

DESCRIPTION

The AP64501 is 5A synchronous buck converters with wide input voltage, ranging from 3.8V to 40V, which integrates a 45mΩ high-side MOSFET and a 20mΩ low-side MOSFET. The AP64501, adopting the peak current mode control, supports the Pulse Skipping Modulation (PSM) with typical 25uA low quiescent current which assists the converter on achieving high efficiency at light load or standby condition.

The AP64501 features programmable soft start time with 570kHz switching frequency. The converter allows power conversion from high input voltage to low output voltage with a minimum 100ns on-time of high-side MOSFET. It also supports Low Drop-Out LDO operation at low voltage difference from input to output condition.

The AP64501 is an Electromagnetic Interference (EMI) friendly buck converter with implementing optimized design for EMI reduction. The AP64501 features Frequency Spread Spectrum FSS with $\pm 6\%$ jittering span of the 500kHz switching frequency and modulation rate 1/512 of switching frequency to reduce the conducted EMI.

The AP64501 offers cycle-by-cycle current limit and hiccup over current protection, thermal shutdown protection, output over-voltage protection and input voltage under-voltage protection. The device is available in an 8-pin thermally enhanced SOP-8 package.

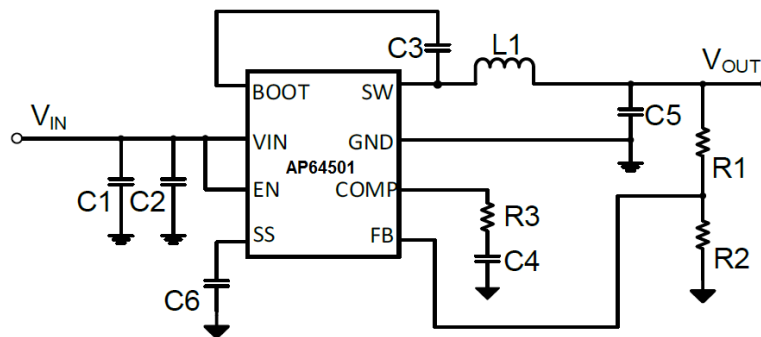
FEATURES

- Wide Input Range: 3.8V-40V
- Up to 5A Continuous Output Current
- 0.8V $\pm 1\%$ Feedback Reference Voltage
- Integrated 45mΩ High-Side and 20mΩ Low-Side Power MOSFETs
- Pulse Skipping Mode (PSM) with 25uA Quiescent Current in Sleep Mode
- 100ns Minimum On-time
- Programmable Soft-start Time
- Adjustable Frequency 100kHz to 1.1MHz
- Fixed Switching Frequency 570kHz
- Frequency Spread Spectrum (FSS) Modulation for EMI Reduction
- Precision Enable Threshold for Programmable Input Voltage Under-voltage Lock Out Protection (UVLO) Threshold and Hysteresis
- Low Dropout Mode Operation
- Derivable Inverting Voltage Regulator
- Overvoltage and Over-temperature Protection
- Available in an ESOP-8 Package
- Totally Lead-Free & Fully RoHS Compliant
- Halogen and Antimony Free. "Green" Device

APPLICATIONS

- Battery Pack Powered System - Cordless Power Tools, Cordless Home Appliance, Drone, Aero Modelling, GPS Tracker etc.
- Cigarette Lighter Adapters, Chargers
- LCD Display
- USB Type-C Power Delivery, USB Charging
- Industrial and Medical Distributed Power Supplies
- Optical Communication and Networking System
- Automotive Systems

TYPICAL APPLICATIONS CIRCUIT



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Rating	Unit
V_{VIN}	Supply Voltage	-0.3 to +42.0	V
V_{EN}	Enable Voltage	-0.3 to +42.0	V
V_{BOOT}	Bootstrap Voltage	-0.3 to +42.0	V
V_{SW}	Switch Node Voltage	-1.0 to +42.0	V
$V_{BOOT-SW}$	BOOT to SW Pin Voltage	-0.3 to +6.0	V
All other pins		-0.3 to +6.0	V
T_J	Junction Temperature	+150	°C
T_L	Lead Temperature	+260	°C
HBM	Human Body Mode	2000	V
CDM	Charged Device Model	500	V

