1.1 V to 5.5 V, Slew Rate Controlled Load Switch in TSOT23-6

DESCRIPTION

The SiP32508 and SiP32509 are a slew rate controlled load switches designed for 1.1 V to 5.5 V operation.

The switch element is of n-channel device that provides low R_{ON} of 44 mΩ typically over a wide range of input.

The devices guarantee low switch on-resistance at 1.2 V input. They feature a controlled soft-on slew rate of typical 2.5 ms that limits the inrush current for designs of heavy capacitive load and minimizes the resulting voltage droop at the power rails.

These devices feature a low voltage control logic interface (On/Off interface) that can interface with low voltage control signals without extra level shifting circuit.

SiP32508 and SiP32509 have exceptionally low shutdown current and provides reverse blocking to prevent high current flowing into the power source.

SiP32509 integrates a switch OFF output discharge circuit. Both SiP32508 and SiP32509 are available in TSOT23-6 package.

FEATURES

- 1.1 V to 5.5 V operation voltage range
- Flat low R_{ON} down to 1.2 V
- 44 mΩ typical from 1.5 V to 5 V
- Slew rate controlled turn-on: 2.5 ms at 3.6 V
- Low quiescent current < 1 µA when disabled 10.5 µA typical at V_{IN} = 1.2 V
- Reverse current blocking when switch is off, with guaranteed less than 2 µA leakage
- Material categorization: For definitions of compliance please see www.vishay.com/doc?99912

Pb-free
RoHS
COMPLIANT
HALOGEN
FREE
Available

APPLICATIONS

- PDAs/smart phones
- Ultrabook and notebook computer
- Tablet devices
- Portable media players
- Digital camera
- GPS navigation devices
- Data storage devices
- Optical, industrial, medical, and healthcare devices
- Peripherals
- Office automation
- Networking

TYPICAL APPLICATION CIRCUIT

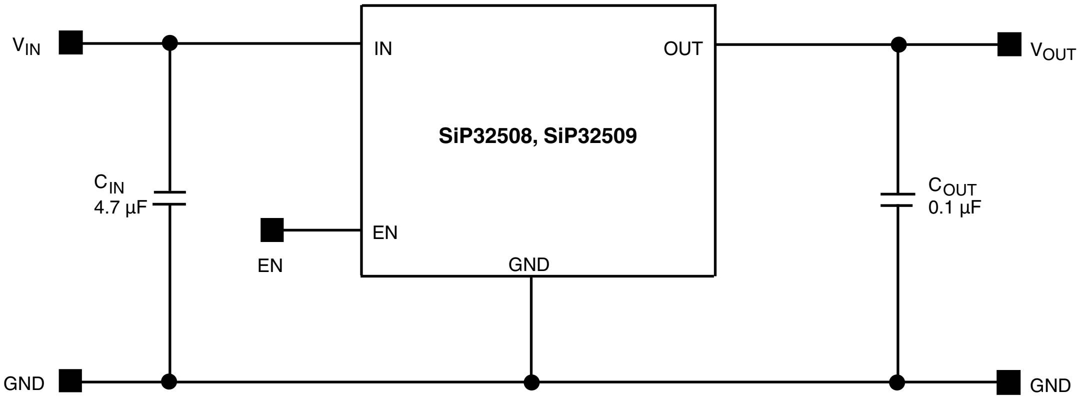


Figure 1 - SiP32508, SiP32509 Typical Application Circuit

ORDERING INFORMATION

Temperature Range	Package	Marking	Part Number
- 40 °C to 85 °C	TSOT23-6	LD	SiP32508DT-T1-GE3
		LE	SiP32509DT-T1-GE3

Note:
GE3 denotes halogen-free and RoHS compliant

ABSOLUTE MAXIMUM RATINGS

Parameter	Limit	Unit
Supply Input Voltage (V_{IN})	- 0.3 to 6	V
Enable Input Voltage (V_{EN})	- 0.3 to 6	
Output Voltage (V_{OUT})	- 0.3 to 6	
Maximum Continuous Switch Current ($I_{max.}$)[c]	3	A
Maximum Repetitive Pulsed Current (1 ms, 10 % Duty Cycle)[c]	6	
Maximum Non-Repetitive Pulsed Current (100 µs, EN = Active)[c]	12	
ESD Rating (HBM)	> 8	kV
Junction Temperature (T_J)	- 40 to 150	°C
Thermal Resistance (θ_{JA})[a]	150	°C/W
Power Dissipation (P_D)[a,b]	833	mW

Notes:
a. Device mounted with all leads and power pad soldered or welded to PC board, see PCB layout.
b. Derate 6.66 mW/°C above T_A = 25 °C, see PCB layout.
c. T_A = 25 °C, see PCB layout

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 in the operational sections of the specifications is not implied. Exposure to absolute maximum rating/conditions for extended periods may affect device reliability.

