

3A/2APWM Control LED Driver with internal **Switch**

❖ GENERAL DESCRIPTION

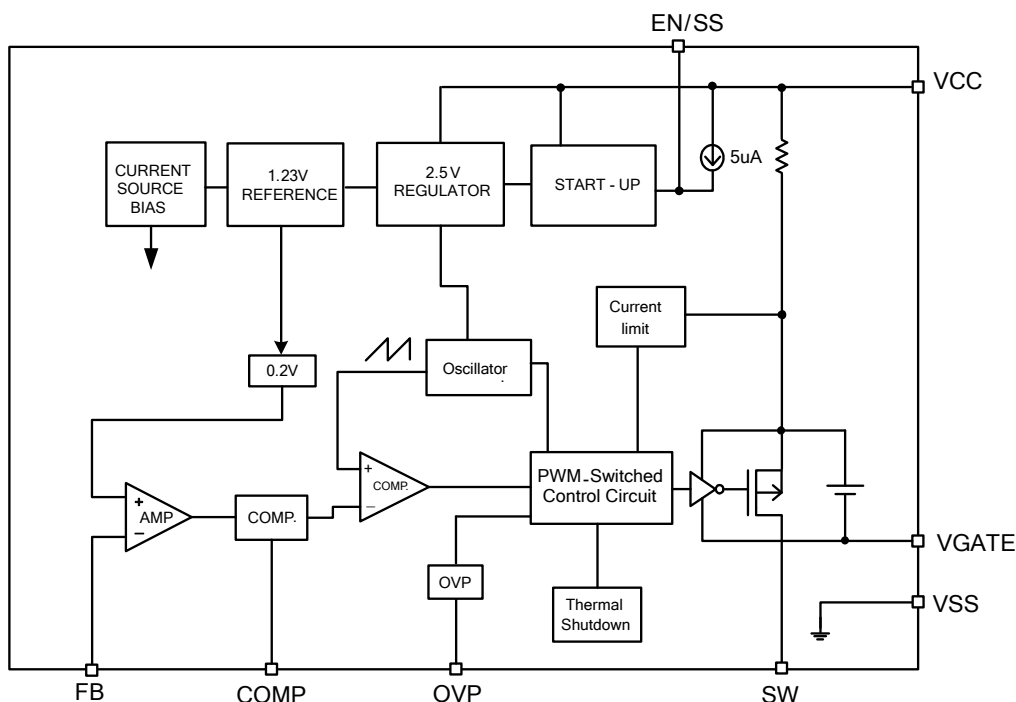
The AX2005/A is a high voltage step-down converter designed for driving up to 10 series white LEDs from a 40V system input. The total LED driving current up to 3A (AX2005) / 2A(AX2005A), which is measured through an external current sense resistor. Its low 200mV feedback voltage reduces power loss and improves efficiency. The OVP pin monitors the output voltage and turns off the converter if an over-voltage condition is present due to an open circuit condition. The AX2005 includes current limit, short circuit protection and thermal shutdown protection preventing damage.

AX2005/A provides high power, high efficiency, and excellent transient characteristics. The PWM control circuit is able to the duty ratio linearly from 0 up to 100%. Since this converter can accommodate an input voltage up to 40V, it is also suitable for the operation via an AC adapter.

❖ FEATURES

- Input voltage : 8V to 40V
- Output voltage is up to 38V
- LED Backlight and High Power LED Application
- Duty ratio : 0% to 100% PWM control
- LED driving current :
 - AX2005: Output current up to 3A
 - AX2005A: Output current up to 2A
- Enable/Disable function with soft start time control.
- Current Limit (CL), Thermal Shutdown and Short Circuit Protections (SCP).
- Over Voltage Protection (OVP)
- Built-in internal SW P-channel MOS.
- SOP-8L-EP Pb-Free package.

