



## US2075C

Preliminary

CMOS IC

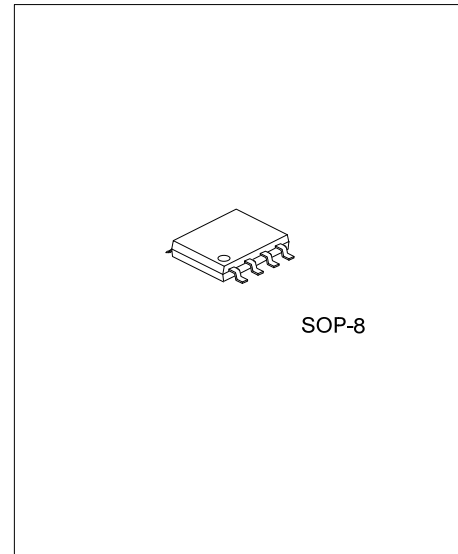
### DUAL-CHANNEL POWER DISTRIBUTION CONTROL SWITCH FOR USB

#### DESCRIPTION

The UTC **US2075C** is a dual channel power switch with independent enable and flag functions, optimized for bus-powered Universal Serial Bus (USB) and self-powered applications.

This product satisfies USB voltage drop requirement with soft start, which eliminates the momentary voltage drop on the upstream port that may occur.

In addition, the UTC **US2075C** is equipped with over-temperature and over-current detectors, each flag output is available to indicate fault conditions independently to the USB controller. The UTC **US2075C** is available in active-high versions.



SOP-8

Lead-free: US2075CL  
Halogen-free: US2075CG

#### FEATURES

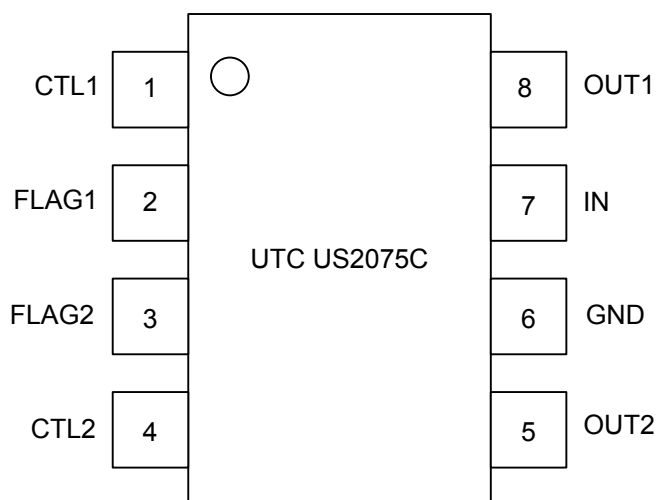
- \* 100  $\mu$ A MAX operating current
- \* 5 $\mu$ A MAX standby current
- \* 3.5V ~ 5.5V operating range
- \* Two P-channel power MOSFET control switch
- \* Over-current protection
- \* Under-voltage lockout circuit
- \* Thermal shutdown circuit
- \* Soft-start circuit
- \* Flag indicates fault conditions

#### ORDERING INFORMATION

| Ordering Number |                   |                | Package | Packing   |
|-----------------|-------------------|----------------|---------|-----------|
| Normal          | Lead Free Plating | Halogen Free   |         |           |
| US2075C-S08-R   | US2075CL-S08-R    | US2075CG-S08-R | SOP-8   | Tape Reel |

|  |  |
|--|--|
| <p>US2075CL-S08-R</p> <p>(1)Packing Type</p> <p>(2)Package Type</p> <p>(3)Lead Plating</p> | <p>(1) R: Tape Reel</p> <p>(2) S08: SOP-8</p> <p>(3) G: Halogen Free, L: Lead Free, Blank: Pb/Sn</p> |
|--|--|

