

Test Circuit 1

Test Circuit 2

Test Circuit 3

All typical operating characteristics curves showed are referred to Test Circuit 1, unless specified to Test Circuit 2 or Test Circuit 3.

Pin Name	Pin Function
VIN	Power Input Voltage
VOUT	Output Voltage
GND	Ground
EN	Chip Enable (Active High)

The diagram illustrates the internal control logic of a DC-DC converter. Key components and their connections include:

- EN (Enable):** A pin input that enables the system.
- Bias:** Provides a reference voltage to the **Control** block.
- Charge Pump:** Generates a negative gate voltage for the **NMOSFET**.
- Oscillator:** Provides a timing signal to the **Control** block.
- Control:** The central logic block that manages the converter's operation, receiving feedback from **Thermal Detection** and **Current Limit**.
- Thermal Detection:** Monitors the device temperature and provides feedback to the **Control** block.
- Current Limit:** Monitors the current through the sense resistor **RS** and provides feedback to the **Control** block.
- NMOSFET:** The power switch that converts the input voltage **VIN** to the output voltage **VOUT**.
- Output:** The converter's output is connected to **VIN**, **(VIN)**, **(VOUT)**, **VOUT**, and **GND** pins.

Absolute Maximum Ratings

- Supply Voltage ----- 7V
- Chip Enable ----- -0.3V to 7V
- Power Dissipation, P_D @ $T_A = 25^\circ\text{C}$
 SOT-23-5 ----- 0.25W
- Package Thermal Resistance
 SOT-23-5, θ_{JA} ----- 250°C/W
- Lead Temperature (Soldering, 10 sec.) ----- 260°C
- Operating Junction Temperature Range ----- -20°C to 100°C
- Storage Temperature Range ----- -65°C to 150°C
- V_{OUT} ESD Level
 - HBM (Human Body Mode) ----- 8kV
 - MM (Machine Mode) ----- 800V

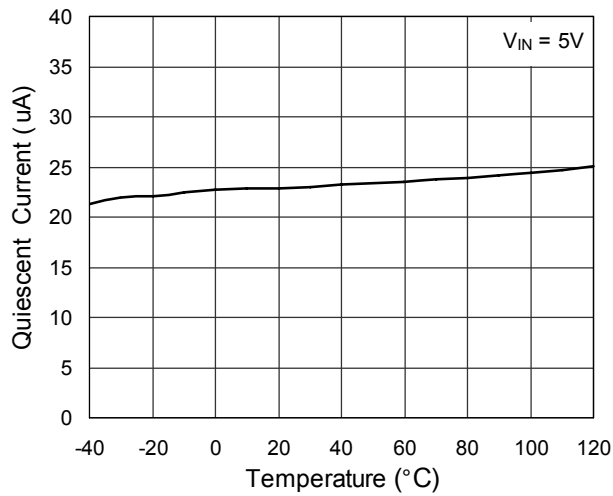
Electrical Characteristics

($V_{IN} = 5\text{V}$, $C_{IN} = C_{OUT} = 1\mu\text{F}$, $T_A = 25^\circ\text{C}$, unless otherwise specified)

