1 General Description

The WP2608 is an ultra-low on-resistance power-distribution switch with external soft start control. It integrates a N-channel MOSFET that can deliver 6A continuous load current.

The device integrates over-temperature protection. The over temperature protection function shuts down the N-channel MOSFET power switch when the junction temperature rises beyond 160 ℃ and will automatically turns on the power switch when the temperature drops by 40 ℃. The device is available in lead free DFN2x2-8/TDFN2x2-8 packages.

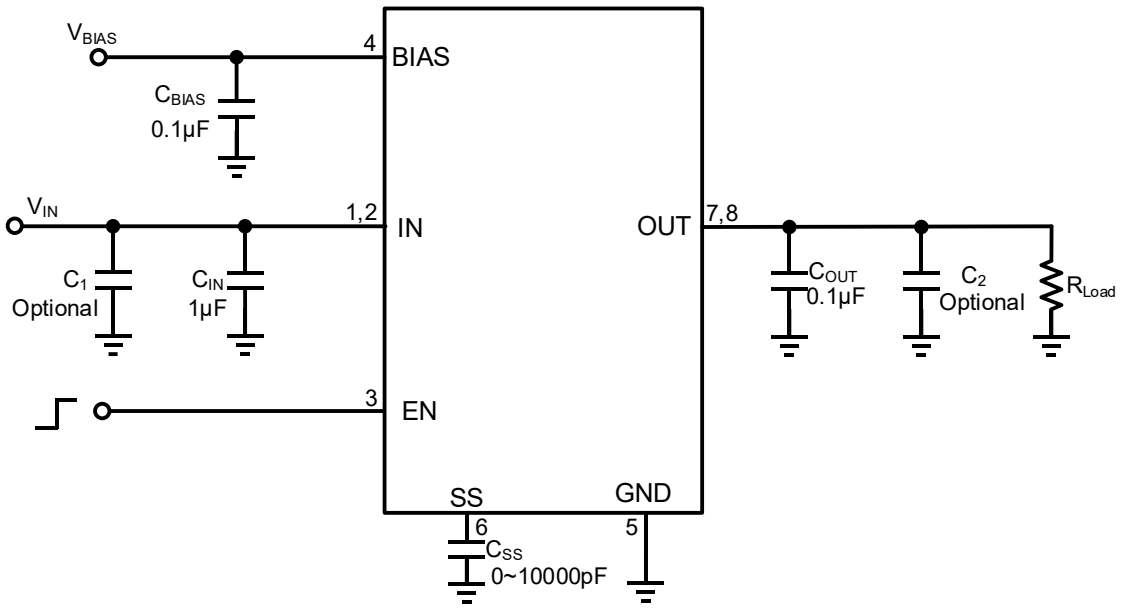
2 Features

- 6A Continuous Current
- $R_{DS(ON)}$:9mΩ(WP2608-T28R)
  20mΩ(WP2608-F28R)
- Soft Start Time Programmable by External Capacitor
- Input Voltage Range (V_{IN}): 0.8V to 5.5V
- Supply Voltage Range (V_{BIAS}): 3V to 5.5V
- Output Discharge when Switch Disabled
- Reverse Current Blocking when Switch Disabled

3 Applications

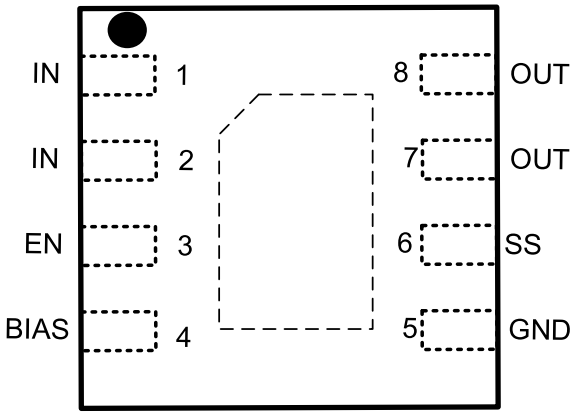
- Notebook PCs
- AIO PC

4 Typical Application Circuit



5 Pin Configuration

(Top View)



6 Pin Description

PIN NUMBER	PIN NAME	I/O	PIN FUNCTIONS
1	IN	I	Switch input.
2	IN	I	
3	EN	I	Enable input. Active High.
4	BIAS	I	Bias voltage input pin for internal control circuitry.
5	GND	-	Common ground.
6	SS	-	Soft start control of switch. A capacitor from this pin to ground sets the rise slew rate of OUT.
7	OUT	O	Switch output.
8	OUT	O	
Exposed Pad		-	Connect the thermal pad to a large area GND plane for improved thermal performance.

7 Absolute Maximum Ratings [1]

（T_A=25℃, unless otherwise noted)

SYMBOL	PARAMETER	RATING	UNIT
V_{BIAS}	BIAS Voltage	-0.3 to 6	V
V_{IN}	IN Voltage	-0.3 to 6	V
V_{OUT}	OUT Voltage	-0.3 to 6	V
V_{EN}	EN Voltage	-0.3 to 6	V
T_J	Maximum Junction Temperature	150	℃
T_{STG}	Storage Temperature	-65 to 150	℃
T_{SDR}	Lead Temperature (Soldering, 10 sec)	260	℃

NOTE 1: Stresses beyond those listed under absolute maximum ratings may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under recommended operating conditions. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability. All voltage values are with respect to the network ground terminal unless otherwise noted.

8 Recommended Operating Conditions

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{BIAS}	BIAS Input Voltage	3.0	5.5	V
V_{IN}	IN Input Voltage	0.8	5.5	V
I_{OUT}	OUT Output Current	0	6	A
	Maximum Pulsed Switch Current, Pulse<300ms, 1% Duty Cycle		8	A
V_{EN}	Input Logic High	1.2		V
	Input Logic Low		0.4	V
T_A	Operating Ambient Temperature	-40	85	℃
T_J	Operating Junction Temperature	-40	125	℃

9 Electrical Characteristics

(V_{IN}= 5V, V_{BIAS} =5V, V_{EN}=High, T_A=25℃, unless otherwise noted)

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
SUPPLY CURRENT						
I_{BIAS}	BIAS Supply Current	No load		50	90	μA
I_{BIAS_SHDN}	BIAS Supply Current at Shutdown	No load, V_{EN}=0V			2	μA
I_{IN_SHDN}	IN Off-State Supply Current	No load, V_{BIAS}=5V, V_{EN}=0V, V_{IN}=5V		0.1	8	μA
		No load, V_{BIAS}=5V, V_{EN}=0V, V_{IN}=3.3V		0.1	3	μA
		No load, V_{BIAS}=5V, V_{EN}=0V, V_{IN}=1.8V		0.1	2	μA
		No load, V_{BIAS}=5V, V_{EN}=0V, V_{IN}=0.8V		0.1	1	μA
I_{REV}	Reverse Leakage Current	V_{EN}=0V, V_{IN}=0V		0.1	16	μA
UNDER-VOLTAGE LOCKOUT (UVLO)						
V_{BIAS_UVLO}	Rising BIAS UVLO Threshold	V_{BIAS} rising	1.9	2.4	2.9	V
	BIAS UVLO Hysteresis			0.1		V
POWER SWITCH						
$R_{DS(ON)}$ [2]	Power Switch On Resistance (WP2608-T28R)	V_{BIAS}=5V, V_{IN}=5V, I_{OUT}=1A, T_A= 25 ℃		9	18	mΩ
		V_{BIAS}=5V, V_{IN}=5V, I_{OUT}=1A, T_A= -40 to 85 ℃			20	mΩ
		V_{BIAS}=3.3V, V_{IN}=3.3V, I_{OUT}=1A, T_A= 25 ℃		12	23	mΩ
		V_{BIAS}=3.3V, V_{IN}=3.3V, I_{OUT}=1A, T_A= -40 to 85 ℃			28	mΩ
$R_{DS(ON)}$ [2]	Power Switch On Resistance (WP2608-F28R)	V_{BIAS}=5V, V_{IN}=5V, I_{OUT}=1A, T_A= 25 ℃		20	25	mΩ
		V_{BIAS}=5V, V_{IN}=5V, I_{OUT}=1A, T_A= -40 to 85 ℃			30	mΩ
		V_{BIAS}=3.3V, V_{IN}=3.3V, I_{OUT}=1A, T_A= 25 ℃		25	30	mΩ
		V_{BIAS}=3.3V, V_{IN}=3.3V, I_{OUT}=1A, T_A= -40 to 85 ℃			35	mΩ

