JW7115/JW7115-1/JW7115-2/JW7111

50mΩ, Single Power Switch with Flag

Parameters Subject to Change Without Notice

DESCRIPTION

The JW®7115/JW7115-1/JW7115-2/JW7111 is a single channel current-limited power switch optimized for Universal Serial Bus (USB) and other hot-swap applications. The rise and fall times are controlled to minimize current overshoot or undershoot during switches on/off.

The device has fast short-circuit response time for improved overall system robustness. It provides a complete protection solution, such as over-current protection, over-temperature protection and short-circuit protection, as well as controlled rise time and under-voltage lockout function. A7.5ms de-glitch time on the open-drain Flag output prevents false over-current reporting.

JW7115/JW7115-1/JW7115-2 offers SOT23-5 package.JW7111 offers both DFN2X2-6 and SOT23-6 packages.

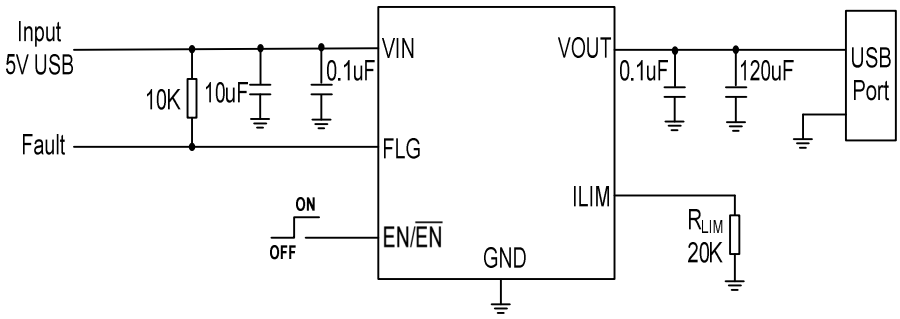
FEATURES

- 50mΩ Integrated N-MOSFET Switch
- Accurate Current Limit
- FLG: active low
- Constant-Current During Over-Current
- Fast Short-Circuit Response Time: 2μs (typ.)
- Operating Range: 2.7V - 5.5V
- Built-in Soft-Start with 3ms Typical Rise Time
- Over-Current, Output Over-Voltage and Thermal Protection
- Fault Report (FAULT) with De-glitch Time
- UL Recognized, File Number E497605
- IEC Recognized, File Number DK-69902-UL
- ESD Protection: 2kV HBM, 500V CDM
- Available in SOT23-5, SOT23-6 and DFN2X2-6Packages

APPLICATIONS

- Set-Top Boxes
- LCD TVs & Monitors
- Residential Gateways
- Laptops, Desktops, Servers, e-books, Printers, Docking
- Stations, HUBs

TYPICAL APPLICATION



ORDER INFORMATION

DEVICE[1)]	PACKAGE	TOP MARKING[2)]	ENABLE	CURRENT LIMIT
JW7111DFNB#TRPBF	DFN2X2-6	JWJ5X YWLLL	Active High	RSET
JW7111SOTB#TRPBF	SOT23-6	JWD4X YWLLL	Active High	RSET
JW7111ADFNB#TRPBF	DFN2X2-6	JWJ4X YWLLL	Active Low	RSET
JW7111ASOTB#TRPBF	SOT23-6	JWJ3X YWLLL	Active Low	RSET
JW7115SOTA#TRPBF	SOT23-5	JWG9X YWLLL	Active High	3.2A
JW7115-1SOTA#TRPBF	SOT23-5	JWH8X YWLLL	Active High	1.3A
JW7115-2SOTA#TRPBF	SOT23-5	JWK3X YWLLL	Active High	2.2A
JW7115ASOTA#TRPBF	SOT23-5	JWJ1X YWLLL	Active Low	3.2A
JW7115A-1SOTA#TRPBF	SOT23-5	JWJ2X YWLLL	Active Low	1.3A
JW7115A-2[3)]	SOT23-5	JWK1X YWLLL	Active Low	2.2A

Notes:

1) JW□□□# TRPBF
   - PB Free
   - Tape and Reel(If" TR" is not shown, it means tube)
   - Package Code
   - Part No.