❖ BLOCK DIAGRAM



❖ PIN ASSIGNMENT

The package of AX2005/A is SOP-8L-EP; the pin assignment is given by:

		Name	Description
(Top View) SOP8L-EP		EN/SS	ON/OFF Shutdown and Soft-start pin
		VSS	GND pin
		VGATE	Driver GATE clamping pin. The pin must connect a 1uF capacitor to VCC
		VCC	IC power supply pin
		SW	Switch pin. Connect external inductor and diode here.
		FB	Feedback pin
		COMP	Compensation pin
		OVP	Over-Voltage Sense Input Pin. Over Voltage is set by out side Resistance

❖ ORDER/MARKING INFORMATION

Order Information	Top Marking
AX2005 X XX X Output Current Blank : 3A A : 2A Package Type ES: SOP-8L-EP Packing Blank : Tube A : Taping	<pre> graph LR Logo[Logo] --- A1[A] A1 --- X1[X] X1 --- 2[2] 2 --- 0[0] 0 --- 0[0] 0 --- 5[5] 5 --- Part[Part number] A1 --- Y1[Y] Y1 --- Y2[Y] Y2 --- W[W] W --- W2[W] W2 --- X[X] X --- ID[ID code: internal] W --- WW[WW: 01~52] X --- Year[Year: 10=2010
11=2011] A1 --- Blank[Blank: AX2005
A: 2005A] </pre>

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

Characteristics	Symbol	Rating	Unit
V _{CC} Pin Voltage	V _{CC}	V _{SS} - 0.3 to V _{SS} + 45	V
Feedback Pin Voltage	V _{FB}	V _{SS} - 0.3 to 6	V
EN/SS Pin Voltage	V _{EN/SS}	V _{SS} - 0.3 to 6	V
OVP Pin Voltage	V _{OVP}	V _{SS} - 0.3 to V _{CC}	V
COMP Pin Voltage	V _{COMP}	V _{SS} - 0.3 to 6	V
VGATE Pin Voltage	V _{GATE}	V _{SS} - 0.3 to V _{CC}	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}	-65 to +150	°C
Operating Junction Temperature Range	T _{OJP}	-40 to +125	°C
Operating Supply Voltage	V _{OP}	8 to 40	V
Output Voltage	V _{OUT}	38	V
Thermal Resistance from Junction to case	θ _{JC}	15	°C/W
Thermal Resistance from Junction to ambient	θ _{JA}	40	°C/W

Note: θ_{JA} is measured with the PCB copper area(need connect to Exposed Pad) of approximately 1.5 in²(Multi-layer).

