DESCRIPTION

The A4775 is a low voltage, high performance single N-MOSFET power switch, designed for power rail on/off control with low RDS(ON)≈70mΩ and full protection functions. The A4775 equipped with a charge pump circuitry to drive the internal MOSFET switch, and a flag output is available to indicate fault conditions against large di/dt which may cause the supply to fall out of regulation. In order to fit different application, an ISET pin is offered for current limit point setting, a resistor from ISET to ground sets the current limit for the switch.

The A4775 also features include soft-start to limit inrush current during plug-in, thermal shutdown to prevent catastrophic switch failure from high-current loads, Output anti back irrigation Protection whether CE pin is connected GND or V_{IN}, under-voltage lockout (UVLO) to ensure that the device remains off unless there is a valid input voltage present, a precision resistor-programmable output current limit up to 3.5A. Besides, the lower quiescent current as 40μA making this device ideal for portable battery-operated equipment.

The A4775 is available in SOT-25, SOT-26, SOP8 TSOT-25, TSOT-26, and DFN6(2x2) packages.

ORDERING INFORMATION

Package Type	Part Number	
SOT-25 SPQ: 3,000pcs/Reel	E5	A4775E5R
		A4775E5VR
SOT-26 SPQ: 3,000pcs/Reel	E6	A4775E6R
		A4775E6VR
TSOT-25 SPQ: 3,000pcs/Reel	TE5	A4775TE5R
		A4775TE5VR
TSOT-26 SPQ: 3,000pcs/Reel	TE6	A4775TE6R
		A4775TE6VR
SOP8 SPQ: 4,000pcs/Reel	M8	A4775M8R
		A4775M8VR
DFN6(2x2) SPQ: 4,000pcs/Reel	J6	A4775J6R
		A4775J6VR
Note	V: Halogen free Package R: Tape & Reel	
AiT provides all RoHS products		

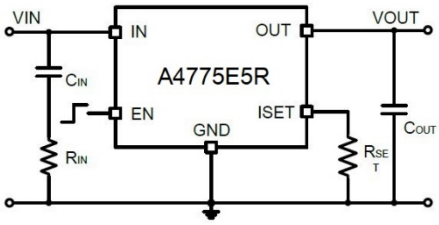
FEATURES

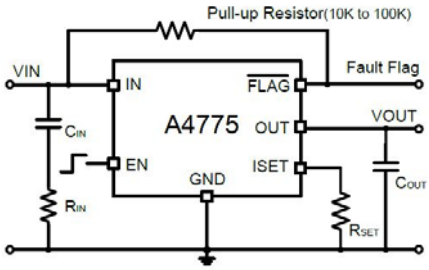
- Adjustable Current Limiting up to 3.5A
  - SOT25, SOT-26, DFN: 3A
  - SOP8:3.5A
- Built-In (Typically 70mΩ) N-MOSFET
- Reverse Current Flow Blocking (no body diode)
- Output Can Be Forced Higher than Input (Off or On State)
- Low Supply Current:
  - 40μA Typical at Switch on State
  - Less than 1μA Typical at Switch Off State
- Wide Input Voltage Ranges: 2V to 5.5V
- Open-Drain Fault Flag Output
- Hot Plug-In Application (Soft-Start)
- 1.7V Typical Under-Voltage Lockout (UVLO)
- Reverse-Voltage Protection
- Thermal Shutdown Protection

APPLICATIONS

- USB 3G/4G/5G Data card
- USB Dongle
- Mini PC Accessories
- LCD Monitor, LCD-TV
- USB Power Module for ADSL
- Information Appliance and Set-Top Box
- Battery-Powered Equipment

TYPICAL APPLICATION

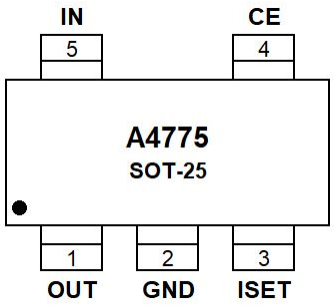




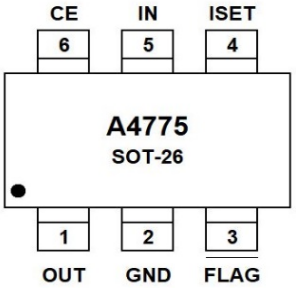
Current Limit: I_{LIMSET}(A)