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
V_{IN}	Supply Voltage	3.8	40	V
T_A	Operating Junction Temperature	-40	+125	°C

EVALUATION BOARD

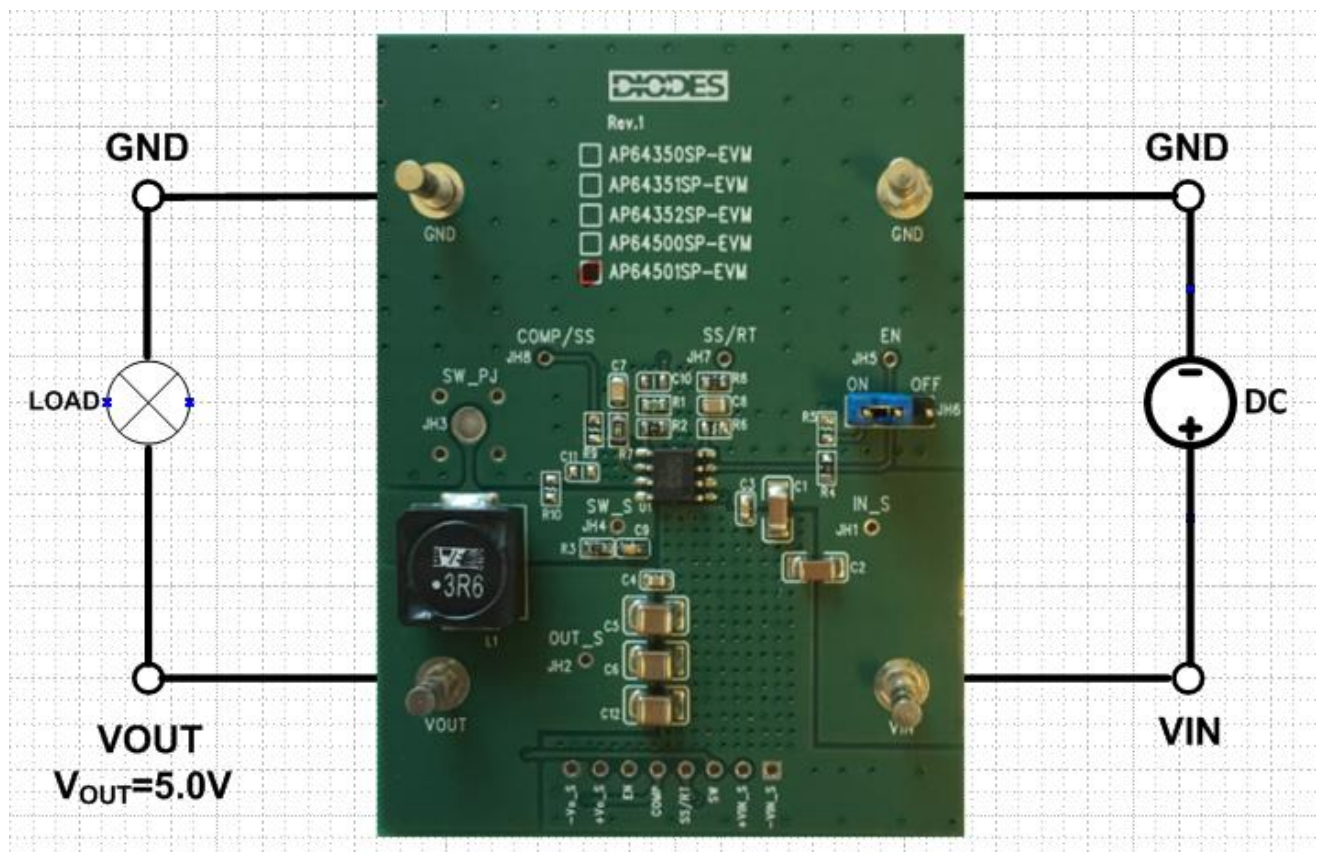


Figure 1. AP64501SP-EVM

QUICK START GUIDE

The AP64501SP-EVM has a simple layout and allows access to the appropriate signals through test points. To evaluate the performance of the AP64501SP, follow the procedure below:

1. Connect a power supply to the input terminals V_{IN} and GND. Set V_{IN} to 12V.
2. Connect the positive terminal of the electronic load to V_{OUT} and negative terminal to GND.
3. For Enable, place a jumper at JH6 to “ON” position to connect EN pin to V_{IN} through 100K Ω resistor to enable IC. Jump to “OFF” position to disable IC.
4. The evaluation board should now power up with a 5.0V output voltage.
5. Check for the proper output voltage of 5.0V ($\pm 1\%$) at the output terminals V_{OUT} and GND. Measurement can also be done with a multimeter with the positive and negative leads between V_{OUT} and GND.
6. Set the load to 5A through the electronic load. Check for the stable operation of the SW signal on the oscilloscope. Measure the switching frequency.

MEASUREMENT/PERFORMANCE GUIDELINES:

- 1) When measuring the output voltage ripple, maintain the shortest possible ground lengths on the oscilloscope probe. Long ground leads can erroneously inject high frequency noise into the measured ripple.
- 2) For efficiency measurements, connect an ammeter in series with the input supply to measure the input current. Connect an electronic load to the output for output current.

SETTING OUTPUT VOLTAGE:

Table 1 shows a list of recommended component selections for common output voltages.

V_{OUT}	R1	R2	L1	R7	C7
1.2V	11K Ω	22.1K Ω	1.5 μ H	3.74K Ω	2.7nF
1.5V	19.6K Ω	22.1K Ω	2.2 μ H	4.75K Ω	2.7nF
1.8V	27.4K Ω	22.1K Ω	2.2 μ H	5.62K Ω	2.7nF
2.5V	47.5K Ω	22.1K Ω	3.3 μ H	7.87K Ω	2.7nF
3.3V	69.8K Ω	22.1K Ω	3.3 μ H	10.5K Ω	2.7nF
5.0V	115K Ω	22.1K Ω	3.6 μ H	15.8K Ω	2.7nF
12V	309K Ω	22.1K Ω	10 μ H	37.4K Ω	2.7nF

