# AP64100SP-EVM

**3.8V TO 40V, 1A, Low IQ, SYNCHRONOUS DC-DC BUCK CONVERTER WITH PROGRAMMABLE FREQUENCY**

## DESCRIPTION

The AP64100 is 1A, synchronous buck converter with a wide input voltage range of 3.8V to 40V. The device fully integrates a 150mΩ high-side power MOSFET and a 80mΩ low-side power MOSFET to provide high-efficiency step-down DC-DC conversion.

The APAP64100 device is easily used by minimizing the external component count due to its adoption of peak current mode control.

The AP64100 design is optimized for Electromagnetic Interference (EMI) reduction. The device has a proprietary gate driver scheme to resist switching node ringing without sacrificing MOSFET turn-on and turn-off times, which reduces high-frequency radiated EMI noise caused by MOSFET switching. The AP64100 also features Frequency Spread Spectrum (FSS) with a switching frequency jitter of ±6%, which reduces EMI by not allowing emitted energy to stay in any one frequency for a significant period of time

The device is available in a SO-8EP (Standard) package.

## FEATURES

- Wide Input Range: 3.8V-40V
- 1A Continuous Output Current
- 0.8V ±1% Reference Voltage
- 25µA Ultralow Quiescent Current (Pulse Frequency Modulation)
- Adjustable Switching Frequency: 100kHz to 2.2MHz
- External Clock Synchronization: 100kHz to 2.2MHz
- Up to 88% Efficiency at 5mA Light Load
- Proprietary Gate Driver Design for Best EMI Reduction
- Frequency Spread Spectrum (FSS) to Reduce EMI
- Low-Dropout (LDO) Mode
- Precision Enable Threshold to adjust UVLO
- Protection Circuitry
  - Undervoltage Lockout (UVLO)
  - Output Overvoltage Protection (OVP)
  - Cycle-by-Cycle Peak Current Limit
  - Thermal Shutdown
- **Totally Lead-Free & Fully RoHS Compliant**
- **Halogen and Antimony Free. "Green" Device**

## APPLICATIONS

- Distributed Power Bus Supplies
- Power Tools and Laser Printers
- White Goods and Small Home Appliances
- Home Audio
- Network Systems
- Consumer Electronics
- Optical Communication and Networking Systems
- General Purpose Point of Load