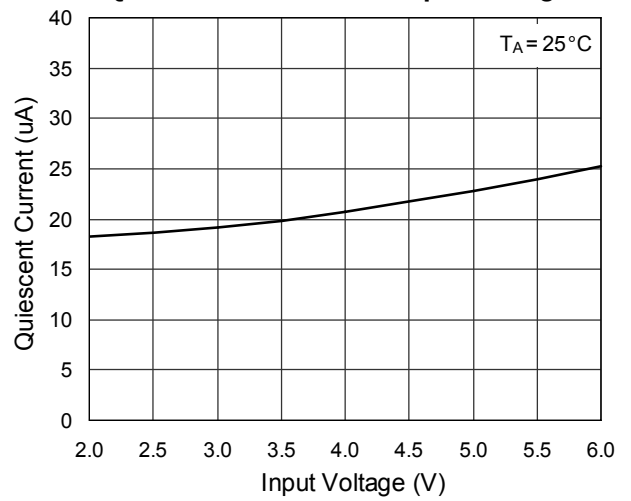
Parameter		Symbol	Test Conditions	Min	Typ	Max	Units
Input Voltage Range		V_{IN}		2.2	--	6	V
Output NMOSFET $R_{DS(ON)}$	RT9701xBL	$R_{DS(ON)}$	$I_L = 1\text{A}$	–	85	100	$\text{m}\Omega$
	RT9701xB		$I_L = 1\text{A}$	–	87	100	
Quiescent Current			$V_{IN} = 3\text{V}$	–	19	40	μA
			$V_{IN} = 5\text{V}$	–	23	45	
Output Turn-On Rising Time		T_R	$R_L = 10\Omega$, 90% Settling	–	400	--	μs
Current Limit Threshold		I_{LIMIT}	$R_L = 2\Omega$	1.1	1.5	2	A
Short-circuit Fold Back Current		I_{OS}	$V_{OUT} = 0\text{V}$, measured prior to thermal shutdown	–	1.0	--	A
EN Input High Threshold	RT9701xB			2.0	--	--	V
EN Input Low Threshold	RT9701xB			–	--	0.8	V
Shutdown Supply Current	RT9701xB	I_{OFF}	EN = "0"	–	0.1	1	μA
Output Leakage Current	RT9701xB	$I_{LEAKAGE}$	EN = "0", $V_{OUT} = 0\text{V}$	–	0.5	10	μA
V_{IN} Under Voltage Lockout		UVLO		1.3	1.8	--	V
V_{IN} Under Voltage Hysteresis				–	100	--	mV
Thermal Limit		T_{SD}		–	130	--	$^\circ\text{C}$
Thermal Limit Hysteresis		ΔT_{SD}		–	20	--	$^\circ\text{C}$

