

1.6A, 13V, 600KHz Synchronous Rectified Step-Down Converter

❖ GENERAL DESCRIPTION

The AX3821 is a monolithic synchronous buck regulator. The device integrates two 100mΩ MOSFETs, and provides 1.6A of continuous load current over a wide input voltage of 4.5V to 13V. Current mode control provides fast transient response and cycle-by-cycle current limit.

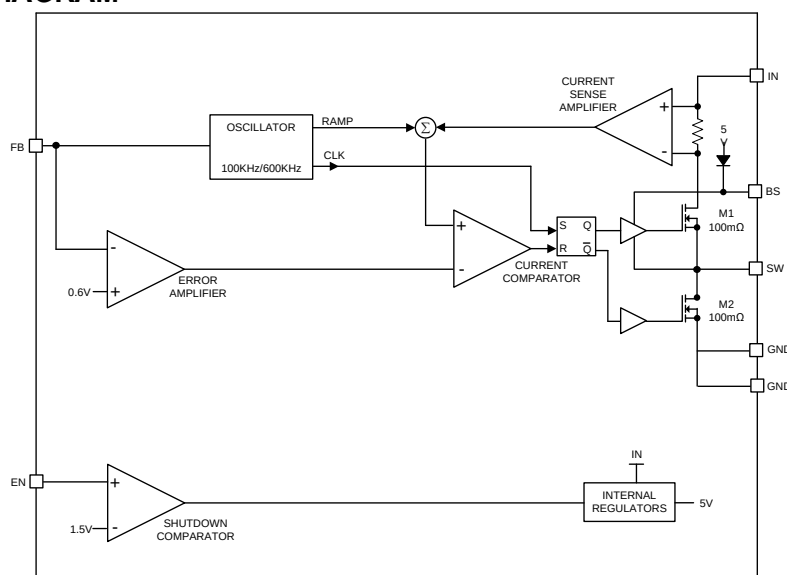
Internal soft-start prevents inrush current at turn-on, and in shutdown mode the supply current drops to 1μA.

This device, available in SOT-23-6L package, provides a very compact solution with minimal external components.

❖ FEATURES

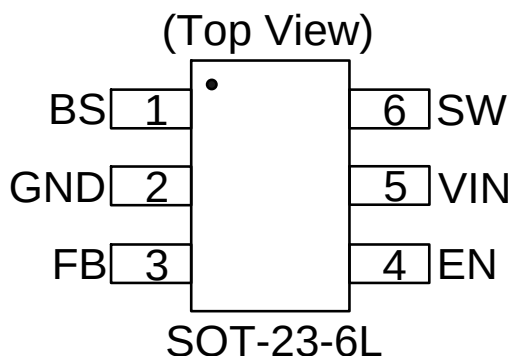
- 1.6A Output Current
- Wide 4.5V to 13V Operating Input Range
- Integrated 100mΩ Power MOSFET Switches
- Output adjust from V_{FB} to 11V
- Internal compensation
- Up to 94% Efficiency
- Stable with Low ESR Ceramic Output Capacitors
- Fixed 600KHz Frequency
- Cycle-by-Cycle Over Current Protection
- Thermal shutdown and short circuit protections

❖ BLOCK DIAGRAM



❖ PIN ASSIGNMENT

The package of AX3821 is SOT-23-6L; the pin assignment is given by:



Name	Description
BS	Bootstrap. A 10nF capacitor is connected between SW and BS pins to drive the power switch's gate above the supply voltage.
GND	Ground Pin. Connect this pin to exposed pad.
FB	Feedback. An external resistor divider from the output to GND, tapped to the FB pin sets the output voltage.
VIN	Power Supply Input. Drive 4.5V to 13V voltage to this pin to power on this chip. Connect a 10μF ceramic bypass capacitor between VIN and GND to eliminate noise.
SW	Switch Output. Connect this pin to the switch end of the inductor.
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 100kΩ resistor for automatic startup.

❖ ORDER/MARKING INFORMATION

Order Information	Top Marking
AX3821XX Package Type C: SOT-23-6L Packing Blank: Tube A : Taping	RYYWX AX3821 → ID code:internal → WW:01~26 (A~Z) 27~52 (a~z) → Year: A=2010 1=2011 2=2012 ⋮ 9=2019

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

Characteristics	Symbol	Rating	Unit
Input Voltage	V_{IN}	-0.3 to +13	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}	0.6 to 11	V
Ambient Operating Temperature		-40 to +85	$^{\circ}\text{C}$
Thermal Resistance from Junction to case	θ_{JC}	180	$^{\circ}\text{C/W}$
Thermal Resistance from Junction to ambient	θ_{JA}	250	$^{\circ}\text{C/W}$