SYMBOL	PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNIT
R_{DIS}	OUT Discharge Resistance	V_{EN}=0V, V_{OUT}=1V		100	150	Ω
SOFT-START CONTROL PIN						
I_{SS}	SS Discharge Current	V_{SS}=6V, V_{EN}=0V, measured at SS		560		μA
EN INPUT PIN						
V_{EN}	Input Logic High		1.2			V
	Input Logic Low				0.4	V
I_{EN}	Input Current				1	μA
OVER-TEMPERATURE PROTECTION (OTP)						
T_{SD}	Over-Temperature Threshold	T_A rising		160		℃
	Over-Temperature Threshold Hysteresis	T_A falling		40		℃

NOTE 2: $R_{DS(ON)}$ for -40 to 85℃ is guaranteed by design, not tested in production.

10 Typical Performance Characteristics

(V_{IN} = 5V, V_{EN} = 5V, C_{IN}=10μF, C_{OUT}=0.1μF, T_A=25℃, unless otherwise noted)

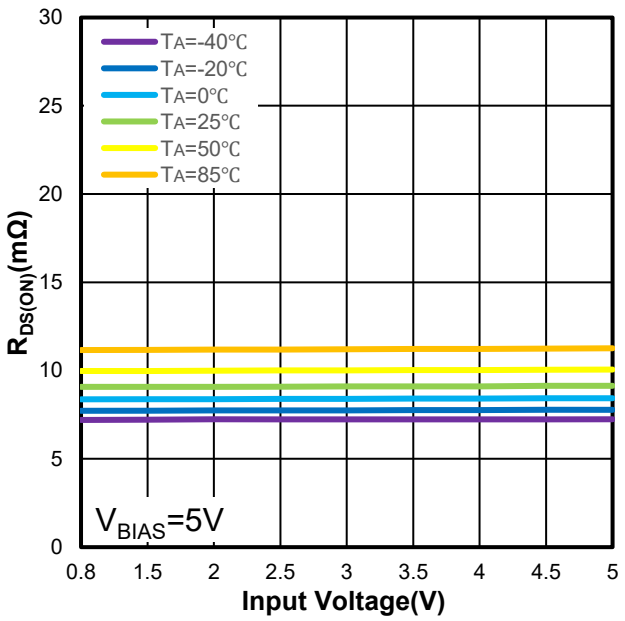


Figure 1. Switch On Resistance vs. Input Voltage vs. Ambient Temperature (WP2608-T28R)

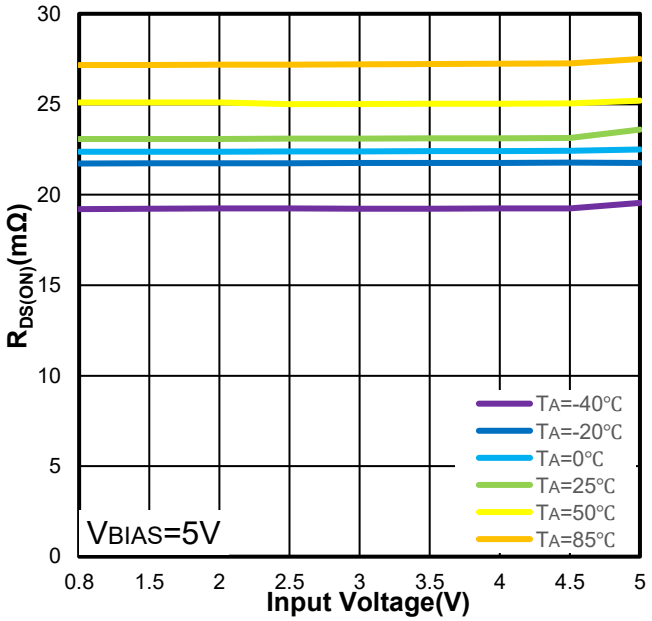


Figure 2. BIAS Supply Current vs. Input Voltage vs. Ambient Temperature (WP2608-F28R)

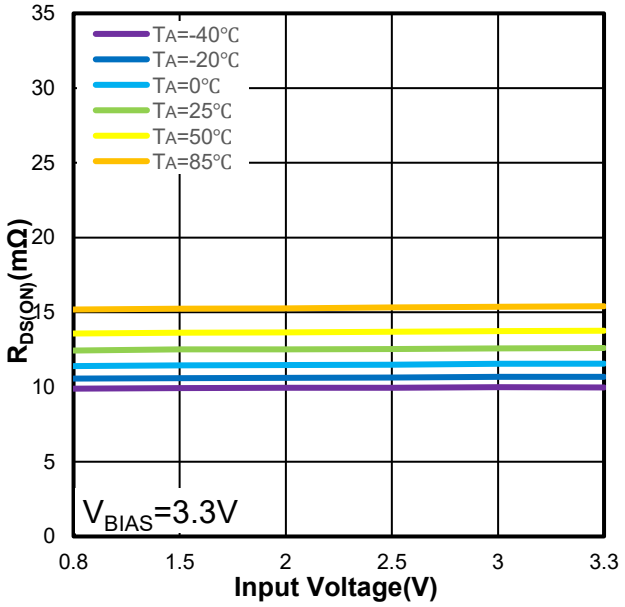


Figure 3. Switch On Resistance vs. Input Voltage vs. Ambient Temperature (WP2608-T28R)

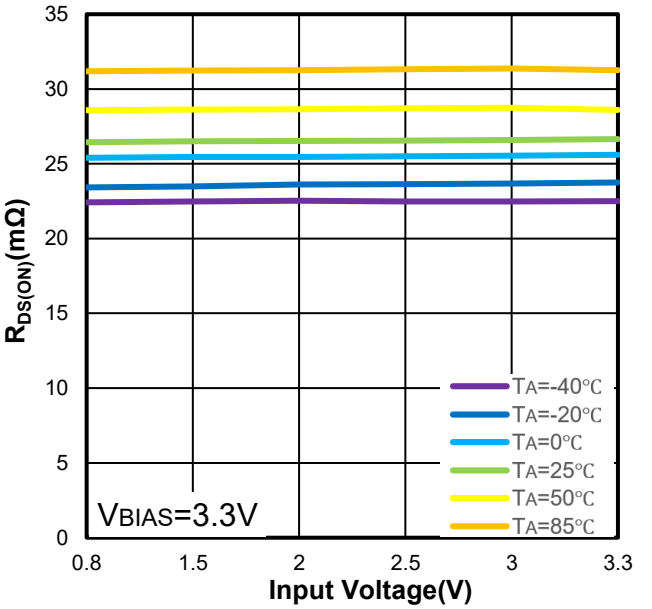


Figure 4. BIAS Supply Current vs. Input Voltage vs. Ambient Temperature (WP2608-F28R)

