



## US3026A

CMOS IC

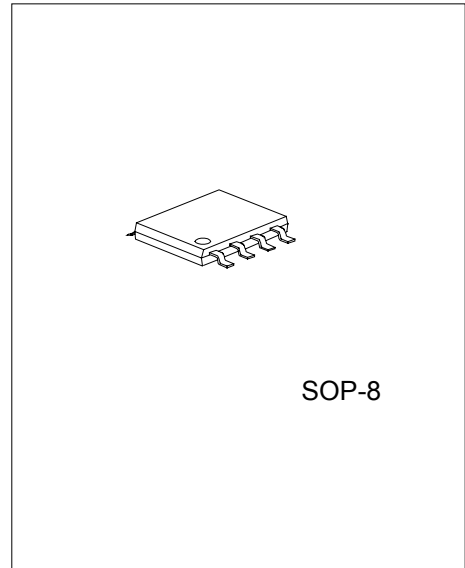
### DUAL-CHANNEL USB POWER SWITCH AND OVER-CURRENT PROTECTION

#### ■ DESCRIPTION

The UTC **US3026A** is a standard dual channels power switch with independent over-current protection fault flag functions, optimized for bus-powered Universal Serial Bus (USB) and self-powered applications, including Notebook and desktop PC's that supply power to more than one port.

The UTC **US3026A** also offers thermal shutdown protection that reduces current consumption in fault modes for each switch and the entire device. With a 1ms delay on the fault FLAG output prevents erroneous over current reporting caused by in-rush currents during hot-plug events.

In addition, the UTC **US3026A** employs soft-start circuitry that minimizes in-rush current in applications where highly capacitive loads are employed.



SOP-8

\*Pb-free plating product number: US3026AL

#### ■ FEATURES

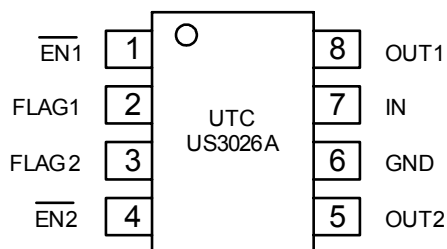
- \* Two P-channel power MOSFET control switch
- \* 110 $\mu$ A Max operating current
- \* 5 $\mu$ A Max standby current
- \* 145 m $\Omega$  Max switch resistance
- \* 2.7V ~ 5.5V input voltage range
- \* 500mA minimum continuous load current
- \* Smooth turn-on eliminates in-rush induced voltage drop
- \* 1 ms fault flag delay filters Hot-Plug events
- \* Over-current protection
- \* Under-voltage lockout circuit
- \* Thermal shutdown protection
- \* Flag indicates fault conditions

#### ■ ORDERING INFORMATION

| Order Number  |                   | Package | Packing   |
|---------------|-------------------|---------|-----------|
| Normal        | Lead Free Plating |         |           |
| US3026A-S08-R | US3026AL-S08-R    | SOP-8   | Tape Reel |
| US3026A-S08-T | US3026AL-S08-T    | SOP-8   | Tube      |

|                |                                                       |                                                                                       |
|----------------|-------------------------------------------------------|---------------------------------------------------------------------------------------|
| US3026AL-S08-R | (1)Packing Type<br>(2)Package Type<br>(3)Lead Plating | (1) R: Tape Reel, T: Tube<br>(2) S08: SOP-8<br>(3) L: Lead Free Plating, Blank: Pb/Sn |
|----------------|-------------------------------------------------------|---------------------------------------------------------------------------------------|