## TYPICAL APPLICATIONS CIRCUIT

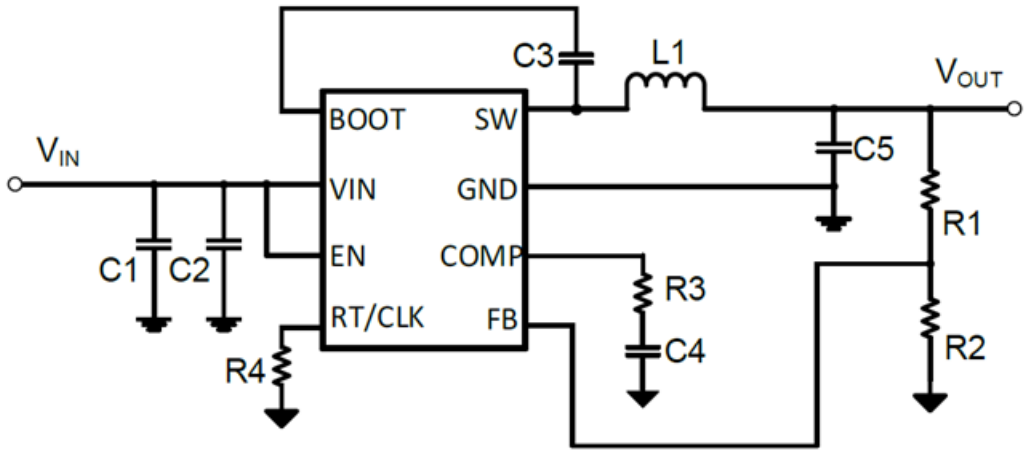



**Figure 1. Typical Application Circuit**

## ABSOLUTE MAXIMUM RATINGS

| Symbol | Parameter | Rating | Unit |
|---|---|---|---|
| VIN | Supply Pin Voltage | -0.3 to +42.0 (DC) | V |
| | | -0.3 to +45.0 (400ms) | |
| $V_{BST}$ | Bootstrap Pin Voltage | $V_{SW}$ - 0.3 to $V_{SW}$ + 6.0 | V |
| $V_{EN}$ | Enable/UVLO Pin Voltage | -0.3 to +42.0 | V |
| $V_{RT/CLK}$ | RT/CLK Pin Voltage | -0.3 to +6.0 | V |
| $V_{FB}$ | Feedback Voltage | -0.3V to +6.0 | V |
| $V_{COMP}$ | Compensation Pin Voltage | -0.3 to +6.0 | V |
| $V_{SW}$ | Switch Node Voltage | -0.3 to VIN + 0.3 (DC) | V |
| | | -2.5 to VIN + 2.0 (20ns) | |
| $T_J$ | Junction Temperature | +160 | °C |
| $T_L$ | Lead Temperature | +260 | °C |

## RECOMMENDED OPERATING CONDITIONS

| Symbol | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| VIN | Supply Voltage | 3.8 | 40 | V |
| VOUT | Output Voltage | 0.8 | 39 | V |
| $T_A$ | Operating Ambient Temperature Range | -40 | +85 | °C |
| $T_J$ | Operating Junction Temperature Range | -40 | +125 | °C |

