

# TPS2811, TPS2812, TPS2813, TPS2814, TPS2815 DUAL HIGH-SPEED MOSFET DRIVERS

SLVS132F – NOVEMBER 1995 – REVISED OCTOBER 2004

- Industry-Standard Driver Replacement
- 25-ns Max Rise/Fall Times and 40-ns Max Propagation Delay – 1-nF Load,  $V_{CC} = 14\text{ V}$
- 2-A Peak Output Current,  $V_{CC} = 14\text{ V}$
- 5- $\mu\text{A}$  Supply Current — Input High or Low
- 4-V to 14-V Supply-Voltage Range; Internal Regulator Extends Range to 40 V (TPS2811, TPS2812, TPS2813)
- $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$  Ambient-Temperature Operating Range

## description

The TPS28xx series of dual high-speed MOSFET drivers are capable of delivering peak currents of 2 A into highly capacitive loads. This performance is achieved with a design that inherently minimizes shoot-through current and consumes an order of magnitude less supply current than competitive products.

The TPS2811, TPS2812, and TPS2813 drivers include a regulator to allow operation with supply inputs between 14 V and 40 V. The regulator output can power other circuitry, provided power dissipation does

not exceed package limitations. When the regulator is not required, REG\_IN and REG\_OUT can be left disconnected or both can be connected to  $V_{CC}$  or GND.

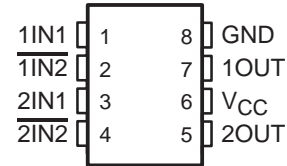
The TPS2814 and the TPS2815 have 2-input gates that give the user greater flexibility in controlling the MOSFET. The TPS2814 has AND input gates with one inverting input. The TPS2815 has dual-input NAND gates.

TPS281x series drivers, available in 8-pin PDIP, SOIC, and TSSOP packages operate over a ambient temperature range of  $-40^{\circ}\text{C}$  to  $125^{\circ}\text{C}$ .

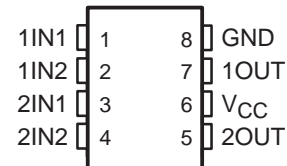
TPS2811, TPS2812, TPS2813 . . . D, P, AND PW PACKAGES (TOP VIEW)



TPS2814 . . . D, P, AND PW PACKAGES (TOP VIEW)



TPS2815 . . . D, P, AND PW PACKAGES (TOP VIEW)



## AVAILABLE OPTIONS

T <sub>A</sub>	INTERNAL REGULATOR	LOGIC FUNCTION	PACKAGED DEVICES		
			SMALL OUTLINE (D)	PLASTIC DIP (P)	TSSOP (PW)
-40°C to 125°C	Yes	Dual inverting drivers Dual noninverting drivers One inverting and one noninverting driver	TPS2811D TPS2812D TPS2813D	TPS2811P TPS2812P TPS2813P	TPS2811PW TPS2812PW TPS2813PW
	No	Dual 2-input AND drivers, one inverting input on each driver Dual 2-input NAND drivers	TPS2814D TPS2815D	TPS2814P TPS2815P	TPS2814PW TPS2815PW

The D package is available taped and reeled. Add R suffix to device type (e.g., TPS2811DR). The PW package is only available left-end taped and reeled and is indicated by the R suffix on the device type (e.g., TPS2811PWR).



