



**THE DATASHEET OF  
AP2815CMMTR-G1**



## 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

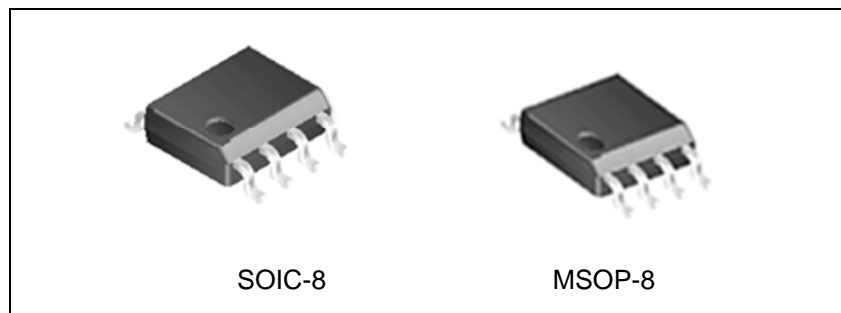


Figure 1. Package Types of AP2815

## Pin Configuration

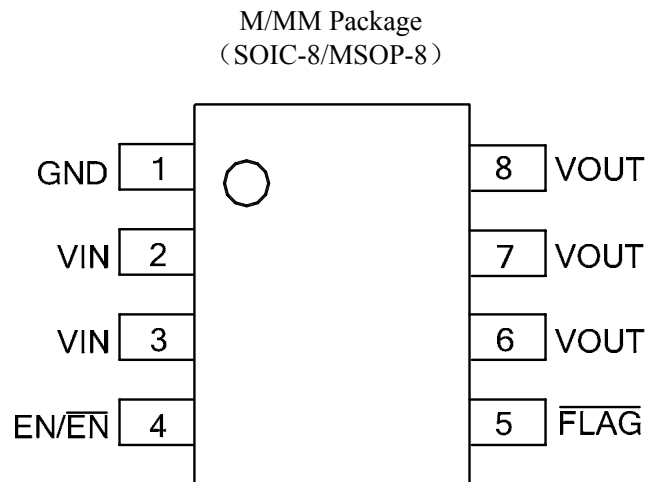


Figure 2. Pin Configuration of AP2815 (Top View)