$$\frac{2.7x10^5}{R_{SET}(\Omega)}$$

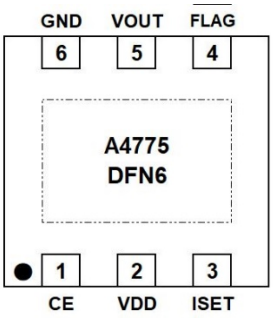
PIN DESCRIPTION



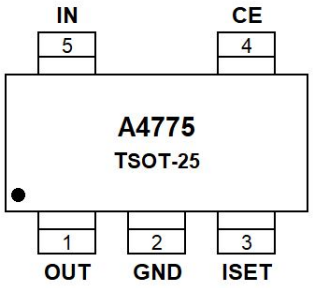
SOT-25, E5
Top View



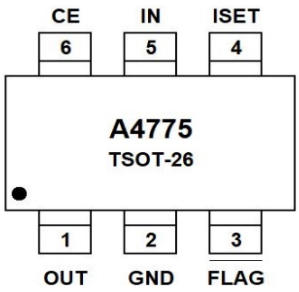
SOT-26, E6
Top View



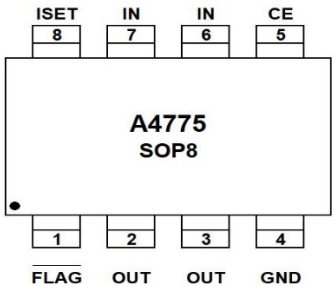
DFN6, J6
Top View



TSOT-25, E5
Top View



TSOT-26, E6
Top View



SOP8, M8
Top View

Pin #				Symbol	Functions
SOT-25 TSOT-25	SOT-26 TSOT-26	DFN6 (2x2)	SOP8		
1	1	5	2,3	OUT	Output Voltage.
2	2	6	4	GND	Ground.
3	4	3	8	ISET	Current Limit Programming Input.
4	6	1	5	CE	Chip Enable (Active High).
5	5		6,7	IN	Power Input Voltage.
	3	4	1	$\overline{\text{FLAG}}$	Open-Drain Fault Flag Output. (Active Low)
		2		VDD	Supply Voltage

ABSOLUTE MAXIMUM RATINGS

Supply Voltage		6.5V
Chip Enable Input Voltage		+0.3V ~ +6.5V
Flag Voltage		6.5V
Power Dissipation *, PD @ T_A = 25°C	SOT-25, SOT-26	0.6W
	TSOT-25, TSOT-26	0.62W
	DFN6	0.70W
	SOP8	0.95W
Package Thermal Resistance	SOT-25, SOT-26, θ_{JC}	60℃/W
	SOT-25, SOT-26, θ_{JA}	203℃/W
	TSOT-25, TSOT-26, θ_{JA}	195℃/W
	DFN6, θ_{JA}	140℃/W
	SOP8, θ_{JA}	104℃/W
Junction Temperature		125℃
Lead Temperature (Soldering, 10 sec.)		260℃
Storage Temperature Range		-65℃ ~ +150V
ESD Susceptibility	(Human Body Mode)	5KV
	(Machine Mode)	500V

Stresses above may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the Electrical Characteristics is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

* The power dissipation figure shown in PCB mounted.

ELECTRICAL CHARACTERISTICS

V_{IN} = 5V and T_A = +25℃, unless otherwise noted.

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
POWER SWITCH						
Input Power range	V_{IN}	-45℃≤T_A≤+125℃	2		5.5	V
Switch On Resistance	$R_{DS(ON)}$	V_{IN}=5V, I_{OUT}=1A	-	65	75	mΩ
Output Rise time	T_R	V_{IN}=5V, C_{IN}=10μA , C_L=1μF, R_L=33Ω (See Figure 1, Parameter Measurement Information)	-	0.2	2	ms
Output Fall time	T_F		-	0.1	0.5	ms
CURRENT LIMIT						
Current-limit Threshold (Maximum DC output current Iout Delivered to Load)	I_{OCP}	V_{IN}=5V, R_{SET}=270kΩ	0.8	1	1.2	A
		V_{IN}=5V, R_{SET}=135kΩ	1.6	2	2.4	A
		V_{IN}=5V, R_{SET}=90kΩ	2.4	3	3.6	A
Current Limit Setting Accuracy	ΔI_{LIMSET}	I_{LIMSET}=1A~2A	-20	-	+20	%
Overcurrent Protection Time	T_{OCP}	V_{IN}=5V	20	35	40	ms
Response Time to Short Circuit	T_{DET}		20	35	40	ms
Regulation Time	T_{REG}		1.8	3	4	ms
ENABLE INPUT CE						
CE Threshold Logic-High Voltage	V_{CEH}	Switch On with no load	-	0.75	-	V
		Switch On with I_{OUT} =10mA	-	1.15	-	V
CE Threshold Logic-Low Voltage	V_{CEL}	Switch Off no load	-	0.7	-	V
		Switch Off I_{OUT} =10mA	-	1.1	-	V
CE Input Current	I_{CE}	V_{CE} =0V~5.5V	-	10	-	pA
Turn on time	T_{ON}	V_{IN}=5V, C_{IN}=10μA , C_L=1μF, R_L=33Ω (See Figure 1, Parameter Measurement Information)	-	-	3	ms
Turn off time	T_{OFF}		-	-	3	ms
REVERSE-VOLTAGE PROTECTION						
V_{OUT} – V_{IN}	V_{REV}		80	135	175	mv
Time from reverse-voltage condition to MOSFET turn off	T_{REV}	V_{IN}=5V	4	6	9	ms
Re-arming Time	T_{RREV}		7	10	15	ms

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Units
SUPPLY CURRENT						
Supply current, low-level output	I_{IN_OFF}	V_{IN}=5V, V_{CE}=0V, No load on OUT	-	0.1	1	μA
Supply current, high-level output	I_{IN_ON}	V_{IN}=V_{CE}=5V, No load on OUT	-	45	80	μA
Reverse leakage current	I_{REV}	V_{OUT}=5V, V_{IN}=V_{CE}=0V	-	0.5	1	μA
FLAG PIN						
FLAG Output Low Voltage	V_{OL}	I_{FLAG}=1mA	-	-	400	mV
Off-state Leakage	I_{LEAK}	V_{FLAG}=5V	-	10	-	nA
FLAG Output Resistance	R_{FLG}	I_{SINK}=1mA	-	14	400	Ω
FLAG Deglitch	T_{FLG}	FLAG De-assertion Time due to Overcurrent or Reverse Voltage Condition	1	2.3	5	ms
THERMAL SHUTDOWN						
Thermal Shutdown Threshold	T_{SD}		-	140	-	℃
Thermal Regulation Threshold	T_{SDOCP}		-	125	-	℃
Thermal Shutdown Rearming Threshold	T_{RSD}		-	115	-	℃
UNDERVOLTAGE LOCKOUT						
IN Pin Low-level Input Voltage	V_{UVLO}	V_{IN} Rising, V_{CE}=5.0V	1.75	1.8	2.0	V
IN Pin Hysteresis	V_{HYST}		-	100	-	mV
Re-arming Time	T_{RUVLO}		20	35	40	ms

