

## 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.

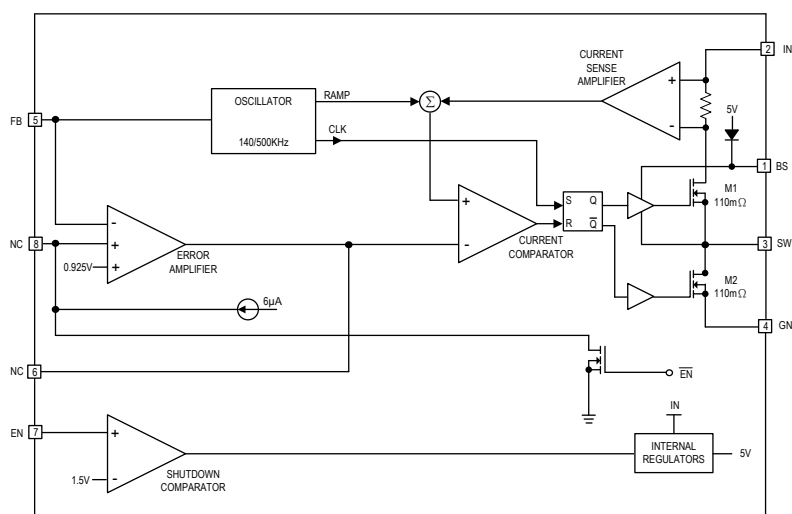
Internal soft-start prevents inrush current at turn-on, and in shutdown mode the supply current drops to 5μA.

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

### ❖ FEATURES

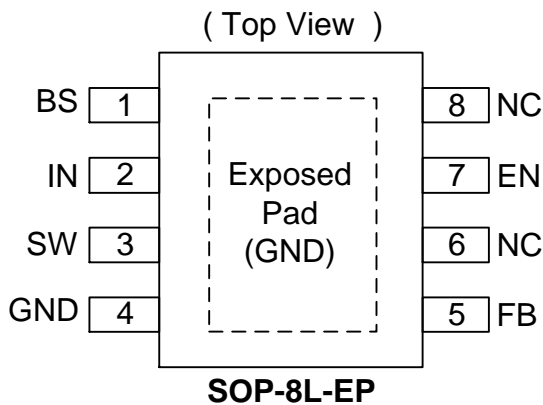
- 3A Output Current
- Wide 4.75V to 23V Operating Input Range
- Integrated 110mΩ Power MOSFET Switches
- Output adjust from  $V_{FB}$  to 20V
- Internal compensation
- Up to 94% Efficiency
- Stable with Low ESR Ceramic Output Capacitors
- Fixed 500KHz Frequency
- Cycle-by-cycle Over Current Protection
- 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
<b>BS</b>	High-Side Gate Drive Boost Input. BS supplies the drive for the high-side N-Channel MOSFET switch. Connect a 0.01μF or greater capacitor from SW to BS to power the high side switch.
<b>IN</b>	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.
<b>SW</b>	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.
<b>GND</b>	Ground.
<b>FB</b>	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.
<b>NC</b>	Not connect
<b>EN</b>	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 100kΩ resistor for automatic startup.

**❖ RDER/MARKING INFORMATION**

Order Information	Top Marking
<p><b>AX3803XXX</b></p> <p>Package Type    Packing                      ES: SOP-8L-EP    Blank: Tube                                                A : Taping</p>	<p>Logo ← <b>AX</b> 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  $T_A=25^{\circ}\text{C}$ )

