



USB HIGH-SIDE POWER SWITCH

R5520H SERIESNO. EA-091-0204

DESCRIPTION

The R5520H is CMOS-based high-side MOSFET switch IC for Universal Serial Bus (USB) applications. Low ON Resistance (Typ. 100m Ω) and low supply current (Typ. 20 μ A at active mode) are realized in this IC. An over-current limit circuit, thermal shutdown circuit, and an under voltage lockout circuit are built-in as protection circuits. Further, a delay circuit for flag signal after detecting over-current, is embedded to prevent miss-operation of error flag because of inrush current. The R5520H is ideal for applications of protection for USB power supply.

FEATURES

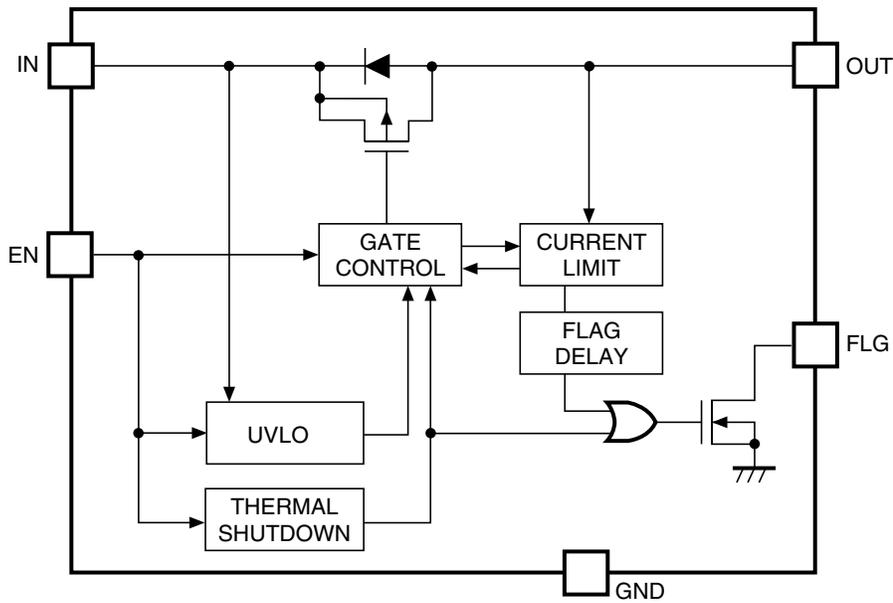
- Built-in 100 m Ω (Typ.) P-channel MOSFET Switch
- Low Supply Current Typ. 20 μ A (at Active Mode)
- Output Current Min. 500mA
- Over- Current Limit / Short Circuit Protection
- Under Voltage Lockout
- Thermal Shutdown Protection
- Soft-start Function
- SOT89-5 pin Package

APPLICATIONS

- USB Peripherals
- Notebook PCs

R5520H

BLOCK DIAGRAM



SELECTION GUIDE

In the R5520H Series, the logic of the enable pin can be designated.

Part Number is designated as follows:

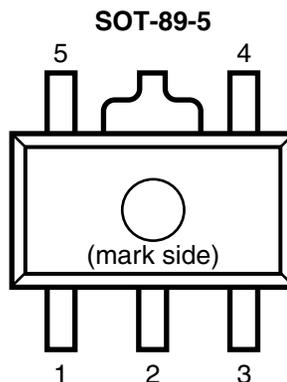
R5520H001x-T1 ← Part Number

↑

a

Code	Description
a	Designation of the logic of the enable pin. A: active with "L" B: active with "H"

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS

$T_{opt}=25^{\circ}\text{C}$

Symbol	Item	Ratings	Unit
V_{IN}	Input Voltage	6	V
V_{EN}	Enable Pin Input Voltage	$-0.3 \sim V_{IN}+0.3$	V
V_{FLG}	Flag Voltage	$-0.3 \sim 6.0$	V
I_{FLG}	Flag Current	14	mA
V_{OUT}	Output Voltage	$-0.3 \sim V_{IN}+0.3$	V
I_{OUT}	Output Current	Internal Limited	
P_d	Power Dissipation	Internal Limited	
T_{opt}	Operating Temperature	$-40 \sim +85$	$^{\circ}\text{C}$
T_{stg}	Storage Temperature	$-55 \sim +125$	$^{\circ}\text{C}$

PIN DESCRIPTION

Pin No.	Symbol	description
1	EN	Enable Pin
2	GND	Ground Pin
3	FLG	FLG pin (Open Drain Output)
4	IN	Power Supply Pin
5	OUT	Output pin