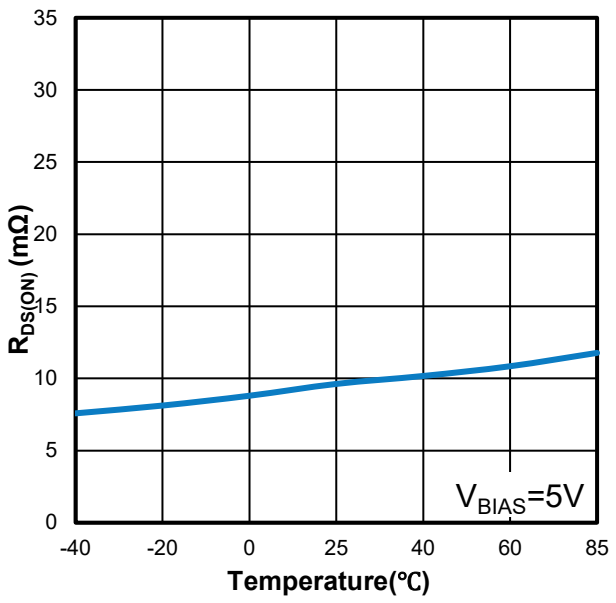


Figure 5. Switch On Resistance vs. Ambient Temperature (WP2608-T28R)

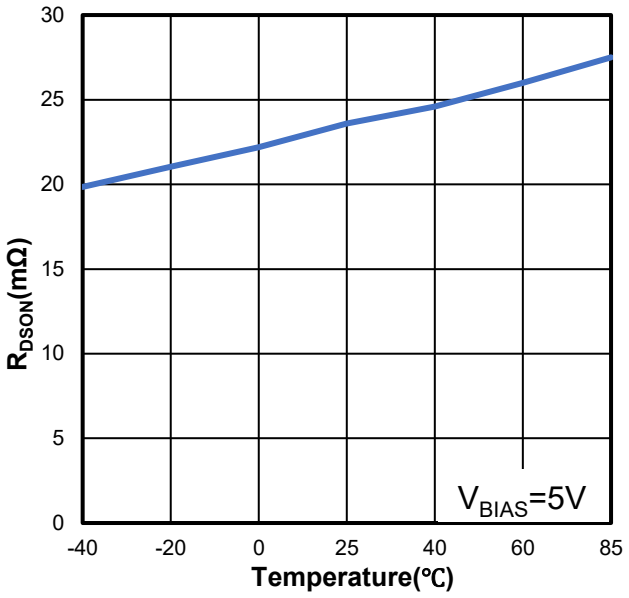


Figure 6. Switch On-Resistance vs. Ambient Temperature (WP2608-F28R)

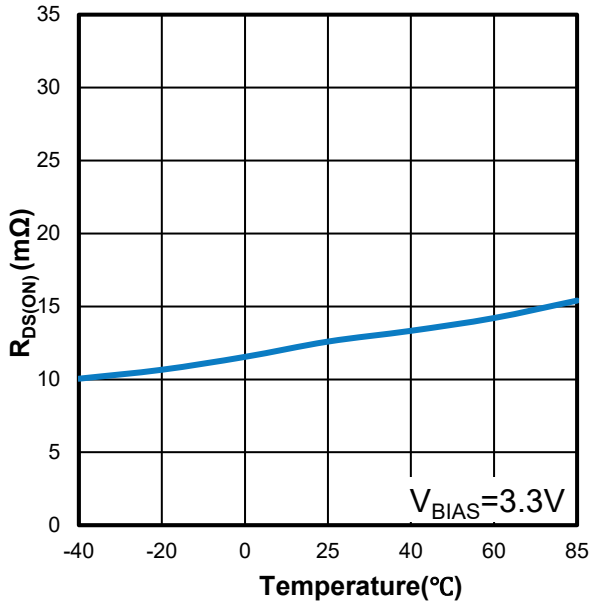


Figure 7. Switch On-Resistance vs. Ambient Temperature (WP2608-T28R)

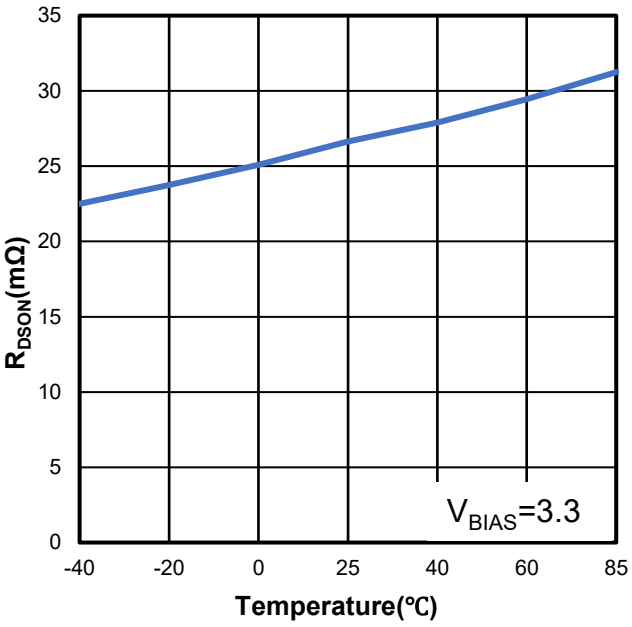


Figure 8. Switch On-Resistance vs. Ambient Temperature (WP2608-F28R)

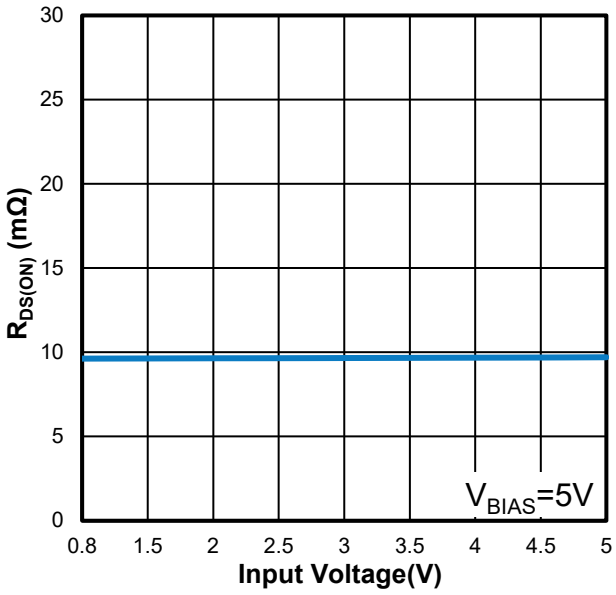


Figure 9. Switch On-Resistance vs. Input Voltage (WP2608-T28R)

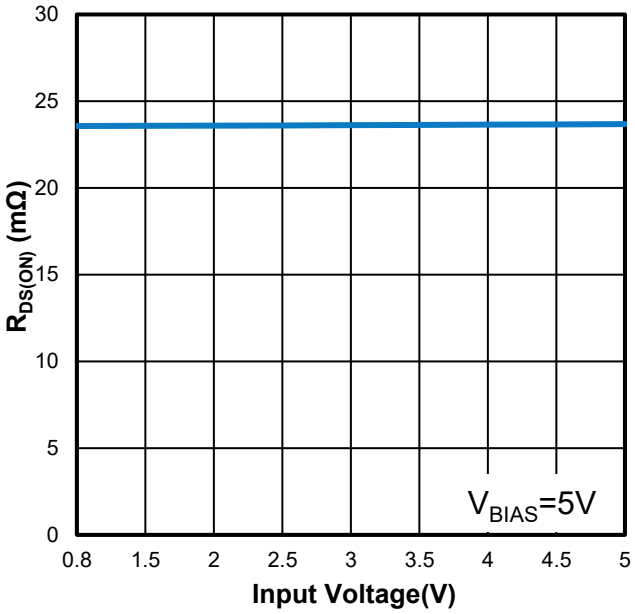


Figure 10. Switch On-Resistance vs. Input Voltage (WP2608-F28R)

