AP62800SJ
EVB User Guide

DESCRIPTION

The AP62800 is an 8A, synchronous buck converter with a wide input voltage range of 4.5V to 17V. The device fully integrates a 22mΩ high-side power MOSFET and a 10mΩ low-side power MOSFET to provide high-efficiency step-down DC-DC conversion.

The AP62800 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 AP62800 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, reducing high-frequency radiated EMI noise caused by MOSFET switching.

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

FEATURES

- VIN: 4.5V to 17V
- Output Voltage (VOUT): 0.6V to 7V
- 8A 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

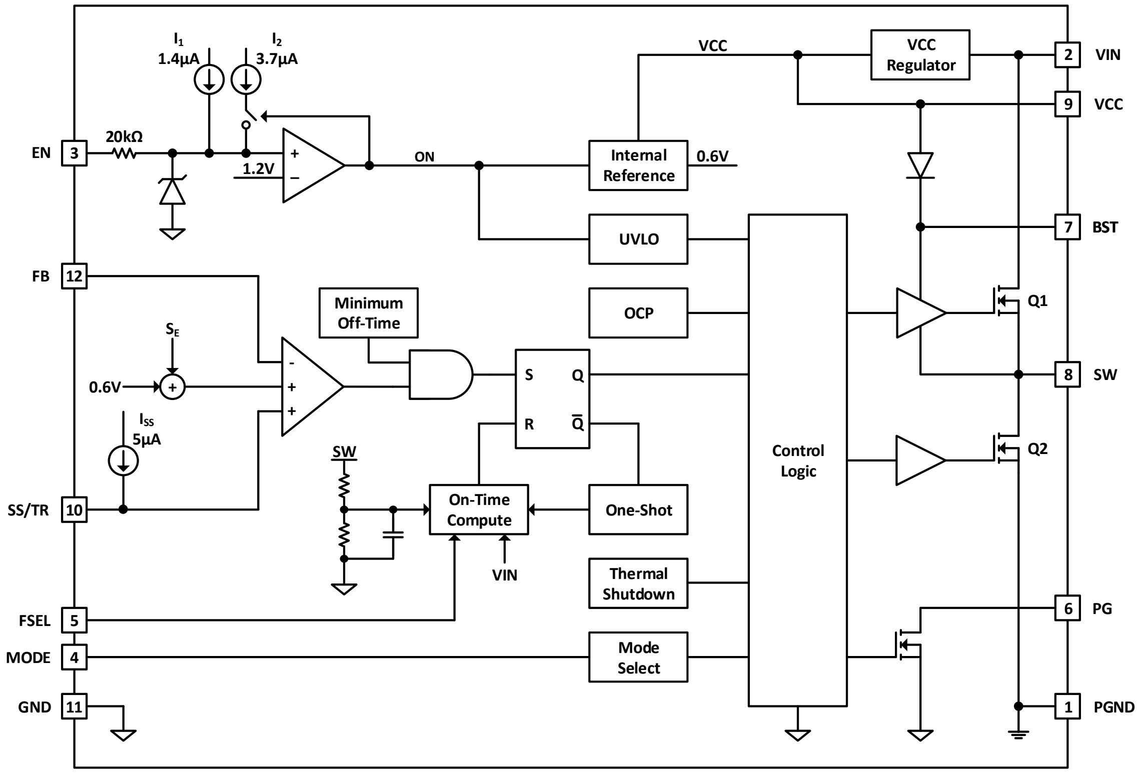

Figure 1. Functional Block Diagram

RECOMMENDED OPERATING CONDITIONS

Symbol	Parameter	Min	Max	Unit
VIN	Supply Voltage	4.5	17.0	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

