DESCRIPTION

The A4779 is an integrated power switch for self-powered and bus-powered Universal Serial Bus (USB) applications. Several Protection functions include current limit, thermal shutdown to prevent catastrophic switch failure caused by increasing power dissipation when continuous heavy loads or short circuit occurs.

A built-in 100mΩ P-channel MOSFET with true shutdown function to eliminate any reversed current flow across the switch when it is powered off. When the output voltage is higher than input voltage, the power switch will be turned OFF by internal output reverse-voltage comparator. $\overline{FLG}$ is an open-drain output, which report over-current or over-temperature event and has a typical 8 ms deglitch timeout period. In addition, $\overline{FLG}$ also has typical 3ms deglitch timeout period and reports output reverse-voltage condition.

The A4779 is available in SOT-25 Package.

FEATURES

- 100mΩ High-Side MOSFET Switch
- 1.5 A Continuous Current
- Built-in Current Limits
- Operating Range: 2.7 V to 5.5 V
- 0.2 ms Typical Rise Time
- Fast Over-current Response 5μs (typ.)
- Under Voltage Lockout
- 30μA Quiescent Supply Current
- 1μA Maximum Shutdown Supply Current
- No Reverse Current when Power Off
- Output Reverse-Voltage Protection
- Deglitched Open-Drain Over-Current Flag Output $\overline{FLG}$
- A4779-H: Active-high Enable Input
- A4779-L: Active-low Enable Input
- Output Auto Discharge Function
- Available in SOT-25 Package

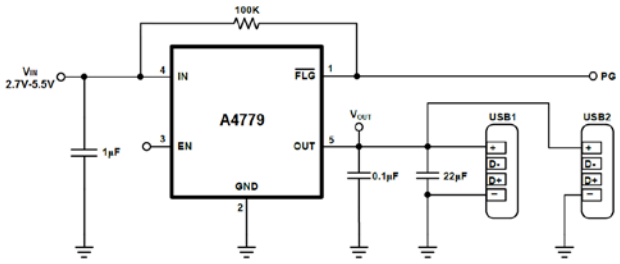
APPLICATION

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

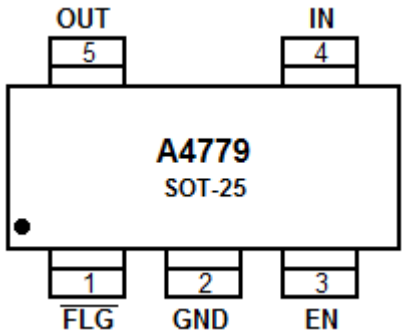
ORDERING INFORMATION

Package Type	Part Number	
SOT-25 SPQ: 3,000pcs/Reel	E5	A4779E5R-T
		A4779E5VR-T
Note	T: Active H: High; L: Low V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

TYPICAL APPLICATION



PIN DESCRIPTION



Top View

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

ABSOLUTE MAXIMUM RATINGS

IN	-0.3V ~ 7V
OUT	-0.3V ~ V_{IN}
EN/$\overline{EN}$	-0.3V ~ V_{IN}+0.3V
$\overline{FLG}$	-0.3V ~ V_{IN}+0.3V
ESD Rating per ESDA/JEDEC JDS-001-2014	
Human Body Mode	2kV[NOTE1]
Package Thermal Resistance [NOTE2]	
θ_{JA}	250°C/W
θ_{JC}	60°C/W
Continuous Power Dissipation (T_A = 25°C)	0.5W
Max Junction Temperature[NOTE3]	150°C
T_S, Storage Temperature	-65°C ~ +150°C
Lead Temperature (Soldering 10 sec.)	260°C

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.

OPERATING RATINGS

Parameter	Symbol	Min	Max	Unit
Supply Voltage	V_{IN}	2.7	5.5	V
Operating Temperature	T_A	-40	85	°C

ELECTRICAL CHARACTERISTICS[NOTE4]

V_{IN} = 5V, C_{IN}=1μF, C_{OUT}=1μF, T_A = 25°C, unless otherwise noted.

