PWM Control 2A Step-Down Converter

❖ GENERAL DESCRIPTION

AX3113 consists of step-down switching regulator with PWM control. These devise include a reference voltage source, oscillation circuit, error amplifier, internal PMOS and etc.

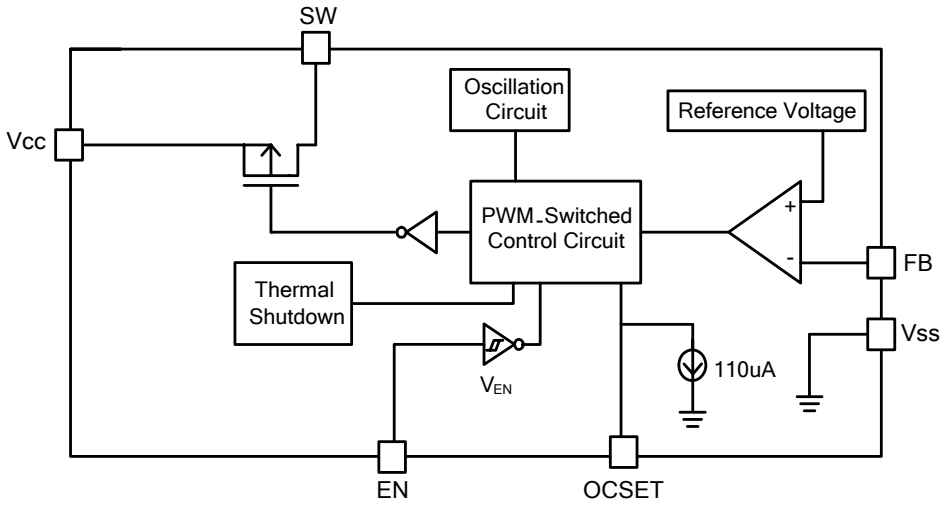
AX3113 provides low-ripple power, high efficiency, and excellent transient characteristics. The PWM control circuit is able to very the duty ratio linearly form 0 up to 100%. An enable function, an over current protect function and short circuit protect function are built inside, and when OCP or SCP happens, the operation frequency will be reduced. Also, an internal compensation block is built in to minimum external component count.

With the addition of an internal P-channel Power MOS, a coil, capacitors, and a diode connected externally, these ICs can function as step-down switching regulators. They serve as ideal power supply units for portable devices when coupled with the SOP-8L package, providing such outstanding features as low current consumption. Since this converter can accommodate an input voltage up to 23V, it is also suitable for the operation via an AC adapter.

❖ FEATURES

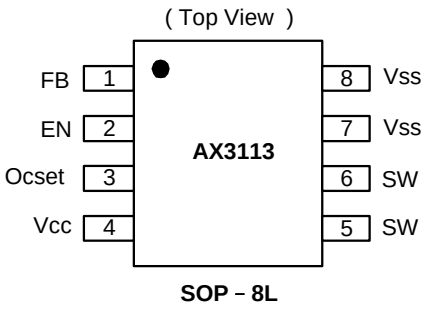
- Input voltage：4V to 23V
- Output voltage：0.8V to Vcc
- Duty ratio：0% to 100% PWM control
- Oscillation frequency：330KHz typ.
- Current Limit(CL), Enable function.
- Thermal Shutdown function.
- Short Circuit Protect (SCP).
- Built-in internal SW P-channel MOS.
- SOP-8L Pb-Free package.

❖ Block Diagram



❖ PIN ASSIGNMENT

The package of AX3113 is SOP-8L; the pin assignment is given by:



SOP – 8L

Name	Description
FB	Feedback pin
EN	Power-off pin H：normal operation(Step-down) L：Step-down operation stopped (All circuits deactivated)
OCSET	Add an external resistor to set max switch output current.
V_{CC}	IC power supply pin
SW	Switch pin. Connect external inductor & diode here.
V_{SS}	GND pin

❖ ORDER/MARKING INFORMATION

Order Information	Top Marking
AX3113 X X X Frequency: Blank : 330Khz Package Type: S: SOP-8L Packing: Blank : Tube, A : Taping	Logo ← AX 3113 → Part number X X X X X → ID code: internal → WW: 01~52 → Year : 06 = 2006

❖ Absolute Maximum Ratings (at Ta=25℃)