Typical Operating Characteristics

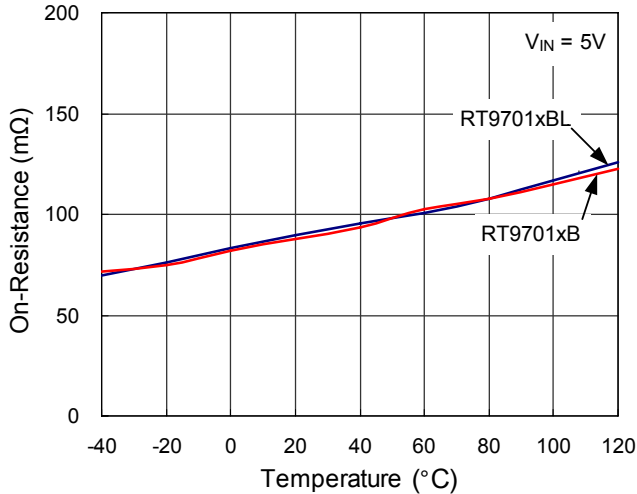
Quiescent Current vs. Temperature



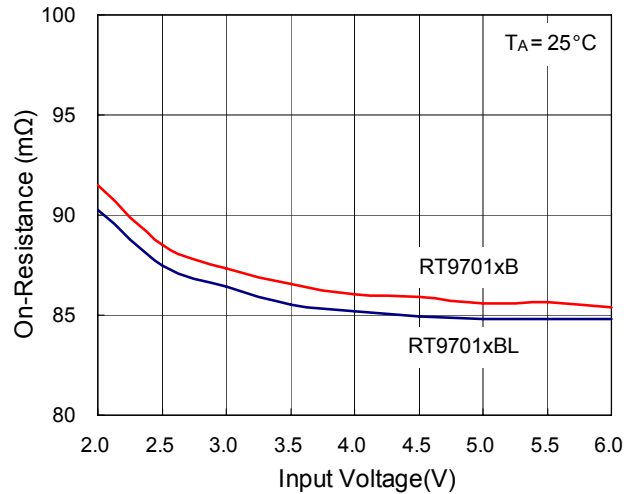
Quiescent Current vs. Input Voltage



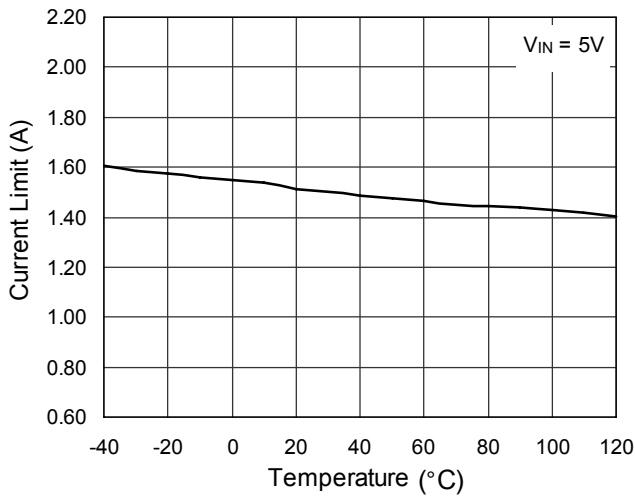
On-Resistance vs. Temperature



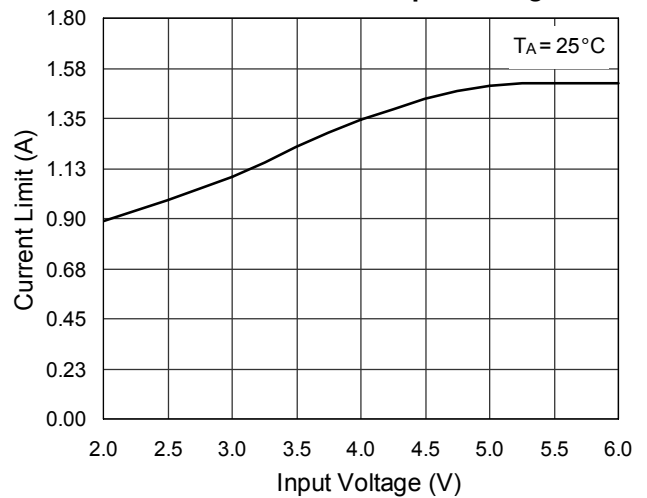
On-Resistance vs. Input Voltage



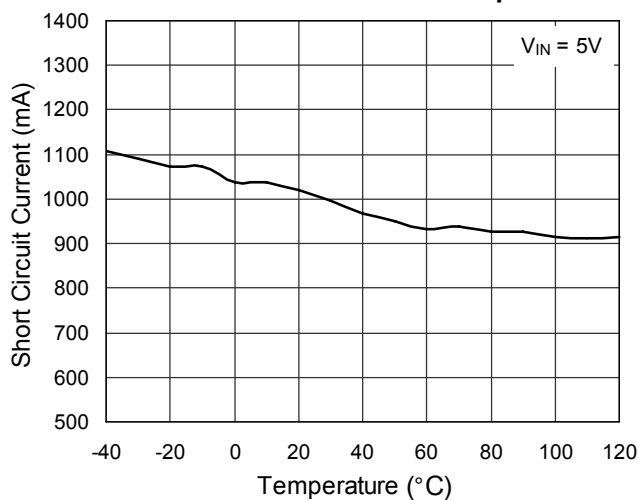