PARAMETER MEASUREMENT INFORMATION

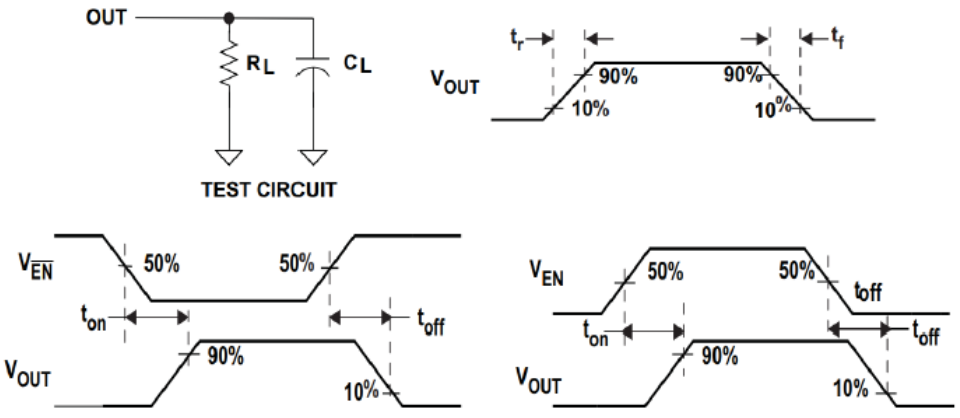


Figure 1. Test Circuit and Voltage Waveforms

TYPICAL PERFORMANCE CHARACTERISTICS

Fig.1 On-State Supply Current VS Input Voltage

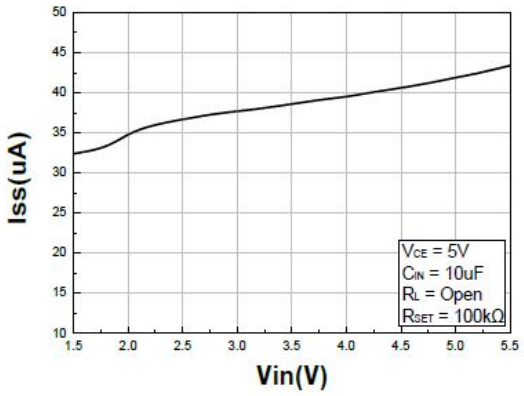


Fig.2 Off-State Supply Current VS Temperature

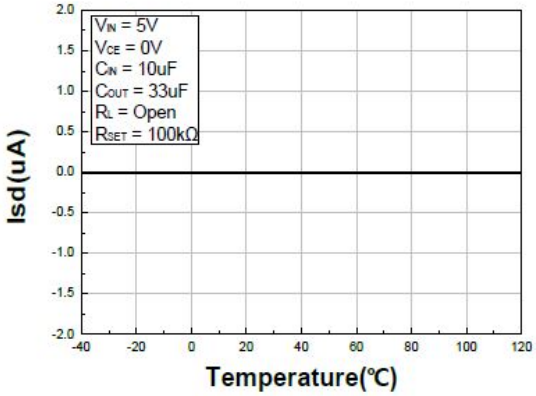


Fig.3 Current Limit VS Input Voltage

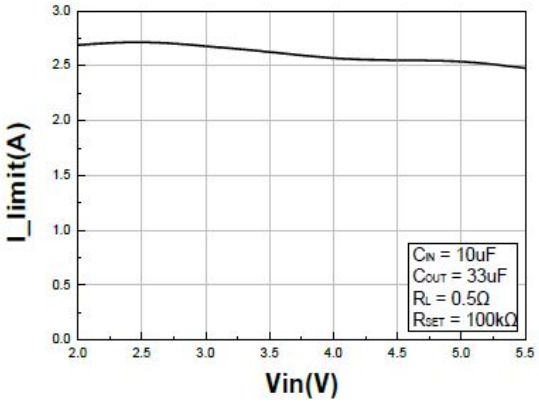


Fig.4 Ron(mΩ) VS Temperature

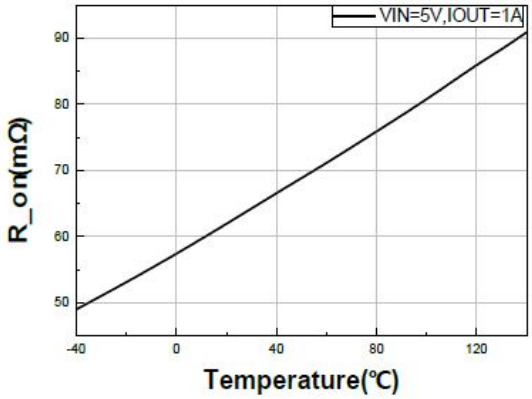


Fig.5 Output Current Limit VS Temperature

