DESCRIPTION

The AP62500 is a 5A, synchronous buck converter with a wide input voltage range of 4.5V to 18V. The device fully integrates a 47mΩ high-side power MOSFET and a 18mΩ low-side power MOSFET to provide high-efficiency step-down DC-DC conversion.

The AP62500 device is easily used by minimizing the external component count due to its adoption of Constant On-Time (COT) control to achieve fast transient response, easy loop stabilization, and low output voltage ripple.

The AP62500 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 device is available in a V-QFN2030-12 (Type A) package.

FEATURES

- VIN: 4.5V to 18V
- Output Voltage (VOUT): 0.6V to 7V
- 5A Continuous Output Current
- 0.6V ± 1% Reference Voltage
- 195µA Quiescent Current
- Selectable Operation Modes
  - Pulse Frequency Modulation (PFM)
  - Ultrasonic Mode (USM)
  - Pulse Width Modulation (PWM)
- Selectable Switching Frequency
  - 400kHz
  - 800kHz
  - 1.2MHz
- Programmable Soft-Start Time
- Proprietary Gate Driver Design for Best EMI Reduction
- Power-Good Indicator
- Precision Enable Threshold to Adjust UVLO
- Protection Circuitry
  - Undervoltage Lockout (UVLO)
  - Cycle-by-Cycle Valley Current Limit
  - Thermal Shutdown

APPLICATIONS

- 5V and 12V Input Distributed Power Bus Supplies
- Television Sets and Monitors
- White Goods and Small Home Appliances
- FPGA, DSP, and ASIC Supplies
- Home Audio
- Network Systems
- Gaming Consoles
- Consumer Electronics
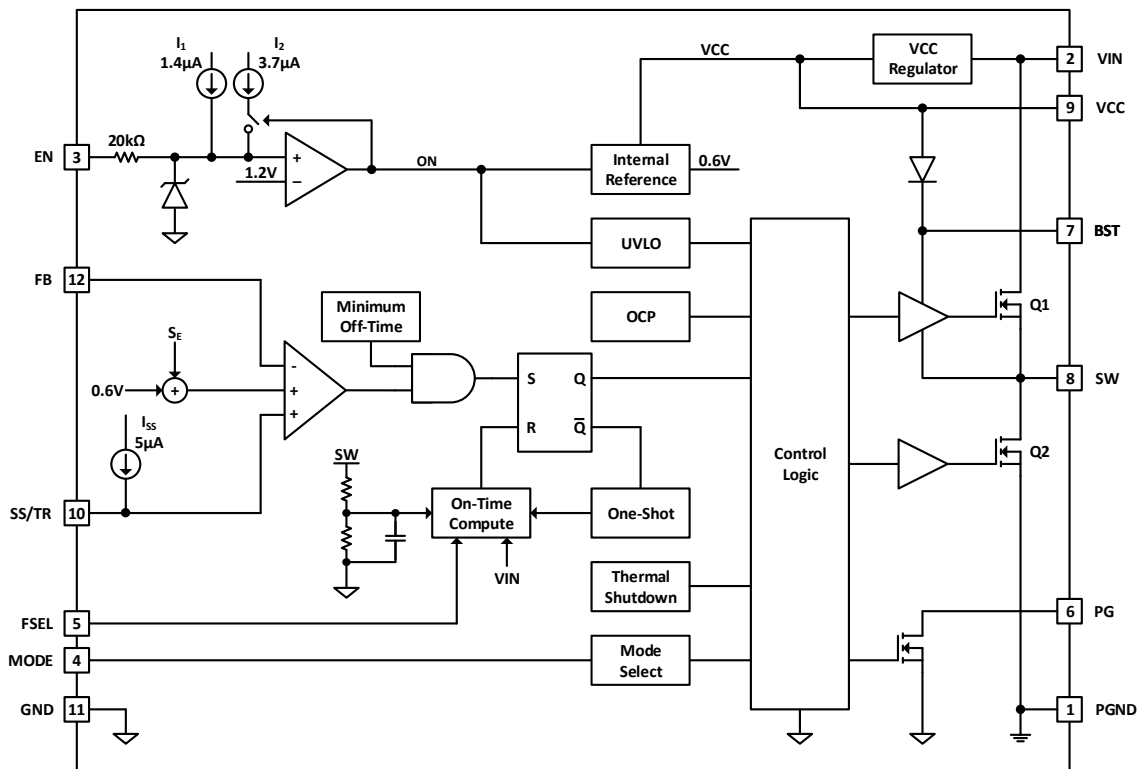- General Purpose Point of Load

FUNCTIONAL BLOCK

Figure 1. Functional Block Diagram

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
VIN	Supply Voltage	4.5	18.0	V
VOUT	Output Voltage	0.6	7.0	V
T_A	Operating Ambient Temperature	-40	+85	°C
T_J	Operating Junction Temperature	-40	+125	°C