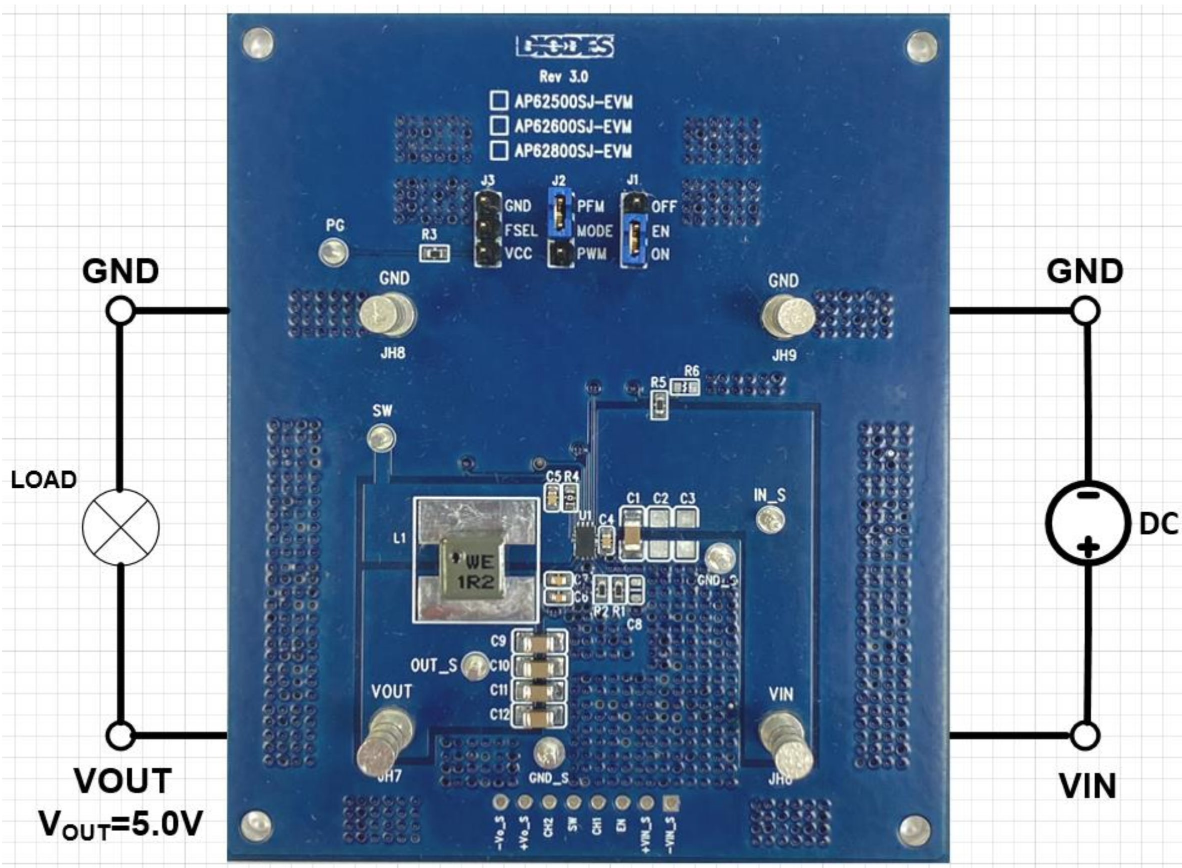

Figure 2. AP62800SJ-EVM

QUICK START GUIDE

The AP62800SJ-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 AP62800.

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

- 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 AP62800SJ-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 8A 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 AP62800

(1) Setting the output voltage

The AP62800 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,

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

First, select a value for R1 according to the value recommended in the 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 input/output capacitors

AP62800							
Output Voltage (V)	**Frequency (kHz)**	**R1 (kΩ)**	**R2 (kΩ)**	**L1 (µH)**	**C1 (µF)**	**C9, C10, C11, C12 (µF)**	**C5 (nF)**
1.2	400	10	10	1.00	22	4 x 22	100
	800			0.47			
	1200			0.33			
1.5	400	15	10	1.10	22	4 x 22	100
	800			0.56			
	1200			0.39			
1.8	400	20	10	1.30	22	4 x 22	100
	800			0.68			
	1200			0.43			
2.5	400	31.6	10	1.60	22	4 x 22	100
	800			0.82			
	1200			0.56			
3.3	400	45.3	10	2.00	22	4 x 22	100
	800			1.00			
	1200			0.68			
5.0	400	73.2	10	2.40	22	4 x 22	100
	800			1.20			
	1200			0.95			

