

Low Noise, Regulated Charge Pump

❖ GENERAL DESCRIPTION

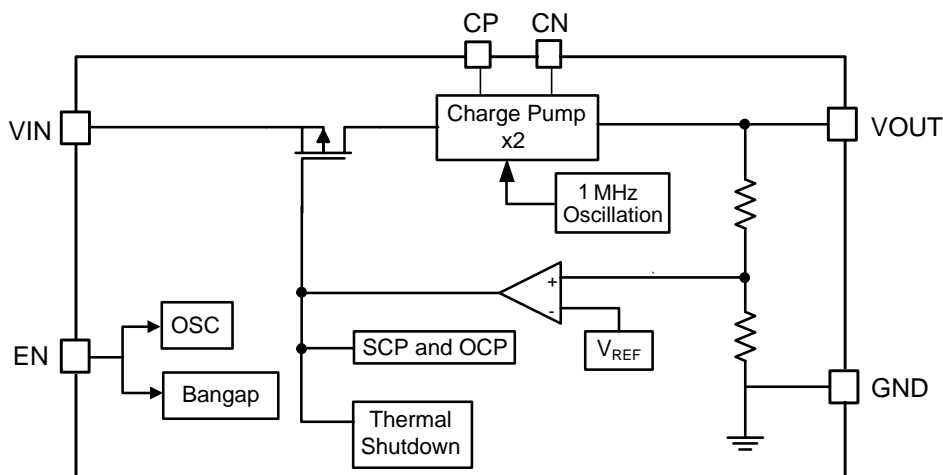
The AX7703A/B is a Low noise charge pump DC/DC converter that produces a regulated 4.5V and 5V output. No external inductor is required for operation. Using three small capacitors, the AX7703A/B can deliver up to 100mA to the voltage regulated output. The AX7703A/B features very low quiescent current and high efficiency over a large portion of its load range, making this device ideal for battery-powered applications.

AX7703A/B has over current protection, short circuit protection and thermal shutdown protection capability. Internal soft-start circuitry effectively reduces the in-rush current while start-up. The AX7703A/B is available in a SOT23-6 package.

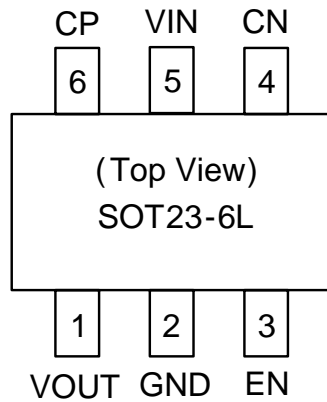
❖ FEATURES

- Input Voltage Range : 2.8V to VOUT
- Fixed 5V/4.5V±4% Output Voltage
- High Frequency 1MHz Operation
- Internal Soft Start Function
- Short Circuit and Thermal shutdown Protection
- ≤ 1μA Shutdown Current
- 6-pin, SOT-23 Pb-Free package

❖ Block Diagram



❖ PIN ASSIGNMET



Name	Description
VOUT	Regulated output pin. Bypass this pin to ground with a 2.2 μ F (min) low equivalent series resistance (ESR) capacitor.
GND	Ground pin
EN	Shutdown input pin H : normal operation L : disable converter
CN	Flying Capacitor Negative Terminal
VIN	IC power supply pin
CP	Flying Capacitor Positive Terminal

❖ ORDER/MARKING INFORMATION

Order Information	Top Marking
<p>AX7703 X X X</p> <p>Output Package Type Packing A : 5V C : SOT23-6L A : Taping B : 4.5V</p>	<p>E1 X X</p> <p>WW: 01~26(A~Z) 27~52(\bar{A}~\bar{Z}) Year: 6 = 2006 A = 2010 Part number: E1 → AX7703A E2 → AX7703B</p>

❖ **Absolute Maximum Ratings** (at $T_a=25^\circ\text{C}$)

