DESCRIPTION

The A4771A is cost-effective, built-in 52mΩ power switch IC for self-powered and bus-powered Universal Serial Bus (USB) applications.

The A4771A is include current limit and thermal shutdown to prevent catastrophic switch failure caused by increasing power dissipation when continuous heavy load or short circuit occur.

The A4771 built-in 52mΩ P-channel MOSFET with true shutdown function to eliminate any reversed current flowing across the switch when the device is powered off. When the output voltage is higher than input voltage, the power switch will be turned off by the internal output reverse-voltage comparator.

$\overline{FLG}$ is an open-drain output, which reports over-current has a typical 8ms deglitch timeout period. In addition, $\overline{FLG}$ also has typical 8ms deglitch timeout period.

The A4771A is available in SOT-25 packages.

ORDERING INFORMATION

Package Type	Part Number	
SOT-25 SPQ:3,000pcs/Reel	E5	A4771AE5R
		A4771AE5VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

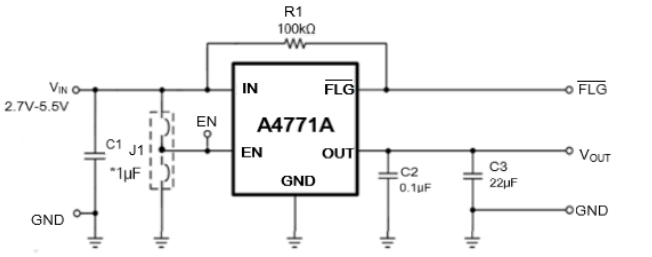
FEATURES

- Continuous Load Current
  2.1A Continuous Load Current
- 52mΩ High-side P-channel MOSFET Switch
- Active High
- Operating Range: 2.7 V to 5.5 V
- 1.2ms Typical soft start time
- 3μA Shutdown Supply Current (typ.)
- Fast Over-current Response 2μs (typ.)
- Under Voltage Lockout
- No Reverse Current when Power Off
- Output Reverse-voltage Protection
- Deglitched Open-drain Over-current Flag Output
- Enable Logic: Active-high
- Output Build-in 250Ω Discharge Tube (Optional According to Version)

APPLICATION

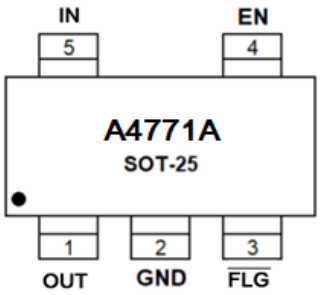
- Notebook PCs
- High-Side Power Protection Switch
- USB Host and Self-Powered Hubs
- USB Bus-Powered Hubs
- Set Top Box
- Smart TV
- MID and Notebook Computer

TYPICAL APPLICATION



Note*: 1uF of input capacitor is enough in most application cases. If the PCB trace of power rail in IN is long, larger input capacitor is necessary.

PIN DESCRIPTION



SOT-25, E5
Top View

Pin#	Symbol	Function
1	OUT	Switch Output: Connected to the drain of the internal MOSFET. Typically connect to switched side of load.
2	GND	Ground
3	$\overline{FLG}$	Open-drain Fault Flag Output. 8ms delay for thermal shutdown.
4	EN	Enable: Logic level enable input. Make sure EN pin never floating.
5	IN	Input Supply: Connected to the source of the internal MOSFET and provides internal DC current to operate the control circuitry.

ABSOLUTE MAXIMUM RATINGS

over operating free-air temperature range, (unless otherwise noted) (1)

V_{DD}, Input Voltage		-0.3V ~ 7.0V
V_{EN}, Input Voltage (All inputs)		-0.3V ~(V_{IN})0.3V
PD, Power Dissipation, TA = 25℃	SOT-25	0.5W
θ_{JA} Thermal Resistance	SOT-25	250℃/W
Lead Temperature (Soldering, 10 sec.)		260℃
T_{STG}, Storage Temperature		-55℃ ~ 150℃
ESD Ratings		
$V_{(ESD)}$, Electrostatic Discharge	Human-body model (HBM)	±4000V

Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.
Class 3A per ESDA/JEDEC JDS-001-2014 classification.
Output was surged on the EVM with input and output bypassing per the Typical Application Circuit on the first page with no device failures.
Thermal Resistance is measured in the natural convection at TA = 25 °C on a low effective single layer thermal conductivity test board of JEDEC 51-3 thermal measurement standard.
T_J culated from the ambient temperature TA and power dissipation PD.