R5520H**ELECTRICAL CHARACTERISTICS**• **R5520H001A/B**T_{opt} = 25°C

Symbol	Item	Conditions	Min.	Typ.	Max.	Unit
V _{IN}	Input Voltage		4.0		5.5	V
I _{DD1}	Supply Current 1	*Note1 OUT = open, (Active)		20	60	μA
I _{DD2}	Supply Current 2	*Note2 OUT = open, (OFF)		0.5	5.0	μA
R _{ON}	Switch On Resistance	V _{IN} = 5V, I _{OUT} = 500mA		100	140	mΩ
		V _{IN} = 4V, I _{OUT} = 500mA		110	150	mΩ
t _{ON}	Output Turn-on Delay	R _L = 10Ω		2	12	ms
t _{OFF}	Output Turn-off Delay	R _L = 10Ω		5	20	μs
V _{UVLO}	UVLO Threshold	V _{IN} = increasing	2.1	2.4	2.7	V
		V _{IN} = decreasing		2.2		V
I _{TH}	Current Limit Threshold	Ramped Load		1.2	2.0	A
I _{LM}	Short Current Limit	V _{OUT} = 0V	0.50	0.75	1.00	A
t _{FD}	Over Current Flag Delay	From Over Current to FLG = "L"	5	10	20	ms
T _{TS}	Thermal Shutdown Temperature Threshold	T _j = increasing		135		°C
		T _j = decreasing		125		
I _{EN}	Enable Pin Input Current			0.01	1.00	μA
V _{EN1}	Enable Pin Input Voltage 1	V _{EN} = increasing		2.1	2.4	V
V _{EN2}	Enable Pin Input Voltage 2	V _{EN} = decreasing	0.8	1.9		V
I _{LO}	Output Leakage Current			1	10	μA
V _{LF}	Flag "L" Output Voltage	I _{SINK} = 1mA			0.4	V
I _{FOF}	Flag Off Current	V _{FLAG} = 5.5V		0.05	2.00	μA

(Note1) EN=L (R5520H001A), EN=H (R5520H001B)

(Note2) EN=H (R5520H001A), EN=L (R5520H001B)

OPERATION

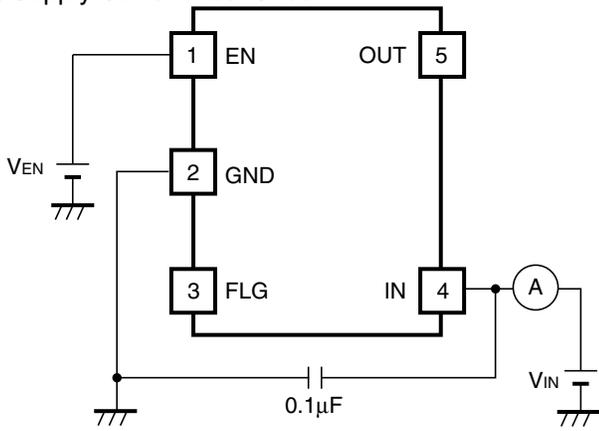
This explanation is based on the typical application.

- (1) There is a parasitic diode between source and drain of the switch transistor. (Refer to the block diagram.) Because of this, in both cases of enable and disable, if the voltage of OUT pin is higher than IN pin, current flows from OUT to IN.
- (2) In case that OUT pin and GND is short, if over-current would continue, the temperature of the IC would increase drastically. If the temperature of the IC is beyond 135°C, the switch transistor turns off and the FLG pin level becomes "L". Then, when the temperature of the IC decreases equal or lower than 125°C, the switch transistor turns on and FLG becomes "H". Unless the abnormal situation of OUT pin is removed, the switch transistor repeats on and off. Refer to the 21) over-current protection operation in the typical characteristics.
- (3) Over-current level is set internally in the IC. There are three types of response against over-current: ①Under the condition that OUT pin is short or large capacity is loaded, if the IC is enabled, the IC becomes constant current state. After the flag delay time passes, FLG becomes "L", that means over current state. Refer to the 20) current limit transient response of typical characteristics. ②While the switch transistor is on, if OUT pin is short or large capacity is loaded, until the current limit circuit responds, large transient current flows. After the transient current is beyond the over-current detector threshold and delay time of the flag passes, FLG becomes "L", that means over current state. Refer to the 22), 23) over-current limit transient response of typical characteristics. ③In the case that load current gradually increases, the IC is not into the constant current state until the current is beyond over current limit. Once the level is beyond the over current detector threshold, load current is limited into over current limit level. Note that load current continuously flows until the load current is beyond the over-current detector threshold.
- (4) FLG pin is Nch Open drain output. If the over-current or over-temperature is detected, FLG becomes "L". If over-current is detected, FLG becomes "L" after the flag delay time t_{FD} passes. Therefore flag signal is not out with in-rush current.
- (5) UVLO circuit prevents that the switch transistor turns on until the input voltage is beyond 2.4V. UVLO circuit can operate when the IC is enabled.

