

Step-up PWM DC/DC Converter

❖ GENERAL DESCRIPTION

The AX5101A is high efficient step-up DC/DC converter. Large output current is possible having a built in internal N channel MOSFET, and using an external coil and diode.

The AX5101A can be operated at switching frequencies of 500 kHz allowing for easy filtering and low noise, the size of the external components can be reduced.

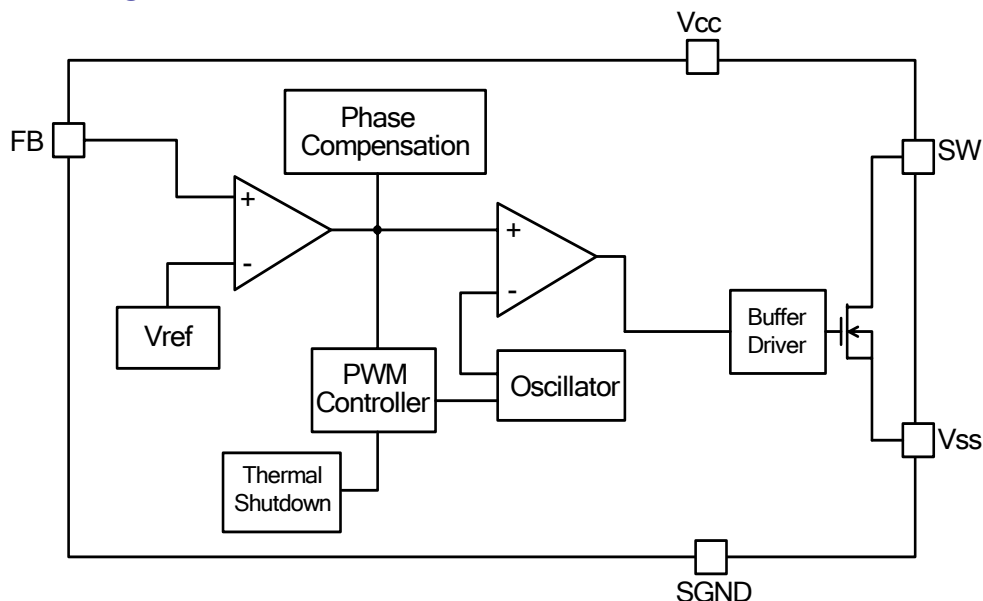
Output voltage is programmable with 1.0V of standard voltage supply internal, and using externally connected components, output voltage (FB) can be set up at will.

This converter also contains an error amplifier circuit as well as a soft-start circuit that prevents inrush-current at startup. The thermal shutdown function is built inside.

❖ FEATURES

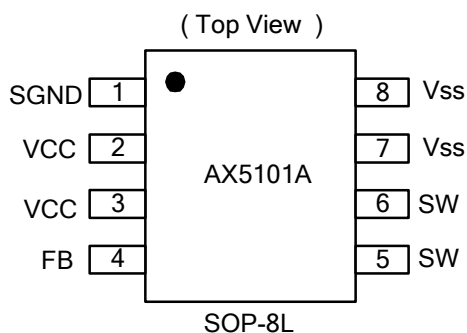
- Input voltage: 3V to 14V
- Output voltage: 3.3V to 28V($\pm 2.5\%$)
- Duty ratio: 0% to 80% PWM control
- Switch current: 3A(MAX)
- Oscillation frequency: 500 KHz.
- Soft-start function
- Thermal Shutdown function
- Built-in internal SW N-channel MOS
- SOP-8L Pb-Free Package.