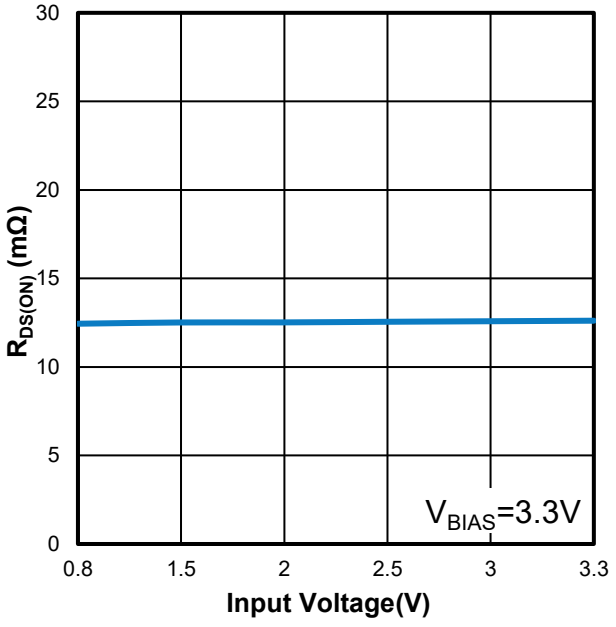


Figure 11. Switch On Resistance vs. Input Voltage (WP2608-T28R)

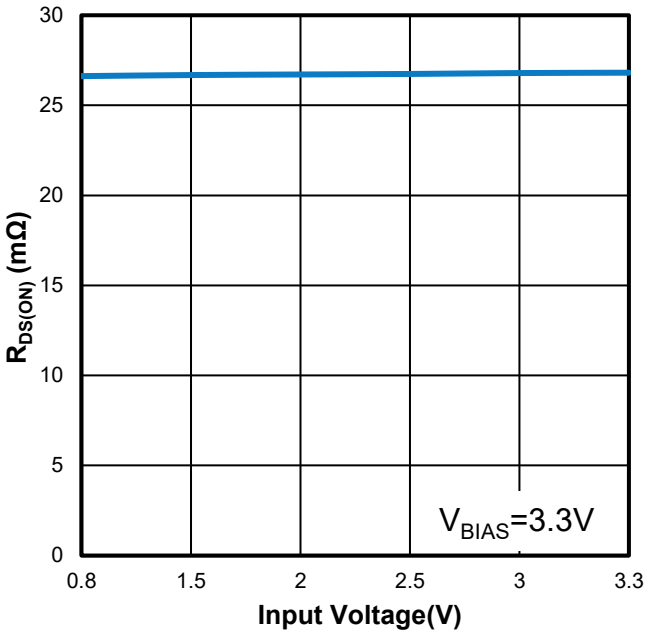


Figure 12. Switch On-Resistance vs. Input Voltage (WP2608-F28R)

