AME5150 Evaluation Board User Guide

1. General Descriptions

The AME5150 is a fixed off time inverting DC/DC converter with integrated N-channel Power MOS. It's ideal for LCD panels requiring high efficiency with light load condition as well as LED application for cellular phone back-lighting, PDAs and other hand-held devices.

2. Features

- Input voltage: 1.5V to 5.5V
- Output voltage: Up to -28V
- Duty ratio: Fixed 400ns TOFF PFM Control
- Oscillation frequency: Various Base on I/O Spec
- Current Limit and Enable Function
- Thermal Shutdown Function
- Input Under Voltage Lockout
- Small SOT-25 Package

3. Applications

- Electronic Information Organizers
- Palmtops
- Cellular and Portable Phones
- Portable Audio Systems
- Various Multi-function Power Supplies

4. Evaluation Board Schematic

(4.1) AME5150 Typical Schematic

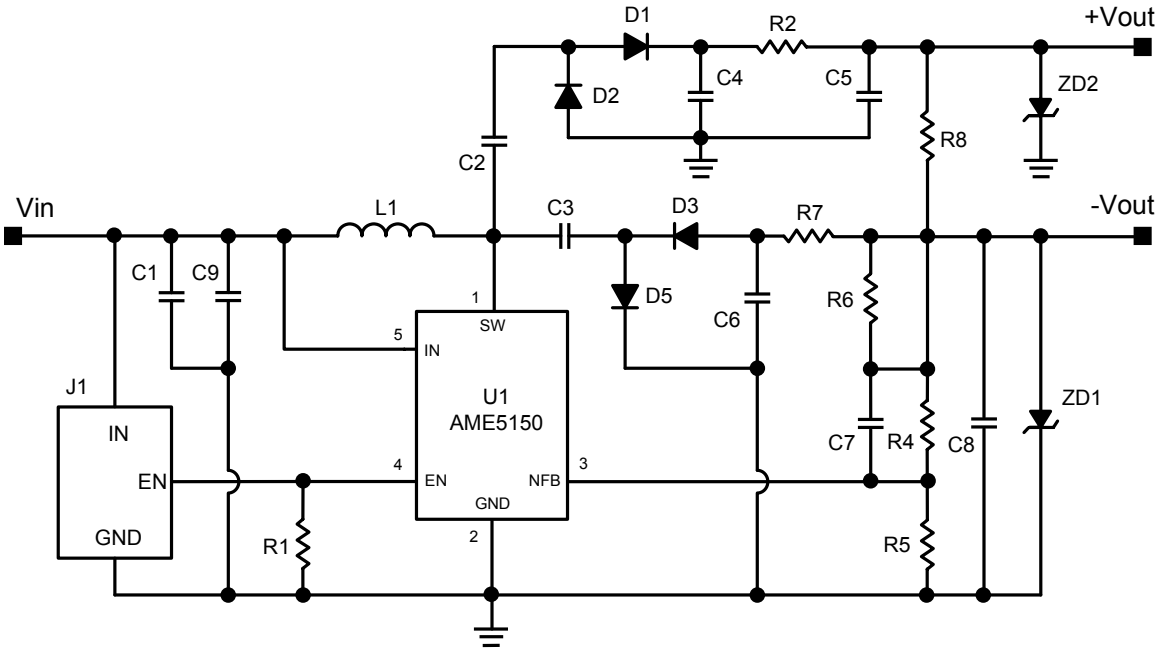

Figure 1

(4.2) AME5150 Typical Schematic for -25V Application

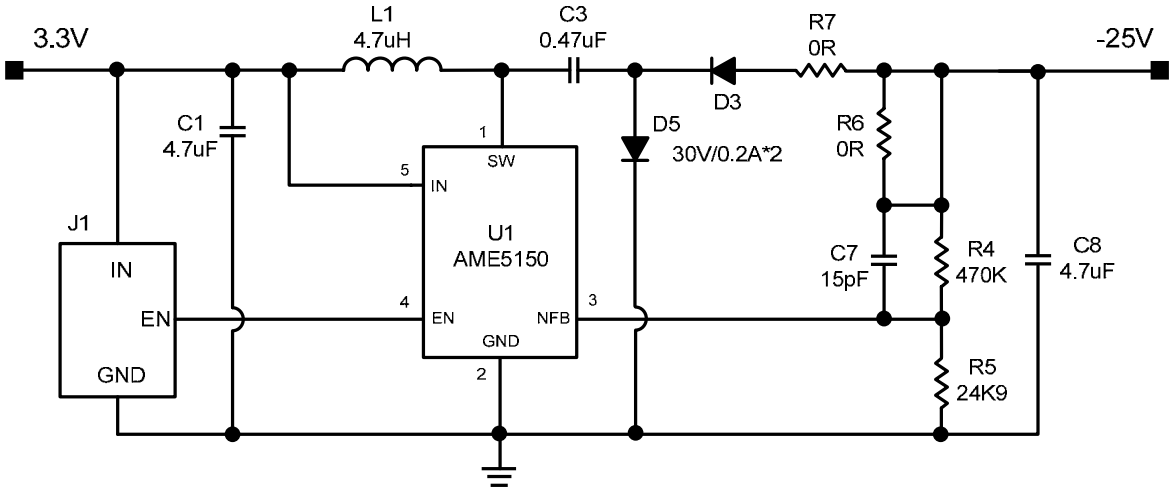

Figure 2

5. Bill of Materials

BOM for Item (4.2)

Component	Q'ty	Value	Description	Part No.	Manufacturer	Package
C1	1	4.7uF/ 6.3V	Ceramic Capacitor	1206B475K6R3C	WALSIN	1206
C3	1	0.47uF/25V	Ceramic Capacitor	0805B474K250C	WALSIN	0805
C7	1	15pF/ 50V	Ceramic Capacitor	0805B150K500C	WALSIN	0805
C8	1	4.7uF/50V	Ceramic Capacitor	1206B475K500C	WALSIN	1206
R4	1	470KΩ	Chip Resistor	RM10FTN4703	TA-I	0805
R5	1	24.9KΩ	Chip Resistor	RM10FTN2492	TA-I	0805
R6, R7	2	0Ω	Chip Resistor	RM10JTN0	TA-I	0805
L1	1	4.7uH	Inductor	SD52-4R7-R	COOPER	SD52
D3,D5	2	30V/0.2A	Schottky Diode	RB520S-30	ROHM	EMD2
U1	1	-	PFM, Micro Power Inverting Boost	AME5150AEEVADJZ	AME	SOT-25
PCB	1	-	Blank PCB	TM091101 Rev. A	AME	
Vin,+Vout, -Vout,GND*3	6	-	Copper Pillar	-	-	-
J1	1	-	Pin Header	-	YD-TECH	1x40 12M/M
-	4	-	Plastic Screw	S-306	PINGOOD	-
-	4	-	Spacer Support	H-6	PINGOOD	-

6. Operating Instructions

(6.1) Connect Vin to the positive point of DC power supply and GND to supply ground.