RECOMMENDED OPERATING CONDITIONS

Over operating free-air temperature range (unless otherwise noted) (3)

Parameter	Symbol	Min.	Max.	Unit
Supply Voltage	V_{CC}	2.7	5.5	V
Operating temperature	T_A	-40	+185	℃

ELECTRICAL CHARACTERISTICS (continued)

V_{IN} = 5V, C_{IN} = 1μF, C_{OUT} = 22μF, TA = 25°C, (unless otherwise noted) (1)

Parameter		Conditions	Min	Typ	Max	Unit
Input Supply Voltage						
V_{IN}	Input Voltage		2.7		5.5	V
I_{IN_ON}	Quiescent Current	V_{IN} = 5.5V, I_{OUT} = 0mA		260	300	μA
I_{IN_OFF}	Shutdown Current	V_{IN} = 5.5V, I_{OUT} = 0mA		3	4	μA
$I_{LEAKAGE}$	Output Leakage Current	V_{OUT} = 5.5V, V_{IN} = 0V		2	10	μA
V_{UVLO_ON}	UVLO Threshold	V_{IN} Rising		2.4	2.8	V
V_{UVLO_HYS}	UVLO Hysteresis			140		mV
Power Switch						
$R_{DS(ON)}$	Output MOSFET	I_{LOAD} = 1A		52		mΩ
Enable and Soft-start						
V_{EN_H}	Enable High Level Threshold	V_{IN} = 5.5V	1.0			V
V_{EN_L}	Enable Low Level Threshold	V_{IN} =2.5V			0.6	V
I_{EN}	EN Input Current	VEN = 5.5V or 0V		2.3		μA
T_{ON}	Turn-on Time	C_L = 1μF, RLOAD = 100Ω		2		ms
T_{OFF}	Turn-off Time	C_L = 1μF, RLOAD = 100Ω		0.03		ms
$R_{DISCHAR}$	Output discharge tube	EN =Low		250		Ω
Enable and Soft-start						
I_{LIMIT}	Current Limit Trigger level	Increase Load till to Output Protect	2.4	2.65	2.9	A
$V_{REVERSE}$	Reverse Voltage Protection	V_{OUT} - V_{IN}	5	35	80	mV
$I_{REVERSE}$	Reverse Current Protection		0.1	0.7	1.5	A

ELECTRICAL CHARACTERISTICS

V_{IN} = 5V, C_{IN} = 1μF, C_{OUT} = 22μF, TA = 25°C, (unless otherwise noted)

Parameter		Conditions	Min	Typ	Max	Unit
Output and Current Limit						
Tr	Output Rise Time	C_{OUT} = 1μF, R_{LOAD} = 100Ω		1.2		ms
T_F	Output Fall Time	C_{OUT} = 1μF, R_{LOAD} = 100Ω		0.3		ms
T_{ios}	TIOS Response Time to short Circuit	V_{IN}=5V, see Fig 1,2		2		μs
Fault Flag ($\overline{FLG}$)						
V_{FLG_LOW}	Output Low Voltage	I_{FLG} = 1mA			180	mV
I_{FLG_SINK}	Continuous Sink Current				10	mA
$I_{FLG\_LEAKAGE}$	Off-state Leakage				1	μA
T_{FLG}	Deglitch Time			8		ms
$T_{FLG\_REVERSE}$	Reverse Deglitch Time			8		ms
Thermal Shutdown						
T_{SD}	Thermal Shutdown Threshold	V_{OUT} > V_{IN}		165		℃
T_{SD_HYS}	Thermal Shutdown Hysteresis			40		℃

