="#">Samples</a>
TPS2114APWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2114A	<a href="#">Samples</a>
TPS2115ADRBR	ACTIVE	SON	DRB	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CGF	<a href="#">Samples</a>
TPS2115ADRBRG4	ACTIVE	SON	DRB	8	3000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CGF	<a href="#">Samples</a>
TPS2115ADRBT	ACTIVE	SON	DRB	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CGF	<a href="#">Samples</a>
TPS2115ADRBTG4	ACTIVE	SON	DRB	8	250	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-2-260C-1 YEAR	-40 to 85	CGF	<a href="#">Samples</a>
TPS2115APW	ACTIVE	TSSOP	PW	8	150	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2115A	<a href="#">Samples</a>
TPS2115APWG4	ACTIVE	TSSOP	PW	8		TBD	Call TI	Call TI	-40 to 85		<a href="#">Samples</a>
TPS2115APWR	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2115A	<a href="#">Samples</a>
TPS2115APWRG4	ACTIVE	TSSOP	PW	8	2000	Green (RoHS & no Sb/Br)	CU NIPDAU	Level-1-260C-UNLIM	-40 to 85	2115A	<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.

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

**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.

**OTHER QUALIFIED VERSIONS OF TPS2115A :**

- Automotive: [TPS2115A-Q1](#)

NOTE: Qualified Version Definitions:

- Automotive - Q100 devices qualified for high-reliability automotive applications targeting zero defects

**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
TPS2114APWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1
TPS2115ADRBT	SON	DRB	8	250	180.0	12.4	3.3	3.3	1.1	8.0	12.0	Q2
TPS2115APWR	TSSOP	PW	8	2000	330.0	12.4	7.0	3.6	1.6	8.0	12.0	Q1

