

3A, 23V, 500KHz Synchronous Rectified Step-Down Converter

❖ GENERAL DESCRIPTION

The AX3803 is a monolithic synchronous buck regulator. The device integrates two 110mΩ MOSFETs, and provides 3A of continuous load current over a wide input voltage of 4.75V to 23V. Current mode control provides fast transient response and cycle-by-cycle current limit.

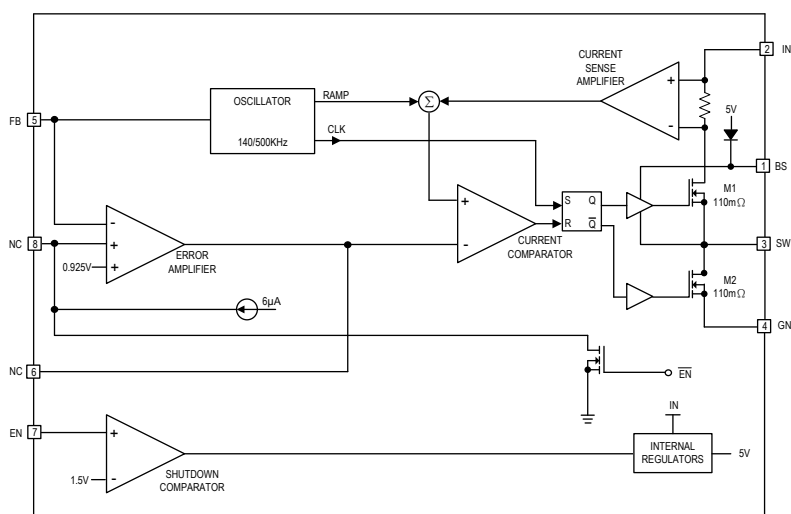
Internal soft-start prevents inrush current at turn-on, and in shutdown mode the supply current drops to 5μA.

This device, available in SOP-8L-EP package, provides a very compact solution with minimal external components.

❖ FEATURES

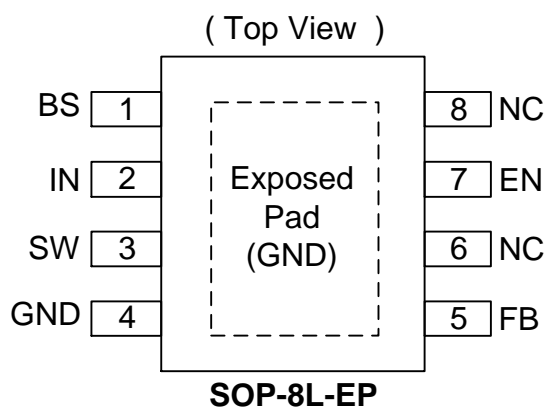
- 3A Output Current
- Wide 4.75V to 23V Operating Input Range
- Integrated 110mΩ Power MOSFET Switches
- Output adjust from V_{FB} to 20V
- Internal compensation
- Up to 94% Efficiency
- Stable with Low ESR Ceramic Output Capacitors
- Fixed 500KHz Frequency
- Cycle-by-Cycle Over Current Protection
- Thermal shutdown and short circuit protections

❖ BLOCK DIAGRAM



❖ PIN ASSIGNMENT

The package of AX3803 is SOP-8L-EP; the pin assignment is given by:



Name	Description
BS	High-Side Gate Drive Boost Input. BS supplies the drive for the high-side N-Channel MOSFET switch. Connect a 0.01 μ F or greater capacitor from SW to BS to power the high side switch.
IN	Power Input. IN supplies the power to the IC, as well as the step-down converter switches. Drive IN with a 4.75V to 23V power source. Bypass IN to GND with a suitably large capacitor to eliminate noise on the input to the IC. See Input Capacitor.
SW	Power Switching Output. SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load. Note that a capacitor is required from SW to BS to power the high-side switch.
GND	Ground.
FB	Feedback Input. FB senses the output voltage to regulate that voltage. Drive FB with a resistive voltage divider from the output voltage. The feedback threshold is 0.925V. See Setting the Output Voltage.
NC	Not connect
EN	Enable Input. EN is a digital input that turns the regulator on or off. Drive EN high to turn on the regulator, drive it low to turn it off. Pull up with 100k Ω resistor for automatic startup.