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Input Supply Voltage						
Input Voltage	V_{IN}		2.7	-	5.5	V
Quiescent Current	I_{IN_ON}	V_{IN}=5.5V, I_{OUT} = 0mA	-	30	-	μA
Shutdown Current	I_{IN_OFF}	V_{IN}=5.5V, I_{OUT} = 0mA	-	0.1	1	μA
Output Leakage Current	$I_{LEAKAGE}$	V_{OUT}=5.5V, V_{IN}=0V	-	2	5	μA
UVLO Threshold	V_{UVLO_ON}	V_{IN} Rising	-	2.45	2.60	V
UVLO Hysteresis	V_{UVLO_HYS}		-	25	-	mV
Power switch						
Output MOSFET	R_{DS_ON}	I_{LOAD}=1A	-	100	136	mΩ
Enable and Soft-start						
Enable High Level Threshold	V_{EN_H}	V_{IN}=5.5V	1.2	-	-	V
Enable Low Level Threshold	V_{EN_L}	V_{IN}=2.5V	-	-	0.7	V
EN Input Current	I_{EN}	V_{EN}=5.5V or 0V	-0.5	5	10	μA
Turn-On Time	t_{ON}	C_L=1μF, R_{LOAD}=100Ω	-	0.2	-	ms
Turn-Off Time	t_{OFF}	C_L=1μF, R_{LOAD}=100Ω	-	0.3	-	ms
Output and Current Limit						
Over Current CC Regulation	I_{LIMIT}	V_{IN} = 5V, V_{OUT}=3.5V	1.6	1.8	2.0	A
Reverse Voltage Protection	$V_{REVERSE}$	V_{OUT}-V_{IN}	5	20	50	mV
Reverse Current Protection	$I_{REVERSE}$		0.1	0.4	1	A
Output Rise Time	t_R	C_{OUT}=1μF, R_{LOAD}=100Ω	-	0.1	-	ms
Output Fall Time	t_F	C_{OUT}=1μF, R_{LOAD}=100Ω	-	0.3	-	ms
Response Time to Short Circuit	t_{SC}	V_{IN}=5V, see figure 1,2	-	5	-	μs
Output Auto Discharge Resistance	R_{OUT}	V_{IN} = 5V, V_{OUT} = 5V In Shutdown Mode	-	300	-	Ω

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
FAULT FLAG $\overline{FLG}$						
Output low Voltage	V_{FLG_LOW}	I_{FLG}=1mA	-	-	180	mV
Continuous Sink Current	I_{FLG_SINK}		-	-	10	mA
Off-state Leakage	$I_{FLG\_LEAKAGE}$		-	-	1	μA
FLG Deglitch Time	t_{FLG}		-	8	-	ms
Thermal Shutdown						
Thermal Shutdown Threshold	T_{SD}		-	150	-	℃
Thermal Shutdown Hysteresis	T_{SD_HYS}		-	20	-	℃
Thermal shutdown Threshold in Current Limit	$T_{CURRENT\_LIMIT}$		-	130	-	℃

NOTE1: Class 2 per ESDA/JEDEC JDS-001-2014 classification.

NOTE2: Thermal Resistance is specified with approximately 1 square of 1oz copper.

NOTE3: T_J is calculated from the ambient temperature T_A and power dissipation P_D.

NOTE4:100% production test at +25 °C. Specifications over the temperature range are guaranteed by design and characterization. The device is not guaranteed to function outside its operating conditions.