## 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

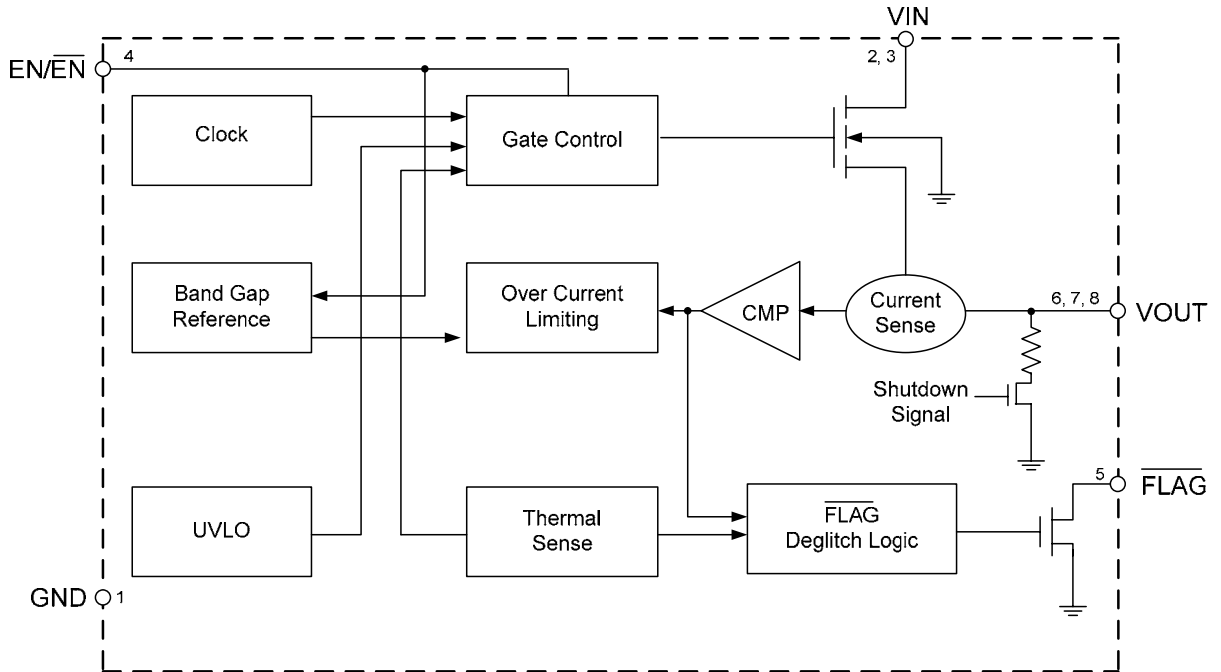


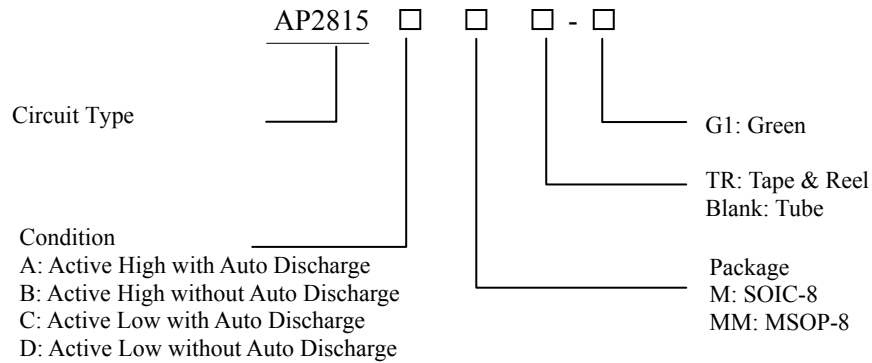
Figure 3. Functional Block Diagram of AP2815