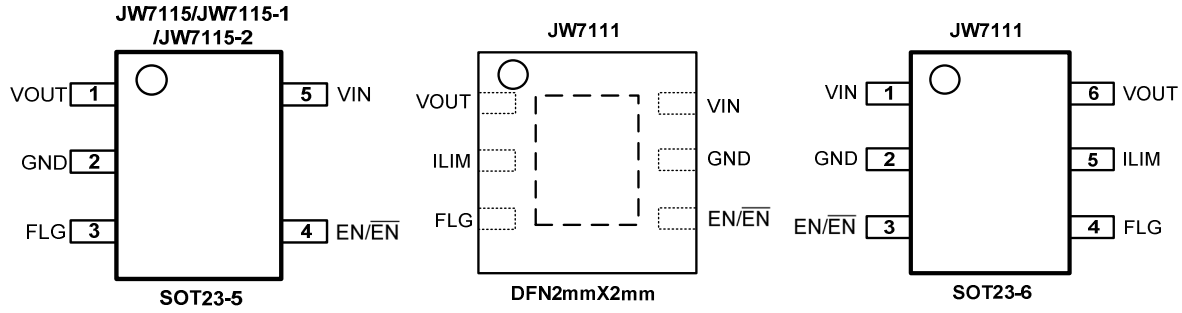
2) Line1: JWPNA
   - Initial control code
   - Product code of JWXXXX
   - Joulwatt LOGO

   Line2: YWLLL
   - Lot number
   - Week code
   - Year code

3) JW7115A-2 is equal to JW7115A-2SOTA#TRPBF,and JW7115A-2 offers SOT23-5 package in tape and reel.

PIN CONFIGURATION

TOP VIEW



ABSOLUTE MAXIMUM RATING[1)]

VIN PIN Voltage ..... -0.3V to 6.5V
VOUTPIN Voltage.....-0.3V to 6.5V
OtherPins Voltage.....-0.3V to6.5V
ILIM Source Current.....1mA
JunctionTemperature[2) 3)] 150ºC
Lead Temperature 260ºC
Storage Temperature .....-65ºC to +150ºC

RECOMMENDED OPERATING CONDITIONS

VIN PIN Voltage ..... 2.7V to 5.5V
VOUTPIN Voltage.....0V to(VIN+0.2V)
EN/$\overline{EN}$PIN Voltage.....0V to 5.5V
High-Level Input Voltage on EN/$\overline{EN}$.....1.4V to VIN
Low-Level Input Voltage on EN/$\overline{EN}$.....0V to0.5V
Operating Junction Temperature….....-40ºC to 125ºC

THERMAL PERFORMANCE[4)]

	θ_{JA}	θ_{Jc}
SOT23-5	220	130ºC/W
DFN2X2-6	120	34ºC/W
SOT23-6	220	130ºC/W

Note:

1) Exceeding these ratings may damage the device.

2) The JW7115/JW7115-1/JW7115-2/JW7111guarantees robust performance from -40°Cto 150°C junction temperature. The junction temperature range specification is assured by design, characterization and correlation with statistical process controls.

3) The JW7115/JW7115-1/JW7115-2/JW7111 includes thermal protection that is intended to protect the device in overload conditions.

4) Measured on JESD51-7, 4-layer PCB.

ELECTRICAL CHARACTERISTICS

TA = +25°C, VIN = 2.7V to 5.5V, V_{EN} = 0V or V_{EN} = VIN, unless otherwise stated.