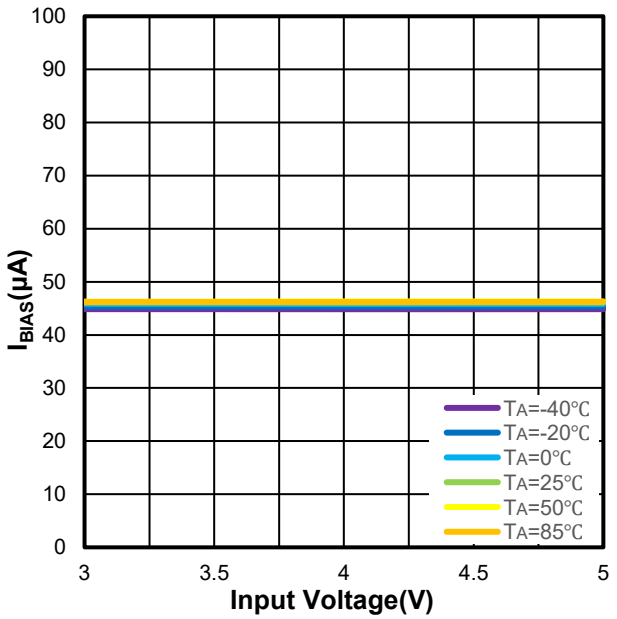


Figure 13. BIAS Supply Current vs. Input Voltage

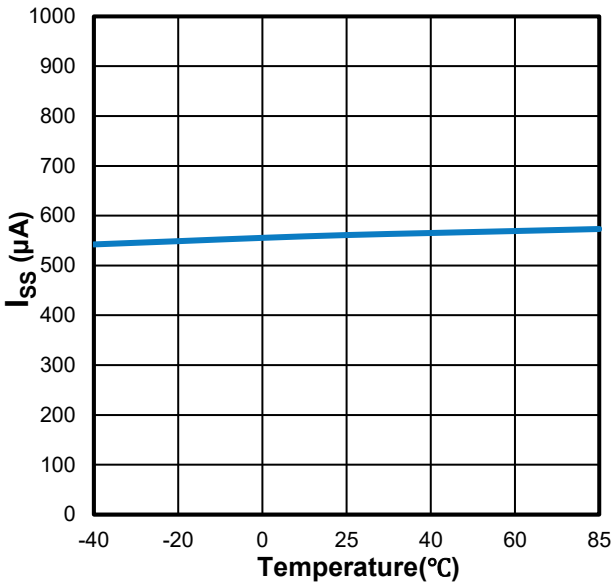


Figure 14. SS Discharge Current vs. Ambient Temperature

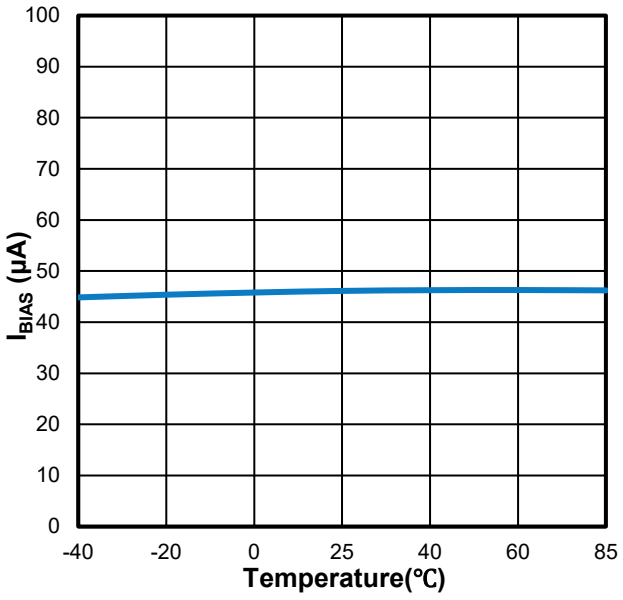


Figure 15. BIAS Supply Current vs. Ambient Temperature

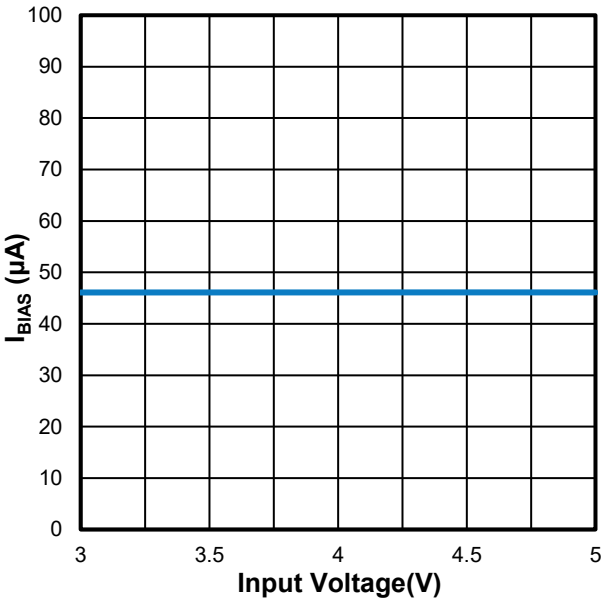


Figure 16. BIAS Supply Current vs. Input Voltage

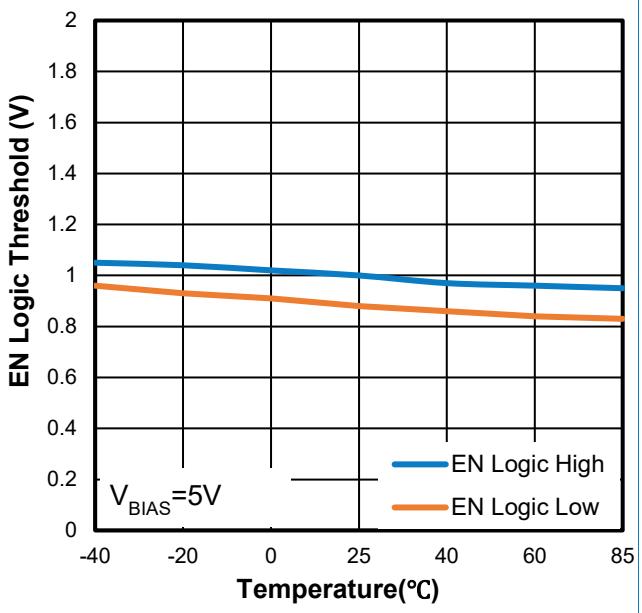


Figure 17. EN Logic Threshold vs. Ambient Temperature

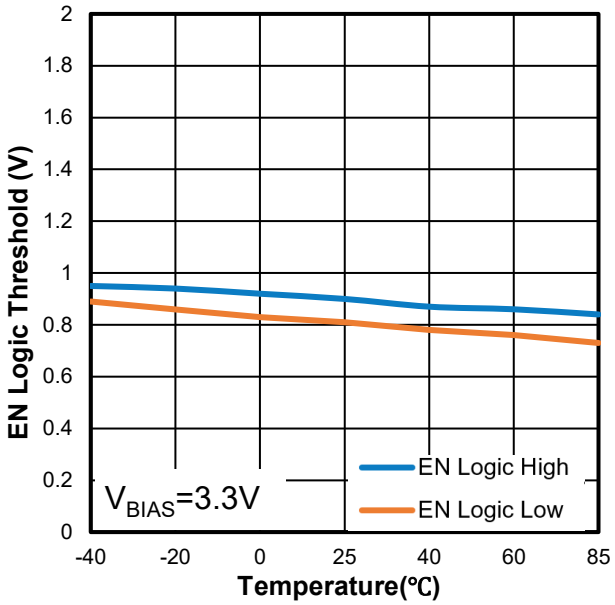


Figure 18. EN Logic Threshold vs. Ambient Temperature

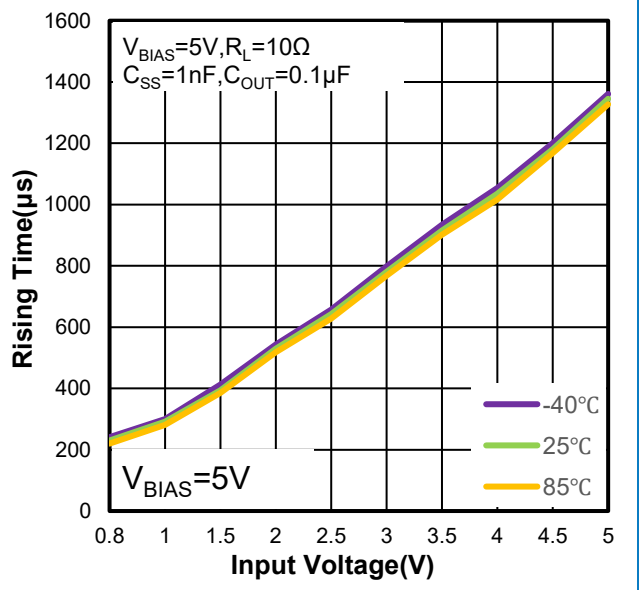


Figure 19. Rising Time vs. Input Voltage

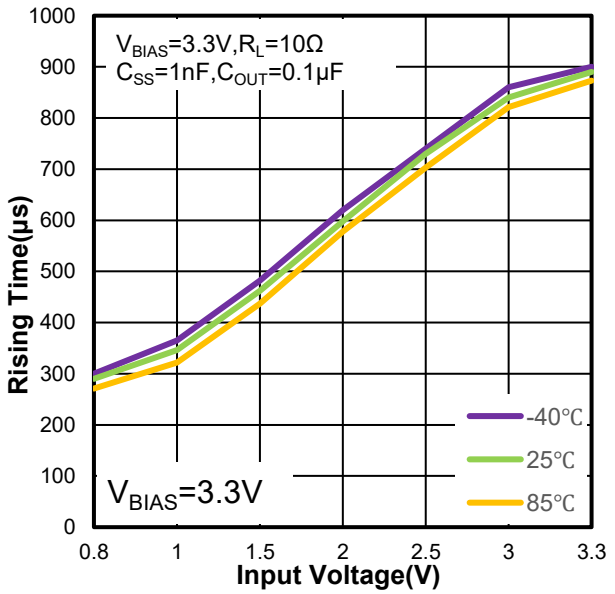


Figure 20. Rising Time vs. Input Voltage

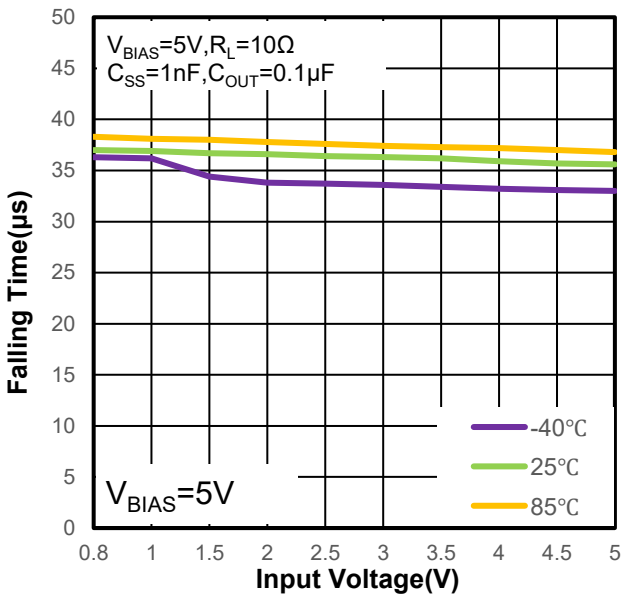


Figure 21. Falling Time vs. Input Voltage

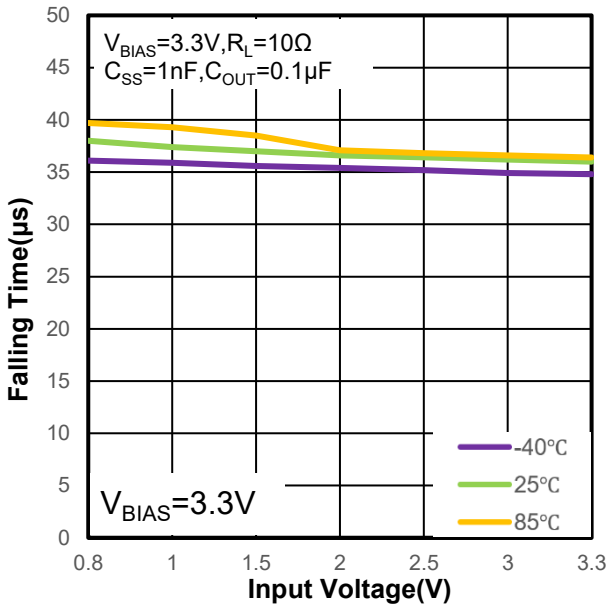


Figure 22. Falling Time vs. Input Voltage

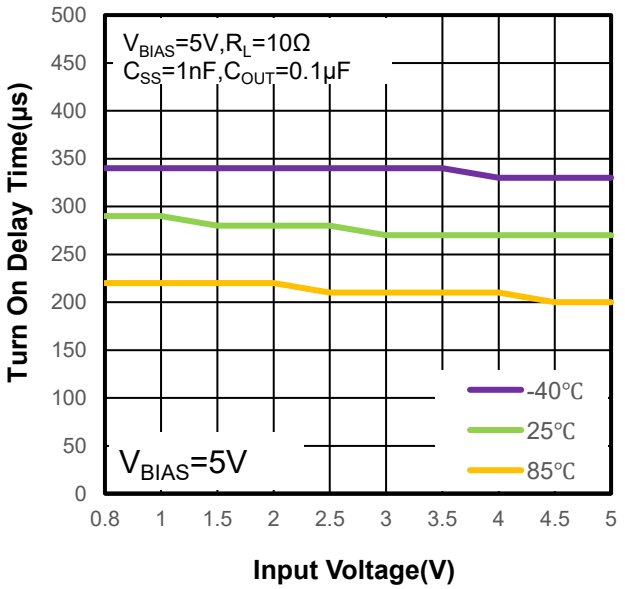


Figure 23. Turn On Delay Time vs. Input Voltage

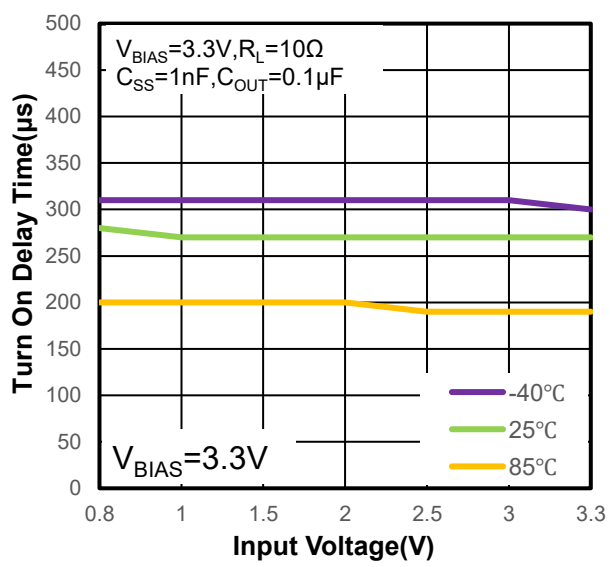


Figure 24. Turn On Delay Time vs. Input Voltage

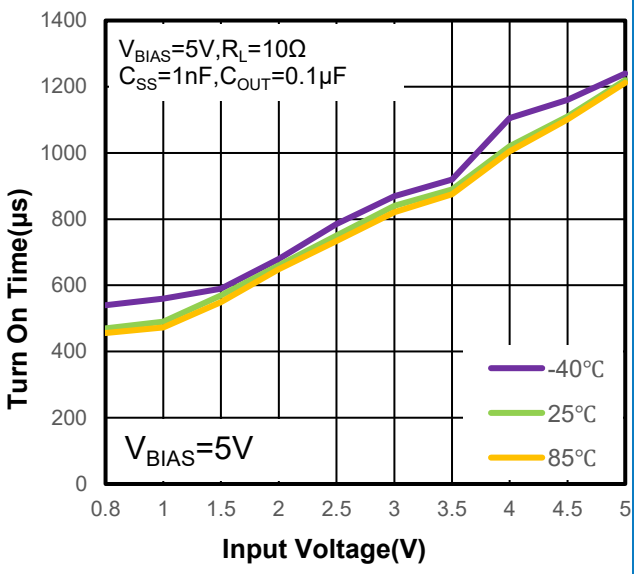


Figure 25. Turn On Time vs. Input Voltage

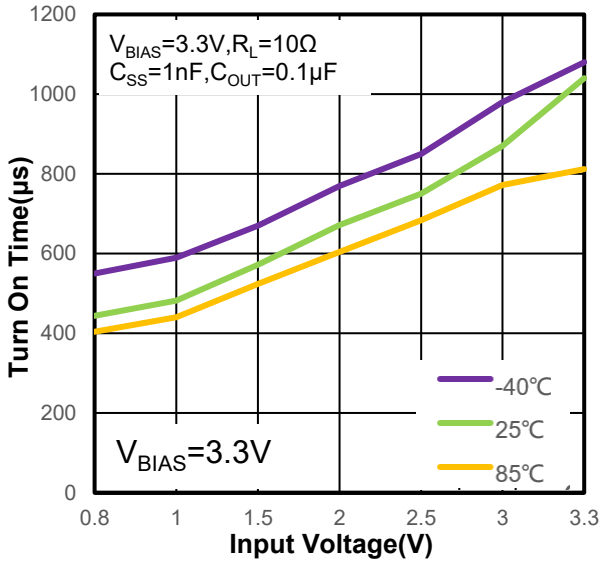


Figure 26. Turn On Time vs. Input Voltage

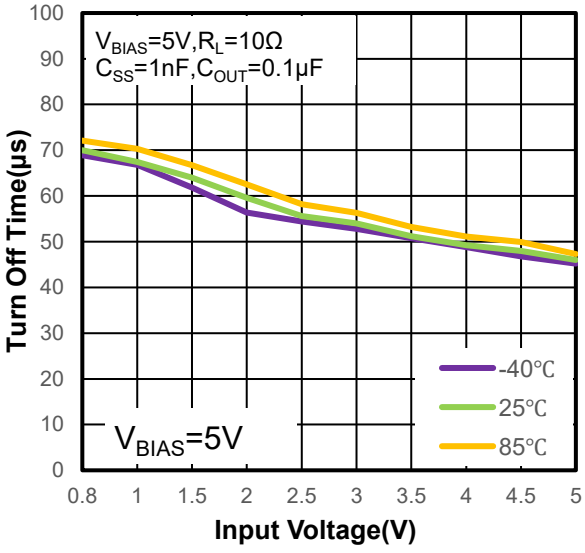


Figure 27. Turn Off Time vs. Input Voltage

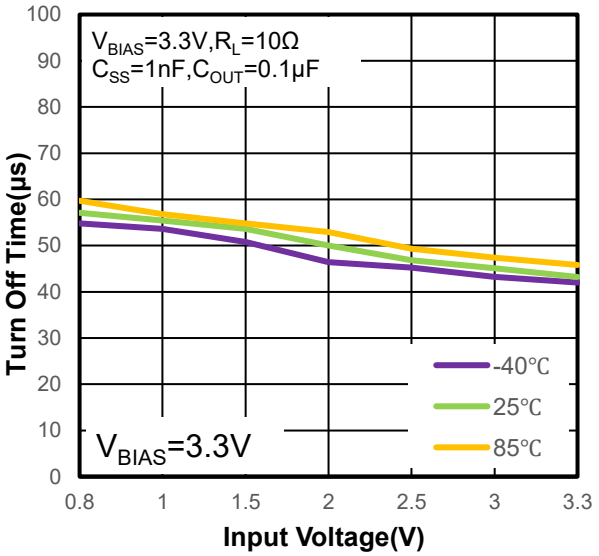


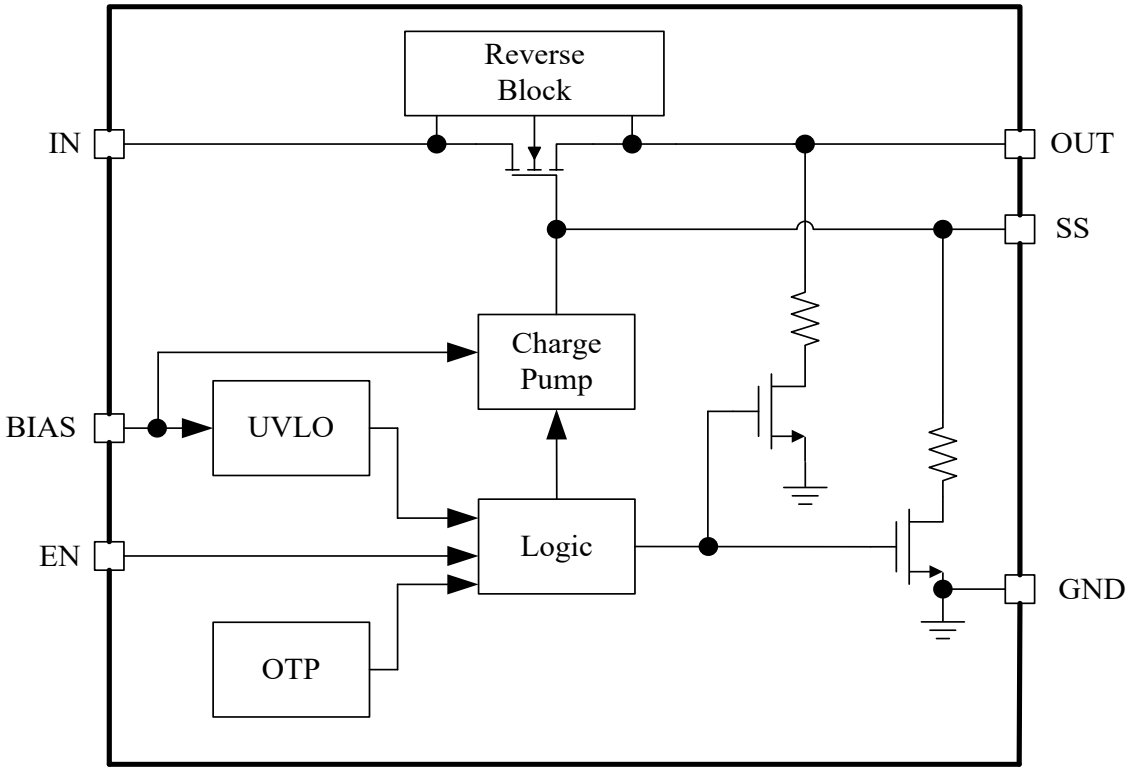
Figure 28. Turn Off Time vs. Input Voltage

11 Function Description

11.1 Overview

The WP2608 is ultra-low on-resistance power-distribution switch with external soft start control in DFN2x2-8/TDFN2x2-8 package. The devices contain a N-channel MOSFET that can deliver 6A continuous load current.

11.2 Block Diagram



11.3 Feature Description

11.3.1 BIAS Under-voltage Lockout (UVLO)

Under-voltage lockout (UVLO) circuit monitors the BIAS pins voltage to prevent wrong logic controls. The UVLO function initiates a soft-start process after the BIAS supply voltages exceed rising UVLO voltage threshold during powering on.

11.3.2 Power Switch