❖ RDER/MARKING INFORMATION

Order Information	Top Marking
<p>AX3803XXX</p> <p>Package Type Packing ES: SOP-8L-EP Blank: Tube A : Taping</p>	<p>Logo ← AX 3 8 0 3 → Part number YYWWX → ID code:internal → WW: 01~52 → Year: 11=2011 12=2012 ⋮ 19=2019</p>

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

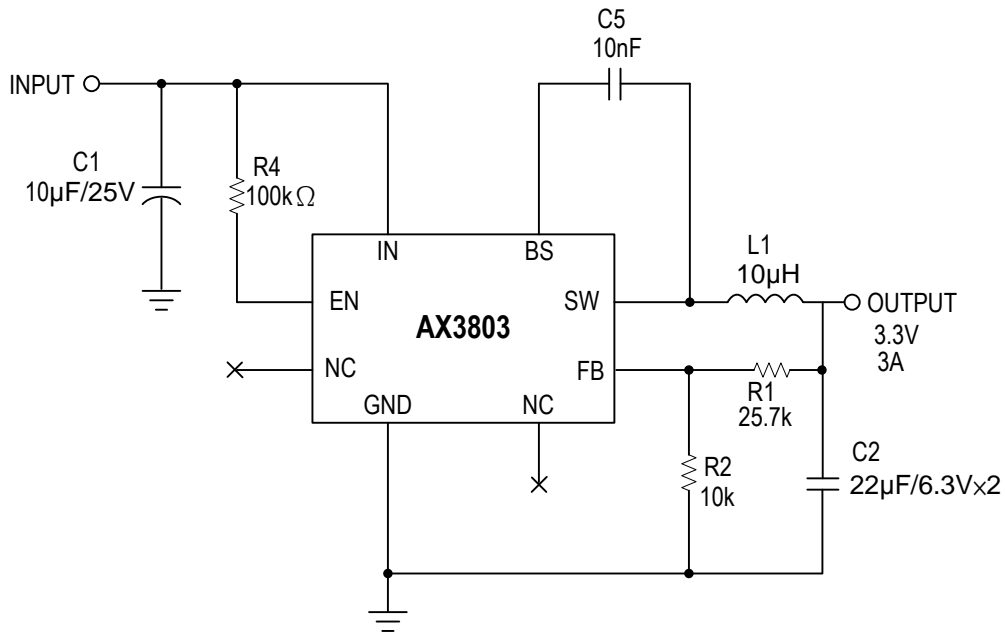
Characteristics	Symbol	Rating	Unit
Input Voltage	V_{IN}	-0.3 to +24	V
Switch Node Voltage	V_{SW}	-1V to $V_{IN}+0.3V$	V
Boost Voltage	V_{BS}	$V_{SW} - 0.3$ to $V_{SW} + 6$	V
All Other Pins		-0.3 to +6	V
Lead Temperature		260	$^{\circ}\text{C}$
Storage Temperature		-65 to +150	$^{\circ}\text{C}$
Junction Temperature	T_J	150	$^{\circ}\text{C}$
Output Voltage	V_{OUT}	0.925 to 20	V
Ambient Operating Temperature		-40 to +85	$^{\circ}\text{C}$
Thermal Resistance from Junction to case	θ_{JC}	15	$^{\circ}\text{C}/\text{W}$
Thermal Resistance from Junction to ambient	θ_{JA}	40	$^{\circ}\text{C}/\text{W}$

Note: θ_{JA} is measured with the PCB copper area of approximately 1 in²(Multi-layer).

