300mA High PSRR, Low Noise LDO Regulator

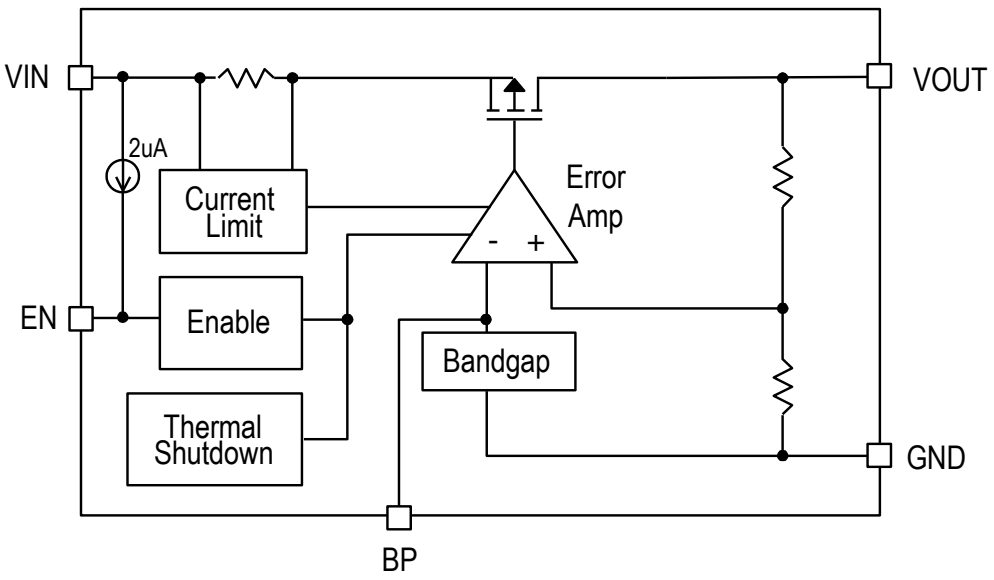
❖ GENERAL DESCRIPTION

The AX6641 is a low dropout, high PSRR, low noise linear regulator with very low quiescent. The Device includes pass element, error amplifier, band-gap, current-limit and thermal shutdown circuitry. 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 80μA. In the shutdown mode, the maximum supply current is approximately 2uA. Due to internal flexible design, result in extensively fixed output voltage versions is 1.2V, 1.5V to 1.8V. Built-in current-limit and thermal-shutdown functions prevent any fault condition from IC damage.

❖ FEATURES

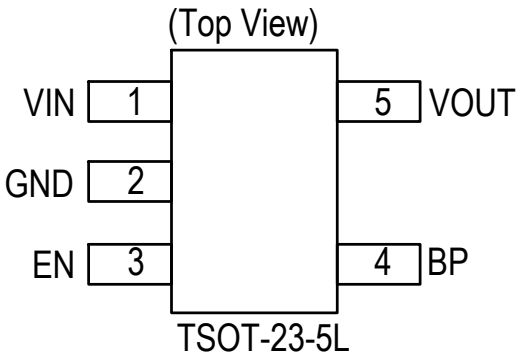
- Input voltage range : 2.9V~5.5V
- Guaranteed 300mA output current
- Low quiescent current is 80μA (typ.)
- Fixed Output voltage is 1.2V, 1.5V and 1.8V.
- High PSRR=85dB@1KHz
- Fast transient response
- Current limit and thermal shutdown protection
- Available in the 5-Pin Pb-Free TSOT-23 Package

❖ BLOCK DIAGRAM



❖ PIN ASSIGNMENT

The package of AX6641 is TSOT-23-5L; 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≧1uF)
VOUT	Output Voltage, The AX6641 is stable with an output capacitor.

❖ ORDER/MARKING INFORMATION

Order Information	Top Marking (TSOT-23-5L)
AX6641 - XX XX X Output voltage: 12 : 1.2V, 15 : 1.5V, 18 : 1.8V Package: BT: TSOT-23-5L Packing: Blank:Tube, A : Taping	L L Y W X → ID Code: Internal Week: 01~26(A~Z) 27~52(a~z) Year : A = 2010, 1 = 2011 Identification code

Appendix

Part Number	Identification code
AX6641-12BT	Ma
AX6641-15BT	Mb
AX6641-18BT	Mc

❖ ABSOLUTE MAXIMUM RATINGS (at T_A=25°C)

