

## General Description

The AP2815 is an integrated high-side power switch that consists of N-Channel MOSFET, charge pump, over current & temperature and other related protection circuits. The switch's low  $R_{DS(ON)}$ , 60m $\Omega$ , is designed to meet the USB voltage drop requirements. The IC integrates soft-start to limit inrush current, over-current protection, load short protection with fold-back, and thermal shutdown to avoid switch failure during hot plug-in. Under voltage lockout (UVLO) function is used to ensure the device remains off unless there is a valid input voltage present. A FLAG output is available to indicate fault conditions to the local USB controller.

The AP2815 is available in standard packages of SOIC-8 and MSOP-8.

## Features

- Low MOSFET on Resistance: 60m $\Omega$  @  $V_{IN}=5.0V$
- Compliant to USB Specifications
- Operating Voltage Range: 2.7V to 5.5V
- Low Supply Current: 65 $\mu A$  (Typ.)
- Low Shutdown Current: 1.0 $\mu A$  (Max)
- Guarantee 1.5A Continuous Load
- Current Limit: 1.65A (Min), 2.8A (Max)
- Under-voltage Lockout
- Logic Level Enable Pin:  
Available in Active-high or Active-low Version
- Soft Start-up
- Over-current Protection
- Over Temperature Protection
- Load Short Protection with Fold-back
- No Reverse Current when Power Off
- Deglitched FLAG Output with Open Drain
- With Output Shutdown Pull-low Resistor for A/C Versions
- UL Approved (File No. E339337)
- Nemko CB Scheme IEC60950-1, Ref. Certif No. NO64001

## Applications

- USB Power Management
- USB Bus/Self Powered Hubs
- Hot-plug Power Supplies
- Battery-Charger circuits
- Notebook, Motherboard PCs

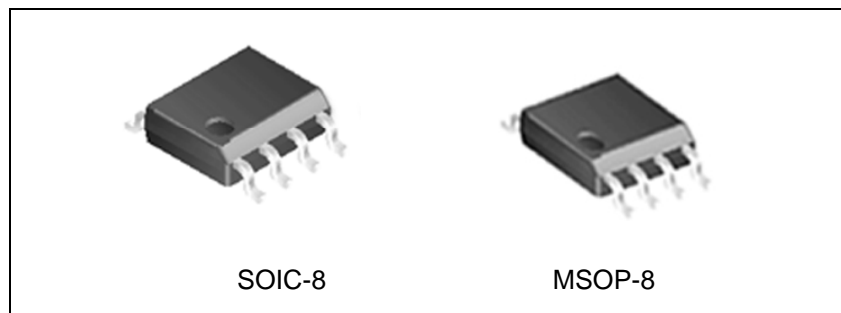


Figure 1. Package Types of AP2815

## Pin Configuration

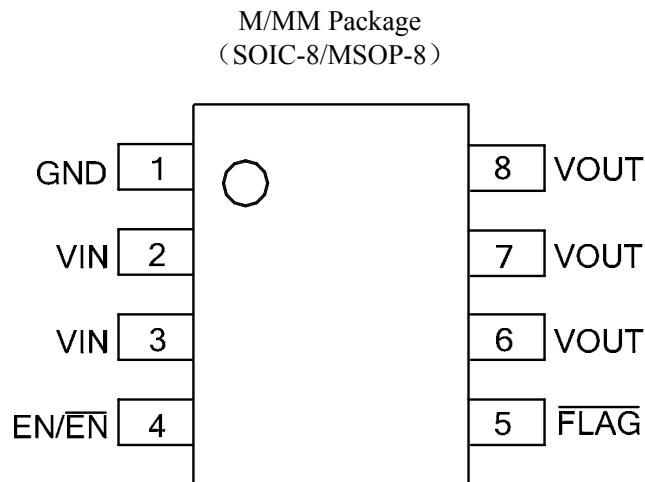


Figure 2. Pin Configuration of AP2815 (Top View)

## Pin Descriptions

Pin No.	Name	Descriptions
1	GND	Ground
2, 3	VIN	Supply Input Pin
4	EN/ $\overline{\text{EN}}$	Chip Enable, Control Input, Active Low or High
5	$\overline{\text{FLAG}}$	Fault FLAG Pin, output with open drain, need a pull-up resistor in application, active low to indicate OCP or OTP.
6, 7, 8	VOUT	Output Voltage

