**US3026A CMOS IC** 

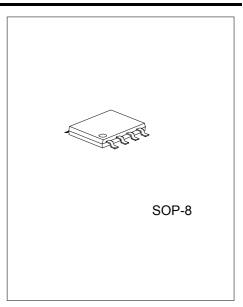
# **DUAL-CHANNEL USB POWER** SWITCH AND OVER-CURRENT **PROTECTION**

#### 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.



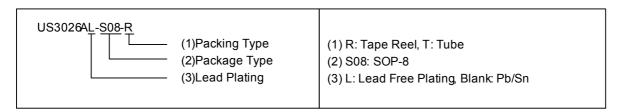
\*Pb-free plating product number: US3026AL

#### **FEATURES**

- \* Two P-channel power MOSFET control switch
- \* 110µA Max operating current
- \* 5µA Max standby current
- \* 145 mΩ 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

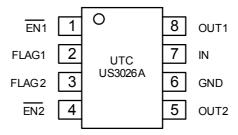
### ORDERING INFORMATION

Order N	Dackago	Dacking	
Normal	Lead Free Plating	Package	Packing
US3026A-S08-R	US3026AL-S08-R	SOP-8	Tape Reel
US3026A-S08-T	US3026AL-S08-T	SOP-8	Tube



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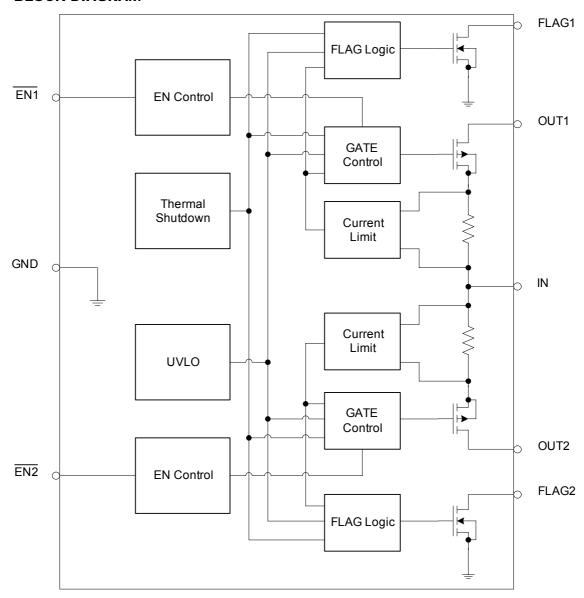
# ■ PIN CONFIGURATIONS



# **■ PIN DESCRIPTION**

PIN NO	PIN NAME	DESCRIPTION			
1	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	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 <sub>OUT</sub>	-0.3 ~ +6	V
Voltage at All Other Pins	V <sub>OTHER</sub>	-0.3 ~ +6	V
Total Power Dissipation	$P_{D}$	300	mW
T <sub>JMAX</sub>	$T_{JMAX}$	160	
Junction Temperature	$T_J$	+155	
Operating Temperature	T <sub>OPR</sub>	-40 ~ +85	
Storage Temperature	T <sub>STG</sub>	-55 ~ <b>+</b> 155	

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 <sub>OPR</sub>	0 ~ +70	

Note: The human body model is a 100pF capacitor discharged through a  $1.5k\Omega$  resistor into each pin.

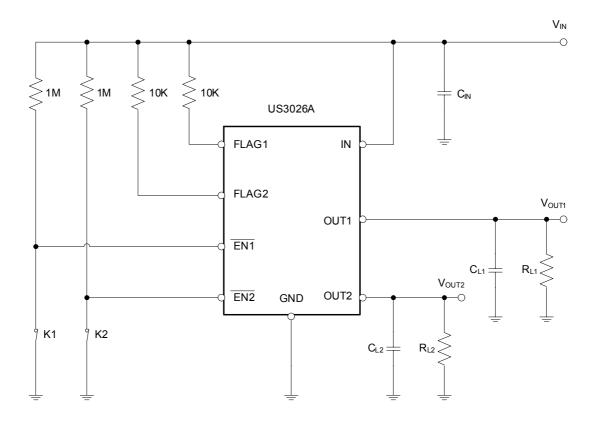
## ■ ELECTRICAL CHARACTERISTICS(T<sub>J</sub> = 25°C, V<sub>IN</sub> = 5.0V, V<sub>EN</sub> = 0V, unless otherwise specified.)

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

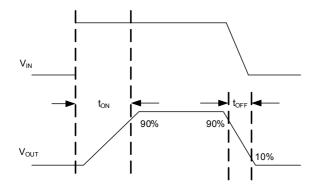
Note: 1. OFF is  $\overline{EN} \ge 2.4V$  and ON is  $\overline{EN} \le 0.8V$ .

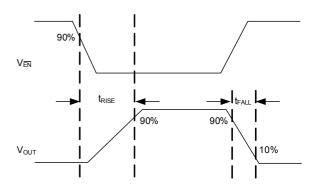
<sup>2.</sup> Thermal Shutdown will protect the device from permanent damage.

