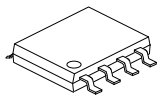
US2175 **CMOS IC**

DUAL USB HIGH-SIDE POWER SWITCH



SOP-8

■ DESCRIPTION

The **US2175** is a high-side power switch with two channels. It particularly designed for the Universal Serial Bus (USB) including self-powered and bus-powered types. The $R_{DS(ON)}$ of the MOSFET switch is as low as 110mΩ.

The **US2175** incorporates protective functions, such as overcurrent protection, thermal shutdown and UVLO (UnderVoltage Lockout) protection circuits. The thermal shutdown function provides individual control for each switch. An open-drain fault flag playing a role as the output of an N-channel is also included. Once any error occurs the fault flag will be in active.

The **US2175** can be applied in hot plug in power supplies and battery charger circuits as well.

■ FEATURES

* Open-Drain Fault Flag.
* High-Side MOSFET Switch with 5V Input Voltage
* 110mΩ $R_{DS(ON)}$ Meets USB Voltage Drop Requirements for Maximum Transmission Wire Length
* Load Current: 500mA
* Output Can be Forced Higher Than Input (Off-State)
* On-State Supply Current: 65μA (TYP.)
* Off-State Supply Current:.1μA (TYP.)
* Current-Limit / Short Circuit Protection and Thermal Shutdown Protection Under Overcurrent Condition
* UVLO Makes the Switch OFF at Start UP
* With Slow Turn ON and Fast Turn OFF
* Enable Active-Low or Active-High
* Halogen Free

■ ORDERING INFORMATION

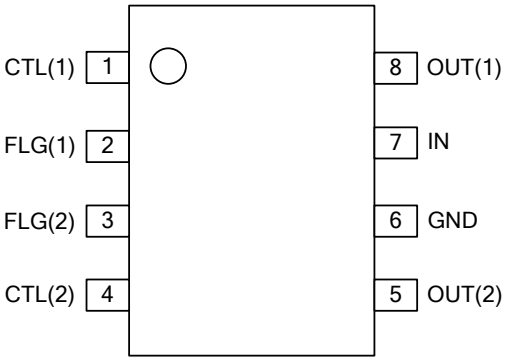
Ordering Number	Package	Packing
US2175XG-S08-R	SOP-8	Tape Reel

US2175XG-S08-R

(1)Packing Type
(2)Package Type
(3)Halogen Free
(4)Logic Level Enable Pin

(1) R: Tape Reel
(2) S08: SOP-8
(3) G:Halogen Free
(4) H: Active High
L: Active Low