❖ Block Diagram



❖ PIN ASSIGNMENT

The package of AX5101A is SOP-8L; the pin assignment is given by:



Name	Description
SGND	Signal ground pin.
Vcc	IC power supply pin
FB	Feedback pin
SW	Switch pin. Connect external inductor & diode here.
Vss	GND pin

❖ ORDER/MARKING INFORMATION

Order Information	Top Marking
AX5101 X X X Frequency Package Type Packing A : 500Khz S: SOP-8L Blank : Tube A : Taping	Logo ← AX 5101 → Part number A X X X X X → ID code: internal WW: 01~52 AX5101A → Year : 06 = 2006

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

Characteristics	Symbol	Rating	Unit
VCC Pin Voltage	V_{CC}	$V_{SS} - 0.3$ to $V_{SS} + 15$	V
Feedback Pin Voltage	V_{FB}	$V_{SS} - 0.3$ to V_{CC}	V
Switch Pin Voltage	V_{SW}	$V_{SS} - 0.3$ to 30	V
Power Dissipation	PD	Internally limited	mW
Storage Temperature Range	T_{ST}	-40 to +150	$^{\circ}\text{C}$
Operating Temperature Range	T_{OP}	-20 to +125	$^{\circ}\text{C}$
Thermal Resistance from Junction to case	θ_{JC}	25	$^{\circ}\text{C}/\text{W}$
Thermal Resistance from Junction to ambient	θ_{JA}	70	$^{\circ}\text{C}/\text{W}$

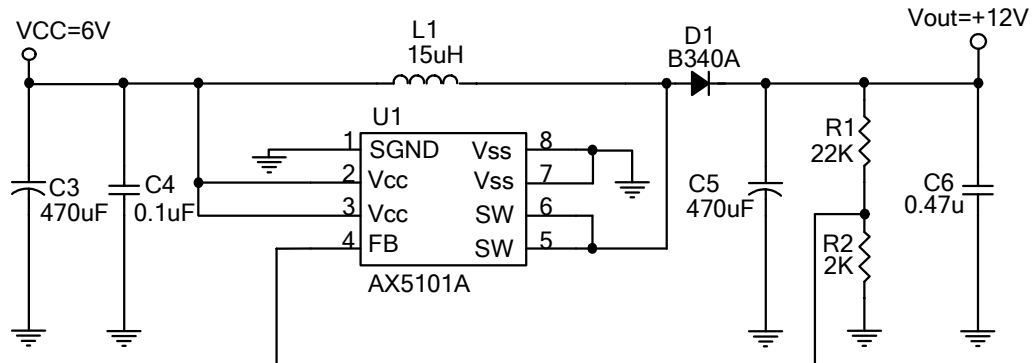
Note : θ_{JA} is measured with the PCB copper area of approximately 2 in²(Multi-layer) that need connect to SW pins(5&6) of the AX5101A.

❖ **Electrical Characteristics** ($V_{IN} = 6\text{V}$, $V_{OUT}=12\text{V}$, $T_a=25^{\circ}\text{C}$, unless otherwise specified)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Operating Supply Voltage	V_{CC}		3	-	14	V
Output Voltage Range	V_{OUT}		3.3	-	28	V
Feedback Voltage	V_{FB}	$I_{OUT}=0.1\text{A}$	0.98	1.00	1.02	V
Quiescent Current	I_{CCQ}	$V_{FB}=1.5\text{V}$ force driver off		4	6	mA
Feedback Bias Current	I_{FB}	$I_{OUT}=0.1\text{A}$	-	0.1	0.5	μA
Switch Current	I_{SW}		3.2	-	-	A
Oscillation Frequency	F_{OSC}	SW pin	400	500	600	KHz
Soft-Start Time	T_{SS}		0.3	4	8	ms
Internal MOSFET $R_{DS(on)}$	$R_{DS(on)}$	$V_{CC}=3\text{V}$, $V_{FB}=0\text{V}$	-	50	70	m Ω
		$V_{CC}=5\text{V}$, $V_{FB}=0\text{V}$		40	60	
		$V_{CC}=12\text{V}$, $V_{FB}=0\text{V}$	-	30	50	
Efficiency	EFFI	$V_{CC}=6\text{V}$ $V_{OUT}=12\text{V}$	-	93	-	%
		$I_{SW} = 2\text{A}$ $I_{SW} = 3\text{A}$		92		
Maximum Duty Cycle	DC_{MAX}	$V_{FB}=0.4\text{V}$	-	80	-	%
Minimum Duty Cycle	DC_{MIN}	$V_{FB}=1.2\text{V}$	-	0	-	
Thermal shutdown Temp	TSD			125		$^{\circ}\text{C}$

