

**DESCRIPTION**

The AP64352 is 3.5A synchronous buck converters with wide input voltage, ranging from 3.8V to 40V, which integrates an 80mΩ high-side MOSFET and a 50mΩ low-side MOSFET. The AP64352, 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 AP64352 features programmable soft-start time together with programmable switching frequency from 300kHz to 2.2MHz with an external resistor, which provides the flexibility to optimize either efficiency or external component size. The converter supports external clock synchronization with a frequency band from 300kHz to 2.2MHz. The AP64352 allows power conversion from high input voltage to low output voltage with

a minimum 100ns on-time of high-side MOSFET.

The AP64352 is an Electromagnetic Interference (EMI) friendly buck converter with implementing optimized design for EMI reduction. The AP64352 features Frequency Spread Spectrum FSS with  $\pm 6\%$  jittering span of the switching frequency and modulation rate 1/512 of switching frequency to reduce the conducted EMI.

The AP64352 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.

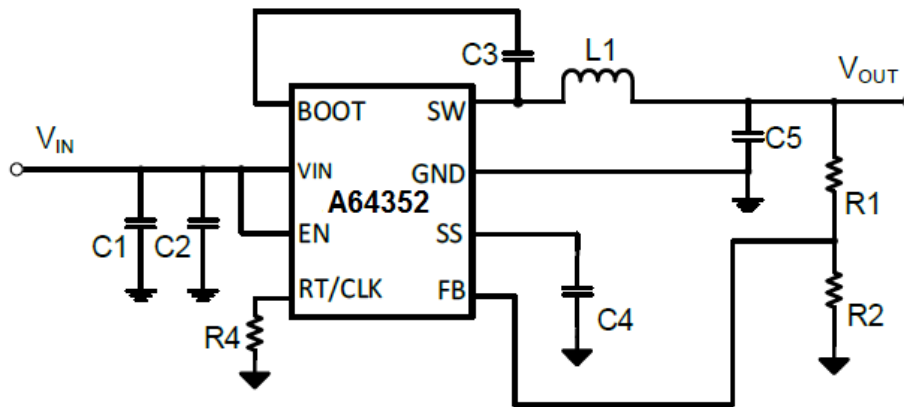
**FEATURES**

- Wide Input Range: 3.8V-40V
- Up to 3.5A Continuous Output Current
- 0.8V  $\pm 1\%$  Feedback Reference Voltage
- Integrated 80mΩ High-Side and 50mΩ Low-Side Power MOSFETs
- Pulse Skipping Mode (PSM) with 25uA Quiescent Current in Sleep Mode
- 100ns Minimum On-time
- 2ms Internal Soft-start Time
- Adjustable Frequency 100KHz to 2.2MHz
- External Clock Synchronization
- 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
- Over-voltage 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 +46.0	V
$V_{SW}$	Switch Node Voltage	-0.3 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