Functional Block Diagram

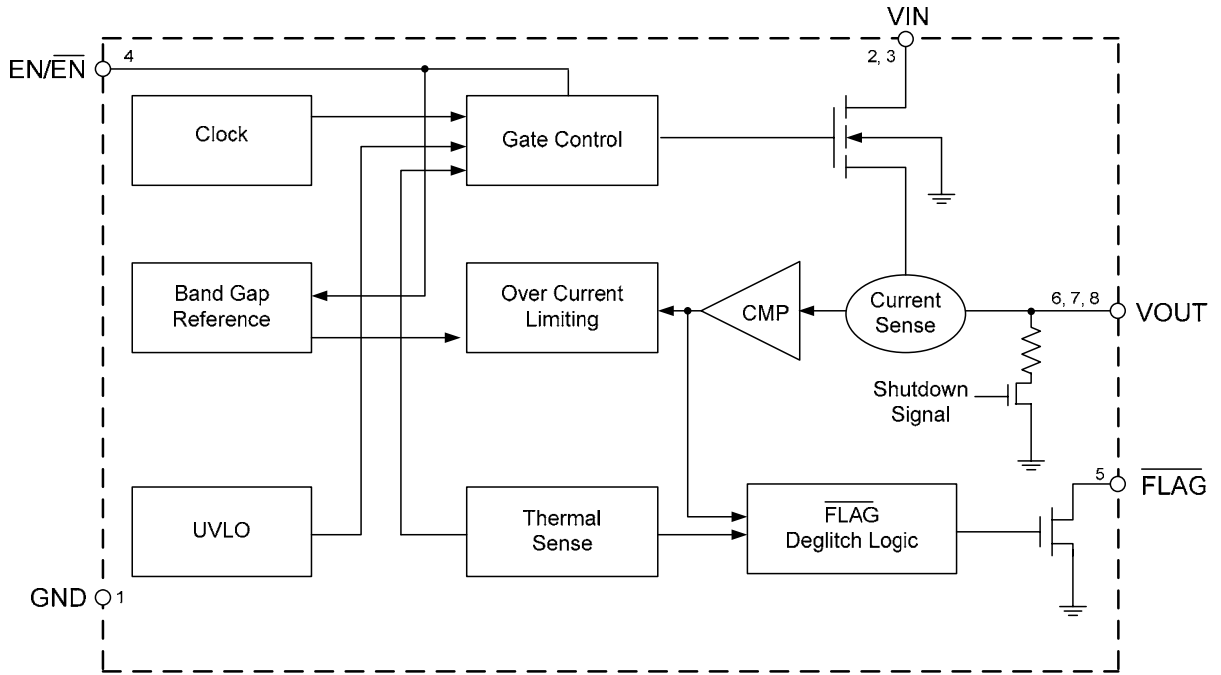


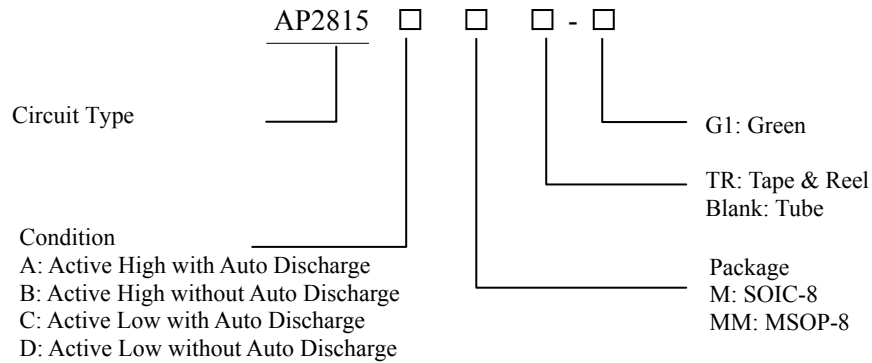
Figure 3. Functional Block Diagram of AP2815



**1.5A High-side Power Distribution Switch with Enable and Flag**

**AP2815**

**Ordering Information**



Product	Package	Temperature Range	Condition	Part Number	Marking ID	Packing Type
AP2815A	SOIC-8	-40 to 85°C	Active High with Auto Discharge	AP2815AM-G1	2815AM-G1	Tube
	MSOP-8			AP2815AMTR-G1	2815AM-G1	Tape & Reel
				AP2815AMM-G1	2815AMM-G1	Tube
				AP2815AMMTR-G1	2815AMM-G1	Tape & Reel
AP2815B	SOIC-8	-40 to 85°C	Active High without Auto Discharge	AP2815BM-G1	2815BM-G1	Tube
	MSOP-8			AP2815BMTR-G1	2815BM-G1	Tape & Reel
				AP2815BMM-G1	2815BMM-G1	Tube
				AP2815BMMTR-G1	2815BMM-G1	Tape & Reel
AP2815C	SOIC-8	-40 to 85°C	Active Low with Auto Discharge	AP2815CM-G1	2815CM-G1	Tube
	MSOP-8			AP2815CMTR-G1	2815CM-G1	Tape & Reel
				AP2815CMM-G1	2815CMM-G1	Tube
				AP2815CMMTR-G1	2815CMM-G1	Tape & Reel
AP2815D	SOIC-8	-40 to 85°C	Active Low without Auto Discharge	AP2815DM-G1	2815DM-G1	Tube
	MSOP-8			AP2815DMTR-G1	2815DM-G1	Tape & Reel
				AP2815DMM-G1	2815DMM-G1	Tube
				AP2815DMMTR-G1	2815DMM-G1	Tape & Reel

BCD Semiconductor's Pb-free products, as designated with "G1" suffix in the part number, are RoHS compliant and Green.