EVALUATION BOARD SCHEMATIC

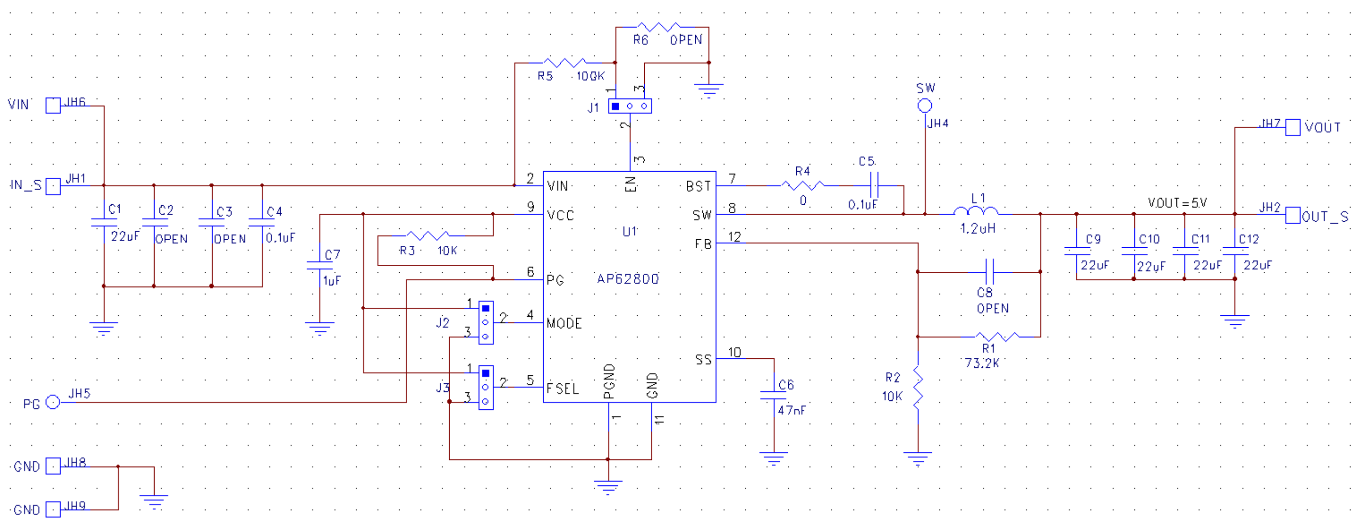

Figure 3. AP62800SJ-EVM Schematic

PCB TOP LAYOUT

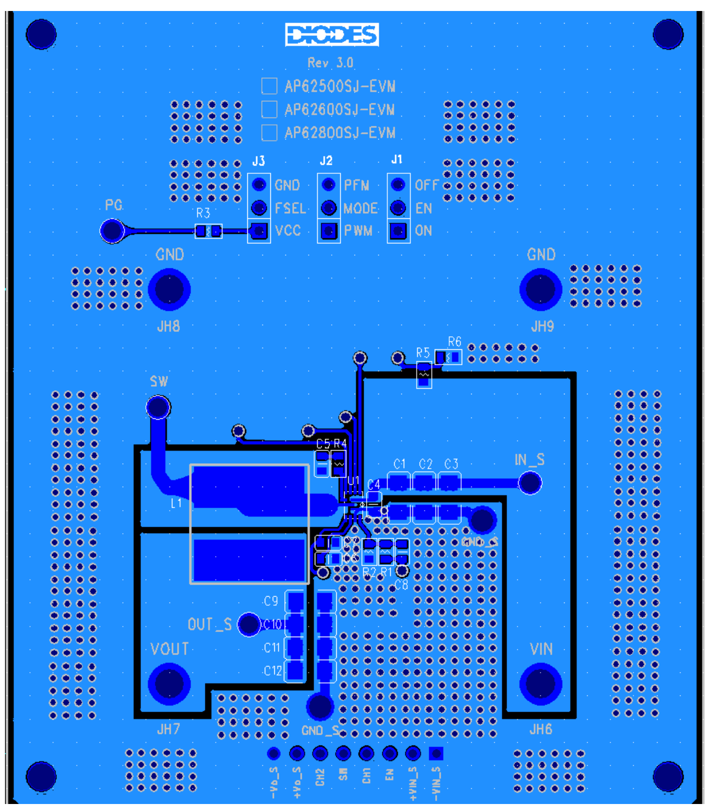

Figure 4. AP62800SJ-EVM – Top Layer

PCB INNER LAYER 2 LAYOUT

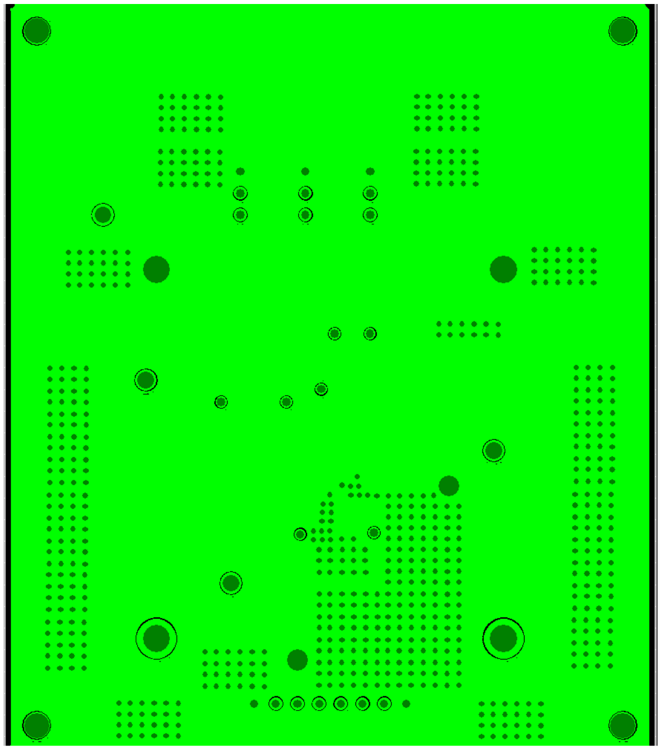

Figure 5. AP62800SJ-EVM – Inner Layer 2

PCB INNER LAYER 3 LAYOUT