EVALUATION BOARD

Figure 2. AP62500SJ-EVM

AP62500SJ-EVM

Issue 1

3 of 12

www.diodes.com

March 2024

© 2024 Copyright Diodes Incorporated. All Rights Reserved.
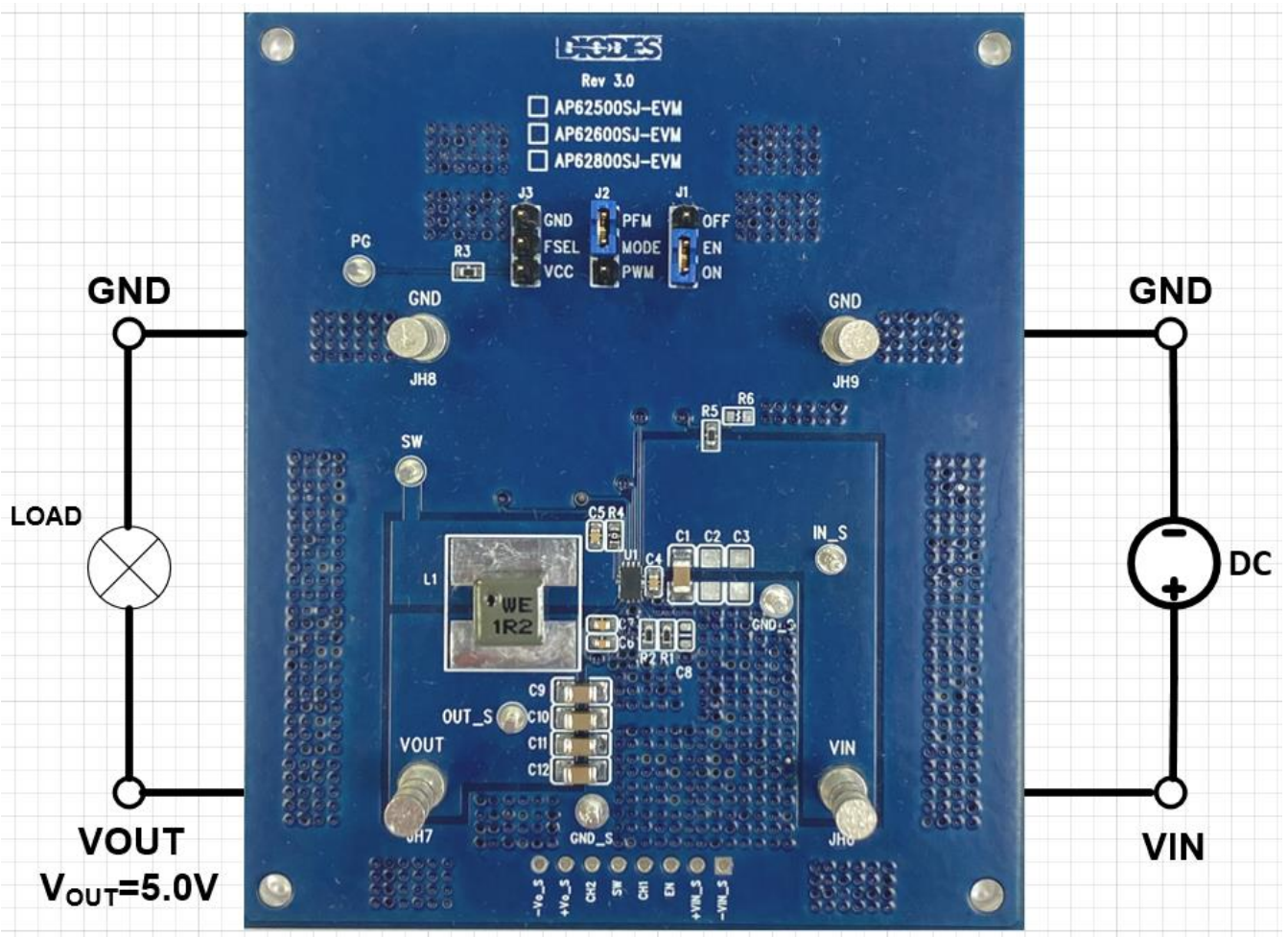
QUICK START GUIDE

The AP62500SJ-EVM has a simple layout and allows access to the appropriate signals through test points. The board is targeted to be used in providing a simple and convenient evaluation environment for the AP62500.

To operate the EVM, set jumpers J1, J2 and J3 to the desired positions per below shown.