**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

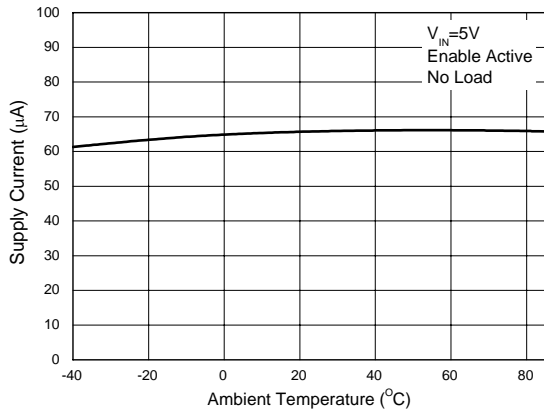


Figure 4. Supply Current vs. Ambient Temperature

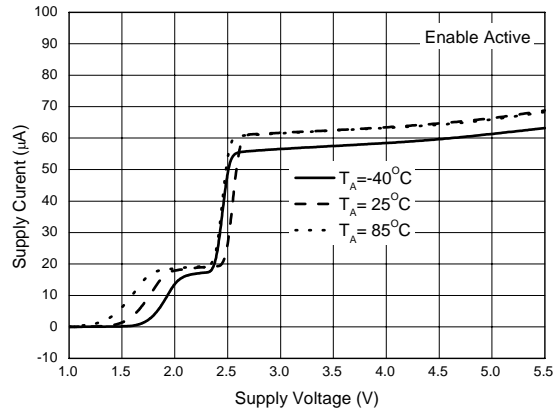


Figure 5. Supply Current vs. Supply Voltage

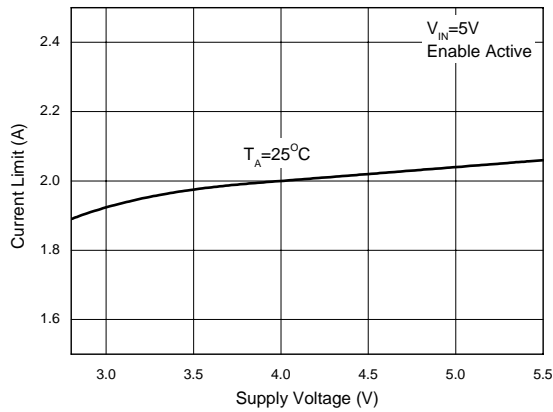


Figure 6. Current Limit vs. Supply Voltage

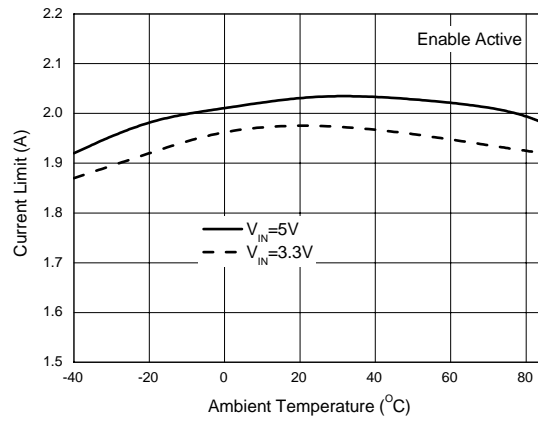


Figure 7. Current Limit vs. Ambient Temperature

Typical Performance Characteristics (Continued)

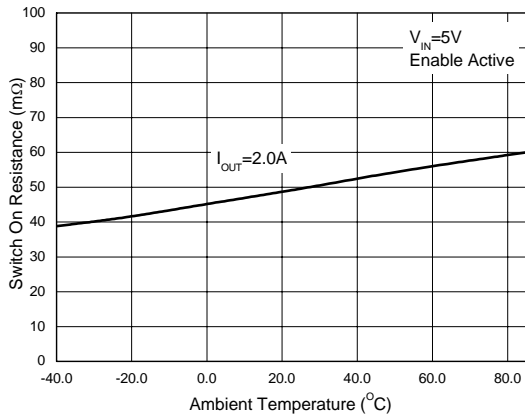


Figure 8. Switch On Resistance vs. Temperature

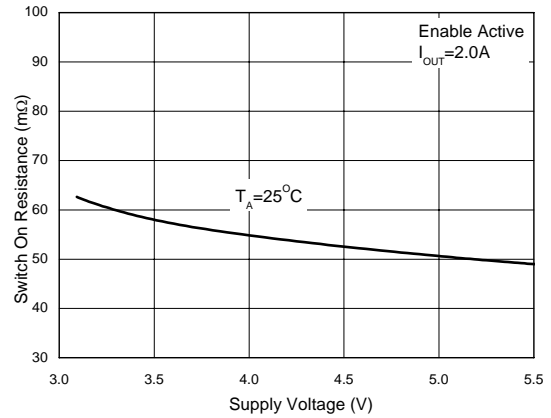


Figure 9. Switch On Resistance vs. Supply Voltage

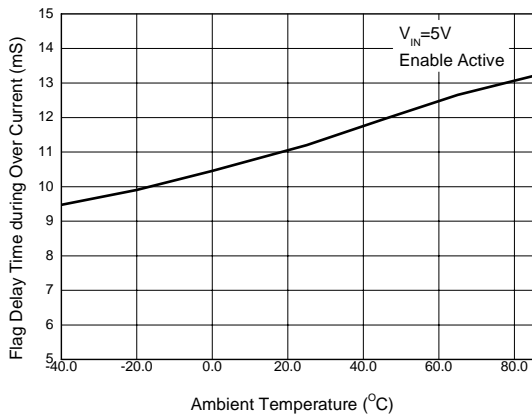


Figure 10. Flag Delay Time during Over Current vs. Ambient Temperature

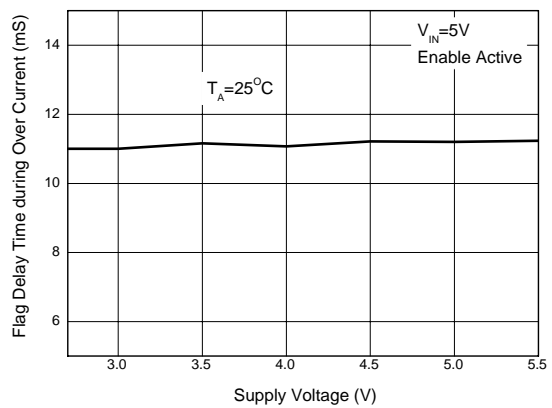


Figure 11. Flag Delay Time during Over Current vs. Supply Voltage

Typical Performance Characteristics (Continued)