The power switch is an N-channel MOSFET with an ultra-low $R_{DS(ON)}$. When IC is in shutdown state, the MOSFET prevents a reverse current flowing from the OUT back to IN.

11.3.3 Soft-start

The WP2608 Provides an adjustable soft-start circuitry to control rise rate of the output voltage and limit the current surge during start-up. The soft-start time is set with a capacitor from the SS pin to the ground.

11.3.4 Over-Temperature Protection (OTP)

When the junction temperature exceeds 160℃, the internal thermal sense circuit turns off the power FET and allows the device to cool down. When the device's junction temperature cools by 40℃, the internal thermal

sense circuit will enable the device, resulting in a pulsed output during continuous thermal protection. Thermal protection is designed to protect the IC in the event of over temperature conditions. For normal operation, the junction temperature cannot exceed T_J=+125 ℃.

12 Application and Implementation

12.1 Application Information

12.1.1 EN Control

Pulling the EN above 1.2V will enable the device, and pulling EN pin below 0.4V will disable the device. The EN pins cannot be left floating.

12.1.2 Capacitor Selection

The WP2608 requires proper input capacitors to supply current surge during stepping load transients to prevent the input voltage rail from dropping. Because the parasitic inductor from the voltage sources or other bulk capacitors to the IN limit the slew rate of the surge currents, more parasitic inductance needs more input capacitance. For normal applications (except OTP or output short circuit has occurred), the recommended input capacitance of IN is 1μF. Additional input capacitance may be needed on the input to reduce voltage overshoot from exceeding the absolute maximum voltage of the device during load transient conditions.

12.1.3 Soft-Start Capacitor

The soft-start capacitor on SS pin can reduce the inrush current and overshoot of output voltage. The soft-start time is set with a capacitor from the SS pin to the ground.

12.1.4 Application Note