RECOMMENDED OPERATING RANGE

Parameter	Limit	Unit
Input Voltage Range (V_{IN})	1.1 to 5.5	V
Operating Junction Temperature Range (T_J)	- 40 to 125	°C

SPECIFICATIONS

Parameter	Symbol	Test Conditions Unless Specified V_{IN} = 5 V, T_A = - 40 °C to 85 °C (Typical values are at T_A = 25 °C)	Limits - 40 °C to 85 °C			Unit
			Min.[a]	Typ.[b]	Max.[a]	
Operating Voltage[c]	V_{IN}		1.1	-	5.5	V
Quiescent Current	I_Q	V_{IN} = 1.2 V, EN = active	-	10.5	17	µA
		V_{IN} = 1.8 V, EN = active	-	21	30	
		V_{IN} = 2.5 V, EN = active	-	34	50	
		V_{IN} = 3.6 V, EN = active	-	54	90	
		V_{IN} = 4.3 V, EN = active	-	68	110	
		V_{IN} = 5 V, EN = active	-	105	180	
Off Supply Current	$I_{Q(off)}$	EN = inactive, OUT = open	-	-	1	
Off Switch Current	$I_{DS(off)}$	EN = inactive, OUT = GND	-	-	1	
Reverse Blocking Current	I_{RB}	V_{OUT} = 5 V, V_{IN} = 0 V, V_{EN} = inactive	-	-	10	
On-Resistance	$R_{DS(on)}$	V_{IN} = 1.2 V, I_L = 100 mA, T_A = 25 °C	-	47	54	mΩ
		V_{IN} = 1.8 V, I_L = 100 mA, T_A = 25 °C	-	44	52	
		V_{IN} = 2.5 V, I_L = 100 mA, T_A = 25 °C	-	44	52	
		V_{IN} = 3.6 V, I_L = 100 mA, T_A = 25 °C	-	44	52	
		V_{IN} = 4.3 V, I_L = 100 mA, T_A = 25 °C	-	44	52	
		V_{IN} = 5 V, I_L = 100 mA, T_A = 25 °C	-	46	52	
On-Resistance Temp.-Coefficient	TC_{RDS}		-	3570	-	ppm/°C

SPECIFICATIONS

Parameter	Symbol	Test Conditions Unless Specified V_{IN} = 5 V, T_A = - 40 °C to 85 °C (Typical values are at T_A = 25 °C)	Limits - 40 °C to 85 °C Min.[a]	Typ.[b]	Max.[a]	Unit
EN Input Low Voltage[c]	V_{IL}	V_{IN} = 1.2 V	-	-	0.3	V
		V_{IN} = 1.8 V	-	-	0.4[d]	
		V_{IN} = 2.5 V	-	-	0.5[d]	
		V_{IN} = 3.6 V	-	-	0.6[d]	
		V_{IN} = 4.3 V	-	-	0.7[d]	
		V_{IN} = 5 V	-	-	0.8[d]	
EN Input High Voltage[c]	V_{IH}	V_{IN} = 1.2 V	0.9[d]	-	-	
		V_{IN} = 1.8 V	1.2[d]	-	-	
		V_{IN} = 2.5 V	1.4[d]	-	-	
		V_{IN} = 3.6 V	1.6[d]	-	-	
		V_{IN} = 4.3 V	1.7[d]	-	-	
		V_{IN} = 5 V	1.8	-	-	
EN Input Leakage	I_{SINK}	V_{EN} = 5.5 V	- 1	-	1	µA
Output Pulldown Resistance	R_{PD}	EN = inactive, T_A = 25 °C, (for SiP32509 only)	-	217	280	Ω
Output Turn-On Delay Time	$t_{d(on)}$	V_{IN} = 3.6 V, R_{LOAD} = 10 Ω, T_A = 25 °C	-	1.8	-	ms
Output Turn-On Rise Time	$t_{(on)}$		1.2	2.5	3.8	
Output Turn-Off Delay Time	$t_{d(off)}$		-	-	0.001	

Notes:
a. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum.
b. Typical values are for DESIGN AID ONLY, not guaranteed nor subject to production testing.
c. For V_{IN} outside this range consult typical EN threshold curve.
d. Not tested, guarantee by design.

PIN CONFIGURATION

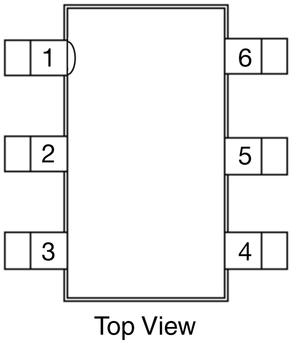


Figure 2 - TSOT23-6 Package

PIN DESCRIPTION

Pin Number	Name	Function
1, 2	OUT	These are output pins of the switch
3	EN	Enable input
4	GND	Ground connection
5, 6	IN	These are input pins of the switch

BLOCK DIAGRAM

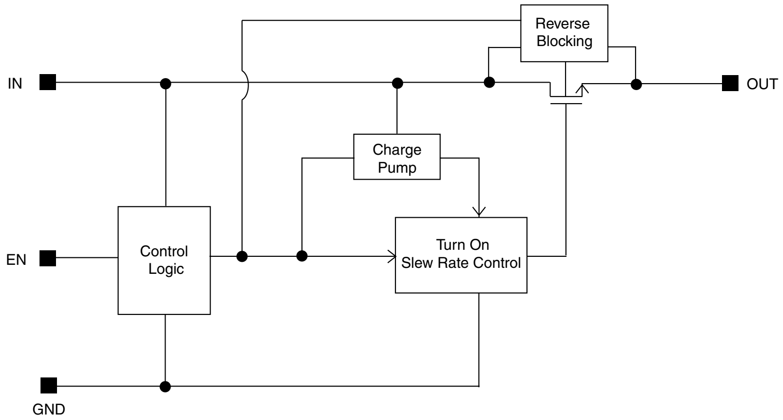


Figure 3 - Functional Block Diagram

TYPICAL CHARACTERISTICS (internally regulated, 25 °C, unless otherwise noted)