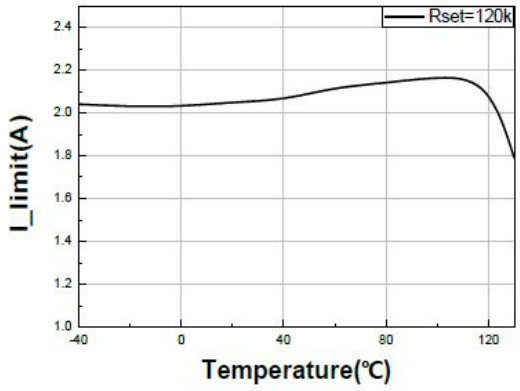


Fig.6 On-Resistance VS Input Voltage

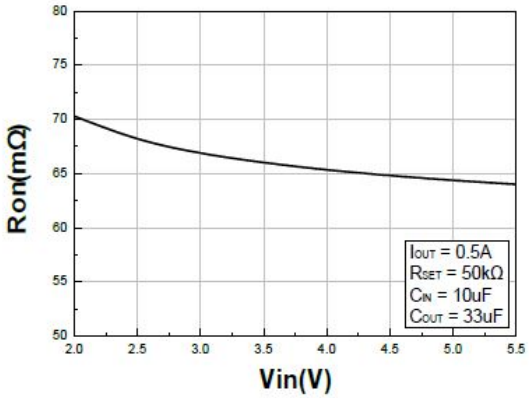


Fig.7 CE Threshold Voltage VS Input Voltage

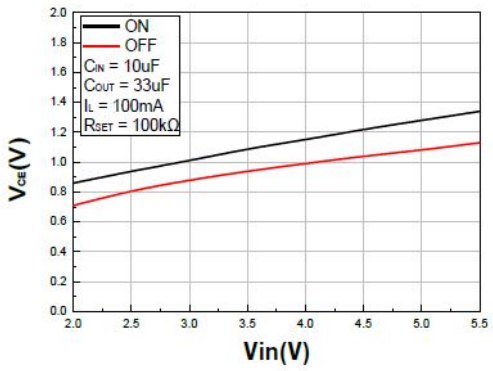


Fig.8 CE Threshold Voltage VS Temperature

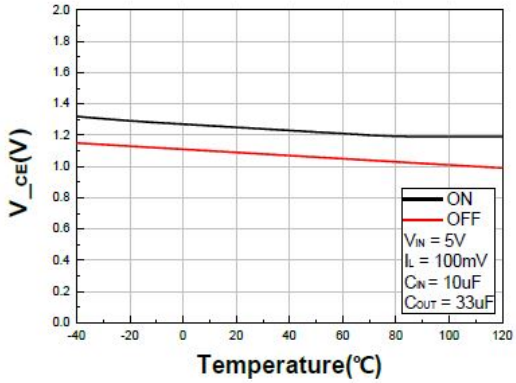


Fig.9 Short Circuit Current Response

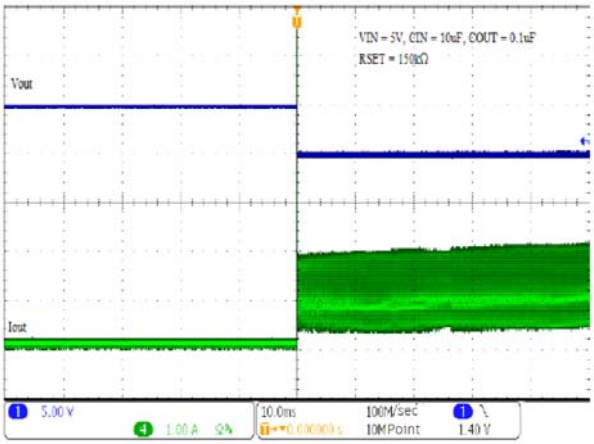


Fig.10 Inrush Current Response

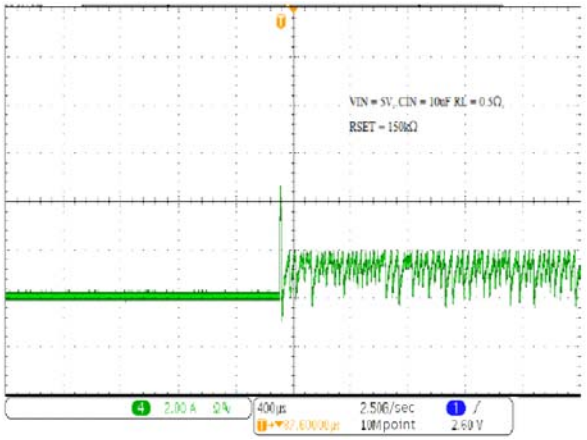


Fig.11 Turn-On Response