Table 1. Common Output Voltages

EVALUATION BOARD SCHEMATIC

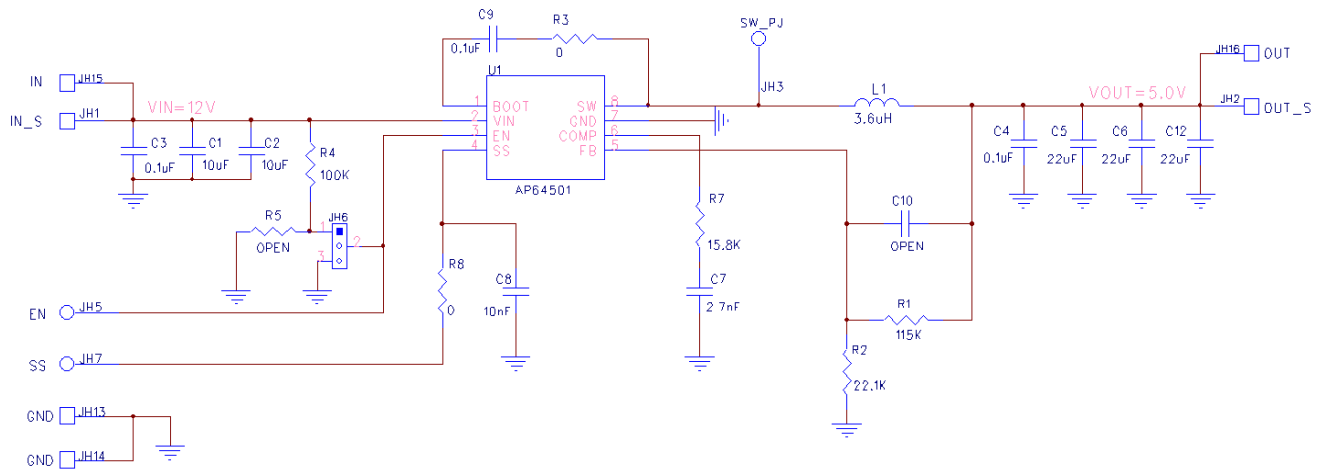


Figure 2. AP64501SP-EVM Schematic

PCB TOP LAYOUT

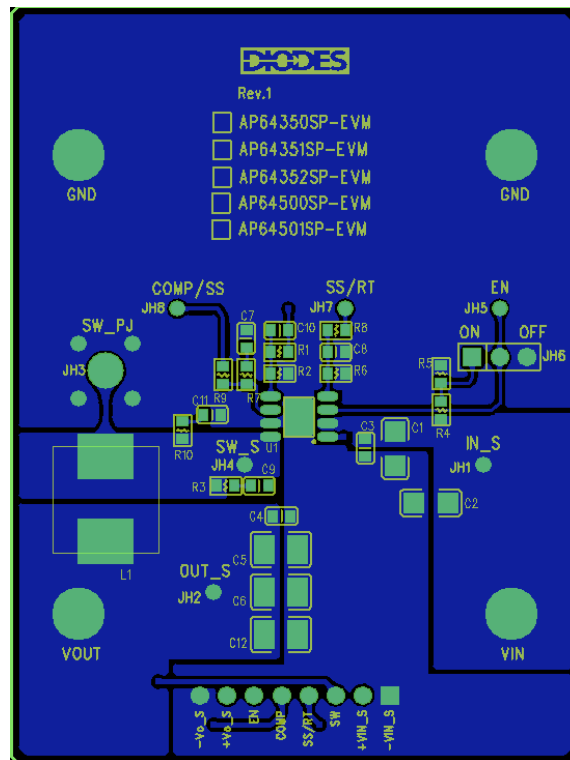