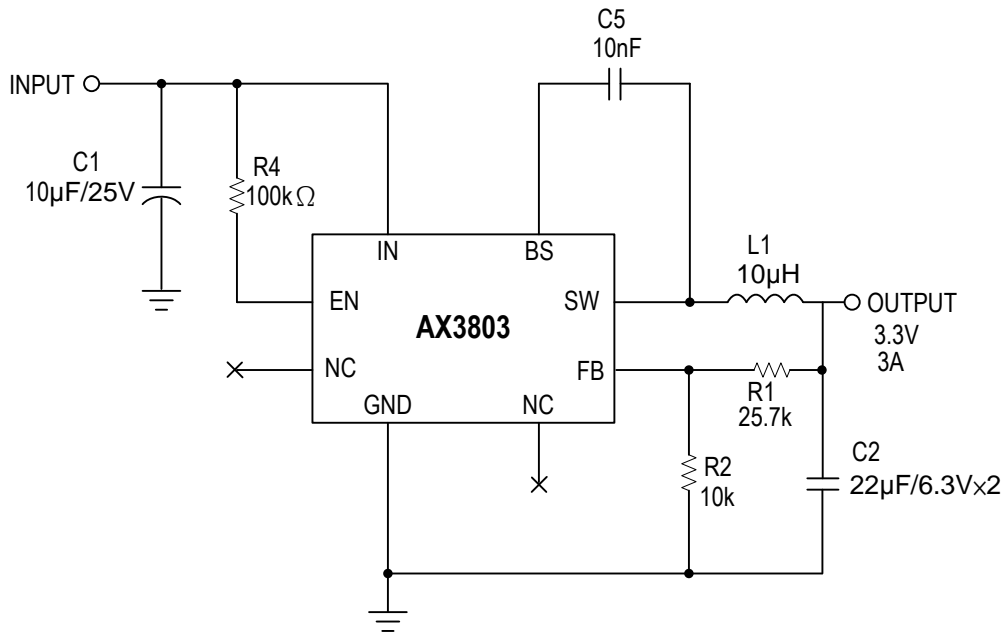
Characteristics	Symbol	Rating	Unit
Input Voltage	$V_{IN}$	-0.3 to +24	V
Switch Node Voltage	$V_{SW}$	-1V to $V_{IN}+0.3\text{V}$	V
Boost Voltage	$V_{BS}$	$V_{SW} - 0.3$ to $V_{SW} + 6$	V
All Other Pins		-0.3 to +6	V
Lead Temperature		260	$^{\circ}\text{C}$
Storage Temperature		-65 to +150	$^{\circ}\text{C}$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

Note:  $\theta_{JA}$  is measured with the PCB copper area of approximately 1 in<sup>2</sup>(Multi-layer).

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

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Operating Voltage	$V_{IN}$		4.75	-	23	V
Shutdown Supply Current	$I_{SD}$	$V_{EN} = 0\text{V}$	-	5	12	$\mu\text{A}$
Shutdown Current Operation		$V_{FB}=1.1\text{V}$	-	0.5	0.7	$\text{mA}$
Feedback Voltage	$V_{FB}$	$4.75\text{V} \leq V_{IN} \leq 23\text{V}$	0.900	0.925	0.950	V
Load Regulation		$I_{OUT}= 0 \sim 3\text{A}$	-2	-	+2	%
High-Side Switch On Resistance (Note)	$R_{DS(ON)1}$		-	110	-	$\text{m}\Omega$
Low-Side Switch On Resistance (Note)	$R_{DS(ON)2}$		-	110	-	$\text{m}\Omega$
High-Side Switch Leakage Current		$V_{EN} = 0\text{V}$ , $V_{SW} = 0\text{V}$	-	-	10	$\mu\text{A}$
Switch Current Limit			3.4	-	-	A
Oscillation Frequency	$F_{OSC1}$		-	500	-	KHz
Short Circuit Oscillation Frequency	$F_{OSC2}$	$V_{FB} = 0\text{V}$	-	140	-	KHz
Maximum Duty Cycle	$D_{MAX}$	$V_{FB} = 0.8\text{V}$	-	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:

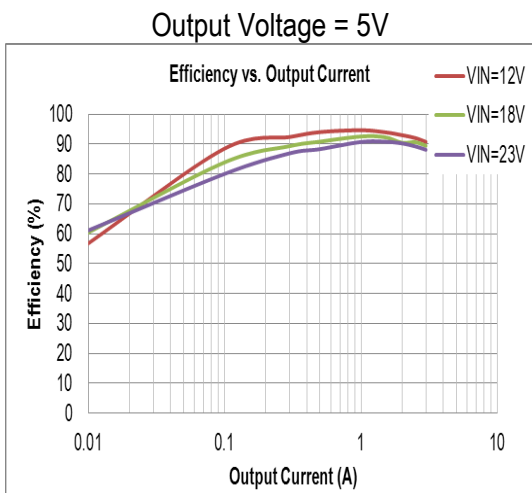
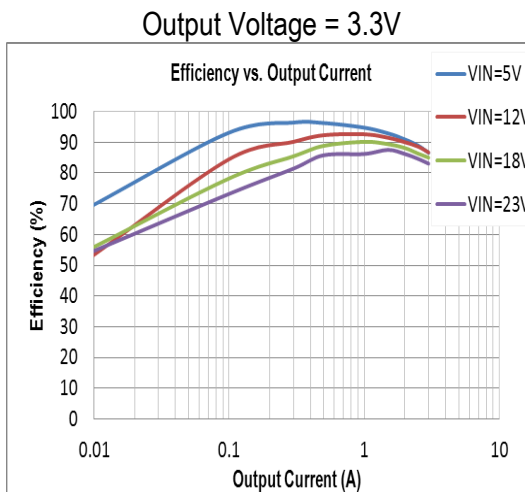
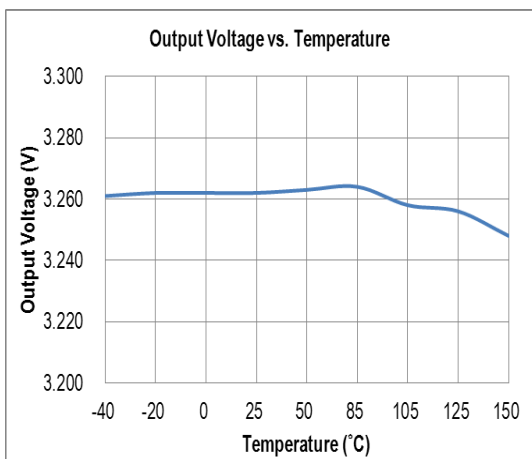
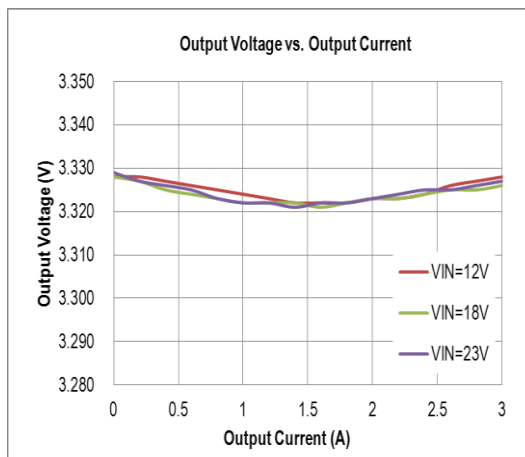
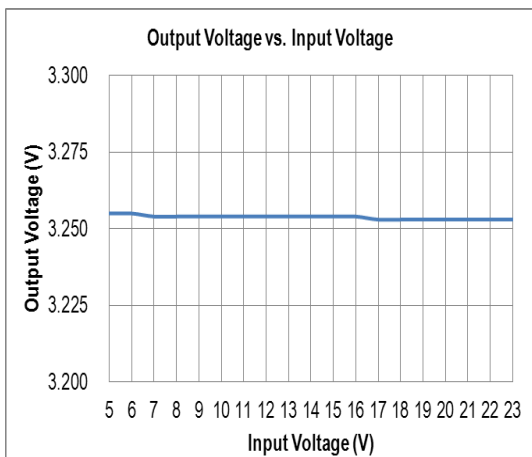
$$V_{OUT} = 0.925 \times \frac{R1 + R2}{R2}$$

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

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

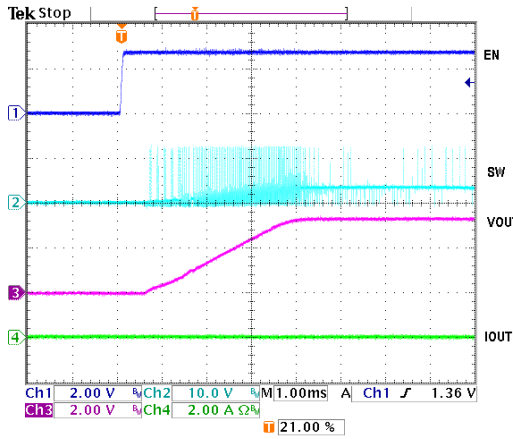
For example, for a 3.3V output voltage,  $R2$  is 10k $\Omega$ , and  $R1$  is 25.7k $\Omega$ .

❖ TYPICAL CHARACTERISTICS

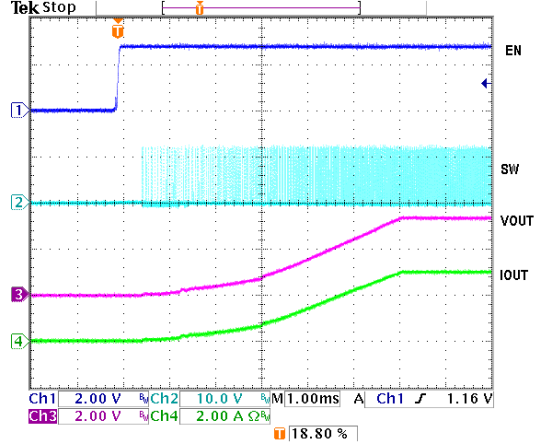


❖ TYPICAL CHARACTERISTICS (COUNTINOUS)