- J1 = EN pin input jumper. For Enable, to enable IC, leave it OPEN or jump to "ON" to program an external resistor voltage divider at R5 and R6 to set the EN level. Jump to "OFF" position to disable IC.
- J2 = PFM, PWM or USM mode selection. At J2, connect a jumper to PWM to force the device in Pulse Width Modulation (PWM) operation mode. Connect a jumper to PFM to ground the pin to operate the device in Pulse Frequency Modulation (PFM) operation mode without Ultrasonic Mode (USM). Leave J2 OPEN to float the pin to operate the device in PFM with USM mode.
- J3 = Switching frequency selection. At J3, connect a jumper to GND to set clock frequency to 400kHz. Leave J3 OPEN to float the pin to set clock frequency to 800kHz. Connect a jumper to VCC to set clock frequency to 1.2MHz.

To evaluate the performance of the AP62500SJ-EVM, 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. By default, the evaluation board should now power up with a 5.0V output voltage. Frequency is 800kHz.

4. 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.

5. 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.

APPLICATION INFORMATION

Setting the Output Voltage of AP62500

(1) Setting the output voltage:

The AP62500 features external programmable output voltage by using a resistor divider network R2 and R1 as shown in the typical application circuit. The output voltage is calculated as below;

$$R1 = R2 \cdot \left(\frac{VOUT}{0.6V} - 1 \right)$$

First, select a value for R1 according to the value recommended in table 1. Then, R3 is determined. The output voltage is given by Table 1 for reference. For accurate output voltage, 1% tolerance is required.

Table 1. Resistor selection for output voltage setting

Vo	R2	R1
1.2V	10kΩ	10kΩ
1.5V	10kΩ	15kΩ
1.8V	10kΩ	20kΩ
2.5V	10kΩ	31.6kΩ
3.3V	10kΩ	45.3kΩ
5V	10kΩ	73.2kΩ

EXTERNAL COMPONENT SELECTION:

Table 2. Recommended inductors and output capacitor **AP62500**							
Output Voltage (V)	Frequency (kHz)	R1 (kΩ)	R2 (kΩ)	L1 (µH)	C1 (µF)	C9, C10, C11 (µF)	C5 (nF)
1.2	400	10	10	1.50	22	3 x 22	100
1.2	800	10	10	0.75	22	3 x 22	100
1.2	1200	10	10	0.51	22	3 x 22	100
1.5	400	15	10	1.80	22	3 x 22	100
1.5	800	15	10	0.87	22	3 x 22	100
1.5	1200	15	10	0.62	22	3 x 22	100
1.8	400	20	10	2.00	22	3 x 22	100
1.8	800	20	10	1.00	22	3 x 22	100
1.8	1200	20	10	0.68	22	3 x 22	100
2.5	400	31.6	10	2.70	22	3 x 22	100
2.5	800	31.6	10	1.30	22	3 x 22	100
2.5	1200	31.6	10	0.87	22	3 x 22	100
3.3	400	45.3	10	3.3	22	3 x 22	100
3.3	800	45.3	10	1.5	22	3 x 22	100
3.3	1200	45.3	10	1.00	22	3 x 22	100
5.0	400	73.2	10	3.5	22	3 x 22	100
5.0	**800**	**73.2**	**10**	**2.2**	**22**	**3 x 22**	**100**
5.0	1200	73.2	10	1.20	22	3 x 22	100

EVALUATION BOARD SCHEMATIC
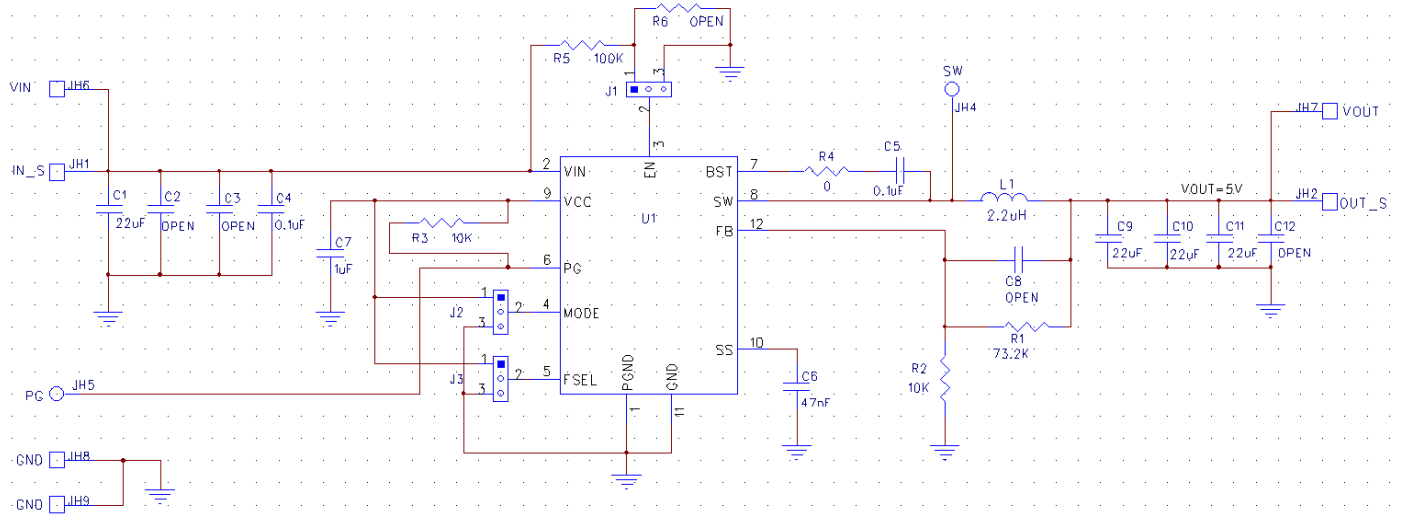
Figure 3. AP62500SJ-EVM Schematic