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

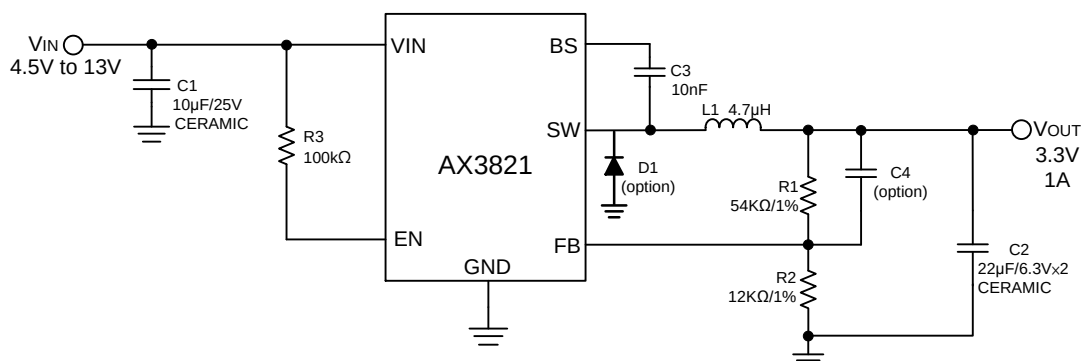
❖ **ELECTRICAL CHARACTERISTICS**

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

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Operating Voltage	V_{IN}		4.5	-	13	V
Shutdown Supply Current	I_{SD}		-	1	-	μA
Shutdown Current Operation		$V_{FB}=0.6\text{V}$	-	0.5	0.7	mA
Feedback Voltage	V_{FB}	$4.5\text{V} \leq V_{IN} \leq 13\text{V}$	0.58	0.6	0.62	V
Line Regulation	$\Delta V_{OUT}/V_{OUT}$	$V_{CC}=5\text{V} \sim 11\text{V}$	-	0.06	-	V
Load Regulation		$I_{OUT}=0 \sim 1.6\text{A}$	-2	-	+2	%
High-Side Switch On Resistance (Note)	$R_{DS(ON)1}$		-	100	-	$\text{m}\Omega$
Low-Side Switch On Resistance (Note)	$R_{DS(ON)2}$		-	100	-	$\text{m}\Omega$
High-Side Switch Leakage Current		$V_{SW} = 0\text{V}$	-	-	10	μA
Switch Current Limit			2	-	-	A
Oscillation Frequency	F_{OSC1}		-	600	-	KHz
Short Circuit Oscillation Frequency	F_{OSC2}	$V_{FB} = 0\text{V}$	-	100	-	KHz
Maximum Duty Cycle	D_{MAX}	$V_{FB} = 0.4\text{V}$	-	90	-	%
EN High-Level Input Voltage	V_{EN_H}		2.5	-	-	V
EN Low-Level Input Voltage	V_{EN_L}		-	-	0.6	V
EN Shutdown Threshold Voltage Hysteresis			-	110	-	mV
Thermal Shutdown	T_{SD}		-	150	-	$^{\circ}\text{C}$
Thermal Shutdown Hysteresis	T_{SH}		-	20	-	$^{\circ}\text{C}$

Note: Guaranteed by design.

❖ APPLICATION CIRCUIT



$$V_{OUT} = V_{FB} \times \left(1 + \frac{R1}{R2}\right), V_{FB} = 0.6V, R2 \text{ suggest } 10k \sim 30K\Omega$$

Table Recommended Component Selection

V _{OUT}	R _H	R _L	L	C _{OUT}
5	110KΩ	15KΩ	4.7µH	22µF*2
3.3	54KΩ	12KΩ	4.7µH	22µF*2
2.5	47KΩ	15KΩ	4.7µH	22µF*2
1.8	60KΩ	30KΩ	4.7µH	22µF*2
1.5	45KΩ	30KΩ	2.2µH	22µF*2