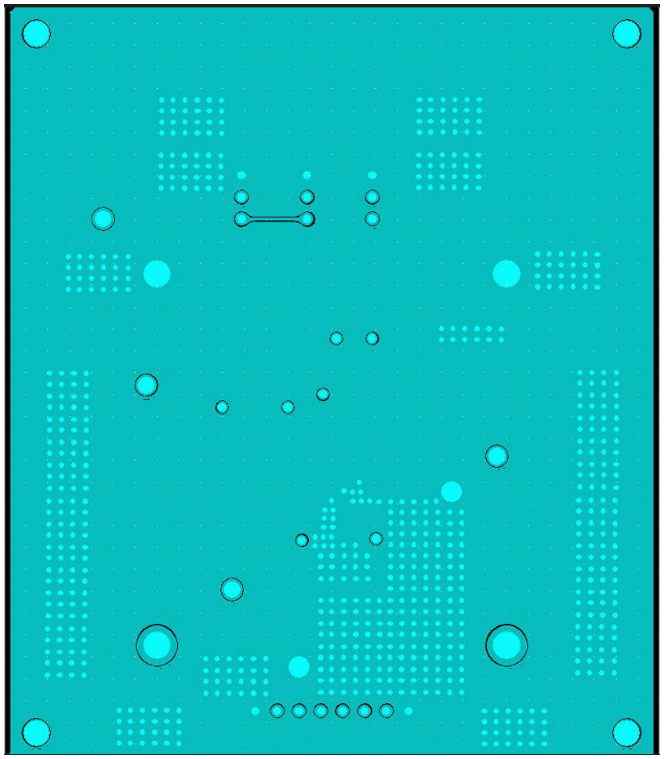

Figure 6. AP62800SJ-EVM – Inner Layer 3

PCB BOTTOM LAYOUT

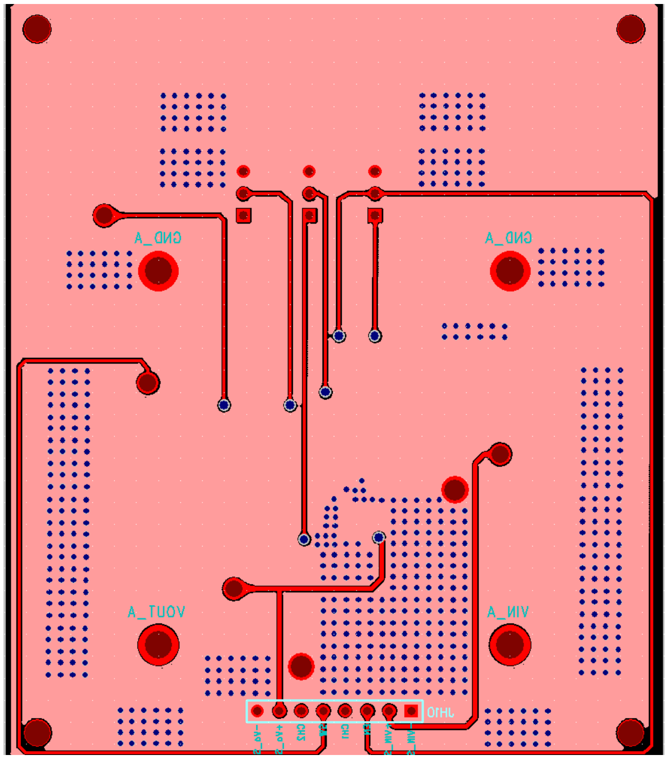

Figure 7. AP62800SJ-EVM – Bottom Layer

BILL OF MATERIALS for AP62800SJ-EVM for V_{OUT}=5V @800kHz

Ref	Value	Description	Qty	Size	Vendor	Manufacturer PN	PCB Layer
C1, C9, C10, C11, C12	22µF	Ceramic Capacitor, 25V, X6S	5	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	1.2µH	DCR=6.4mΩ, Ir=10.3A	1	6.65x6.45x 3.30mm	Wurth Electronics	74439344012	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
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	AP62800	8A Sync DC/DC Converter	1	QFN2030-12	Diodes Incorporated (Diodes)	AP62800SJ	Top

