Switching Regulator Series

Step-Down DC/DC Converter BD9E300EFJ Evaluation Board

BD9E300EFJ-EVK-001

Description

BD9E300EFJ-EVK-001 Evaluation board delivers an output 5.0 volts from an input 7.2 to 33 volts using BD9E300EFJ, a synchronous rectification step-down DC/DC converter integrated circuit, with output current rating of maximum 2.5A. The output voltage can be set by changing the external parts of circuit and the loop-response characteristics also can be adjusted by the phase compensation circuit.

Performance specification (These are representative values, and it is not a guaranteed against the characteristics.)

V_{IN} = 24V, V_{OUT} = 5.0V, Unless otherwise specified.

Parameter	Min	Typ	Max	Units	Conditions
Input Voltage Range	7.0 (NOTE1)		36 (NOTE2)	V	
Output Voltage		5.0		V	R1=12kΩ, R2=3kΩ
Output Voltage Setting Range	V_{IN}×0.15 (NOTE3)		V_{IN}×0.7	V	
Output Current Range	0		2.5	A	
Loop Band Width		31.6		kHz	
Phase Margin		76.5		degrees	
Input Ripple Voltage		100		mVpp	I_O = 2.5A
Output Ripple Voltage		30		mVpp	I_O = 2.5A
Output Rising Time		3.5		ms	
Operating Frequency		1.0		MHz	
Maximum Efficiency		84.7		%	I_O = 0.9A

(NOTE1) When the output voltage is 5.0V, it is 7.2V by limiting ratio of the maximum duty.

(NOTE2) When the output voltage is 5.0V, it is 33V by limiting ratio of the minimum duty.

(NOTE3) However, (V_{IN}×0.15) ≥ 1.0V

Operation Procedures

1. Necessary equipments
   (1) DC power-supply of 7.2V to 33V/2.5A
   (2) Maximum 2.5A load
   (3) DC voltmeter

2. Connecting the equipments
   (1) DC power-supply presets to 24V and then the power output turns off.
   (2) The max. load should be set at 2.5A and over it will be disabled.
   (3) Check Jumper pin of SW1 is short, between intermediate-terminal and OFF-side terminal.
   (4) Connect positive-terminal of power-supply to VIN+terminal and negative-terminal to GND-terminal with a pair of wires.
   (5) Connect load's positive-terminal to VOUT+terminal and negative-terminal to GND-terminal with a pair of wires.
   (6) Connect positive-terminal of DC voltmeter 1 to TP1 and negative-terminal to TP2 for input-voltage measurement.
   (7) Connect positive-terminal of DC voltmeter 2 to TP3 and negative-terminal to TP4 for output-voltage measurement.
   (8) DC power-supply output is turned ON.
   (9) IC is enable (EN) by shorting Jumper-pin of SW1 between intermediate-terminal and ON-side terminal.
   (10) Check DC voltmeter 2 displays 5.0V.
   (11) The load is enabled.
   (12) Check at DC voltmeter 1 whether the voltage-drop (loss) is not caused by the wire's resistance.