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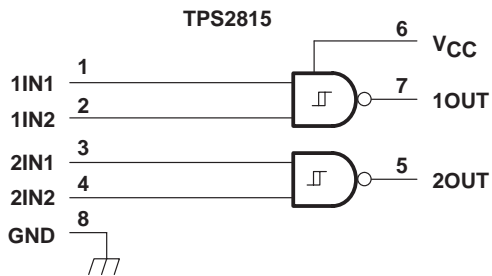
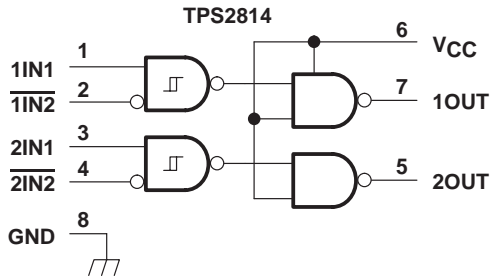
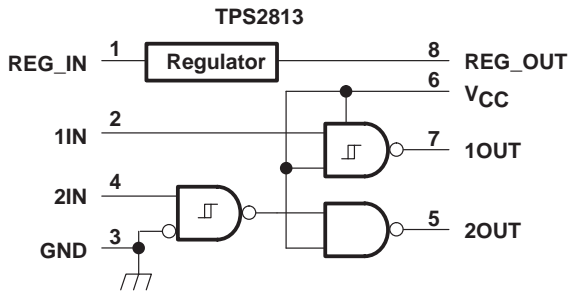
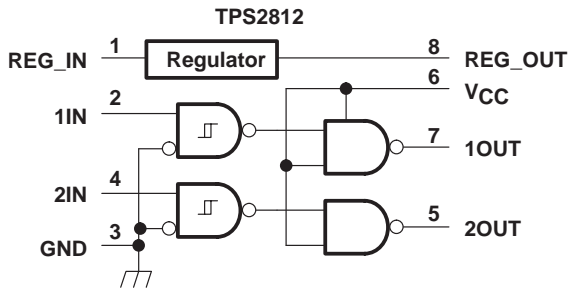
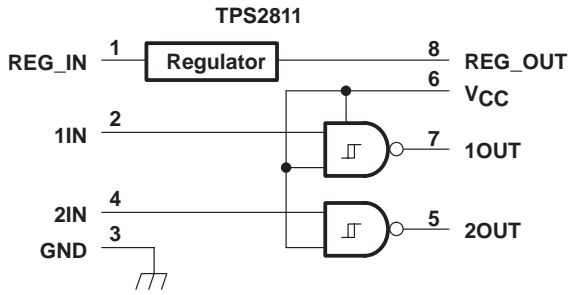
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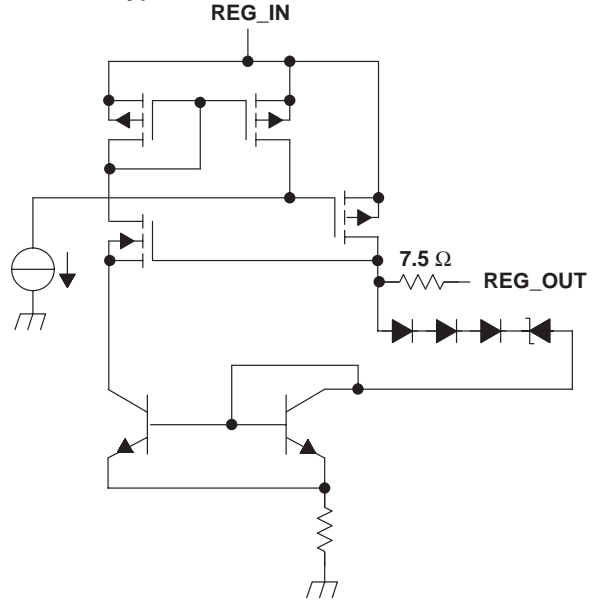
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SLVS132F – NOVEMBER 1995 – REVISED OCTOBER 2004