TYPICAL PERFORMANCE CHARACTERISTICS

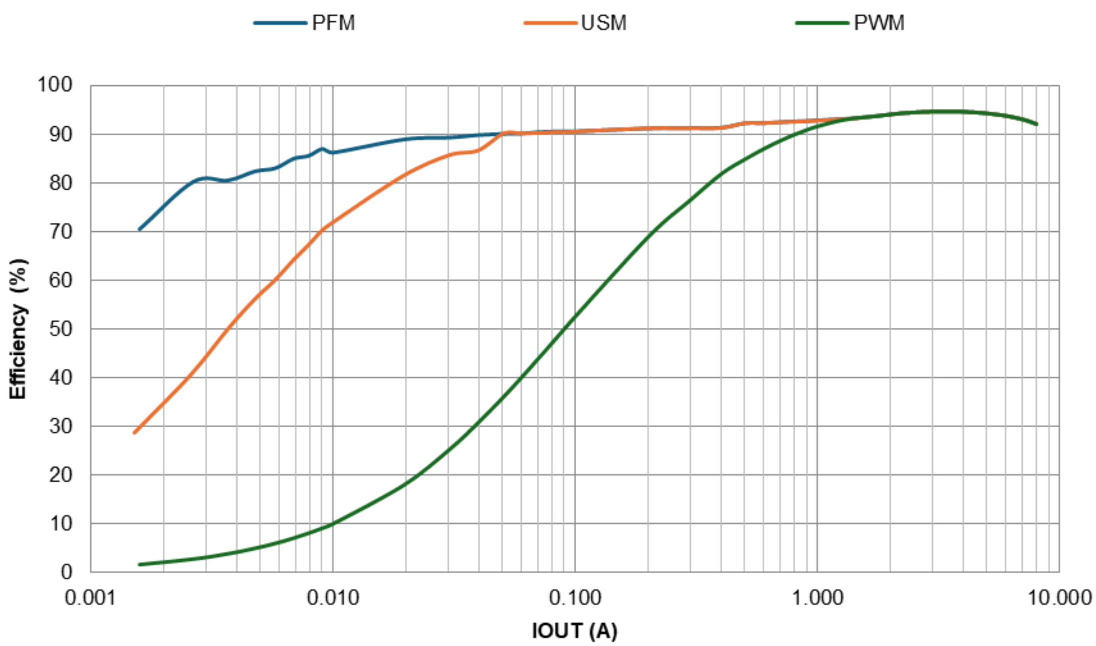

Figure 8. Efficiency vs. Output Current, VIN = 12V, VOUT = 5V, L = 1.2µH, f_{SW} = 800kHz

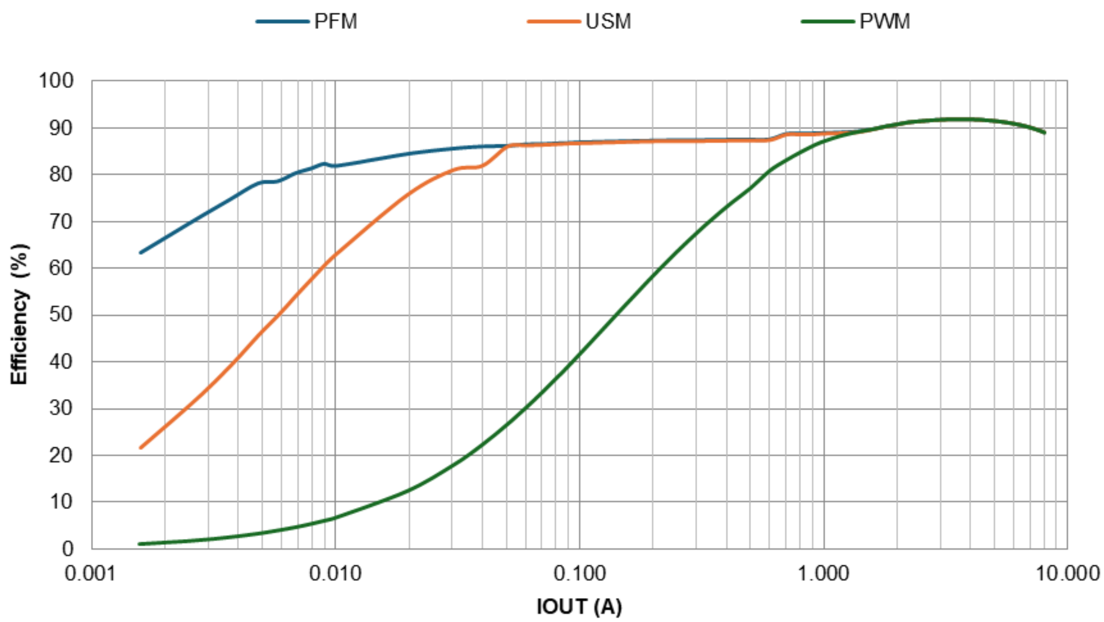

Figure 9. Efficiency vs. Output Current, VIN = 12V, VOUT = 3.3V, L = 1.0µH, f_{SW} = 800kHz