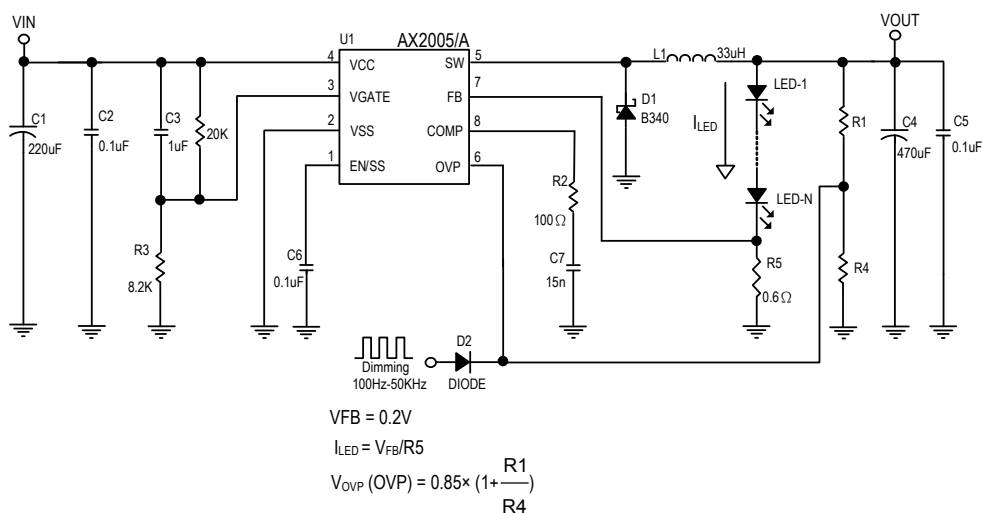
❖ ELECTRICAL CHARACTERISTICS

($V_{CC} = 12V$, $T_A = 25^\circ C$, unless otherwise specified)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Feedback voltage	V_{FB}		0.190	0.200	0.210	V
Quiescent current	I_{CCQ}	$V_{FB}=0.5V$ force driver off	-	3	6	mA
Feedback bias current	I_{FB}	$I_{OUT}=0.1A$	-	0.1	0.5	uA
Shutdown supply current	I_{SD}	$V_{EN/SS}=0V$	-	150	300	uA
Switch current limit	$I_{SW-Limit}$	AX2005A	2.5	-	-	A
		AX2005	3.5	-	-	
Operating frequency	F_{OSC}		240	300	360	KHz
Short frequency	F_{OSC1}		-	50	-	KHz
EN/SS pin shutdown logic input threshold voltage	V_{ENL}		-	-	0.8	V
EN/SS Pull high Current	$I_{EN/SS}$	$V_{EN/SS}=0V$	-	5	-	uA
Internal MOSFET $R_{DS(ON)}$	$R_{DS(ON)}$	$V_{CC}=12V$, $V_{FB}=0V$	-	130	180	mΩ
OVP sense voltage	V_{OVP}		0.833	0.850	0.867	V
Thermal shutdown	T_{SD}		-	150	-	°C
Thermal Shutdown Hysteresis	T_{SH}		-	40	-	°C

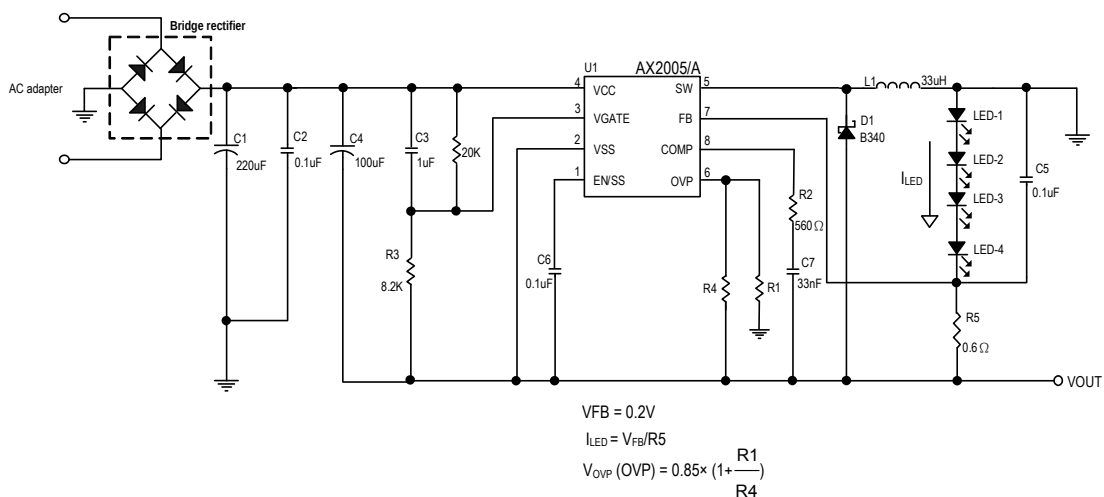
❖ APPLICATION CIRCUIT

1. Normal application circuit (step-down)



C _{OUT} ESR Range	R2	C7
30~80mΩ	470R	10nF
80~300mΩ	100R	15nF

2. AC input application circuit (Inverting)



Part No.	I _{LED}	R5		C1	L1
AX2005/A	350mA	0.57Ω	70mW	100uF	33uH
	750mA	0.266Ω	150mW	220uF	
	1000mA	0.2Ω	200mW	330uF	

❖ FUNCTION DESCRIPTIONS

EN/SS

This pin can be supplied shutdown or soft start function. It is inside pull high function. For normal application, the pin must be connected a capacitor to ground. There is a 5uA current to charge this capacitor, vary the different capacitor value to control soft start time. Allow the switching regulator circuit to be shutdown pulling this pin below a 0.8V threshold voltage; the shutdown supply current is approximately 150uA.

PWM Control

The AX2005/A consists of DC/DC converters that employ a pulse-width modulation (PWM) system. In converters of the AX2005/A, 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.

Current Limiting

The current limit threshold is setting by the internal circuit.

Compensation

In all LED driver applications. Connecting a resistor (R2) and a capacitor (C7) from COMP pin to GND. Please refer the application circuit table to design.

❖ APPLICATION INFORMATION

Setting the LED Current

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

$$I_{LED} = \left(\frac{V_{FB}}{R5} \right), V_{FB} = 0.2V$$

Table 1 Resistor select for LED output current setting

I_{LED}	R5	
350mA	0.57Ω	70mW
750mA	0.266Ω	150mW
1000mA	0.2Ω	200mW

Inductor Selection

For most designs, the different frequency can be reducing the inductor value; The AX2005/A is suggested 33uH.