**1.5A High-side Power Distribution Switch with Enable and Flag****AP2815****Absolute Maximum Ratings (Note 1)**

Parameter	Symbol	Value	Unit	
Power Supply Voltage	$V_{IN}$	6.0	V	
Operating Junction Temperature Range	$T_J$	150	°C	
Storage Temperature Range	$T_{STG}$	-65 to 150	°C	
Lead Temperature (Soldering, 10sec)	$T_{LEAD}$	260	°C	
Thermal Resistance (Junction to Ambient)	$\theta_{JA}$	SOIC-8	135	°C/W
		MSOP-8	150	
ESD (Machine Model)		200	V	
ESD (Human Body Model)		2000	V	

Note 1: Stresses greater than 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 Ratings” for extended periods may affect device reliability.

**Recommended Operating Conditions**

Parameter	Symbol	Min	Max	Unit
Supply Voltage	$V_{IN}$	2.7	5.5	V
Operating Ambient Temperature Range	$T_A$	-40	85	°C

**1.5A High-side Power Distribution Switch with Enable and Flag****AP2815****Electrical Characteristics**

( $V_{IN}=5.0V$ ,  $C_{IN}=2.2\mu F$ ,  $C_{OUT}=1.0\mu F$ , Typical  $T_A = 25^\circ C$ , **Bold** typeface applies over  $-40^\circ C \leq T_A \leq 85^\circ C$  ranges, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Input Voltage Range	$V_{IN}$		2.7		5.5	V
Switch On Resistance	$R_{DS(ON)}$	$V_{IN}=5V$ , $I_{OUT}=1.5A$		60	80	m $\Omega$
Current Limit	$I_{LIMIT}$	$V_{OUT}=4.0V$	1.65	2.2	2.8	A
Supply Current	$I_{SUPPLY}$	$V_{IN}=5V$ , $R_{LOAD}$ Open		65	85	$\mu A$
Fold-back Short Current	$I_{SHORT}$	$V_{OUT}=0$		1.12		A
Shutdown Supply Current	$I_{SHUTDOWN}$	Chip Disable, Shutdown Mode		0.1	1	$\mu A$
Enable High Input Threshold	$V_{ENH}$		1.6		5.5	V
Enable Low Input Threshold	$V_{ENL}$		0		1.0	V
Enable pin Input Current	$I_{EN}$	Force 0 to 5.0V at EN Pin	-1.0		1.0	$\mu A$
Under Voltage Lockout threshold voltage	$V_{UVLO}$	$V_{IN}$ Increasing from 0V	2.2	2.5	2.7	V
Under Voltage Hysteresis	$V_{UVLOHY}$			0.2		V
Reverse Current	$I_{REVERSE}$	Chip Disable, $V_{OUT} > V_{IN}$		0.1	1.0	$\mu A$
Output Pull Low Resistance after Shutdown	$R_{DISCHARGE}$	AP2815A, AP2815C only		13	50	$\Omega$
Output Turn-on Time	$t_{ON}$	From Enable Active to 90% of output		500		$\mu s$
FLAG Pin Delay Time	$t_{DFLG}$	From Over Current Fault Condition to FLAG Active	5	10	15	ms
FLAG Pin Low Voltage	$V_{FLG}$	$I_{SINK}=5mA$		35	70	mV
FLAG Pin Leakage	$I_{LEAKAGE}$	FLAG Disable, Force 5.0V			1.0	$\mu A$
Thermal Shutdown Temperature	$T_{OTSD}$			150		$^\circ C$
Thermal Shutdown Hysteresis	$T_{HYOTSD}$			30		

