

600mA LDO Linear Regulator with Shutdown

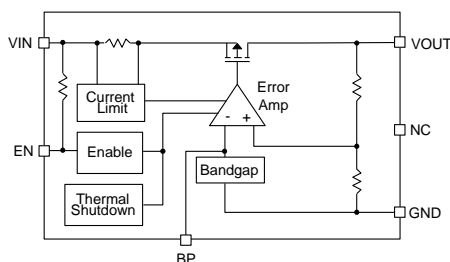
❖ GENERAL DESCRIPTION

The AX6607A is a low dropout, positive linear regulator with very low quiescent. It can supply up to 600mA output current. The BP pin with a 10nF bypass capacitor can help reduce the output noise level. The characteristics of low dropout voltage and less quiescent current make it good for some critical current application, for example, some battery powered devices. The typical quiescent current is approximately 50 μ A. In the shutdown mode, the maximum supply current is less than 1 μ A. The AX6607A regulator is able to operate with output capacitors as small as 1 μ F for stability. The AX6607A series are offering several fixed output voltage types including 1.5V, 1.8V, 2.5V, 2.6V, 2.7V, 2.8V, 2.9V, 3.0V, 3.3V and adjustable versions. Built-in current-limit and thermal-shutdown functions prevent any fault condition from IC damage.

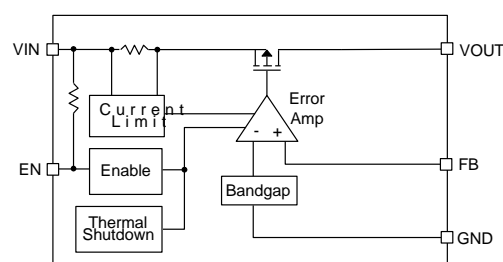
❖ FEATURES

- Input voltage range : 2.6V~5.5V
- Adjustable and 1.5/1.8/2.5/2.6/2.7/2.8/2.9/3.0/3.3V fixed output voltages
- Dropout voltage is 300mV at 600mA output current
- Guaranteed 600mA output current
- Very Low quiescent current at 50 μ A (typ.)
- Needs Only 1 μ F capacitor for Stability
- Maximum supply current in shutdown mode <1 μ A
- Current limit and thermal shutdown protection
- Short circuit current fold-back
- Available in the TDFN-6L Pb-Free Package

❖ BLOCK DIAGRAM



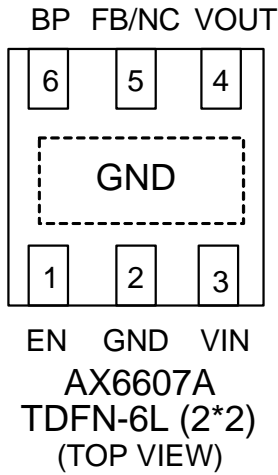
Fixed Version



Adjustable Version

❖ **PIN ASSIGNMENT**

The package of AX6607A is TDFN-6L; the pin assignment is given by:



Name	Description
VIN	Voltage input. The input capacitor in the range of 1uF to 10uF is sufficient.
GND	Ground
EN	Enable pin (Active High)
BP	Reference Noise Bypass (The Bypass capacitor $\geq 1nF$)
VOUT	Output Voltage, The AX6607A is stable with an output capacitor 1uF for greater.
FB/NC	For adjustable output voltage version only, the pin connects two resistances to decide output voltage. When use fixed output voltage version, this pin is NC pin.

❖ **ORDER/MARKING INFORMATION**

Order Information	Top Marking
<p style="text-align: center;">AX6607A - XX XX X</p> <div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px;">Output voltage</div> <div style="border: 1px solid black; padding: 2px;">Package</div> <div style="border: 1px solid black; padding: 2px;">Packing</div> </div> <p>Blank : ADJ Z6 : TDFN-6L(2*2) Blank:Tube 15 : 1.5V 18 : 1.8V 25 : 2.5V 26 : 2.6V 27 : 2.7V 28 : 2.8V 29 : 2.9V 30 : 3.0V 33 : 3.3V A : Taping</p>	<p style="text-align: center;"> LL → Identification Code YWX → ID Code: Internal → Week: 01~26(A~Z) 27~52(a~z) → Year : A = 2010 1 = 2011 </p>

