DESCRIPTION

The A4771 Smart Switch is a current limited P-channel MOSFET power switch designed for high-side load switching applications. This switch operates with inputs ranging from 2.4V to 5.5V, making it ideal for both 3V and 5V systems. An integrated current-limiting circuit protects the input supply against large currents which may cause the supply to fall out of regulation. The A4771 is also protected from thermal overload which limits power dissipation and junction temperatures. It can be used to control loads that require up to 1A. Current limit threshold is programmed with a resistor from SET to ground. The quiescent supply current is typically a low 9μA. In shutdown mode, the supply current decreases to less than 1μA.

The A4771 is available in SOT-25 package.

ORDERING INFORMATION

Package Type	Part Number	
SOT-25	E5	A4771E5R-X
		A4771E5VR-X
Note	X: H: High Level Active L: Low Level Active V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products Suffix " V " means Halogen free Package		

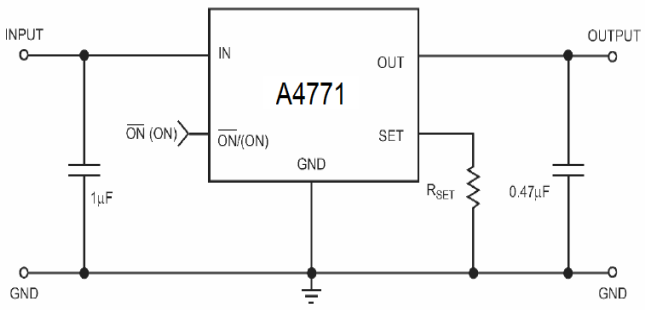
FEATURES

- Input Voltage Range: 2.4V to 5.5V
- Programmable Over-Current Threshold
- Fast Transient Response:
  400ns Response to Short Circuit
- Low Quiescent Current
  9μA Typical
  1μA Max with Switch Off
- 200mΩ Typical $R_{DS(ON)}$
- Only 2.5V Needed for ON/OFF Control
- Under-Voltage Lockout
- Thermal Shutdown
- 4kV ESD Rating
- Temperature Range: -40°C to +85°C
- Available in SOT-25 Package

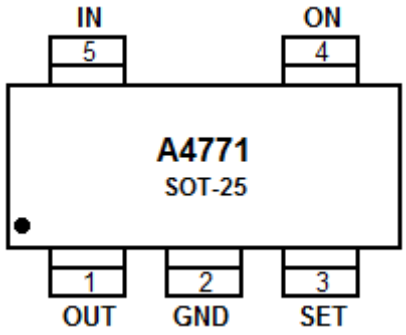
APPLICATION

- Hot Swap Supplies
- Notebook Computers
- Peripheral Ports
- Personal Communication Devices

TYPICAL APPLICATION



PIN DESCRIPTION



Top View

Pin #	Symbol	Function
1	OUT	P-channel MOSFET drain. Connect a 0.47μF capacitor from OUT to GND.
2	GND	Ground connection.
3	SET	Current limit set input. A resistor from SET to ground sets the current limit for the switch.
4	ON	Enable input. Two versions are available, active-high and active-low. See Ordering Information for details.
5	IN	P-channel MOSFET source. Connect a 1μF capacitor from IN to GND.

ABSOLUTE MAXIMUM RATINGS

T_A = 25°C, unless otherwise noted

V_{IN}, IN to GND	-0.3V~ 7V
V_{ON}, ON($\overline{ON}$) to GND	-0.3V ~V_{IN} + 0.3V
V_{SET}, V_{OUT}, SET, OUT to GND	-0.3V ~V_{IN} + 0.3V
I_{MAX}, Maximum Continuous Switch Current	2A
T_J, Operating Junction Temperature Range	-40~150°C
T_{LEAD}, Soldering Temperature (Soldering, 10s)	260°C
V_{ESD}, ESD Rating[NOTE1] - HBM	4kV

Stress beyond above listed “Absolute Maximum Ratings” may lead permanent damage to the device. These are stress ratings only and operations of the device at these or any other conditions beyond those indicated in the operational sections of the specifications are not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

NOTE1: Human body model is a 100pF capacitor discharged through a 1.5kΩ resistor into each pin.