Figure 3. AP64501SP-EVM – Top Layer

PCB BOTTOM LAYOUT

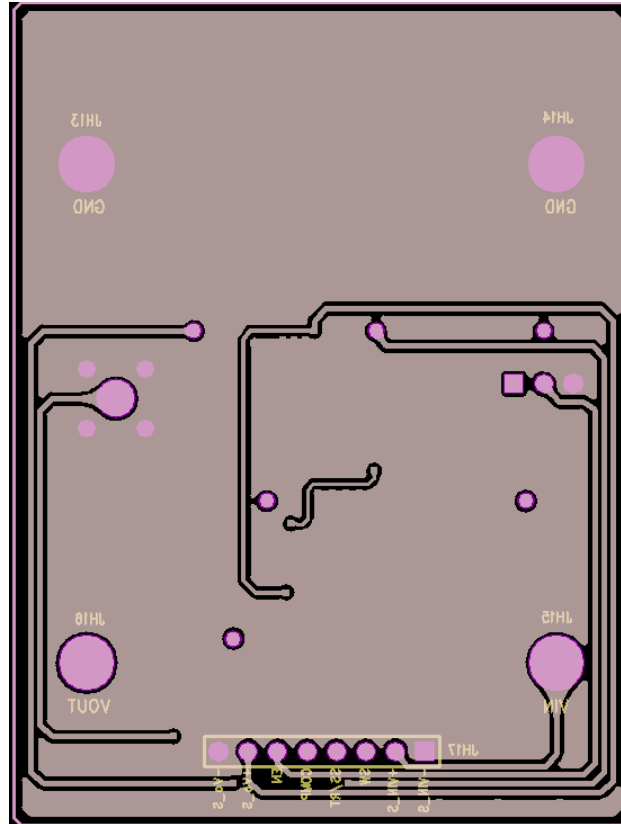
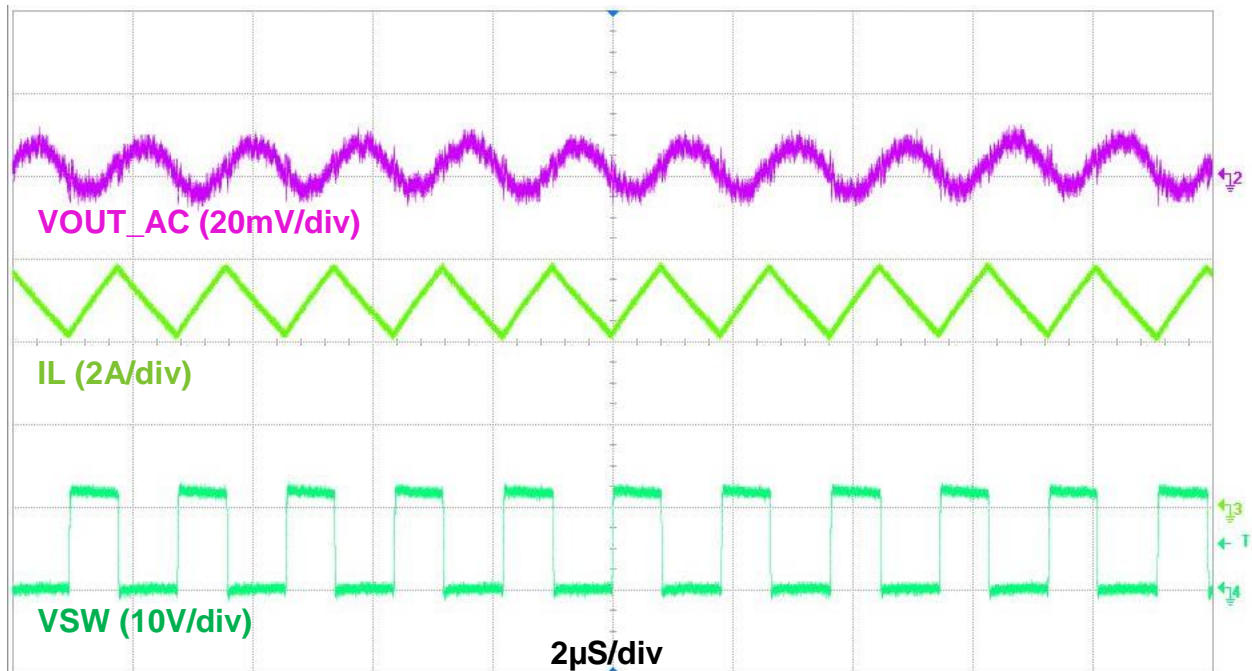
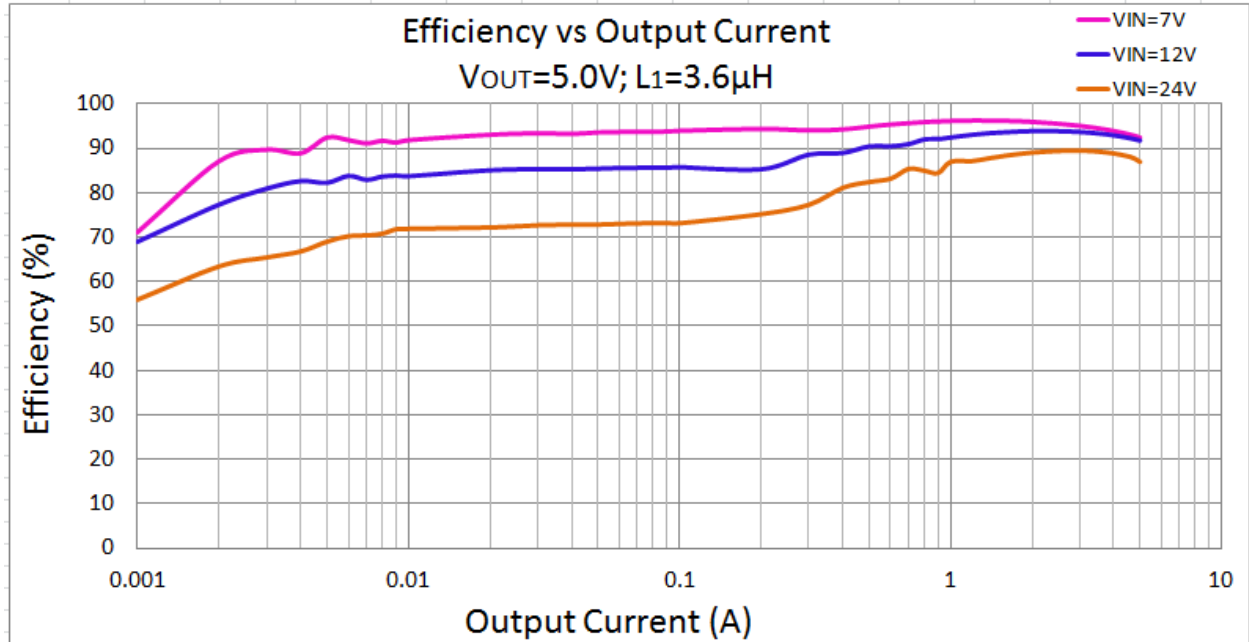