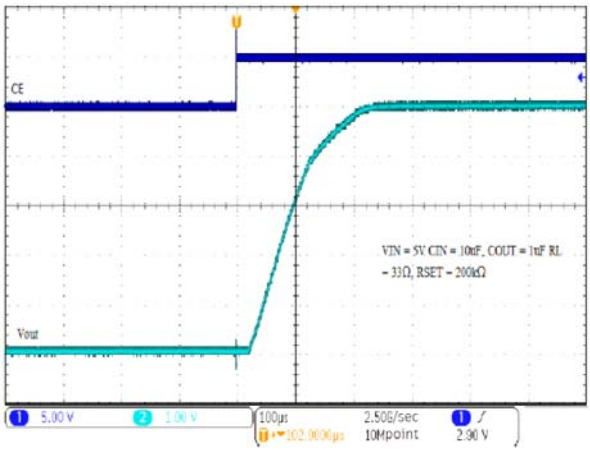


Fig.12 Turn-Off Response

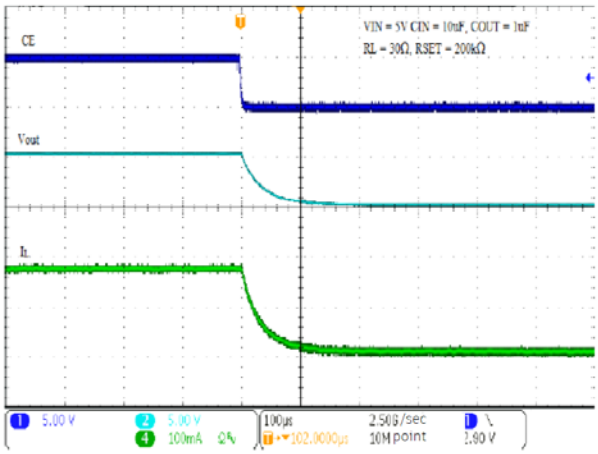


Fig.13 UVLO at Rising

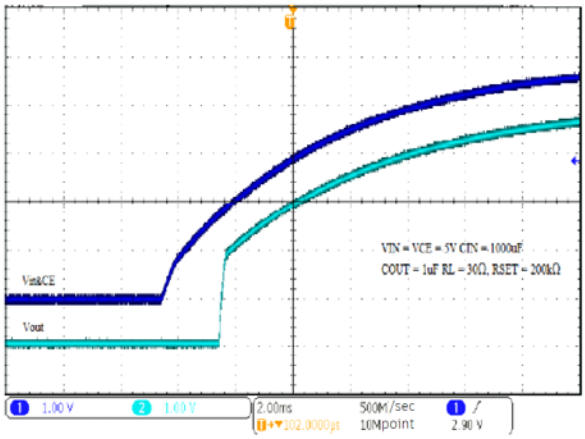


Fig.14 UVLO at Falling

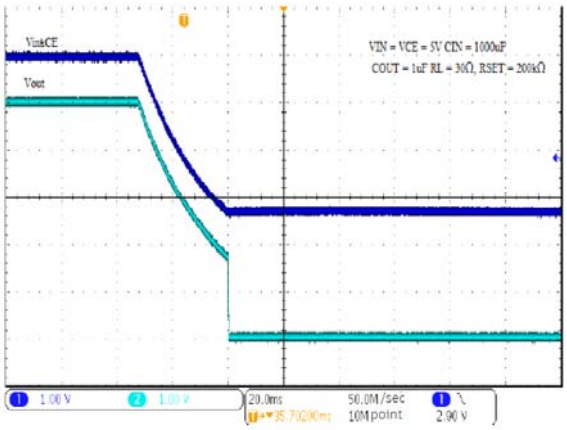


Fig.15 Current Limit with Thermal Shutdown

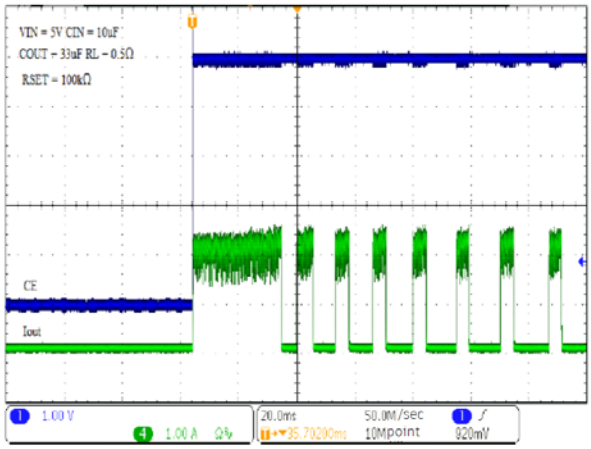


Fig.16 Short- Circuit with Thermal Shutdown

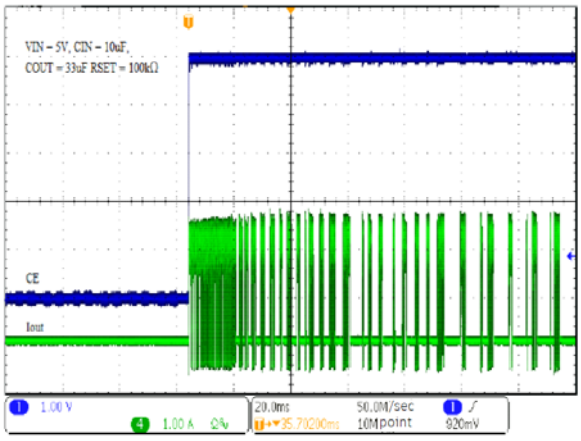


Fig.17 Soft-Start Response

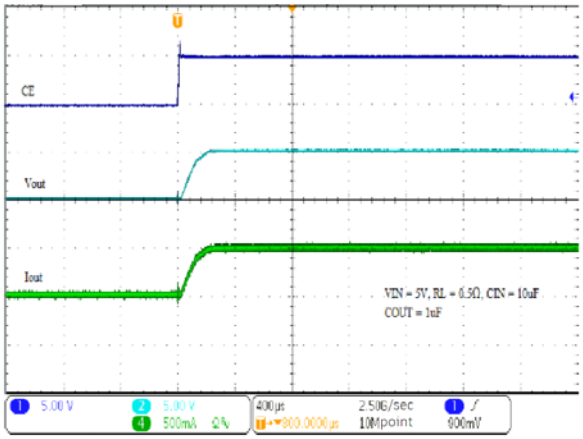


Fig.18 FLAG Response
(Enable into Current Limit)