THERMAL CHARACTERISTICS[NOTE2]

Parameter	Symbol	Value	Units
Thermal Resistance	θ_{JA}	150	°C/W
Power Dissipation	P_D	667	mW

NOTE2: Mounted on a demo board.

ELECTRICAL CHARACTERISTICS

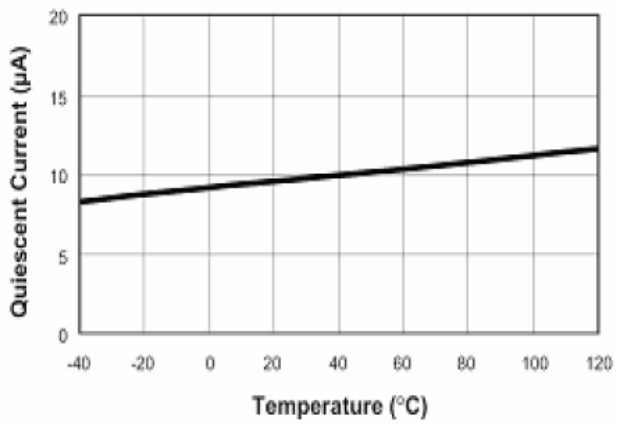
V_{IN} = 5V, T_A = -40°C to +85°C, unless otherwise noted. Typical values are T_A= 25°C

Parameter	Symbol	Conditions	Min	Typ	Max	Units
Operation Voltage	V_{IN}		2.4		5.5	V
Quiescent Current	I_Q	V_{IN} = 5V, ON($\overline{ON}$)=Active, I_{OUT} = 0		7	25	μA
Off Supply Current	$I_{Q(OFF)}$	ON($\overline{ON}$)= Inactive, V_{IN} = 5.5V			1	μA
Off Switch Current	$I_{SD(OFF)}$	ON($\overline{ON}$)= Inactive, V_{IN}=5.5V,V_{OUT}=0		0.01	1	μA
Under-Voltage Lockout	V_{UVLO}	Rising Edge, 1% Hysteresis		1.8	2.4	V
On Resistance	$R_{DS(ON)}$	V_{IN} = 5.0V, T_A = 25°C		200		mΩ
		V_{IN} = 4.5V, T_A = 25°C		210		
		V_{IN} = 3.0V, T_A = 25°C		250		
On Resistance Temperature Coefficient	TC_{RDS}			2800		ppm/℃
Current Limit	I_{LIM}	R_{SET} = 7.2kΩ	0.75	1	1.25	A
Minimum Current Limit	$I_{LIM(MIN)}$			130		mA
ON($\overline{ON}$) Input Low Voltage	$V_{ON(L)}$	V_{IN} = 2.7V to 5.5V			0.8	V
ON ($\overline{ON}$) Input High Voltage	$V_{ON(H)}$	V_{IN} = 2.7V to < 4.2V	2.0			
		V_{IN} ≥4.2V to 5.0V	2.4			
ON ($\overline{ON}$) Input Leakage	$I_{ON(SINK)}$	V_{ON} = 5.5V		0.01	1	μA
Current Limit Response Time	T_{RESP}	V_{IN} = 5V		50		μs
Turn-Off Time	T_{OFF}	V_{IN} = 5V, R_L = 10Ω		10	16	μs
Turn-On Time	T_{ON}	V_{IN} = 5V, R_L = 10Ω		14	200	μs
Over-Temperature Threshold	T_{SD}	V_{IN} = 5V, T_J Increasing		125		°C
		V_{IN} = 5V, T_J Decreasing		115		