■ PIN CONFIGURATION



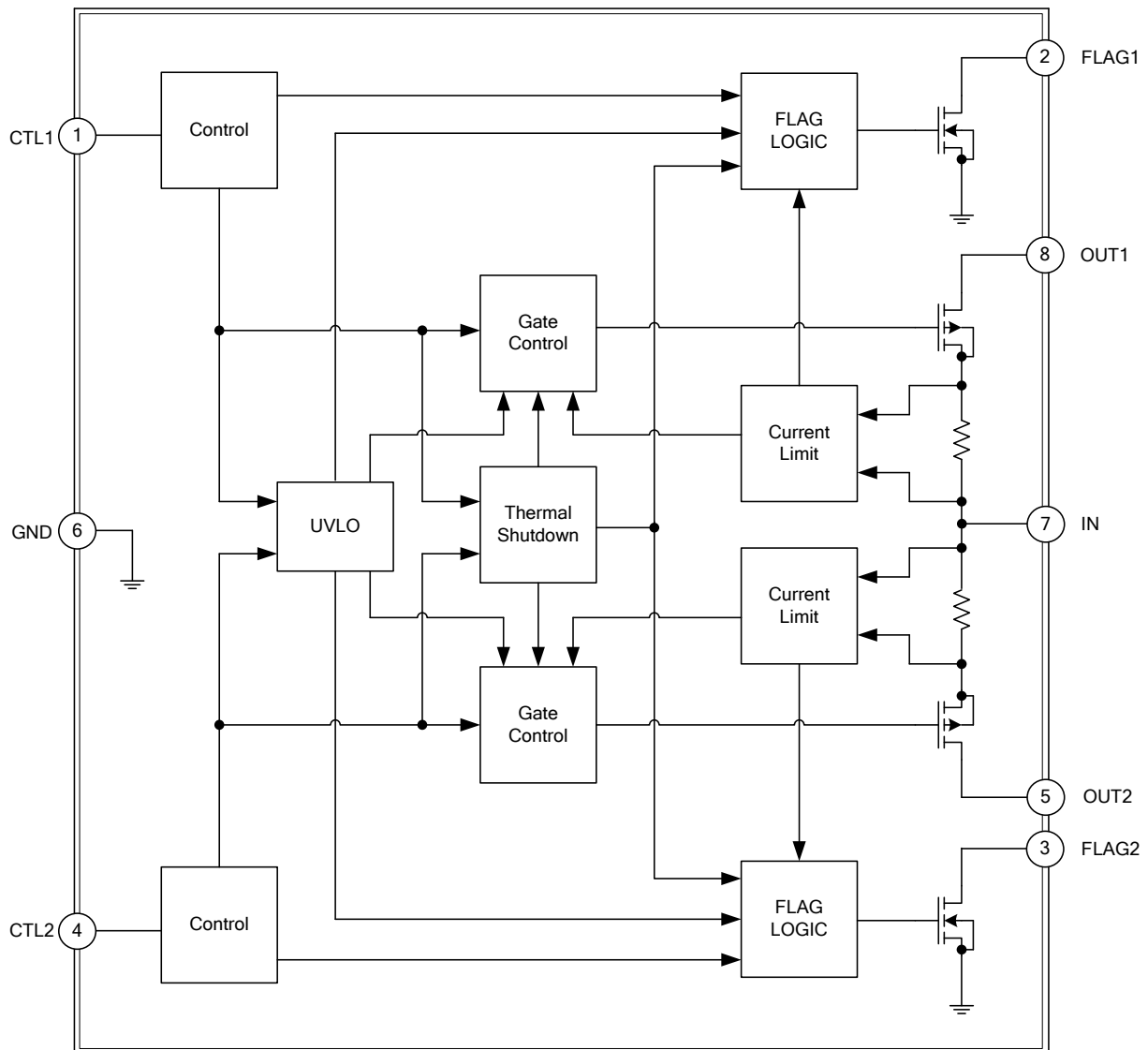
■ PIN DESCRIPTION

| PIN NO | PIN NAME | DESCRIPTION  |
|--------|----------|--|
| 1      | CTL1     | Switch1Control Input: Logic-compatible, active-high. TTL input   |
| 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      | CTL2     | Switch2 Control Input: Logic-compatible, active-high. TTL input  |
| 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 circuit   |
| 8      | OUT1     | Switch1 Output: Drain of MOSFET for output. Usually, connected to Load   |