Characteristics	Symbol	Rating	Unit
VIN Pin Voltage	V_{IN}	- 0.3 to 6V	V
VOUT Pin Voltage	V_{OUT}	- 0.3 to 6V	V
Other Pin Voltage		- 0.3 to 6V	V
Storage Temperature Range	T_{ST}	-65 to +150	
Junction Temperature	T_J	-40 to 125	
Thermal Resistance from Junction to ambient	θ_{JA}	250	/W
Power Dissipation[$PD=(T_J-T_A) / \theta_{JA}$]	PD	0.4	W

Note : θ_{JA} is measured in the natural convection at $T_A = 25^\circ\text{C}$ on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

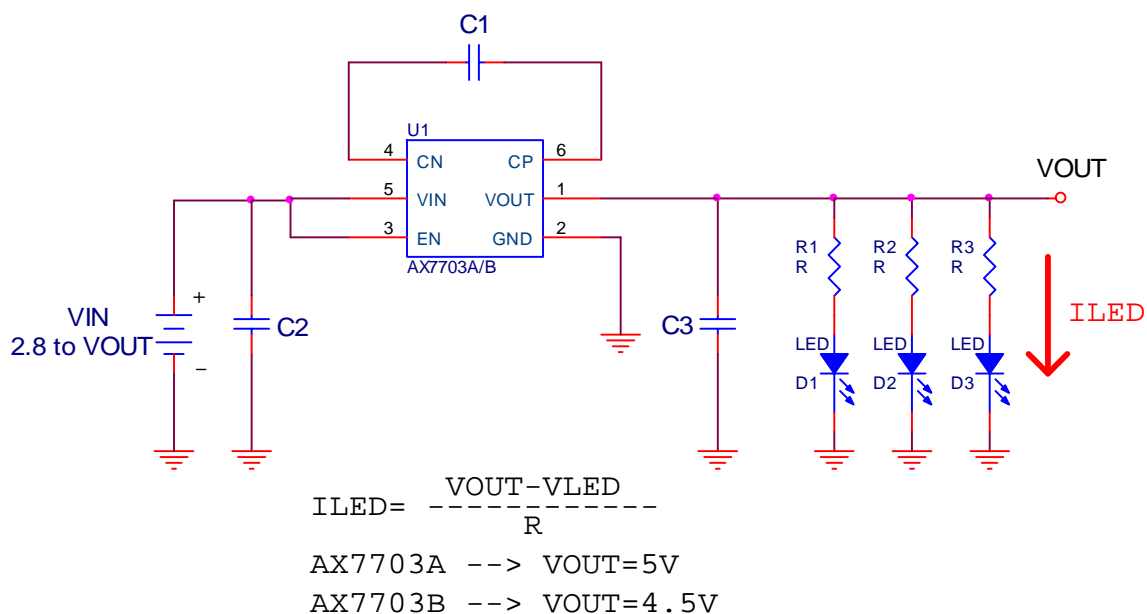
❖ **Recommended Operating Conditions**

Characteristics	Symbol	Rating	Unit
Operating Temperature Range	T_{OP}	-40 to +85	

❖ **Electrical Characteristics** ($V_{IN} = 3.7\text{V}$, $T_a=25^\circ\text{C}$, unless otherwise specified)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range	V_{IN}		2.8	-	V_{OUT}	V
Quiescent Current	I_Q	$I_{OUT} = 0$	-	2	4	mA
Shutdown Current	I_{SD}		-	-	1	μA
Output Voltage	V_{OUT}	AX7703A, $V_{IN}>3.2\text{V}$, $I_{OUT}<110\text{mA}$	4.8	5	5.2	V
		AX7703B, $V_{IN}>3.2\text{V}$, $I_{OUT}<150\text{mA}$	4.32	4.5	4.68	
Maximum Output Current	I_{OUT}	AX7703A, $V_{IN}>3.2\text{V}$, $C_{PUMP} = 1\mu\text{F}$	110	-	-	mA
		AX7703B, $V_{IN}>3.2\text{V}$, $C_{PUMP} = 1\mu\text{F}$	150	-	-	mA
Input Current Limit	I_{OC}		300	350	500	mA
Short circuit current	I_{SC}		-	180	250	mA
Oscillator Frequency	F_{OSC}		0.8	1.0	1.2	MHz
Vout Ripple		$I_{OUT}=60\text{mA}$, $C_{OUT}=2.2\mu\text{F}(X7R,X5R)$	-	40	-	mV
EN Pin Logic input threshold voltage	V_{IH}		1.5	-	-	V
	V_{IL}		-	-	0.4	
EN Pin Input Current	I_{IH}	$V_{EN}=V_{IN}$ (ON)	-	-	0.1	μA
	I_{IL}	$V_{EN}=\text{GND}$ (OFF)	-	-	0.11	μA
Thermal shutdown Temp	TSD		-	140	-	

❖ Application Circuit



DEVICE	Application Condition	C1 (uF)	C2 (uF)	C3 (uF)
AX7703A	I _{OUT} <60mA @ V _{IN} >3.2V	0.22	2.2	2.2
	I _{OUT} <110mA @ V _{IN} >3.2V	1	10	10
AX7703B	I _{OUT} <80mA @ V _{IN} >3.2V	0.22	2.2	2.2
	I _{OUT} <150mA @ V _{IN} >3.2V	1	10	10

* C1, C2 and C3 must be used Low ESR capacitors, X7R or X5R dielectrics are recommended.