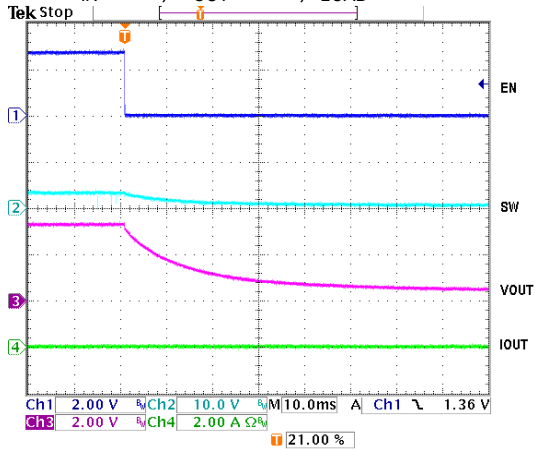
Enable On Waveform  
 $V_{IN}=12V, V_{OUT}=3.3V, I_{LOAD}=\text{No Load}$



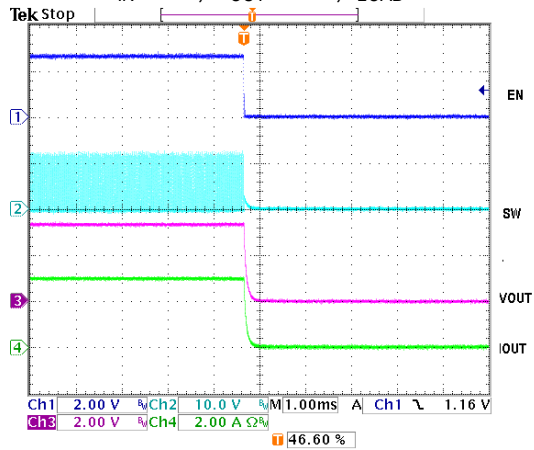
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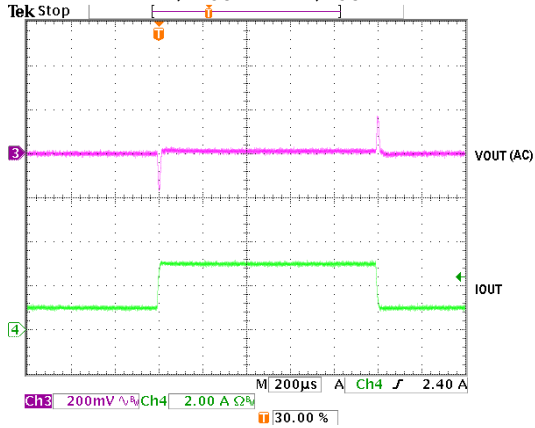
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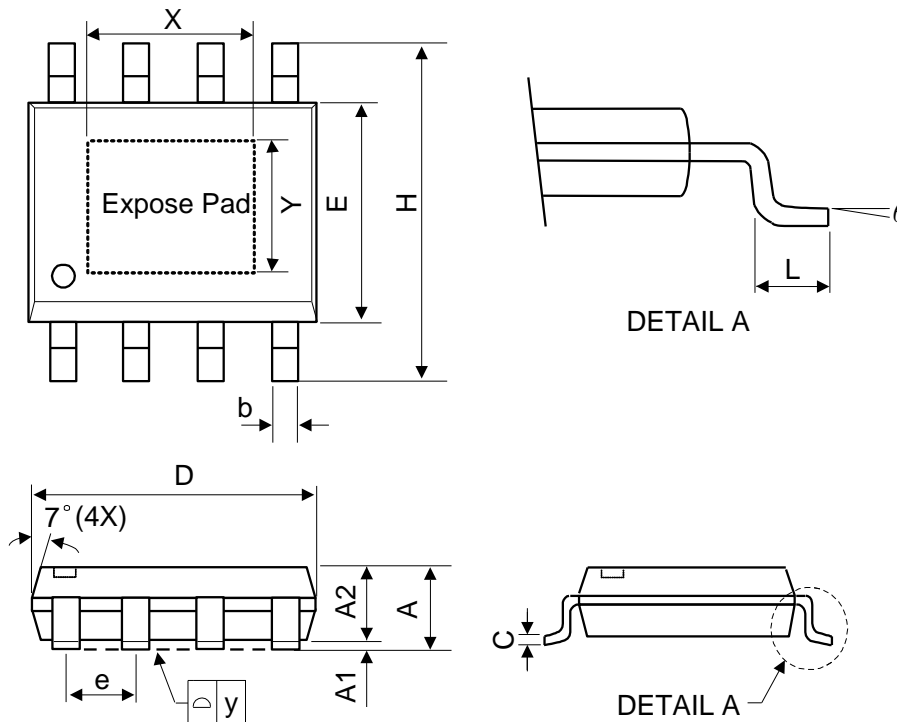


Enable Off Waveform  
 $V_{IN}=12V, V_{OUT}=3.3V, I_{LOAD}=3A$



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