Current Limit vs. Temperature



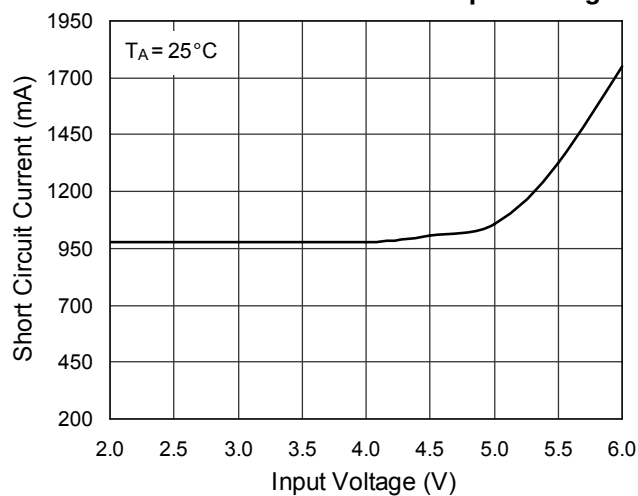
Current Limit vs. Input Voltage



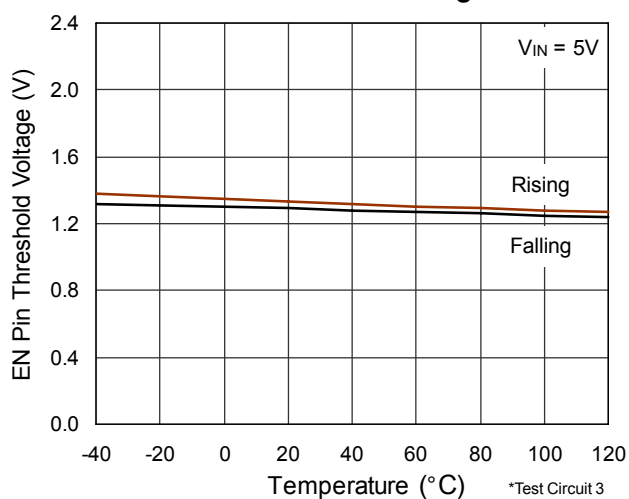
Short Circuit Current vs. Temperature



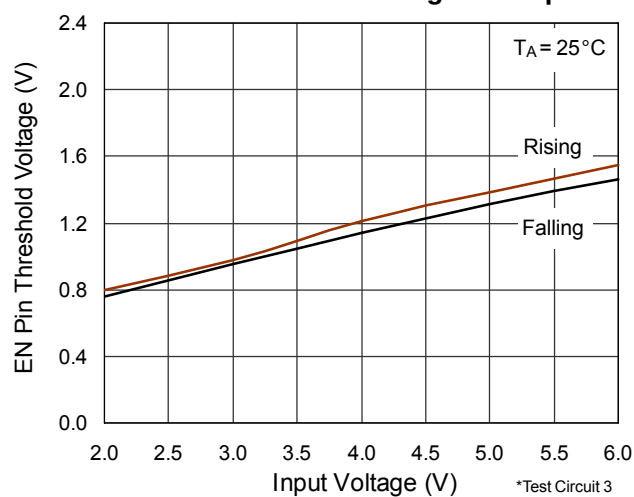
Short Circuit Current vs. Input Voltage



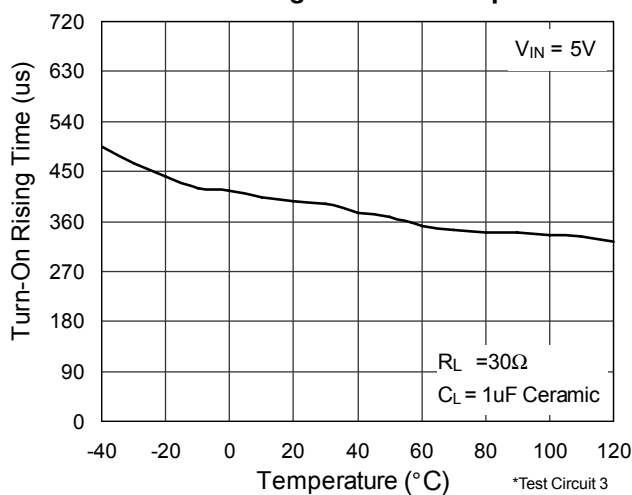
EN Pin Threshold Voltage vs.