Appendix

Part Number	Identification Code	Part Number	Identification Code
AX6607A-ADJ	MA	AX6607A-2.7V	MS
AX6607A-1.5V	ME	AX6607A-2.8V	MT
AX6607A-1.8V	MH	AX6607A-2.9V	MU
AX6607A-2.5V	MQ	AX6607A-3.0V	MV
AX6607A-2.6V	MR	AX6607A-3.3V	MY

❖ ABSOLUTE MAXIMUM RATINGS (at $T_A=25\text{ }^\circ\text{C}$)

Characteristics	Symbol	Rating	Unit
V_{IN} Pin Voltage	V_{IN}	GND - 0.3 to GND + 6	V
Output Voltage	V_{OUT}	GND - 0.3 to $V_{IN} + 0.3$	V
Enable Voltage	V_{EN}	GND - 0.3 to GND + 6	V
BP Pin Voltage	V_{BP}	GND - 0.3 to GND + 6	V
Feedback Voltage	V_{FB}	GND - 0.3 to GND + 6	V
Power Dissipation	PD	830	mW
Storage Temperature Range	T_{ST}	-40 to +150	$^\circ\text{C}$
Operating Temperature Range	T_{OP}	-40 to +85	$^\circ\text{C}$
Junction Temperature	T_J	-40 to +125	$^\circ\text{C}$
Thermal Resistance from Junction to case	θ_{JC}	25	$^\circ\text{C}/\text{W}$
Thermal Resistance from Junction to ambient	θ_{JA}	120	$^\circ\text{C}/\text{W}$

Note: θ_{JA} is measured with the PCB copper area of approximately 1 in² (Multi-layer). That need connect to Exposed pad.

❖ ELECTRICAL CHARACTERISTICS ($V_{IN}=5\text{V}$, $T_A=25\text{ }^\circ\text{C}$, unless otherwise noted)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units	
Input Voltage	V_{IN}	$I_{OUT}=30\text{mA}$ (Note1)	2.6	-	5.5	V	
Quiescent Current	I_Q	$I_{OUT}=0\text{mA}$	-	50	-	μA	
Shutdown Current	I_{SD}	$V_{EN}=0\text{V}$	-	-	1	μA	
Output Voltage Accuracy	ΔV_{OUT}	$V_{IN}=V_{OUT}+0.1\text{V}$ to 5.5V $V_{OUT}\geq 2.5\text{V}$, $I_{OUT}=1\text{mA}$	-2	-	+2	%	
		$V_{IN}=2.6\text{V}$ to 5.5V $2.5\text{V} > V_{OUT} \geq 1.5\text{V}$, $I_{OUT}=1\text{mA}$	-3	-	+3		
Feedback Voltage	V_{FB}	$V_{IN}=2.6\text{V}$ to 5.5V, $I_{OUT}=1\text{mA}$	0.784	0.8	0.816	V	
FB Input Leakage Current	I_{FB}	$V_{FB}=0.8\text{V}$	-100	-	100	nA	
Dropout Voltage (Note2)	V_{DROP}	$I_{OUT}=600\text{mA}$	$1.5\text{V} \leq V_{OUT} \leq 2.1\text{V}$	-	1100	1200	mV
			$2.1\text{V} < V_{OUT} \leq 2.8\text{V}$	-	500	600	
			$2.8\text{V} < V_{OUT} \leq 3.3\text{V}$	-	300	500	
Current Limit	I_{LIMIT}		700	-	-	mA	
Short Circuit Current	I_{Short}	Output Voltage $< 0.375 \cdot V_{OUT}$	-	300	-	mA	
Load Regulation (Note 3)	ΔV_{LOAD}	$I_{OUT}=10\text{m} \sim 0.6\text{A}$	-	10	30	mV	
Ripple Rejection	PSRR	$C_{IN}=1\mu\text{F}$, $C_{O}=1\mu\text{F}$, $I_{OUT}=10\text{mA}$	$F=120\text{Hz}$	-	65	-	dB
			$F=1\text{KHz}$	-	55	-	
Enable Input Threshold	V_{ENH}		1.5	-	-	V	
	V_{ENL}		-	-	0.4		
Enable Pin Current	I_{ENH}	$V_{EN}=V_{IN}$	-	0.003	0.1	μA	
	I_{ENL}	$V_{EN}=0\text{V}$	-	0.35	1		
Temperature Shutdown	T_{SD}		-	140	-	$^\circ\text{C}$	
Temperature Shutdown Hysteresis	T_{SH}		-	30	-	$^\circ\text{C}$	