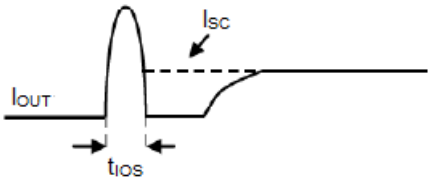


Figure 1. Response Time to Short Circuit

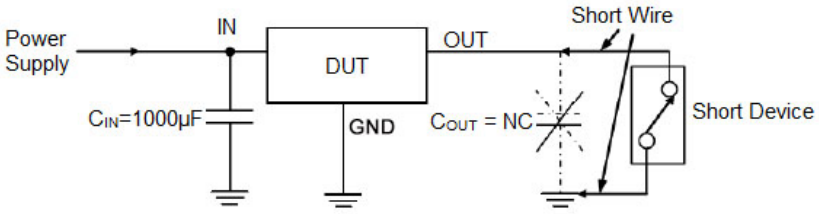


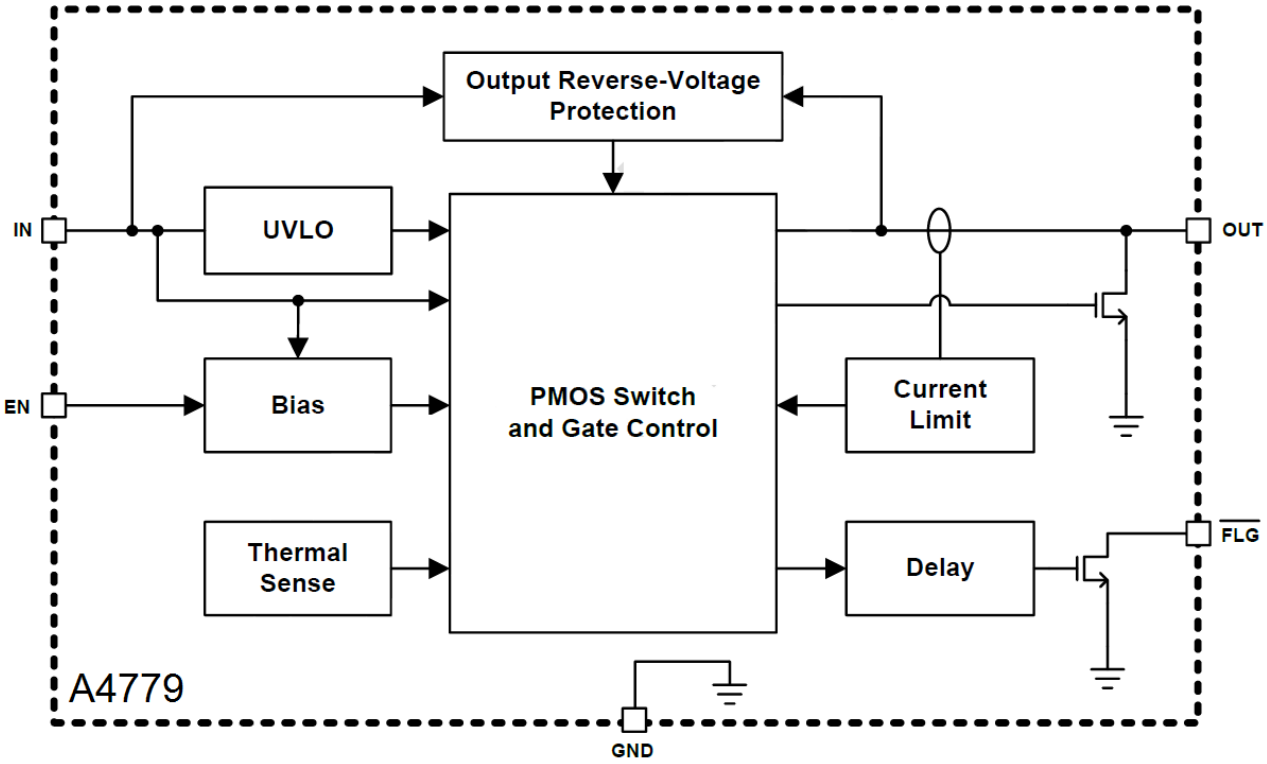
Figure 2. Setup to Measure the Response Time to Short Circuit

Note:

In order to identify the short circuit characteristic of the IC, avoid the interferences of parasitic inductor, output capacitor and contact resistance. It is recommended following the procedures below:

1. Add 1000μF of capacitor between V_{IN} and GND, and close to IC.
2. Remove output capacitor.
3. Short the output by using the Short Device.
4. Measure output current (I_{OUT}).

BLOCK DIAGRAM



DETAILED INFORMATION

Input and Output

IN (input) is the power supply connection to the logic circuitry and the Source of the internal PMOSFET. OUT (output) is the Drain of the internal MOSFET. In a typical application, current flows through the switch from IN to OUT toward the load.

Thermal Shutdown

The A4779 protects itself with two independent thermal sensing circuits that monitor the operating temperature of the power-switch and disables operation if the temperature exceeds recommended operating conditions. 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 first thermal sensor turns off the power-switch when the die temperature exceeds 130°C and the part is in current limit. The second thermal sensor turns off the power-switch when the die temperature exceeds 150°C regardless of whether the power-switch is in current limit. Hysteresis is built into both thermal sensors, and the switch turns on after the device has cooled approximately 20°C (Thermal shutdown threshold hysteresis in current-limit is 20°C). The switch continues to cycle off and on until the fault is removed. The open-drain $\overline{FLG}$ is asserted (active low) immediately during an over-temperature shutdown condition.