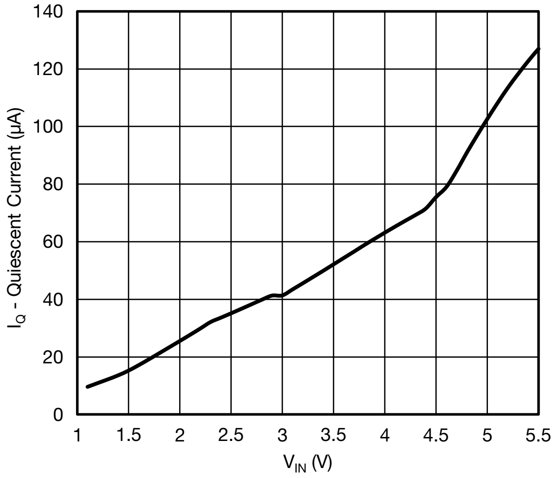


Figure 4 - Quiescent Current vs. Input Voltage

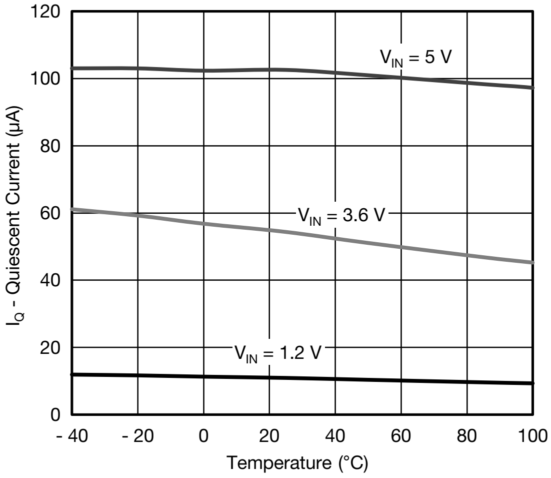


Figure 6 - Quiescent Current vs. Temperature

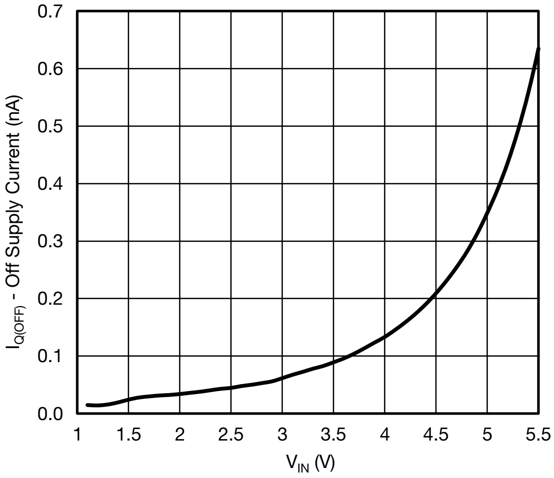


Figure 5 - Off Supply Current vs. Input Voltage

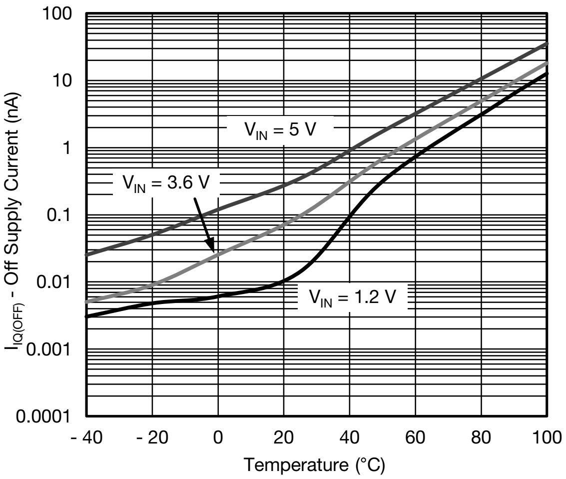


Figure 7 - Off Supply Current vs. Temperature

TYPICAL CHARACTERISTICS (internally regulated, 25 °C, unless otherwise noted)