Typical Performance Characteristics

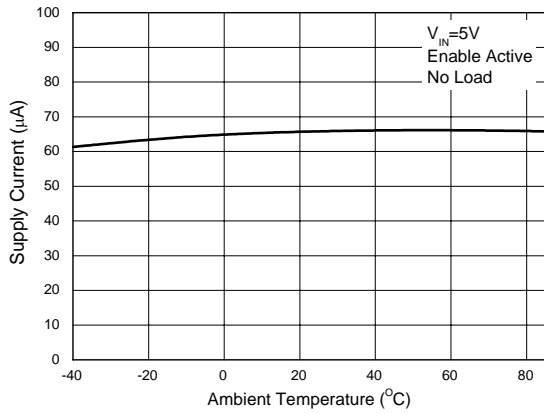


Figure 4. Supply Current vs. Ambient Temperature

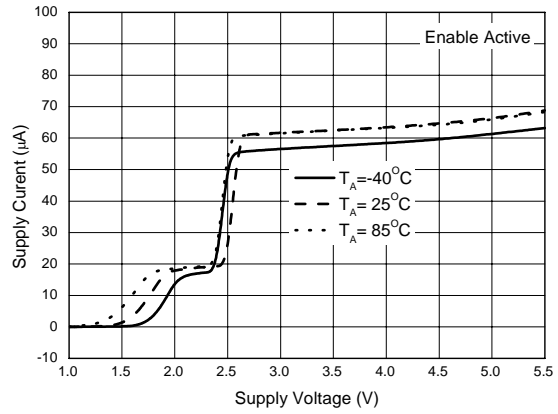


Figure 5. Supply Current vs. Supply Voltage

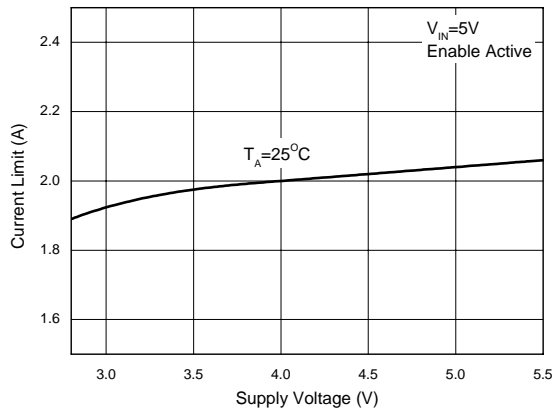


Figure 6. Current Limit vs. Supply Voltage

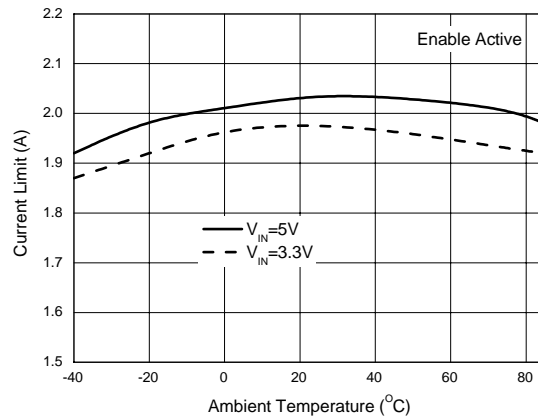


Figure 7. Current Limit vs. Ambient Temperature

Typical Performance Characteristics (Continued)