PCB TOP LAYOUT
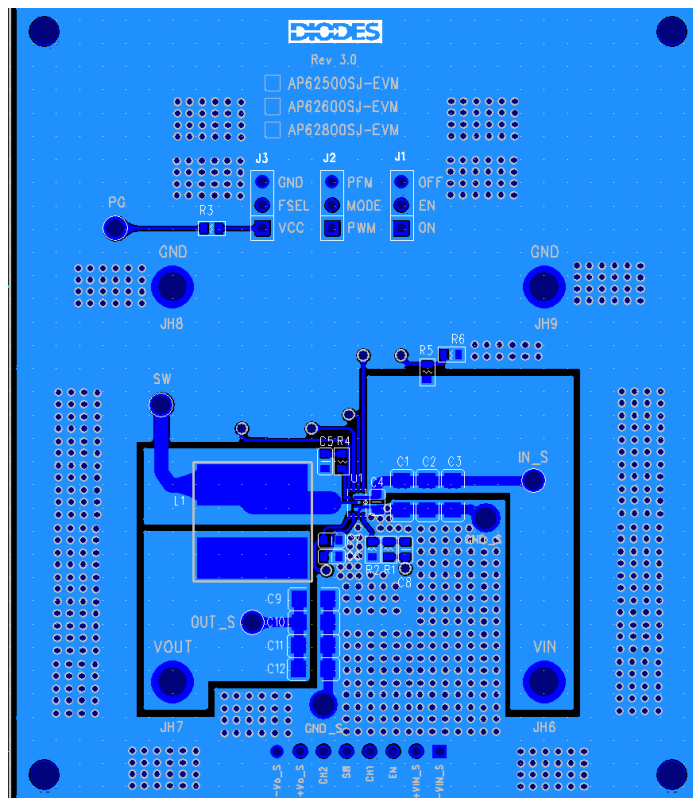
Figure 4. AP62500SJ-EVM – Top Layer

AP62500SJ-EVM
Issue 1

6 of 12
www.diodes.com

March 2024
© 2024 Copyright Diodes Incorporated. All Rights Reserved.

PCB INNER LAYER 2 LAYOUT
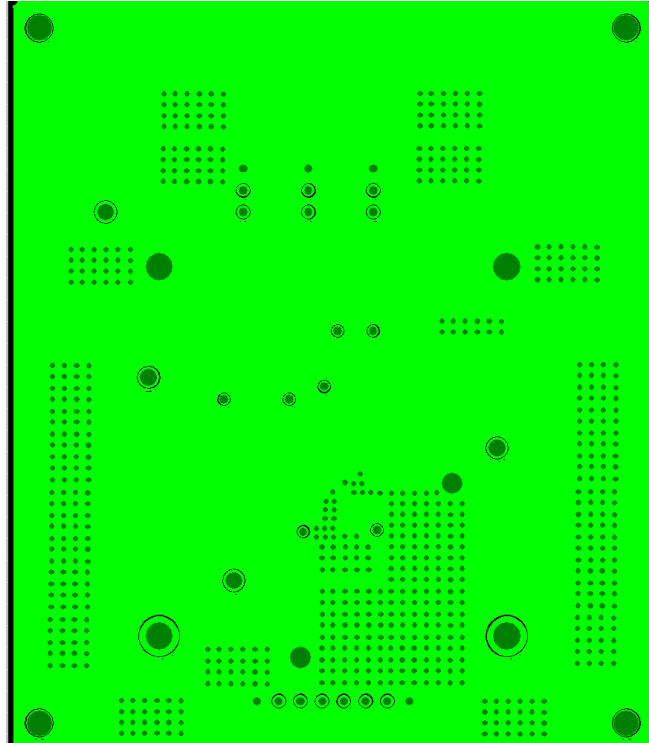
Figure 5. AP62500SJ-EVM – Inner Layer 2