## EVALUATION BOARD

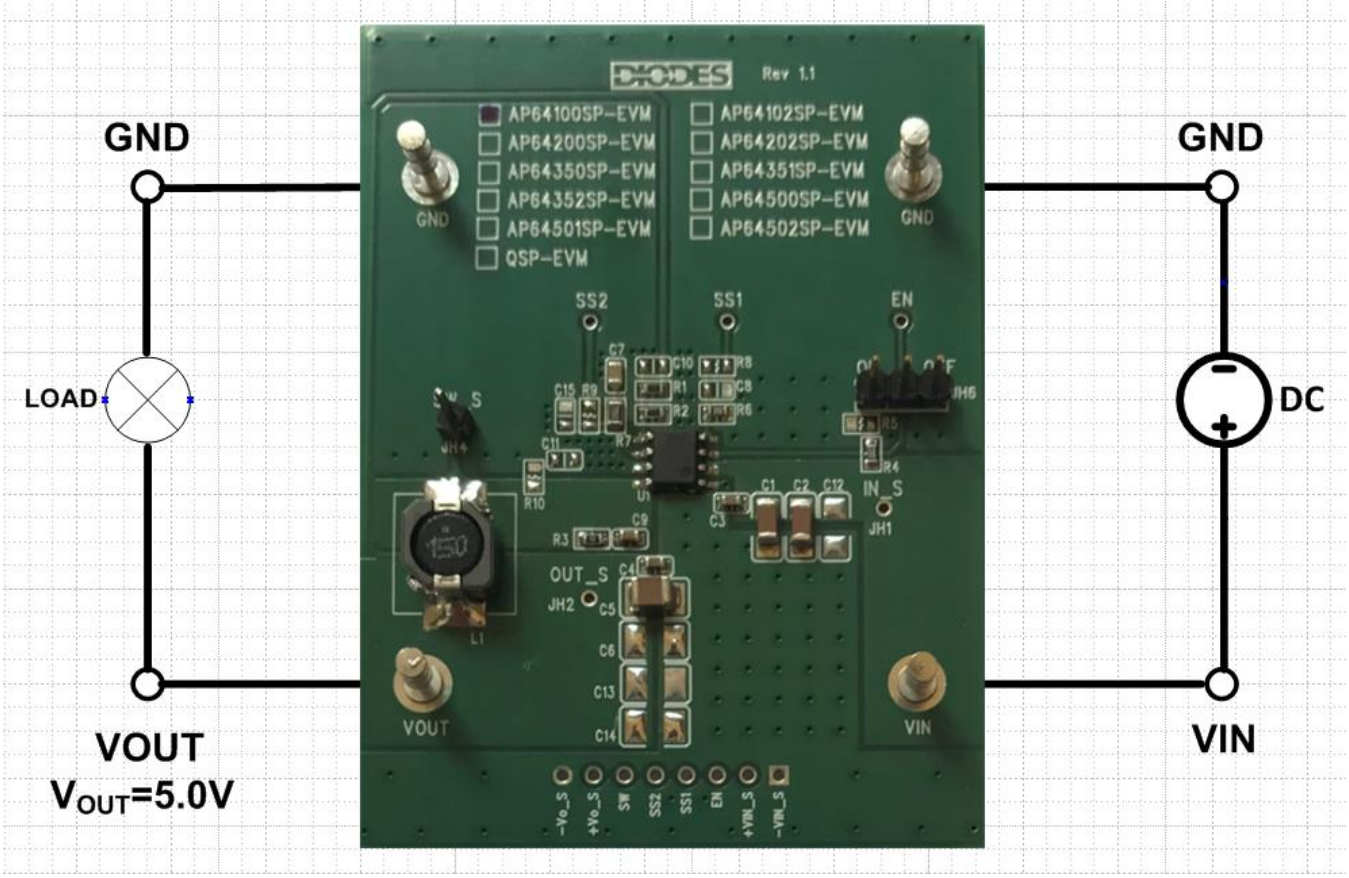



**Figure 2. AP64100SP-EVM**

## QUICK START GUIDE

The AP64100SP-EVM has a simple layout and allows access to the appropriate signals through test points. To evaluate the performance of the AP64100SP, follow the procedure below:

1. Connect a power supply to the input terminals VIN and GND. Set VIN to 12V.
2. Connect the positive terminal of the electronic load to VOUT and negative terminal to GND.
3. For Enable, to enable IC, place a jumper at JH6 to “ON” position to connect EN pin to VIN through 100KΩ resistor or leave it OPEN. 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 (±1%) at the output terminals VOUT and GND. Measurement can also be done with a multimeter with the positive and negative leads between VOUT and GND.
6. Set the load to 1A 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.

| VOUT | R1 | R2 | L1 | R7 | C7 | C1, C2 | C5, C6 | C10 |
|---|---|---|---|---|---|---|---|---|
| 1.2V | 4.99KΩ | 10KΩ | 6.8µH | 1.69KΩ | 10nF | 2x10µF | 22µF | OPEN |
| 1.5V | 8.66KΩ | 10KΩ | 8.2µH | 2.10KΩ | 10nF | 2x10µF | 22µF | OPEN |
| 1.8V | 12.4KΩ | 10KΩ | 10µH | 2.55KΩ | 10nF | 2x10µF | 22µF | OPEN |
| 2.5V | 21.5KΩ | 10KΩ | 10µH | 3.48KΩ | 10nF | 2x10µF | 22µF | OPEN |
| 3.3V | 31.6KΩ | 10KΩ | 15µH | 4.64KΩ | 10nF | 2x10µF | 22µF | OPEN |
| 5.0V | 52.3KΩ | 10KΩ | 15µH | 6.98KΩ | 10nF | 2x10µF | 22µF | OPEN |
| 12V | 140KΩ | 10KΩ | 33µH | 11.3KΩ | 10nF | 2x10µF | 22µF | OPEN |