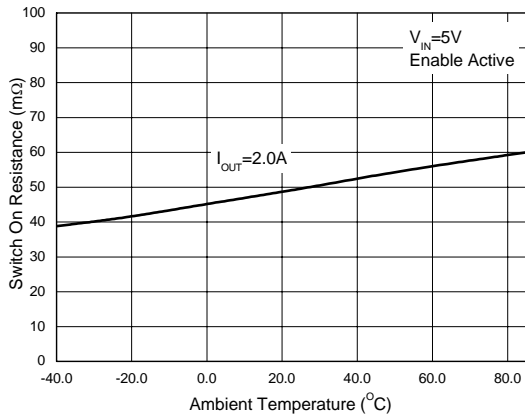


Figure 8. Switch On Resistance vs. Temperature

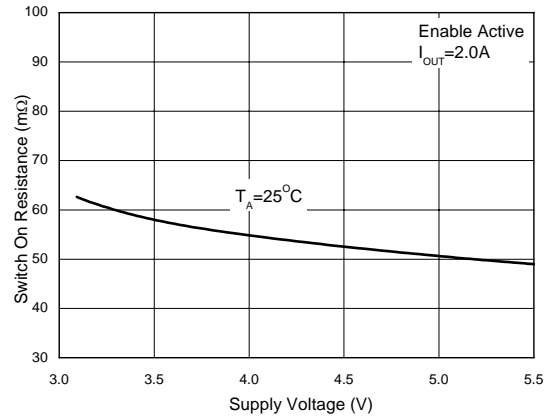


Figure 9. Switch On Resistance vs. Supply Voltage

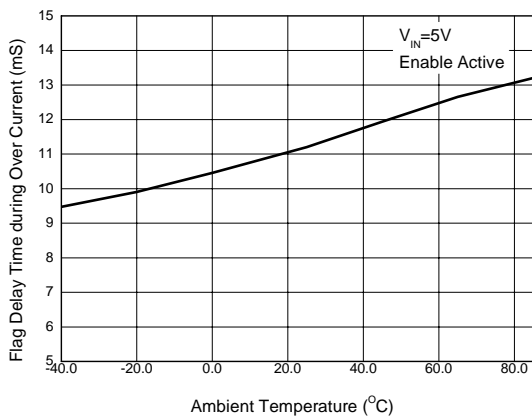


Figure 10. Flag Delay Time during Over Current vs. Ambient Temperature

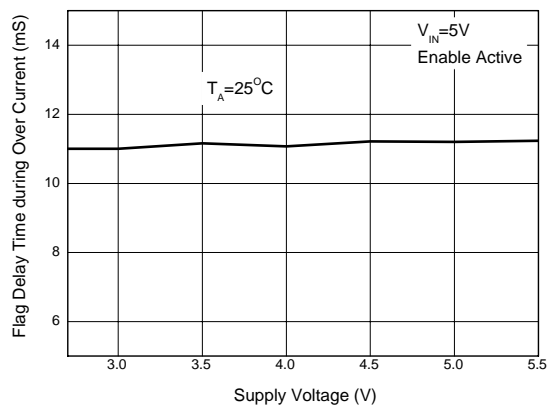


Figure 11. Flag Delay Time during Over Current vs. Supply Voltage



Typical Performance Characteristics (Continued)

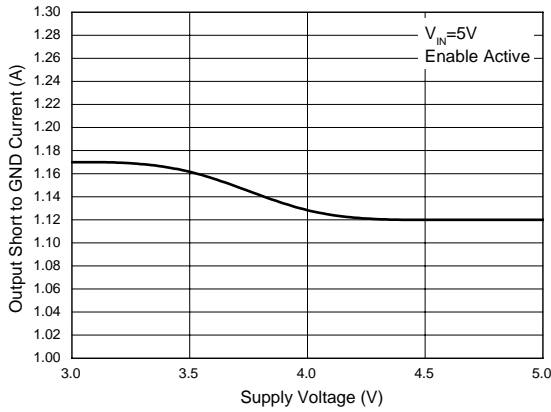


Figure 12. Output Short to GND Current vs. Supply Voltage

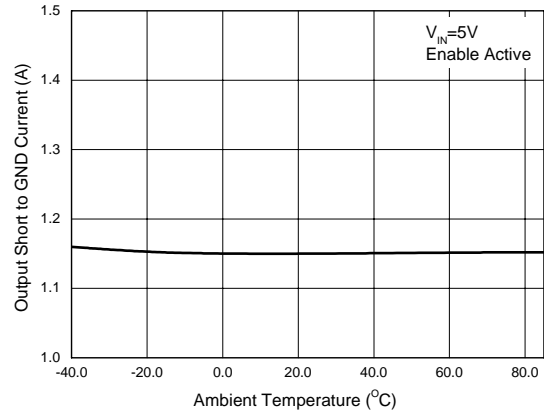


Figure 13. Output Short to GND Current vs. Ambient Temperature

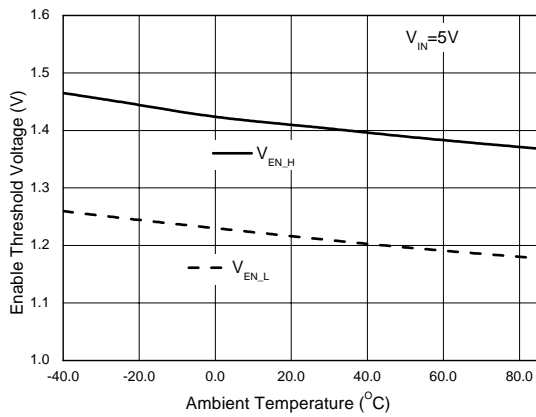


Figure 14. Enable Threshold Voltage vs. Ambient Temperature

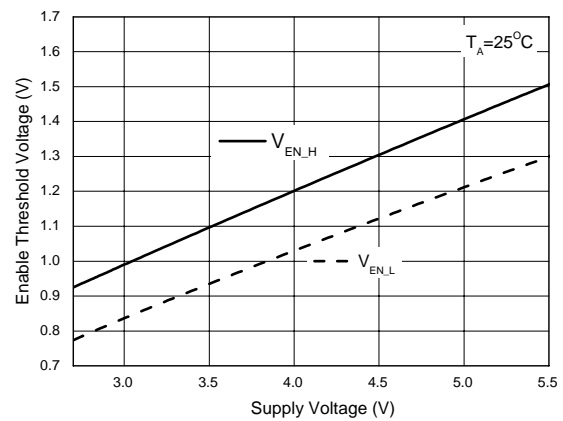


Figure 15. Enable Threshold Voltage vs. Supply Voltage

Typical Performance Characteristics (Continued)

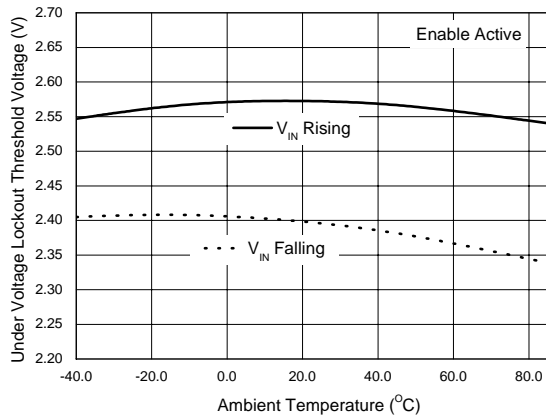


Figure 16. UVLO Voltage vs. Ambient Temperature



Figure 17. Output Short to GND Current ( $V_{IN}=5V, C_{IN}=1.0\mu F$ )