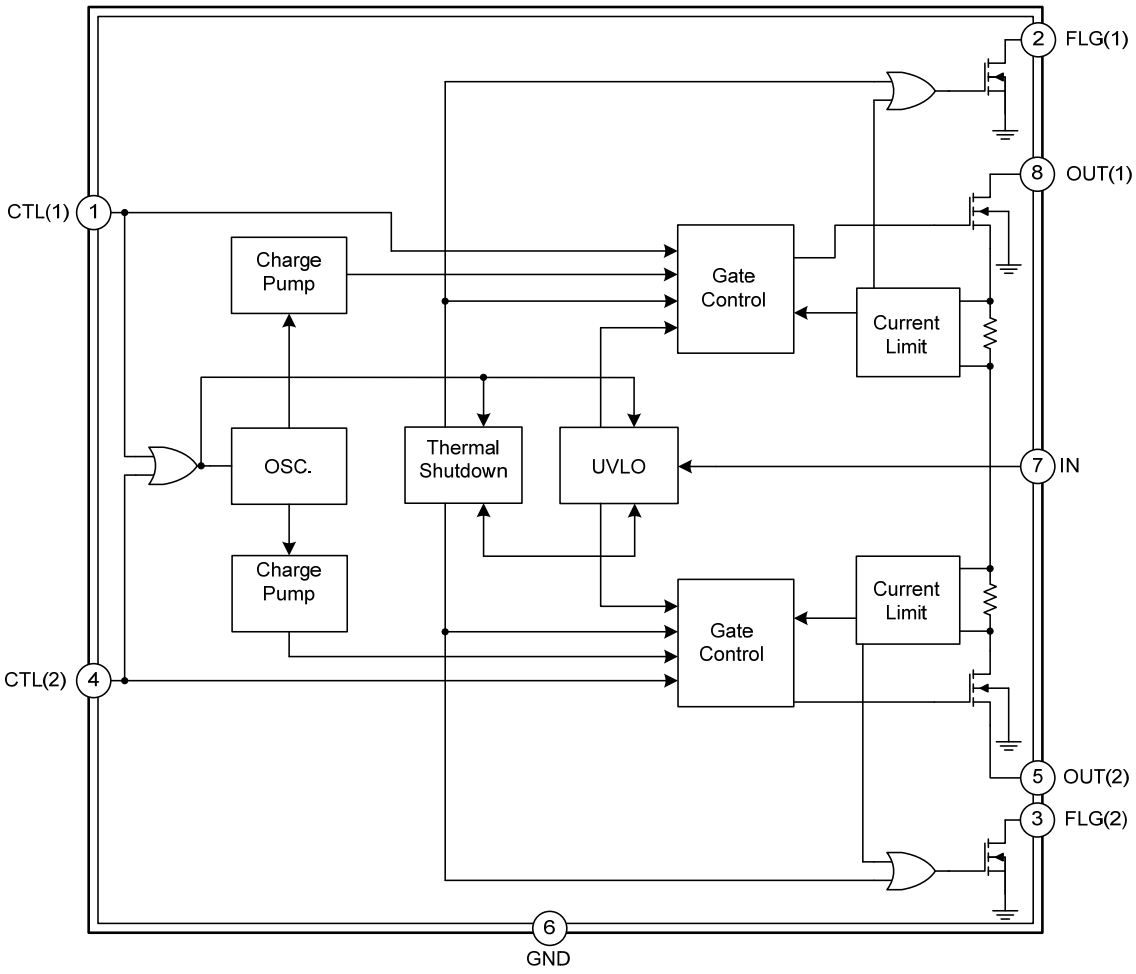
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO.	PIN NAME	DESCRIPTION
1	CTL(1)	Switch A Control Input: Logic-Compatible, Active-Low or Active-High. TTL input
2	FLG(1)	Fault Detection Flag (1) (OUTPUT): Active-Low. N-ch Open-Drain. Indicates Over-Current, Thermal Shutdown.
3	FLG(2)	Fault Detection Flag (2) (OUTPUT): Active-Low. N-ch Open-Drain. Indicates Over-Current, Thermal Shutdown.
4	CTL(2)	Switch B Control Input: Logic-Compatible, Active-Low or Active-High. TTL Input
5	OUT(2)	Switch B Output: Drain of MOSFET for Output. Usually, Connected to Load
6	GND	Power Ground.
7	IN	Power Supply Input.
8	OUT(1)	Switch A Output: Drain of MOSFET for Output. Usually, Connected to Load

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATING

PARAMETER	SYMBOL	RATINGS	UNIT
Supply Voltage	V_{CC}	7	V
Control Input Voltage	V_{CTL}	-0.3~ +6.5	V
Fault Flag Voltage	V_{FLG}	7	V
Power Dissipation (Ta = 25°C)	P_D	625	mW
Junction Temperature	T_J	+125	°C
Ambient Operating Temperature	T_{OPR}	-40 ~ +85	°C
Storage Temperature	T_{STG}	-65~ +150	°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.

■ THERMAL DATA

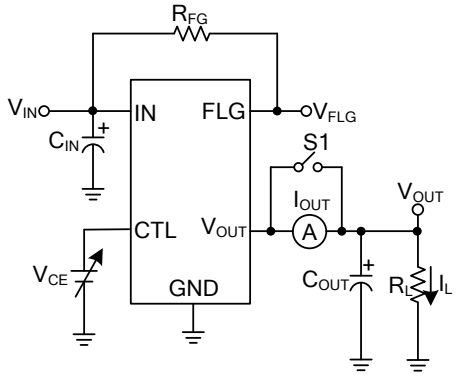
PARAMETER	SYMBOL	RATINGS	UNIT
Junction to Ambient (no Heatsink)	θ_{JA}	160	°C/W