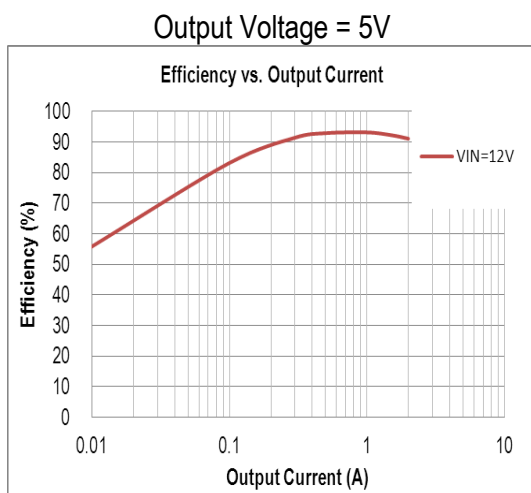
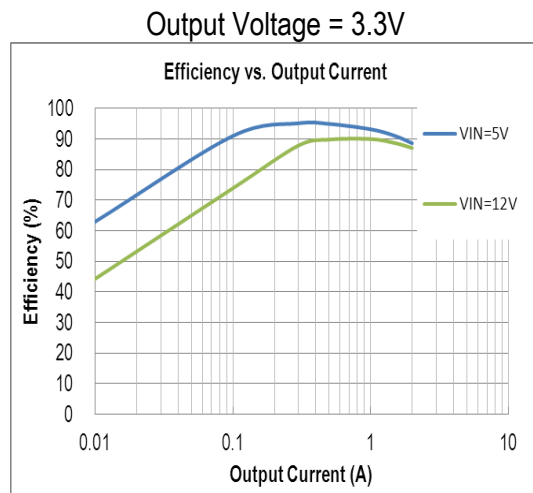
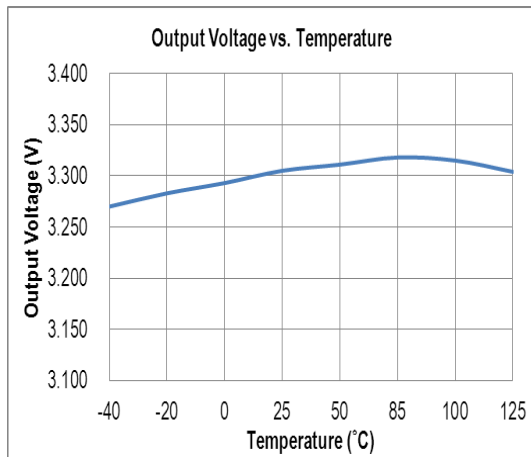
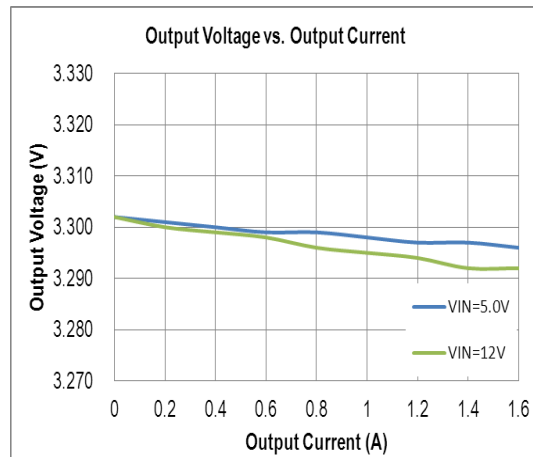
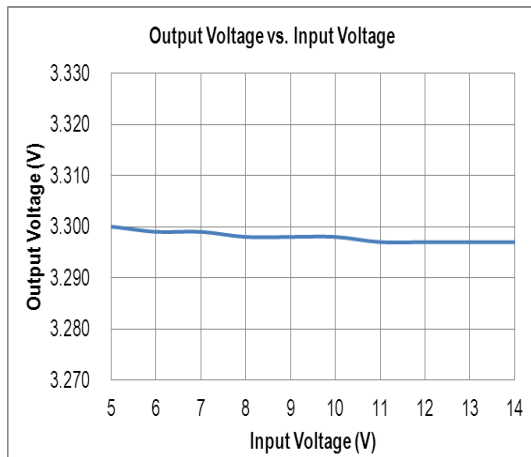
❖ FUNCTION DESCRIPTIONS

The AX3821 is a synchronous rectified, current-mode, step-down regulator. It regulates input voltages from 4.5V to 13V down to an output voltage as low as 0.6V, and supplies up to 1.6A of load current.