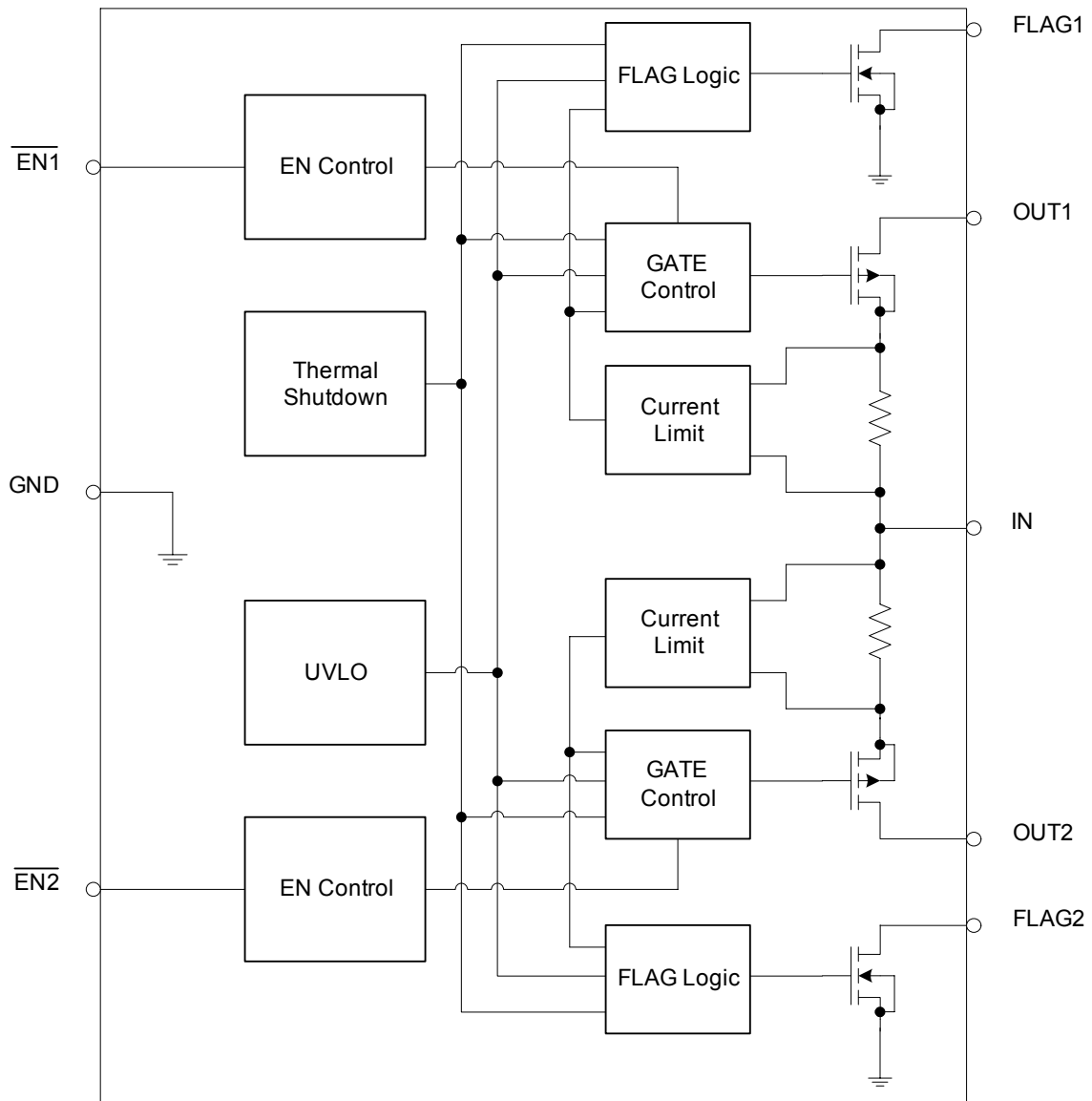
## ■ PIN CONFIGURATIONS



## ■ PIN DESCRIPTION

| PIN NO | PIN NAME                | DESCRIPTION                                                                                                                |
|--------|-------------------------|----------------------------------------------------------------------------------------------------------------------------|
| 1      | $\overline{\text{EN1}}$ | Switch1 Enable input: Logic-compatible enables inputs                                                                      |
| 2      | FLAG1                   | Fault Detection Flag 1 (OUTPUT): Active-low. N-ch open-drain. Indicates over-current, thermal shutdown, or UVLO conditions |
| 3      | FLAG2                   | Fault Detection Flag 2 (OUTPUT): Active-low. N-ch open-drain. Indicates over-current, thermal shutdown, or UVLO conditions |
| 4      | $\overline{\text{EN2}}$ | Switch2 Enable input: Logic-compatible enables inputs                                                                      |
| 5      | OUT2                    | Switch2 OUTPUT: Drain of MOSFET for Output. Usually, connected to Load                                                     |
| 6      | GND                     | Ground                                                                                                                     |
| 7      | IN                      | Power input: Source of MOSFET for Output. Power Supply to Internal Circuitry of IC                                         |
| 8      | OUT1                    | Switch1 OUTPUT: Drain of MOSFET for Output. Usually, connected to Load                                                     |

## ■ BLOCK DIAGRAM



## ■ ABSOLUTE MAXIMUM RATINGS

| PARAMETER                 | SYMBOL      | RATINGS    | UNIT |
|---------------------------|-------------|------------|------|
| Supply Voltage            | $V_{IN}$    | -0.3 ~ +6  | V    |
| Output Voltage            | $V_{OUT}$   | -0.3 ~ +6  | V    |
| Voltage at All Other Pins | $V_{OTHER}$ | -0.3 ~ +6  | V    |
| Total Power Dissipation   | $P_D$       | 300        | mW   |
| $T_{JMAX}$                | $T_{JMAX}$  | 160        | °C   |
| Junction Temperature      | $T_J$       | +155       | °C   |
| Operating Temperature     | $T_{OPR}$   | -40 ~ +85  | °C   |
| Storage Temperature       | $T_{STG}$   | -55 ~ +155 | °C   |

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.