❖ Application Circuit

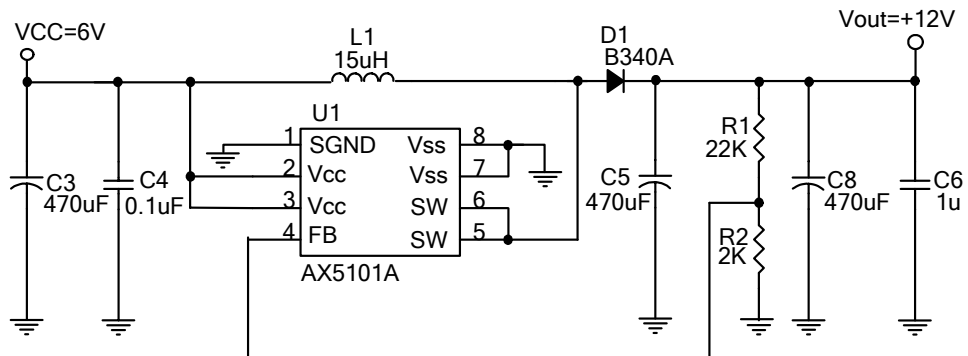
1. VCC=6V, VOUT=12V/0.8A



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

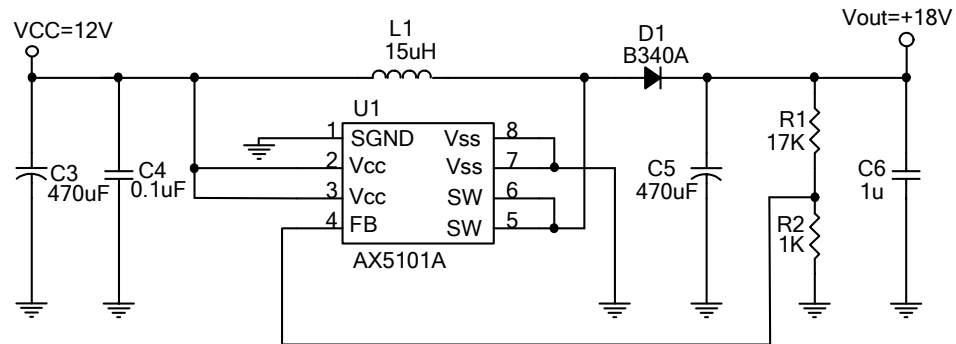
$V_{REF} = 1.0V$; $R2$ suggest $0.75K \sim 2.5k$

2. VCC=6V, VOUT=12V/1.4A



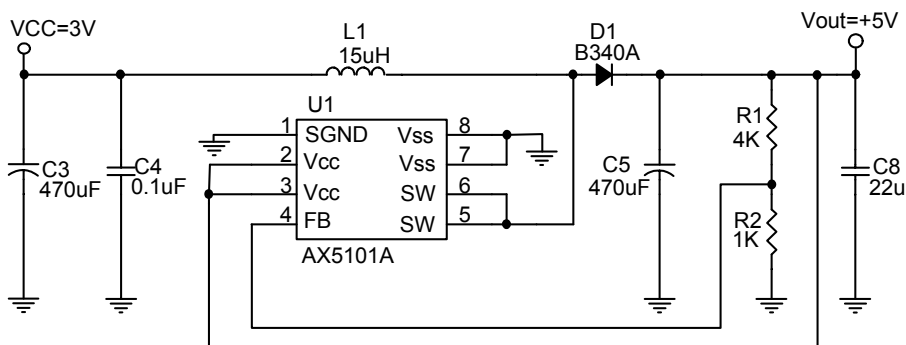
$V_{IN}=6V, I_{SW}=3A$			
V_{OUT}	12V	18V	24V
L1 Value	15uH	22uH	27uH