(6.2) Connect -Vout to the positive point of E-load and GND to supply ground or parallel an appropriate resistor to pull up the loading.

(6.3) Importing a logic signal to EN pin will enable the AME5150. Logic high (V_{EN}>1.5V) switches on AME5150, logic low puts it into low current shutdown mode.

7. Application Information

(7.1) Setting Output Voltage & Current

(7.1 1) Output Voltage

The regulated output voltage is set by an external resistor divider (R4 and R5 in Figure 2.) from the output to the V_{NFB} pin and is determined by:

$$V_{OUT} = -\left(|V_{NFB}| \times (1 + \frac{R_4}{R_5}) + R_4 \times I_{NFB} \right)$$

Where V_{NFB} equals -1.23V and I_{NFB} equals 2uA for AME5150.

(7.1.2) Duty Cycle & Output Current

According to input and output voltage to calculate duty cycle and switching frequency. Selecting feasible inductance can calculate output current by following equations.

$$D = \frac{|V_{OUT}| + V_{DIODE} - V_{IN}}{|V_{OUT}| + V_{DIODE} - V_{SW}}$$

$$V_{SW} = I_{CL(Typ)} \times R_{DS(ON)(Max)}$$

$$I_{LOAD(\max)} = (1 - D) \times \{ I_{CL(\min)} - \frac{D \times (V_{IN} - V_{SW})}{2fL} \}$$

Where:

V_{IN} is input voltage

V_{OUT} is output voltage

T_{OFF} is the duration of switch off; for AME5150 T_{OFF} is fixed 400ns

V_{DIODE} is the forward voltage of Schottky Diode

V_{SW} is (“switch current limit” times “switch on-Resistance”); See the datasheet to have

L is the inductance

f is the switching frequency

$I_{LOAD(max)}$ means the maximum ability of output driving

(7.2) Capacitor Selection

4.7uF input capacitor can reduce input ripple. For better voltage stability, to increase the input capacitance or using LC filter is able to achieve.

1uF output capacitor is sufficient to reduce output voltage ripple. For better voltage filtering, ceramic capacitors with low ESR are recommended. X5R and X7R types are suitable to select because of their wider voltage and temperature ranges.