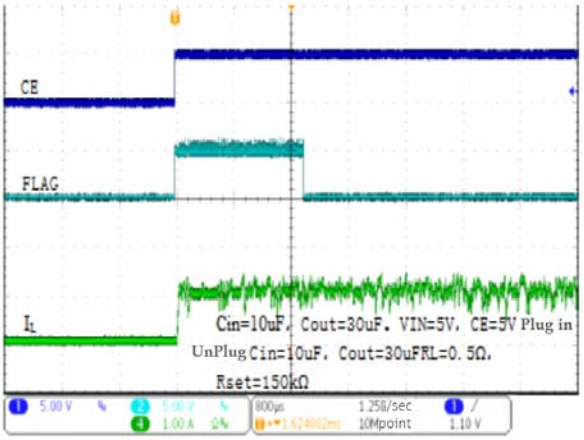
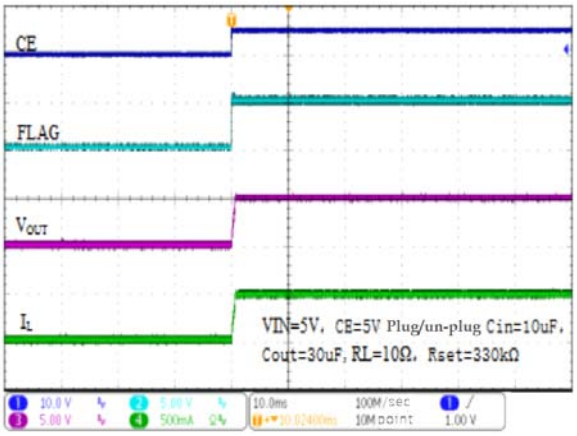
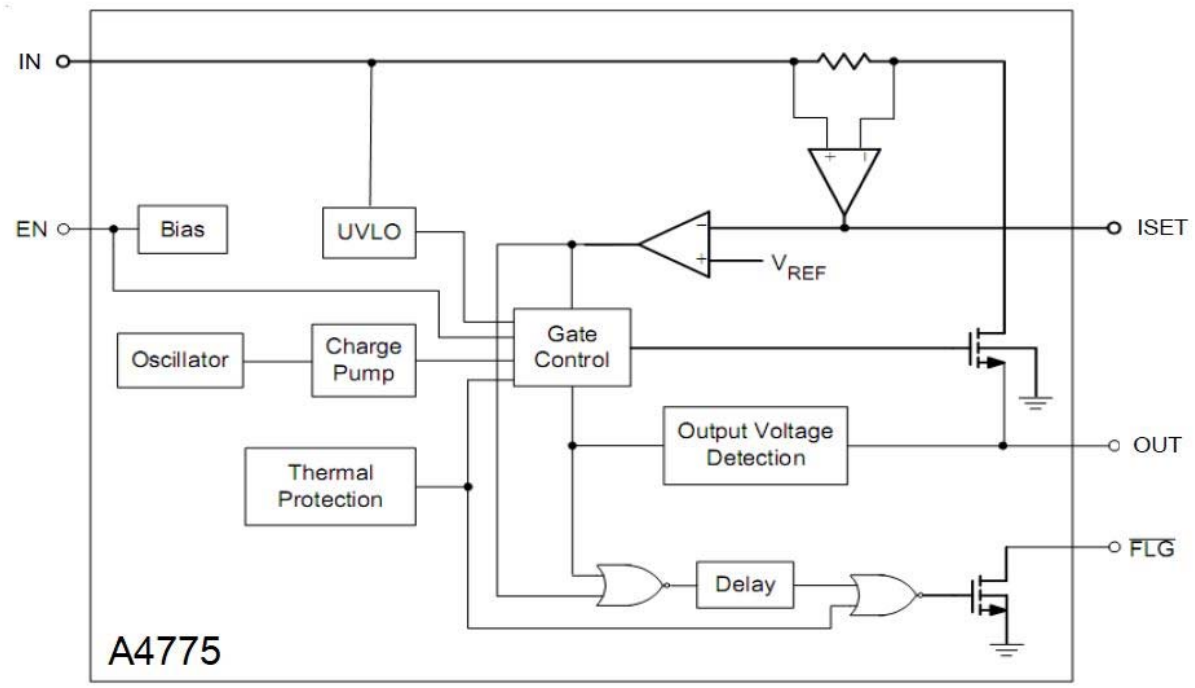


Fig.19 FLAG Response at Chip Enable



BLOCK DIAGRAM



DETAILED INFORMATION

The A4775 is a high-side, N-Channel, power switch available with active-high enable input. Low RDS(ON)≈70mΩ and full protection functions make it optimized to replace complex discrete on/off control circuitry.

Chip Enable Input

The switch will be disabled when the CE pin is in a logic low condition. During this condition, the internal circuitry and MOSFET are turned off, reducing the supply current to 0.1μA typically. The maximum guaranteed voltage for a logic low at the CE pin is 0.8V. A minimum guaranteed voltage of 2V at the CE pin will turn the A4775 back on. Floating the input may cause unpredictable operation. CE should not be allowed to go negative with respect to GND. The CE pin may be directly tied to VIN to keep the part on.

Soft-Start for Hot Plug-In Applications

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

Fault Flag

The A4775 provides a FLAG signal pin which is an N-Channel open drain MOSFET output. This open drain output goes low when VOUT < VIN -1V, current limit or the die temperature exceeds 150°C approximately. The FLAG output is capable of sinking a 10mA load to typically 150mV above ground. The FLAG pin requires a pull-up resistor, this resistor should be large in value to reduce energy drain. A 10kΩ to 100kΩ pull-up resistor works well for most applications. In the case of an over-current condition, FLAG will be asserted only after the flag response delay time, tD, has elapsed. This ensures that FLAG is asserted only upon valid over-current conditions and that erroneous error reporting is eliminated.
For example, false over-current conditions may occur during hot-plug events when a highly large capacitive load is connected and causes a high transient inrush current that exceeds the current limit threshold. The FLAG response delay time tD is typically 2.3ms.