❖ Application Information

Capacitor Selection

Careful selection of the three external capacitors C1, C2 and C3 is very important because they will affect ramp up time, output ripple and transient performance. Optimum performance will be obtained when low ESR (<100mΩ) ceramic capacitors are used for C1 and C2 and C3. In general, low ESR may be defined as less than 100mΩ. In all cases, X7R or X5R dielectric are recommended. For particular application, low ESR Tantalum capacitors may be substituted; however optimum output ripple performance may not be realized. Aluminum electrolytic capacitors are not recommended for using with the AX7703A/B due to there are high ESR characteristic.

In general, lower values for C1, C2 and C3 may be utilized for light load current applications (<60mA). Drawing a load current of 60mA or less may use a C2 and C3

4/6

capacitor value as low as 2.2μF and a C1 value of 0.22μF. C2 and C3 may range from 2.2μF for light loads to 10μF for heavy output load conditions (<110mA). C1 may range from 0.22μF for light loads to 1μF for heavy output load conditions. If C1 is increased, C3 should also be increased by the same ratio to minimize output ripple. As a basic rule, the ratio between C2, C3 and C1 should be approximately 10 to 1. Lowering the C2, C3 and C1 value can decrease the ramp-up time of VOUT, but it will increase the output ripple oppositely.

Efficiency

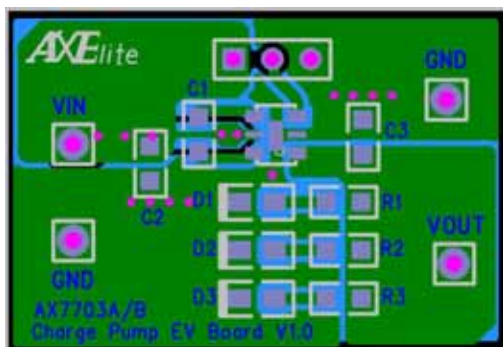
The efficiency of the charge pump regulator varies with the output voltage version, the applied input voltage, the load current, and the internal operation mode of the device. The approximate efficiency is given by:

$$\begin{aligned} \text{Efficiency (\%)} &= \frac{P_{\text{OUT}}}{P_{\text{IN}}} \times 100\% = \frac{V_{\text{OUT}} \times I_{\text{OUT}}}{V_{\text{IN}} \times 2I_{\text{OUT}}} \times 100\% \\ &= \frac{V_{\text{OUT}}}{2V_{\text{IN}}} \times 100\% \quad (\text{2X mode Charge Pump Operating}) \end{aligned}$$