3. VCC=12V, VOUT=18V/1.8A



$V_{IN}=12V, I_{SW}=3A$			
V_{OUT}	18V	24V	28V
L1 Value	15uH	22uH	27uH

4. VCC=3.0V, VOUT=5V/0.45A



❖ Function Descriptions

PWM Control

The AX5101A consists of DC/DC converters that employ a pulse-width modulation (PWM) system.

In converters of the AX5101A, the pulse width varies in a range from 0 to 80%, 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.

Setting the Output Voltage

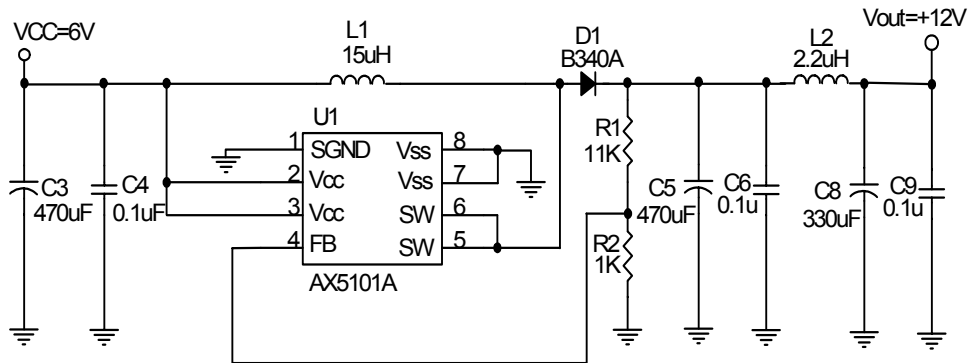
Application circuit item shows the basic application circuit with AX5101A adjustable output version. The external resistor sets the output voltage according to the following equation:

$$V_{OUT} = 1.0V \times \left(1 + \frac{R1}{R2}\right)$$

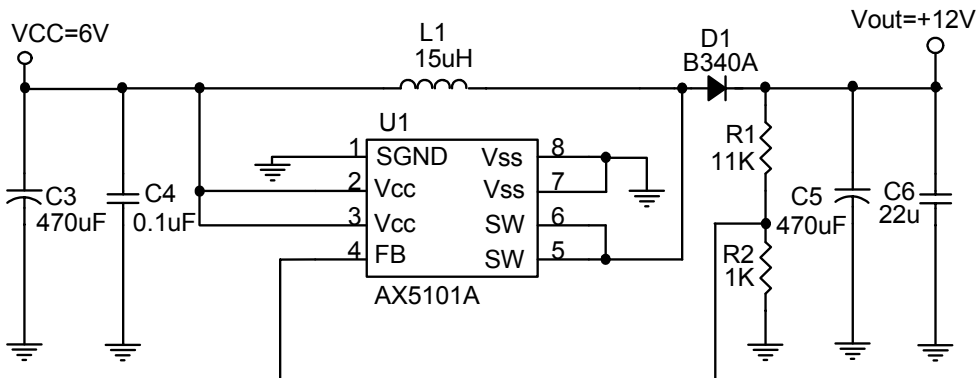
Output Voltage Ripple

Application circuit item shows the basic application circuit with AX5101A. The output voltage ripple (V_{RIPPLE}) very lager at high switch current ($I_{SW}=3A$, $V_{RIPPLE} \doteq 0.7V$), external π filters can reduce output voltage ripple or add MLCC 22uF at output (see next page for output ripple wave):

a. π filters



b. C6=22uF(MLCC)