## TAPE AND REEL BOX DIMENSIONS

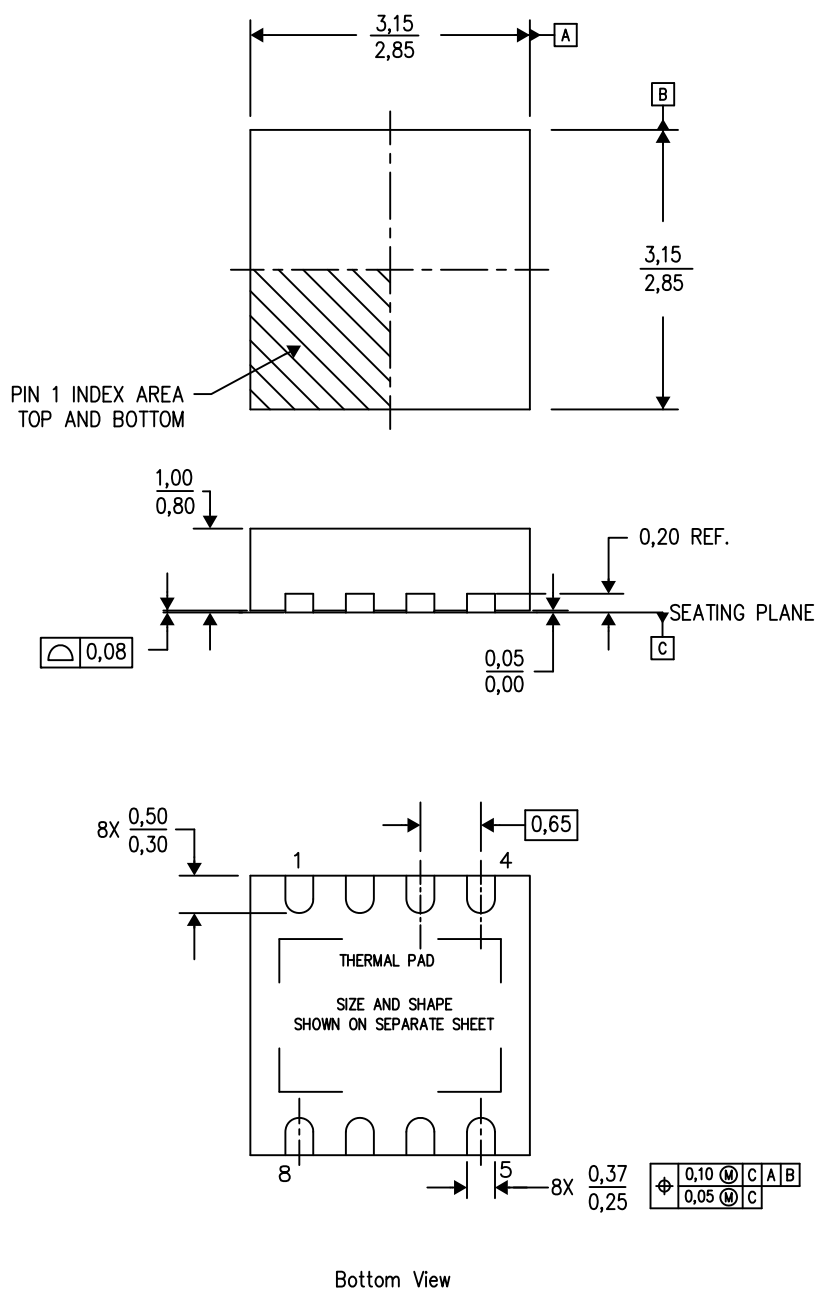


\*All dimensions are nominal

Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
TPS2114APWR	TSSOP	PW	8	2000	367.0	367.0	35.0
TPS2115ADRBT	SON	DRB	8	250	210.0	185.0	35.0
TPS2115APWR	TSSOP	PW	8	2000	367.0	367.0	35.0

DRB (S-PVSON-N8)

PLASTIC SMALL OUTLINE NO-LEAD



4203482-2/K 06/12

- 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. Small Outline No-Lead (SON) package configuration.
  - D. The package thermal pad must be soldered to the board for thermal and mechanical performance.
  - E. See the additional figure in the Product Data Sheet for details regarding the exposed thermal pad features and dimensions.

DRB (S-PVSON-N8)

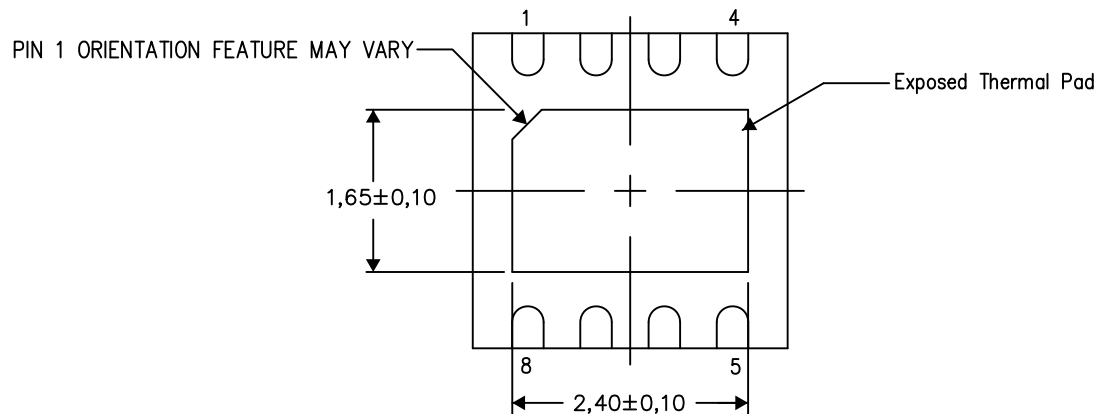
PLASTIC SMALL OUTLINE NO-LEAD

## THERMAL INFORMATION

This package incorporates an exposed thermal pad that is designed to be attached directly to an external heatsink. The thermal pad must be soldered directly to the printed circuit board (PCB). After soldering, the PCB can be used as a heatsink. In addition, through the use of thermal vias, the thermal pad can be attached directly to the appropriate copper plane shown in the electrical schematic for the device, or alternatively, can be attached to a special heatsink structure designed into the PCB. This design optimizes the heat transfer from the integrated circuit (IC).