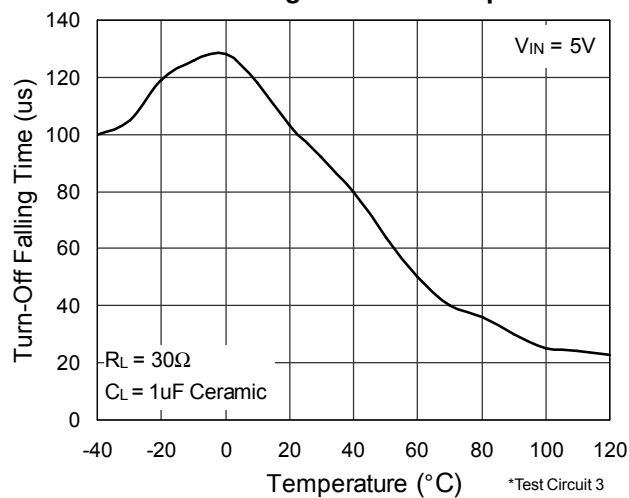
EN Pin Threshold Voltage vs. Input



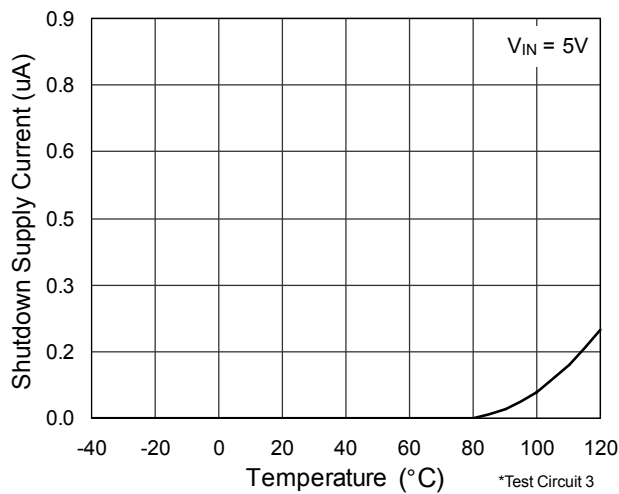
Turn On Rising Time vs. Temperature



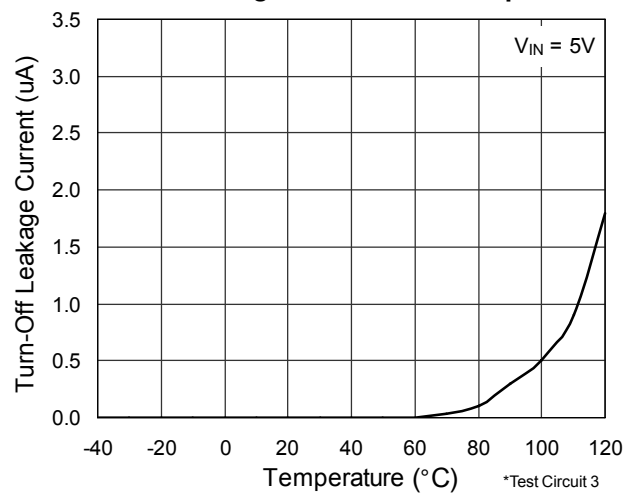
Turn Off Falling Time vs. Temperature



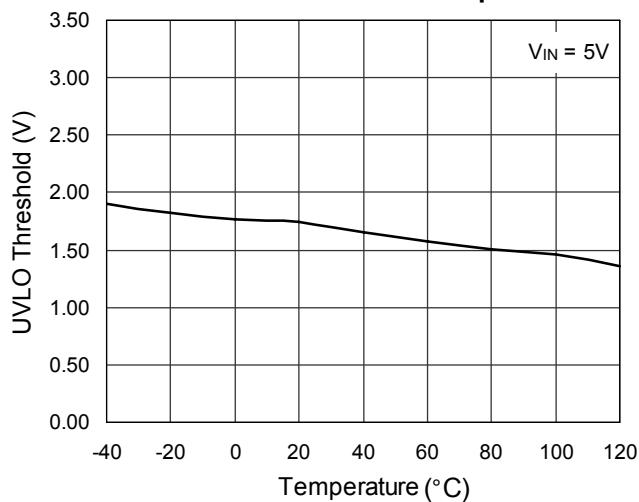
Shutdown Supply Current vs. Temperature



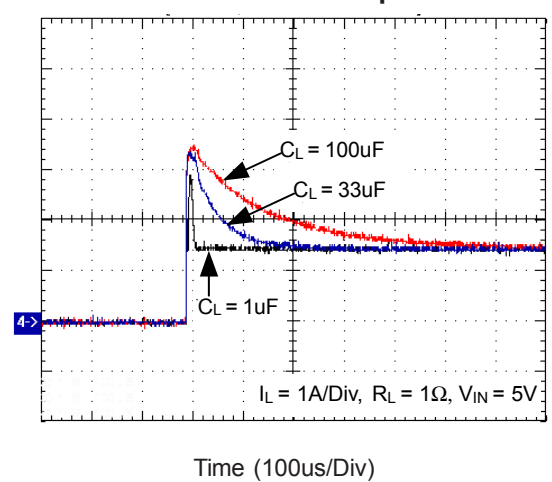
Turn-Off Leakage Current vs. Temperature