Absolute maximum ratings are stress ratings only and functional device operation is not implied.

## ■ OPERATING RATINGS

| PARAMETER             | SYMBOL    | RATINGS     | UNIT |
|-----------------------|-----------|-------------|------|
| Supply Voltage Range  | $V_{IN}$  | +2.7 ~ +5.5 | V    |
| Operating Temperature | $T_{OPR}$ | 0 ~ +70     | °C   |

Note: The human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

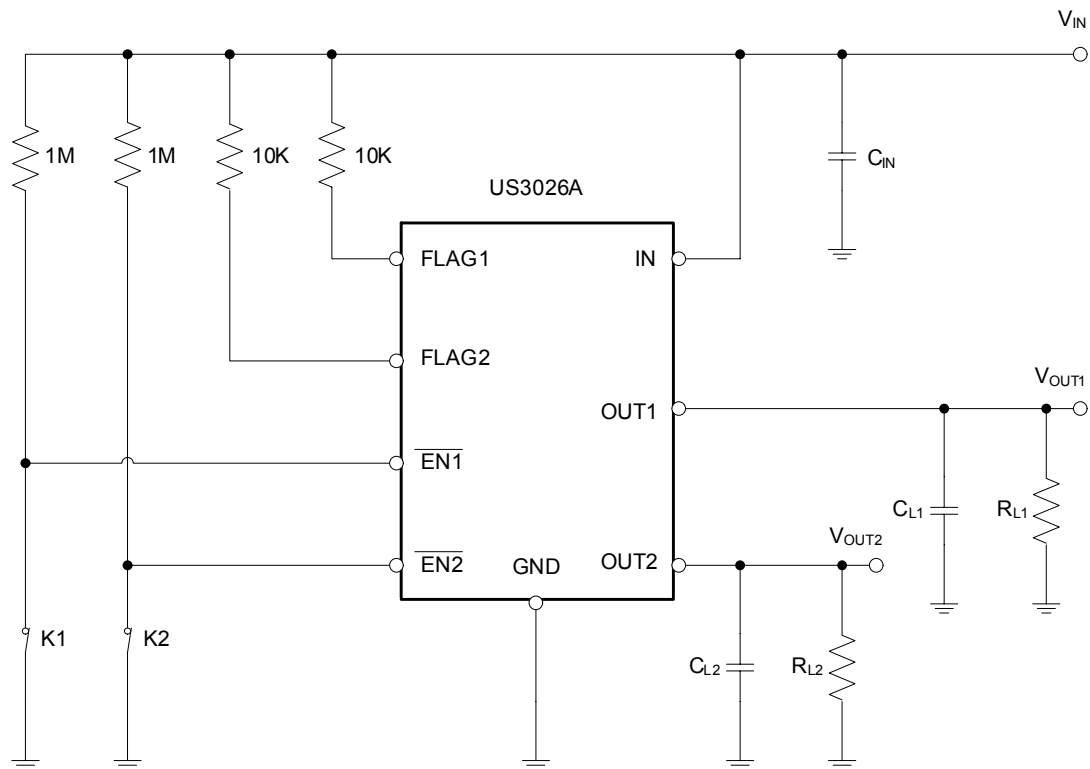
## ■ ELECTRICAL CHARACTERISTICS ( $T_J = 25^\circ\text{C}$ , $V_{IN} = 5.0\text{V}$ , $V_{EN} = 0\text{V}$ , unless otherwise specified.)