Under-voltage Lockout

UVLO (under-voltage lockout) prevents the output MOSFET from turning on until IN (input voltage) exceeds 2.45V typically. After the switch turns on, if the voltage drops below 2.425V typically, UVLO shuts off the output MOSFET.

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 20mV (typ) and the MOSFET switch will turn on when output reverse-voltage condition is removed.

$\overline{FLG}$ Function

The $\overline{FLG}$ open-drain output is asserted (active low) when an over current condition is encountered after a 8ms deglitch timeout. The typical trigger point is above 1.6A. The $\overline{FLG}$ output remains asserted until the over-current condition is removed. Over temperature condition is also reported by $\overline{FLG}$ open-drain output. In

addition, $\overline{FLG}$ is also asserted (active low) in output reverse-voltage condition when the output reverse-voltage condition is removed.

Supply Filtering

A 1μF bypass capacitor from IN to GND, located near the A4779, 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. Input transients must not exceed the absolute maximum supply voltage (V_{IN_MAX} = 7V) even for a short duration.

Enable Input

EN (Enable) must be driven by 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.

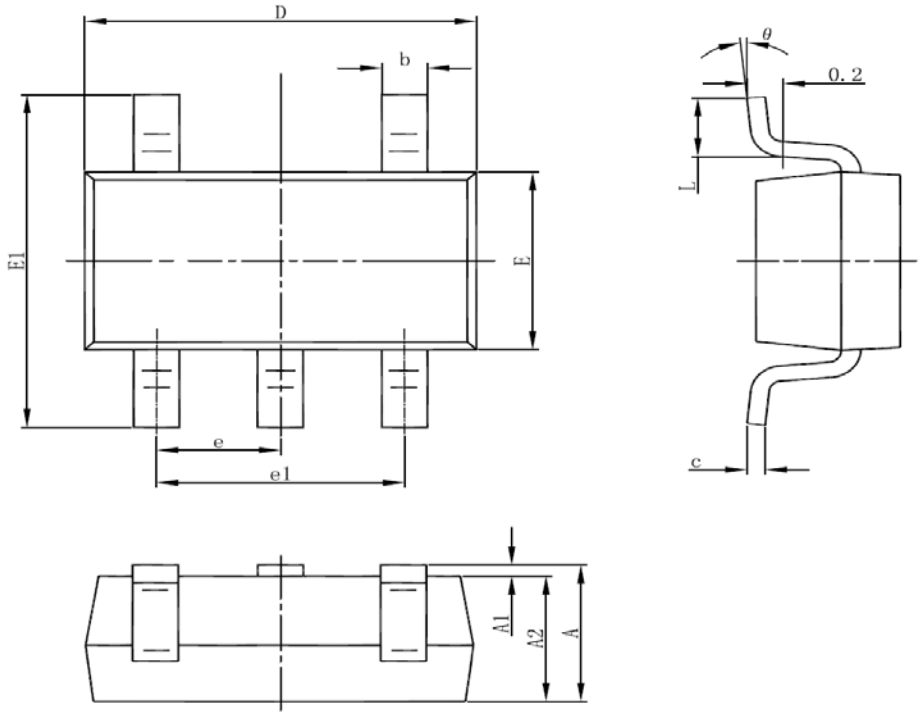
Layout Considerations

For best performance of the A4779 series, the following guidelines must be strictly followed:

1. Input and output capacitors should be placed close to the IC and connected to ground plane to reduce noise coupling.
2. The GND should be connected to a strong ground plane for heat sink.
3. Keep the main current traces as possible as short and wide.

PACKAGE INFORMATION

Dimension in SOT-25 (Unit: mm)



Symbol	Millimeters		Inches	
	Min	Max	Min	Max
A	1.050	1.250	0.041	0.049
A1	0.000	0.100	0.000	0.004
A2	1.050	1.150	0.041	0.045
b	0.300	0.500	0.012	0.020
c	0.100	0.200	0.004	0.008
D	2.820	3.020	0.111	0.119
E	1.500	1.700	0.059	0.067
E1	2.650	2.950	0.104	0.116
e	0.950(BSC)		0.037(BSC)	
e1	1.800	2.000	0.071	0.079
L	0.300	0.600	0.012	0.024
θ	0°	8°	0°	8°

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