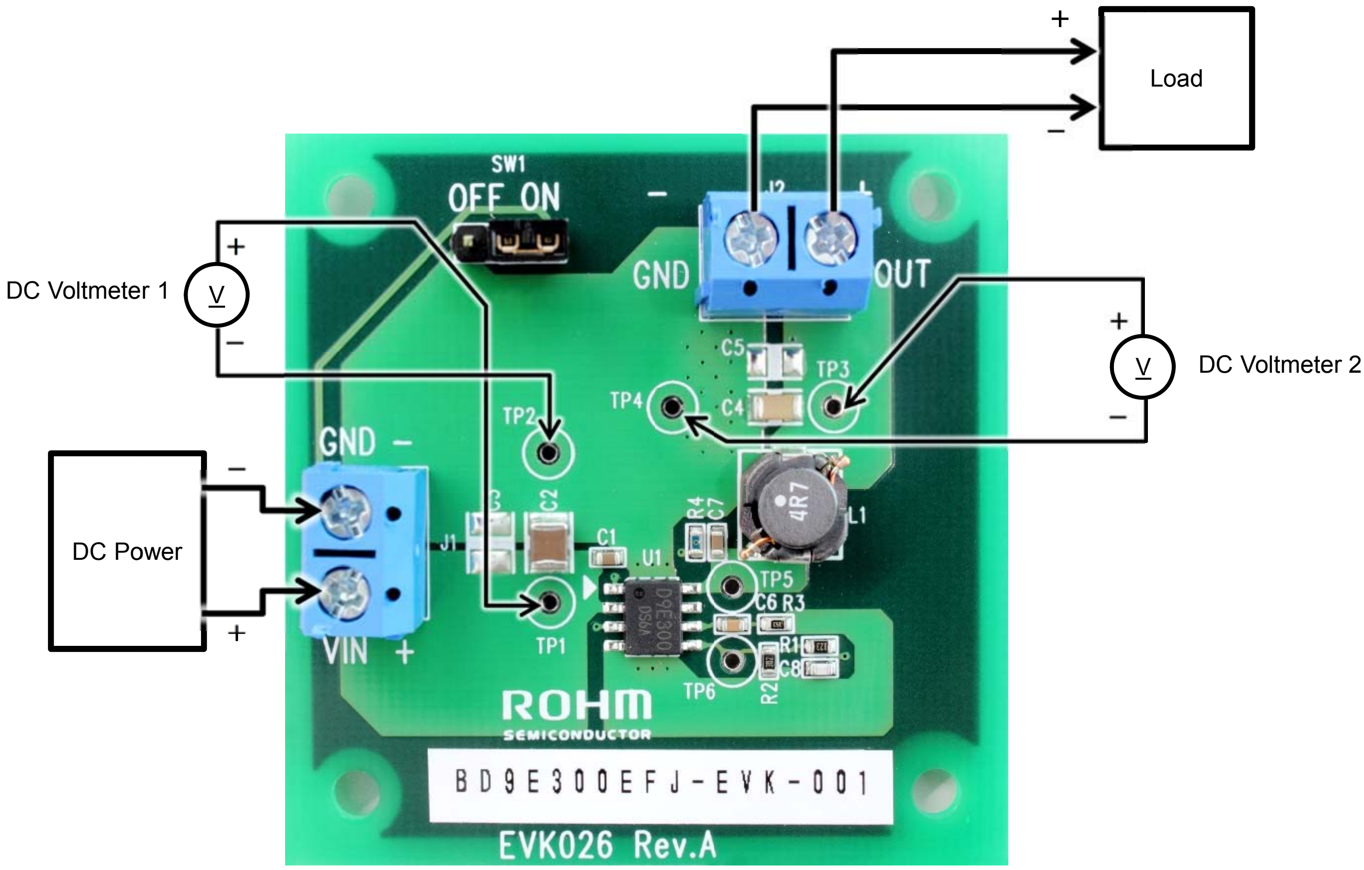

Figure 1. Connection Diagram

Enable-Pin

To minimize current consumption during standby-mode and normal operation, Enable-mode can be switched by controlling EN pin(3pin) of the IC. Standby-mode is enabled by shorting Jumper-pin of SW1 between intermediate-terminal and OFF-side terminal and normal-mode operation by shorting between intermediate-terminal and ON-side terminal.
It also can be swithed between standby-mode and normal-mode operation by removing Jumper-pin and controlling the voltage between EN and GND-terminal. Standby-mode is enabled when the voltage of EN is under 0.8V, and normal-mode operation when it is over 2.5V.