| PARAMETER                                     |      | SYMBOL                   | TEST CONDITIONS                                                                      | MIN  | TYP  | MAX | UNIT               |
|-----------------------------------------------|------|--------------------------|--------------------------------------------------------------------------------------|------|------|-----|--------------------|
| DC CHARACTERISTIC                             |      |                          |                                                                                      |      |      |     |                    |
| $\overline{\text{EN}}$ Input Logic            | High | $V_{\text{IH}}$          | (Note 1)                                                                             | 2.4  | 1.7  |     | V                  |
|                                               | Low  | $V_{\text{IL}}$          | (Note 1)                                                                             |      | 1.6  | 0.8 | V                  |
| Under-Voltage Lockout Threshold               |      | $V_{\text{UVLO}}$        | $V_{\text{IN}}$ =increasing                                                          |      | 2.3  | 2.7 | V                  |
|                                               |      |                          | Hysteresis voltage                                                                   |      | 100  |     | mV                 |
| OUT Pins Continuous Output Current            |      | $I_{\text{OUT}}$         | Each Output                                                                          | 0.5  |      |     | A                  |
| Over-Current Threshold                        |      | $\text{THD}_{\text{OC}}$ |                                                                                      |      | 1.5  | 2.2 | A                  |
| OUT Pins Output Leakage Current               |      | $I_{\text{LEAK}}$        | $V_{\overline{\text{EN}}} = V_{\text{IN}}$                                           |      | 0.01 | 10  | $\mu\text{A}$      |
| $\overline{\text{EN}}$ Leakage Current        |      | $I_{\text{EN}}$          | $V_{\overline{\text{EN}}} = 0\text{V}$ or $V_{\overline{\text{EN}}} = V_{\text{IN}}$ | -0.5 |      | 0.5 | $\mu\text{A}$      |
| Supply Current                                | OFF  | $I_{\text{O(OFF)}}$      | Switch-Off                                                                           |      | 1    | 5   | $\mu\text{A}$      |
|                                               | ON   | $I_{\text{O(ON)}}$       | Switch-On                                                                            |      |      | 110 | $\mu\text{A}$      |
| Error FLAG Leakage Current                    |      | $I_{\text{FH}}$          | $V_{\text{FLAG}} = 5\text{V}$                                                        |      | 0.01 | 1   | $\mu\text{A}$      |
| On Resistance                                 |      | $R_{\text{ON}}$          | $V_{\text{IN}} = 5\text{V}$ , $I_{\text{OUT}} = 500\text{mA}$ , each switch          |      | 105  | 145 | m $\Omega$         |
|                                               |      |                          | $V_{\text{IN}} = 2.7\text{V}$ , $I_{\text{OUT}} = 500\text{mA}$ , each switch        |      | 135  | 180 |                    |
| FLAG Output Voltage                           |      | $R_{\text{FO}}$          | $I_{\text{FO}} = 10\text{ mA}$ , $V_{\text{IN}} = 5.0\text{V}$                       |      | 10   | 20  | $\Omega$           |
|                                               |      |                          | $I_{\text{FO}} = 10\text{ mA}$ , $V_{\text{IN}} = 3.3\text{V}$                       |      | 11   | 30  |                    |
|                                               |      |                          | $I_{\text{FO}} = 10\text{ mA}$ , $V_{\text{IN}} = 2.7\text{V}$                       |      | 12   | 40  |                    |
| Over-Temperature Shutdown Threshold           |      | $\text{THD}_{\text{OT}}$ | $T_{\text{J}}$ Increasing, with no shorted output                                    |      | 155  |     | $^{\circ}\text{C}$ |
|                                               |      |                          | $T_{\text{J}}$ Increasing, with shorted output (s)                                   |      | 145  |     |                    |
|                                               |      |                          | $T_{\text{J}}$ Decreasing (Note 2)                                                   |      | 135  |     |                    |
| AC CHARACTERISTIC                             |      |                          |                                                                                      |      |      |     |                    |
| Over Current Flag Delay                       |      | $t_{\text{OC}}$          | $R_{\text{L}} = 0$                                                                   |      | 1    |     | ms                 |
| OUT Rise Time                                 |      | $t_{\text{R}}$           | $R_{\text{L}} = 10\Omega$                                                            |      | 160  |     | $\mu\text{s}$      |
| OUT Fall Time                                 |      | $t_{\text{F}}$           | $R_{\text{L}} = 10\Omega$                                                            |      | 5    |     | $\mu\text{s}$      |
| Turn on Delay, $\overline{\text{EN}}$ to OUT  |      | $t_{\text{ON}}$          | $R_{\text{L}} = 10\Omega$                                                            |      | 240  |     | $\mu\text{s}$      |
| Turn off Delay, $\overline{\text{EN}}$ to OUT |      | $t_{\text{OFF}}$         | $R_{\text{I}} = 10\Omega$                                                            |      | 5    |     | $\mu\text{s}$      |