TYPICAL PERFORMANCE CHARACTERISTICS

Fig1 RDS(ON) vs. Input Voltage

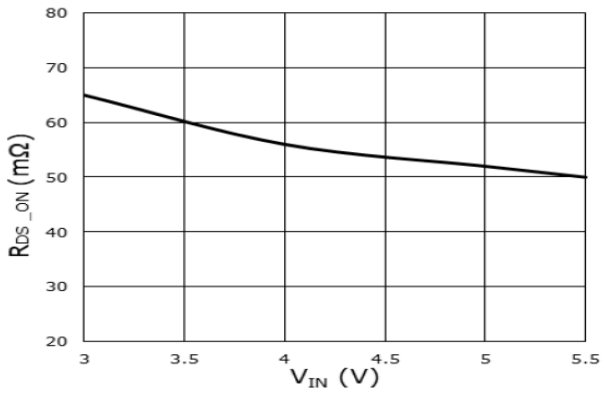


Fig2 Short Circuit Output Current vs. VIN

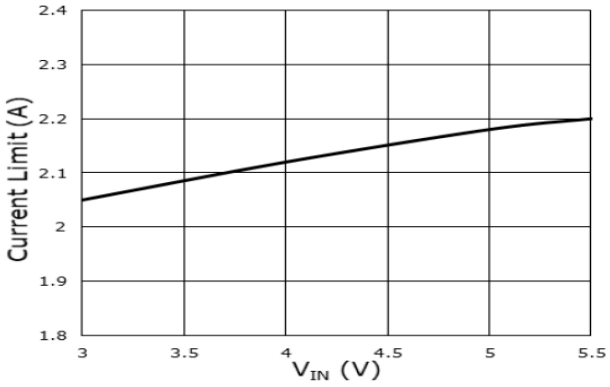


Fig3 Quiescent Supply vs. Input Voltage

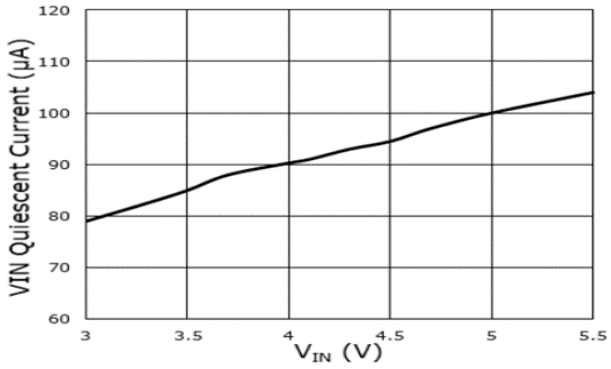


Fig4 Voltage Drop vs. Output Current

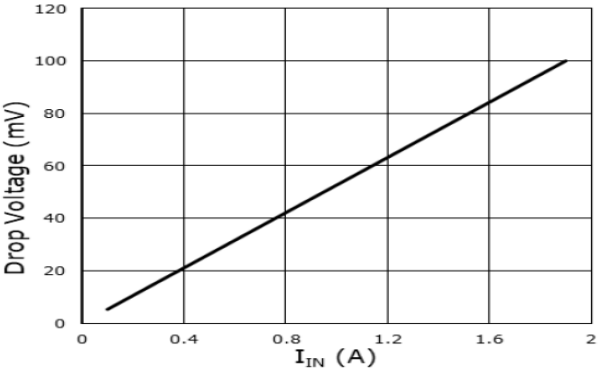