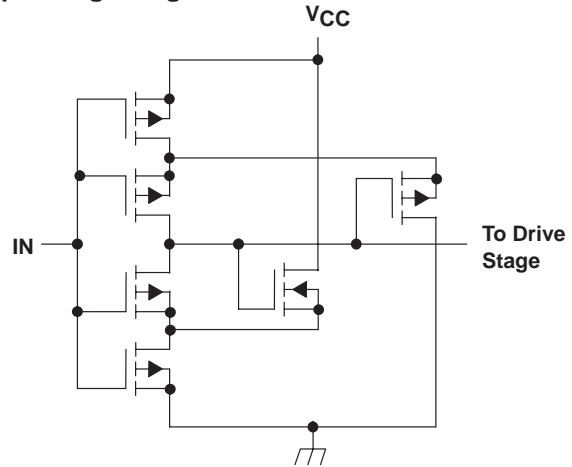
## functional block diagram



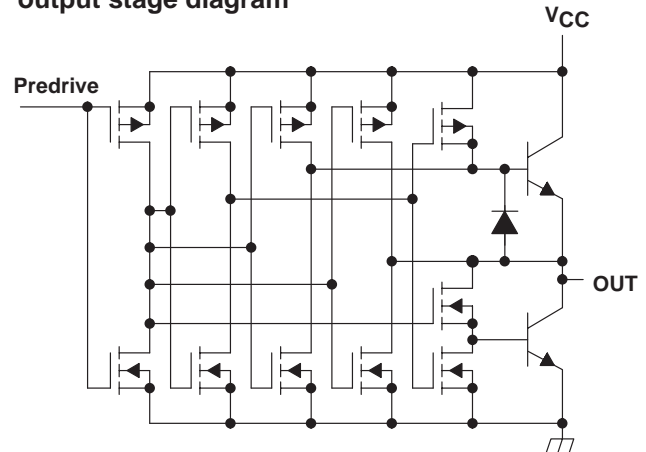
## regulator diagram (TPS2811, TPS2812, TPS2813 only)



## input stage diagram



## output stage diagram

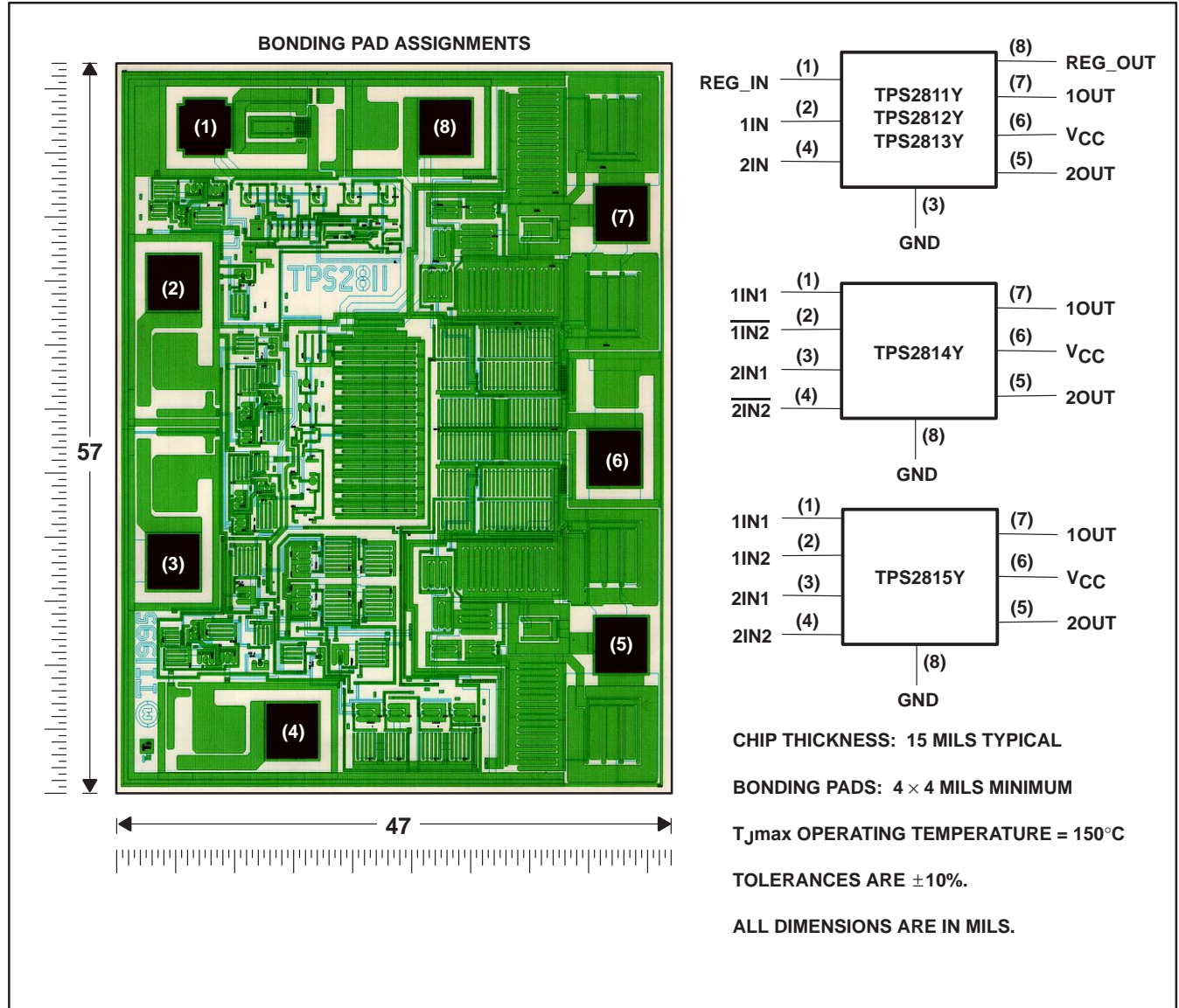


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## TPS28xxY chip information