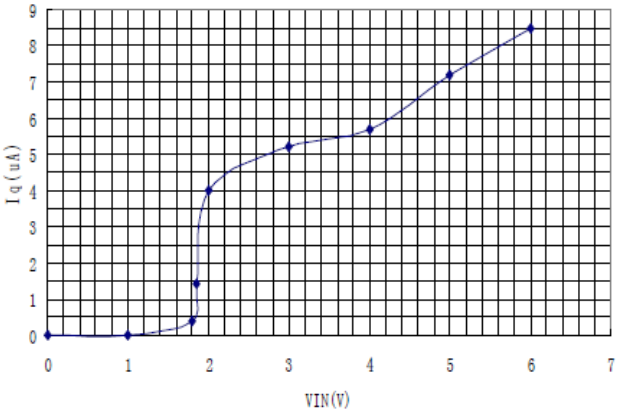
TYPICAL PERFORMANCE CHARACTERISTICS

V_{IN} = 5V, T_A= 25°C, unless otherwise noted

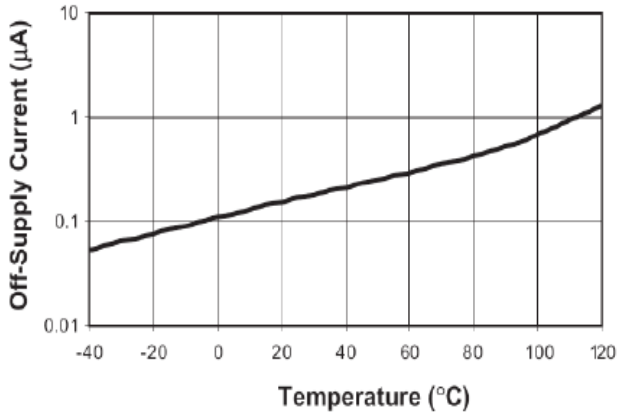
1. Quiescent Current vs. Temperature



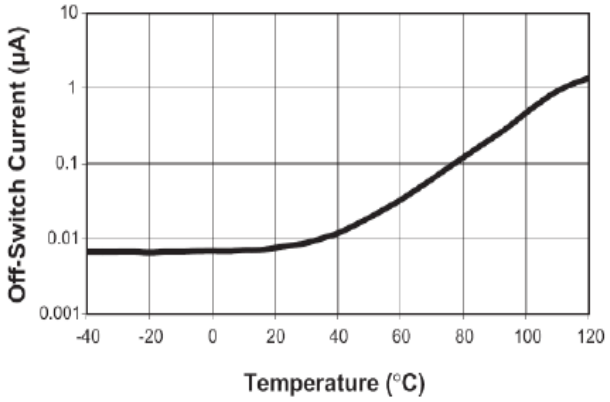
2. Quiescent Current vs. V_{IN}



3. Off-Supply Current vs. Temperature

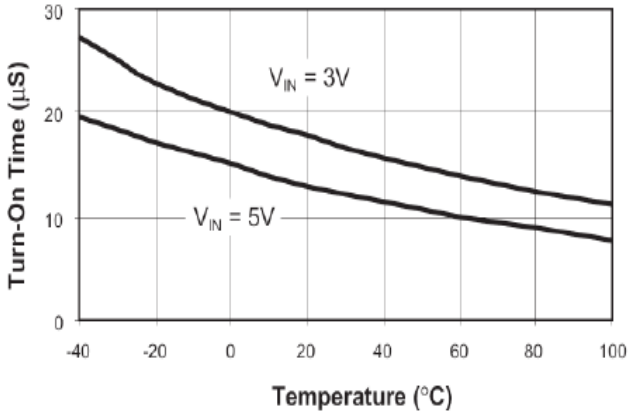


4. Off-Switch Current vs. Temperature



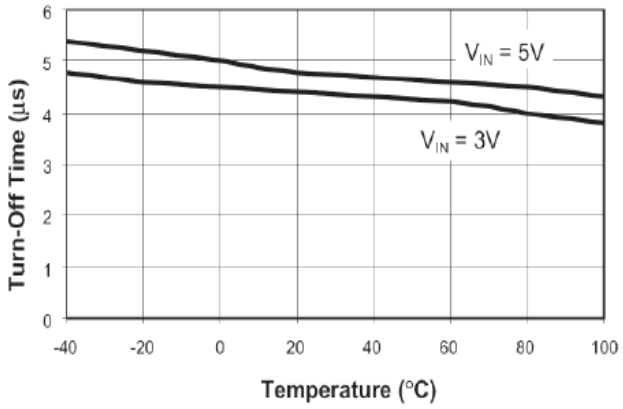