Fig5 EN Voltage vs. VIN

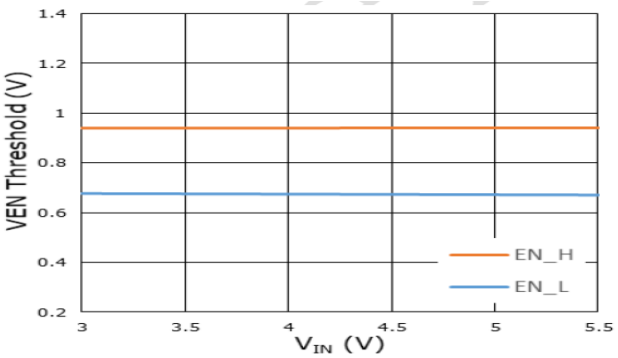


Fig6 Over-current Protection Characteristics

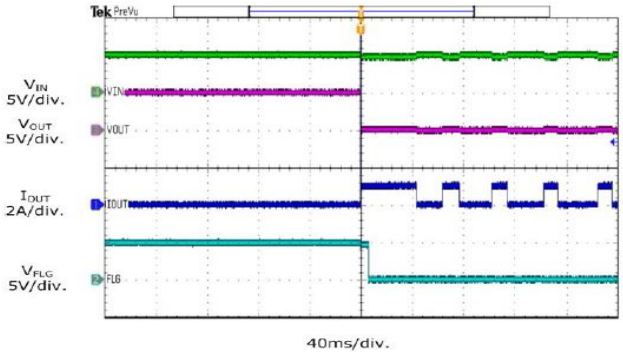


Fig7 Resistance Load Inrush Response 0A to 1.25A

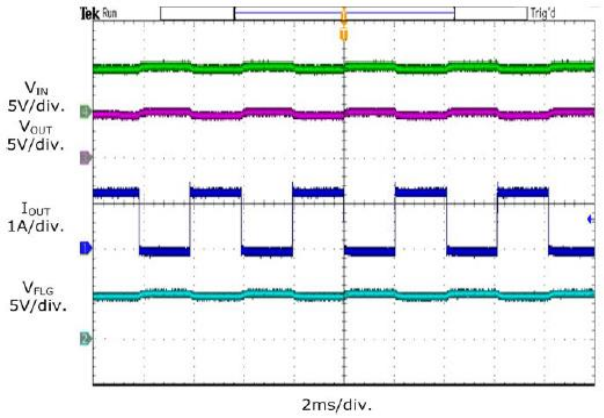


Fig8 Thermal Shutdown Response

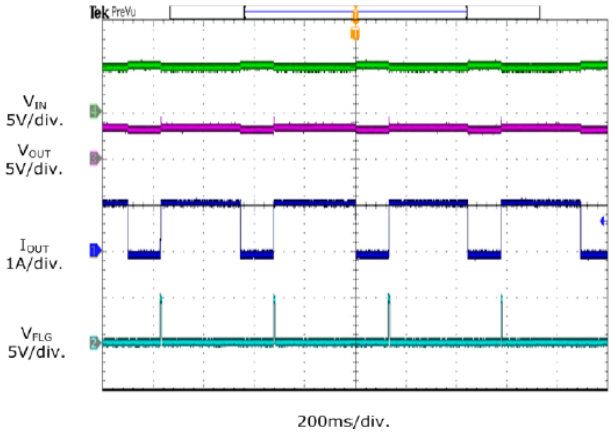


Fig9 Capacitance Load Inrush Response