■ ELECTRICAL CHARACTERISTICS (V_{IN} = 5V, Ta = 25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Supply Current	I_{OFF}	OUT=Open		1	5	μA
	I_{ON}	OUT=Open		65	100	μA
Control Input Voltage	V_{IL}	V_{CTL}=Logic “0”			0.8	V
	V_{IH}	V_{CTL}=Logic “1”	2.4			V
Control Input Current	I_{IL}	V_{CTL} =Logic “0”		0.01	1	μA
	I_{IH}	V_{CTL} =Logic “1”		0.01	1	μA
Control Input Capacitance	C_I			1		pF
Output MOSFET Resistance	R_{ON}	I_{OUT}= 500mA		110	150	mΩ
Output Turn-On Rise Delay	$T_{D\ ON}$	R_L=10Ω each Output		40		μS
Output Turn-On Rise Time	T_{ON}	R_L=10Ω each Output		500		μS
Output Turn-Off Delay	$T_{D\ OFF}$	R_L=10Ω each Output		1	20	μS
Output Turn-Off Fall Time	T_{OFF}	R_L=10Ω each Output		1	20	μS
Output Leakage Current	$I_{I(LEAK)}$			0.5	10	μA
Current Limit Threshold	I_{LIMIT}	V_{OUT}=4V		1.3	2	A
Short Current	I_{SC}	V_{OUT}=0V		1		A
Over Temperature Shutdown Threshold	T_{SD}	T_J Increasing		135		°C
		T_J Decreasing		115		°C
Error Flag Output Resistance	R_{FLG}	V_{IN}=5V, I_L=10mA		15	80	Ω
		V_{IN}=3.3V, I_L=10mA		20	100	Ω
Error Flag Off Current	$I_{FLG\ OFF}$	V_{FLG}=5V		0.01	1	μA
UVLO Threshold	V_{UVLO}	V_{IN} Increasing		2.6		V
		V_{IN} Decreasing		2.4		V

■ TEST CIRCUITS

(1)



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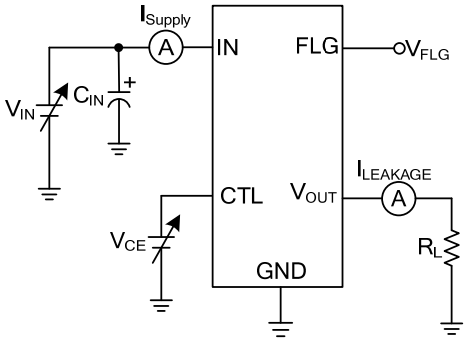

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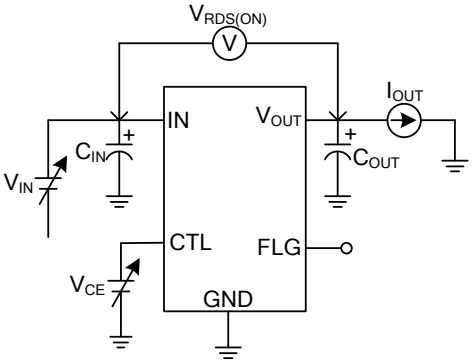

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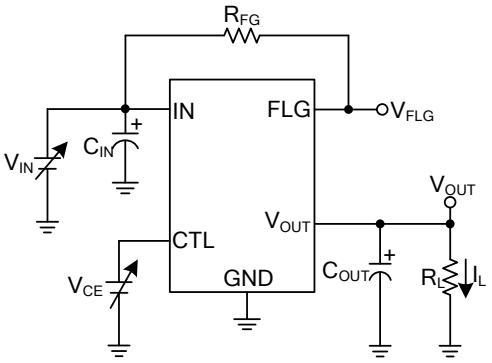