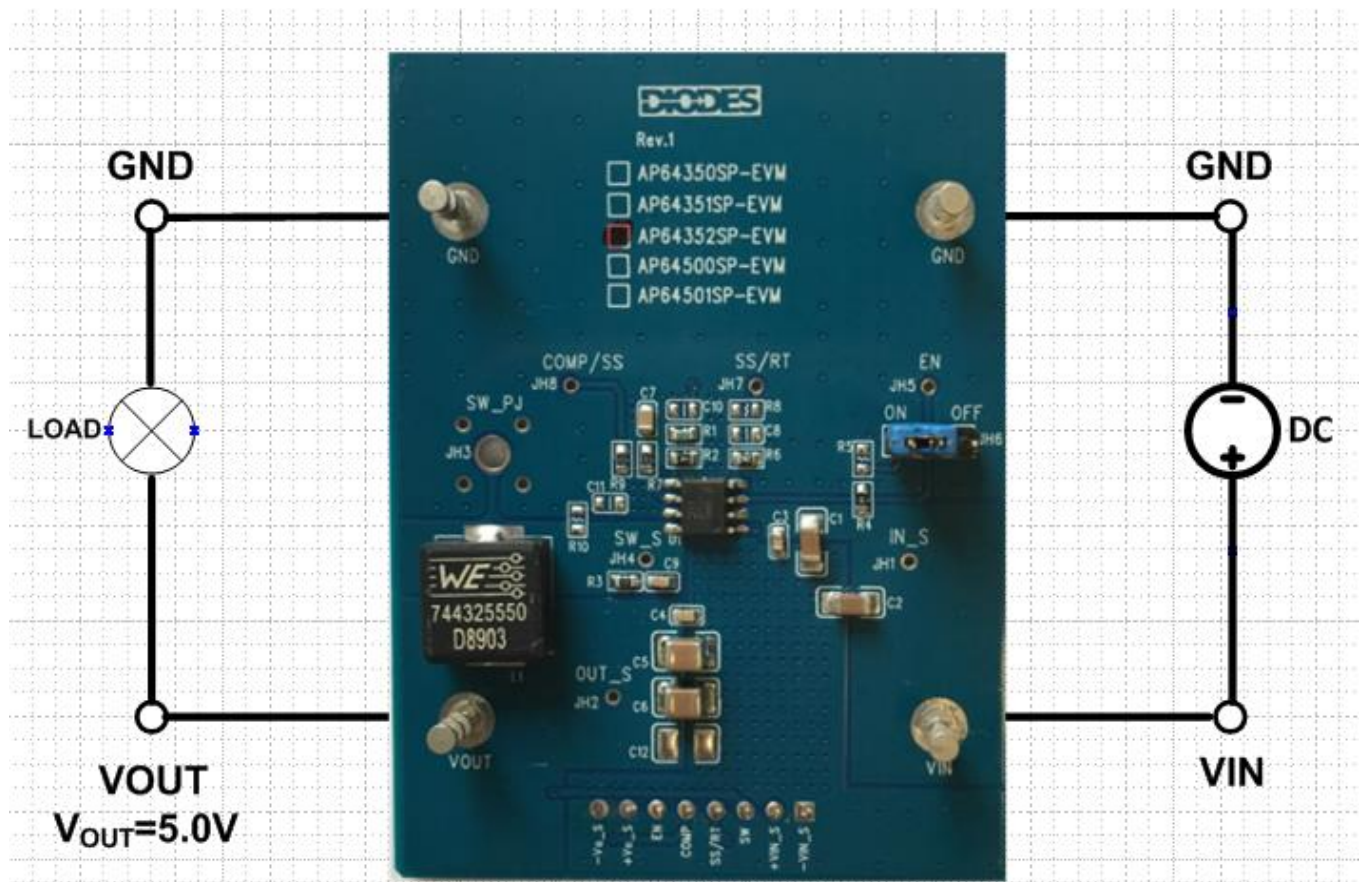
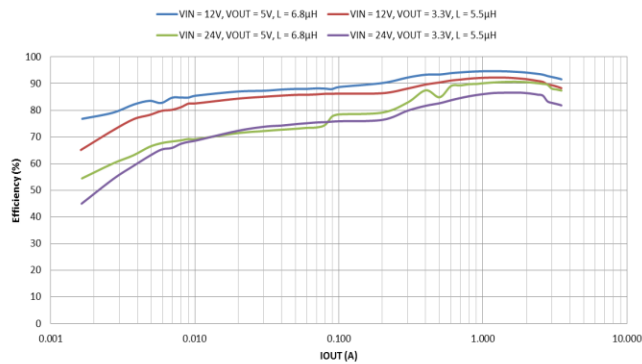


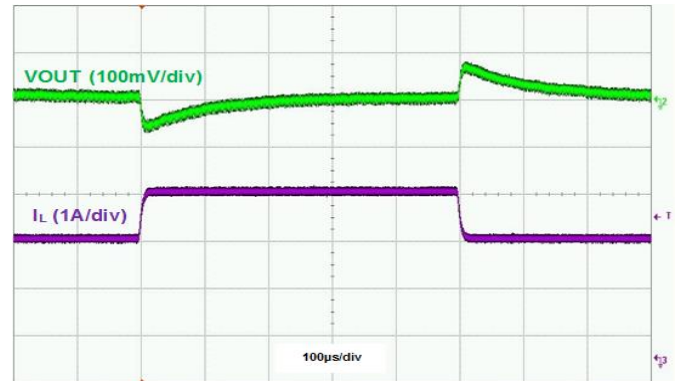
Figure 1. AP64352SP-EVM

### TYPICAL PERFORMANCE CHARACTERISTICS

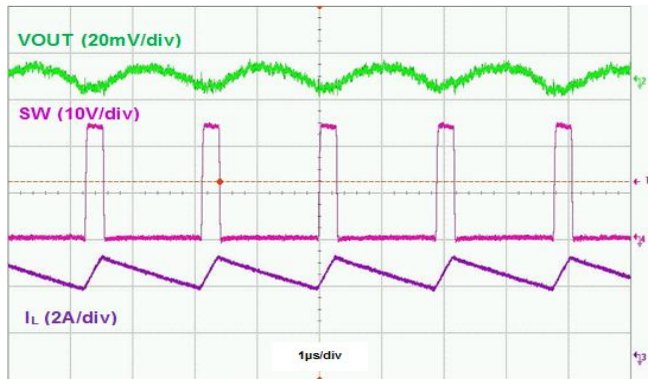
**Figure 1. Efficiency vs Output Current**