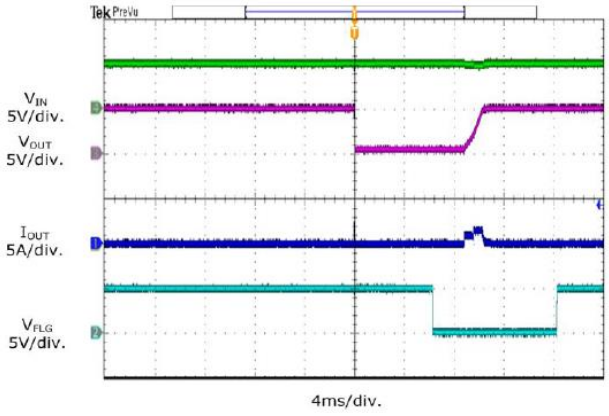


Fig10 Output Current at Short Circuit Moment

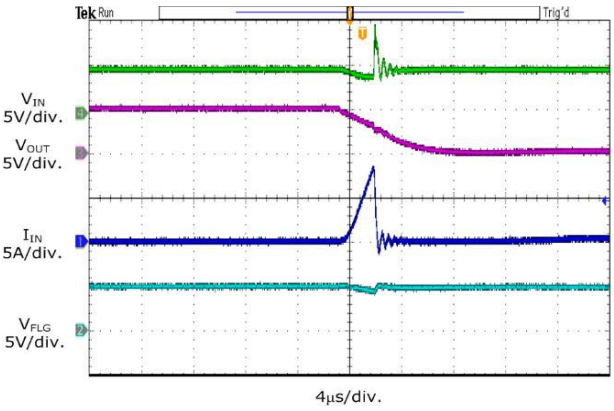


Fig11 Reverse-voltage Protection Response

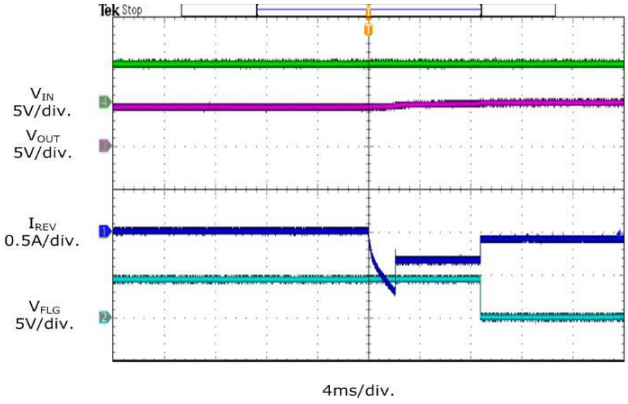


Fig4 Reverse-voltage Protection Recovery

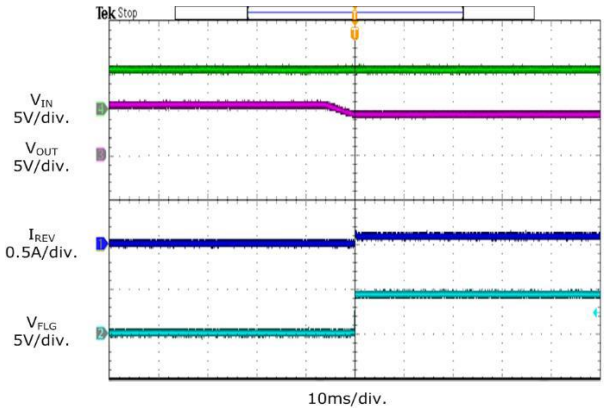
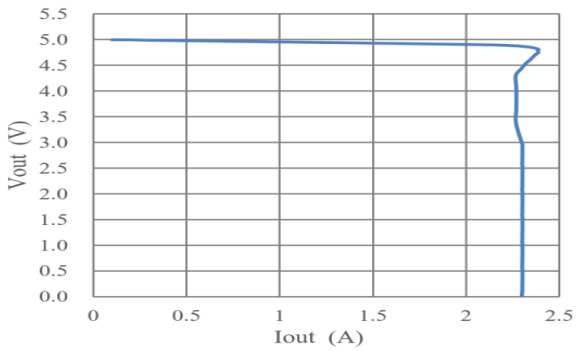
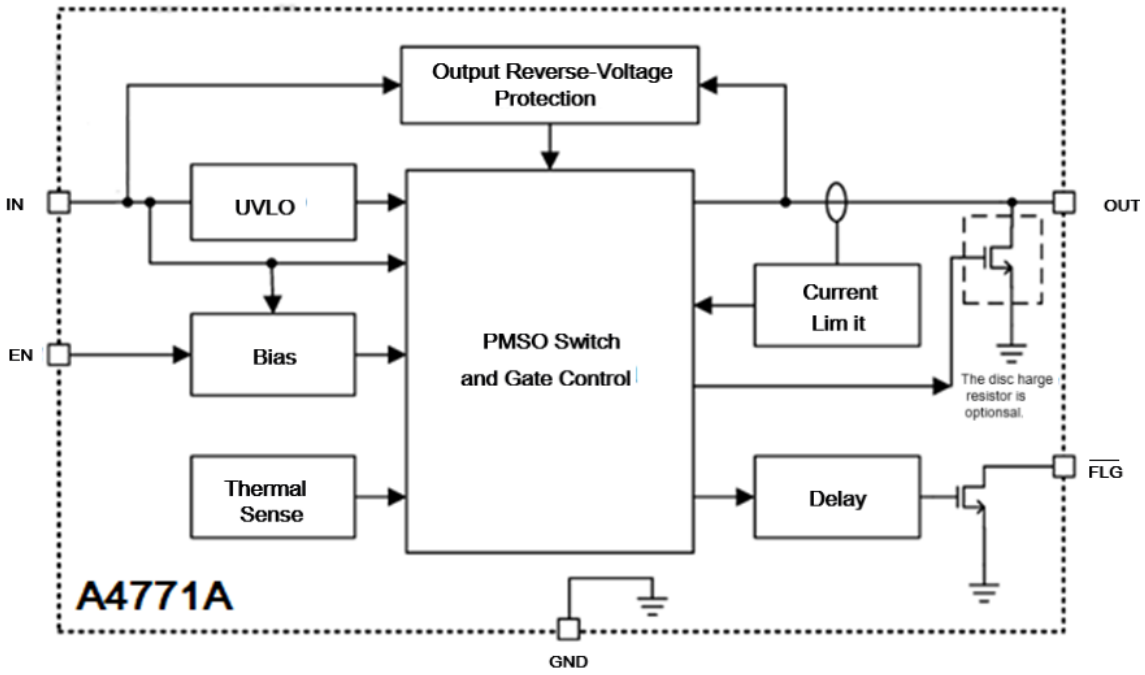