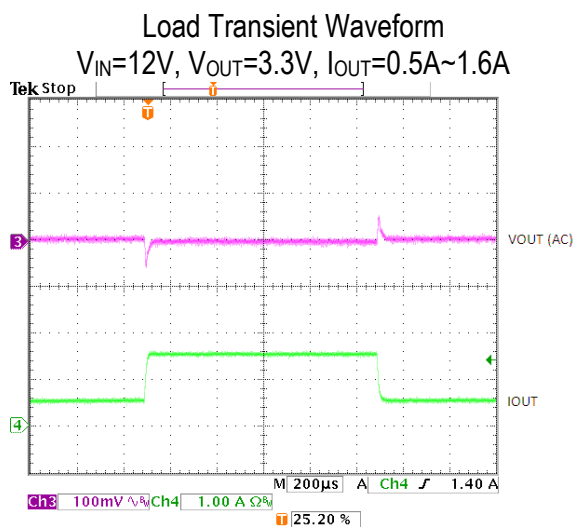
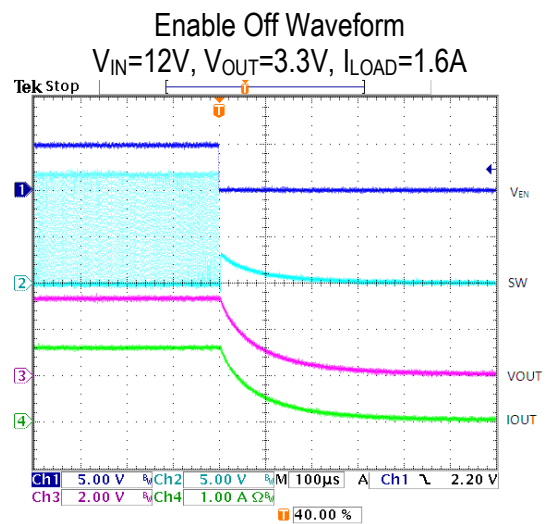
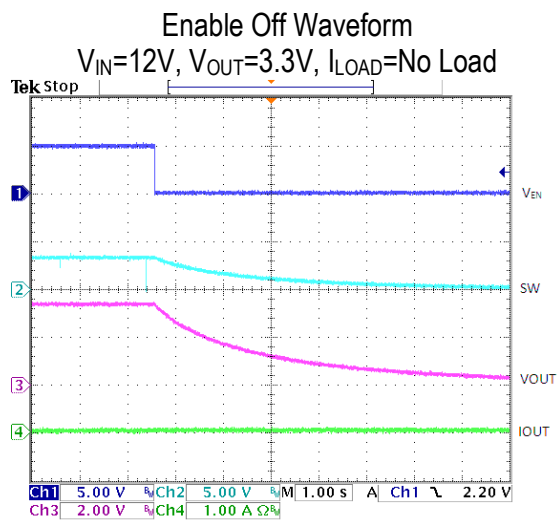
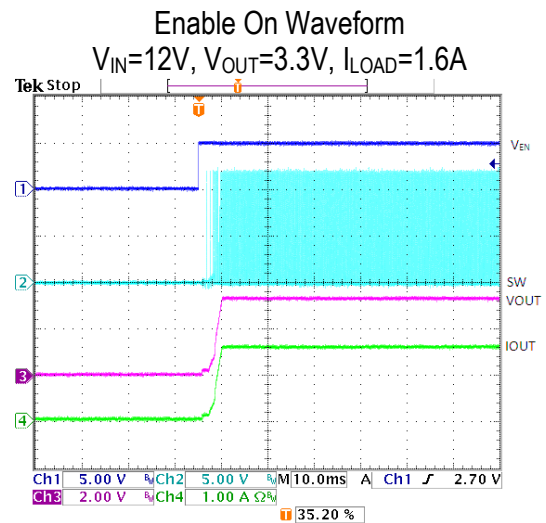
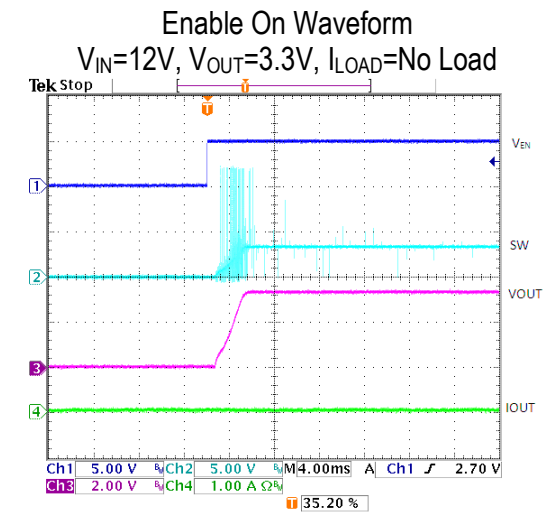
The AX3821 uses current-mode control to regulate the output voltage. The output voltage is measured at FB through a resistive voltage divider and amplified through the internal Transconductance error amplifier.

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.