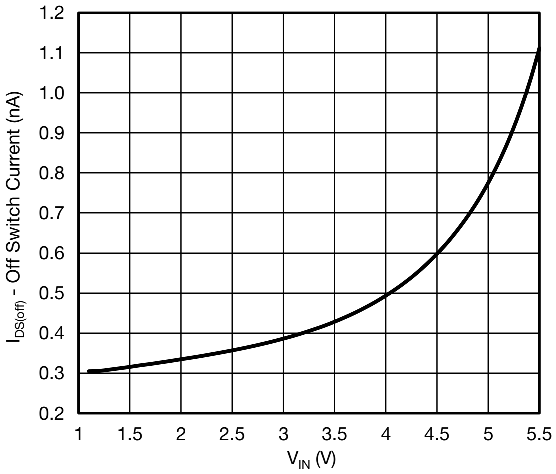


Figure 8 - Off Switch Current vs. Input Voltage

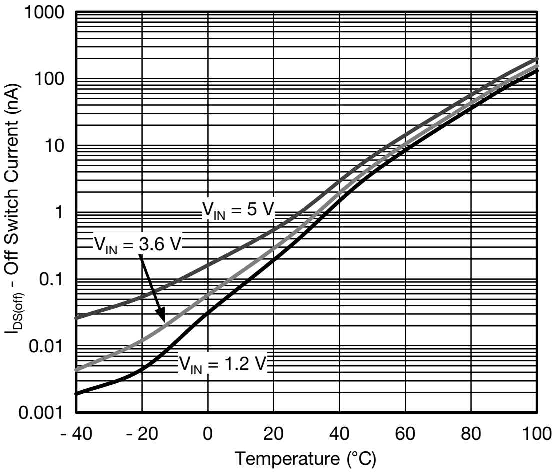


Figure 11 - Off Switch Current vs. Temperature

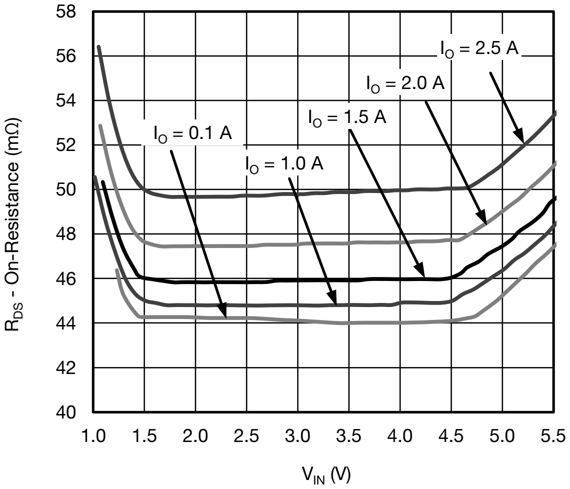


Figure 9 - $R_{DS(on)}$ vs. V_{IN}

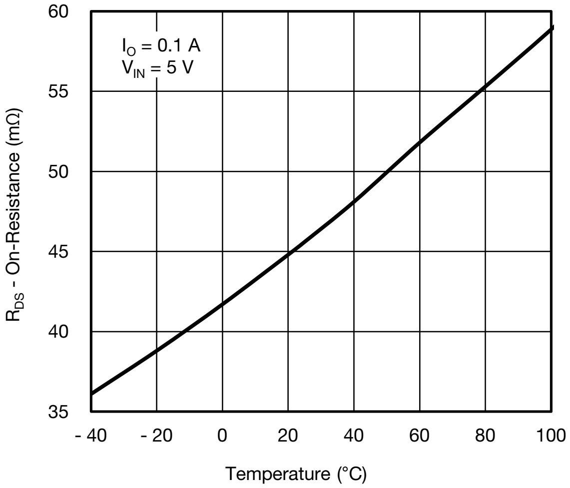


Figure 12 - $R_{DS(on)}$ vs. Temperature

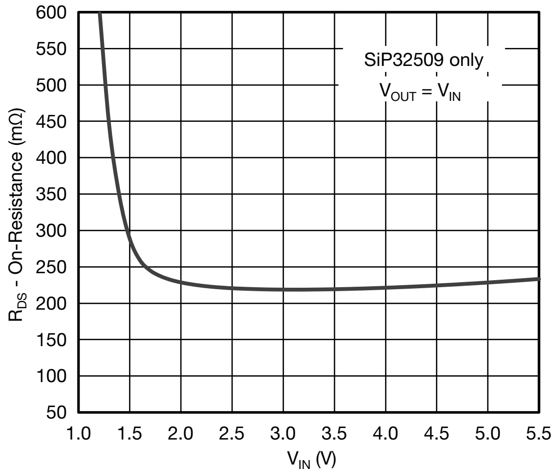


Figure 10 - Output Pull Down vs. V_{IN}

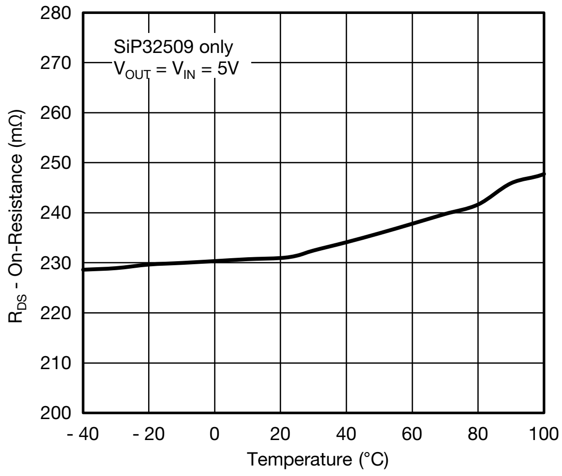


Figure 13 - Output Pull Down vs. Temperature

TYPICAL CHARACTERISTICS (internally regulated, 25 °C, unless otherwise noted)