Fig13 Reverse-voltage Protection Response



BLOCK DIAGRAM



DETAILED INFORMATION

Functional Descriptions

The A4771A is the power supply connection to the logic circuitry and the source of the internal P-channel MOSFET. OUT (output) is the drain of the internal P-channel MOSFET. In a typical application, current flows through the switch from IN to OUT toward the load.

Thermal Shutdown

The A4771Aprotects itself with thermal sensing circuits that monitor the operating temperature of the power-switch and disables operation to protect itself. The device operates in constant-current mode during an over-current condition, which increases the voltage drop across power-switch. The power dissipation in the package is proportional to the voltage drop across the power-switch, so the junction temperature rises during an over-current condition. The thermal sensor turns off the power-switch when the die temperature exceeds 165°C regardless of whether the power-switch is in current limit, and the switch turns on after the device has cooled down approximately 40°C. The switch continues to cycle off and on until the fault is removed. The open-drain $\overline{\text{FLG}}$ is asserted (active low) immediately during an over-temperature shutdown condition.

Under-voltage Lockout

UVLO (under-voltage lockout) prevents the internal MOSFET switch from turning on until VIN (input voltage) exceeds 2.4V typically. After the switch turns on, if the input voltage drops below 2.26V typically, UVLO shuts off the switch.

Output Reverse-voltage Protection

The output reverse-voltage protection turns off the MOSFET switch whenever the output voltage is higher than the input voltage by 35 mV (typ.) and the MOSFET switch will turn on when output reverse-voltage condition is removed.

$\overline{\text{FLG}}$ Function

The $\overline{\text{FLG}}$ open-drain output is asserted (active low) when an over current condition is encountered after 8ms deglitch timeout. The $\overline{\text{FLG}}$ output remains asserted until the over-current condition is removed. Over temperature condition is also reported by $\overline{\text{FLG}}$ open-drain output. In addition, $\overline{\text{FLG}}$ is also asserted in output reverse-voltage condition. For the stability of $\overline{\text{FLG}}$ overcurrent indication signal, the FLG indication signal of A4771A takes effect at about 1.4A, 1.9A and 2.3A respectively.

Supply Filtering

A 1μF bypass capacitor from IN pin to GND pin, located near the IC is strongly recommended to control supply transients. Without a bypass capacitor, an output short may cause sufficient ringing on the input (from supply lead inductance) to damage internal control circuitry. If the input lead is too long, it can be considered to eliminate the input spike under some operating conditions by using a 100uF electrolytic capacitor in parallel with a 0.1uF ceramic chip capacitor. Input transients must not exceed the absolute maximum supply voltage (VIN_MAX = 7V) even for a short duration.

Enable Input

EN (enable) must be driven by a logic high or logic low for a clearly defined input. Floating the input may cause unpredictable operation. EN should not be allowed to go negative with respect to GND

Short Circuit Condition

The current limit circuitry prevents the power-switch from damage due to overcurrent. When a heavy load or short circuit is applied to the output, a large transient current may flow through until the circuitry responses. Once the circuitry responds, it limits the output current to ISC. Since the current-sense amplifier is overdriven during this time and the power-switch is disabled momentarily, the output current drops to nearly zero. The current-sense amplifier recovers and ramps the output current to IOS. The output current keep at IOS until the short circuit condition is removed or the device begins to thermal cycle.