Item	Symbol	Condition[5]		Min.	Typ.	Max.	Units
Supply							
Input UVLO	V_{UVLO}	VIN Rising			2.4	2.65	V
Input UVLO Hysteresis	ΔV_{UVLO}	VIN Decreasing			150		mV
Input Shutdown Current	I_{SHDN}	JW7115x	VIN= 5V, Disabled, VOUT = Open		0.1	1	uA
		JW7111x	VIN= 5V, Disabled, VOUT = Open			3	uA
Input Quiescent Current	I_Q	JW7115x	VIN= 5.5V, Enabled, VOUT = Open		90	130	uA
		JW7111x	VIN= 5.5V, Enabled, VOUT = Open, RLIM=10kΩ		130	160	uA
Power Switch							
Switch On-Resistance	$R_{DS(ON)}$	SOT2x3-5	T_J = +25°C, VIN= 5.0V Load=0.2A		55	65	mΩ
			-40°C ≤ T_A ≤ +85°C			70	
		SOT23-6	T_J = +25°C, VIN= 5.0V, Load=0.2A		55	65	
			-40°C ≤ T_A ≤ +85°C			70	
		DFN2X2-6	T_J = +25°C, VIN= 5.0V Load=0.2A		50	60	
			-40°C ≤ T_A ≤ +85°C			75	
Output Turn-On Rise Time	t_R	VIN= 5.5V, C_L = 1μF, R_{LOAD} = 100Ω. Figure 1.			1.1	1.5	ms
		VIN= 2.7V, C_L = 1μF, R_{LOAD} = 100Ω.			0.7	1	
Output Turn-Off Fall Time	t_F	VIN= 5.5V, C_L = 1μF, R_{LOAD} = 100Ω.e Figure 1.		0.1		0.5	ms
		VIN= 2.7V, C_L = 1μF, R_{LOAD} = 100Ω.		0.1		0.5	
Enable Pin							
EN/$\overline{EN}$ Input Leakage Current	$I_{LEAK-EN}$	VIN= 5V, V_{EN} = 0V and 6V		-0.5		0.5	uA
Turn-On Time	t_{ON}	C_L = 1μF, R_L = 100Ω. See Figure 1.				3	ms
Turn-Off Time	t_{OFF}	C_L = 1μF, R_L = 100Ω. See Figure 1.				1	ms
EN High Level Voltage	V_{ENH}	JW7111/JW7115/JW7115-1/JW7115-2		1.4			V
		JW7111A/JW7115A/JW7115A-1/JW7115A-2		1.1			
EN Low Level Voltage	V_{ENL}	JW7111/JW7115/JW7115-1/JW7115-2				1	
		JW7111A/JW7115A/JW7115A-1/JW7115A-2				0.7	

Output Discharge							
Discharge Resistance[6)]	R_{DIS}	VIN= 5V, Disabled, I_{OUT} =1mA			600		Ω
Fault Flag							
FAULT Output Low Voltage	V_{OL}	I_{FAULT} = 1mA				180	mV
FAULT Blanking and Latch Off Time(Over-Current)	t_{Blank_OC}	Assertion or de-assertion due to over current			5	7.5	10	ms
FAULT Off Current	I_{FOH}	V_{FAULT} = 6V				1	uA
Current Limit							
Current-Limit Threshold (maximum DC output current), VOUT = VIN -0.5V	I_{LIMIT}	JW7115/ JW7115A	-40°C ≤ T_A ≤+85°C		3	3.3	3.6	A
		JW7115-2/ JW7115A-2			2.0	2.2	2.4	
		JW7115-1/ JW7115A-1			1.1	1.3	1.5	
		JW7111/ JW7111A	R_{LIM} = 10kΩ	-40°C ~+85°C	2.2	2.4	2.6	
			R_{LIM} = 15kΩ	-40°C ~+85°C	1.4	1.6	1.8	
			R_{LIM} = 20kΩ	-40°C ~+85°C	1.0	1.2	1.4	
			R_{LIM} = 50kΩ	-40°C ~+85°C	0.45	0.55	0.7	
			I_{LIMIT} Shorted to GND		2.2	2.4	2.6	
Short-Circuit Current Limit, VOUT Connected to GND[7)]	I_{SHORT}	JW7115/ JW7115A				3.2		A
		JW7115-1/ JW7115A-1				1.3		
		JW7115-2/ JW7115A-2				2.2		
		JW7111/ JW7111A	R_{LIM} = 10kΩ			2		A
			R_{LIM} = 15kΩ			1.35		
			R_{LIM} = 20kΩ			1		
			R_{LIM} = 49.9kΩ			0.45		
Short-Circuit Response Time	t_{SHORT}	VOUT= 0V to I_{OUT} = I_{LIMIT}(VOUT shorted to ground). See Figure 2.				2		µs
Thermal Shutdown							
Thermal Shutdown Threshold[7)]	T_{SHDN}	Enabled, R_{LOAD} = 1kΩ				160		°C
Thermal Shutdown Threshold underCurrent Limit[7)]	T_{SHDN_OCP}	Enabled, R_{LOAD} = 1kΩ				140		°C
Thermal Shutdown	T_{HYS}					20		°C