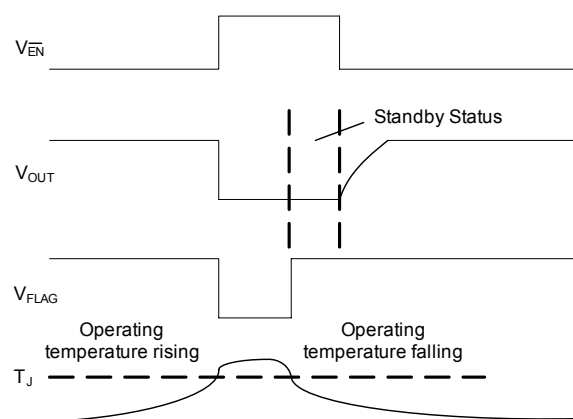
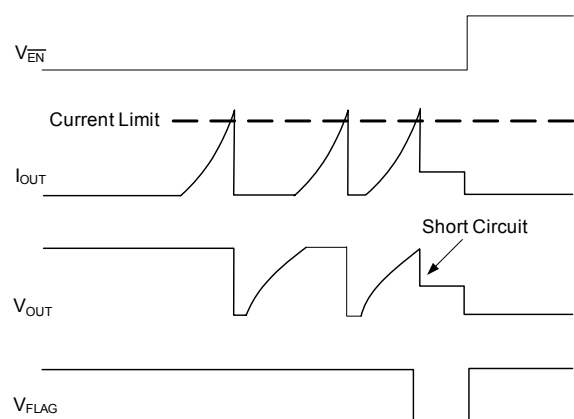
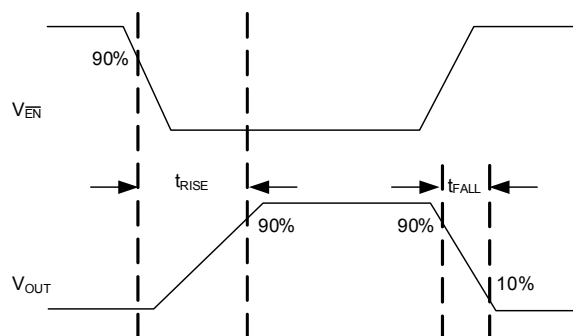
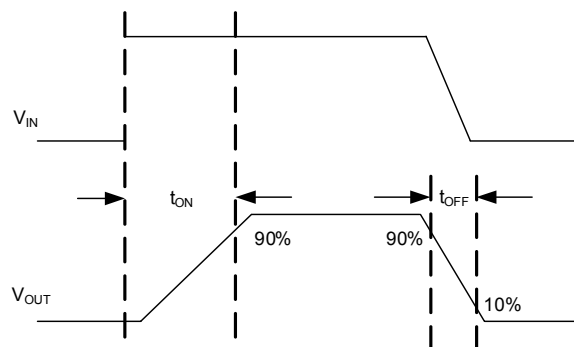
Note: 1. OFF is  $\overline{EN} \geq 2.4\text{V}$  and ON is  $\overline{EN} \leq 0.8\text{V}$ .

2. Thermal Shutdown will protect the device from permanent damage.

## ■ TEST CIRCUIT



# TIMING DIAGRAM



## ■ FUNCTIONAL DESCRIPTION

The UTC **US3026A** is dual P-Channel switches with active-low and active-high enable inputs, respectively. Fault conditions (such as UVLO, thermal shutdown and over-current) that appear will turn off the power switch, and the FLAG pin will go low. Of course, the two internal FLAG circuits also operate respectively.

### Input and Output

IN (Input) is the power supply connection to the control circuitry and the source of the output MOSFET. OUTX (Output) is the connection to the drain of the output MOSFET. In a typical application circuit, current flows through the switch from IN to OUTX towards the load. If  $V_{OUT}$  is greater than  $V_{IN}$  when the switch is enabled, current will flow from OUTX to IN since the MOSFET is bi-directional.

### Power ON and OFF

The UTC **US3026A** performs a soft-start operation on power application, which is to prevent an over-current or inrush-current from flowing through the switch from IN to OUTX towards to the load, while the high-capacity capacitor is connected to the OUTX.

### Thermal Shutdown

The UTC **US3026A** is internally protected against excessive power dissipation by thermal shutdown protection circuit. If device junction temperature rise above approximately 145°C, both switches are turned off, both fault FLAG outputs are activated, and they goes low. Hysteresis ensures that both switches turned off by thermal shutdown will not be turned on again until the die temperature is reduced to 135°C. When the thermal shutdown circuit is activated, the output pins are in the OFF status. However, the UTC **US3026A** enters the standby status when  $\overline{EN}$  pins are all inactive.

### Current Limit

The current limit circuit is designed to protect the output MOSFET, the load and the IC supply from damage caused by excessive currents. The current limit threshold is preset internally, If an over-current is detected, the IC performs a slow-start operation again, it is assumed that output is short circuit, and FLAG pin will go low, FLAG output is available to indicate fault conditions independently to the USB controller.