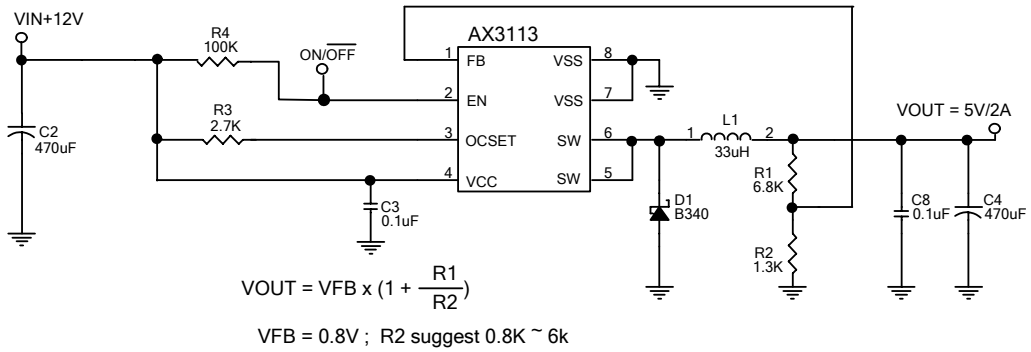
Characteristics	Symbol	Rating	Unit
VCC Pin Voltage	V_{CC}	V_{SS} - 0.3 to V_{SS} + 23	V
Feedback Pin Voltage	V_{FB}	V_{SS} - 0.3 to V_{CC}	V
ON/OFF Pin Voltage	V_{EN}	V_{SS} - 0.3 to V_{CC} + 0.3	V
Switch Pin Voltage	V_{SW}	V_{SS} - 0.3 to V_{CC} + 0.3	V
Power Dissipation	PD	Internally limited	mW
Storage Temperature Range	T_{ST}	-40 to +150	℃
Operating Junction Temperature Range	T_J	-20 to +125	℃
Operating Supply Voltage	V_{OP}	4 to 23	V
Output Current	I_{OUT}	0 to 2	A
Thermal Resistance from Junction to case	θ_{JC}	25	℃/W
Thermal Resistance from Junction to ambient	θ_{JA}	70	℃/W

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

❖ Electrical Characteristics (VIN = 12V, Ta=25℃, unless otherwise specified)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Feedback Voltage	V_{FB}	I_{OUT}=0.1A	0.784	0.800	0.816	V
Quiescent Current	I_{CCQ}	V_{FB}=1.2V force driver off	-	3	5	mA
Feedback Bias Current	I_{FB}	I_{OUT}=0.1A	-	0.1	0.5	uA
Shutdown Supply Current	I_{SD}	V_{EN} =0V	-	2	10	uA
OCSET pin bias current	I_{OCSET}		95	110	125	uA
Switch Current	I_{SW}		2.3	-	-	A
Line Regulation	$\triangle V_{OUT}/V_{OUT}$	V_{CC} = 5V~23V, I_{OUT}=0.2A	-	1	2	%
Load Regulation	$\triangle V_{OUT}/V_{OUT}$	I_{OUT} = 0.1 to 2A	-	0.2	0.5	%
Oscillation Frequency	F_{OSC}	SW pin	260	330	400	KHz
Switching Rising Time	Tr	I_{OUT}=1.5A	-	15	-	ns
Switching Falling Time	Tf	I_{OUT}=1.5A	-	15	-	ns
EN Pin Logic input threshold voltage	V_{SH}	High (regulator ON)	2.0	-	-	V
	V_{SL}	Low (regulator OFF)	-	-	0.8	
EN Pin Input Current	I_{SH}	V_{EN}=2.5V (ON)	-	20	-	uA
	I_{SL}	V_{EN}=0.3V (OFF)	-	-10	-	uA
Internal MOSFET R_{DSON}	R_{DSON}	V_{CC}=5V, V_{FB}=0V	-	200	240	mΩ
		V_{CC}=12V, V_{FB}=0V	-	100	120	
Efficiency	EFFI	V_{CC} = 12V, V_{OUT} = 5V, I_{OUT} = 1A	-	92	-	%
		V_{CC} = 12V, V_{OUT} = 5V, I_{OUT} = 2A		91		

❖ Application Circuit



L1 recommend value (V_{IN}=12V ,I_{OUT}=2A,)				
V_{OUT}	1.8 V	2.5V	3.3V	5V
L1 Value	18uH	22uH	27uH	33uH

❖ Function Descriptions

PWM Control

The AX3113 consists of DC/DC converters that employ a pulse-width modulation (PWM) system. In converters of the AX3113, the pulse width varies in a range from 0 to 100%, according to the load current. The ripple voltage produced by the switching can easily be removed through a filter because the switching frequency remains constant. Therefore, these converters provide a low-ripple power over broad ranges of input voltage and load current.