Hysteresis[7)]						

Note：

5) Pulse-testing techniques maintain junction temperature close to ambient temperature; thermal effects must be taken into account separately.

6) The discharge function is active when the device is disabled (when enable is de-asserted or during power-up power-down when VIN< VUVLO).The discharge function offers a resistive discharge path for the external storage capacitor for limited time.

7) Guaranteed by design

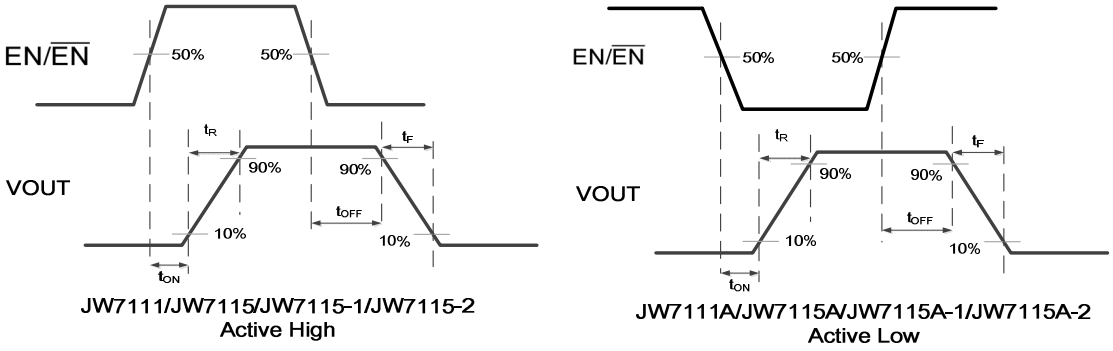


Figure 1 Voltage Waveforms

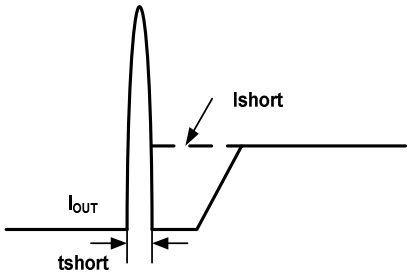
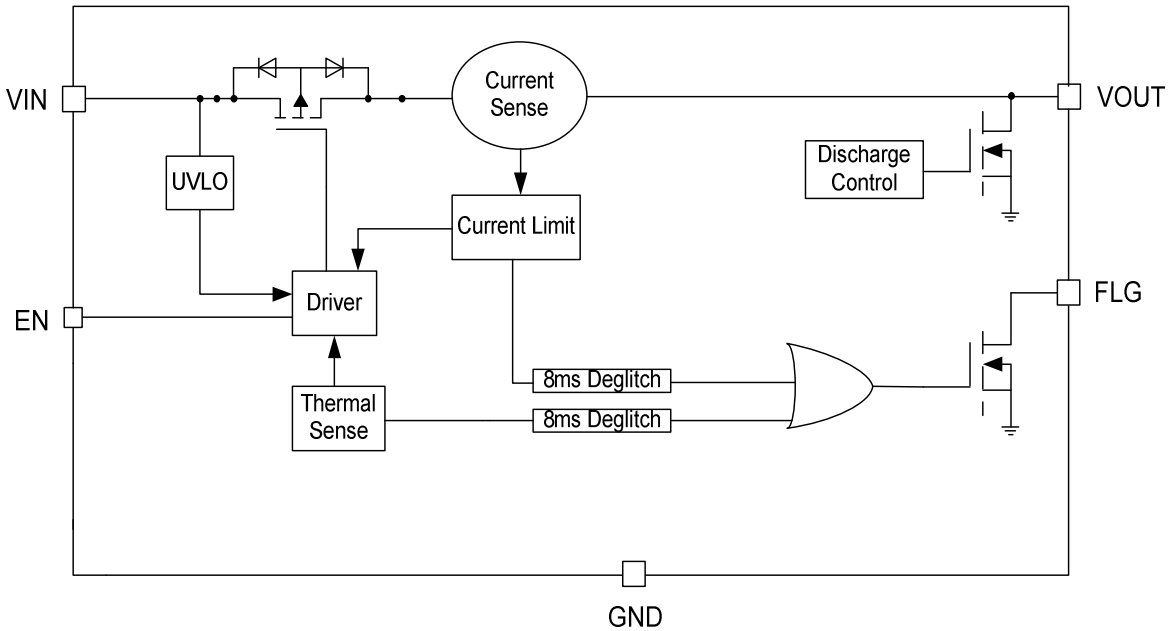