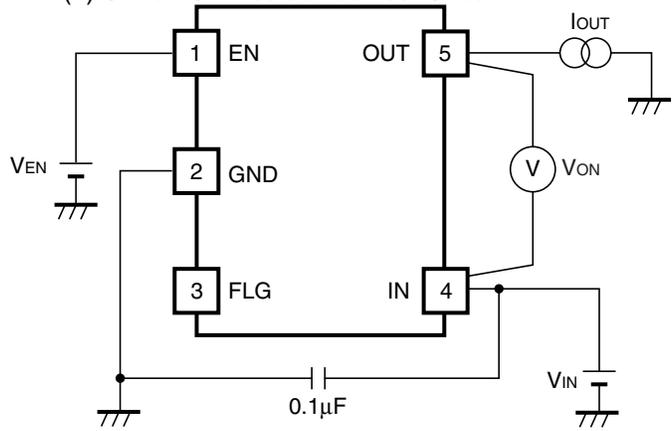
R5520H

TEST CIRCUITS

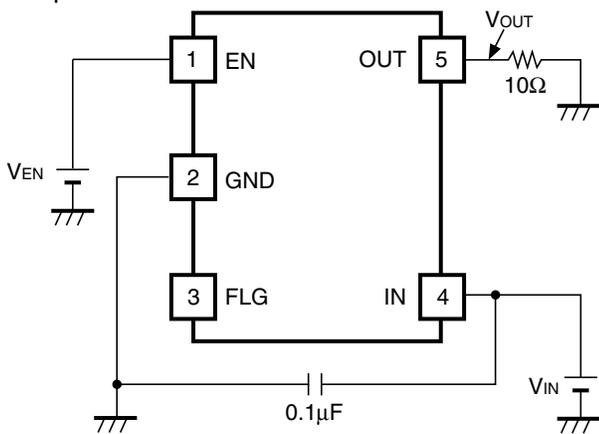
(1) Supply Current Test Circuit



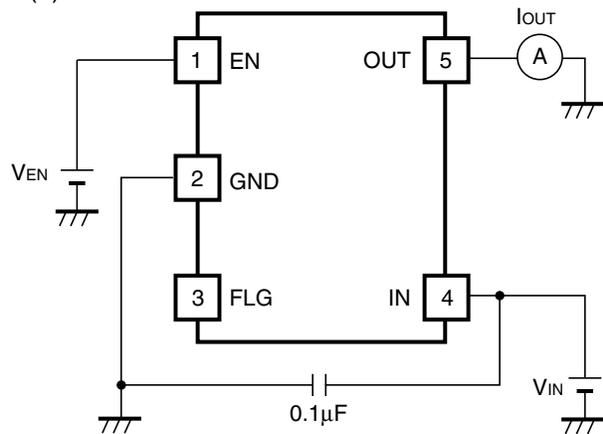
(2) Switch On Resistance Test Circuit



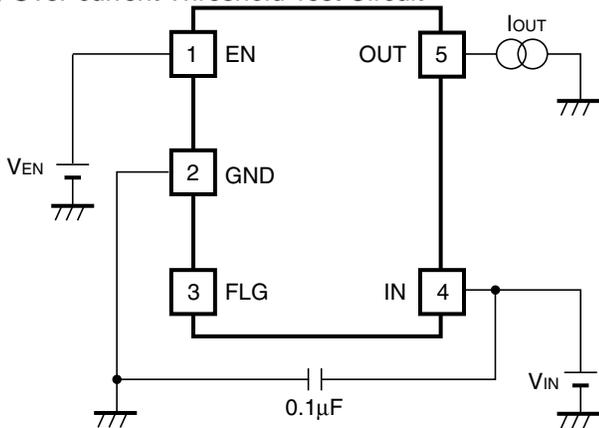
(3) Output On Time Test Circuit



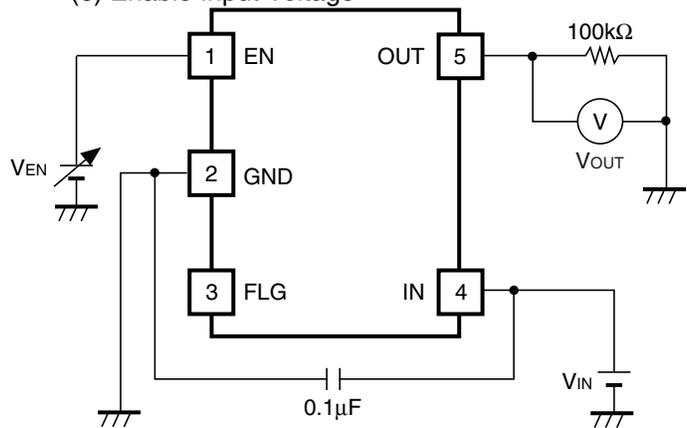
(4) Over-current Limit Test Circuit



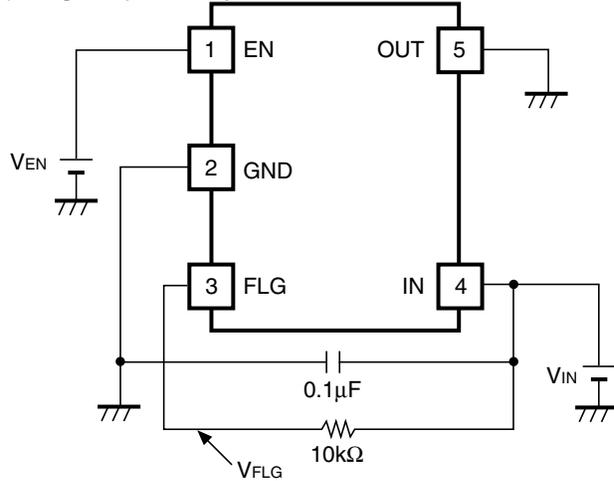
(5) Over-current Threshold Test Circuit



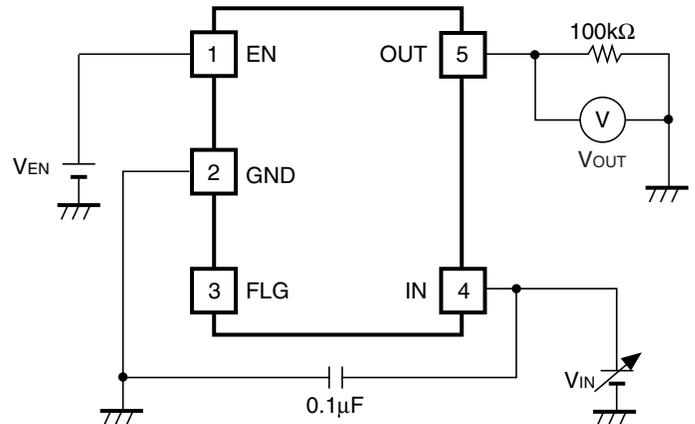
(6) Enable Input Voltage



(7) Flag Output Delay Time