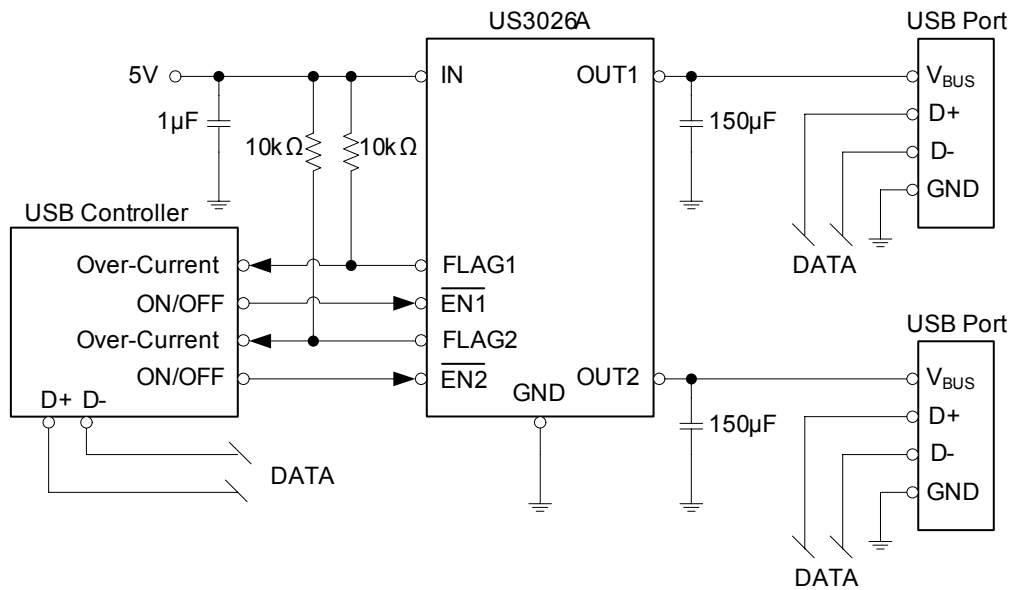
### Under-Voltage Lockout

UVLO prevents the output MOSFET switch from turning on until input voltage exceeds 2.3V (typical). If input voltage drops below 2.2V (typical), UVLO shuts off the both output MOSFET switches and signals the FLAG.