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 20% of the maximum load current 2A, $\Delta I_L = 0.4A$. 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 ($2A + 0.2A$).

Input Capacitor Selection

This capacitor should be located close to the IC using short leads and the voltage rating should be approximately 1.5 times the maximum input voltage. The RMS current rating requirement for the input capacitor of a buck regulator is approximately 1/2 the DC load current. A low ESR input capacitor sized for maximum RMS current must be used. A 220μF low ESR capacitor for most applications is sufficient.

Over Voltage Protection

The OVP voltage is set by outside resistance (R1 and R4). The external resistor sets the OVP voltage according to the following equation:

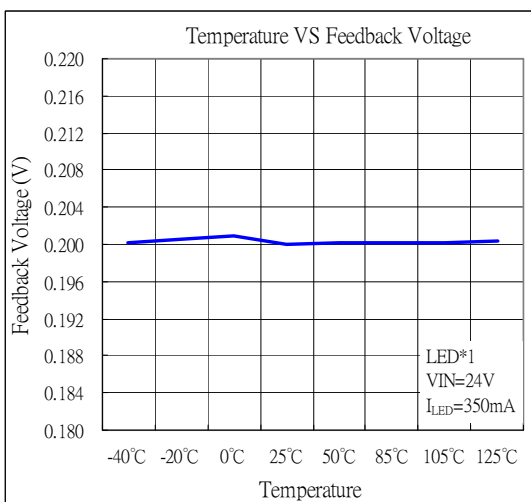
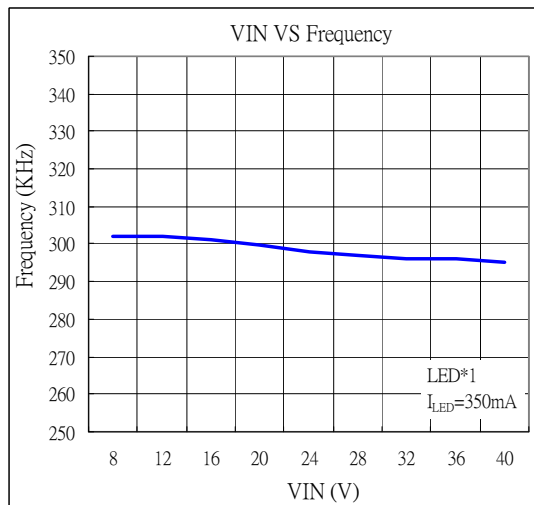
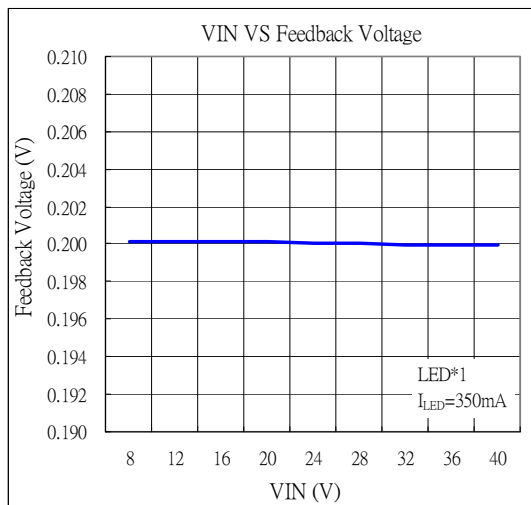
$$V_{OUT}(OVP) = V_{OVP} \times \left(1 + \frac{R4}{R1}\right)$$

If $V_{OVP} > 0.85V$, The OVP is happened that to disable the driver until $V_{OVP} < 0.85V$.

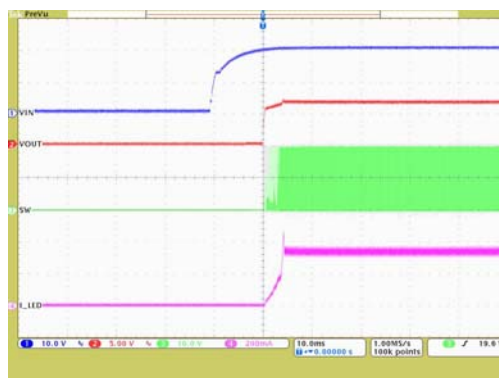
Output Capacitor Selection

For lower output voltage ripple and more stable LED current, higher value output capacitor and low ESR is recommended. A 470uF electrolytic capacitor works for most of the applications.