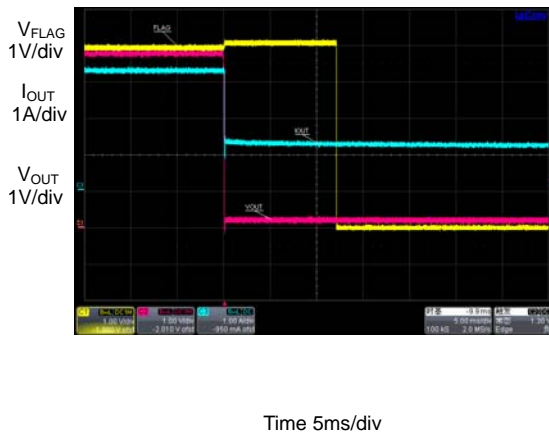


Figure 18. FLAG Response during Over Current

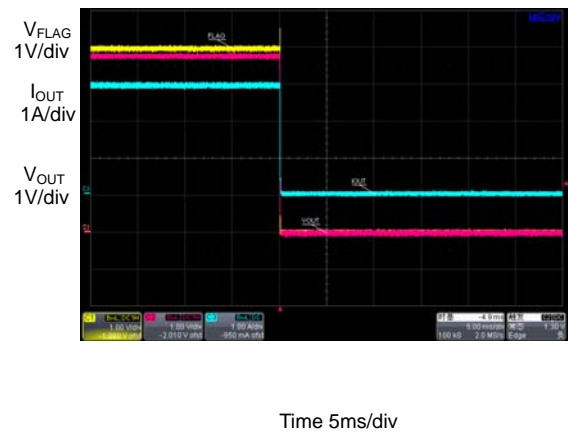
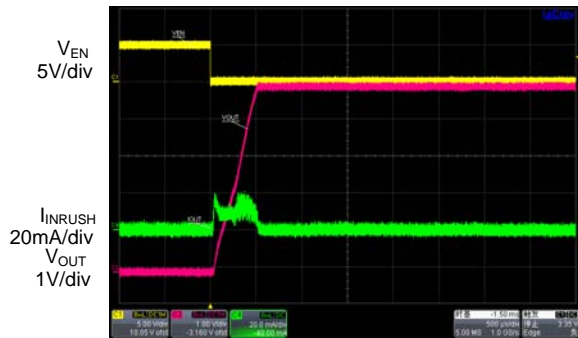


Figure 19. FLAG Response during Over Temperature ( $T_A=125^\circ C$ )

Typical Performance Characteristics (Continued)



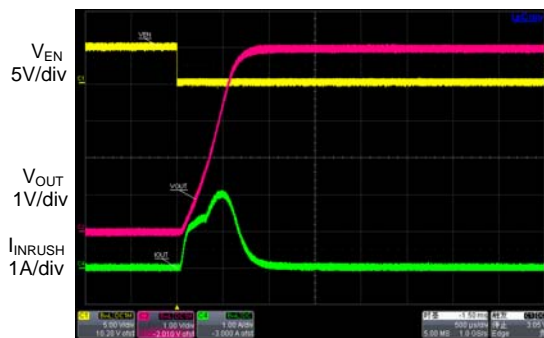
Time 500µs/div

Figure 20. Output Turn On and Rise Time ( $C_{IN}=1.0\mu F$ ,  $C_{OUT}=1.0\mu F$ , No Load)



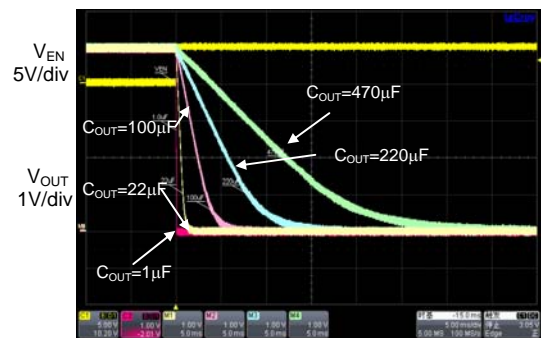
Time 500µs/div

Figure 21. Output Turn On and Rise Time ( $C_{IN}=1.0\mu F$ ,  $C_{OUT}=1.0\mu F$ ,  $R_L=3.3\Omega$ )



Time 500µs/div

Figure 22. Output Turn On and Rise Time ( $C_{IN}=1.0\mu F$ ,  $C_{OUT}=220\mu F$ , No Load)



Time 5ms/div

Figure 23. Output Turn Off and Fall Time ( $V_{IN}=5V$ ,  $C_{IN}=1.0\mu F$ , No Load)