Characteristics	Symbol	Rating	Unit
V_{IN} Pin Voltage	V_{IN}	GND - 0.3 to GND + 6.5	V
Output Voltage	V_{OUT}	GND - 0.3 to V_{IN} + 0.3	V
Enable Voltage	V_{EN}	GND - 0.3 to GND + 6.5	V
Power Dissipation	PD	250	mW
Storage Temperature Range	T_{ST}	-40 to +150	°C
Operating Temperature Range	T_{OP}	-40 to +85	°C
Junction Temperature	T_J	-40 to +125	°C
Thermal Resistance from Junction to case	θ_{JC}	180	°C/W
Thermal Resistance from Junction to ambient	θ_{JA}	250	°C/W

Note: θ_{JA} is measured with the PCB copper area of approximately 1 in^2 (Multi-layer).That need connect to GND pin.

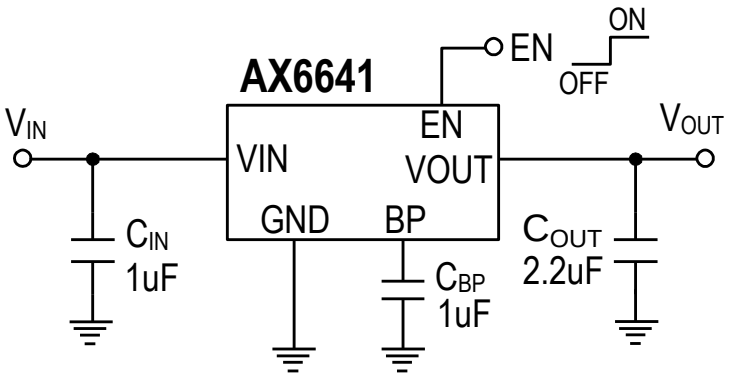
❖ ELECTRICAL CHARACTERISTICS

(V_{IN}=3V whichever is greater, T_A=25°C, unless otherwise noted)

Characteristics	Symbol	Conditions		Min	Typ	Max	Units
Input Voltage	V_{IN}	I_{OUT}=10mA		2.9	-	5.5	V
Output Voltage Accuracy	ΔV_{OUT}	I_{OUT}=1mA		-2	-	+2	%
Quiescent Current	I_Q	I_{OUT} =0mA		-	100	150	μA
Dropout Voltage **(Note1)**	V_{DROP}	I_{OUT}=300mA	V_{OUT}=1.2V	-	1600	1800	mV
			V_{OUT}=1.5V	-	1300	1500	
			V_{OUT}=1.8V	-	1000	1200	
Current Limit	I_{LIMIT}			400	-	-	mA
Line Regulation	ΔV_{LINE}	I_{OUT} =1mA, V_{IN}=3V to 5.5V		-	1	5	mV
Load Regulation **(Note2)**	ΔV_{LOAD}	I_{OUT} =1m~300mA		-	6	20	mV
Ripple Rejection	PSRR	C_{OUT}=2.2uF,I_{OUT} =1mA	F=100Hz	-	90	-	dB
			F=1KHz	-	85	-	
Enable Input Threshold	V_{ENH}			1.5	-	-	V
	V_{ENL}			-	-	0.4	
Enable Pin Current	I_{EN}	V_{IN}=5V, V_{EN}=0V		-	2	4	μA
Shutdown Current	I_{SD}	V_{IN}=5V, V_{EN}=0V		-	2	5	μA
Temperature Coefficient	T_C	I_{OUT}=1mA, V_{IN}=5V		-	50	-	ppm/°C
Temperature Shutdown	T_S			-	160	-	°C
Temperature Shutdown Hysterisis	T_{SH}			-	25	-	°C

Note1. The dropout voltage is defined as V_{IN}-V_{OUT}, which is measured when V_{OUT} drop about 100mV.
Note2. Regulation is measured at constant junction temperature by using pulsed testing with a low ON time.

❖ APPLICATION CIRCUIT



❖ APPLICATION INFORMATION

Like any low-dropout regulator, the AX6641 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. 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 1μF capacitor on the input and a 2.2μF capacitor on the output of the AX6641. Larger input capacitor values and lower ESR provide better supply-noise rejection and transient response. A large value output capacitor may be necessary if large, fast transients are anticipated and the device is located several inches from the power source. The capacitors are recommended to use 2.2uF X5R or X7R dielectric ceramic capacitors between device outputs to ground for transient stability.