This chip, when properly assembled, displays characteristics similar to those of the TPS28xx. Thermal compression or ultrasonic bonding may be used on the doped aluminum bonding pads. The chip may be mounted with conductive epoxy or a gold-silicon preform.



# TPS2811, TPS2812, TPS2813, TPS2814, TPS2815

## DUAL HIGH-SPEED MOSFET DRIVERS

SLVS132F – NOVEMBER 1995 – REVISED OCTOBER 2004

### Terminal Functions

#### TPS2811, TPS2812, TPS2813

TERMINAL NAME	TERMINAL NUMBERS			DESCRIPTION
	TPS2811 Dual Inverting Drivers	TPS2812 Dual Noninverting Drivers	TPS2813 Complimentary Drivers	
REG_IN	1	1	1	Regulator input
1IN	2	2	2	Input 1
GND	3	3	3	Ground
2IN	4	4	4	Input 2
2OUT	5 = $\overline{2IN}$	5 = 2IN	5 = 2IN	Output 2
VCC	6	6	6	Supply voltage
1OUT	7 = $\overline{1IN}$	7 = 1IN	7 = $\overline{1IN}$	Output 1
REG_OUT	8	8	8	Regulator output

#### TPS2814, TPS2815

TERMINAL NAME	TERMINAL NUMBERS		DESCRIPTION
	TPS2814 Dual AND Drivers with Single Inverting Input	TPS2815 Dual NAND Drivers	
1IN1	1	1	Noninverting input 1 of driver 1
$\overline{1IN2}$	2	-	Inverting input 2 of driver 1
1IN2	-	2	Noninverting input 2 of driver 1
2IN1	3	3	Noninverting input 1 of driver 2
$\overline{2IN2}$	4	-	Inverting input 2 of driver 2
2IN2	-	4	Noninverting input 2 of driver 2
2OUT	5 = $2IN1 \bullet \overline{2IN2}$	5 = $\overline{2IN1} \bullet \overline{2IN2}$	Output 2
VCC	6	6	Supply voltage
1OUT	7 = $1IN1 \bullet \overline{1IN2}$	7 = $\overline{1IN1} \bullet \overline{1IN2}$	Output 1
GND	8	8	Ground

DISSIPATION RATING TABLE

PACKAGE	$T_A \leq 25^\circ\text{C}$ POWER RATING	DERATING FACTOR ABOVE $T_A = 25^\circ\text{C}$	$T_A = 70^\circ\text{C}$ POWER RATING	$T_A = 85^\circ\text{C}$ POWER RATING
P	1090 mW	8.74 mW/°C	697 mW	566 mW
D	730 mW	5.84 mW/°C	467 mW	380 mW
PW	520 mW	4.17 mW/°C	332 mW	270 mW

# TPS2811, TPS2812, TPS2813, TPS2814, TPS2815 DUAL HIGH-SPEED MOSFET DRIVERS

SLVS132F – NOVEMBER 1995 – REVISED OCTOBER 2004

## absolute maximum ratings over operating free-air temperature range (unless otherwise noted)<sup>†</sup>

Supply voltage, $V_{CC}$ .....	-0.3 V to 15 V
Regulator input voltage range, REG_IN .....	$V_{CC} - 0.3$ V to 42 V
Input voltage range, 1IN, 2IN, 1IN1, 1IN2, $\overline{1IN2}$ , 2IN1, 2IN2, $\overline{2IN2}$ .....	-0.3 V to $V_{CC} + 0.5$ V
Output voltage range, 1OUT, 2OUT .....	$-0.5 < V < V_{CC} + 0.5$ V
Continuous regulator output current, REG_OUT .....	25 mA
Continuous output current, 1OUT, 2OUT .....	$\pm 100$ mA
Continuous total power dissipation .....	See Dissipation Rating Table
Operating ambient temperature range, $T_A$ .....	-40°C to 125°C
Storage temperature range, $T_{stg}$ .....	-65°C to 150°C
Lead temperature 1,6 mm (1/16 inch) from case for 10 seconds .....	260°C

<sup>†</sup> 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.