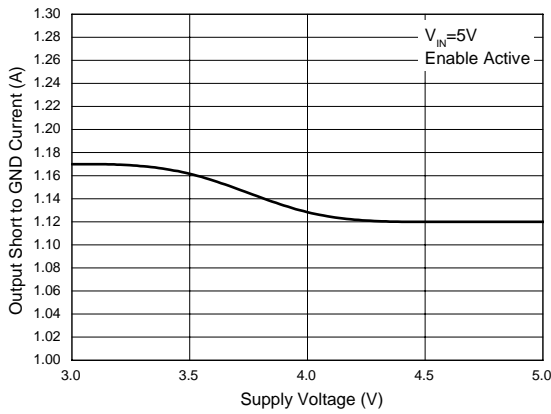


Figure 12. Output Short to GND Current vs. Supply Voltage

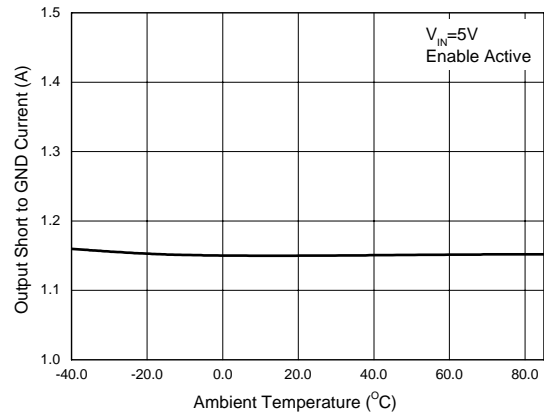


Figure 13. Output Short to GND Current vs. Ambient Temperature

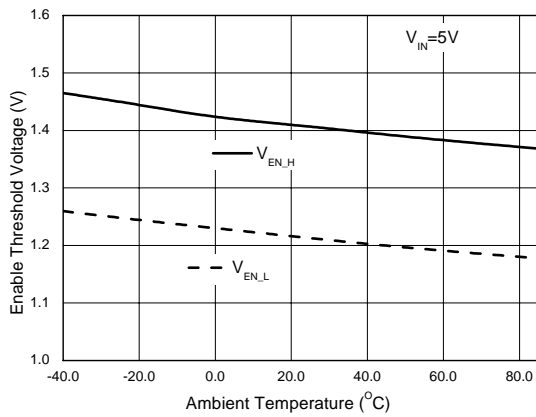


Figure 14. Enable Threshold Voltage vs. Ambient Temperature

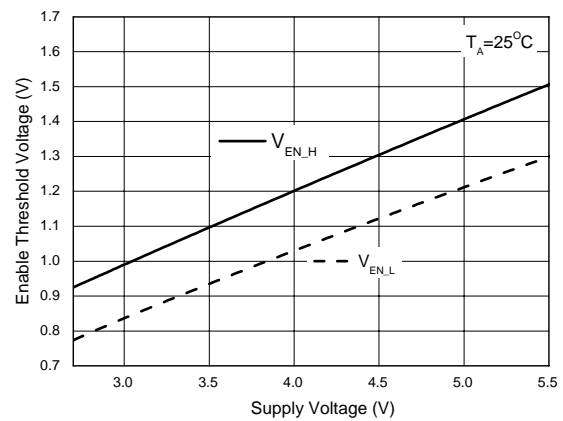


Figure 15. Enable Threshold Voltage vs. Supply Voltage

Typical Performance Characteristics (Continued)

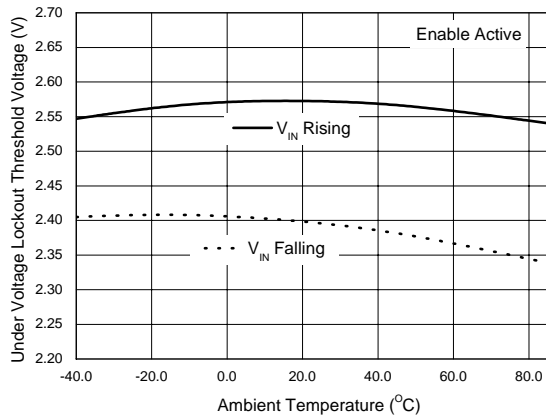


Figure 16. UVLO Voltage vs. Ambient Temperature

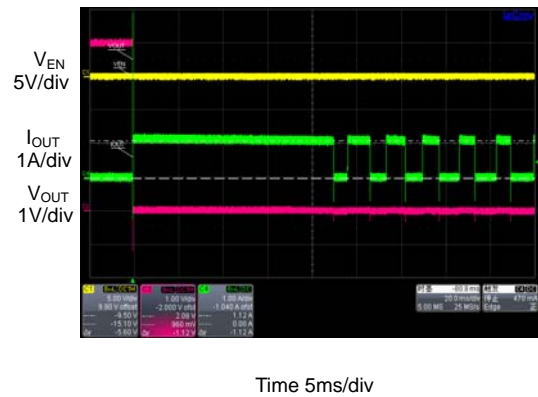


Figure 17. Output Short to GND Current ( $V_{IN}=5V$ ,  $C_{IN}=1.0\mu F$ )