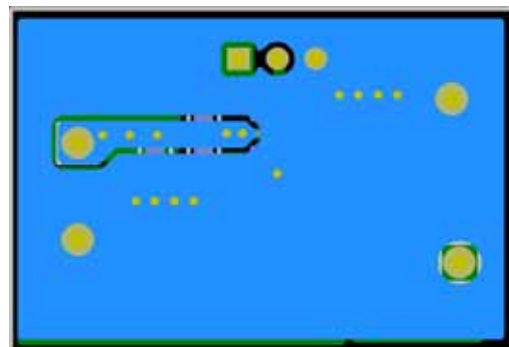
For a charge pump with an output of 5V and a nominal input of 3V, the theoretical efficiency is 83.33%. Due to internal switching losses and IC quiescent current consumption, the actual efficiency can be measured as 82.41%.

PCB Board Layout

The AX7703A/B is a high-frequency switched-capacitor converter. For best performance and minimize vout ripple, place all of the components as close to IC as possible. Besides a solid ground plane is recommended on the bottom layer of the PCB. The ground should be connected C2 and C3 together and as close to the IC as possible.



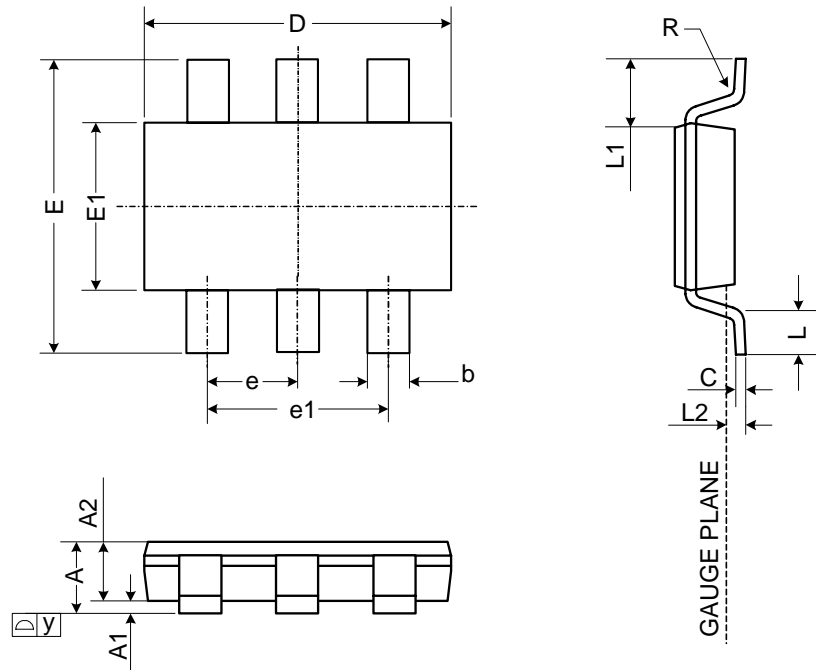
Top Layer



Bottom Layer

❖ **Typical Characteristics**

❖ **Package Outlines (SOT23-6L)**



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	0.75	-	0.90	0.030	-	0.035
A1	0.00	-	0.10	0.000	-	0.004
A2	0.70	0.75	0.80	0.028	0.030	0.031
b	0.35	-	0.51	0.014	-	0.020
C	0.10	-	0.25	0.004	-	0.010
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		
e1	1.90 BSC.			0.075		
L	0.37	-	-	0.015	-	-
L1	0.60 REF.			0.024		
L2	0.25 BSC.			0.010		
y	-	-	0.10	-	-	0.004
R	0.10	-	-	0.004	-	-