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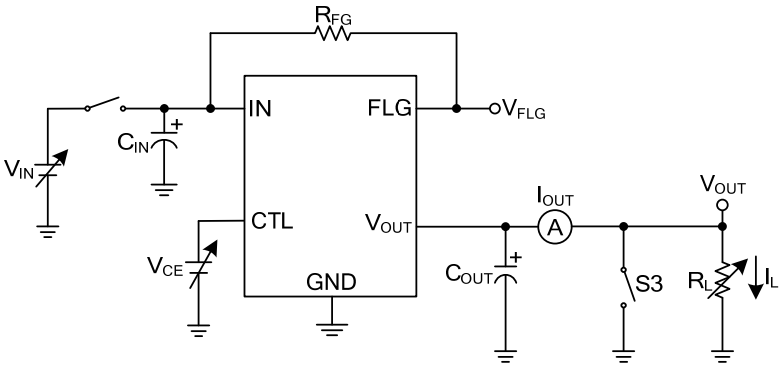
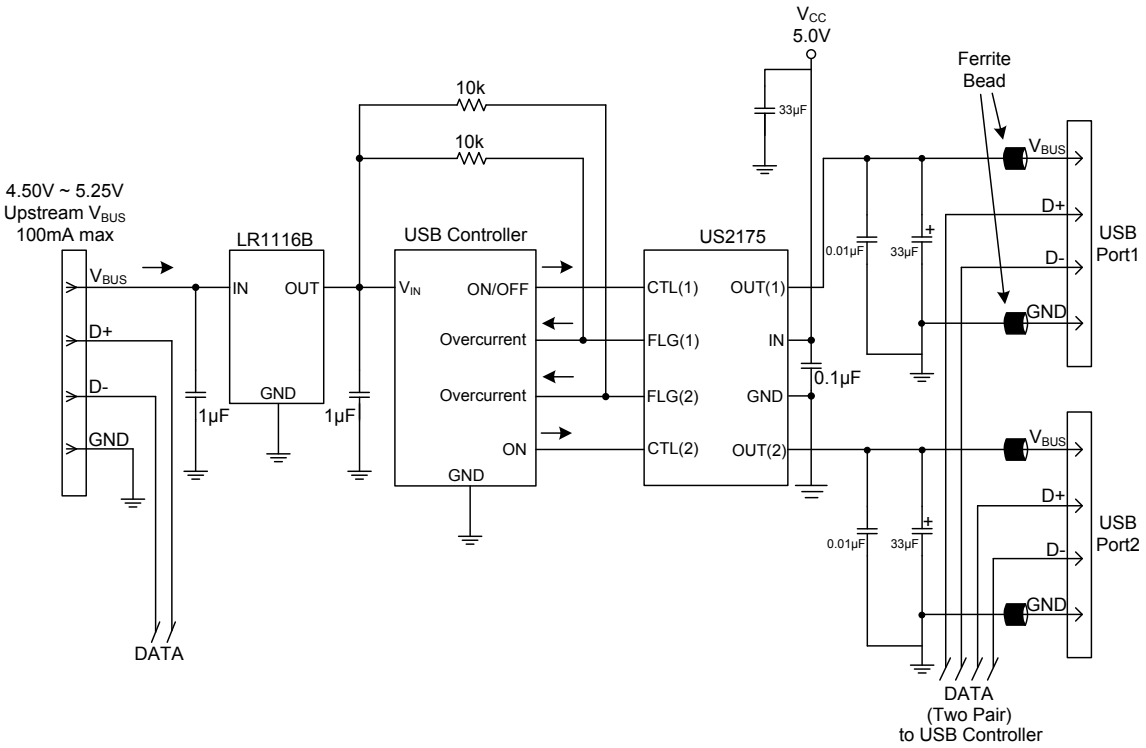


Note: Above test circuits reflected the graphs shown on “Typical Characteristics” are as follows:

(1) On-State Supply Current vs. Input Voltage & Temperature, Off-State Supply Current vs. Input Voltage & Temperature
(2) Flag Trigger & Release Response, Inrush Current at Start-up
(3) Ramped Load Response, Short-Current Response at Start-up
(4) Thermal Shutdown Response, Turn off Response, Turn on Response
(5) Short Circuit Current Response, Ramped Load Response, Thermal Shutdown Response

■ TYPICAL APPLICATION CIRCUIT



■ APPLICATION INFORMATION

Fault Flag

The fault flag mainly protects the system from damage caused by such status as thermal shutdown, overcurrent.

Current Limit

The current limit function prevents both excessive in-rush current caused by the plug-in events and the short-circuit status for MOSFET switches. The current limit threshold is fixed internally, allowing a 1A minimum current to flow through the MOSFET switches.

Thermal Shutdown

Both thermal shutdown circuits turn both MOSFET switches off if the temperature rises approximately 135°C, at the same time FLG pin becomes active. 10°C of hysteresis ensures the MOSFETs will not turn on again until the chip temperature is reduced to 125°C.

Under overcurrent fault conditions, the thermal shutdown will turn off the MOSFET switch which is in this status due to temperature rise, the other keeps its state.

Supply Filtering

In order to control supply transients, a bypass capacitor placed between IN pin and GND pin is suggested. 0.1μF to 1μF is suitable. Without a bypass capacitor, an output short may cause sufficient ringing on the input (from supply lead inductance) to damage internal control circuitry.

Transient Requirements

Ferrite beads are recommended in series with all power and ground connector pins to prevent EMI and excessive in-rush current generated from input capacitance of down stream during a hot plug-in event. The USB devices support dynamic attachment (hot plug-in) of peripherals. .