Figure 2 Response Time to Short Circuit Waveform

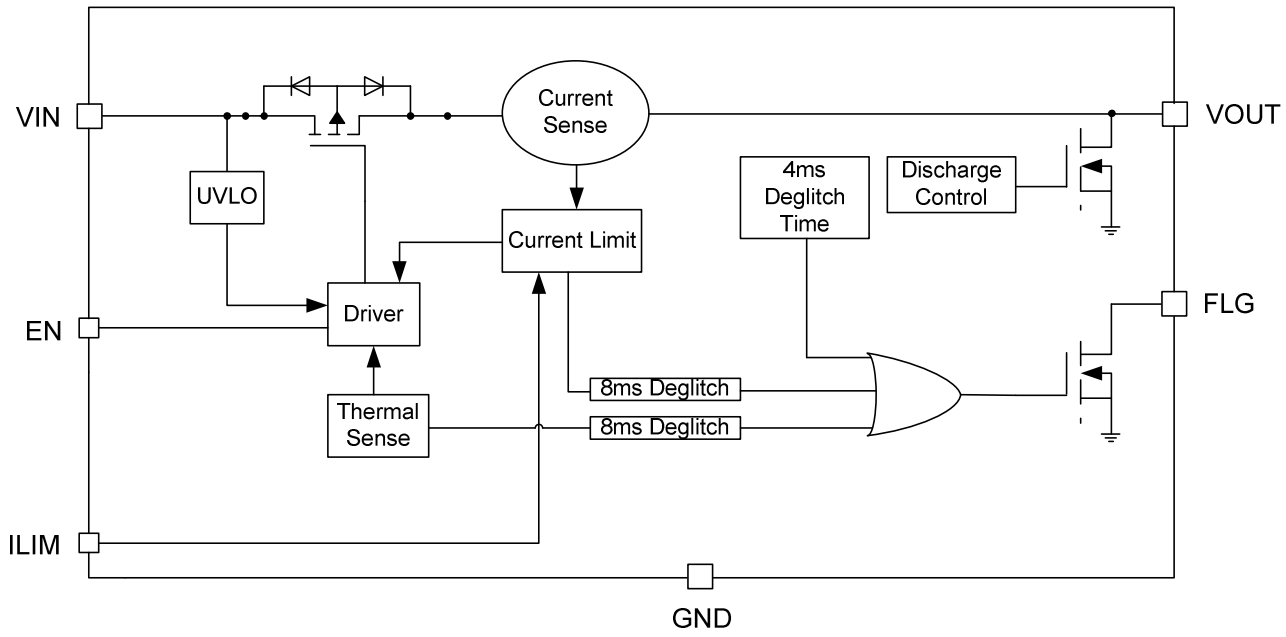
PIN DESCRIPTION

Pin			Name	Description
SOT23-5	SOT23-6	DFN2X2-6		
1	6	1	VOUT	Output voltage
2	2	5	GND	Ground(0V)
3	4	3	FLG	Active-low open-drain output, asserted during over current, over-temperature.
4	3	4	EN/$\overline{EN}$	Enable input JW7115/JW7115-1/JW7115-2/JW7111: logic high turns on power switch. JW7115A/JW7115A-1/JW7115A-2/JW7111A: logic low turns on power switch.
5	1	6	VIN	Input, connect a 0.1μF or greater ceramic capacitor from VIN to GND as close to IC as possible.
-	5	2	ILIM	Use external resistor to set current-limit threshold; Recommended 10kΩ≦R_{LIM}≦232kΩ.

BLOCK DIAGRAM



JW7115/JW7115-1/JW7115-2/JW7115A/JW7115A-1/JW7115A-2
Block Diagram



JW7111/JW7111A block diagram

FUNCTIONAL DESCRIPTION

TheJW7115/JW7115-1/JW7115-2/JW7111integrates high-side MOSFET optimized for Universal Serial Bus (USB) that requires protection functions. The MOSFET is driven with controlled gate voltage and slew-rate, which makes this USB device ideal for hot-swap or hot-plug applications.

Discharge Function

When enable is de-asserted, or when the input voltage is under UVLO level, the discharge function is active. The output capacitor is discharged through an internal NMOS in series with a600Ω resistor. The discharge time is dependent on the RC time constant of the resistance and output capacitance.

FAULT Response

The Fault Flag function is realized by an open-drain circuit. The output goes active low for any of following faults: current limit threshold, short-circuit current limit, or thermal shutdown. In order to avoid the mis-trigger, a 7.5ms deglitch timer is inserted when a fault condition occurs. The FLG output remains low until over-current, short-circuit current limit or over-temperature condition is removed.

Connecting a heavy capacitive load to the output of the device can cause a momentary over-current condition, which does not trigger the FAULT as long as the Fault condition lasts less than 7.5msdeglitch. This deglitch timer is also applied for over-current recovery and over-temperature recovery.

Power Supply Considerations

A 0.01-μF to 0.1-μF X7R or X5R ceramic capacitor between VIN and GND, close to the device, is highly recommended. This limits the input voltage drop during line transients. Placing a high-value electrolytic capacitor on the input (10μF minimum) and output pin (120μF) is recommended when the output load is heavy.