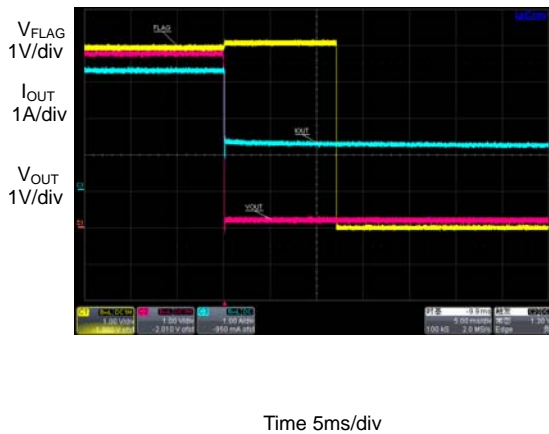


Figure 18. FLAG Response during Over Current

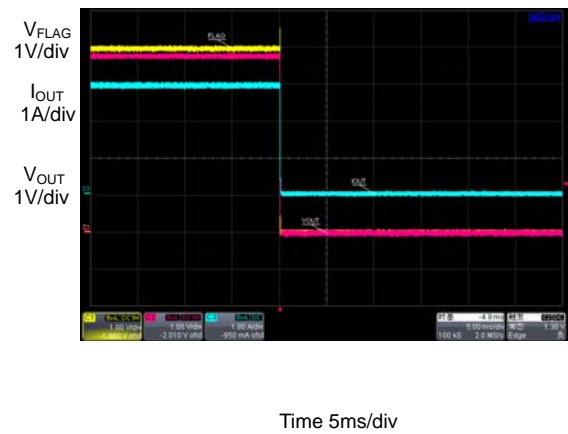
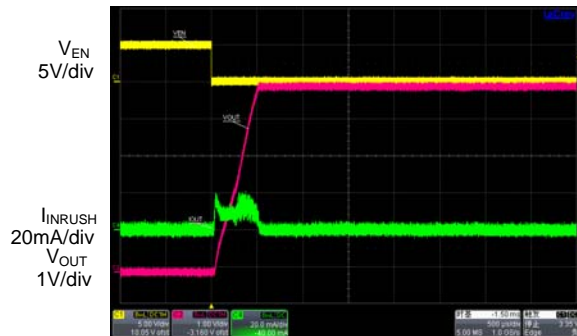


Figure 19. FLAG Response during Over Temperature ( $T_A=125^\circ C$ )

**Typical Performance Characteristics (Continued)**


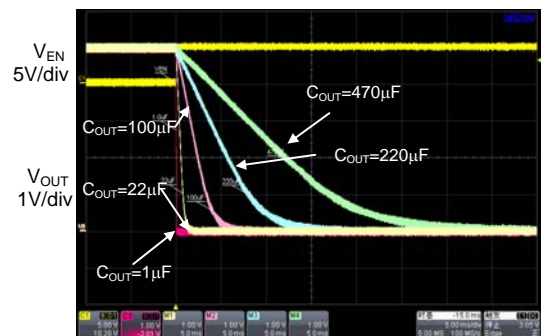
Time 500µs/div

 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)