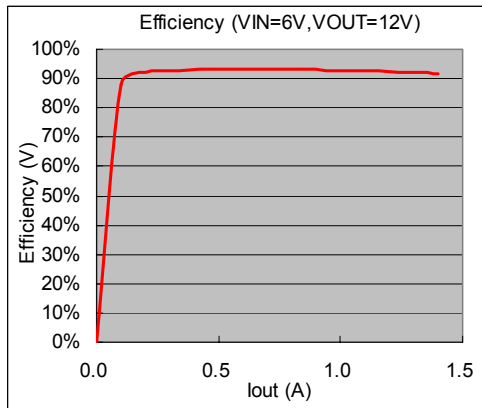


PCB layout guide

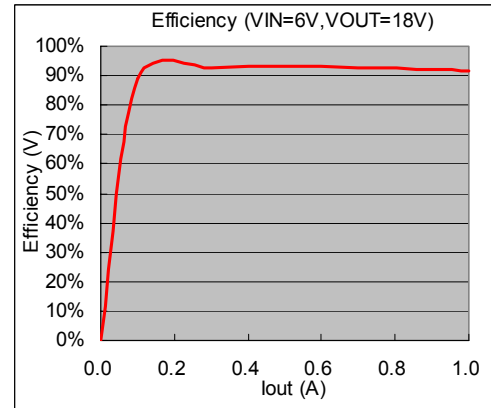
If you need low T_c & T_j or large PD(Power Dissipation), The dual SW pins(5&6) at the SOP-8L package are internally connected to die pad, The PCB layout should allow for maximum possible copper area at the V_{CC} pins of the AX5101A.

❖ Typical Characteristics

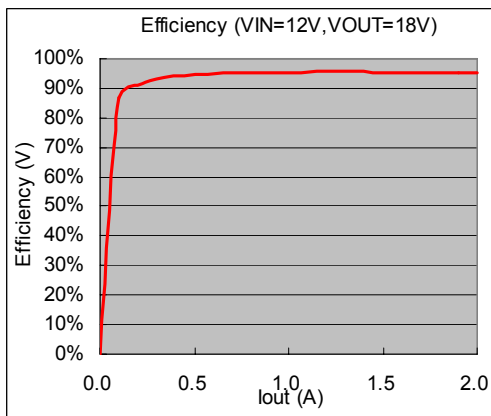
Efficiency
($V_{IN}=6V$, $V_{OUT}=12V/1.4A$)



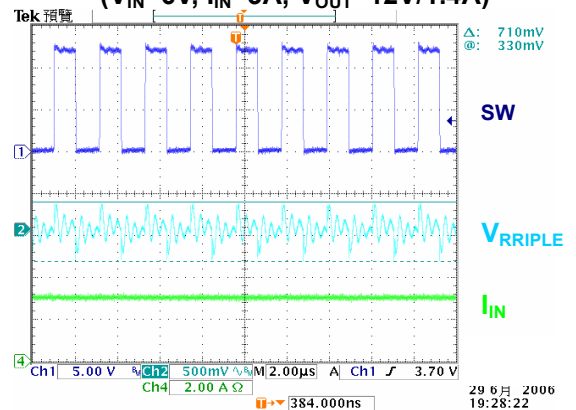
Efficiency
($V_{IN}=6V$, $V_{OUT}=18V/1.0A$)



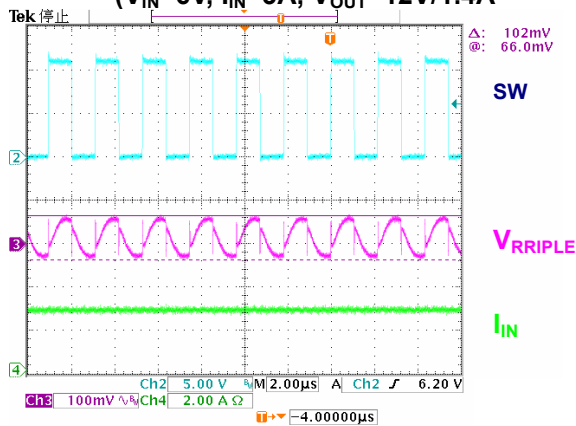
Efficiency
($V_{IN}=12V$, $V_{OUT}=18V/2.0A$)