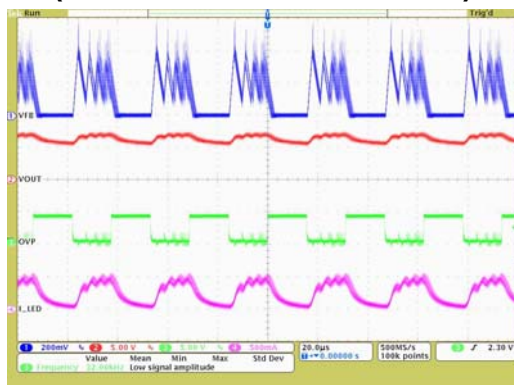
❖ TYPICAL CHARACTERISTICS



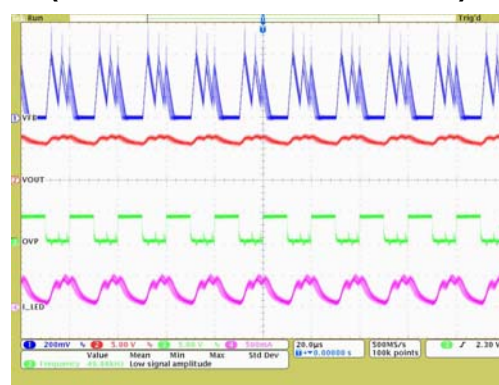
Start-up (VIN=24V, 1W-LED*2, $I_{LED}=350mA$)



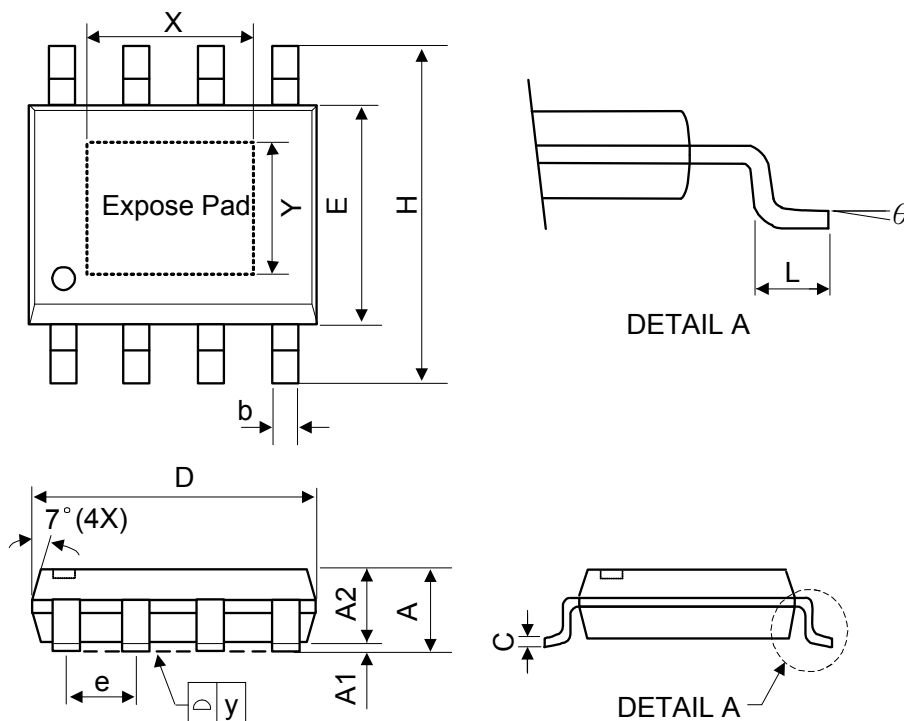
LED Dimming (32KHz) (VIN=24V, 1W-LED*2, $I_{LED}=350mA$)



LED Dimming (50KHz) (VIN=24V, 1W-LED*2, $I_{LED}=350mA$)



❖ PACKAGE OUTLINES



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	1.35	1.55	1.75	0.053	0.061	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	4.70	4.90	5.10	0.185	0.193	0.200
E	3.70	3.90	4.10	0.146	0.154	0.161
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
X	-	2.34	-	-	0.092	-
Y	-	2.34	-	-	0.092	-
θ	0°	-	8°	0°	-	8°