**Table 1. Common Output Voltages**

## EVALUATION BOARD SCHEMATIC

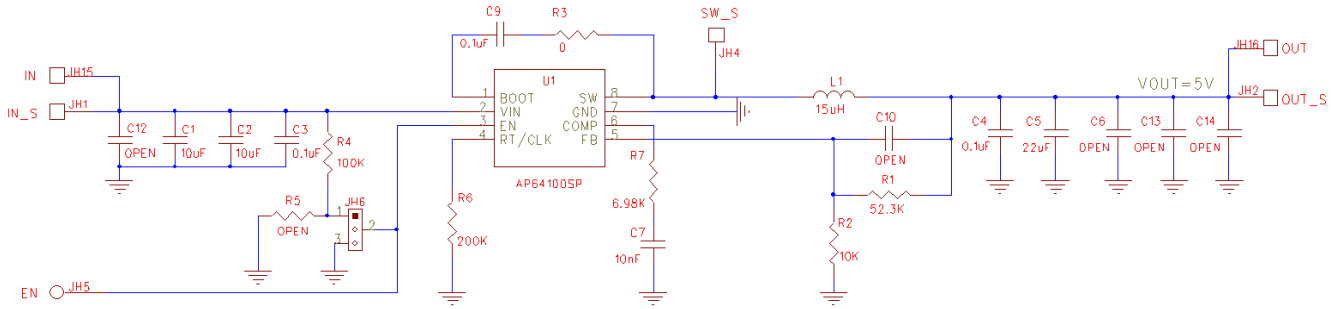



**Figure 3. AP64100SP-EVM Schematic**

## PCB TOP LAYOUT

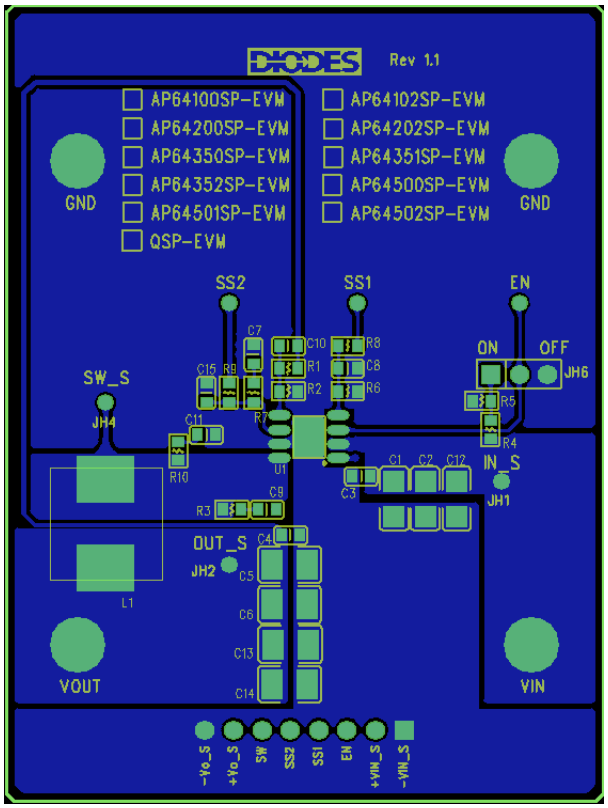



**Figure 4. AP64100SP-EVM – Top Layer**

## PCB BOTTOM LAYOUT

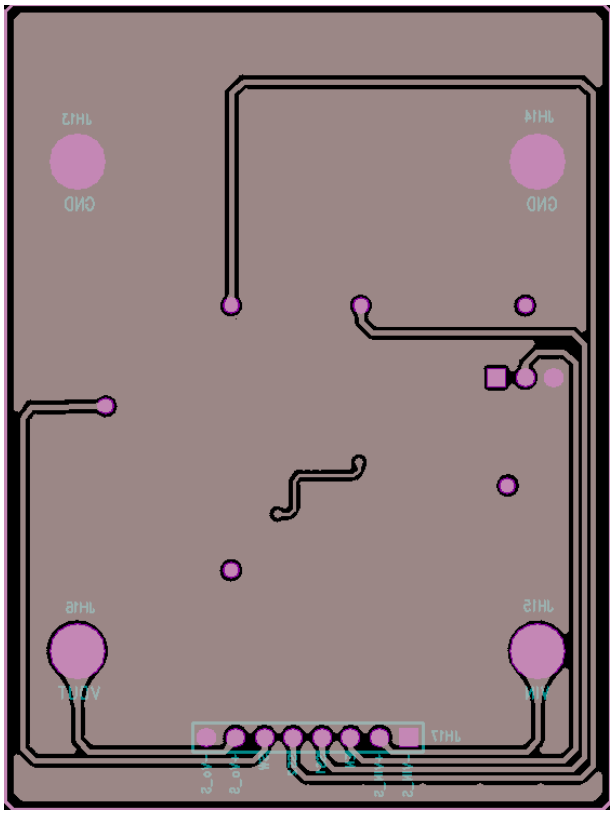



**Figure 5. AP64100SP-EVM – Bottom Layer**

## BILL OF MATERIALS for AP64100SP-EVM for $V_{OUT}$=5V

| Ref | Value | Description | Qty | Size | Vendor Name | Manufacturer PN | PCB Layer |
|---|---|---|---|---|---|---|---|
| C1, C2 | 10µF | Ceramic Capacitor, 50V, X7R, 10% | 2 | 1206 | Samsung | CL31B106KBHNNNE | Top |
| C3, C4, C9 | 0.1µF | Ceramic Capacitor, 50V, X7R, 10% | 3 | 0603 | Wurth Electronics | 885012206095 | Top |
| C5 | 22µF | Ceramic Capacitor, 16V, X7R | 1 | 1210 | Samsung | CL32B226KOJNNNE | Top |
| C7 | 10nF | Ceramic Capacitor, 50V, X7R | 1 | 0603 | Wurth Electronics | 885382206002 | Top |