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, AX6641 regulator has internal thermal shutdown 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 AX6641 series can deliver a current of up to 300mA 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:

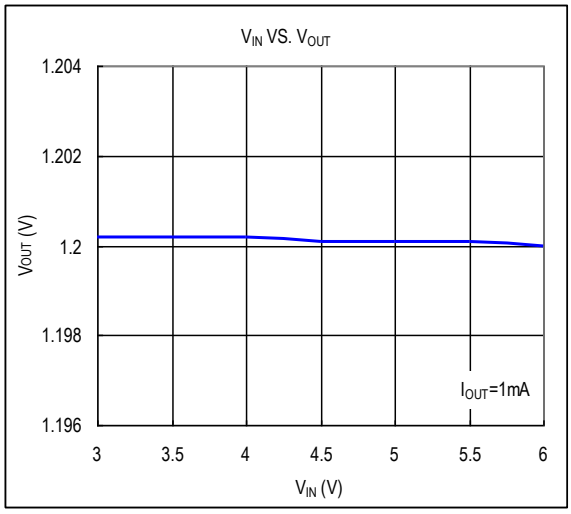
$$PD\ (MAX) = (T_{J\ (MAX)} - T_A) / \theta_{JA}$$

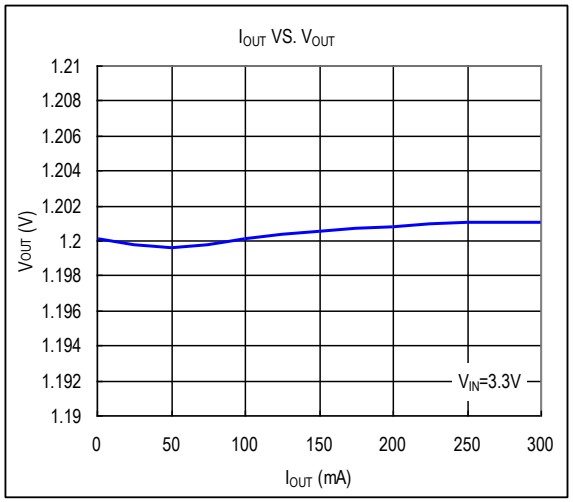
Where $T_{J\ (MAX)}$ is the maximum junction temperature of the die (125°C) and T_A is the maximum ambient temperature. The junction to ambient thermal resistance (θ_{JA}) for SOT-23-5 package at recommended minimum footprint is 250°C/W.

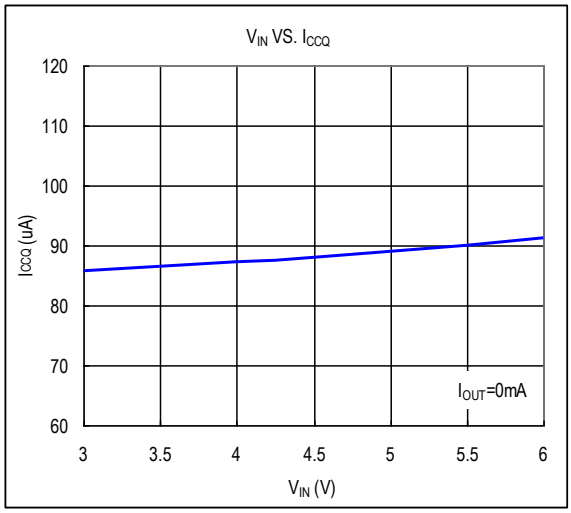
PCB Layout

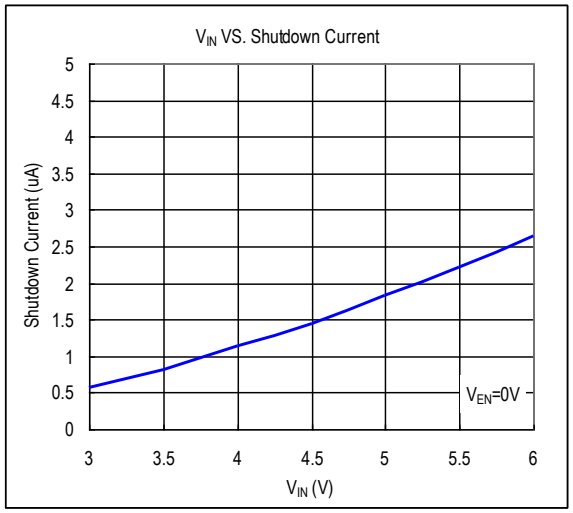
An input capacitance of ≅ 1μF is required between the AX6641 input pin and ground (the amount of the capacitance may be increased without limit), this capacitor must be located a distance of not more than 1cm from the input and return to a clean analog ground. Input capacitor can filter out the input 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.