Reverse-Voltage Protection

The reverse-voltage protection feature turns off the N-channel MOSFET whenever the output voltage exceeds the input voltage by 140 mV. A reverse current of (VOUT-VIN)/RDS(ON) will be present when this occurs. This prevents damage to devices on the input side of the A4775 by preventing significant current from sinking into the input capacitance. The A4775 devices allow the N-channel MOSFET to turn on once the output voltage goes below the input voltage for the same 2.3ms deglitch time. The reverse-voltage comparator also asserts the FLAG after 2.3ms.

Under-Voltage Lockout

Under-Voltage lockout (UVLO) prevents the MOSFET switch from turning on until input voltage exceeds approximately 1.7V. If input voltage drops below approximately 1.3V, UVLO turns off the MOSFET switch, FLAG will be asserted accordingly. Under- Voltage detection functions only when the chip enable input is enabled.

Current Limiting

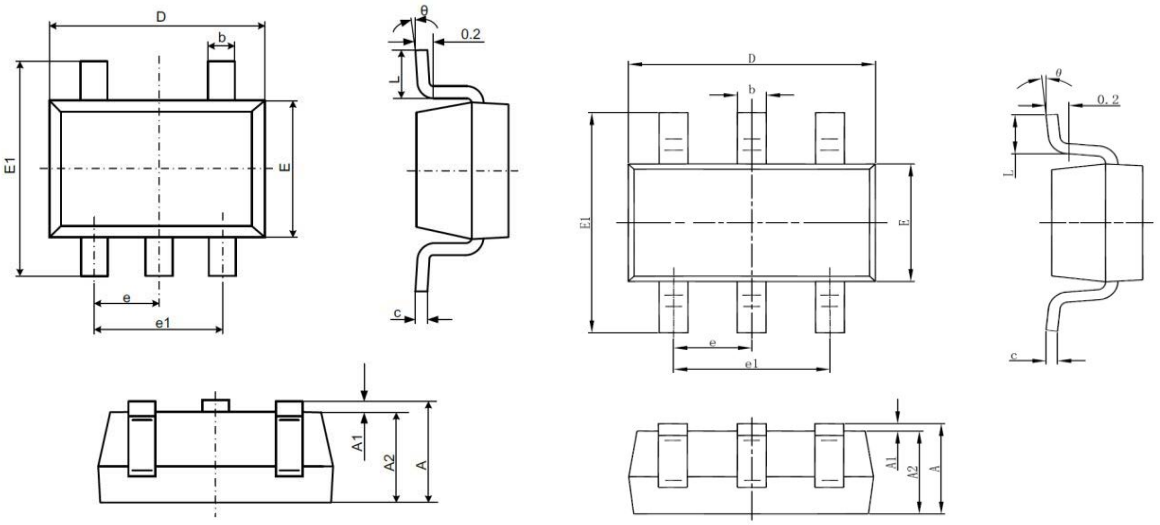
The current limit circuitry prevents damage to the MOSFET switch and external load. It is user adjust- able with an external set resistor, RSET, ILIMIT = 270k/RSET in the range of 600mA to 3.5A. The accuracy of current limit set point may vary with operating temperature and supply voltage. See “Typical Performance Characteristics” graph for further details.

Thermal Shutdown

Thermal shutdown is employed to protect the device from damage if the die temperature exceeds approximate 150°C. If enabled, the switch automatically restarts when the die temperature falls 30°C. The output and FLAG signal will continue to cycle on and off until the device is disabled or the fault is remove.

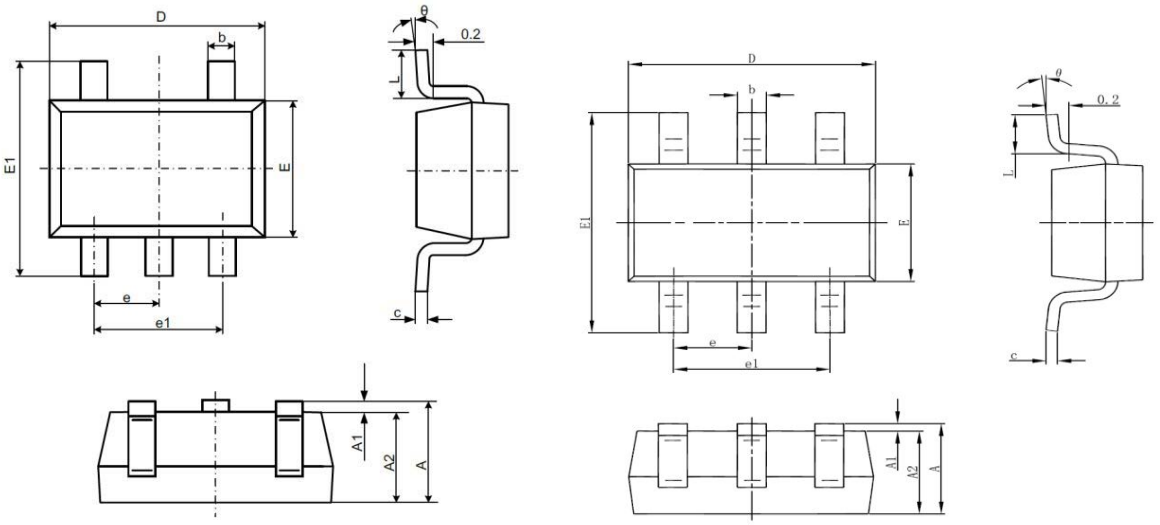
PACKAGE INFORMATION

Dimension in SOT-25/SOT-26 (Unit: mm)