(7.3) Inductor Value Calculation

A larger value of inductor will reduce the peak inductor current, resulting in smaller input ripple current, higher efficiency and reducing stress on the internal MOSFET. Low DCR inductor also can increase average efficiency. Calculate the required inductance by the equation below.

The recommended value of inductor for AME5150 application is 2.2uH ~ 10uH.

$$L \geq \left(\frac{\left|V_{OUT}\right| - V_{IN(\min)} + V_{DIODE}}{I_{CL(\min)}}\right) \times T_{OFF}$$

(7.4) Board Layout Considerations

High frequency switching regulators require very careful layout of key components in order to get stable operation and low noise. A good PCB layout could make AME5150 working perfect to achieve the best performance.

(7.5) PCB Layout Example

The PCB layout example is for standard Inverting converter application with AME5150 device. It proves this EV board can achieve reliable performance. It follows the layout guidelines below.

(7.5.1) Use a ground plane under the switching regulator can effectively minimize inter-plane coupling.

(7.5.2) Using 20mil wide track for GND (as wide as possible), and all GND nodes are as close as possible.

(7.5.3) The SW node, schottky diode and output capacitor C8 signal path should be kept extremely short.

(7.5.4) The feedback components R4, R5 and C7 must be kept close to the FB pin of U1 to prevent noise injection on the FB pin trace and keeping far away from SW node.

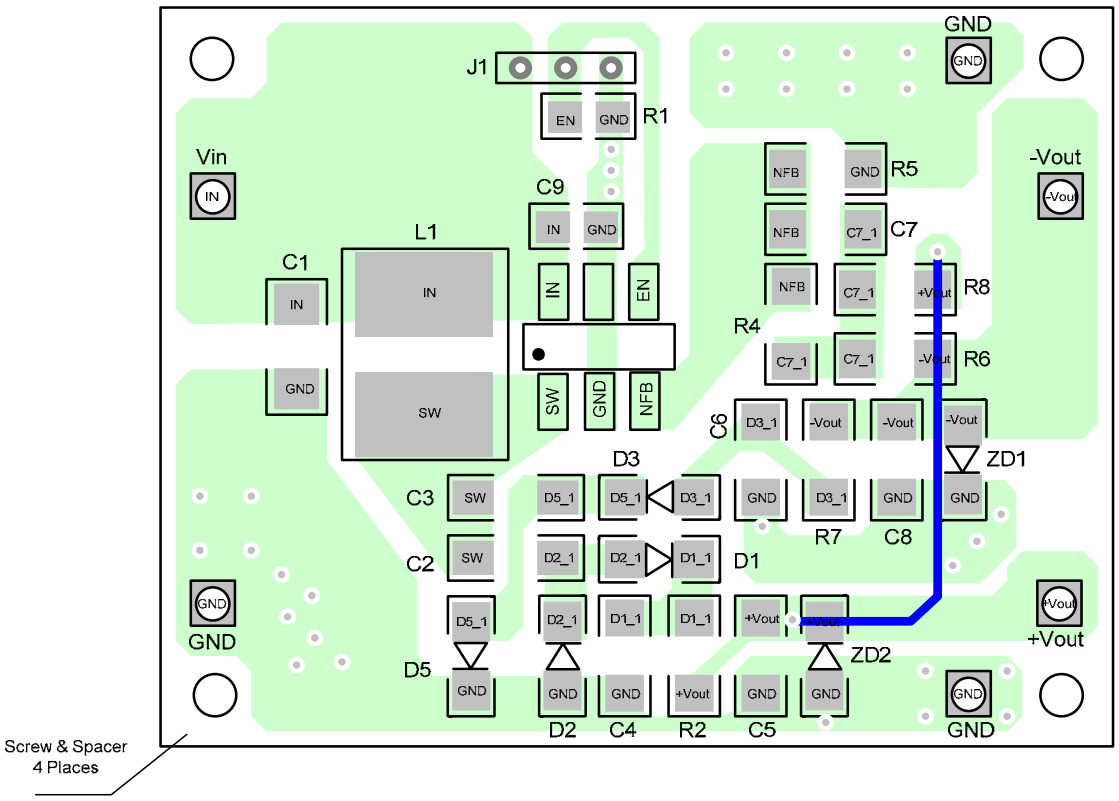

Figure 3

(7.6) Freewheeling Diode Selection

The freewheeling diode conduction time is longer than the N-channel Power MOS off time. Therefore, the diode parameters improve the overall efficiency. Using Schottky diodes as freewheeling rectifiers reduces diode reverse recovery time and the voltage drop across the diode is lower. For this design, choice RB520S-30, with 30V reverse voltage, 0.2A forward current, and around 0.4V forward voltage drop.

The freewheeling diode should be place close to the SW pin of the AME5150 to minimize noise coupling due to trace inductance.