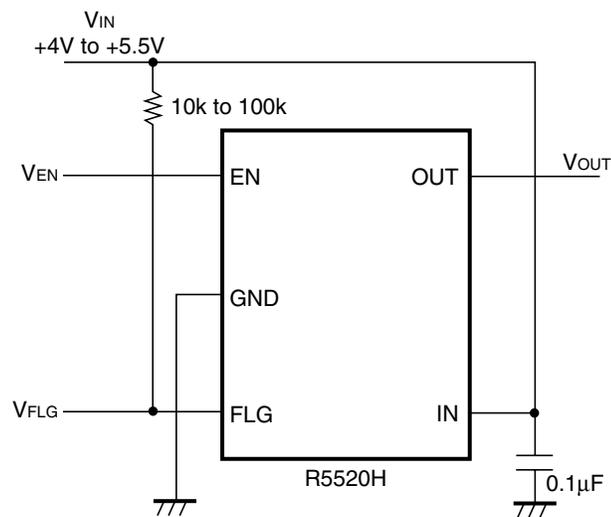


(8) UVLO Threshold



TYPICAL APPLICATION AND TECHNICAL NOTES

• R5520H001A/R5520H001B

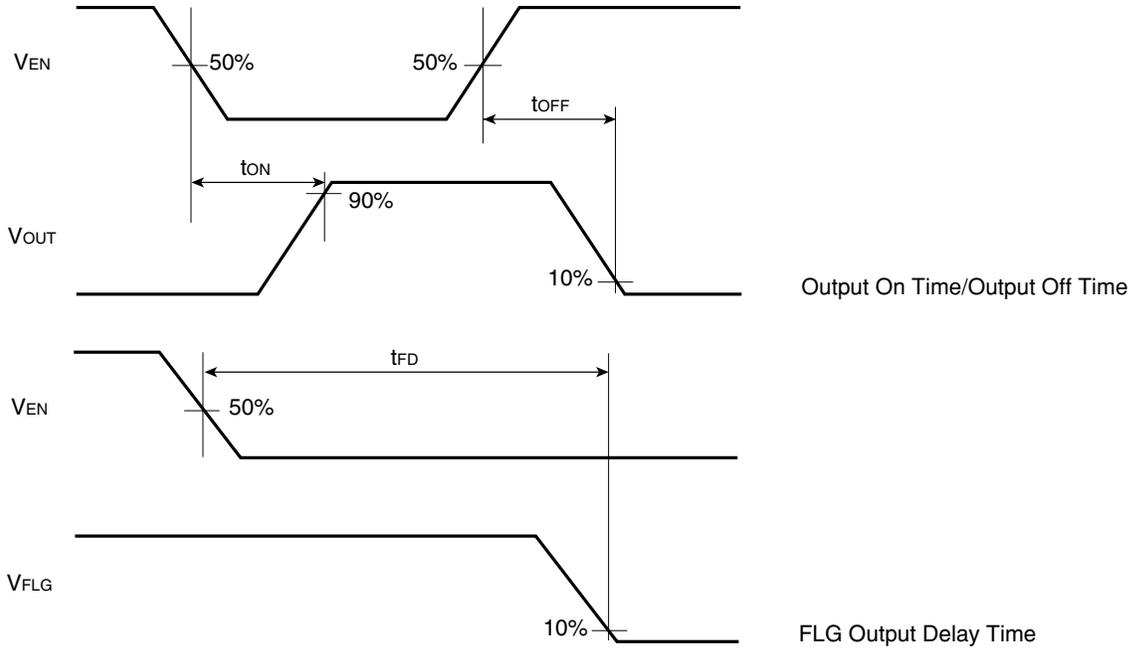


- Put a capacitance range from $0.1\mu\text{F}$ to $1\mu\text{F}$ bypass capacitor between IN pin and GND pin of the IC. Without a bypass capacitor, in case of output short, because of the high side inductance of IN pin, ringing may be generated and it might be a cause of an unstable operation.
- Recommended pull-up resistance value range of flag pin is from $10\text{k}\Omega$ to $100\text{k}\Omega$.