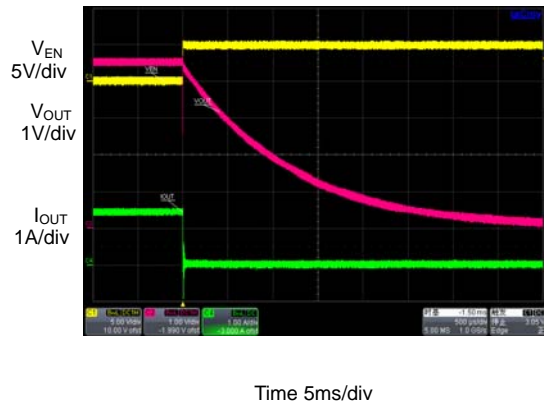
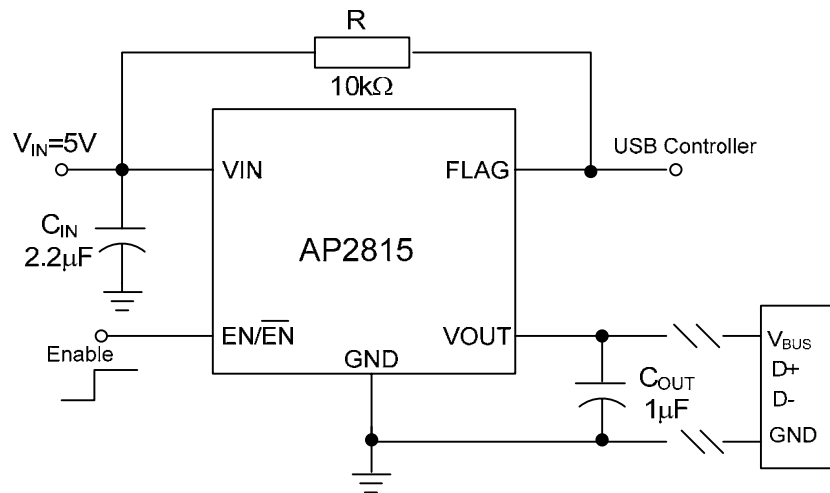
**Typical Performance Characteristics (Continued)**

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: 2.2µF input capacitor is enough in most application cases.

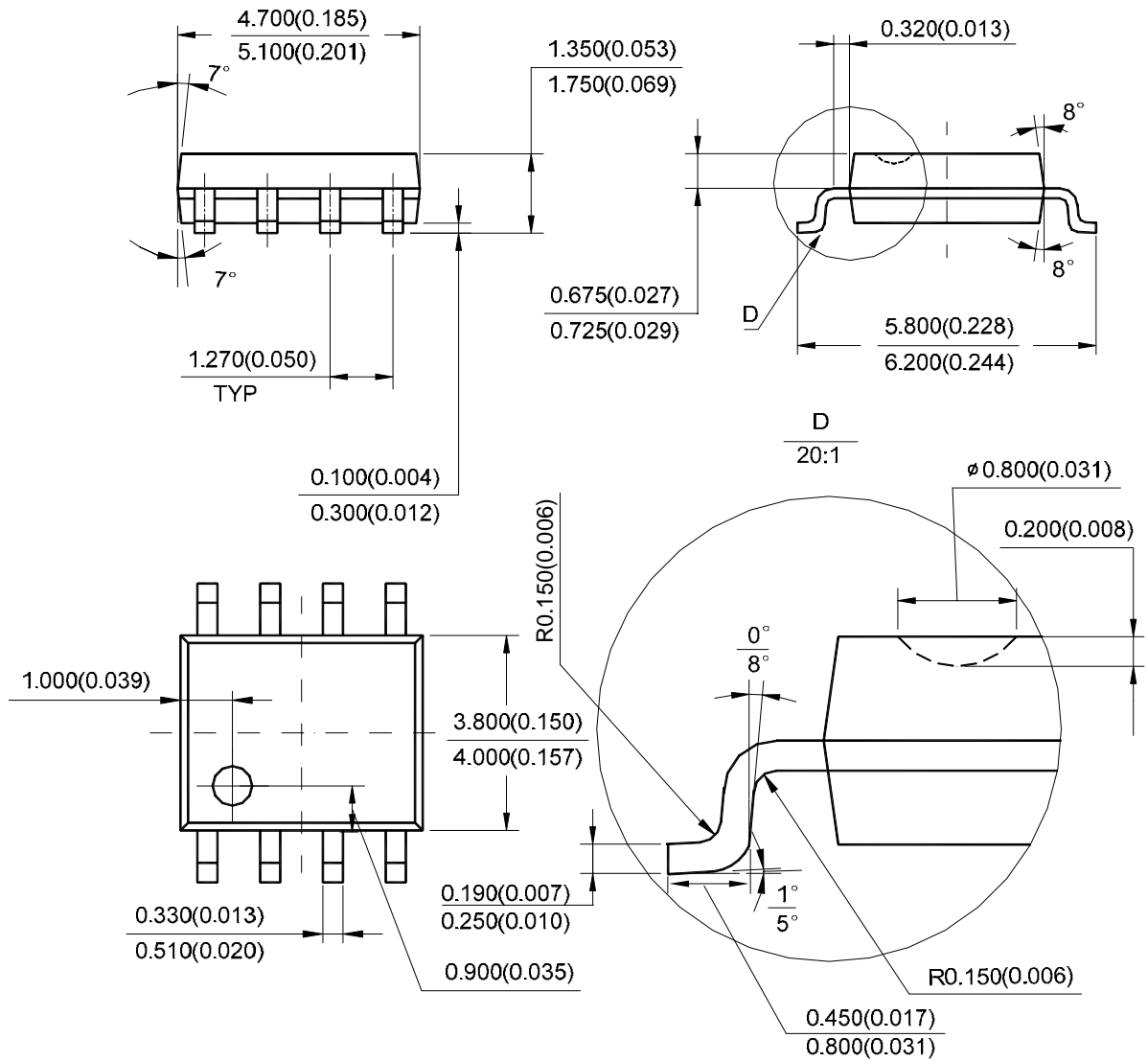
If the  $V_{OUT}$  is short to ground frequently during usage, large size input capacitor is necessary, recommend 22µF.