Additionally, bypassing the device output with a 0.1μF to 4.7μF ceramic capacitor improves the immunity of the device to short-circuit condition.

This capacitor also prevents output from going negative during turn-off due to parasitic inductance. If the negative kick is less than -1V, a schottky diode in parallel with VOUT pin is recommended. Otherwise, the device may go malfunction.

Generic Hot-Plug Applications

In many applications it is common to remove modules or PC boards while the main unit is still operating. These are considered hot-plug applications. Such implementations require the control of current surges. The most effective way to control the current surge is to limit and slowly ramp the current and voltage being applied to the card, similar to the Soft Start in which a power supply normally turns on. Due to the controlled rising and falling times of the switch, these devices can be used to provide a softer start-up to devices being hot-plugged into a powered system.

The UVLO feature also ensures that the switch is off after the card has been removed, and that the switch is off during the next insertion.

Under-Voltage Lockout (UVLO)

Whenever the input voltage falls below UVLO threshold (~2.4V), the power switch is turned off. This facilitates the design of hot-insertion systems where it is not possible to turn off the power switch before input power is removed.

Over-Current and Short-Circuit Protection

An internal sensing FET is employed to sense over-current conditions. Unlike current-sense resistors, sensing FETs do not increase the series resistance of the current path. When an over

current condition is detected, The switch maintains a constant output current and reduces the output voltage accordingly. Complete shutdown occurs only if the fault stays long enough to activate over-temperature protection.

Over-Current FAULT Signal

The FAULT signal will be asserted in response to OCP before the device reaches its current limit. The output current upon FAULT signal triggered will be lower than the I_limit value. To implement FAULT signal for precision system protection control, it is recommended to leave enough margin from maximum continuous operating current.