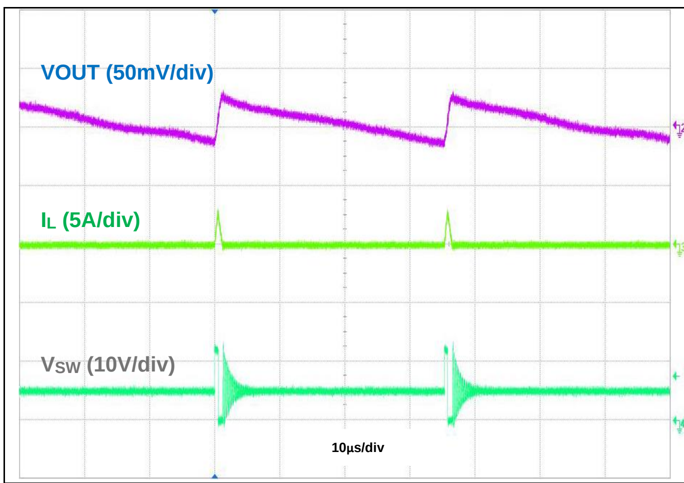	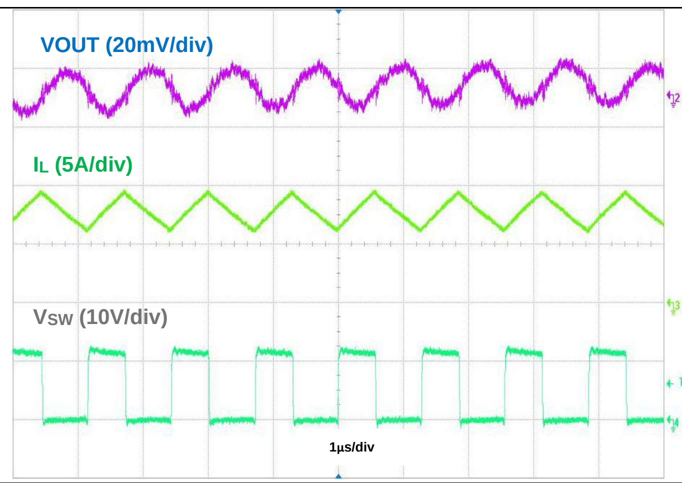
Figure 10. Output Voltage Ripple, IOUT = 50mA VIN = 12V, VOUT = 5V PFM f_{SW} = 800kHz	**Figure 11. Output Voltage Ripple, IOUT = 8A VIN = 12V, VOUT = 5V PFM f_{SW} = 800kHz**

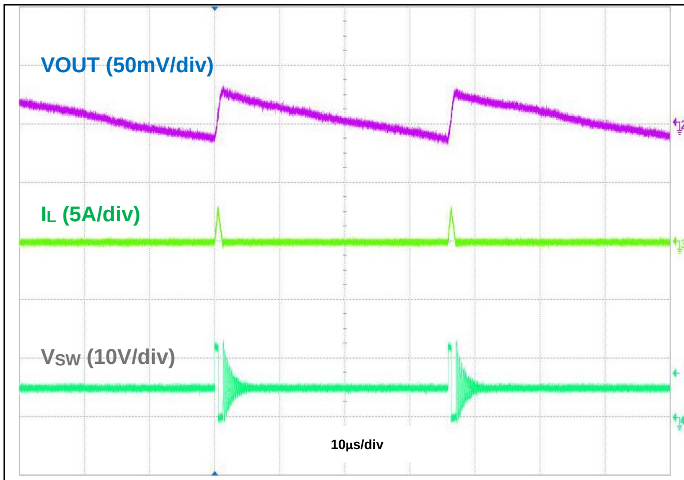

Figure 12. Output Voltage Ripple, IOUT = 50mA
VIN = 12V, VOUT = 5V USM f_{SW} = 800kHz