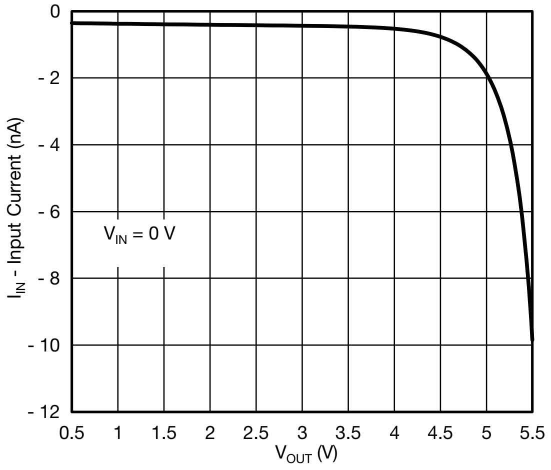


Figure 14 - Reverse Blocking Current vs. Output Voltage

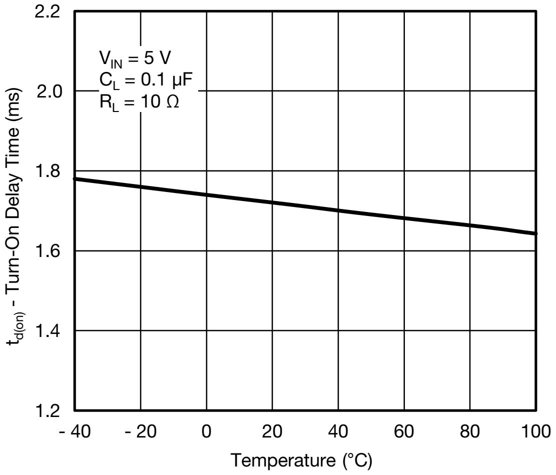


Figure 16 - Turn-On Delay Time vs. Temperature

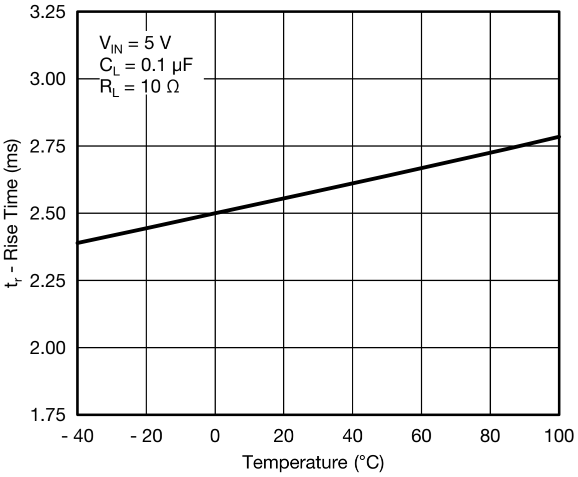


Figure 15 - Rise Time vs. Temperature

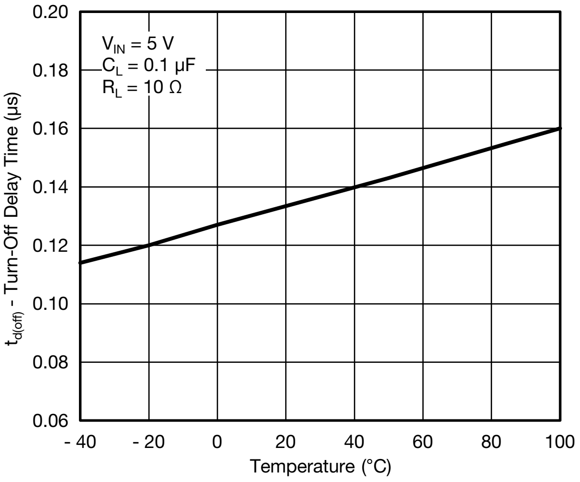


Figure 17 - Turn-Off Delay Time vs. Temperature

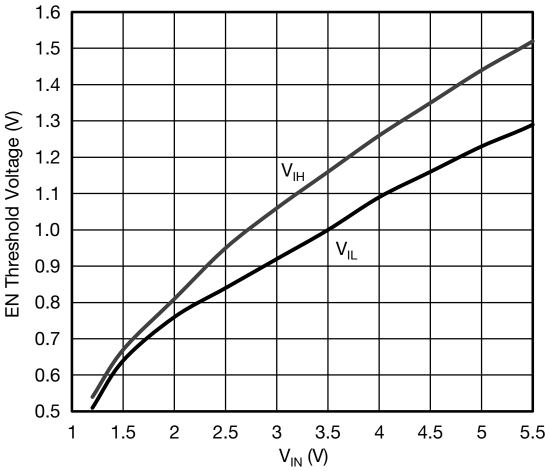


Figure 18 - EN Threshold Voltage vs. Input Voltage

TYPICAL WAVEFORMS

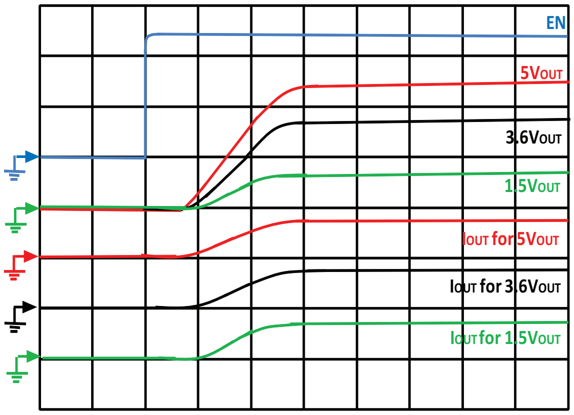


Figure 19 - Typical Turn-on Delay, Rise Time
C_{OUT} = 0.1 µF, C_{IN} = 4.7 µF, I_{OUT} = 1.5 A