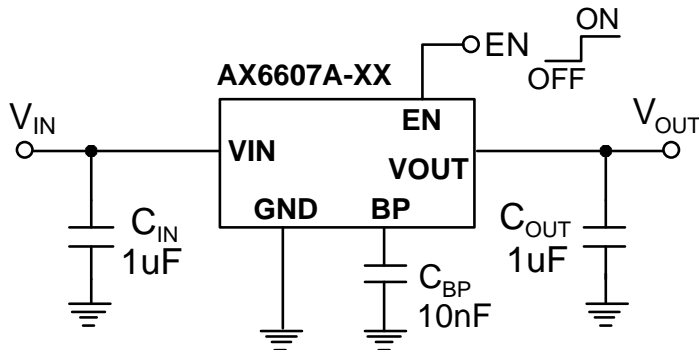
Note1. Minimum V_{IN} voltage is defined by output adds a dropout voltage.

Not 2. The dropout voltage is defined as $V_{IN}-V_{OUT}$, which is measured when V_{OUT} drop about 100mV.

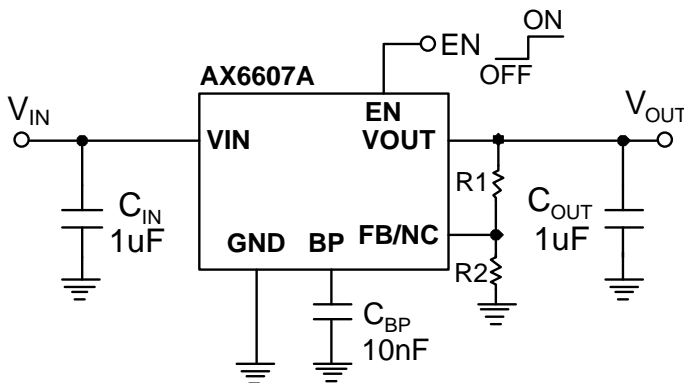
Not 3. Regulation is measured at constant junction temperature by using pulsed testing with a low ON time.

❖ APPLICATION CIRCUIT

(1) Fixed Output Voltage Version



(2) Adjustable Output Voltage Version



❖ FUNCTION DESCRIPTIONS

A minimum of 1uF capacitor must be connected from V_{OUT} to ground to insure stability. Typically a large storage capacitor is connected from V_{IN} to ground to ensure that the input voltage does not sag below the minimum dropout voltage during the load transient response. This pin must always be dropout voltage higher than V_{OUT} in order for the device to regulate properly.

❖ APPLICATION INFORMATION

Like any low-dropout regulator, the AX6607A requires input and output decoupling capacitors. The device is specifically designed for portable applications requiring minimum board space and smallest components. These capacitors must be correctly selected for good performance (see Capacitor Characteristics Section). Please note that linear regulators with a low dropout voltage have high internal loop gains which require care in guarding against oscillation caused by insufficient decoupling capacitance.

Capacitor Selection

Normally, use a 1 μ F capacitor on the input and a 1 μ F capacitor on the output of the AX6607A. Larger input capacitor values and lower ESR (X5R, X7R) provide better supply-noise rejection and transient response. A higher- value output capacitor (2.2 μ F) may be necessary if large, fast transients are anticipated and the device is located several inches from the power source.

Input-Output (Dropout) Voltage

A regulator's minimum input-to-output voltage differential (dropout voltage) determines the lowest usable supply voltage. In battery-powered systems, this determines the useful end-of-life battery voltage. Because the device uses a PMOS, its dropout voltage is a function of drain-to source on-resistance, $R_{DS(ON)}$, multiplied by the load current:

$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{OUT}$$

Current Limit and Thermal Shutdown Protection

In order to prevent overloading or thermal condition from damaging the device, AX6607A regulator has internal thermal and current limiting functions designed to protect the device. It will rapidly shut off PMOS pass element during overloading or over temperature condition.