It is recommended that the voltage of IN should be less than 4V when the load current is greater than 2 A.

12.1.5 Thermal Consideration

The junction temperature of the switch depends on several factors such as the load, PCB layout, ambient temperature and package type. Power dissipation can be calculated based on the output current and the $R_{DS(ON)}$ of the switch as below.

$$P_D = R_{DS(ON)} \times I^2$$

The junction temperature can be estimated by the following thermal equation:

$$T_J = P_D \times R_{\theta JA} + T_A$$

Where:

T_A = Ambient temperature

$R_{\theta JA}$ = Thermal resistance

P_D = Total power dissipation

With all possible conditions, the junction temperature must be within the range specified under operating conditions. The maximum output current must be derated at higher ambient temperature to ensure the junction temperature does not exceed the maximum junction temperature which is 125℃.

12.1.6 Soft-Start Time

C_{SS} (pF)	Soft-Start Time (μs) 10% to 90%, V_{BIAS}=5V, C_L=0.1μF, C_{IN}=1μF, R_L=10Ω, Typical values are at T_A=25℃.						
	V_{IN}=5V	V_{IN}=3.3V	V_{IN}=1.8V	V_{IN}=1.5V	V_{IN}=1.2V	V_{IN}=1.05V	V_{IN}=0.8V
0	142	106	78	70	65	56	50
220	437	335	196	169	145	125	104
330	581	394	267	200	146	129	111
470	805	563	295	282	210	183	156
1000	1442	1198	571	517	369	321	242
2200	3107	2446	1131	1070	752	716	545
4700	6389	3439	2550	2046	1480	1447	1210
10000	13440	7164	5949	5091	4142	3662	2967

C_{SS} (pF)	Soft-Start Time (μs) 10% to 90%, V_{BIAS}=3.3V, C_L=0.1μF, C_{IN}=1μF, R_L=10Ω, Typical values are at T_A=25℃.						
	-	V_{IN}=3.3V	V_{IN}=1.8V	V_{IN}=1.5V	V_{IN}=1.2V	V_{IN}=1.05V	V_{IN}=0.8V
0	-	177	143	109	97	75	53
220	-	343	202	182	148	131	109
330	-	434	272	220	181	164	129
470	-	585	331	294	225	210	162
1000	-	1283	626	525	418	405	333
2200	-	2634	1285	1088	887	771	639
4700	-	5260	2626	2162	1698	1501	1248
10000	-	11650	6083	5104	4207	3770	2980

13. Evaluation Modules

Evaluation Modules (EVMs) are available to help evaluate the device performance. We have evaluation modules for different packages, you can contact us to get the evaluation module or schematic.