Figure 4. AP64501SP-EVM – Bottom Layer

BILL OF MATERIALS for AP64501SP-EVM

Ref	Value	Description	Qty	Size	Vendor Name	Manufacturer PN
C1, C2	10 μ F	Ceramic Capacitor, 50V, X7R, 10%	2	1206	Samsung	CL31B106KBHNNNE
C3, C4	0.1 μ F	Ceramic Capacitor, 50V, X7R, 10%	2	0603	Würth Electronics	885012206095
C5, C6, C12	22 μ F	Ceramic Capacitor, 16V, X7R	3	1210	Samsung	CL32B226KOJNNNE
C7	2.7nF	Ceramic Capacitor, 50V, X7R	1	0603	Murata	GRM1885C1H272JA01D
C8	10nF	Ceramic Capacitor, 25V, X7R	1	0603	Würth Electronics	885012206065
C9	0.1 μ F	Ceramic Capacitor, 25V, X7R	1	0603	Würth Electronics	885012206071
R1	115K Ω	RES SMD 1% 1/8W	1	0603	Panasonic	ERJ-3EKF1153V
R2	22.1K Ω	RES SMD 1% 1/8W	1	0603	Stackpole	RNCP0603FTD22K1
R3	0 Ω	RES SMD 1% 1/10W	1	0603	Vishay	CRCW06030000Z0EAC
R4	100K Ω	RES SMD 1% 1/10W	1	0603	Vishay	CRCW0603100KFKEA
R7	15.8K Ω	RES SMD 1% 1/10W	1	0603	Bourns Inc	CR0603-FX-1582ELF
R8	0 Ω	RES SMD 1% 1/10W	1	0603	Vishay	CRCW06030000Z0EAC
L1	3.6 μ H	DCR=12.2m Ω , Ir=8.2A	1	10.2x10.2x4.5mm	Würth Electronics	7447797360
JH6		PCB Header, 40 POS	1	1X3	3M	2340-611TG
JH13, JH14, JH15, JH16	1598	Terminal Turret Triple 0.094" L (Test Points)	4	Through-Hole	Keystone Electronics	1598-2
U1	AP64501	Sync DC/DC Converter	1	SO-8EP	Diodes Inc	AP64501SP

TYPICAL PERFORMANCE CHARACTERISTICS



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