NOTE 1: All voltages are with respect to device GND pin.

## recommended operating conditions

	MIN	MAX	UNIT
Regulator input voltage range	8	40	V
Supply voltage, $V_{CC}$	4	14	V
Input voltage, 1IN1, 1IN2, $\overline{1IN2}$ , 2IN1, 2IN2, $\overline{2IN2}$ , 1IN, 2IN	-0.3	$V_{CC}$	V
Continuous regulator output current, REG_OUT	0	20	mA
Ambient temperature operating range	-40	125	°C

## TPS28xx electrical characteristics over recommended operating ambient temperature range, $V_{CC} = 10$ V, REG\_IN open for TPS2811/12/13, $C_L = 1$ nF (unless otherwise noted)

### inputs

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>†</sup>	MAX	UNIT
Positive-going input threshold voltage	$V_{CC} = 5$ V		3.3	4	V
	$V_{CC} = 10$ V		5.8	9	V
	$V_{CC} = 14$ V		8.3	13	V
Negative-going input threshold voltage	$V_{CC} = 5$ V	1	1.6		V
	$V_{CC} = 10$ V	1	4.2		V
	$V_{CC} = 14$ V	1	6.2		V
Input hysteresis	$V_{CC} = 5$ V		1.6		V
Input current	Inputs = 0 V or $V_{CC}$	-1	0.2	1	$\mu$ A
Input capacitance			5	10	pF

<sup>†</sup> Typical values are for  $T_A = 25^\circ\text{C}$  unless otherwise noted.

### outputs

PARAMETER	TEST CONDITIONS	MIN	TYP <sup>†</sup>	MAX	UNIT
High-level output voltage	$I_O = -1$ mA	9.75	9.9		V
	$I_O = -100$ mA	8	9.1		
Low-level output voltage	$I_O = 1$ mA		0.18	0.25	V
	$I_O = 100$ mA		1	2	
Peak output current	$V_{CC} = 10$ V		2		A

<sup>†</sup> Typical values are for  $T_A = 25^\circ\text{C}$  unless otherwise noted.

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SLVS132F – NOVEMBER 1995 – REVISED OCTOBER 2004

## regulator (TPS2811/2812/2813 only)

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Output voltage	$14 \leq \text{REG\_IN} \leq 40 \text{ V}$ , $0 \leq I_O \leq 20 \text{ mA}$	10	11.5	13	V
Output voltage in dropout	$I_O = 10 \text{ mA}$ , $\text{REG\_IN} = 10 \text{ V}$	9	9.6		V

† Typical values are for  $T_A = 25^\circ\text{C}$  unless otherwise noted.

## supply current

PARAMETER	TEST CONDITIONS	MIN	TYP†	MAX	UNIT
Supply current into $V_{CC}$	Inputs high or low		0.2	5	$\mu\text{A}$
Supply current into REG_IN	$\text{REG\_IN} = 20 \text{ V}$ , $\text{REG\_OUT}$ open		40	100	$\mu\text{A}$

† Typical values are for  $T_A = 25^\circ\text{C}$  unless otherwise noted.

**TPS28xxY electrical characteristics at  $T_A = 25^\circ\text{C}$ ,  $V_{CC} = 10 \text{ V}$ , REG\_IN open for TPS2811/12/13,  $C_L = 1 \text{ nF}$  (unless otherwise noted)**

## inputs

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Positive-going input threshold voltage	$V_{CC} = 5 \text{ V}$		3.3		V
	$V_{CC} = 10 \text{ V}$		5.8		V
	$V_{CC} = 14 \text{ V}$		8.2		V
Negative-going input threshold voltage	$V_{CC} = 5 \text{ V}$		1.6		V
	$V_{CC} = 10 \text{ V}$		3.3		V
	$V_{CC} = 14 \text{ V}$		4.2		V
Input hysteresis	$V_{CC} = 5 \text{ V}$		1.2		V
Input current	Inputs = 0 V or $V_{CC}$		0.2		$\mu\text{A}$
Input capacitance			5		pF