❖ ELECTRICAL CHARACTERISTICS ($V_{IN} = 12V$, $T_A = +25^{\circ}\text{C}$, unless otherwise noted.)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Operating Voltage	V_{IN}		4.75	-	23	V
Shutdown Supply Current	I_{SD}	$V_{EN} = 0V$	-	5	12	μA
Shutdown Current Operation		$V_{FB}=1.1V$	-	0.5	0.7	mA
Feedback Voltage	V_{FB}	$4.75V \leq V_{IN} \leq 23V$	0.900	0.925	0.950	V
Load Regulation		$I_{OUT}= 0 \sim 3A$	-2	-	+2	%
High-Side Switch On Resistance (Note)	$R_{DS(ON)1}$		-	110	-	m Ω
Low-Side Switch On Resistance (Note)	$R_{DS(ON)2}$		-	110	-	m Ω
High-Side Switch Leakage Current		$V_{EN} = 0V$, $V_{SW} = 0V$	-	-	10	μA
Switch Current Limit			3.4	-	-	A
Oscillation Frequency	F_{OSC1}		-	500	-	KHz
Short Circuit Oscillation Frequency	F_{OSC2}	$V_{FB} = 0V$	-	140	-	KHz
Maximum Duty Cycle	D_{MAX}	$V_{FB} = 0.8V$	-	90	-	%
EN High-Level Input Voltage	V_{EN_H}		1.5	-	-	V
EN Low-Level Input Voltage	V_{EN_L}		-	-	0.4	V
EN Shutdown Threshold Voltage Hysteresis			-	110	-	mV
Thermal Shutdown	T_{SD}		-	100	-	$^{\circ}\text{C}$
Thermal Shutdown Hysteresis	T_{SH}		-	20	-	$^{\circ}\text{C}$

Note: Guaranteed by design.

❖ APPLICATION CIRCUIT


$$V_{OUT} = V_{FB} \times \left(1 + \frac{R1}{R2}\right), \quad V_{FB} = 0.925V, \quad R2 \text{ suggest } 10k \sim 30K\Omega$$

Table Recommended Component Selection

V _{IN} (V)	V _{OUT} (V)	R1 (KΩ)	R2 (KΩ)	L1 (µH)	C _{OUT} (µF)
12	5	44.1	10	15	22 X 2
5 or 12	3.3	25.7	10	10	22 X 2
5 or 12	1.8	9.5	10	4.7	22 X 2
5 or 12	1.2	3	10	3.3	22 X 2
5 or 12	1	0.81	10	2.2	22 X 2

❖ FUNCTION DESCRIPTIONS

The AX3803 is a synchronous rectified, current-mode, step-down regulator. It regulates input voltages from 4.75V to 23V down to an output voltage as low as 0.925V, and supplies up to 3A of load current.

The AX3803 uses current-mode control to regulate the output voltage. The output voltage is measured at FB through a resistive voltage divider and amplified through the internal Transconductance error amplifier.

The converter uses internal N-Channel MOSFET switches to step-down the input voltage to the regulated output voltage. Since the high side MOSFET requires a gate voltage greater than the input voltage, a boost capacitor connected between SW and BS is needed to drive the high side gate. The boost capacitor is charged from the internal 5V rail when SW is low.

❖ APPLICATION INFORMATION

COMPONENT SELECTION

Setting the Output Voltage

The output voltage is set using a resistive voltage divider from the output voltage to FB pin. The voltage divider divides the output voltage down to the feedback voltage by the ratio:

$$V_{FB} = V_{OUT} \times \frac{R2}{R1 + R2}$$

Where V_{FB} is the feedback voltage and V_{OUT} is the output voltage.