5. Turn-On vs. Temperature

R_{LOAD}=10Ω, C_{LOAD}=0.47µF



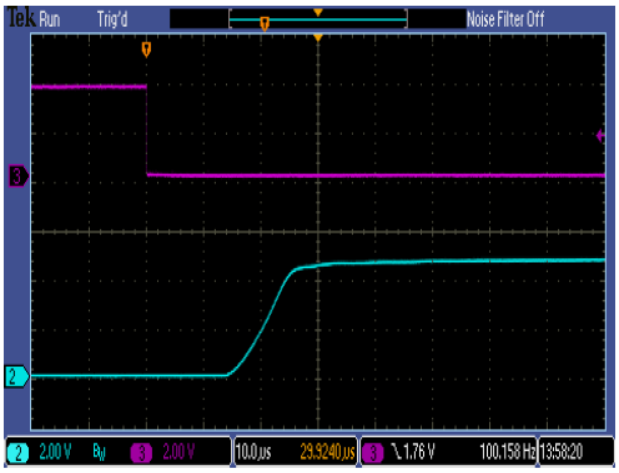
6. Turn-Off vs. Temperature

R_{LOAD}=10Ω, C_{LOAD}=0.47µF

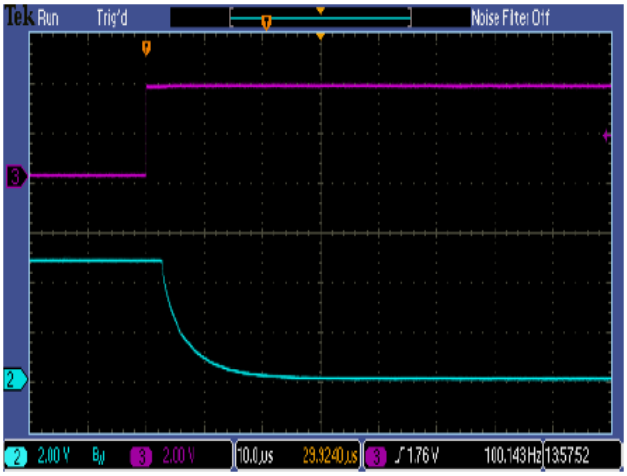


7. V_{IN}=5V,R_L=10Ω,R_C=0.47uF(Channel3=V_{EN},Channel2=V_O)

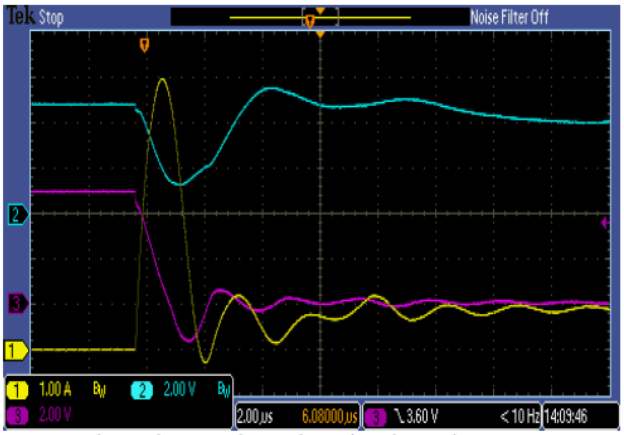
Turn on



Turn off

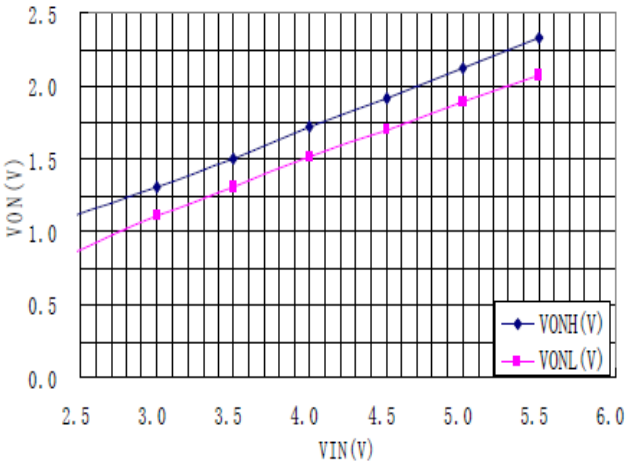


Short circuit to GND

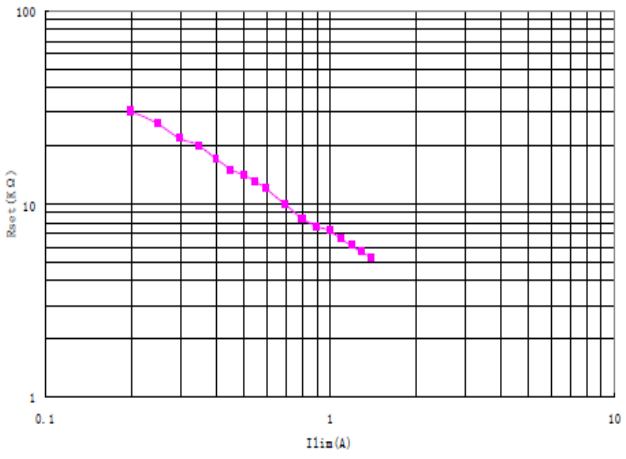


Channel1=IO,Channel2=Vin,Channel3=Vo