Short Circuit Transient

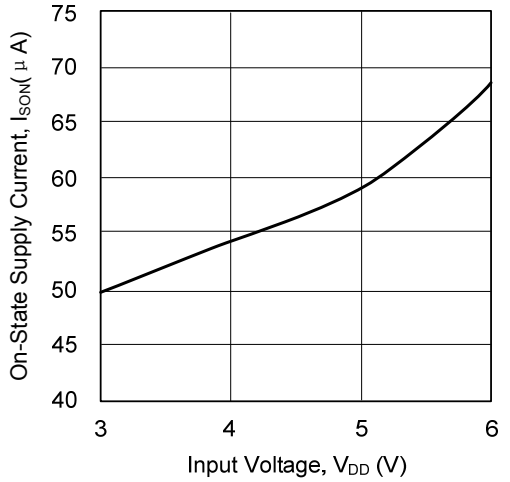
A 33μF/16V tantalum or a 100μF/10V electrolytic capacitor located closely to downstream connector for each port is recommended to provide transient protection and a bulk capacitance provides the short-term transient current needed during a hot-attachment event.

Printed Circuit Layout

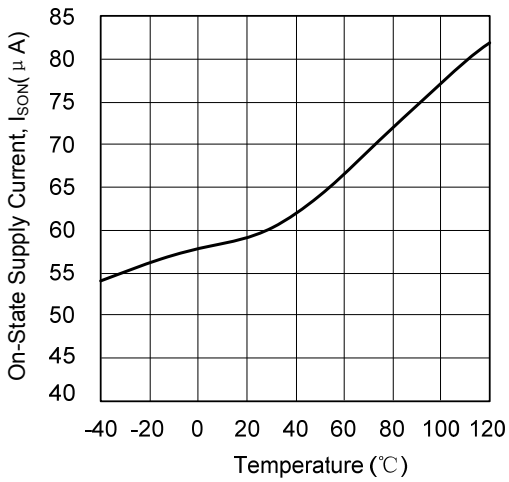
To meet the requirements for power circuitry of USB printed circuit boards, maximum thermal consumption and minimum voltage drop and EMI is required.

■ TYPICAL CHARACTERISTICS

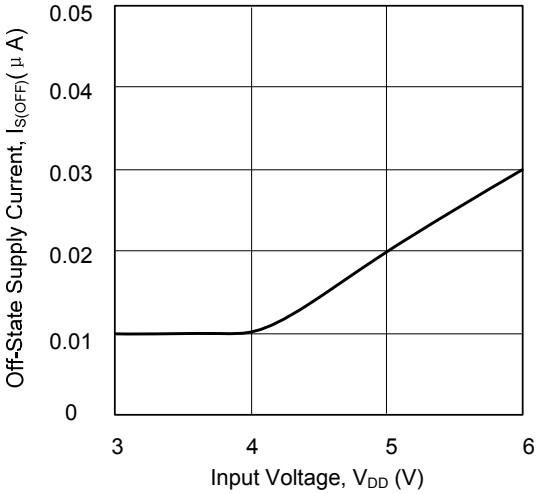
On-State Supply Current vs. Input Voltage