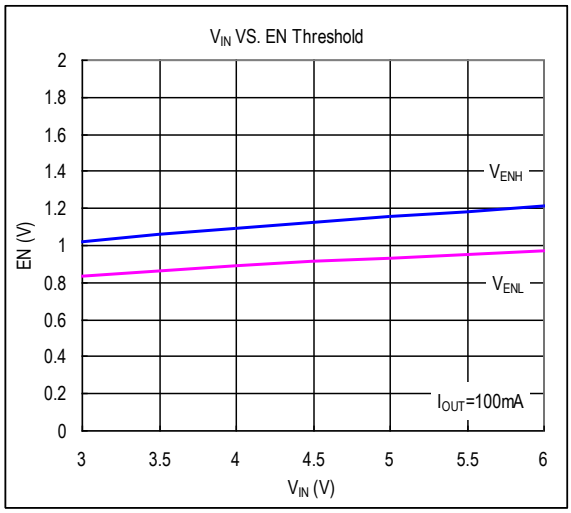
❖ TYPICAL CHARACTERISTICS

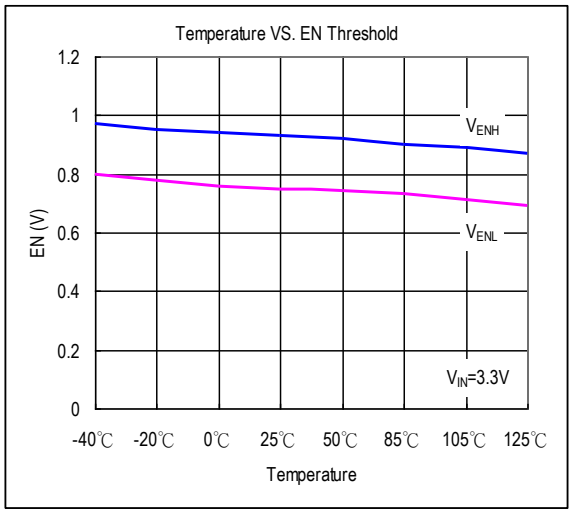




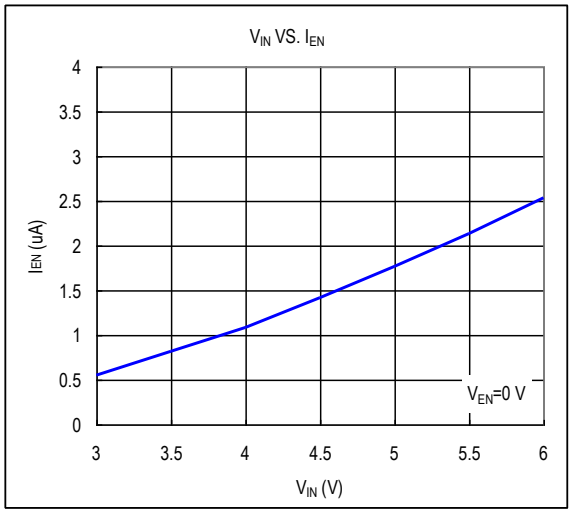


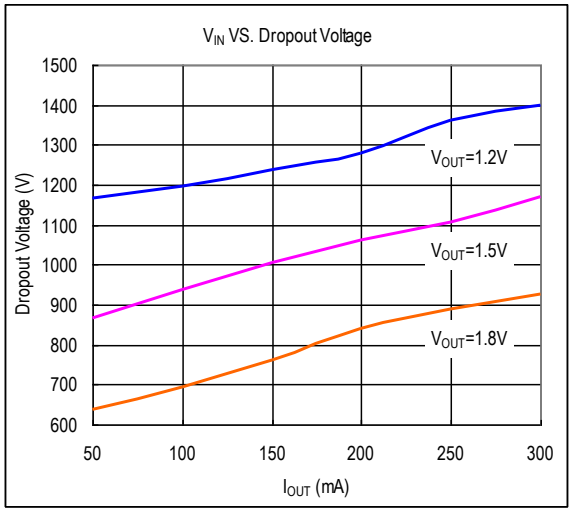


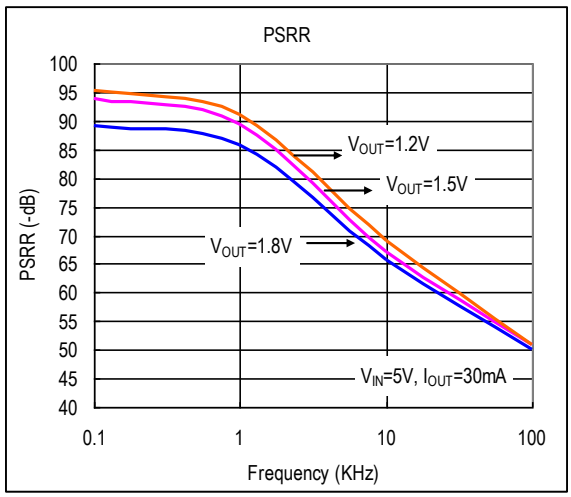




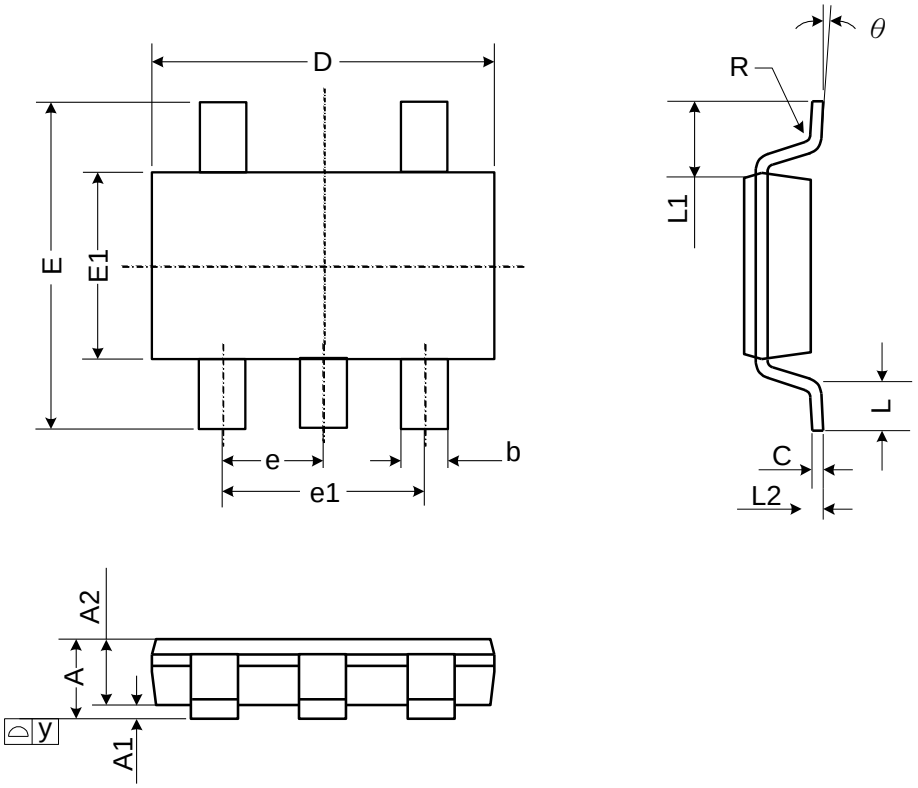
❖ TYPICAL CHARACTERISTICS (CONTINUOUS)







❖ PACKAGE OUTLINES



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.10	-	-	0.043
A1	0.00	-	0.10	0	-	0.004
A2	0.70	0.90	1.00	0.028	0.035	0.039
b	0.30	0.40	0.50	0.012	0.016	0.020
C	0.08	0.14	0.20	0.003	0.006	0.008
D	2.80	2.90	3.00	0.110	0.114	0.118
E	2.60	2.80	3.00	0.102	0.110	0.118
E1	1.50	1.60	1.70	0.059	0.063	0.067
e	0.95 BSC.			0.037 BSC.		
e1	1.90 BSC.			0.075 BSC.		
L	0.30	0.45	0.60	0.012	0.018	0.024
L1	0.60 REF.			0.024 REF.		
L2	0.25 BSC.			0.010 BSC.		
y	-	-	0.10	-	-	0.004
R	0.10	-	-	0.004	-	-
θ	0°	-	8°	0°	-	8°

JECED outline: MO-193 AB