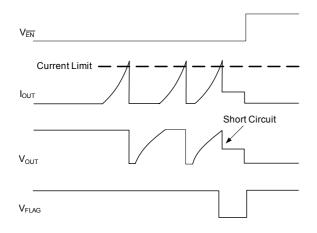
# **■ TEST CIRCUIT**

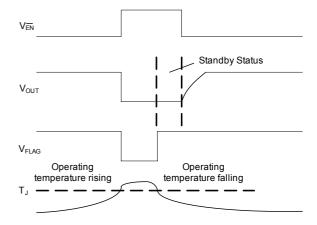


## **■ TIMING DIAGRAM**









#### ■ 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 , 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 . When the thermal shutdown circuit is activated, the output pins are in the OFF status. However, the UTC **US3026A** enters the standby status when  $\overline{\text{EN}}$  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.

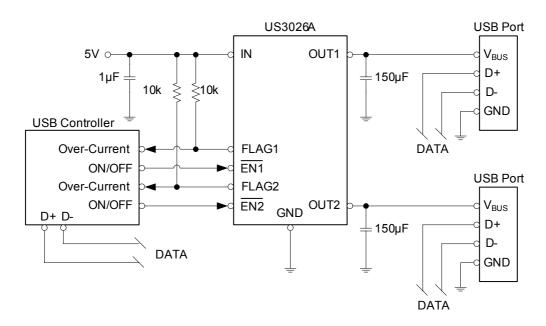
#### **Under-Voltage Lockout**

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.

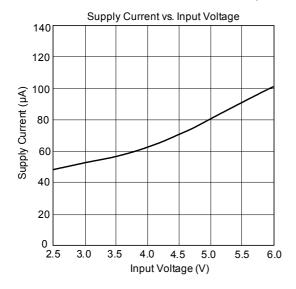
#### Fault FLAG

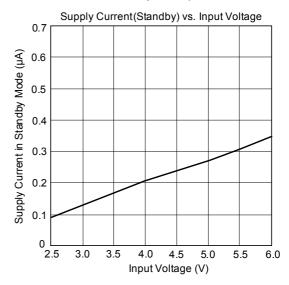
The fault FLAG is an output with open-drain of N-channel. The fault FLAG is pulled down when any of the conditions such as under-voltage, current limit and thermal shutdown. In a typical application circuit, the FALG pin has a pull-up resistor of  $10k\Omega$  to input voltage.

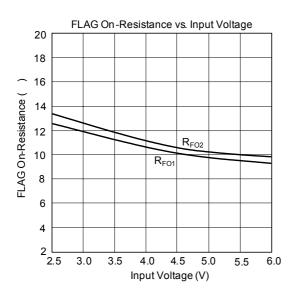
## ■ TYPICAL APPLICATION CIRCUIT

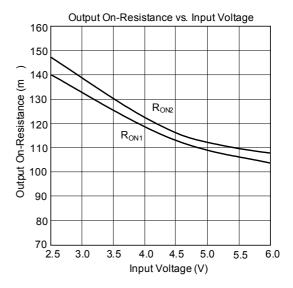


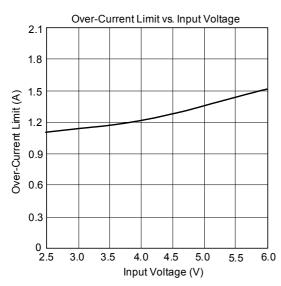
## ■ TYPICAL CHARACTERISTICS (T<sub>J</sub> = 25 , V<sub>IN</sub> = 5.0V, unless otherwise specified)

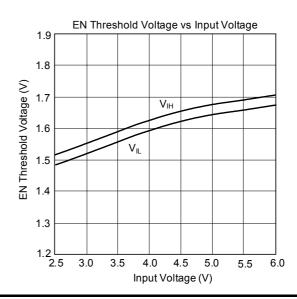




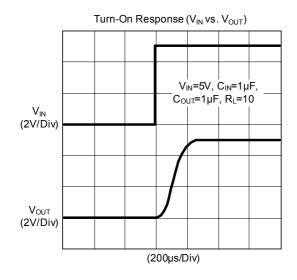


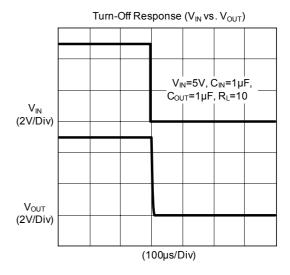


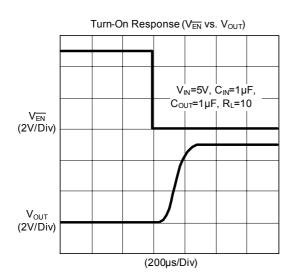


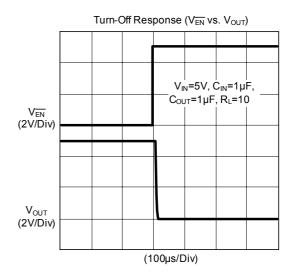


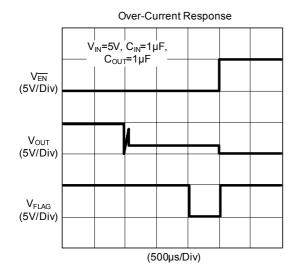
# **■ TYPICAL CHARACTERISTICS(Cont.)**

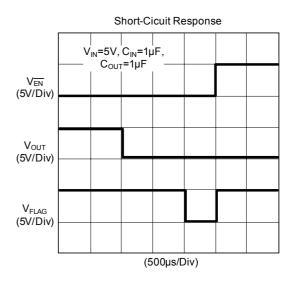












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