Thus the output voltage is:

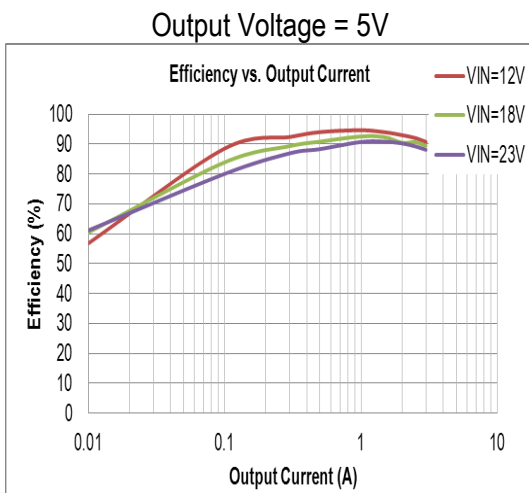
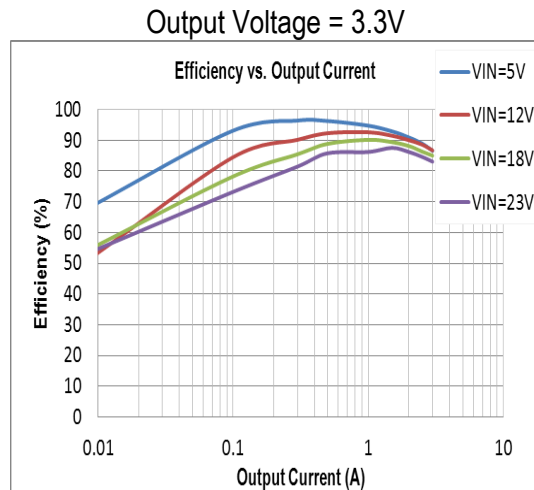
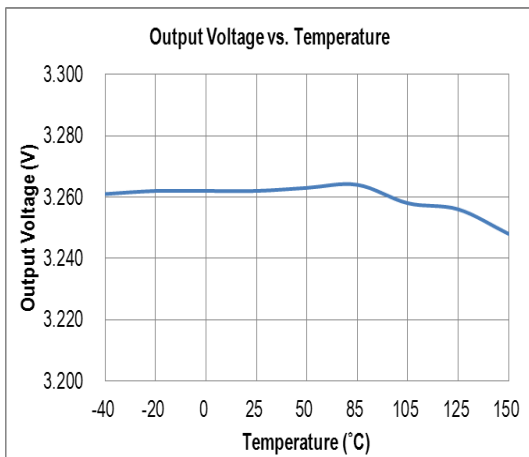
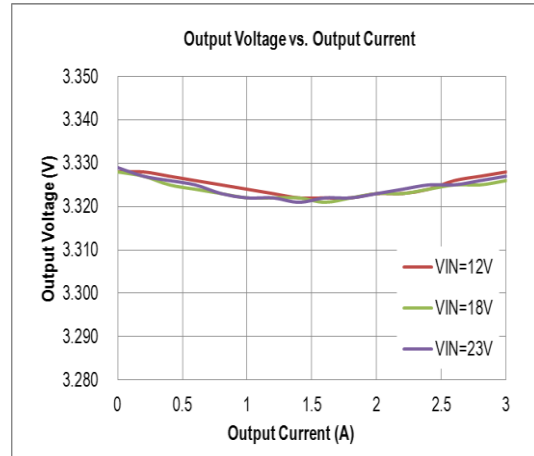
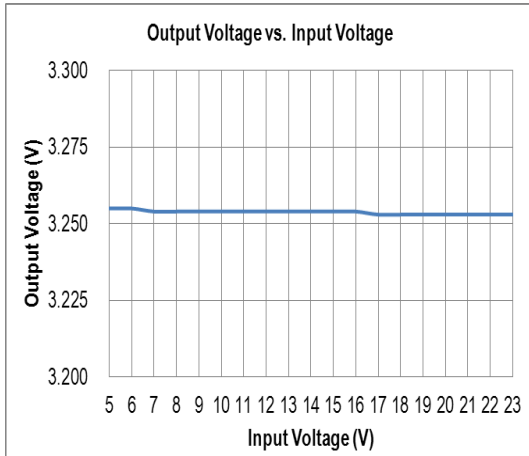
$$V_{OUT} = 0.925 \times \frac{R1 + R2}{R2}$$