RDS(ON) Current Limiting

The current limit threshold is setting by the external resistor (R3) connecting from V_{CC} supply to OCSET pin. The internal 110uA sink current crossing the resistor sets the voltage at pin of OCSET. When the PWM voltage is less than the voltage at OCSET, an over-current condition is triggered. Please refer to the formula for setting the minimum current limit value:

$$I_{SW(MIN)} = \frac{I_{OCSET} \times R3 + 0.08}{R_{DS(ON)}}$$

(Normally, The $I_{SW(MIN)}$ setting more than I_{OUT} 1.0A).

Example:

I_{SW} = (0.110mA x 2.7k + 0.08)/ 0.12Ω= 3.15A - (V_{IN}=12V)
I_{SW} = (0.110mA x 5.6K + 0.08)/ 0.24Ω= 2.9A - (V_{IN}=5V)

Setting the Output Voltage

Application circuit item shows the basic application circuit with adjustable output version. The external resistor sets the output voltage according to the following equation:

$$V_{OUT} = 0.8V \times \left(1 + \frac{R1}{R2}\right)$$

Table 1 Resistor select for output voltage setting

V_{OUT}	R2	R1
5V	1.3K	6.8K
	5.6K	30K
3.3V	1.5K	4.7K
	5.6K	18K
2.5V	2.2K	4.7K
1.8V	2K	2.5K
1.5V	2.2K	2.0K
1.2V	3K	1.5K

The R2 setting 5.6k that No load current can be reduce to under 4mA for EL CAP.

Inductor Selection

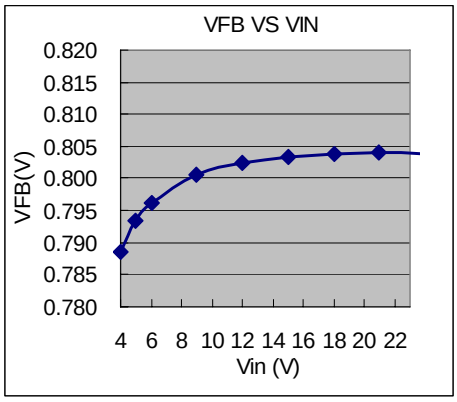
For most designs, the operates with inductors of 15μH to 33μH. The inductor value can be derived from the following equation:

$$L = \frac{V_{OUT} \times (V_{IN} - V_{OUT})}{V_{IN} \times \Delta I_L \times f_{OSC}}$$

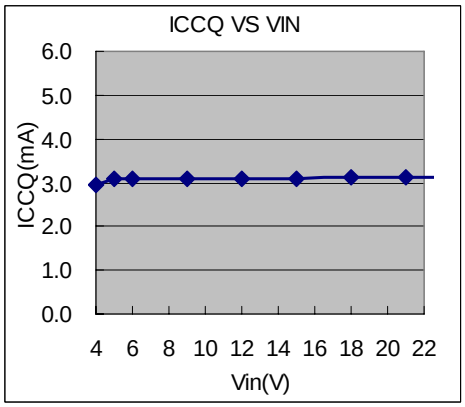
Where is inductor Ripple Current. Large value inductors lower ripple current and small value inductors result in high ripple currents. Choose inductor ripple current approximately 15% of the maximum load current 2A, ΔI_L=0.3A. The DC current rating of the inductor should be at least equal to the maximum load current plus half the ripple current to prevent core saturation (2A+0.15A).