Thermal Considerations

The AX6607A series can deliver a current of up to 600mA over the full operating junction temperature range. However, the maximum output current must be dated at higher ambient temperature to ensure the junction temperature does not exceed 125°C. With all possible conditions, the junction temperature must be within the range specified under operating conditions. Power dissipation can be calculated based on the output current and the voltage drop across regulator.

$$PD = (V_{IN} - V_{OUT}) I_{OUT}$$

The final operating junction temperature for any set of conditions can be estimated by the following thermal equation:

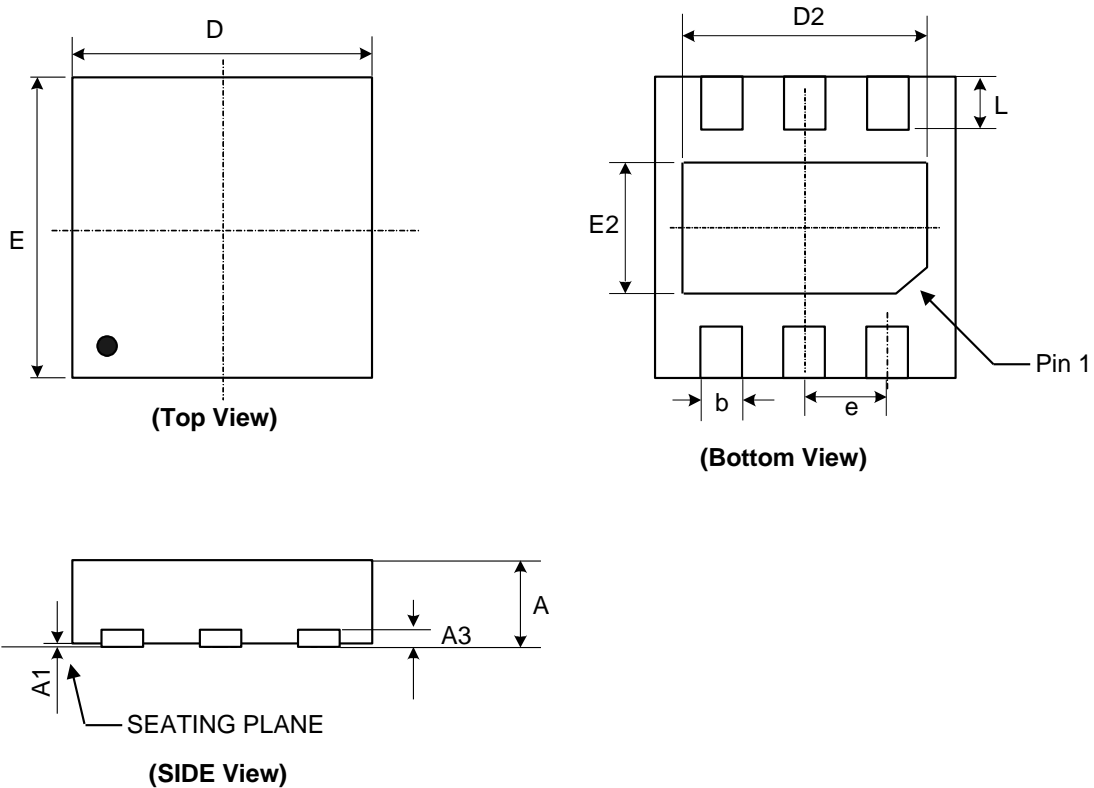
$$PD (MAX) = (T_{J(MAX)} - T_A) / \theta_{JA}$$

Where $T_{J(MAX)}$ is the maximum junction temperature of the die (125 °C) and T_A is the maximum ambient temperature. The junction to ambient thermal resistance (θ_{JA}) for TDFN-6L package at recommended minimum footprint is 120°C/W.

PCB Layout

An input capacitance of $\cong 1\mu F$ is required between the AX6607A input pin and ground (the amount of the capacitance may be increased without limit), this capacitor must be located a distance of not more than 1cm from the input and return to a clean analog ground. Input capacitor can filter out the input voltage spike caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire. Otherwise, the actual voltage at the VIN pin may exceed the absolute maximum rating. The output capacitor also must be located a distance of not more than 1cm from output to a clean analog ground. Because it can filter out the output spike caused by the surge current due to the inductive effect of the package pin and the printed circuit board's routing wire.

❖ PACKAGE OUTLINES



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.70	0.75	0.80	0.028	0.030	0.031
A1	0.00	0.02	0.05	0.000	0.001	0.002
A3	0.203 REF.			0.008 REF.		
b	0.20	0.28	0.35	0.009	0.011	0.013
D	1.95	2.00	2.05	0.077	0.079	0.081
D2	1.35	1.50	1.65	0.055	0.059	0.063
E	1.95	2.00	2.05	0.077	0.079	0.081
E2	0.75	0.90	1.05	0.031	0.035	0.039
e	0.65 BSC.			0.026 BSC.		
L	0.20	0.30	0.40	0.008	0.012	0.016