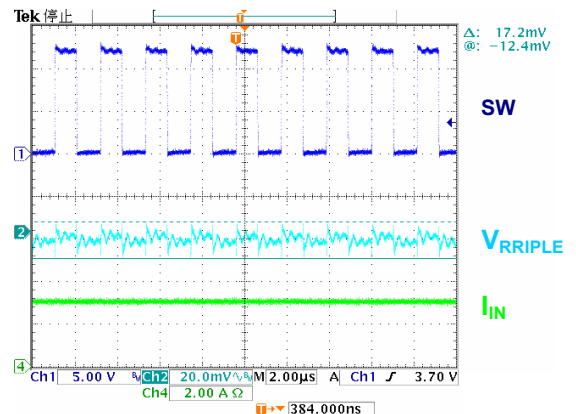
VOUT RIPPLE=710mV
($V_{IN}=6V$, $I_{IN}=3A$, $V_{OUT}=12V/1.4A$)



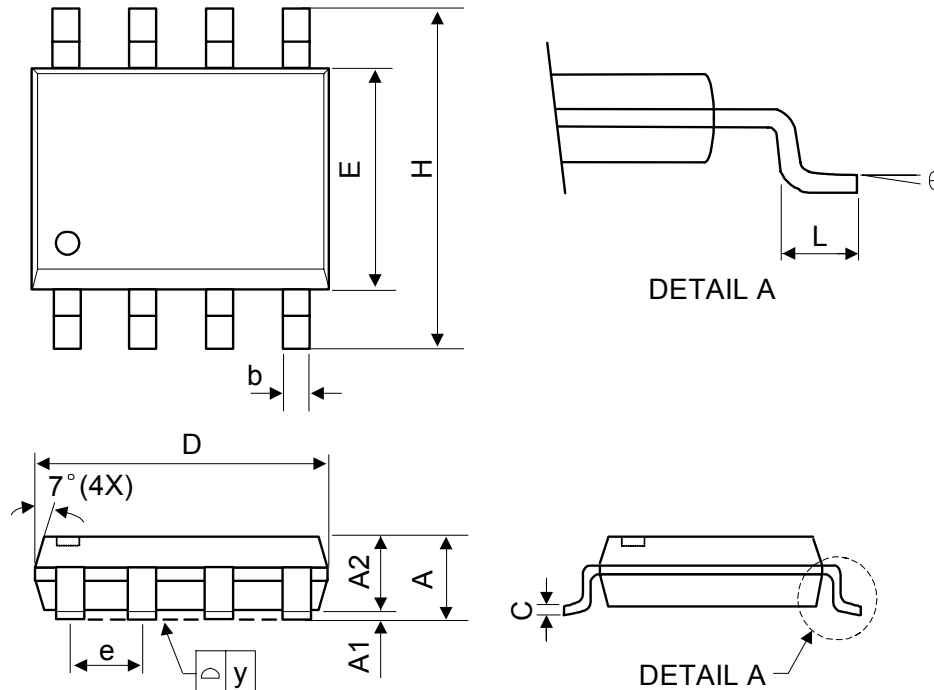
($C_6=22\mu F$ (MLCC – PAGE 6))
VOUT RIPPLE=102mV
($V_{IN}=6V$, $I_{IN}=3A$, $V_{OUT}=12V/1.4A$)



(external π filters – PAGE 6)
VOUT RIPPLE=17mV
($V_{IN}=6V$, $I_{IN}=3A$, $V_{OUT}=12V/1.4A$)



❖ 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°