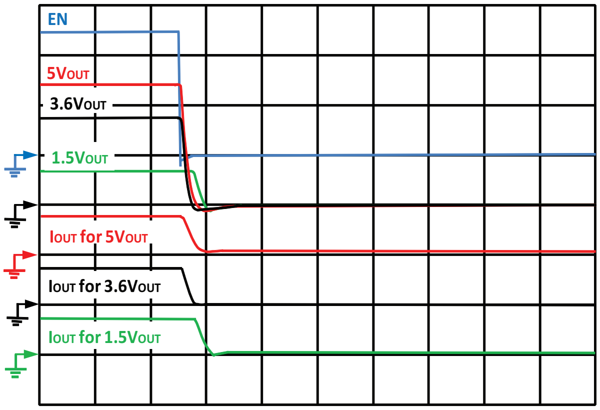


Figure 22 - Typical Fall Time
C_{OUT} = 0.1 µF, C_{IN} = 4.7 µF, I_{OUT} = 1.5 A

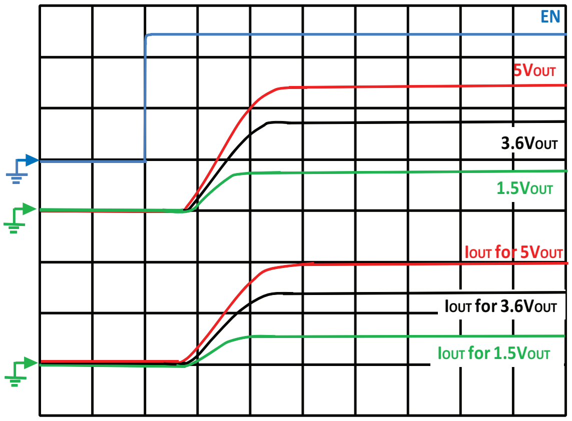


Figure 20 - Typical Turn-on Delay, Rise Time
C_{OUT} = 0.1 µF, C_{IN} = 4.7 µF, R_{OUT} = 10 Ω

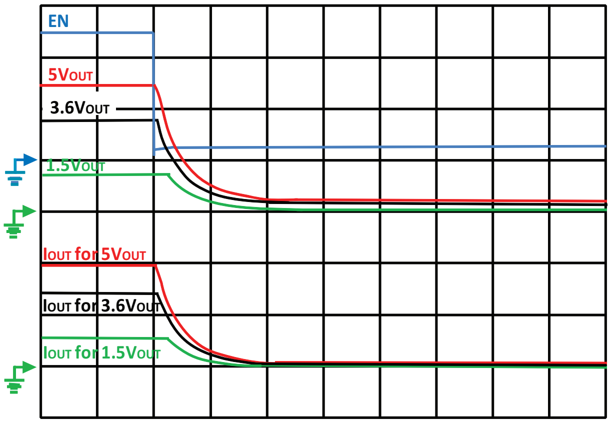


Figure 23 - Typical Fall Time
C_{OUT} = 0.1 µF, C_{IN} = 4.7 µF, R_{OUT} = 10 Ω

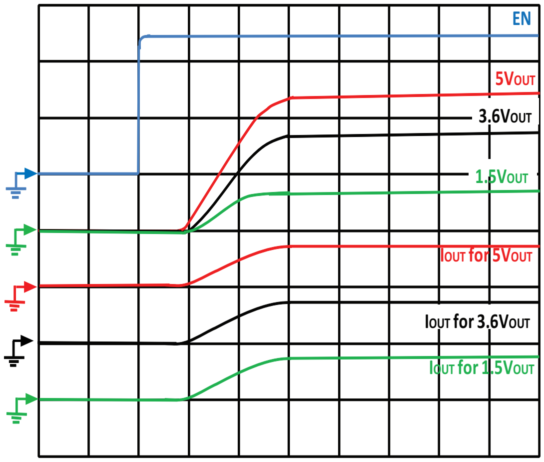


Figure 21 - Typical Turn-on Delay, Rise Time
C_{OUT} = 200 µF, C_{IN} = 4.7 µF, I_{OUT} = 1.5 A

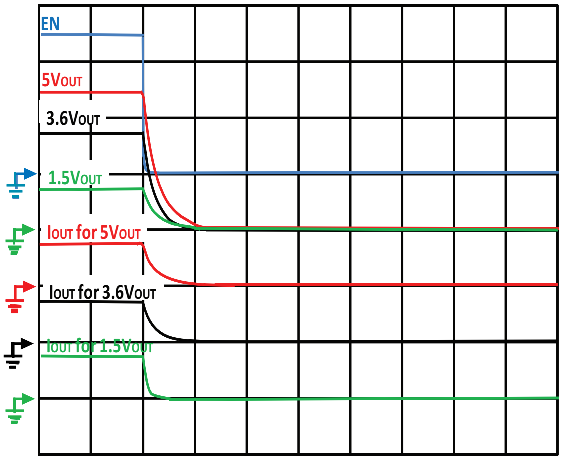
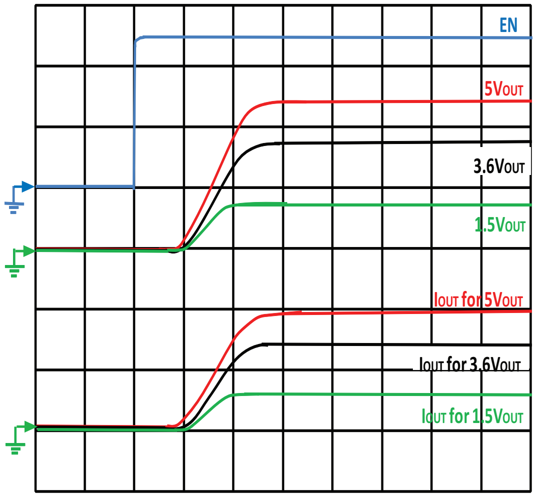
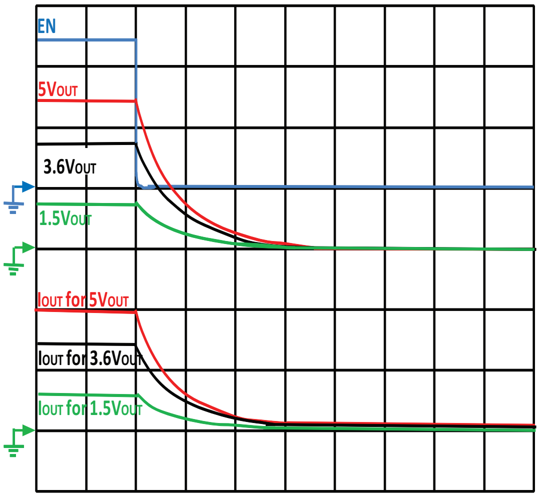