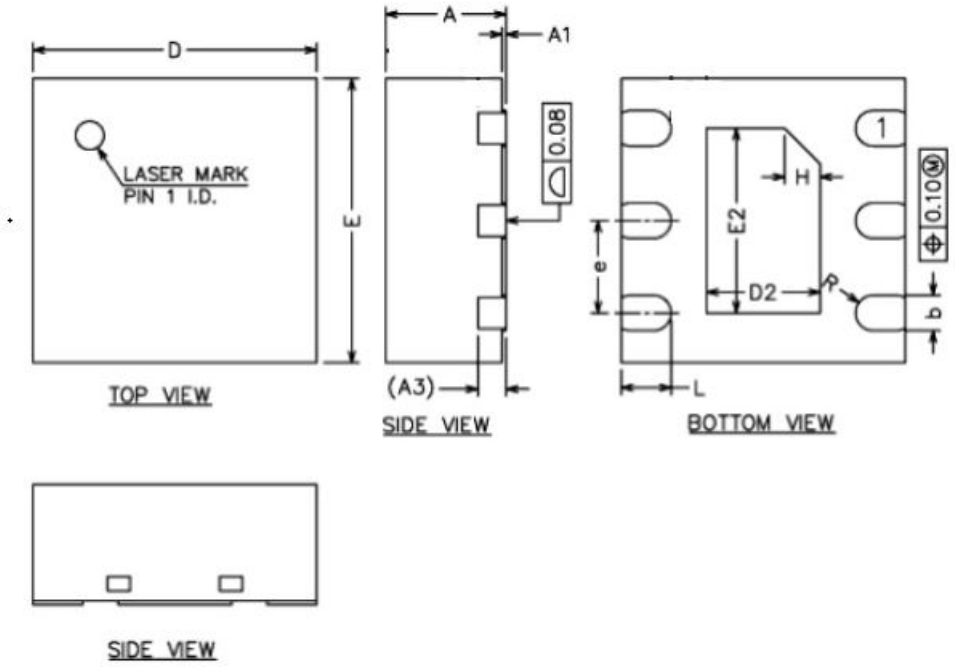
Symbol	MILLIMETERS	
	Min.	Max.
A	1.050	1.250
A1	0.000	0.100
A2	1.050	1.150
b	0.300	0.500
c	0.100	0.200
D	2.820	3.020
E	1.500	1.700
E1	2.650	2.950
e	0.950(BSC)	
e1	1.800	2.000
L	0.300	0.600
θ	0℃	8℃

Dimension in TSOT-25/TSOT-26 (Unit: mm)



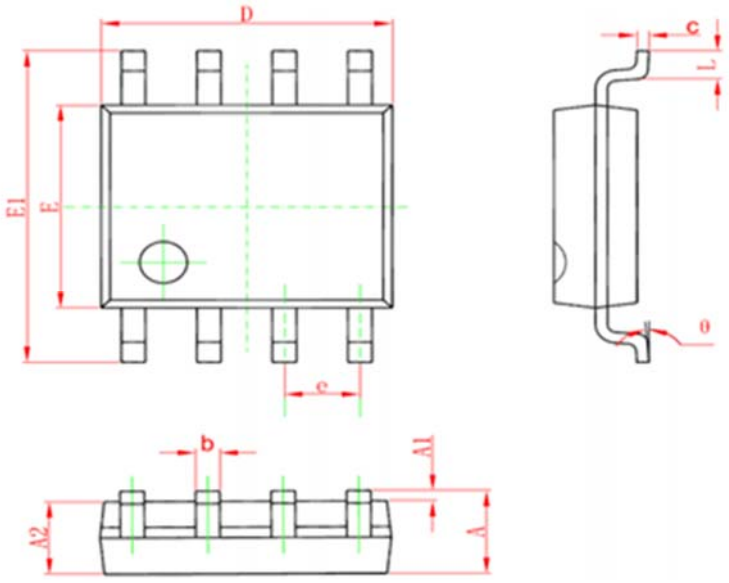
Symbol	MILLIMETERS	
	Min.	Max.
A	-	0.900
A1	0.000	0.100
A2	0.700	0.800
b	0.300	0.500
c	0.100	0.200
D	2.820	3.020
E	1.500	1.700
E1	2.650	2.950
e	0.950(BSC)	
e1	1.800	2.000
L	0.300	0.600
θ	0℃	8℃

Dimension in DFN6 (Unit: mm)



Symbol	MILLIMETERS	
	Min.	Max.
A	0.700	0.800
A1	0.000	0.050
A3	0.203 Ref	
D	1.900	2.100
E	1.900	2.100
D2	0.950	1.050
E2	1.550	1.650
b	0.250	0.350
e	0.650(TYP)	
H	0.200	
L	0.200	0.300

Dimension in SOP8 (Unit: mm)



Symbol	Min	Max
A	1.350	1.750
A1	0.100	0.250
A2	1.350	1.550
b	0.330	0.510
c	0.170	0.250
D	4.700	5.100
E	3.800	4.000
E1	5.800	6.200
e	1.270(BSC)	
L	0.400	1.270
θ	0°	8°

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