■ TRUTH TABLE (H: High, L: Low, ON: Turn on, OFF: Turn off, X: H or L)

| CTL1 (IN) | FLAG1 (OUT) | OUT1 (OUT) | CTL2 (IN) | FLAG2 (OUT) | OUT2 (OUT) | Operation Mode                          |
|-----------|-------------|------------|-----------|-------------|------------|---|
| H         | H           | ON         | H         | H           | ON         | Normal Operation                        |
| H         | H           | ON         | L         | H           | OFF        | Only OUT1 is ON.                        |
| L         | H           | OFF        | H         | H           | ON         | Only OUT2 is ON.                        |
| L         | H           | OFF        | L         | H           | OFF        | Standby Mode                            |
| H         | L           | ON         | H         | H           | ON         | Over current Detection Only for OUT1    |
| H         | H           | ON         | H         | L           | ON         | Over current Detection Only for OUT2    |
| X         | L           | OFF        | X         | L           | OFF        | Thermal Shutdown Circuit Operation      |
| X         | L           | OFF        | X         | L           | OFF        | Under voltage Lockout Circuit Operation |

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS ( $T_a=25^\circ\text{C}$ )

| PARAMETER               | SYMBOL     | RATINGS      | UNIT             |
|-------------------------|------------|--------------|------------------|
| Input Voltage           | $V_{IN}$   | -0.3 ~ +6    | V                |
| Flag Voltage            | $V_{FLAG}$ | -0.3 ~ +6    | V                |
| Flag Current            | $I_{FLAG}$ | 50           | mA               |
| Output Voltage          | $V_{OUT}$  | $V_{IN}+0.3$ | V                |
| Output Current          | $I_{OUT}$  | -0.1 ~ +0.5  | A                |
| Control Input           | $V_{CTL}$  | -0.3 ~ +6    | V                |
| Total Power Dissipation | $P_D$      | 300          | mW               |
| Junction Temperature    | $T_J$      | +150         | $^\circ\text{C}$ |
| Operating Temperature   | $T_{OPR}$  | 0 ~ +85      | $^\circ\text{C}$ |
| Storage Temperature     | $T_{STG}$  | -55 ~ +150   | $^\circ\text{C}$ |

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.

■ RECOMMENDED OPERATING RANGE

| PARAMETER                   | SYMBOL     | TEST CONDITIONS        | MIN | TYP | MAX | UNIT             |
|-----------------------------|------------|------------------------|-----|-----|-----|------------------|
| Thermal Shutdown Protection | $T_{SHDN}$ | Temperature Rising     |     | 150 |     | $^\circ\text{C}$ |
|                             |            | Temperature Hysteresis |     | 5   | 10  | $^\circ\text{C}$ |

■ DC ELECTRICAL CHARACTERISTICS ( $V_{IN}=+5\text{V}$ ,  $T_{OPR}=+25^\circ\text{C}$ , Unless otherwise specified)