❖ TYPICAL CHARACTERISTICS



❖ TYPICAL CHARACTERISTICS (COUNTINOUS)



❖ 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 VFB is the feedback voltage and V_{OUT} is the output voltage.
Thus the output voltage is:

$$V_{OUT}=0.6 \times \frac{R1 + R2}{R2}$$

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

$$R1= 20 \times (V_{OUT} - 0.6) (k\Omega)$$

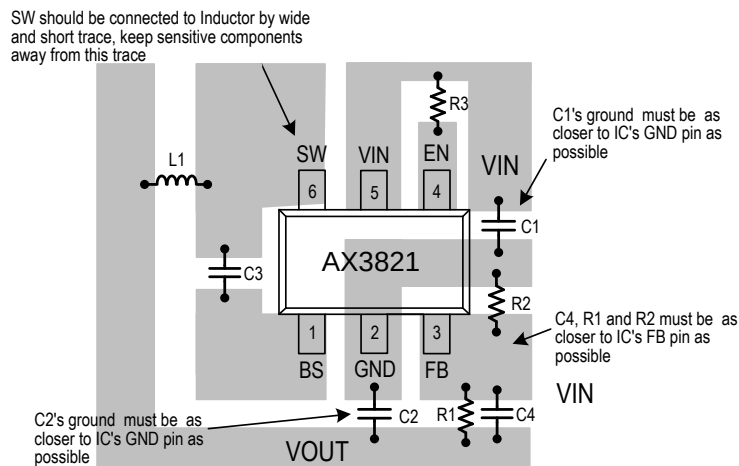
For example, for a 3.3V output voltage, R2 is 12kΩ, and R1 is 54kΩ.

Layout Guidance

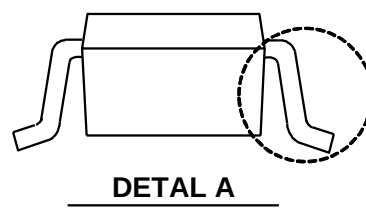
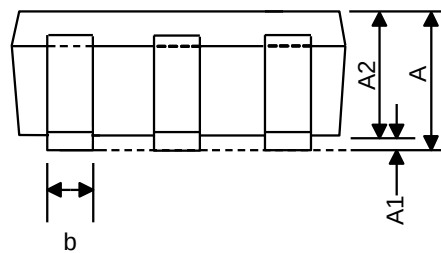
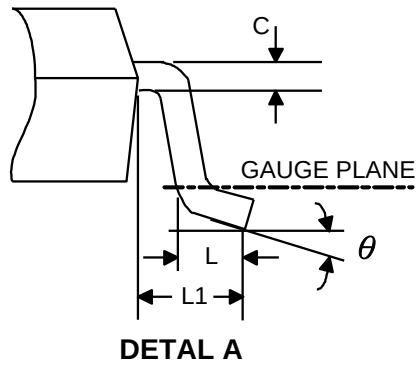
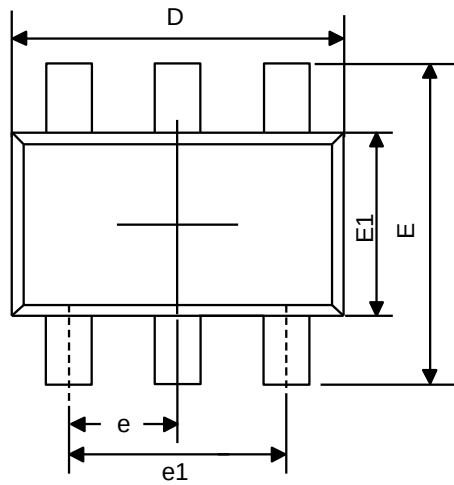
When laying out the PC board, the following suggestions should be taken to ensure proper operation of the AX3821. These items are also illustrated graphically in below.

1. The power traces, including the GND trace, the SW trace and the V_{IN} trace should be kept short, direct and wide to allow large current flow. Put enough multiply-layer pads when they need to change the trace layer.
2. Connect the input capacitor C1 to the V_{IN} pin as closely as possible to get good power filter effect.
3. Keep the switching node, SW, away from the sensitive FB node.
4. Do not trace signal line under inductor.

SOT-23-6L Layout Guide



❖ PACKAGE OUTLINES



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.45	-	-	0.057
A1	0.00	-	0.15	0	0.003	0.006
A2	0.90	1.10	1.30	0.035	0.043	0.051
b	0.30	0.40	0.50	0.012	0.016	0.020
C	0.08	-	0.22	0.003	0.006	0.009
D	2.70	2.90	3.10	0.106	0.114	0.122
E1	1.40	1.60	1.80	0.055	0.063	0.071
E	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	0.45	0.60	0.012	0.018	0.024
L1	0.50	0.60	0.70	0.020	0.024	0.028
e1	1.9 BSC			0.075 BSC		
e	0.95 BSC			0.037 BSC		
θ	0°	4°	8°	0°	4°	8°

JEDEC outline: MO-178 AB