PCB INNER LAYER 3 LAYOUT
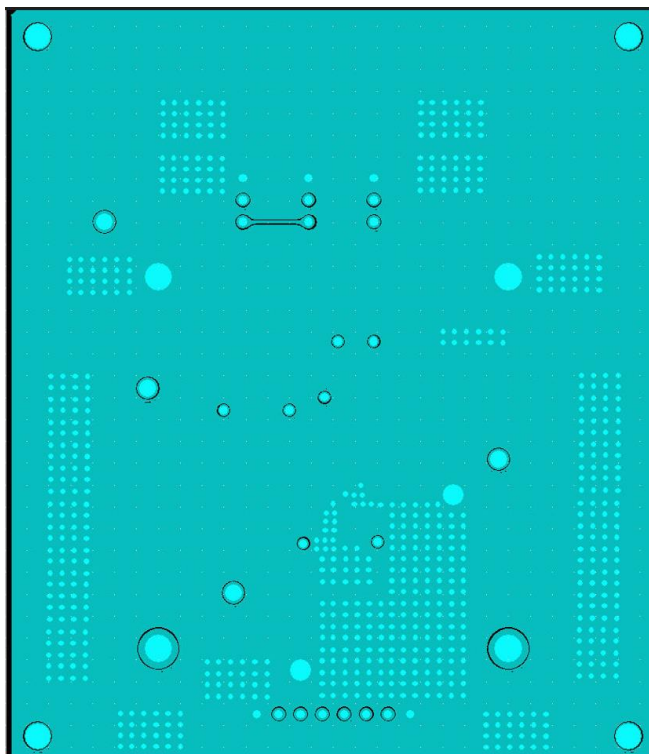
Figure 6. AP62500SJ-EVM – Inner Layer 3

PCB BOTTOM LAYOUT
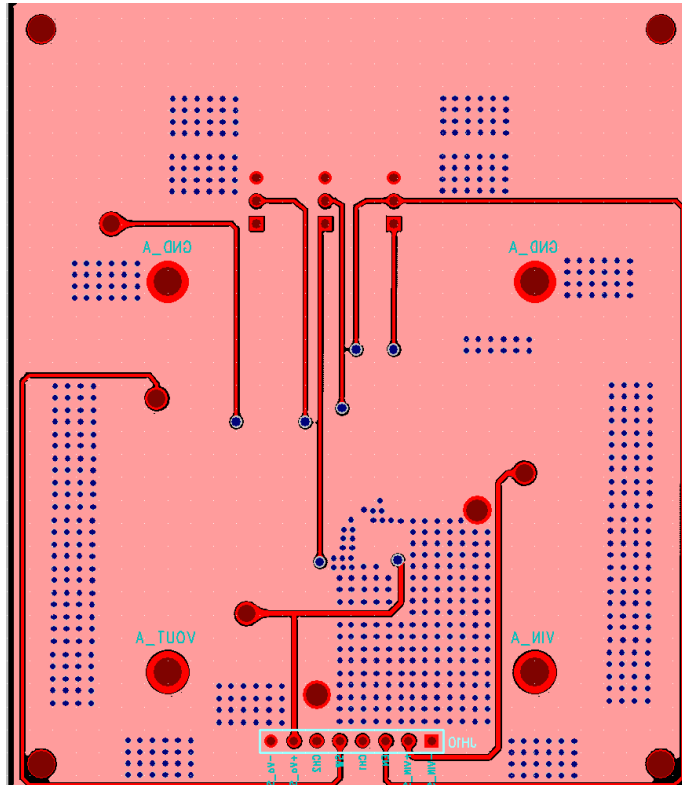
Figure 7. AP62500SJ-EVM – Bottom Layer

BILL OF MATERIALS for AP62500SJ-EVM for V_{OUT}=5V @800kHz

Ref	Value	Description	Qty	Size	Vendor	Manufacturer PN	PCB Layer
C1, C9, C10, C11	22µF	Ceramic Capacitor, 25V, X6S	4	1206	Samsung	CL31X226KAHN3NE	Top
C4, C5	0.1µF	Ceramic Capacitor, 50V, X7R, 10%	2	0603	Wurth Electronics	885012206095	Top
C6	47nF	Ceramic Capacitor, 50V, X7R, 10%	1	0603	Wurth Electronics	885012206093	Top
C7	1µF	Ceramic Capacitor, 25V, X7R, 10%	1	0603	Wurth Electronics	885012206076	Top
L1	2.2µH	DCR=10.5mΩ, Ir=8A	1	6.65x6.45x3.30mm	Wurth Electronics	74439344022	Top
R1	73.2KΩ	RES SMD 1%	1	0603	Panasonic	ERJ-3EKF7322V	Top
R2, R3	10KΩ	RES SMD 1%	2	0603	Panasonic	ERJ-3EKF1002V	Top
R4	0Ω	RES SMD 1%	1	0603	Yageo	RC0603FR-070RL	Top

AP62500SJ-EVM
Issue 1
8 of 12
www.diodes.com
March 2024
© 2024 Copyright Diodes Incorporated. All Rights Reserved.