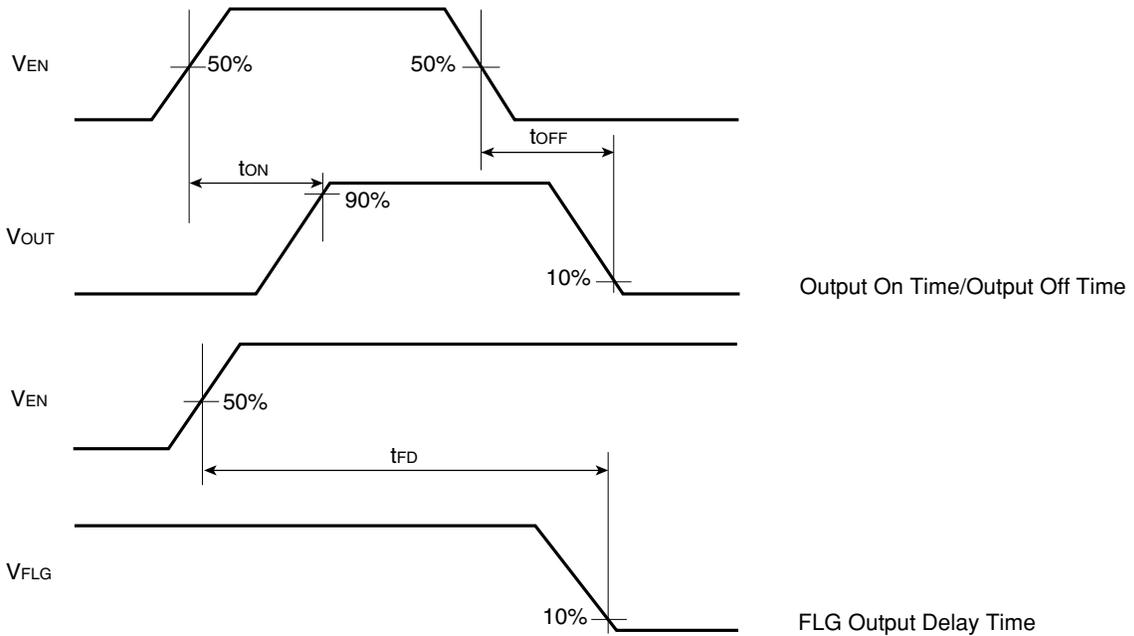
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TIMING CHART