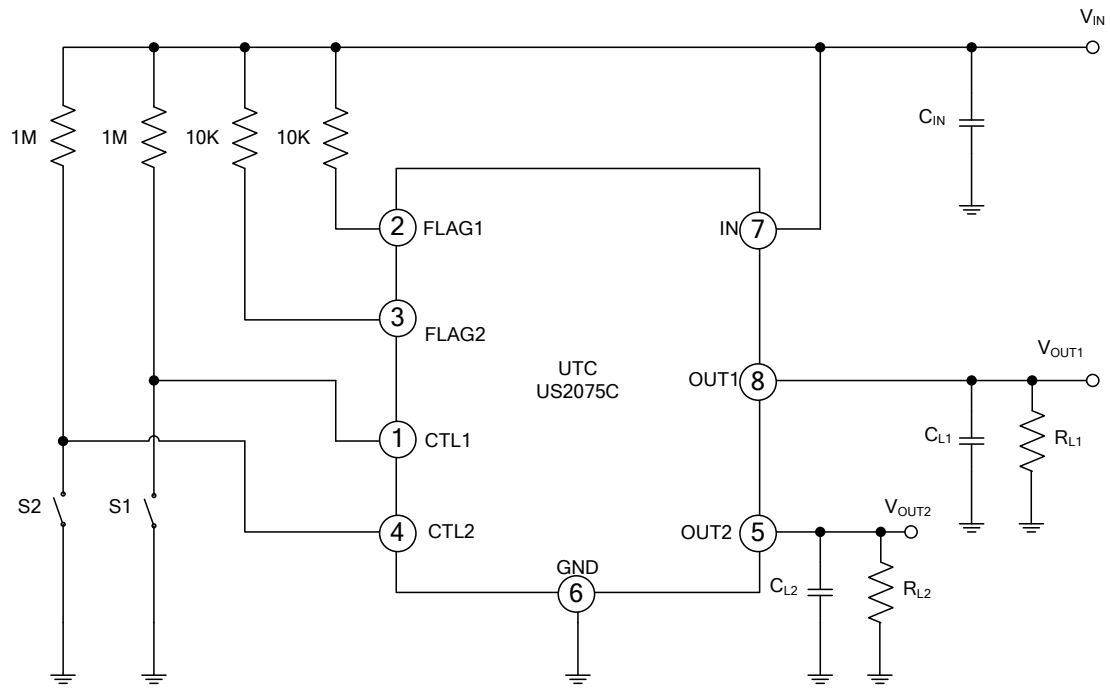
| PARAMETER                   | SYMBOL        | TEST CONDITIONS   | MIN  | TYP | MAX  | UNIT          |
|-----------------------------|---------------|---|------|-----|------|---------------|
| Input Voltage               | $V_{IN}$      |   | 3.5  | 5   | 5.5  | V             |
| CTL Voltage, Low            | $V_{IL}$      | CTL Pin (Note)  |      |     | 1.0  | V             |
| CTL Voltage, High           | $V_{IH}$      | CTL Pin (Note)  | 2.0  |     |      | V             |
| Under-Voltage Lockout       | $V_{UVLO}$    | $V_{IN}$ =Increasing  | 2.2  | 2.5 | 2.8  | V             |
|                             |               | $V_{IN}$ =Decreasing  | 2.0  | 2.3 | 2.6  | V             |
|                             |               | Hysteresis Voltage  | 0.05 |     | 0.25 | V             |
| Supply Current              | $I_{SW\_ON}$  | $V_{CTL} = V_{IN}$ ,<br>$V_{OUT1}=V_{OUT2}=\text{Open}$     |      |     | 100  | $\mu\text{A}$ |
|                             | $I_{SW\_OFF}$ | $V_{CTL} = \text{GND}$ ,<br>$V_{OUT1}=V_{OUT2}=\text{Open}$ |      | 1   | 5    | $\mu\text{A}$ |
| Output Leakage Current      | $I_{O(LEAK)}$ | $V_{CTL} = \text{GND}$                                      |      |     | 10   | $\mu\text{A}$ |
| Flag Leakage Current        | $I_{F(LEAK)}$ | $V_{FLAG}=5\text{V}$  |      | 0.1 | 1    | $\mu\text{A}$ |
| Current Limit               | $I_{LIMIT}$   | $T_a=0\sim 80^\circ\text{C}$                                | 0.6  | 0.9 | 1.25 | A             |
| Flag Output Resistance      | $R_{OUT}$     | $I_L=10\text{mA}$   |      | 10  | 20   | $\Omega$      |
| Output MOSFET on-Resistance | $R_{ON}$      | $I_{OUT}=500\text{mA}$                                      |      | 105 | 145  | m $\Omega$    |

Note: ON is  $CTL > 2.0\text{V}$  and OFF is  $CTL < 1.0\text{V}$ .