R5	100KΩ	RES SMD 1%	1	0603	Yageo	AC0603FR-13100KL	Top
J1, J2, J3		PCB Header, 40 POS	3	1X3	3M	2340-6111TG	Top
JH6, JH7, JH8, JH9	1598	Terminal Turret Triple 0.094" L (Test Points)	4	Through-Hole	Keystone Electronics	1598-2	Top
U1	AP62500	5A Sync DC/DC Converter	1	QFN2030-12	Diodes Incorporated (Diodes)	AP62500SJ	Top

AP62500SJ-EVM
Issue 1

9 of 12
www.diodes.com

March 2024
© 2024 Copyright Diodes Incorporated. All Rights Reserved.

TYPICAL PERFORMANCE CHARACTERISTICS
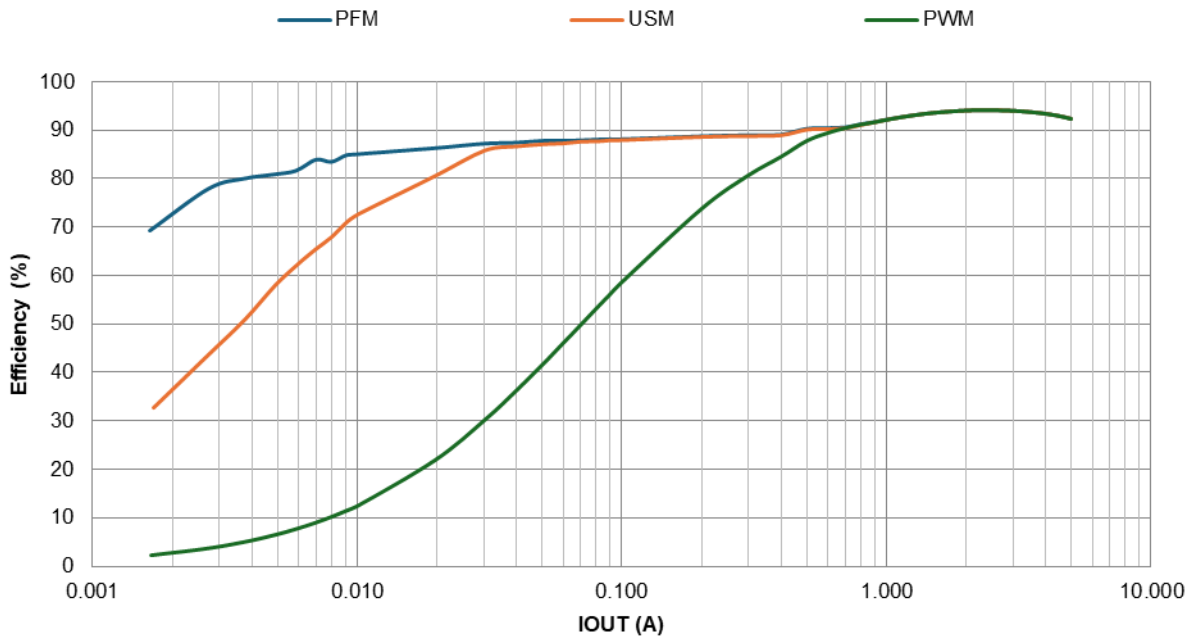