• R5520H001A

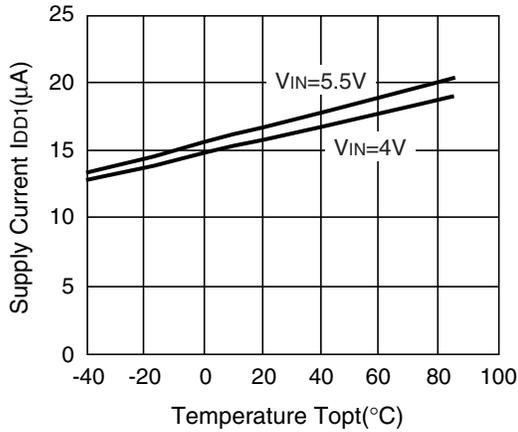


• R5520H001B

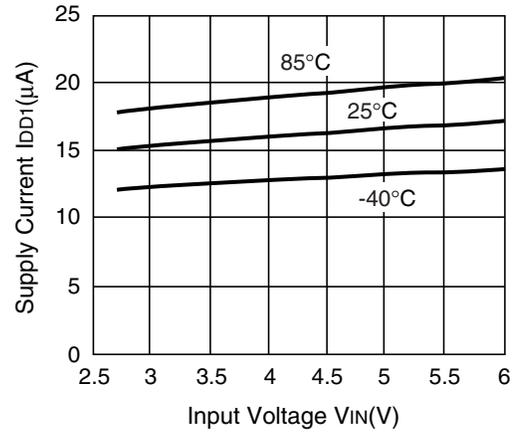


TYPICAL CHARACTERISTICS

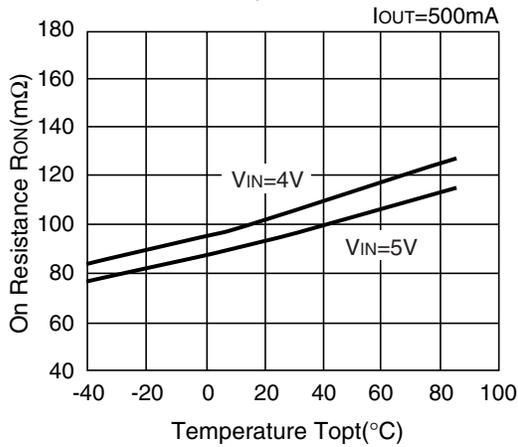
1) Supply Current vs. Temperature



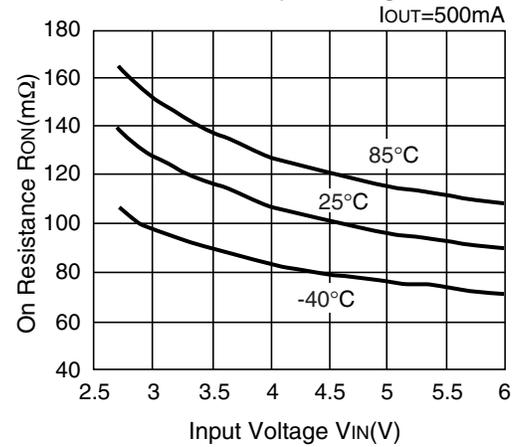
2) Supply Current vs. Input Voltage



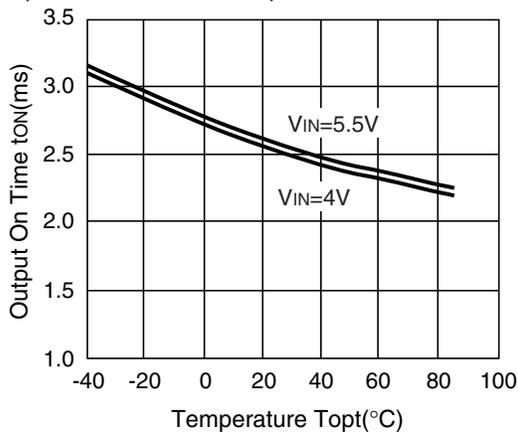
3) On Resistance vs. Temperature



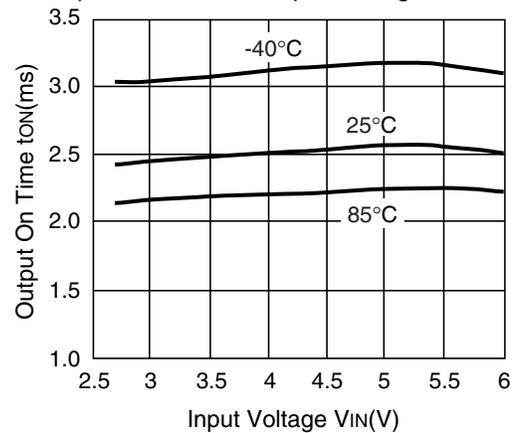
4) On Resistance vs. Input Voltage



5) Output On Time vs. Temperature

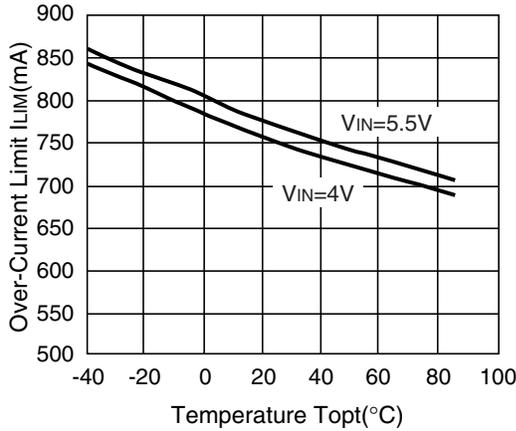


6) Output On Time vs. Input Voltage

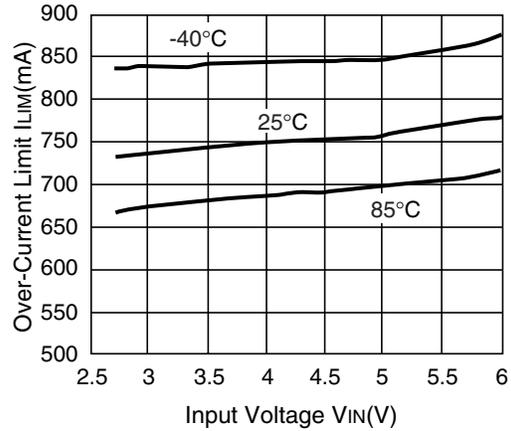


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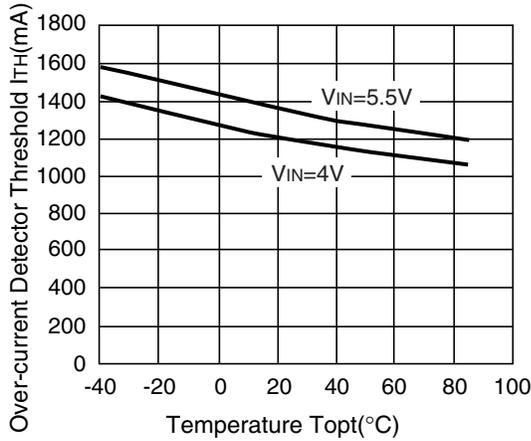
7) Over-current limit vs. Temperature



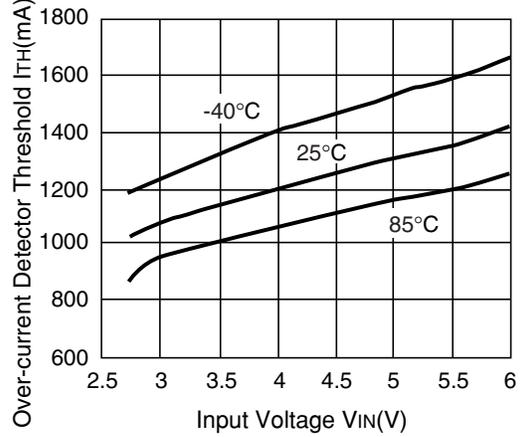
8) Over-current limit vs. Input Voltage



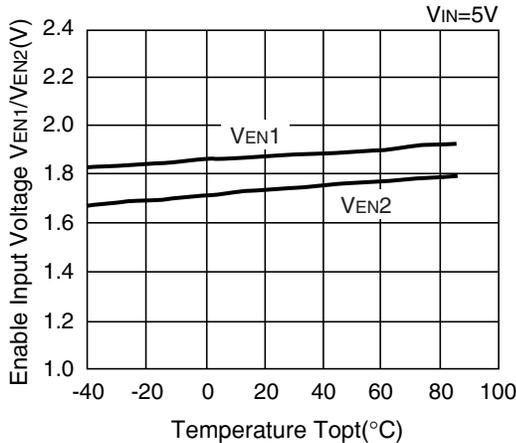
9) Over-current Detector Threshold vs. Temperature



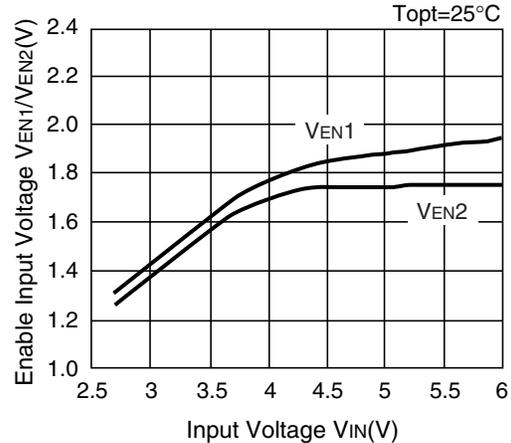
10) Over-current Detector Threshold vs. Input Voltage