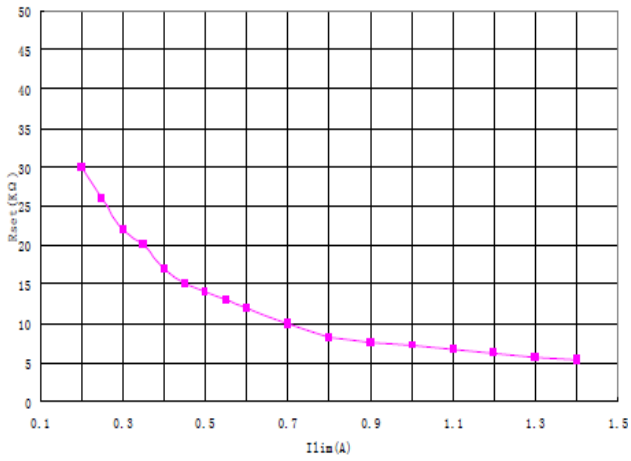
8. V_{ON} vs. V_{IN}



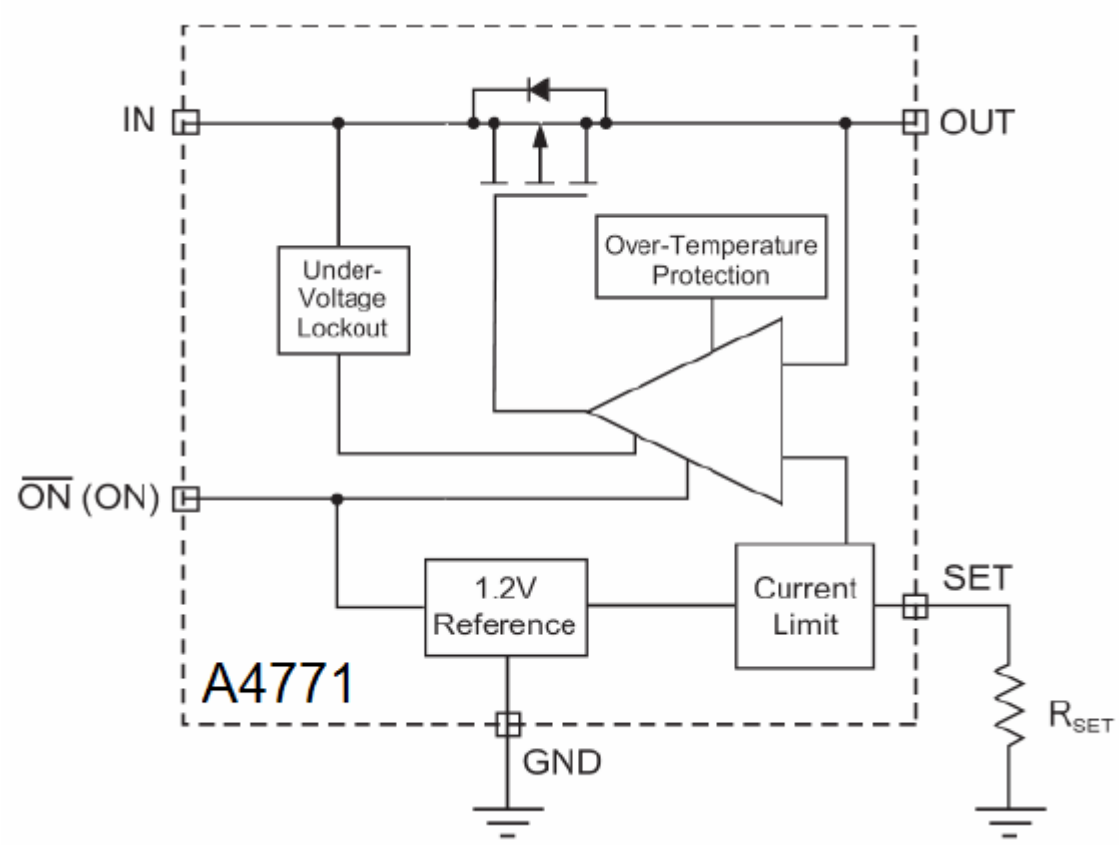
9. R_{SET} vs. I_{LIM}



10. R_{SET} vs. I_{LIM}



BLOCK DIAGRAM



DETAILED INFORMATION

Application Information

Setting Current Limit

In most applications, the variation in I_{LIM} must be taken into account when determining R_{SET}. The I_{LIM} variation is due to processing variations from part to part, as well as variations in the voltages at IN and OUT, plus the operating temperature. These three factors add up to a ±25% tolerance Figure 1 illustrates a cold device with a statistically higher current limit and a hot device with a statistically lower current limit, both with R_{SET} equal to 10kΩ. While the chart, "R_{SET} vs. I_{LIM}" indicates an I_{LIM} of 0.7A with an R_{SET} of 10kΩ, this figure shows that the actual current limit will be at least 0.525A and no greater than 0.880A.