Figure 25. Typical Application of AP2815

Mechanical Dimensions

SOIC-8

Unit: mm(inch)

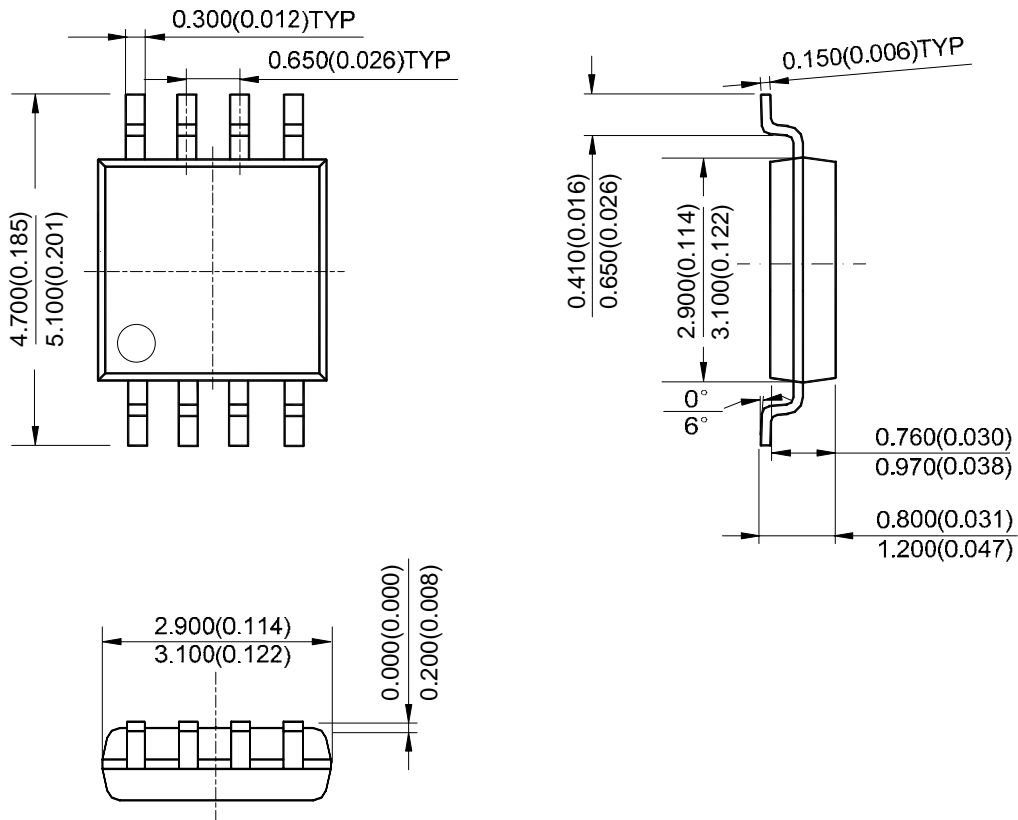


Note: Eject hole, oriented hole and mold mark is optional.

Mechanical Dimensions (Continued)

MSOP-8

Unit: mm(inch)



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



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