## outputs

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
High-level output voltage	$I_O = -1 \text{ mA}$		9.9		V
	$I_O = -100 \text{ mA}$		9.1		
Low-level output voltage	$I_O = 1 \text{ mA}$		0.18		V
	$I_O = 100 \text{ mA}$		1		
Peak output current	$V_{CC} = 10.5 \text{ V}$		2		A

## regulator (TPS2811, 2812, 2813)

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Output voltage	$14 \leq \text{REG\_IN} \leq 40 \text{ V}$ , $0 \leq I_O \leq 20 \text{ mA}$		11.5		V
Output voltage in dropout	$I_O = 10 \text{ mA}$ , $\text{REG\_IN} = 10 \text{ V}$		9.6		V

## power supply current

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply current into $V_{CC}$	Inputs high or low		0.2		$\mu\text{A}$
Supply current into REG_IN	$\text{REG\_IN} = 20 \text{ V}$ , $\text{REG\_OUT}$ open		40		$\mu\text{A}$

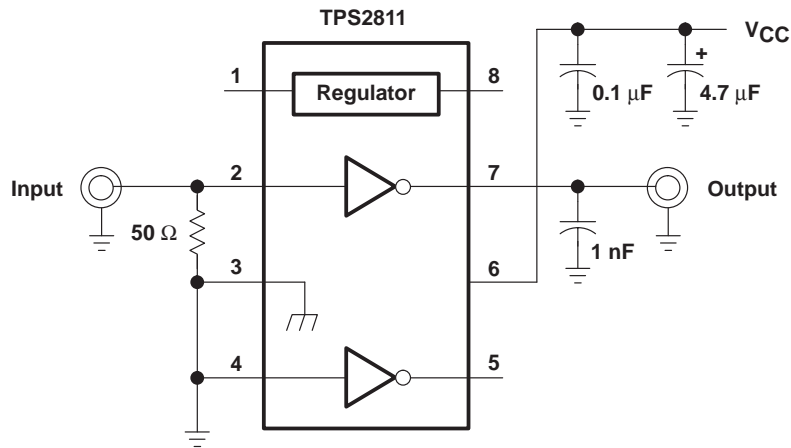
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SLVS132F – NOVEMBER 1995 – REVISED OCTOBER 2004

switching characteristics for all devices over recommended operating ambient temperature range, REG\_IN open for TPS2811/12/13,  $C_L = 1\text{ nF}$  (unless otherwise specified)

PARAMETER		TEST CONDITIONS	MIN	TYP	MAX	UNIT
$t_r$	Rise time	$V_{CC} = 14\text{ V}$		14	25	ns
		$V_{CC} = 10\text{ V}$		15	30	
		$V_{CC} = 5\text{ V}$		20	35	
$t_f$	Fall time	$V_{CC} = 14\text{ V}$		15	25	ns
		$V_{CC} = 10\text{ V}$		15	30	
		$V_{CC} = 5\text{ V}$		18	35	
$t_{PHL}$	Prop delay time high-to-low-level output	$V_{CC} = 14\text{ V}$		25	40	ns
		$V_{CC} = 10\text{ V}$		25	45	
		$V_{CC} = 5\text{ V}$		34	50	
$t_{PLH}$	Prop delay time low-to-high-level output	$V_{CC} = 14\text{ V}$		24	40	ns
		$V_{CC} = 10\text{ V}$		26	45	
		$V_{CC} = 5\text{ V}$		36	50	

## PARAMETER MEASUREMENT INFORMATION



NOTE A: Input rise and fall times should be  $\leq 10\text{ ns}$  for accurate measurement of ac parameters.

Figure 1. Test Circuit For Measurement of Switching Characteristics

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SLVS132F – NOVEMBER 1995 – REVISED OCTOBER 2004