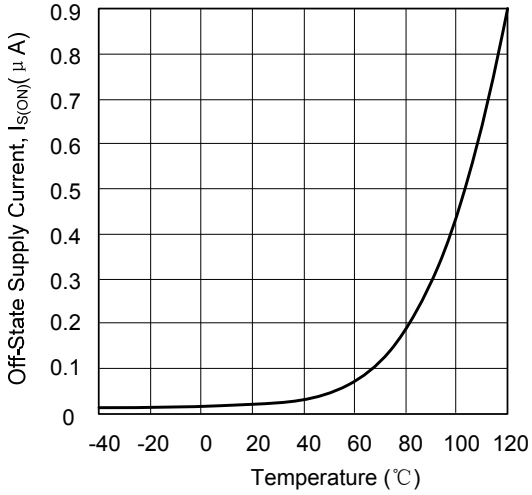
On-State Supply Current vs. Temperature



Off-State Supply Current vs. Input Voltage

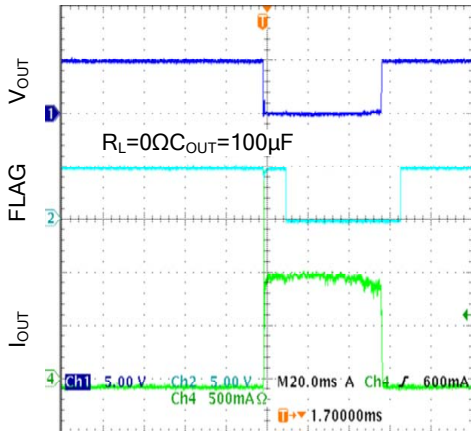


Off-State Supply Current vs. Temperature

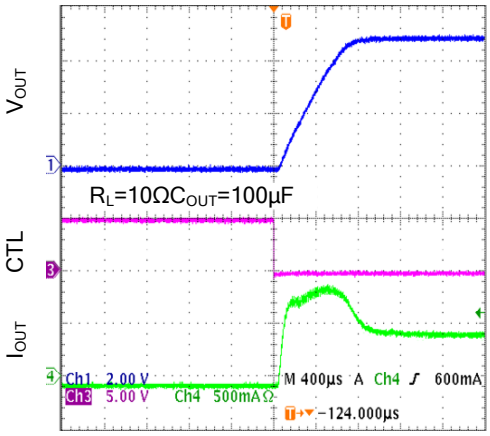


■ TYPICAL CHARACTERISTICS (Cont.)

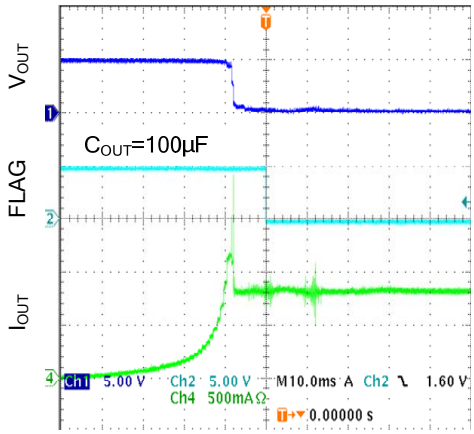
Flag Trigger & Release Response



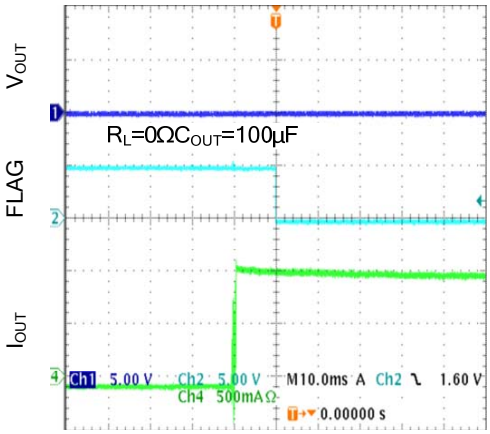
Inrush Current at Start-up



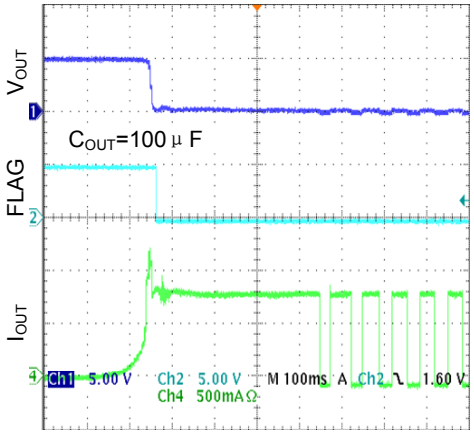
Ramped Load Response



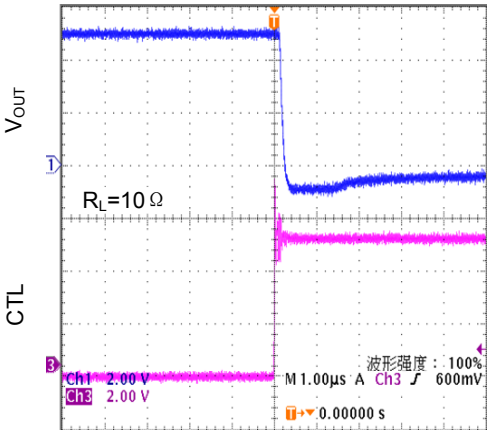
Short-Current Response at Start-up



Thermal Shutdown Response



Turn off Response



■ TYPICAL CHARACTERISTICS (Cont.)

Turn on Response