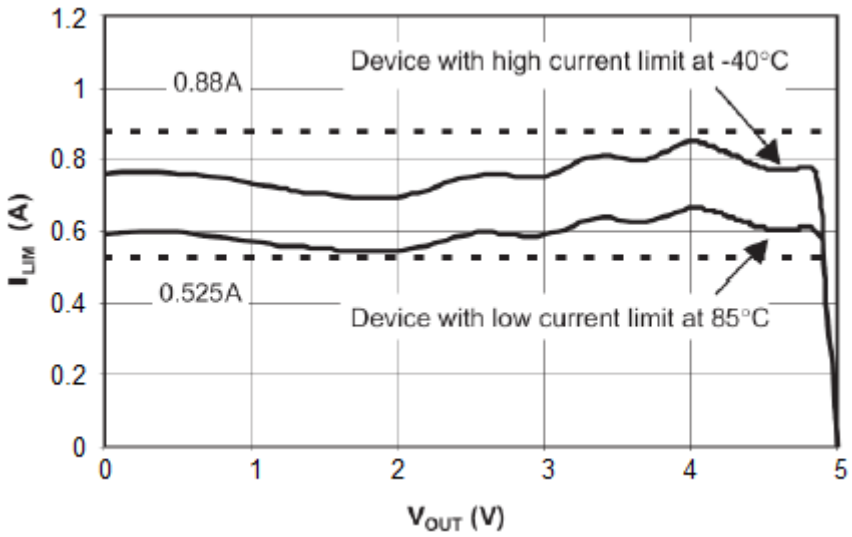


Figure 1: Current Limit Using 10kΩ.

To determine R_{SET}, start with the maximum current drawn by the load and multiply it by 1.33 (typical I_{LIM} = minimum I_{LIM} / 0.75). This is the typical current limit value. Next, refer to "R_{SET} vs. I_{LIM}" and find the R_{SET} that corresponds to the typical current limit value. Choose the largest resistor available that is less than or equal to it. For greater precision, the value of R_{SET} may also be calculated using the I_{LIM}, R_{SET} product found in the chart "R_{SET} Coefficient vs. I_{LIM}." The maximum current is derived by multiplying the typical current for the chosen R_{SET} in the chart by 1.25. A few standard resistor values are listed in the table "Current Limit R_{SET} Values."

Current Limit R_{SET} Values

R_{SET} (KΩ)	Current Limit Typ. (mA)	Device Will not Current Limit Below (mA)	Device Always Current Limits Below (mA)
30	200	150	250
26	250	188	313
22	300	225	375
20	350	263	438
17	400	300	500
15	450	338	563
14	500	375	625
13	550	413	688
12	600	450	750
10	700	525	875
8.3	800	600	1000
7.8	900	675	1125
7.2	1000	750	1250
6.6	1100	825	1375
6.1	1200	900	1500
5.6	1300	975	1625
5.3	1400	1050	1750

Example: A USB port requires 0.5A. 0.5A multiplied by 1.33 is 0.665A. From the chart named "R_{SET} vs. I_{LIM}," R_{SET} should be less than 12kΩ. 10kΩ is a standard value that is a little less than 12kΩ but very close. The chart reads approximately 0.700A as a typical I_{LIM} value for 10kΩ. Multiplying 0.700A by 0.75 and 1.25 shows that the A4771 will limit the load current to greater than 0.525A but less than 0.875A.

Operation in Current Limit

When a heavy load is applied to the output of the A4771, the load current is limited to the value of I_{LIM} determined by R_{SET}. See Figure 2, "Overload Operation." Since the load is demanding more current than I_{LIM}, the voltage at the output drops. This causes the A4771 to dissipate a larger than nor-mal quantity of power, and its die temperature to increase. When the die temperature exceeds an over-temperature limit, the A4771 will shut down until is has cooled sufficiently, at which point it will startup again.

The A4771 will continue to cycle on and off until the load is removed, power is removed, or until a logic high level is applied to ON.

Enable Input

In many systems, power planes are controlled by integrated circuits which run at lower voltages than the power plane itself. The enable input ON of the A4771 has low and high threshold voltages that accommodate this condition. The threshold voltages are compatible with 5V TTL and 2.5V to 5V CMOS.

Reverse Voltage

The A4771 is designed to control current flowing from IN to OUT. If a voltage is applied to OUT which is greater than the voltage on IN, large currents may flow. This could cause damage to the A4771