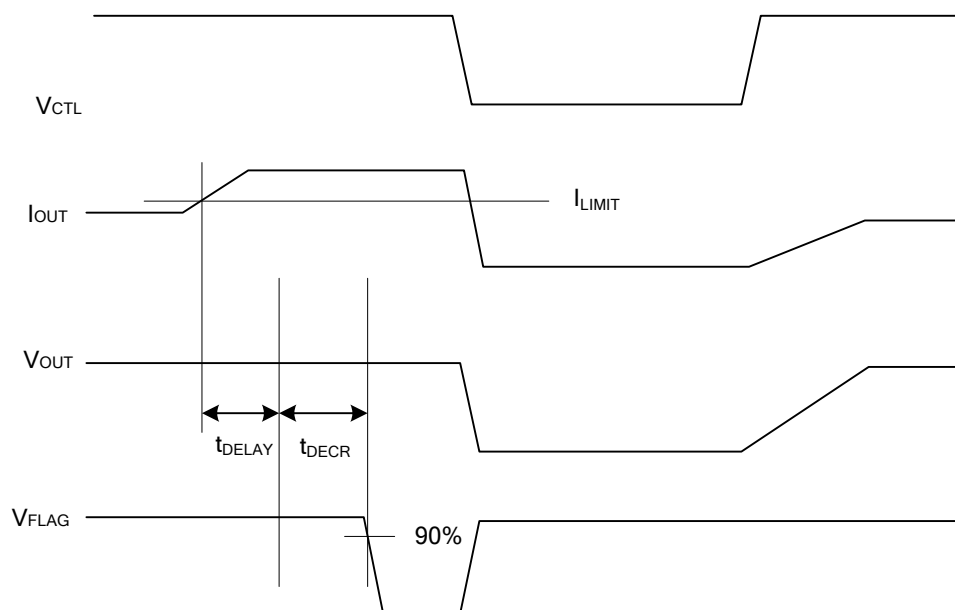
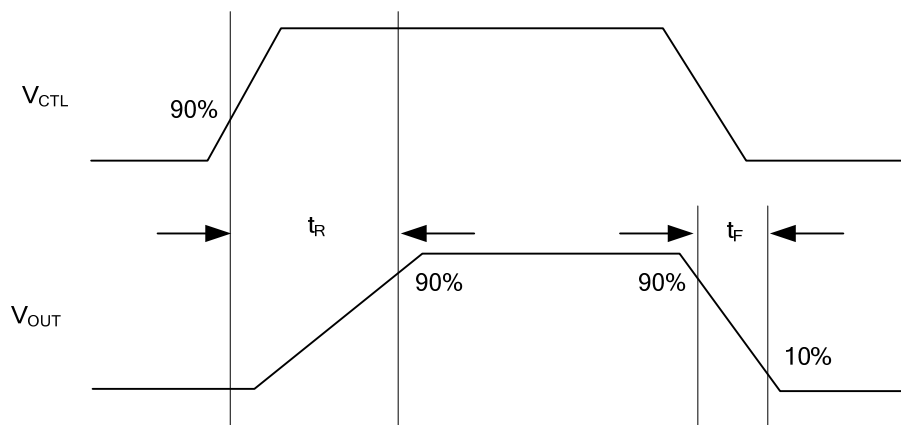
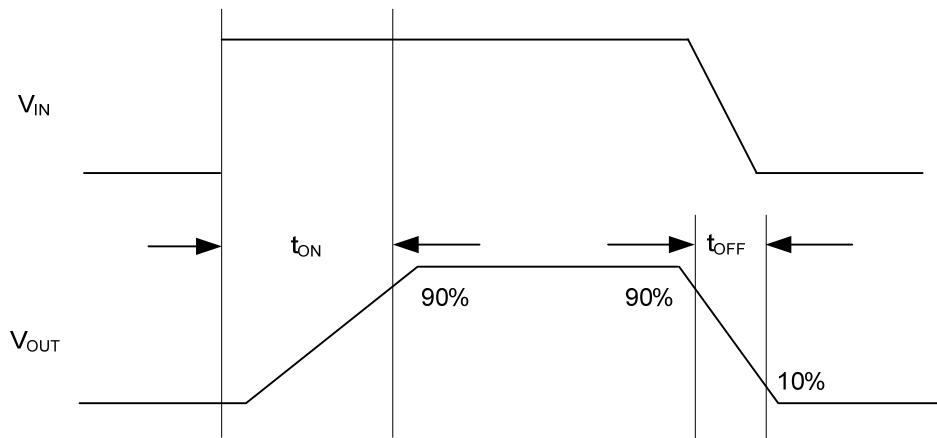
■ AC ELECTRICAL CHARACTERISTICS

| PARAMETER                               | SYMBOL      | TEST CONDITIONS             | MIN | TYP | MAX | UNIT          |
|---|-------------|-----------------------------|-----|-----|-----|---------------|
| Output Turn-on Rise Time                | $t_R$       | $R_L=10\Omega$ , Per Output | 2.5 | 5   | 8   | ms            |
| Output Turn-off Fall Time               | $t_F$       | $R_L=10\Omega$ , Per Output |     |     | 10  | $\mu\text{s}$ |
| Over-Current Detection Delay Time       | $t_{DELAY}$ |                             |     | 20  |     | $\mu\text{s}$ |
| Over-Current Detection Output Rise Time | $t_{DECR}$  | $R_L=10\Omega$ , Per Output | 2.5 | 5   | 8   | ms            |