The duration and the amplitude of the large transient current at short circuit moment vary with the measurement setup and the external components, especially ESR of input capacitor. Fig2 shows the recommended setup to measure the short circuit characteristic. The 'Short Device' in Fig2 should be a low $R_{DS(ON)}$, high current and low gate charge N-channel MOSFET to simulate the real situation.

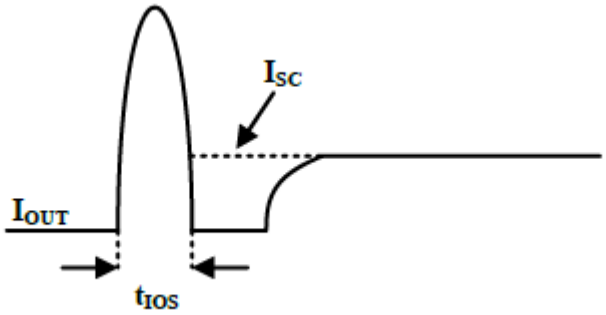


Fig1 Output Current at Short Circuit Moment

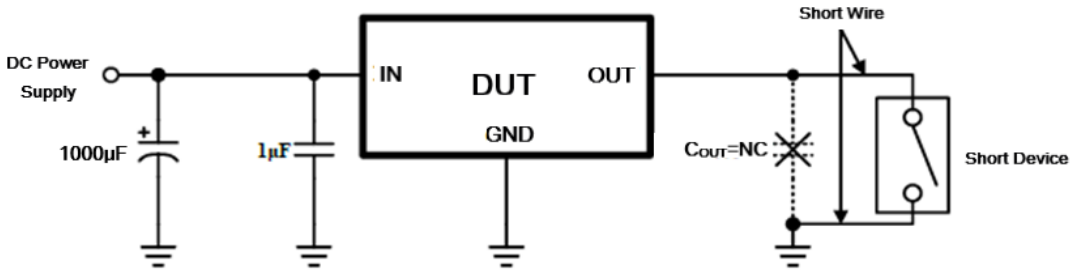
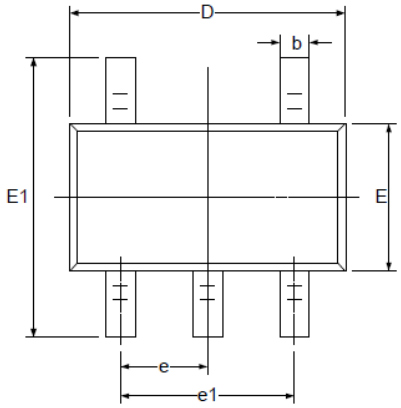
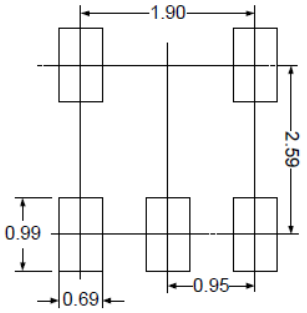


Fig2 Setup to Measure the Short Circuit Characteristic

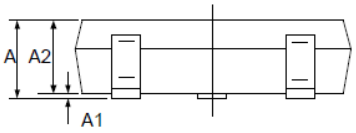
PACKAGE INFORMATION

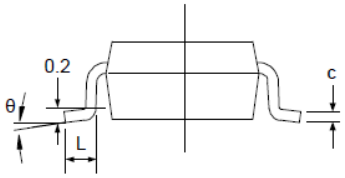
Dimension in SOT-25 (Unit: mm)





RECOMMENDED LAND PATTERN





Symbol	Millimeters	
	Min	Max
A	1.050	1.250
A1	0.000	0.100
A2	1.050	1.150
b	0.300	0.500
c	0.100	0.200
D	2.850	3.050
E	1.500	1.700
E1	2.650	2.950
e	0.950 BSC	
E1	1.800	2.000
L	0.300	0.600
θ	0°	8°

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