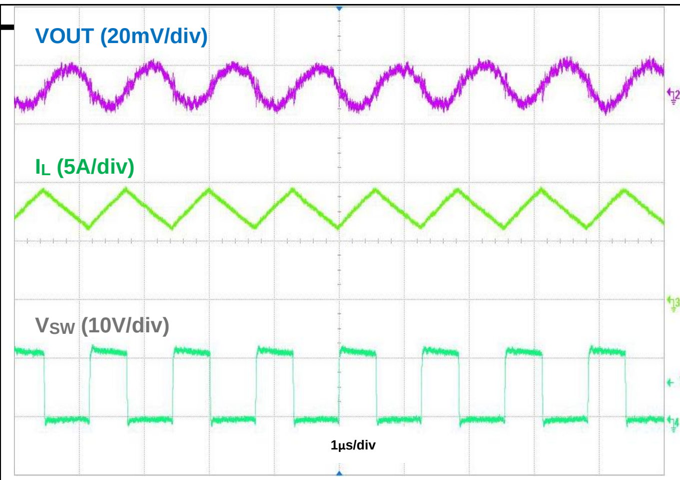

Figure 13. Output Voltage Ripple, IOUT = 8A
VIN = 12V, VOUT = 5V USM f_{SW} = 800kHz

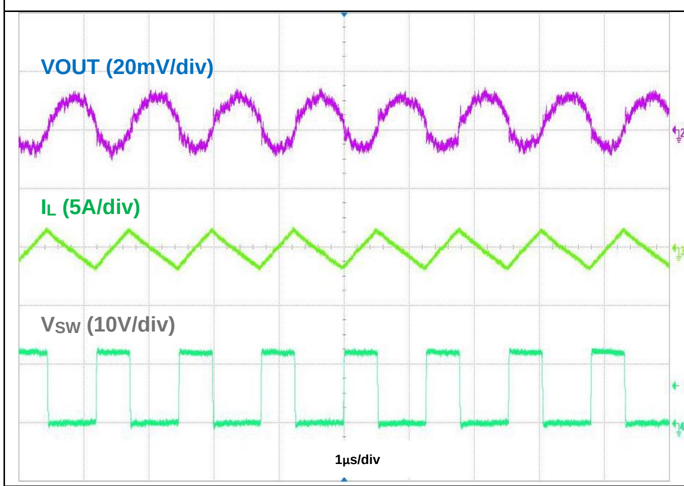

Figure 14. Output Voltage Ripple, IOUT = 50mA
VIN = 12V, VOUT = 5V PWM f_{SW} = 800kHz

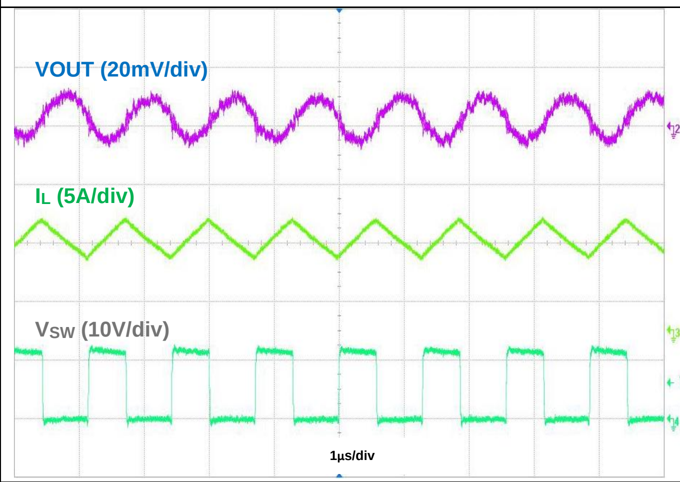

Figure 15. Output Voltage Ripple, IOUT = 8A
VIN = 12V, VOUT = 5V PWM f_{SW} = 800kHz

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