■ TEST CIRCUIT



■ TIMING DIAGRAM



## ■ FUNCTIONAL DESCRIPTION

The UTC **US2075C** is dual P-Channel switch 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 **US2075C** 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 **US2075C** is internally protected against excessive power dissipation by thermal shutdown protection circuit. If device junction temperature rise above approximately 150°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 145°C. When the thermal shutdown circuit is activated, the output pins are in the OFF status. However, the UTC **US2075C** enters the standby status when CTL 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.

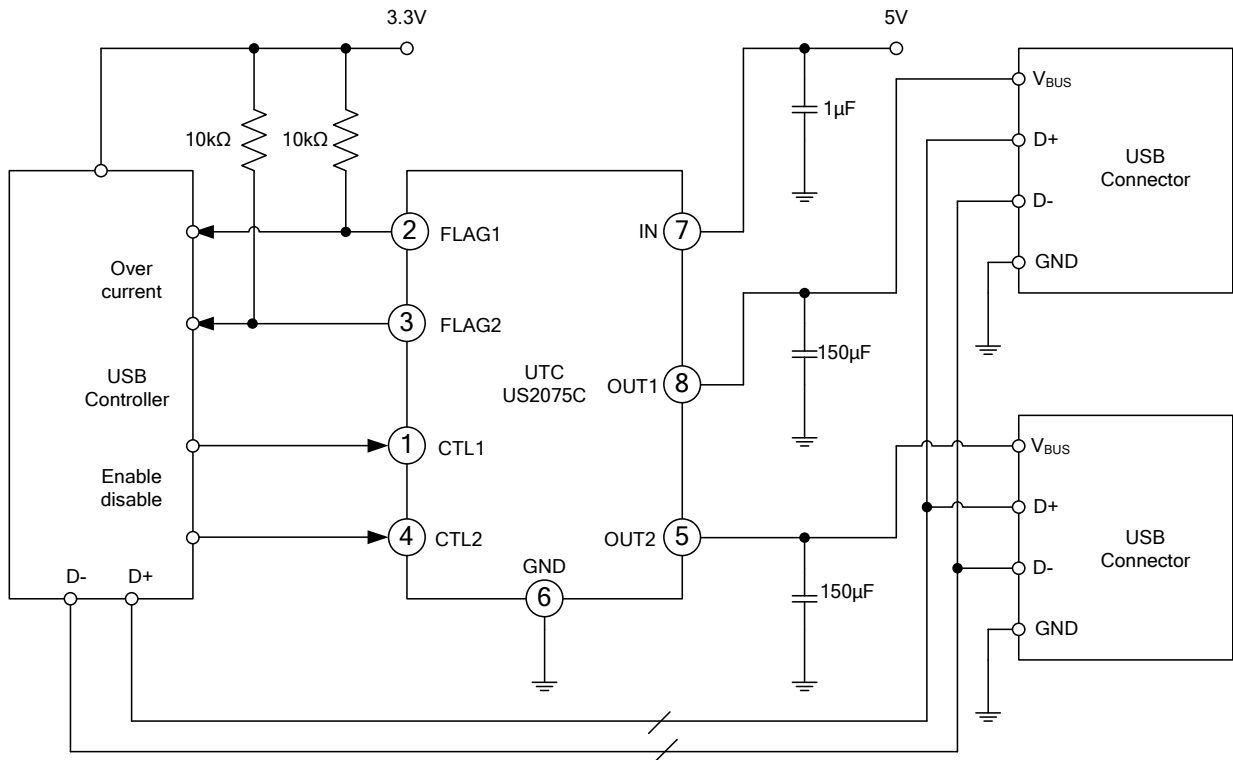
### UNDER-VOLTAGE LOCKOUT

UVLO prevents the output MOSFET switch from turning on until input voltage exceeds 2.5V (typical). If input voltage drops below 2.3V (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 FALG pin has a pull-up resistor of 10kΩ to input voltage.