## PARAMETER MEASUREMENT INFORMATION

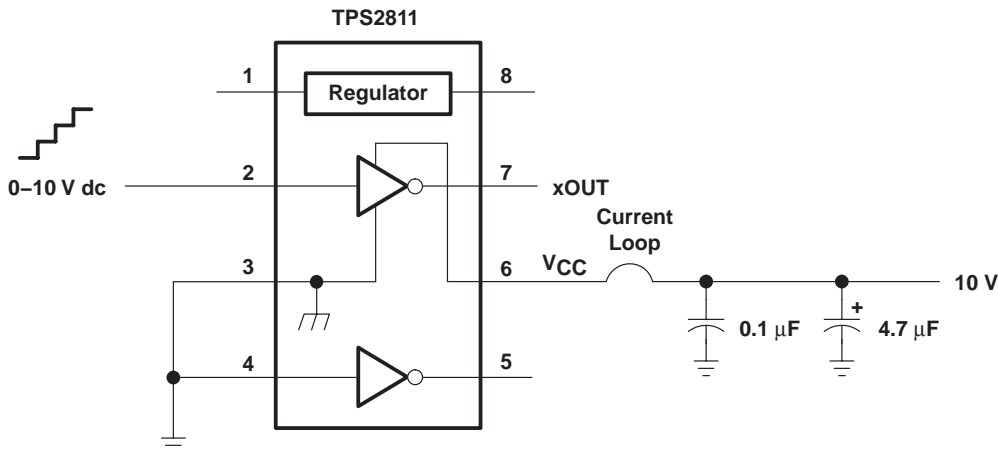


Figure 2. Shoot-through Current Test Setup



Figure 3. Typical Timing Diagram (TPS2811)

## TYPICAL CHARACTERISTICS

### Tables of Characteristics Graphs and Application Information

#### typical characteristics

PARAMETER	vs PARAMETER 2	FIGURE	PAGE
Rise time	Supply voltage	4	10
Fall time	Supply voltage	5	10
Propagation delay time	Supply voltage	6, 7	10
Supply current	Supply voltage	8	11
	Load capacitance	9	11
	Ambient temperature	10	11
Input threshold voltage	Supply voltage	11	11
Regulator output voltage	Regulator input voltage	12, 13	12
Regulator quiescent current	Regulator input voltage	14	12
Peak source current	Supply voltage	15	12
Peak sink current	Supply voltage	16	13
Shoot-through current	Input voltage, high-to-low	17	13
	Input voltage, low-to-high	18	13



**APPLICATION INFORMATION**

**Table 1. Bill of Materials,  
 3.3-V, 3-A Synchronous-Rectified Buck Converter**

REFERENCE	DESCRIPTION	VENDOR	
U1	TL5001CD, PWM	Texas Instruments,	972-644-5580
U2	TPS2812D, N.I. MOSFET Driver	Texas Instruments,	972-644-5580
CR1	3 A, 15 V, Schottky, 30BQ015	International Rectifier,	310-322-3331
CR2,CR3	Signal Diode, BAS16ZX	Zetex,	516-543-7100
C1	1 $\mu$ F, 16 V, Tantalum		
C2	0.033 $\mu$ F, 50 V		
C3	0.0022 $\mu$ F, 50 V		
C4	0.022 $\mu$ F, 50 V		
C5,C7,C10,C12	100 $\mu$ F, 16 V, Tantalum, TPSE107M016R0100	AVX,	800-448-9411
C6	1000 pF, 50 V		
C9	0.22 $\mu$ F, 50 V		
C11	0.47 $\mu$ F, 50 V, Z5U		
C13	10 $\mu$ F, 10 V, Ceramic, CC1210CY5V106Z	TDK,	708-803-6100
C14	0.1 $\mu$ F, 50 V		
C15	1.0 $\mu$ F, 50 V		
J1,J2	4-Pin Header		
L1	27 $\mu$ H, 3 A/5 A, SML5040	Nova Magnetics, Inc.,	972-272-8287
Q1	IRF7406, P-FET	International Rectifier,	310-322-3331
Q2	IRF7201, N-FET	International Rectifier,	310-322-3331
R1	1.00 k $\Omega$ , 1%		
R2	1.6 k $\Omega$		
R3	180 $\Omega$		
R4	2.32 k $\Omega$ , 1 %		
R5,R12,R13	10 k $\Omega$		
R6	15 $\Omega$		
R7	3.3 $\Omega$		
R8	121 k $\Omega$ , 1%		
R9	90.9 k $\Omega$ , 1%		
R10	1 k $\Omega$		
R11	30 k $\Omega$		

NOTES: 2. Unless otherwise specified, capacitors are X7R ceramics.  
 3. Unless otherwise specified, resistors are 5%, 1/10 W.