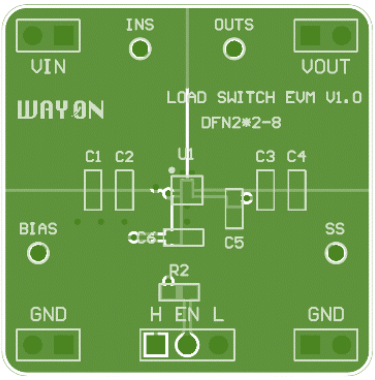
The module names are listed in the following below.

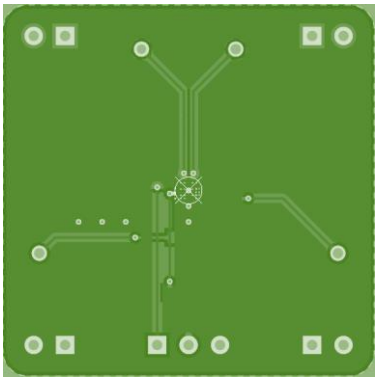
NAME	PACKAGE	EVALUATION MODULE
WP2608-T28R	TDFN2x2-8	LOAD SWITCH EVM V1.0 DFN2x2-8
WP2608-F28R	DFN2x2-8	LOAD SWITCH EVM V1.0 DFN2x2-8

Layout Guidelines

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

Layout Example





14 Naming Conventions

WP AB CC-DDD E

WP: WAYON Protection IC;

A: Product Category - 2: Load Switch;

B: Maximum Output Current - 6: 6A;

CC: Serial number;

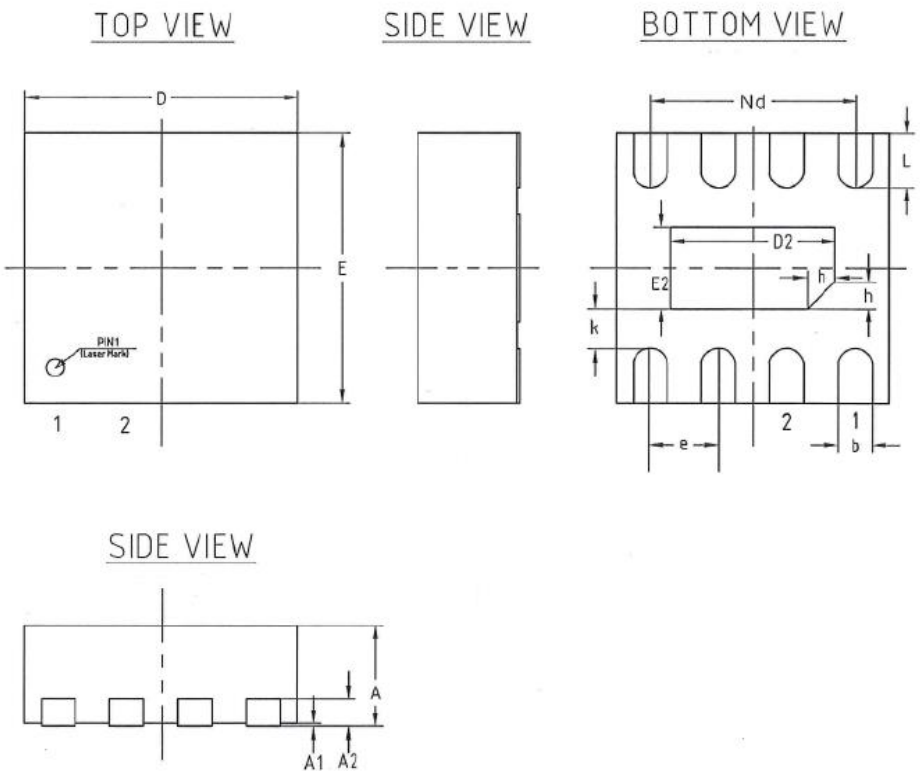
DDD: Package - F28: DFN2x2-8;

T28: TDFN2×2-8

E: R-Reel & T- tube;

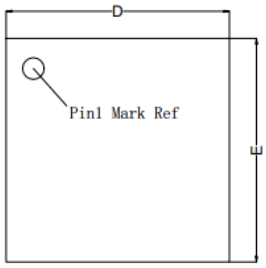
15 Package Information

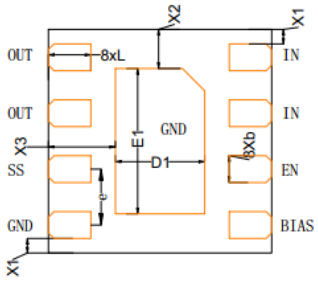
DFN2x2-8

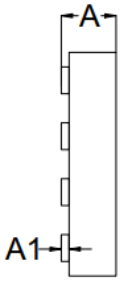


SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.70	0.75	0.80
A1		0.02	0.05
A2		0.203REF	
B	0.20	0.25	0.30
D	1.90	2.00	2.10
D2	1.10	1.20	1.30
E	1.90	2.00	2.10
E2	0.60	0.70	0.80
e		0.50BSC	
K	0.25	0.30	0.35
L	0.30	0.35	0.40
h	0.15	0.20	0.25
Nd		1.5BSC	

TDFN2x2-8







SYMBOL	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	0.500	0.550	0.600
A1		0.04REF	
D	1.90	2.00	2.10
E	1.90	2.00	2.10
D1	0.750	0.800	0.850
E1	1.250	1.300	1.350
b	0.190	0.240	0.290
L	0.330	0.380	0.430
e	0.450	0.500	0.550
X1	0.080	0.130	0.180
X2	0.300	0.350	0.400
X3	0.550	0.600	0.650

16 Ordering Information

PART NUMBER	DISCHARGE	CURRENT	PACKAGE	PACKING QUANTITY	MARKING*
WP2608-T28R	Yes	6A	TDFN2x2-8	3K/Reel	2608 XXXX
WP2608-F28R	Yes	6A	DFN2x2-8	3K/Reel	2608 XXXX

* XXXX is variable.

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WAYON website: http://www.way-on.com
For additional information, please contact your local Sales Representative.
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Specifications are subject to change without notice.
The device characteristics and parameters in this data sheet can and do vary in different applications and actual device performance may vary over time.
Users should verify actual device performance in their specific applications.

Product Specification Statement

- The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.
- The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. WAYON shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and WAYON assumes no responsibility for the application of the product.
- WAYON strives to provide accurate and up-to-date information to the best of our ability. However, due to technical, human, or other reasons, WAYON cannot guarantee that the information provided in the product specification is entirely accurate and error-free. WAYON shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications. WAYON reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with WAYON to ensure that the product specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult WAYON in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.
- Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.
- The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. WAYON shall assume no responsibility for any consequences resulting from such usage.
- Users should also comply with relevant laws, regulations, policies, and standards when using the product specification. Users are responsible for the risks and liabilities arising from the use of the product specification and must ensure that it is not used for illegal purposes. Additionally, users should respect the intellectual property rights related to the product specification and refrain from infringing upon any third-party legal rights. WAYON shall assume no responsibility for any disputes or controversies arising from the above-mentioned issues in any form.