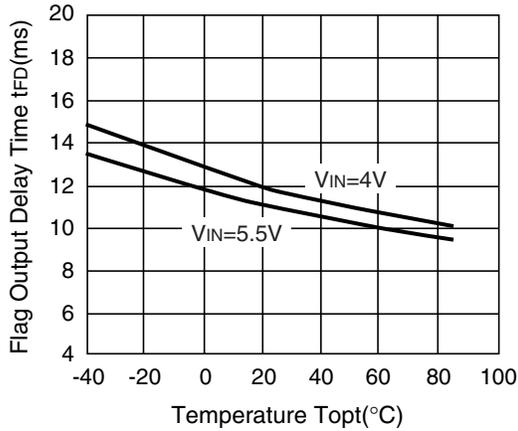
11) Enable Input Voltage vs. Temperature



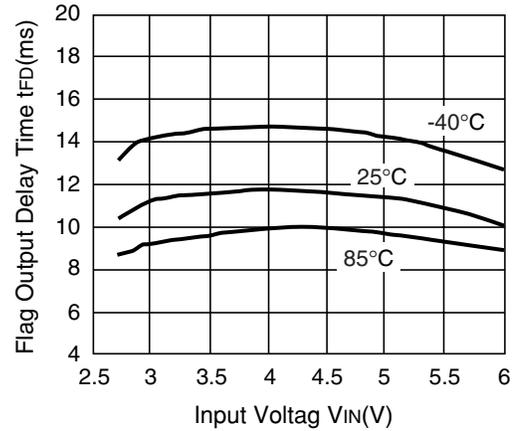
12) Enable Input Voltage vs. Input Voltage



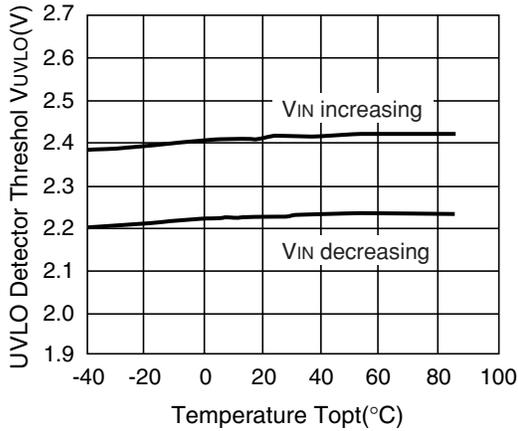
13) Flag Output Delay Time vs. Temperature



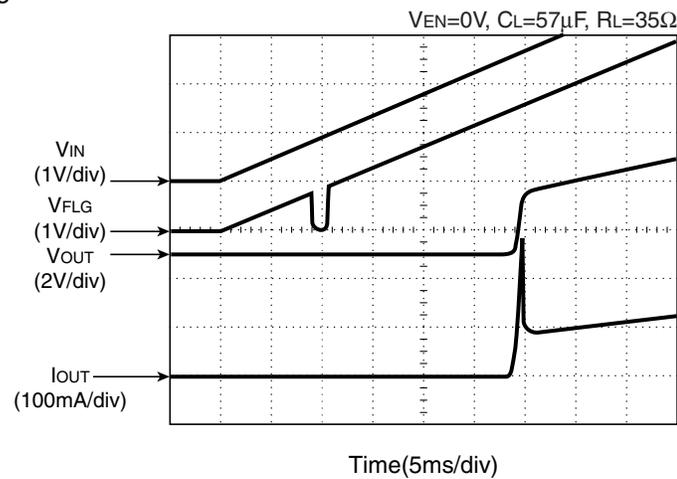
14) Flag Output Delay Time vs. Input Voltage