Figure 24 - Typical Fall Time
C_{OUT} = 200 µF, C_{IN} = 4.7 µF, I_{OUT} = 1.5 A



2 V/Div, 0.25 A/Div, 2 ms/Div

Figure 25 - Typical Turn-on Delay, Rise Time
C_{OUT} = 200 µF, C_{IN} = 4.7 µF, R_{OUT} = 10 Ω



2 V/Div, 0.25 A/Div, 2 ms/Div

Figure 26 - Typical Fall Time
C_{OUT} = 200 µF, C_{IN} = 4.7 µF, R_{OUT} = 10 Ω

DETAILED DESCRIPTION

SiP32508 and SiP32509 are advanced slew rate controlled high side load switches consisted of a n-channel power switches. When a device is enable the gate of the power switch is turned on at a controlled rate to avoid excessive in-rush current. Once fully on the gate to source voltage of the power switch is biased at a constant level. The design gives a flat on resistance throughout the operating voltages. When the device is off, the reverse blocking circuitry prevents current from flowing back to input if output is raised higher than input. The reverse blocking mechanism also works in case of no input applied.

APPLICATION INFORMATION

Input Capacitor

SiP32508 and SiP32509 do not require input capacitor. To limit the voltage drop on the input supply caused by transient inrush currents, a input bypass capacitor is recommended. A 2.2 µF ceramic capacitor placed as close to the V_{IN} and GND should be enough. Higher values capacitor can help to further reduce the voltage drop. Ceramic capacitors are recommended for their ability to withstand input current surge from low impedance sources such as batteries in portable devices.

Output Capacitor

While these devices work without an output capacitor, an 0.1 µF or larger capacitor across V_{OUT} and GND is recommended to accommodate load transient condition. It also helps preventing parasitic inductance from forcing V_{OUT} below GND when switching off. Output capacitor has minimal affect on device's turn on slew rate time. There is no requirement on capacitor type and its ESR.

Enable

The EN pin is compatible with both TTL and CMOS logic voltage levels. Enable pin voltage can be above IN once it is within the absolute maximum rating range.

Protection Against Reverse Voltage Condition

Both SiP32508 and SiP32509 contain reverse blocking circuitry to protect the current from going to the input from the output in case where the output voltage is higher than the input voltage when the main switch is off. Reverse blocking works for input voltage as low as 0 V.

Thermal Considerations

SiP32508 and SiP32509 are designed to maintain a constant output load current. Due to physical limitations of the layout and assembly of the device the maximum switch current is 3 A, as stated in the Absolute Maximum Ratings table. However, another limiting characteristic for the safe operating load current is the thermal power dissipation of the package. To obtain the highest power dissipation (and a thermal resistance of 150 °C/W) the IN and OUT pins of the device should be connected to heat sinks on the printed circuit board. Figure 21 shows a typical PCB layout. All copper traces and vias for the IN and OUT pins should be sized adequately to carry the maximum continuous current.

The maximum power dissipation in any application is dependant on the maximum junction temperature, $T_{J(max.)}$ = 125 °C, the junction-to-ambient thermal resistance for the TSOT23-6 package, $\theta_{J\text{-}A}$ = 150 °C/W, and the ambient temperature, T_A, which may be formulaically expressed as:

$$P\ (\text{max.}) = \frac{T_J\ (\text{max.}) - T_A}{\theta_{J-A}} = \frac{125 - T_A}{150}$$

It then follows that, assuming an ambient temperature of 70 °C, the maximum power dissipation will be limited to about 367 mW.

So long as the load current is below the 3 A limit, the maximum continuous switch current becomes a function of two things: the package power dissipation and the $R_{DS(on)}$ at the ambient temperature.