CurrentLimit Setting

The currentlimit of JW7111/JW7111A can be programmed by an external resistor. The currentlimit is proportional to the current sourced out of ILIM pin.

The recommended 1% resistor range for R_{LIM} is 10kΩ ≤RLIM≤49.9kΩ. The traces routing the R_{LIM} resistor to the JW7111/JW7111A should be as short as possible to reduce parasitic effects on the current-limit accuracy.

To design a maximum currentlimit, find the intersection of R_{LIM} and the maximum desired load current. The typical current limit can be calculated by

$$I_{lim} = \frac{0.1}{R_{Lim}} \times 232.33 + 0.077$$

And also R_{LIM} can be calculated by

$$R_{lim} = \frac{23.233}{I_{Lim} - 0.77} (k\Omega)$$

Over-Temperature Protection

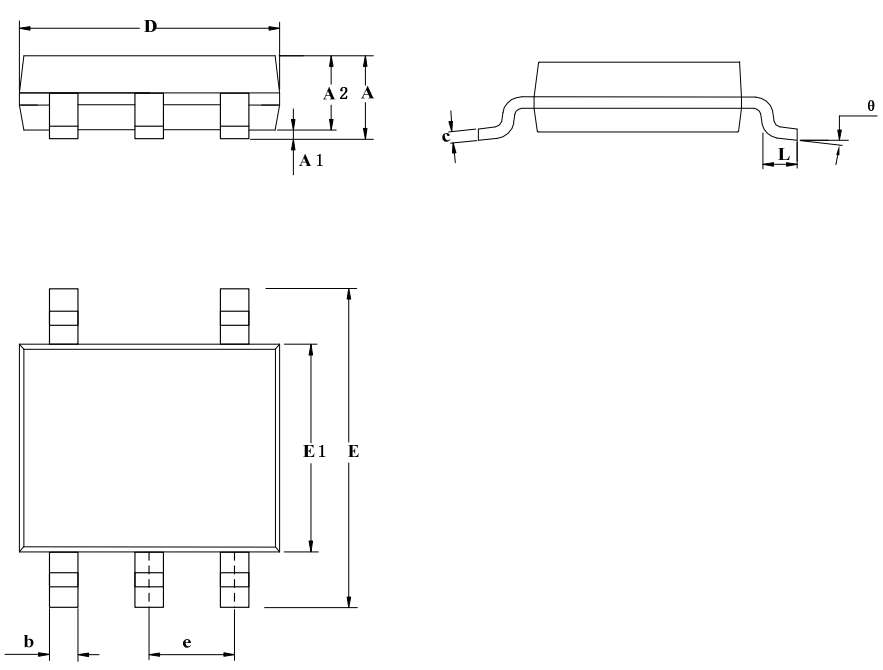
Thermal protection prevents the IC from damage when the die temperature exceeds safe margins. This mainly occurs when heavy-overload or short-circuit faults occurs. IC implements a thermal sensing circuit to monitor the operating junction temperature. Once the die temperature rises to approximately +160°C (+140°C in case the part is under current limit), the thermal protection feature activates as follows: The internal thermal sense circuitry turns the power switch off and the FLG output is asserted, thus preventing the power switch from damage. Once the junction temperature drops to 140°C, the MOSFET restart to work.

External Rlim Suggestion

Min Current Limit Value(A)	Theoric Resistor Value(kΩ)	Selected Resistor Value(kΩ) 1% ot 0.1%	Typical OCP Target Value(A)	Maximum Current Limit Value(A)
0.5	44.4	44.2	0.60	0.75
0.6	36.1	35.7	0.73	0.89
0.7	30.4	30.1	0.85	1.02
0.8	26.3	26.1	0.97	1.15
0.9	23.2	23.2	1.08	1.27
1	20.7	20.5	1.21	1.41
1.1	19.0	18.7	1.32	1.52
1.2	17.6	17.4	1.41	1.61
1.3	16.3	16.2	1.51	1.71
1.4	15.3	15	1.63	1.83
1.5	14.3	14.3	1.70	1.90
1.6	13.5	13.3	1.82	2.02
1.7	12.7	12.7	1.91	2.11
1.8	12.1	12.1	2.00	2.20
1.9	11.5	11.5	2.10	2.30
2	10.9	10.7	2.25	2.45
2.1	10.5	10.2	2.35	2.55
2.2	10.0	10	2.40	2.60