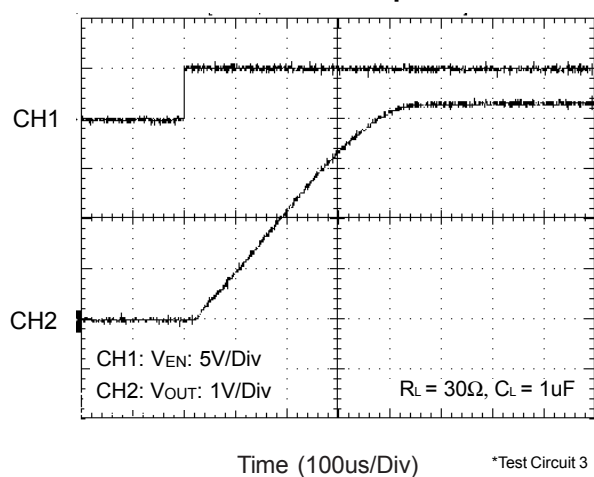
UVLO Threshold vs. Temperature



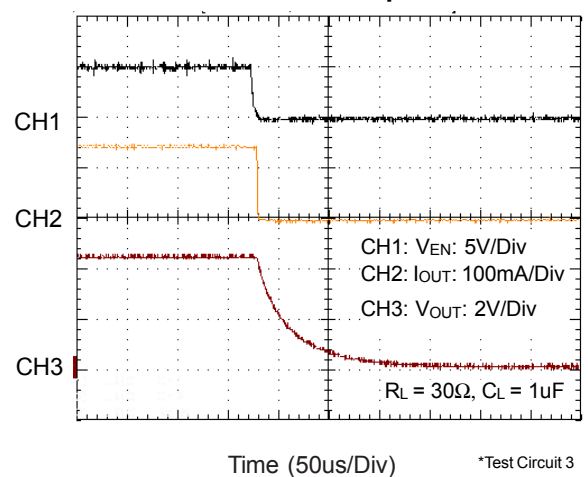
Inrush Current Response



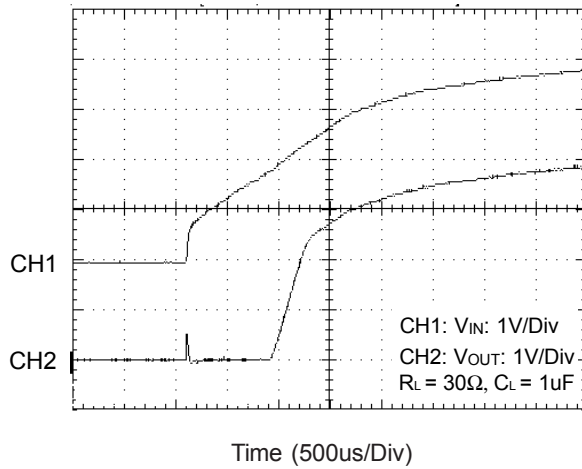
Turn - On Response



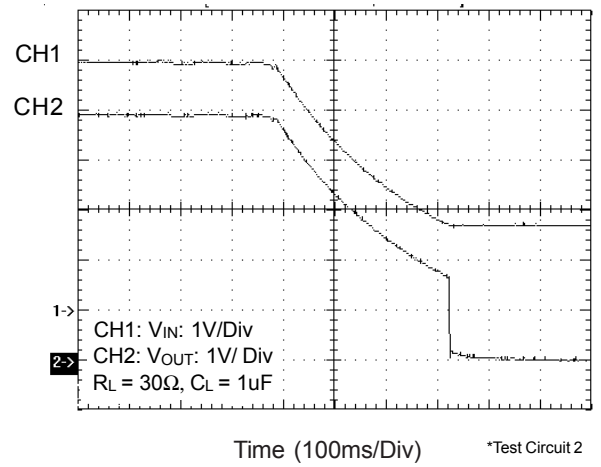
Turn - Off Response



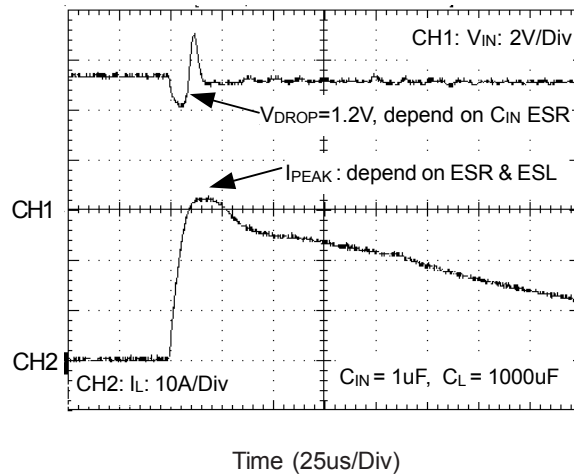
UVLO at Rising



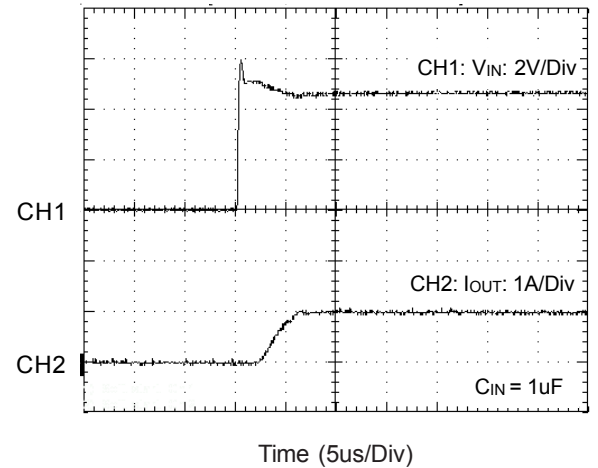
UVLO at Falling



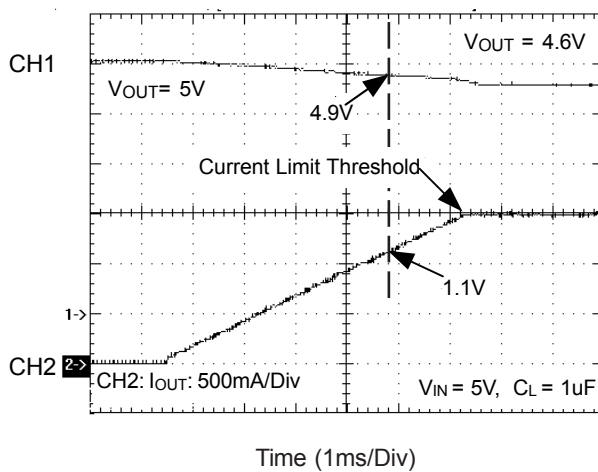
Inrush Short Circuit Response



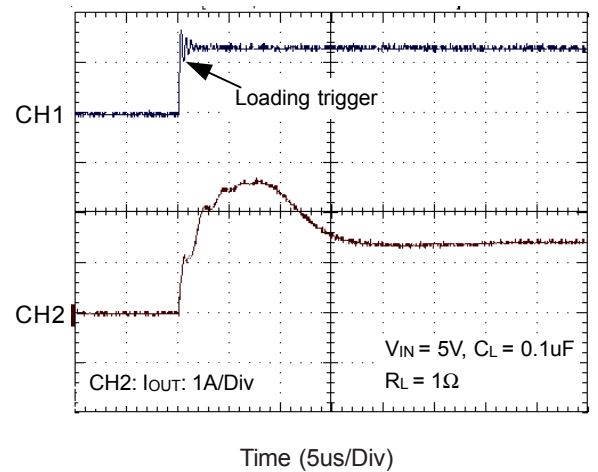
Soft - start Short Circuit Response

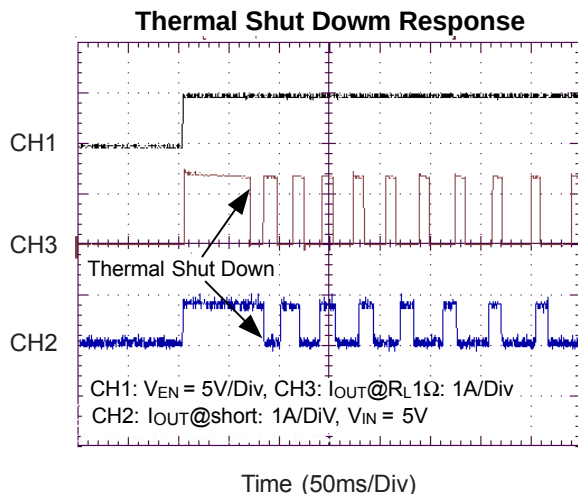


Ramped Load Response



Current Limit Response





Application Information

The RT9701 is a high-side single N-Channel MOSFET switch with active-high enable input.

Input and Output

VIN (input) is the power supply connection to the circuitry and the drain of the output MOSFET. VOUT (output) is the source of the output MOSFET. In a typical circuit, current flows through the switch from VIN to VOUT toward the load. Both VOUT pins must be short on the board and connected to the load and so do both VIN pins but connected to the power source.

Thermal Shutdown

Thermal shutdown shuts off the output MOSFET if the die temperature exceeds 130°C and 20°C of hysteresis forces the switch turning off until the die temperature drops to 110°C.

Soft Start

In order to eliminate the upstream voltage droop caused by the large inrush current during hot-plug events, the “soft-start” feature effectively isolates power supplies from such highly capacitive loads.

Under-voltage Lockout

UVLO prevents the MOSFET switch from turning on until input voltage exceeds 1.8V (typical). If input voltage drops below 1.8V (typical), UVLO shuts off the MOSFET switch.

Current Limiting and Short Protection

The current limit circuit is designed to protect the system supply, the MOSFET switch and the load from damage caused by excessive currents. The current limit threshold is set internally to allow a minimum of 1.1A through the MOSFET but limits the output current to approximately 1.5A typical. When the output is short to ground, it will limit to a constant current 1A until thermal shutdown or short condition removed.