For information on the Quad Flatpack No-Lead (QFN) package and its advantages, refer to Application Report, QFN/SON PCB Attachment, Texas Instruments Literature No. SLUA271. This document is available at [www.ti.com](http://www.ti.com).

The exposed thermal pad dimensions for this package are shown in the following illustration.



Bottom View

Exposed Thermal Pad Dimensions

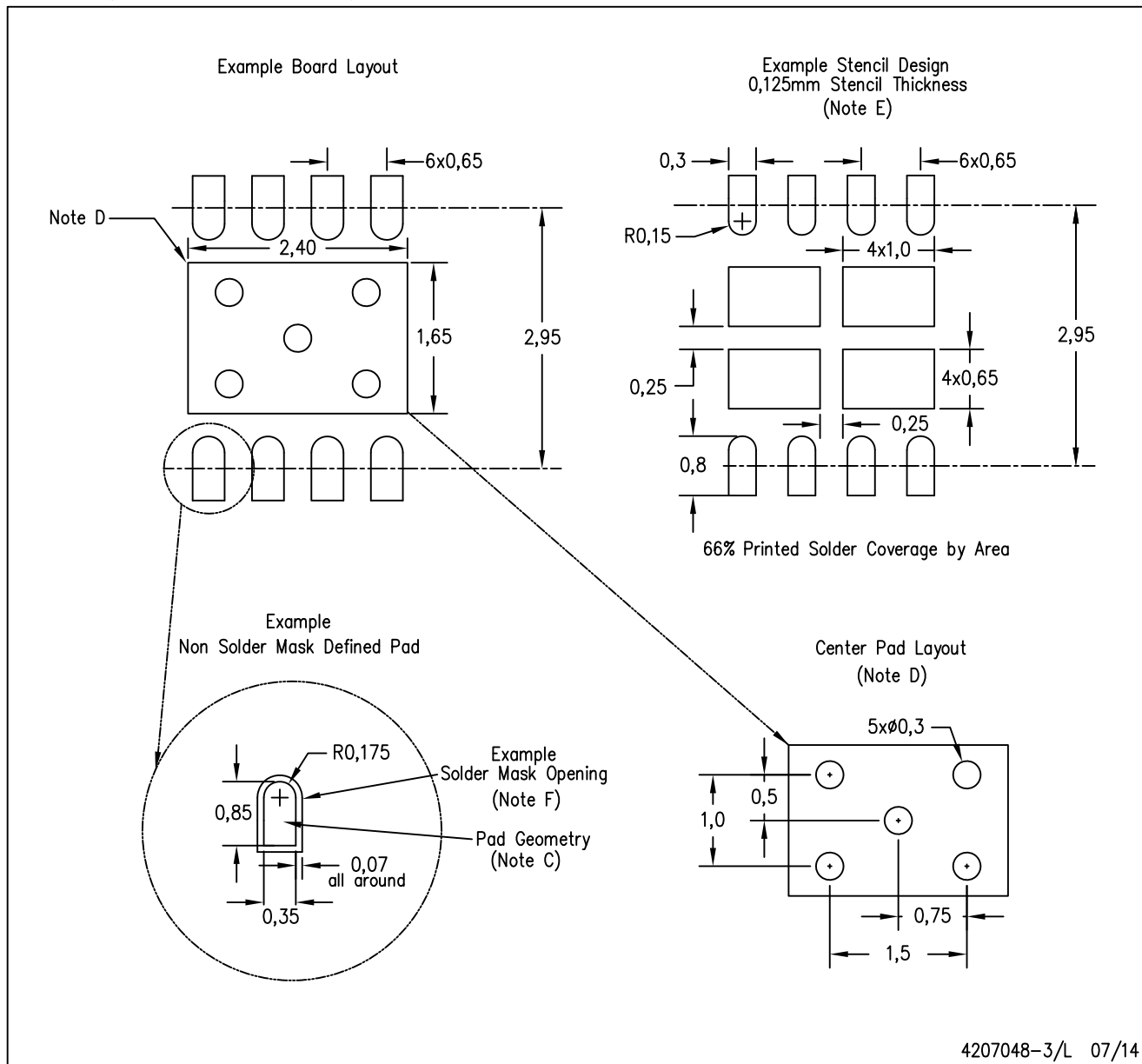
4206340-3/P 07/14

NOTE: All linear dimensions are in millimeters



DRB (S-PVSON-N8)

PLASTIC SMALL OUTLINE NO-LEAD



- NOTES:
- A. All linear dimensions are in millimeters.
  - B. This drawing is subject to change without notice.
  - C. Publication IPC-7351 is recommended for alternate designs.
  - D. This package is designed to be soldered to a thermal pad on the board. Refer to Application Note, QFN Packages, Texas Instruments Literature No. SLUA271, and also the Product Data Sheets for specific thermal information, via requirements, and recommended board layout. These documents are available at [www.ti.com](http://www.ti.com) <<http://www.ti.com>>.