❖ Typical Characteristics

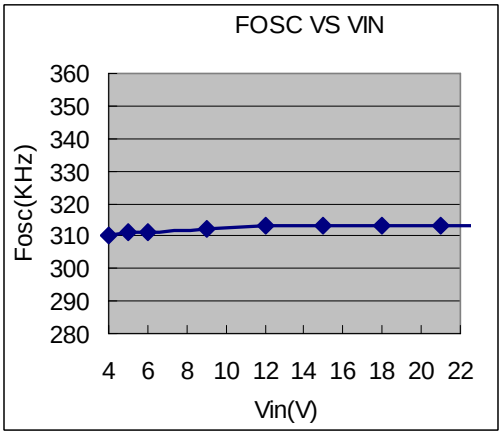
VFB VS VIN



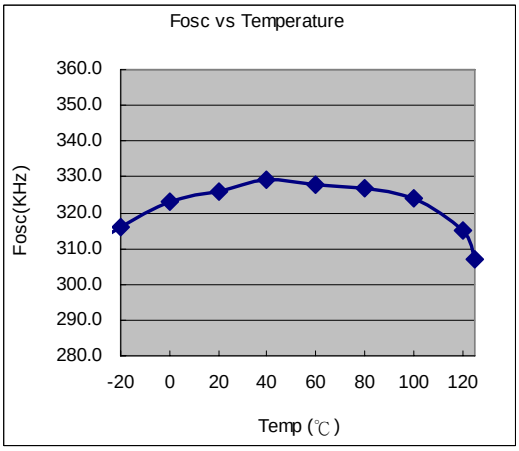
ICCQ VS VIN



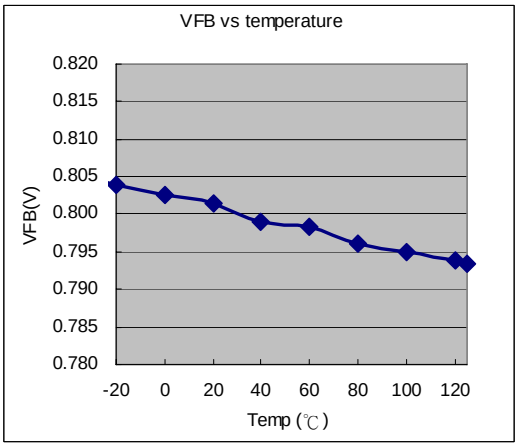
FOSC VS VIN



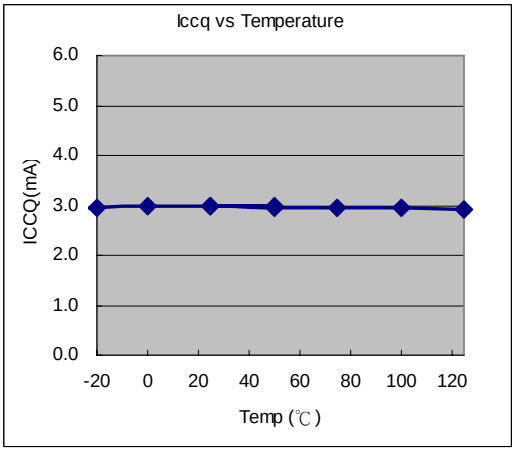
FOSC VS TEMPERATURE



VFB VS TEMPERATURE



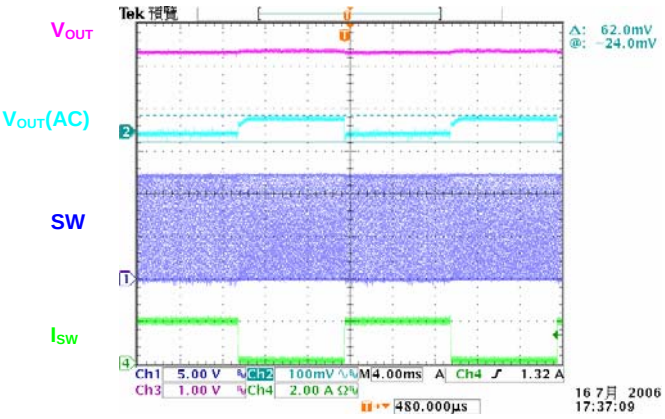
ICCQ VS TEMPERATURE



❖ Typical Characteristics

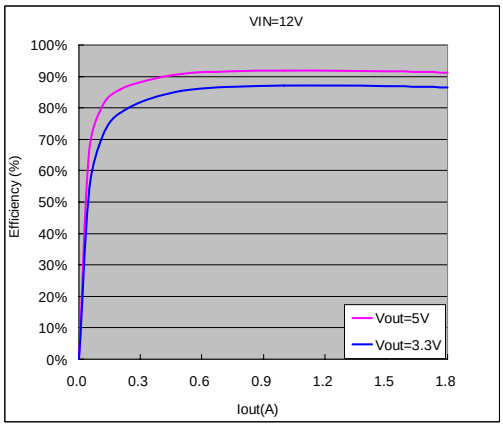
Load Transient Response

(V_{IN}=12V, V_{OUT}=5V, I_{OUT}=0.1~2A)