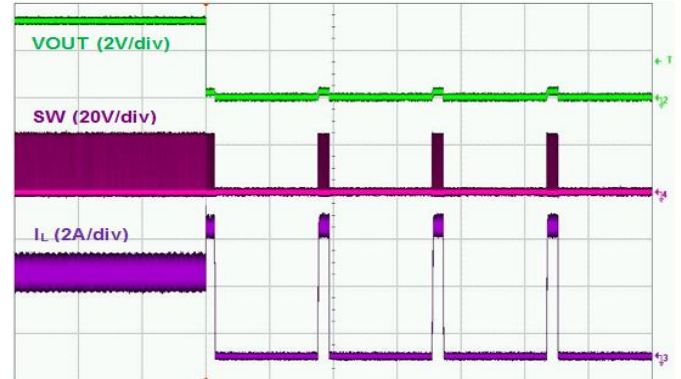
**Figure 2. Load Transient 2.5A to 3.5A**



**Figure 3. Output Voltage Ripple, I<sub>OUT</sub>=3.5A**



**Figure 4. Output Short Protection, I<sub>OUT</sub>=3.5A**



### **QUICK START GUIDE**

The AP64352SP-EVM has a simple layout and allows access to the appropriate signals through test points. To evaluate the performance of the AP64352SP, 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 $\Omega$  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 3.5A 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
1.2V	11K $\Omega$	22.1K $\Omega$	3.3 $\mu$ H
1.5V	19.6K $\Omega$	22.1K $\Omega$	3.3 $\mu$ H
1.8V	27.4K $\Omega$	22.1K $\Omega$	3.3 $\mu$ H
2.5V	47.5K $\Omega$	22.1K $\Omega$	4.7 $\mu$ H
3.3V	69.8K $\Omega$	22.1K $\Omega$	4.7 $\mu$ H
5.0V	115K $\Omega$	22.1K $\Omega$	5.5 $\mu$ H
12V	309K $\Omega$	22.1K $\Omega$	10 $\mu$ H