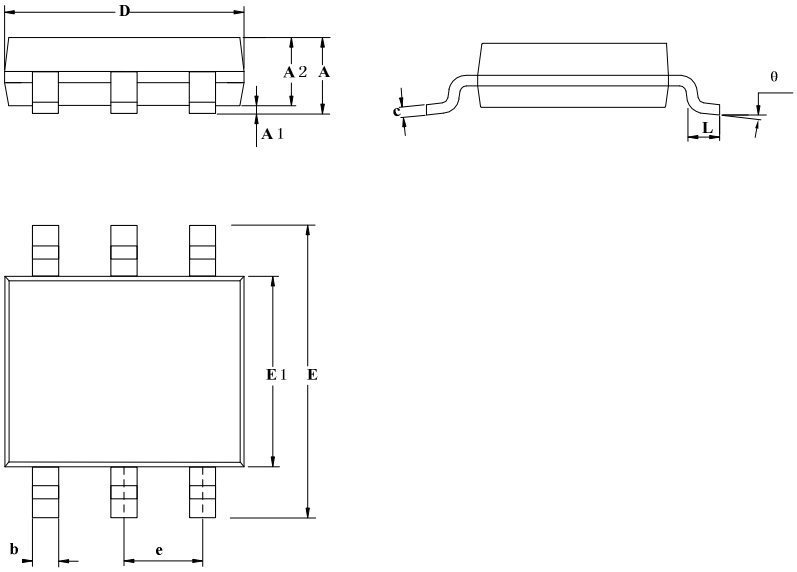
PACKAGE OUTLINE

SOT23-5 UNIT: mm



SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	1.05	1.15	1.25
A1	0	0.05	0.15
A2	0.95	1.05	1.20
b	0.20	0.40	0.60
c	0.05	—	0.21
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.95（BSC）		
L	0.30	0.45	0.60
θ	0°	—	8°

SOT23-6 UNIT: mm



SYMBOL	MILLIMETER		
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A1	0	0.05	0.15
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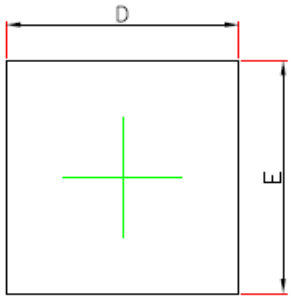
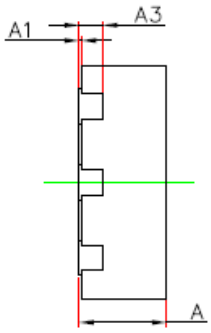
b	0.20	0.40	0.60
c	0.05	—	0.21
D	2.72	2.92	3.12
E	2.60	2.80	3.00
E1	1.40	1.60	1.80
e	0.95（BSC）		
L	0.30	0.45	0.60
θ	0°	—	8°

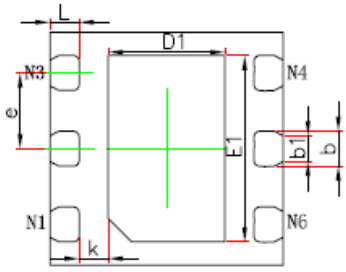
DFN2X2-6 UNIT: mm



TOP VIEW



SIDE VIEW



BOTTOM VIEW

Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min.	Max.	Min.	Max.
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF.	
D	1.900	2.100	0.075	0.083
E	1.900	2.100	0.075	0.083
D1	0.900	1.100	0.035	0.043
E1	1.500	1.700	0.059	0.067
k	0.250 REF.		0.010REF.	
b	0.250	0.350	0.010	0.014
b1	0.220 REF.		0.009 REF.	
e	0.650BSC.		0.026BSC.	
L	0.174	0.326	0.007	0.013

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