$R2$ can be as high as 100k Ω , but a typical value is 10k Ω . Using the typical value for $R2$, $R1$ is determined by:

$$R1 = 10.811 \times (V_{OUT} - 0.925) \text{ (k}\Omega\text{)}$$

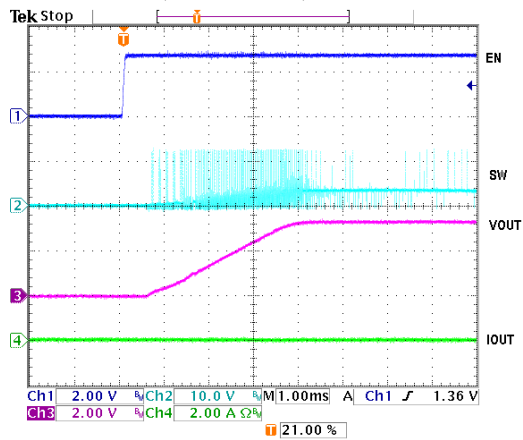
For example, for a 3.3V output voltage, $R2$ is 10k Ω , and $R1$ is 25.7k Ω .

❖ TYPICAL CHARACTERISTICS

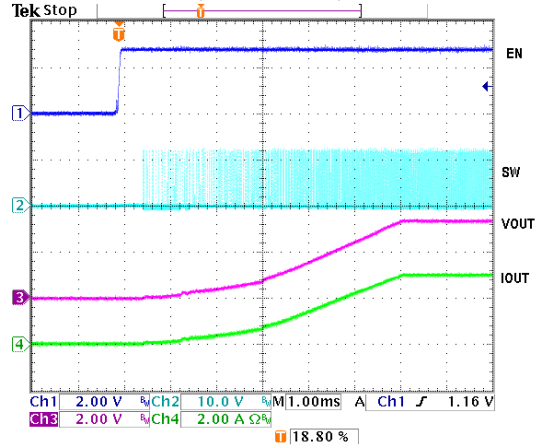


❖ TYPICAL CHARACTERISTICS (COUNTINOUS)

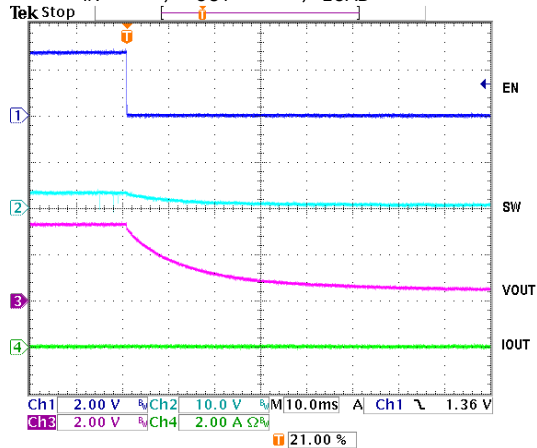
Enable On Waveform
 $V_{IN}=12V, V_{OUT}=3.3V, I_{LOAD}=\text{No Load}$



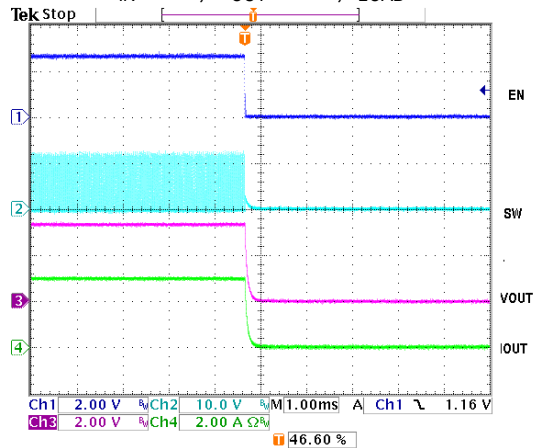
Enable On Waveform
 $V_{IN}=12V, V_{OUT}=3.3V, I_{LOAD}=3A$