### Fault FLAG

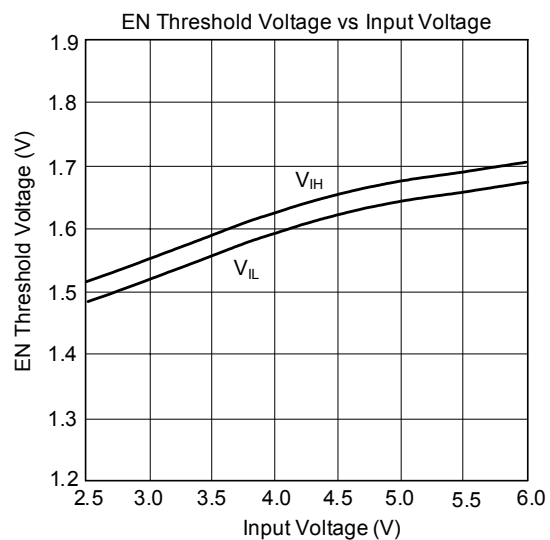
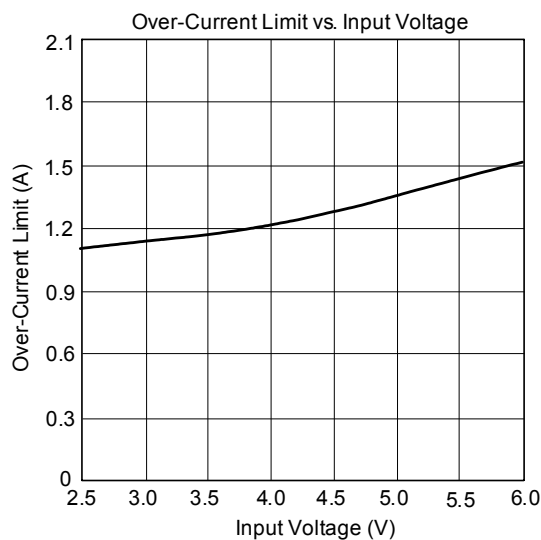
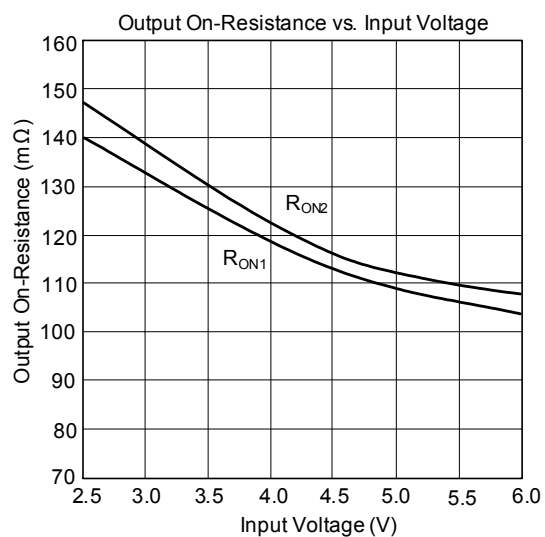
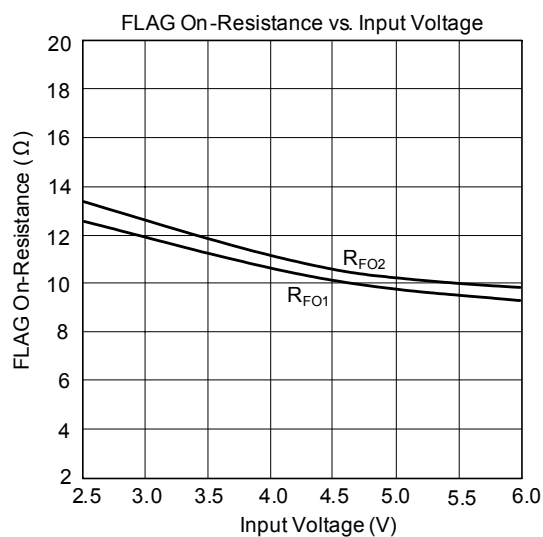
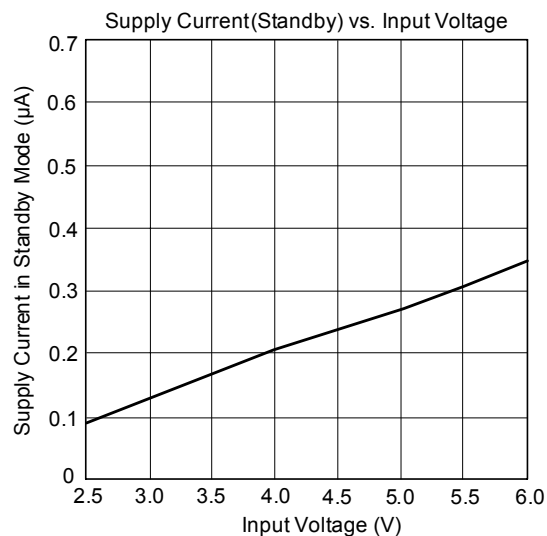
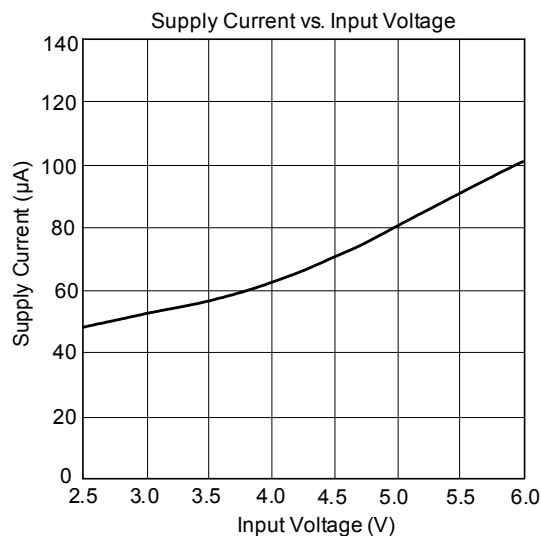
The fault FLAG is an output with open-drain of N-channel. The fault FLAG is pulled down when any of the conditions such as under-voltage, current limit and thermal shutdown. In a typical application circuit, the FLAG pin has a pull-up resistor of 10kΩ to input voltage.