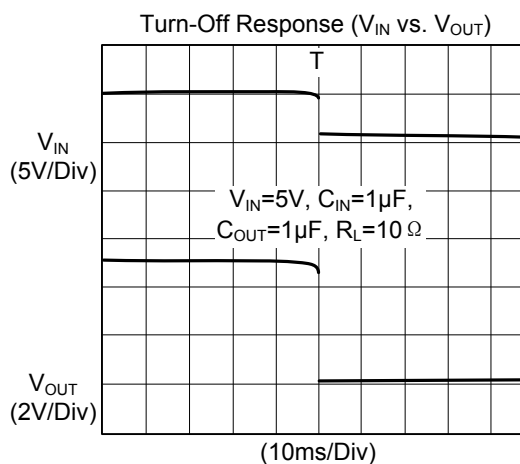
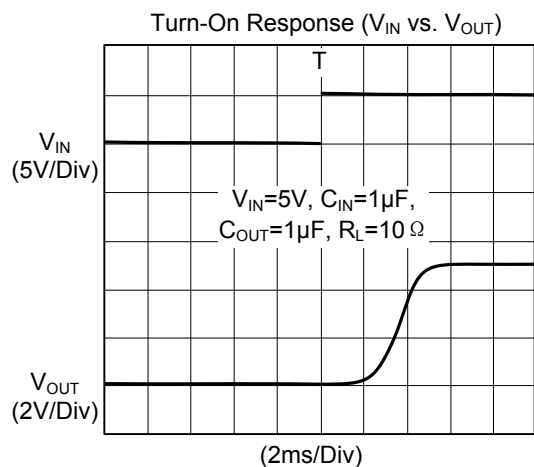
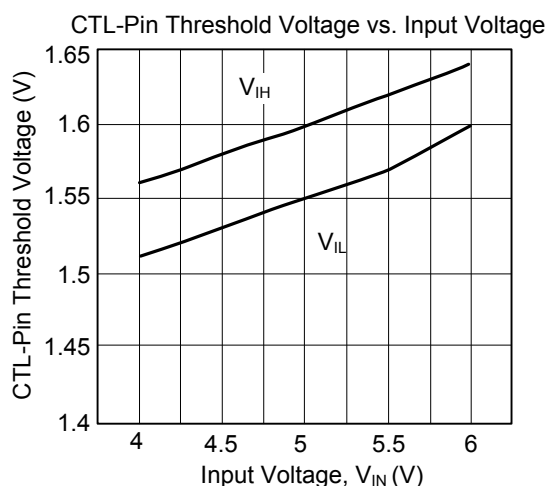
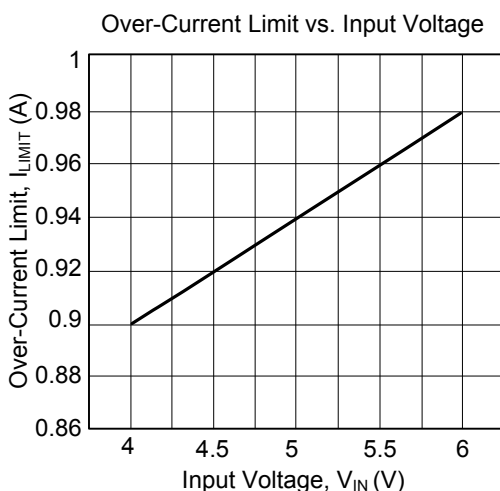
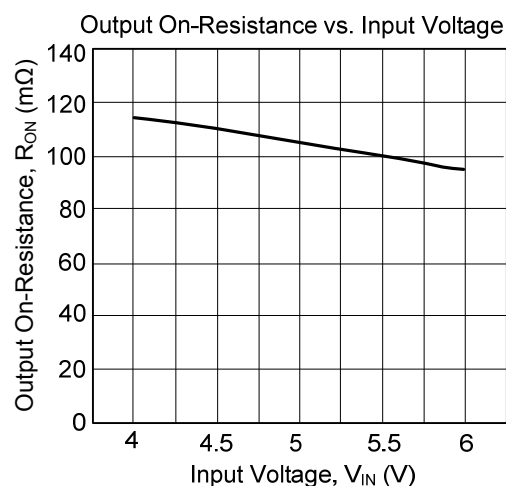
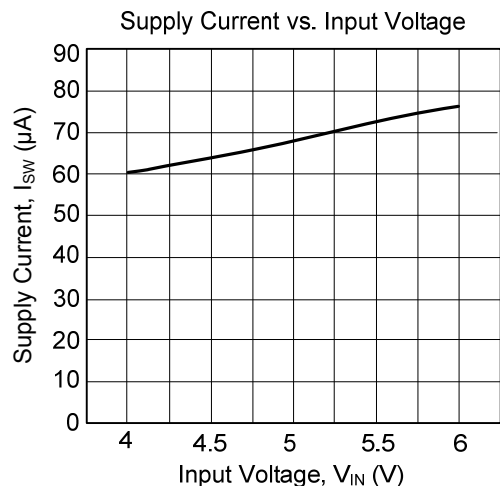
■ TYPICAL APPLICATION CIRCUIT