| R1 | 52.3KΩ | SMD Resistor, 1% | 1 | 0603 | Panasonic | ERJ-3EKF5232V | Top |
| R2 | 10KΩ | SMD Resistor, 1% | 1 | 0603 | Panasonic | ERJ-3EKF1002V | Top |
| R3 | 0Ω | RES SMD 1% 1/10W | 1 | 0603 | Vishay | CRCW06030000Z0EAC | Top |
| R4 | 100KΩ | RES SMD 1% 1/10W | 1 | 0603 | Yageo | RC0603FR-07100KL | Top |
| R6 | 200KΩ | RES SMD 1% 1/10W | 1 | 0603 | Yageo | RC0603FR-07200KL | Top |
| R7 | 6.98KΩ | RES SMD 1% 1/10W | 1 | 0603 | Panasonic | ERJ-3EKF6981V | Top |
| L1 | 15µH | DCR=69.5mΩ, Ir=2.2A | 1 | 7.4x 7.3x 4.5mm | Wurth Electronics | 7447773150 | Top |
| JH6 | | PCB Header, 40 POS | 1 | 1X3 | 3M | 2340-6111TG | Top |
| VIN, VOUT, GNDx2 | 1598 | Terminal Turret Triple 0.094" L (Test Points) | 4 | Through-Hole | Keystone Electronics | 1598-2 | Top |
| U1 | AP64100 | Sync DC-DC Converter | 1 | SO-8EP | Diodes Incorporated (Diodes) | AP64100SP | Top |