## ■ TYPICAL APPLICATION CIRCUIT

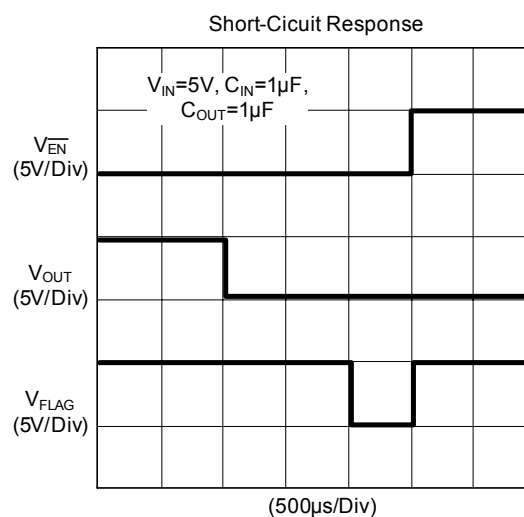
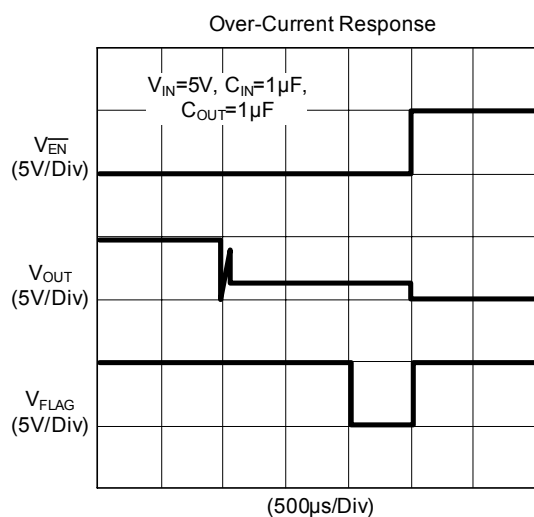
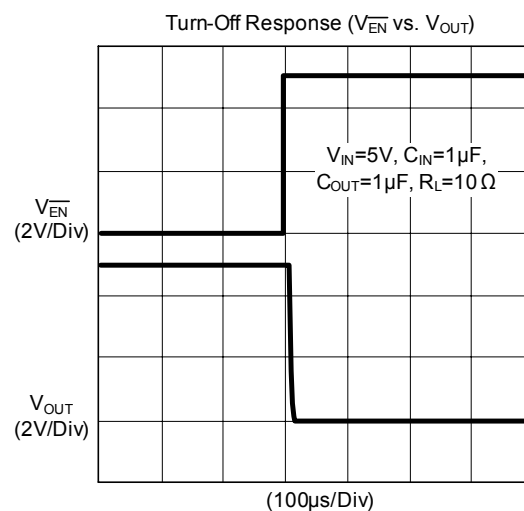
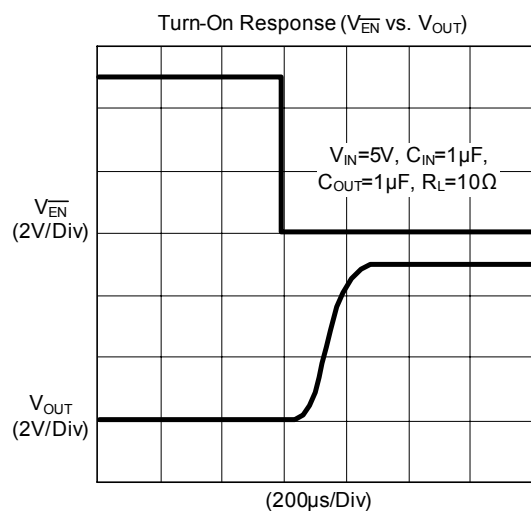
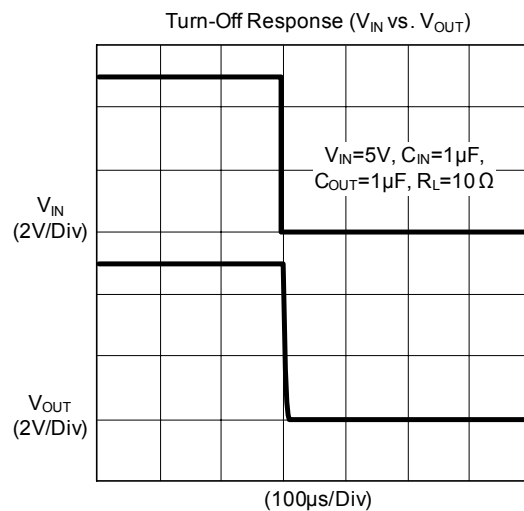
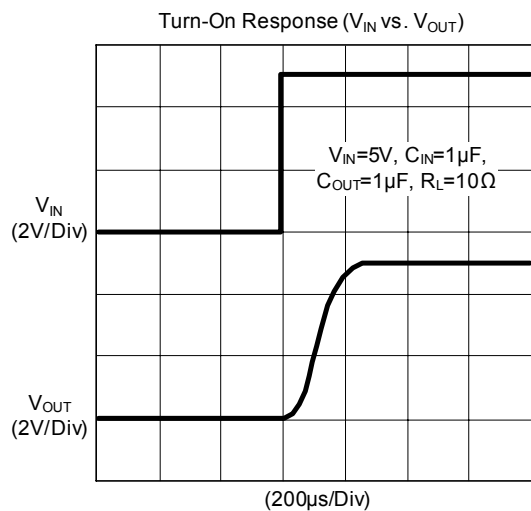




■ **TYPICAL CHARACTERISTICS** ( $T_J = 25^\circ\text{C}$ ,  $V_{IN} = 5.0\text{V}$ , unless otherwise specified)



# ■ TYPICAL CHARACTERISTICS(Cont.)



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