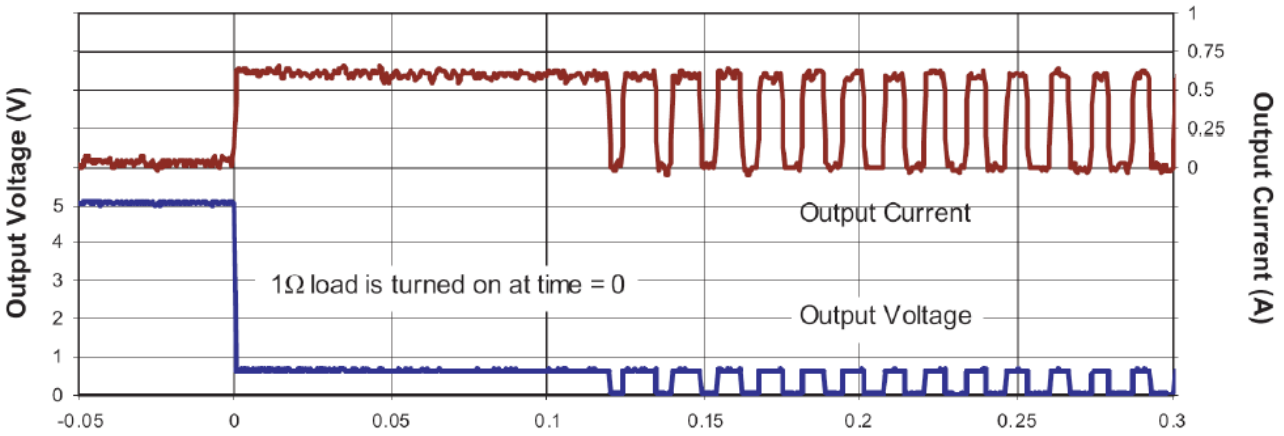
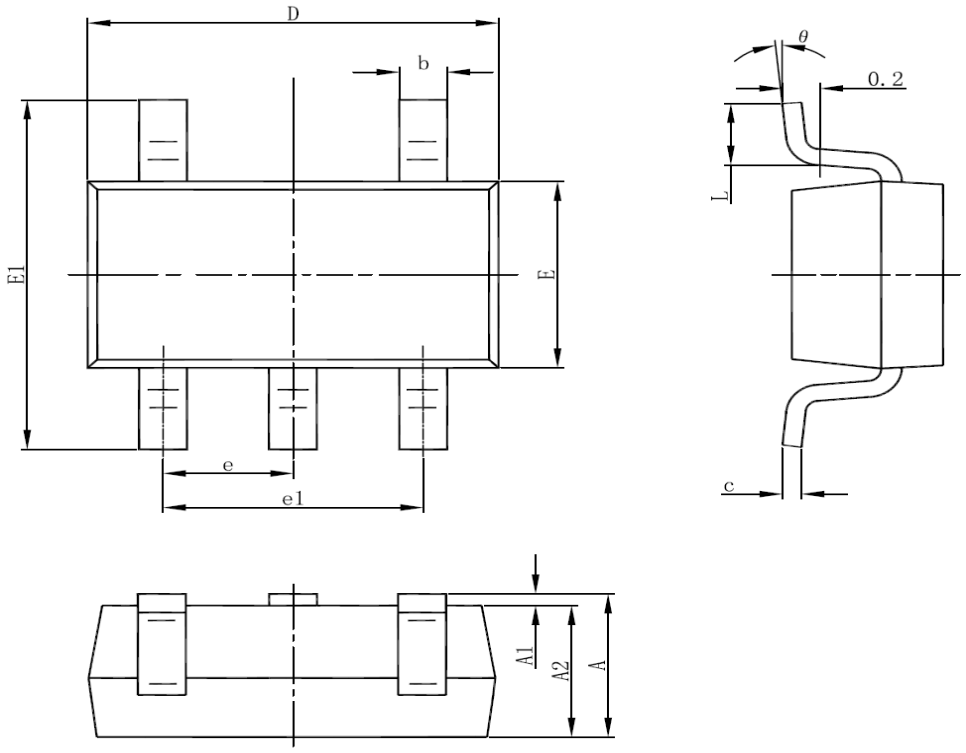


Figure 2: Overload Operation

PACKAGE INFORMATION

Dimension in SOT-25 (Unit: mm)



Symbol	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	2.820	3.020
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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