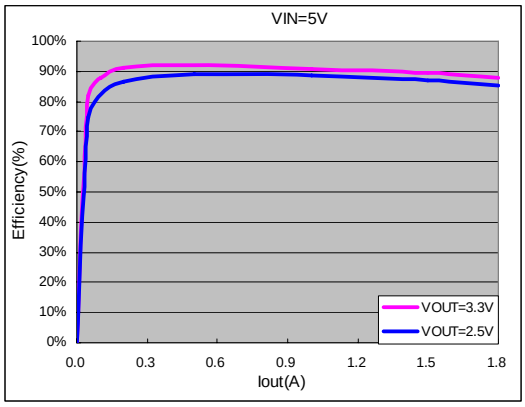
Efficiency

(V_{IN}=12V, V_{OUT}=5V/3.3V)

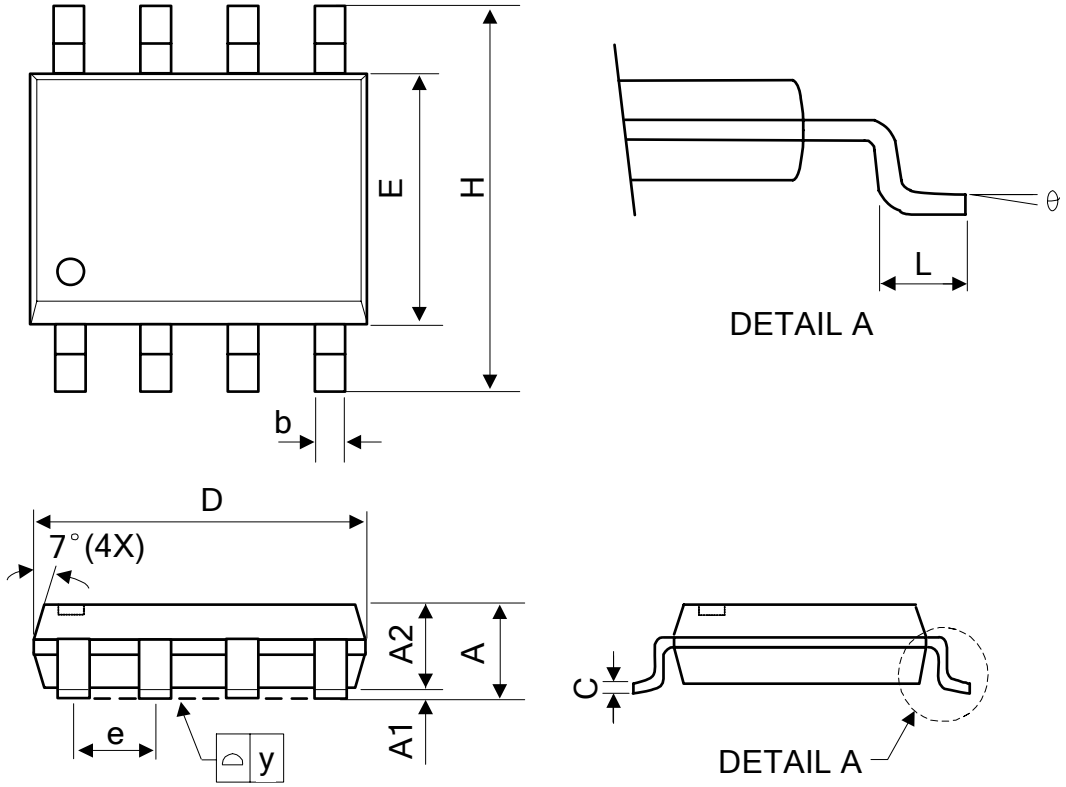


Efficiency

(V_{IN}=5V, V_{OUT}=3.3V/2.5V)



❖ Package Outlines



Symbol	Dimensions In Millimeters			Dimensions In Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.40	1.60	1.75	0.055	0.063	0.069
A1	0.10	-	0.25	0.040	-	0.100
A2	1.30	1.45	1.50	0.051	0.057	0.059
C	0.19	0.20	0.25	0.0075	0.008	0.010
D	4.80	4.90	5.00	0.189	0.193	0.197
E	3.80	3.90	4.00	0.150	0.154	0.157
H	5.79	5.99	6.20	0.228	0.236	0.244
L	0.38	0.71	1.27	0.015	0.028	0.050
b	0.33	0.41	0.51	0.013	0.016	0.020
e	1.27 TYP			0.050 TYP		
y	-	-	0.10	-	-	0.004
θ	0°	-	8°	0°	-	8°

原厂授权代理

高科智电子（香港）有限公司
深圳市四海恒通科技有限公司

地址：深圳市福田区鼎城国际大厦 17 楼 1701
电话：0755- 61358291/2　　传真：0755-61358293
贸易通：gofocn / gofoled　商务 QQ：228833412
网址：www.gofotech.com　E-mail：gofotech@163.com

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