As an example let us calculate the worst case maximum load current at $T_A = 70$ °C. The worst case $R_{DS(on)}$ at 25 °C occurs at an input voltage of 1.2 V and is equal to 55 mΩ. The $R_{DS(on)}$ at 70 °C can be extrapolated from this data using the following formula:

$R_{DS(on)}$ (at 70 °C) = $R_{DS(on)}$ (at 25 °C) x (1 + T_C x DT)

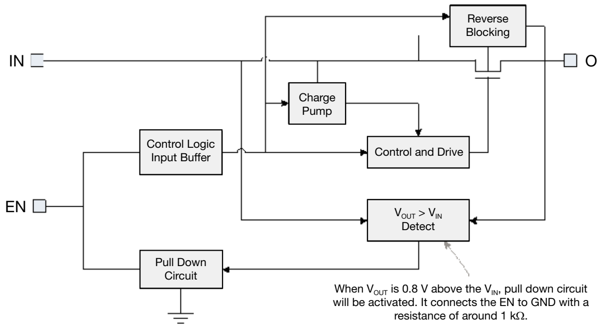
Where T_C is 3570 ppm/°C. Continuing with the calculation we have

$R_{DS(on)}$ (at 70 °C) = 52 mΩ x (1 + 0.00357 x (70 °C - 25 °C)) = 60 mΩ

The maximum current limit is then determined by

$$I_{LOAD}\,(\text{max.}) < \sqrt{\frac{P\,(\text{max.})}{R_{DS(ON)}}}$$

which in this case is 2.4 A. Under the stated input voltage condition, if the 2.4 A current limit is exceeded the internal die temperature will rise and eventually, possibly damage the device.

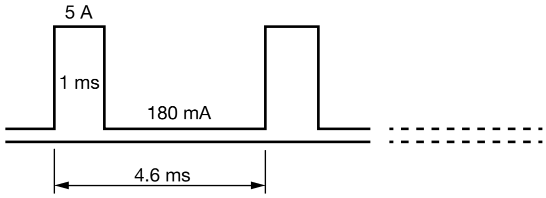


Active EN Pull Down for Reverse Blocking

When an internal circuit detects the condition of V_{OUT} 0.8 V higher than V_{IN}, it will turn on the pull down circuit connected to EN, forcing the switching OFF. The pull down value is about 1 kΩ.

Pulse Current Capability

The device is mounted on the evaluation board shown in the PCB layout section. It is loaded with pulses of 5 A and 1 ms for periods of 4.6 ms.



The SiP32508 and SiP32509 can safely support 5 A pulse current repetitively at 25 °C.

Switch Non-Repetitive Pulsed Current

The SiP32508 and SiP32509 can withstand inrush current of up to 12 A for 100 µs at 25 °C when heavy capacitive loads are connected and the part is already enabled.

Recommended Board Layout

For the best performance, all traces should be as short as possible to minimize the inductance and parasitic effects. The input and output capacitors should be kept as close as possible to the input and output pins respectively.

Connecting the central exposed pad to GND, using wide traces for input, output, and GND help reducing the case to ambient thermal impedance.

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Please note that some Vishay documentation may still make reference to RoHS Directive 2002/95/EC. We confirm that all the products identified as being compliant to Directive 2002/95/EC conform to Directive 2011/65/EU.

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OCEAN CHIPS
Океан Электроники
Поставка электронных компонентов

Компания «Океан Электроники» предлагает заключение долгосрочных отношений при поставках импортных электронных компонентов на взаимовыгодных условиях!

Наши преимущества:

- Поставка оригинальных импортных электронных компонентов напрямую с производств Америки, Европы и Азии, а так же с крупнейших складов мира;
- Широкая линейка поставок активных и пассивных импортных электронных компонентов (более 30 млн. наименований);
- Поставка сложных, дефицитных, либо снятых с производства позиций;
- Оперативные сроки поставки под заказ (от 5 рабочих дней);
- Экспресс доставка в любую точку России;
- Помощь Конструкторского Отдела и консультации квалифицированных инженеров;
- Техническая поддержка проекта, помощь в подборе аналогов, поставка прототипов;
- Поставка электронных компонентов под контролем ВП;
- Система менеджмента качества сертифицирована по Международному стандарту ISO 9001;
- При необходимости вся продукция военного и аэрокосмического назначения проходит испытания и сертификацию в лаборатории (по согласованию с заказчиком);
- Поставка специализированных компонентов военного и аэрокосмического уровня качества (Xilinx, Altera, Analog Devices, Intersil, Interpoint, Microsemi, Actel, Aeroflex, Peregrine, VPT, Syfer, Eurofarad, Texas Instruments, MS Kennedy, Miteq, Cobham, E2V, MA-COM, Hittite, Mini-Circuits, General Dynamics и др.);

Компания «Океан Электроники» является официальным дистрибьютором и эксклюзивным представителем в России одного из крупнейших производителей разъемов военного и аэрокосмического назначения **«JONHON»**, а так же официальным дистрибьютором и эксклюзивным представителем в России производителя высокотехнологичных и надежных решений для передачи СВЧ сигналов **«FORSTAR»**.

AVIC JONHON

«JONHON» (основан в 1970 г.)

Разъемы специального, военного и аэрокосмического назначения:

(Применяются в военной, авиационной, аэрокосмической, морской, железнодорожной, горно- и нефтедобывающей отраслях промышленности)

«FORSTAR» (основан в 1998 г.)

ВЧ соединители, коаксиальные кабели, кабельные сборки и микроволновые компоненты:

(Применяются в телекоммуникациях гражданского и специального назначения, в средствах связи, РЛС, а так же военной, авиационной и аэрокосмической отраслях промышленности).

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