  - E. Laser cutting apertures with trapezoidal walls and also rounding corners will offer better paste release. Customers should contact their board assembly site for stencil design recommendations. Refer to IPC 7525 for stencil design considerations.
  - F. Customers should contact their board fabrication site for solder mask tolerances.

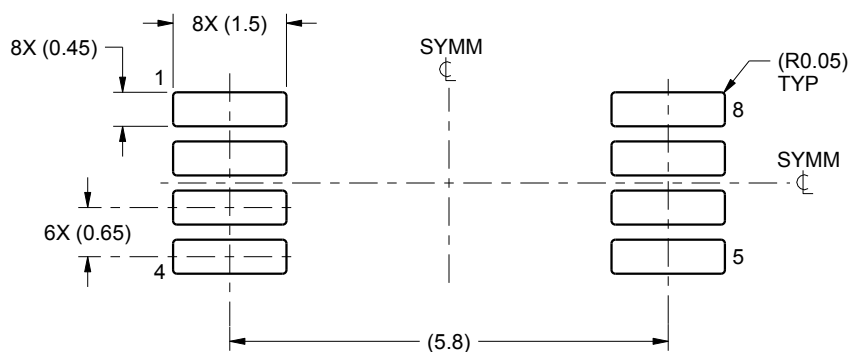


# EXAMPLE BOARD LAYOUT

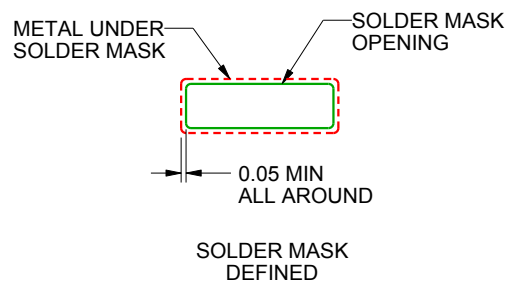
PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



LAND PATTERN EXAMPLE  
SCALE:10X



SOLDER MASK DETAILS  
NOT TO SCALE

4221848/A 02/2015

NOTES: (continued)

6. Publication IPC-7351 may have alternate designs.

7. Solder mask tolerances between and around signal pads can vary based on board fabrication site.

## EXAMPLE STENCIL DESIGN

PW0008A

TSSOP - 1.2 mm max height

SMALL OUTLINE PACKAGE



SOLDER PASTE EXAMPLE  
BASED ON 0.125 mm THICK STENCIL  
SCALE:10X

4221848/A 02/2015

NOTES: (continued)

8. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.
9. Board assembly site may have different recommendations for stencil design.

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

### Applications

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

### TI E2E Community

[e2e.ti.com](http://e2e.ti.com)