## TYPICAL PERFORMANCE CHARACTERISTICS

**Figure 6. Efficiency vs Output Current**

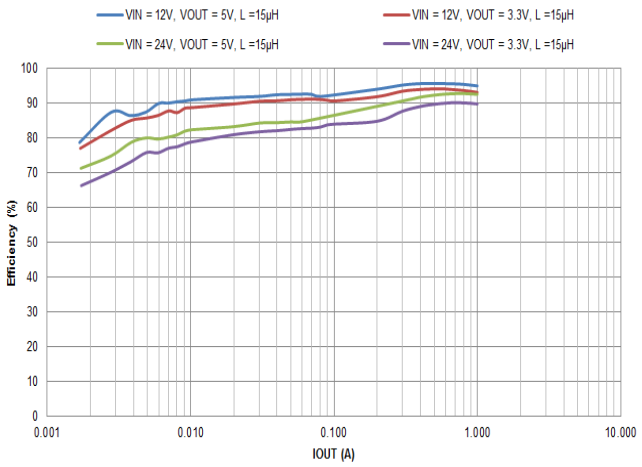



**Figure 7. Load Transient 0.5A to 1A**

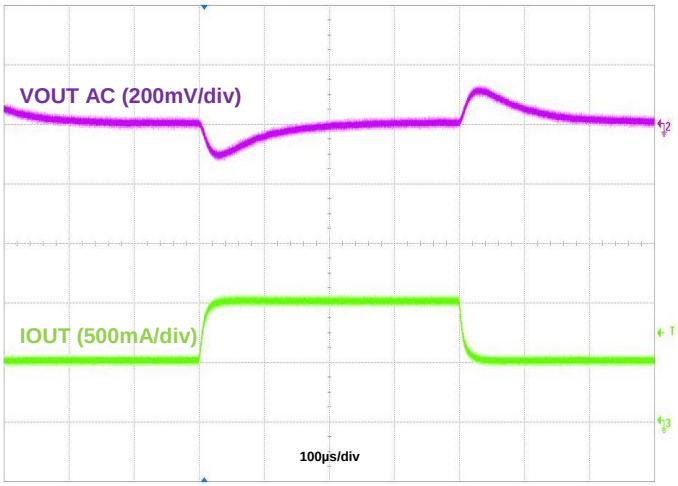



**Figure 8. Output Voltage Ripple, IOUT=1A**

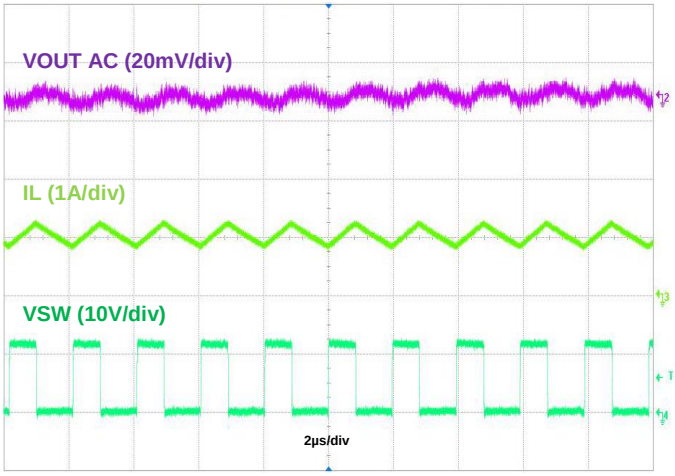
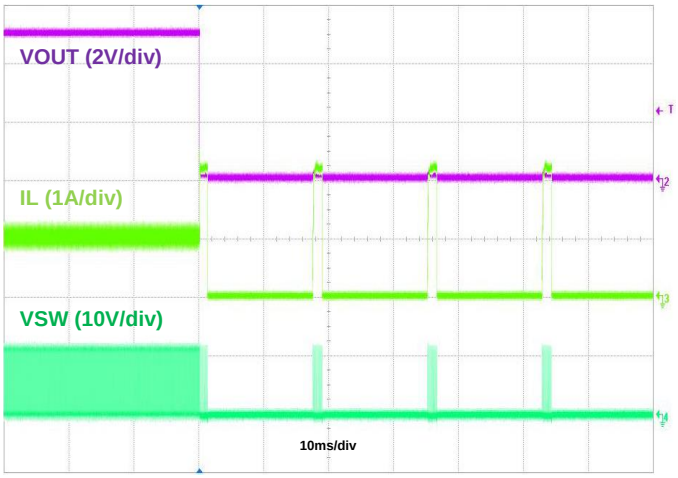



**Figure 9. Output Short Protection, IOUT=1A**



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