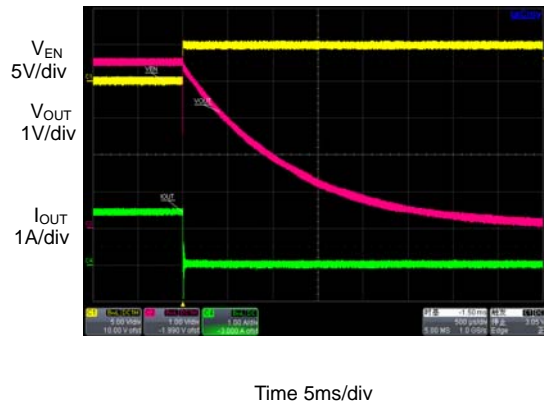
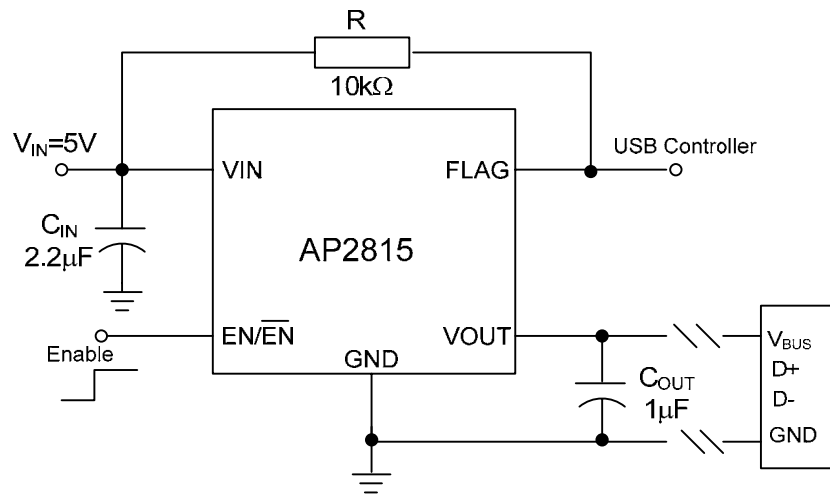
**Typical Performance Characteristics (Continued)**

Figure 24. Output Turn Off and Fall Time  
( $V_{IN}=5V$ ,  $C_{IN}=1.0\mu F$ ,  $C_{OUT}=470\mu F$ ,  $R_L=3.3\Omega$ )

## Typical Application



Note 2:  $2.2\mu F$  input capacitor is enough in most application cases.

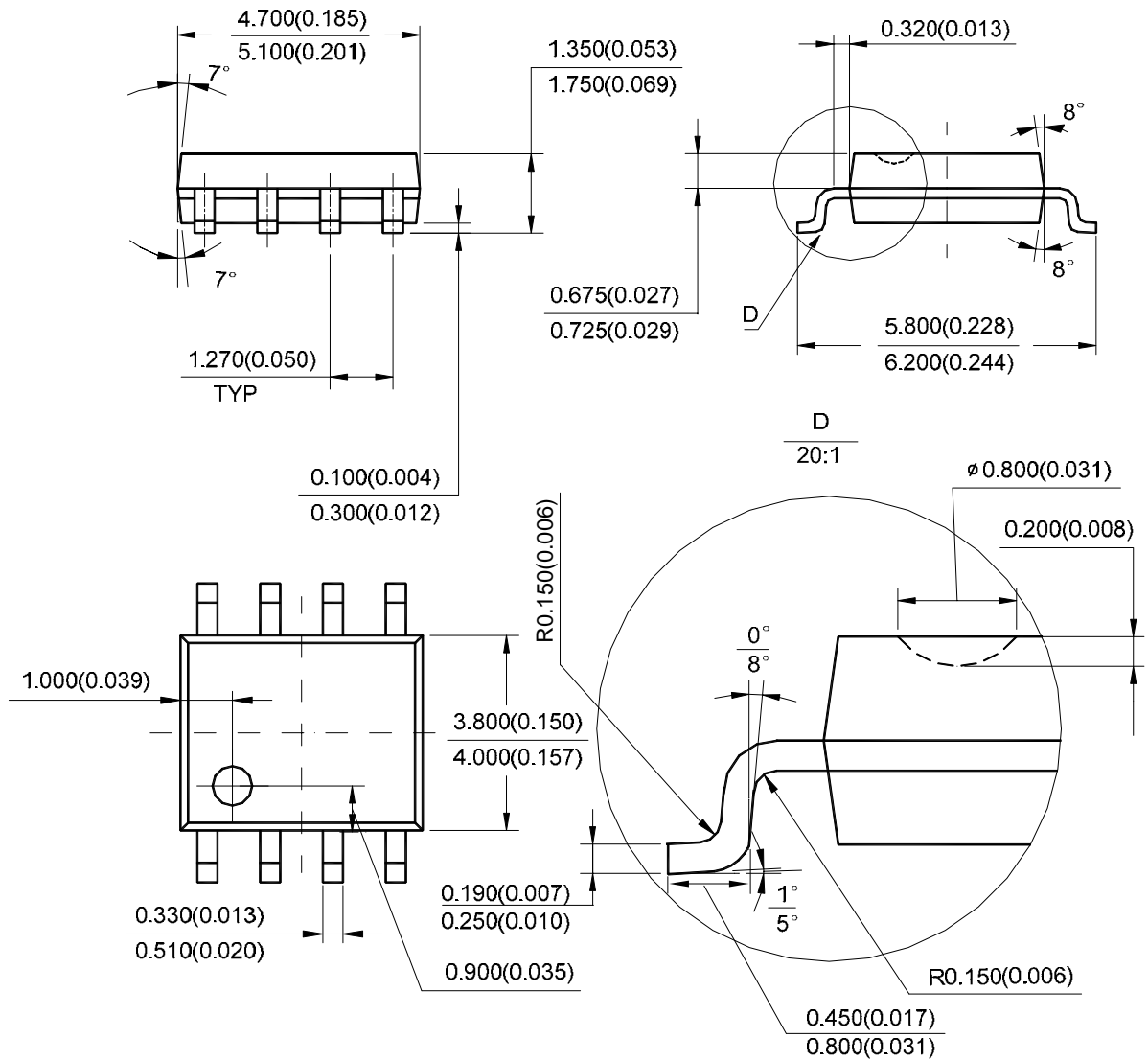
If the  $V_{OUT}$  is short to ground frequently during usage, large size input capacitor is necessary, recommend  $22\mu F$ .