15) UVLO Threshold vs. Temperature

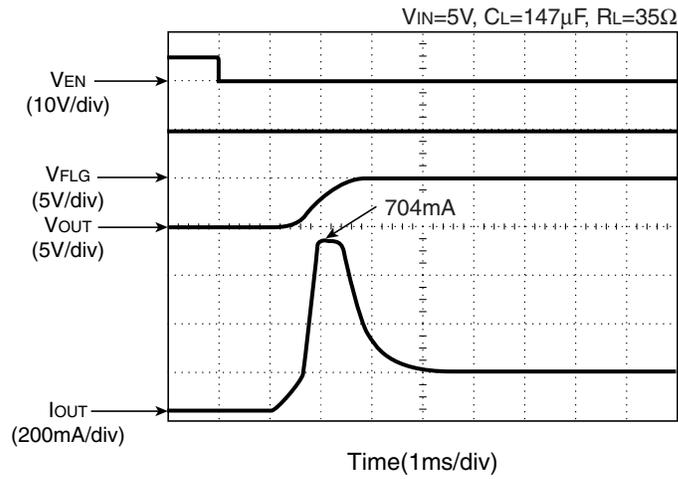


16) UVLO at V_{IN} increasing

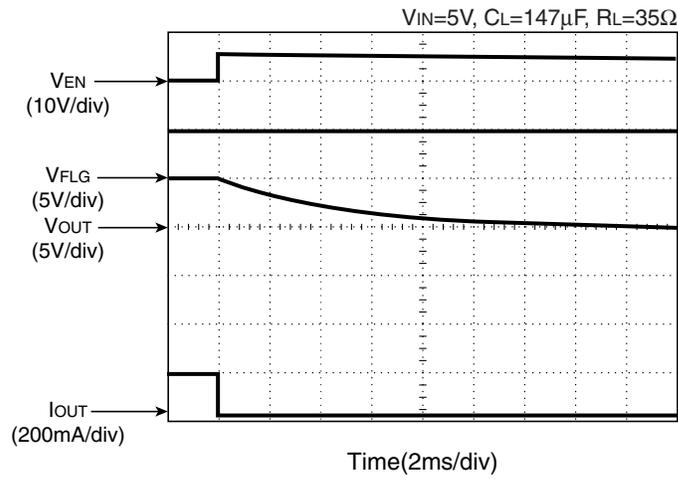


R5520H

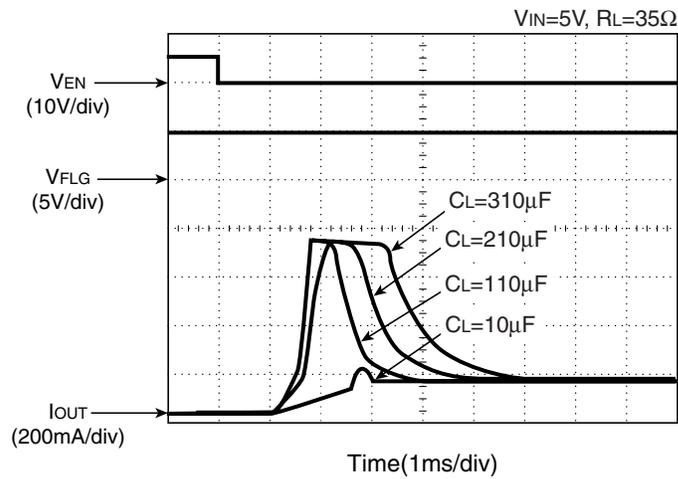
17) Turn-on response



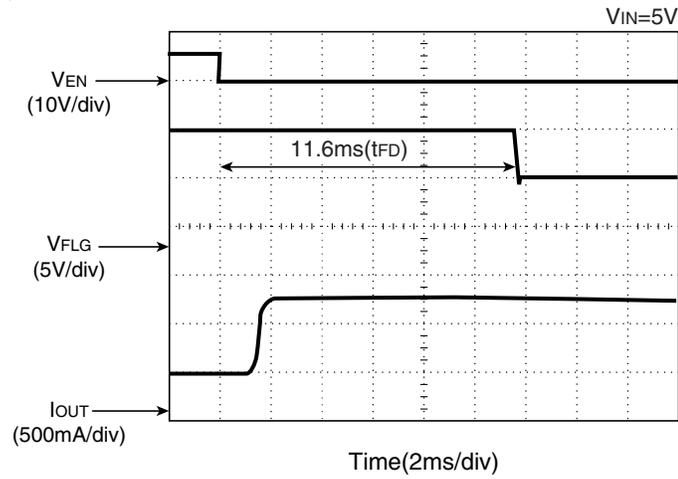
18) Turn off Response



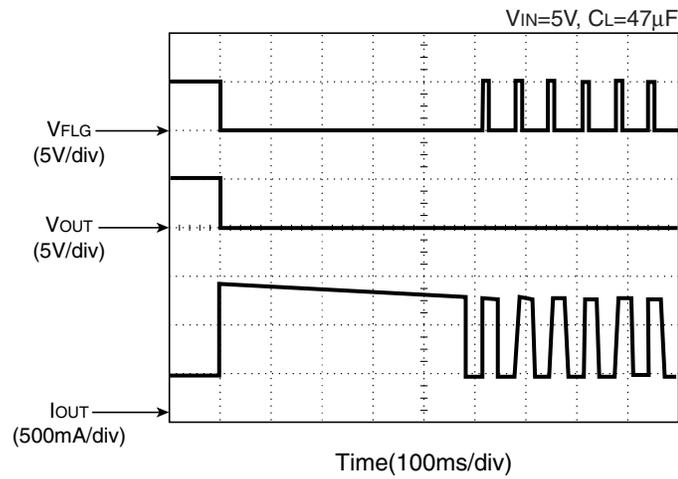
19) Inrush current



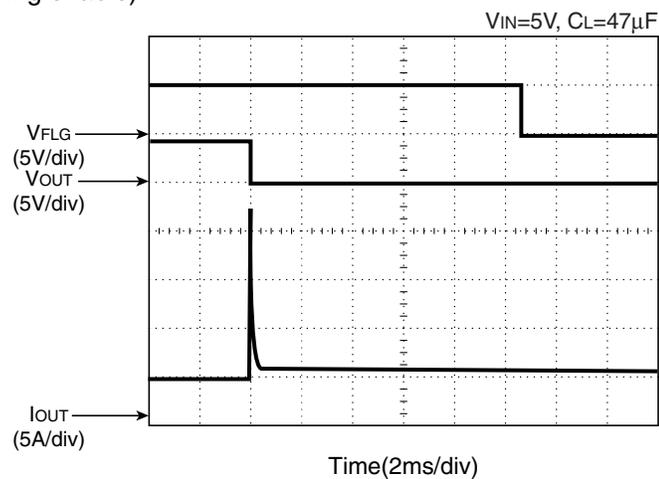
20) Current Limit Transient Response
(Case: Enable to Short)



21) Thermal Shutdown



22) Current Limit Transient Response
(Case: Output short during enable)



R5520H

23) Zoomed in 22)