Figure 8. Efficiency vs. Output Current, VIN = 12V, VOUT = 5V, L = 2.2μH, f$_{SW}$ = 800kHz
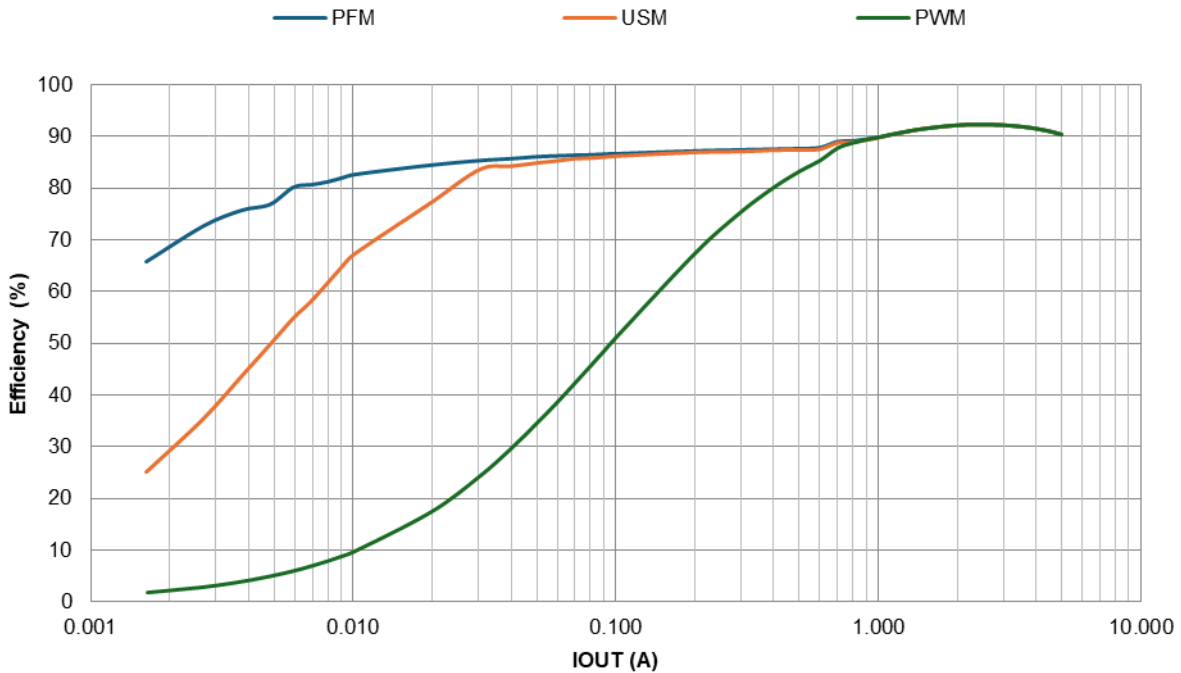
Figure 9. Efficiency vs. Output Current, VIN = 12V, VOUT = 3.3V, L = 1.5μH, f$_{SW}$ = 800kHz
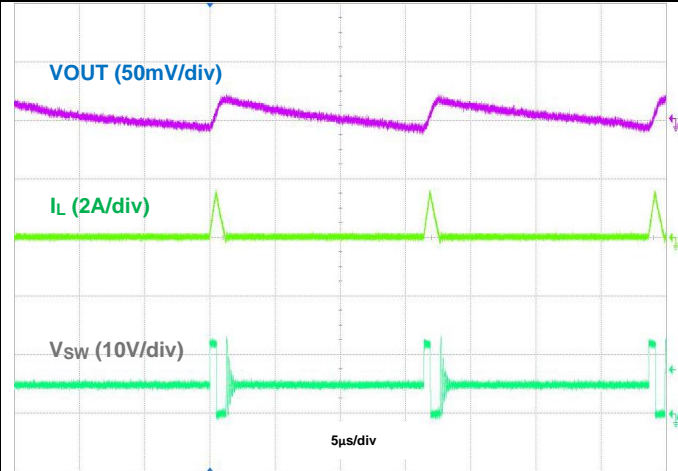
Figure 10. Output Voltage Ripple, IOUT = 50mA
VIN = 12V, VOUT = 5V PFM f$_{SW}$ = 800kHz
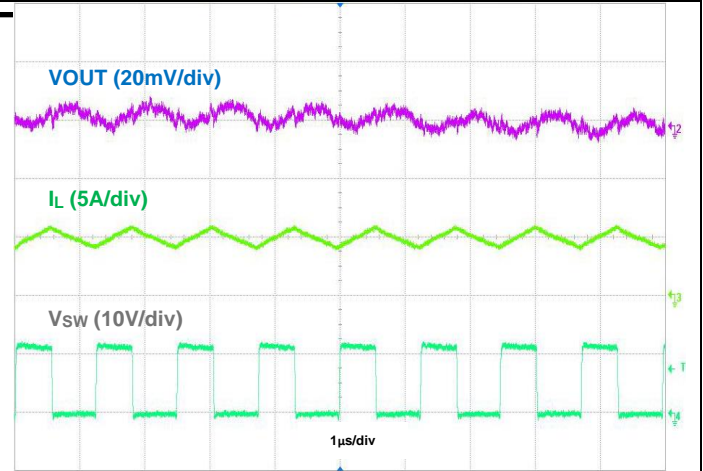
Figure 11. Output Voltage Ripple, IOUT = 5A
VIN = 12V, VOUT = 5V PFM f$_{SW}$ = 800kHz
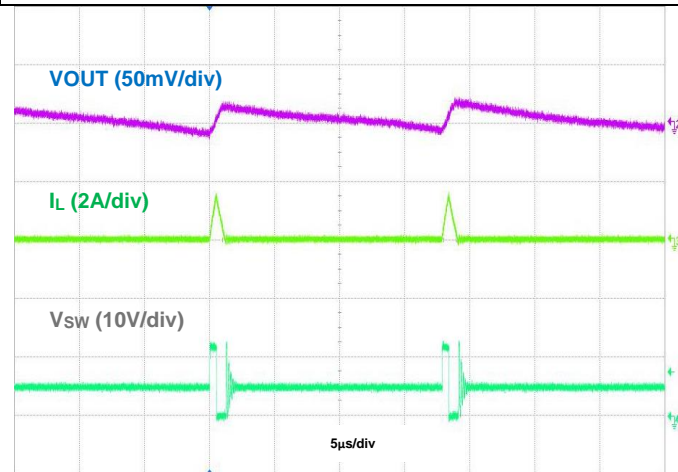