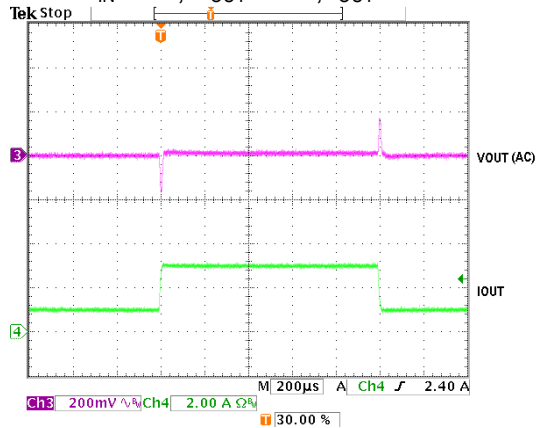
Enable Off Waveform
 $V_{IN}=12V, V_{OUT}=3.3V, I_{LOAD}=\text{No Load}$

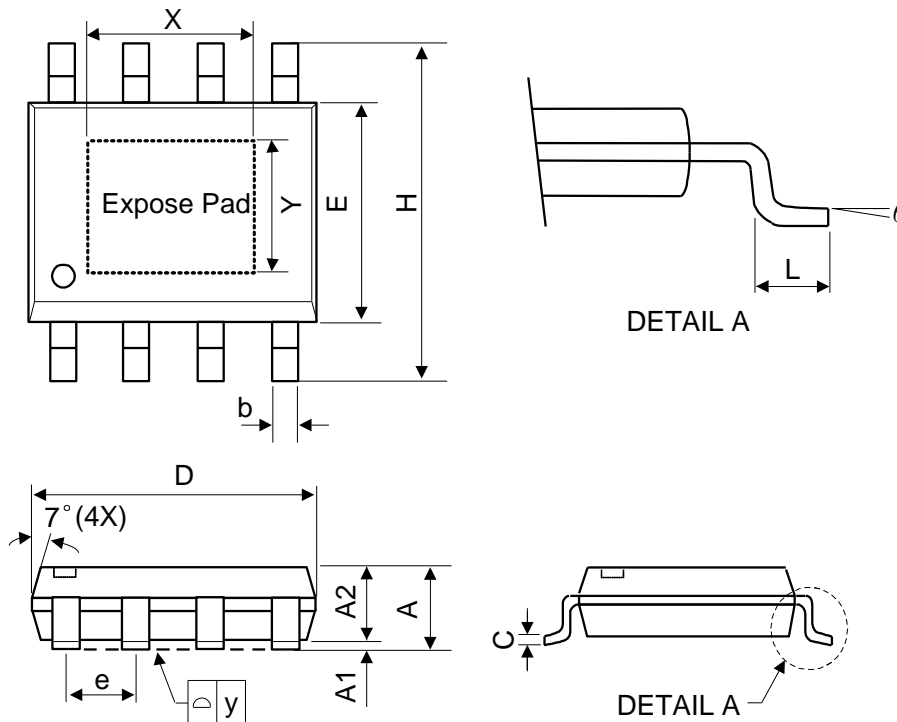


Enable Off Waveform
 $V_{IN}=12V, V_{OUT}=3.3V, I_{LOAD}=3A$



Load Transient Waveform
 $V_{IN}=12V, V_{OUT}=3.3V, I_{OUT}=1A\sim 3A$



❖ PACKAGE OUTLINES
(1) SOP-8L-EP


Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.75	-	-	0.069
A1	0	-	0.15	0	-	0.06
A2	1.25	-	-	0.049	-	-
C	0.1	0.2	0.25	0.0075	0.008	0.01
D	4.7	4.9	5.1	0.185	0.193	0.2
E	3.7	3.9	4.1	0.146	0.154	0.161
H	5.8	6	6.2	0.228	0.236	0.244
L	0.4	-	1.27	0.015	-	0.05
b	0.31	0.41	0.51	0.012	0.016	0.02
e	1.27 BSC			0.050 BSC		
y	-	-	0.1	-	-	0.004
X	-	2.34	-	-	0.092	-
Y	-	2.34	-	-	0.092	-
θ	0°	-	8°	0°	-	8°

Mold flash shall not exceed 0.25mm per side

JEDEC outline: MS-012 BA