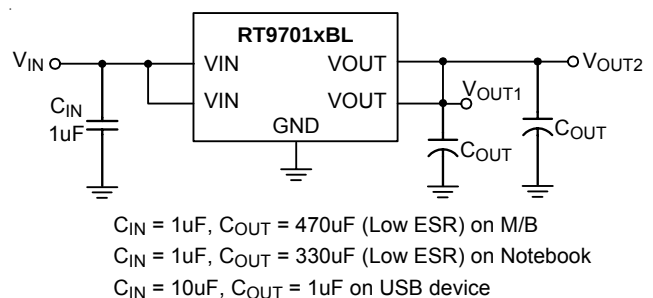


Figure 1. High Side Power Switch

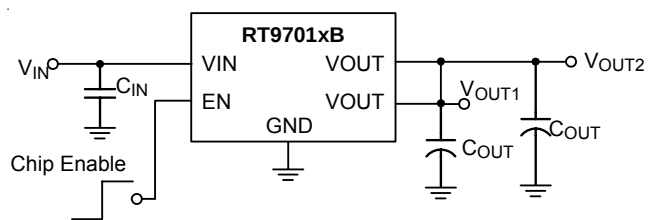


Figure 2. High Side Power Switch with Chip Enable Control

Filtering

To limit the input voltage drop during hot-plug events, connect a 1uF ceramic capacitor from VIN to GND. However, higher capacitor values will further reduce the voltage drop at the input.

Connect a sufficient capacitor from VOUT to GND. This capacitor helps to prevent inductive parasitics from pulling VOUT negative during turn-off or EMI damage to other components during the hot-detachment. It is also necessary for meeting the USB specification during hot plug-in operation. If RT9701 is implanted in device end application, minimum 1uF capacitor from VOUT to GND is recommended and higher capacitor values are also preferred.

In choosing these capacitors, special attention must be paid to the Effective Series Resistance, ESR, of the capacitors to minimize the IR drop across the capacitor ESR. A lower ESR on this capacitor can get a lower IR drop during the operation.

Ferrite beads in series with all power and ground lines are recommended to eliminate or significantly reduce EMI. In selecting a ferrite bead, the DC resistance of the wire used must be kept to a minimum to reduce the voltage drop.

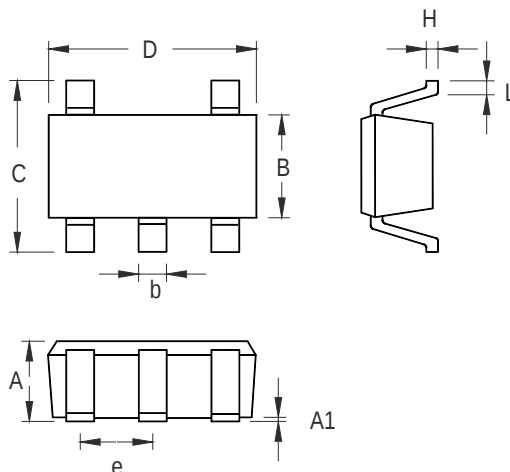
Reverse current preventing

The output MOSFET and driver circuitry are also designed to allow the MOSFET source to be externally forced to a higher voltage than the drain ($V_{OUT} > V_{IN} \geq 0$). To prevent reverse current from such condition, disable the switch (RT9701xB) or connect VIN to a fixed voltage under 1.3V.

Layout and Thermal Dissipation

- Place the switch as close to the USB connector as possible. Keep all traces as short as possible to reduce the effect of undesirable parasitic inductance.
- Place the ot capacitor and ferrite beads asclose to the USB connector as possible.
- If ferrite beads are used, use wires with minimum resistance and large solder pads to minimize connection resistance.
- If the package is with dual VOUT or VIN pins, short both the same function pins as Figure 1 or Figure 2 to reduce the internal turn-on resistance. If the output power will be delivered to two individual ports, it is specially necessary to short both VOUT pin at the switch output side in order to protect the switch when each port are plug-in separately.
- Under normal operating conditions, the package can dissipate the channel heat away. Wide power-bus planes connected to VIN and VOUT and a ground plane in contact with the device will help dissipate additional heat.

Outline Dimension



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.035	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.356	0.559	0.014	0.022
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

SOT-23-5 Surface Mount Package

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