Figure 12. Output Voltage Ripple, IOUT = 50mA
VIN = 12V, VOUT = 5V USM f$_{SW}$ = 800kHz
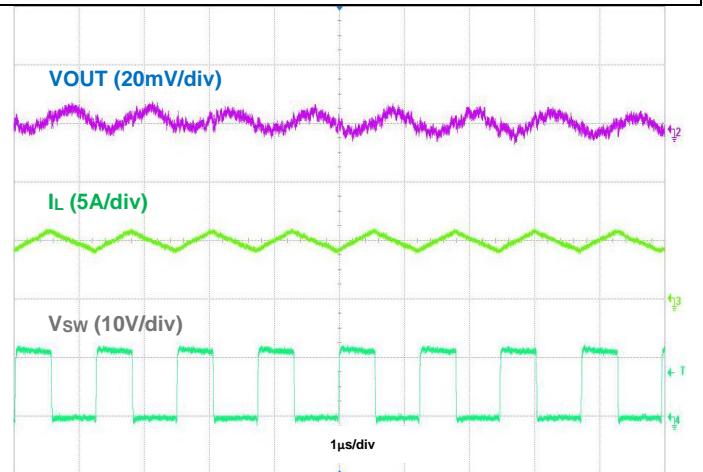
Figure 13. Output Voltage Ripple, IOUT = 5A
VIN = 12V, VOUT = 5V USM f$_{SW}$ = 800kHz
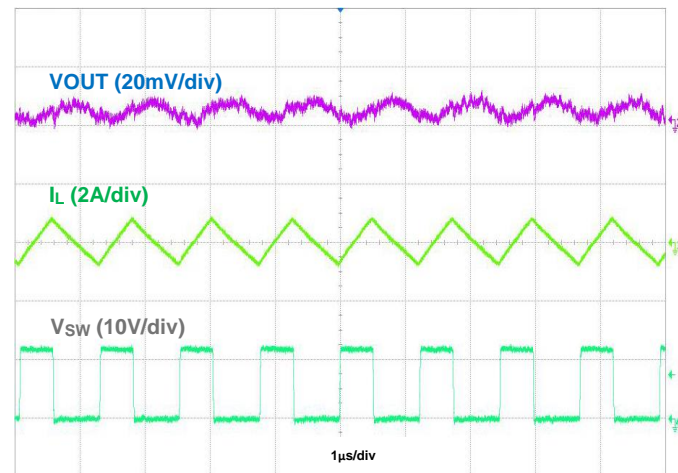
Figure 14. Output Voltage Ripple, IOUT = 50mA
VIN = 12V, VOUT = 5V PWM f$_{SW}$ = 800kHz
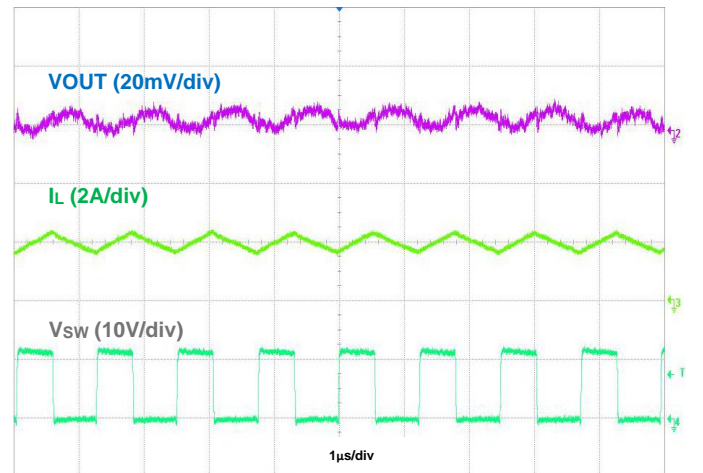
Figure 15. Output Voltage Ripple, IOUT = 5A
VIN = 12V, VOUT = 5V PWM f$_{SW}$ = 800kHz

IMPORTANT NOTICE