Figure 25. Typical Application of AP2815

Mechanical Dimensions

SOIC-8

Unit: mm(inch)

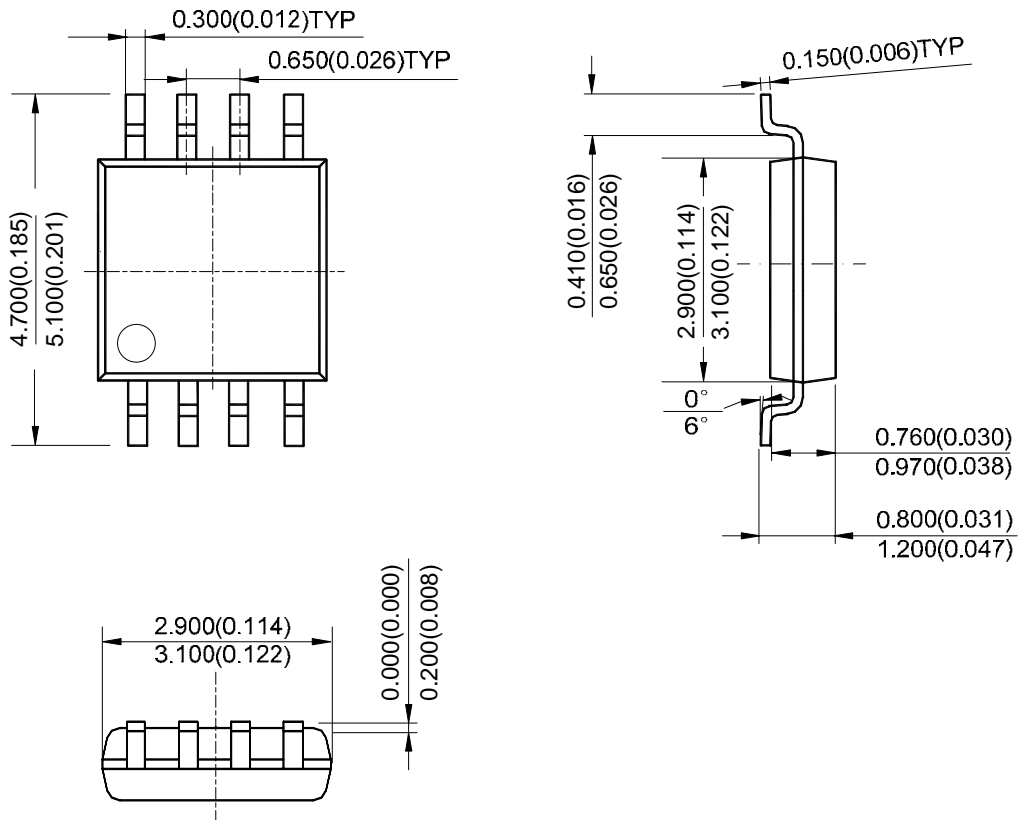


Note: Eject hole, oriented hole and mold mark is optional.

Mechanical Dimensions (Continued)

MSOP-8

Unit: mm(inch)



Note: Eject hole, oriented hole and mold mark is optional.



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