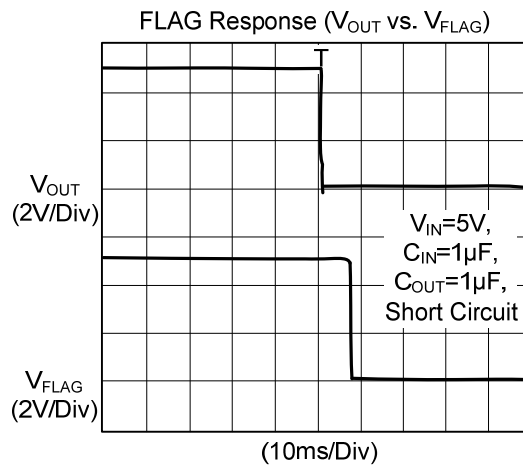
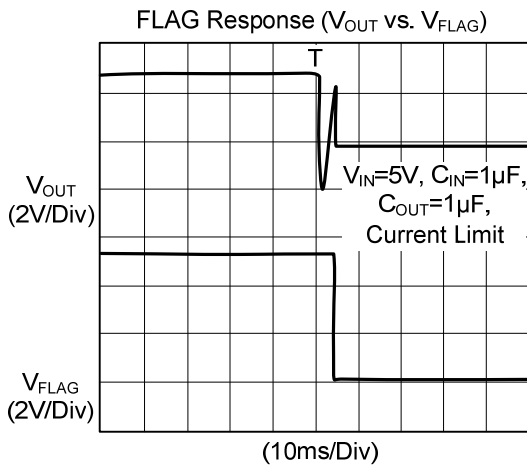
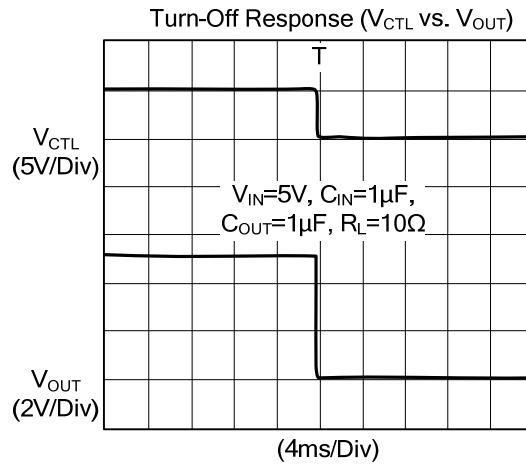
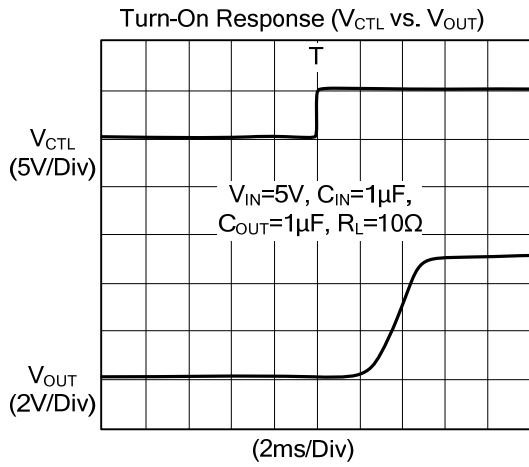
TWO USB output ports controllable by USB controller



■ TYPICAL CHARACTERISTICS



■ TYPICAL CHARACTERISTICS(Cont.)



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