**Table 1. Common Output Voltages**

**EVALUATION BOARD SCHEMATIC**

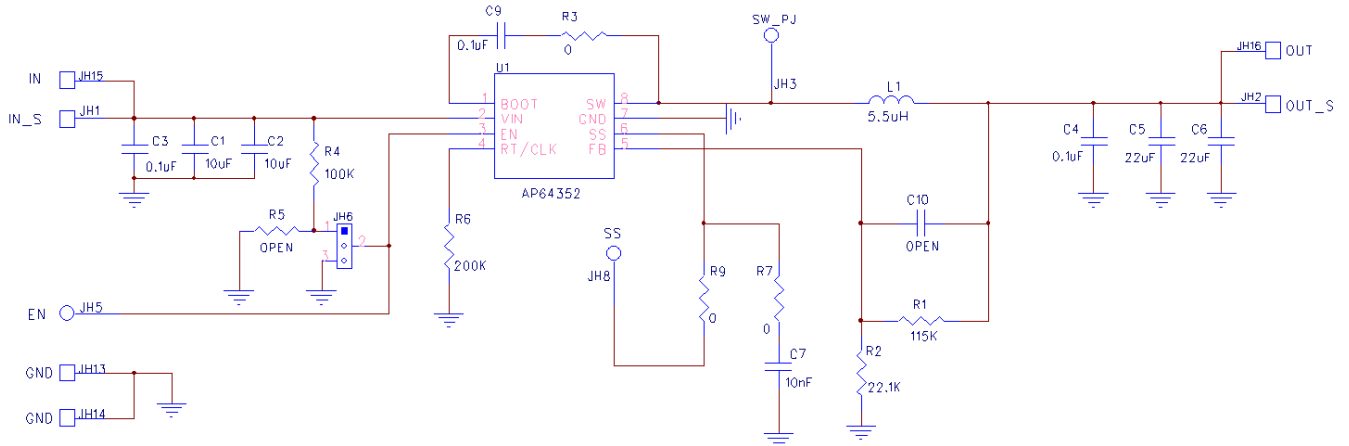


Figure 2. AP64352SP-EVM Schematic

**PCB TOP LAYOUT**

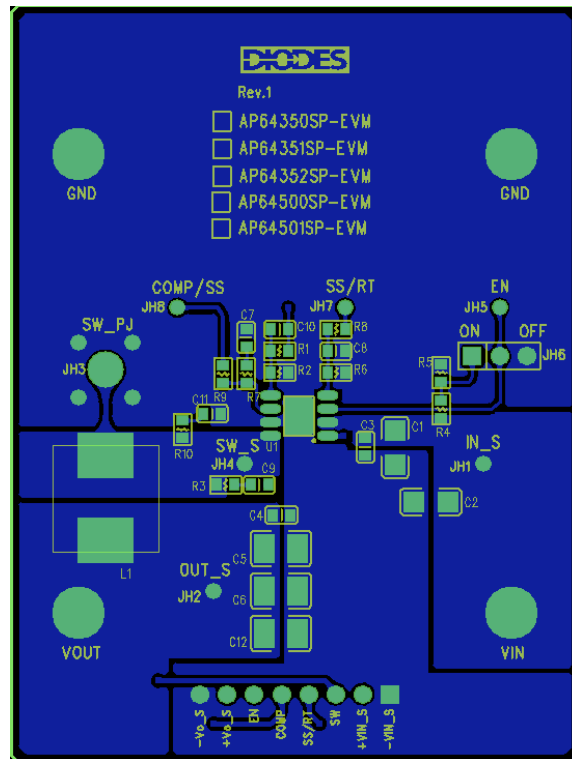
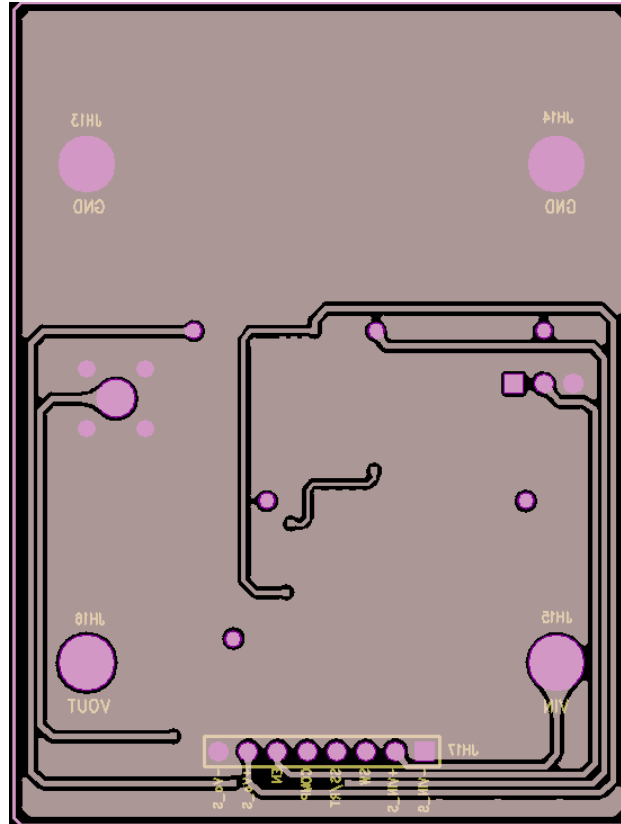


Figure 3. AP64352SP-EVM – Top Layer

**PCB BOTTOM LAYOUT**



**Figure 4. AP64352SP-EVM – Bottom Layer**

### BILL OF MATERIALS for AP64352SP-EVM

Ref	Value	Description	Qty	Size	Vendor Name	Manufacturer PN
C1, C2	10 $\mu$ F	Ceramic Capacitor, 50V, X7R, 10%	2	1206	Samsung	CL31B106KBHNNNE
C3, C4	0.1 $\mu$ F	Ceramic Capacitor, 50V, X7R, 10%	2	0603	Würth Electronics	885012206095
C5, C6	22 $\mu$ F	Ceramic Capacitor, 16V, X7R	2	1210	Samsung	CL32B226KOJNNNE
C7	10nF	Ceramic Capacitor, 25V, X7R	1	0603	Würth Electronics	885012206065
C9	0.1 $\mu$ F	Ceramic Capacitor, 25V, X7R	1	0603	Würth Electronics	885012206071
R1	115K $\Omega$	RES SMD 1% 1/8W	1	0603	Panasonic	ERJ-3EKF1153V
R2	22.1K $\Omega$	RES SMD 1% 1/8W	1	0603	Stackpole	RNCP0603FTD22K1
R3	0 $\Omega$	RES SMD 1% 1/10W	1	0603	Vishay	CRCW06030000Z0EAC
R4	100K $\Omega$	RES SMD 1% 1/10W	1	0603	Yageo	RC0603FR-07100KL
R6	200K $\Omega$	RES SMD 1% 1/10W	1	0603	Yageo	RC0603FR-07200KL
R7, R9	0 $\Omega$	RES SMD 1% 1/10W	2	0603	Vishay	MCT06030Z0000ZP500
L1	5.5 $\mu$ H	DCR=10.3m $\Omega$ , Ir=10A	1	10.2x10.2x5mm	Würth Electronics	744325550
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	AP64352	Sync DC/DC Converter	1	SO-8EP	Diodes Inc	AP64352SP



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