Cricuit Diagram

V_{IN} = 7.2V to 33V, V_{OUT} = 5.0V

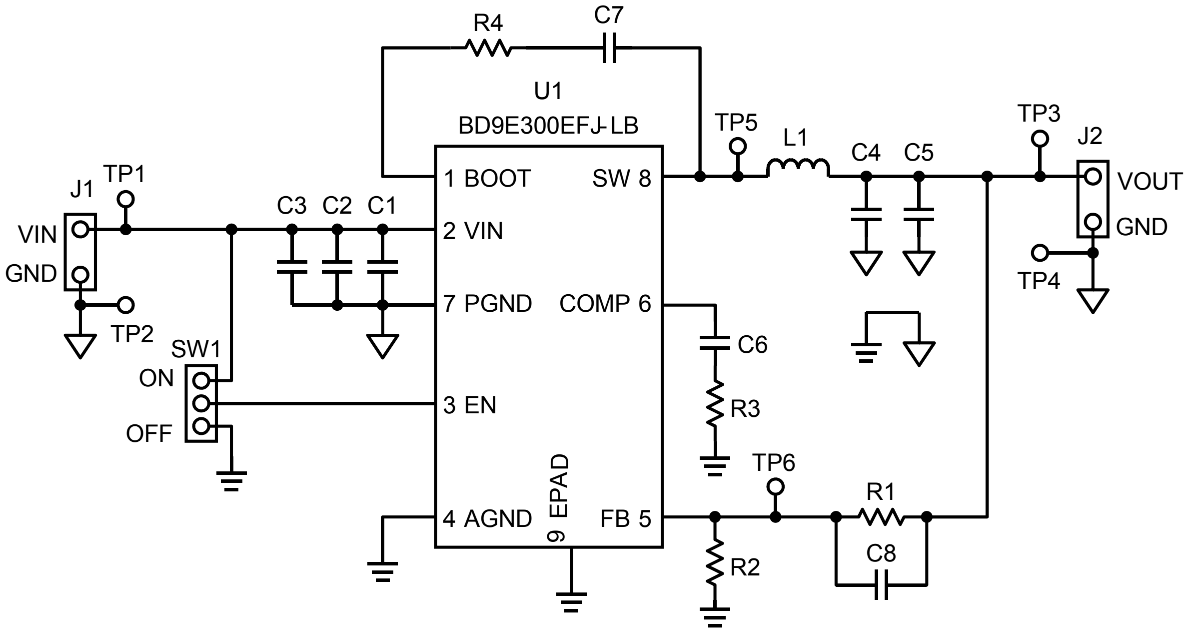

Figure 2. BD9E300EFJ-EVK-001 Circuit Diagram

Bill of Materials

Count	Reference Designator	Type	Value	Description	Manufacturer Part Number	Manufacturer	Configuration (mm)
2	C1, C7	Ceramic Capacitor	0.1µF	50V, B, ±20%	GRM188B31H104MA92	MURATA	1608
1	C2	Ceramic Capacitor	10µF	50V, B, ±10%	GRM32EB31H106KA12	MURATA	3225
0	C3	Ceramic Capacitor	-	Not installed	-	-	3225
1	C4	Ceramic Capacitor	22µF	10V, B, ±10%	GRM31CB31A226KE19	MURATA	3216
0	C5	Ceramic Capacitor	-	Not installed	-	-	3216
1	C6	Ceramic Capacitor	2200pF	50V, B, ±10%	GRM188B11H222KA01	MURATA	1608
1	C8	Ceramic Capacitor	100pF	50V, CH, ±5%	GRM1882C1H101JA01	MURATA	1608
1	L1	Inductor	4.7µH	±30%, DCR=26mΩmax, 4.1A	CLF7045T-4R7N	TDK	7269
1	R1	Resistor	12kΩ	1/10W, 50V, 1%	MCR03ERPF1202	ROHM	1608
1	R2	Resistor	3kΩ	1/10W, 50V, 1%	MCR03ERPF3001	ROHM	1608
1	R3	Resistor	15kΩ	1/10W, 50V, 1%	MCR03ERPF1502	ROHM	1608
1	R4	Resistor	0Ω	Jumper	MCR03ERPJ000	ROHM	1608
1	SW1	Pin header	-	2.54mm × 3 contacts	PH-1x03SG	USECONN	-
1	U1	IC	-	Buck DC/DC Converter	BD9E300EFJ-LB	ROHM	HTSOP-J8
2	J1, J2	Terminal Block	-	2 contacts, 15A, 14 to 22AWG	TB111-2-2-U-1-1	Alphaplus Connectors & Cables	-
1	-	Jumper	-	Jumper pin for SW1	MJ254-6BK	USECONN	-

Layout

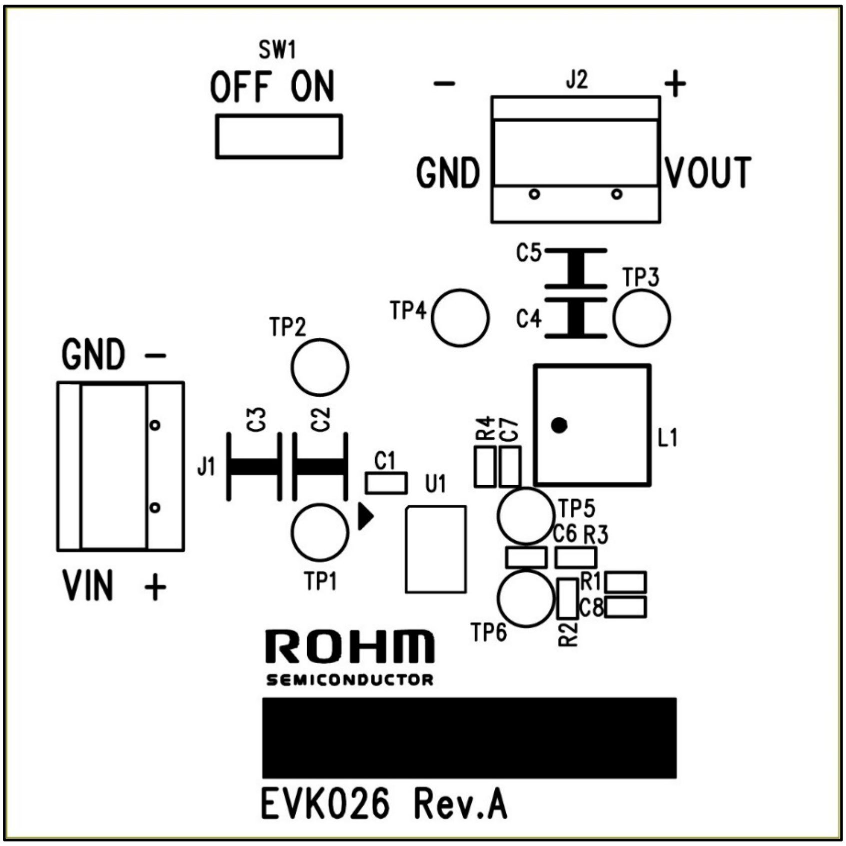

Figure 3. Top Silk Screen (Top view)

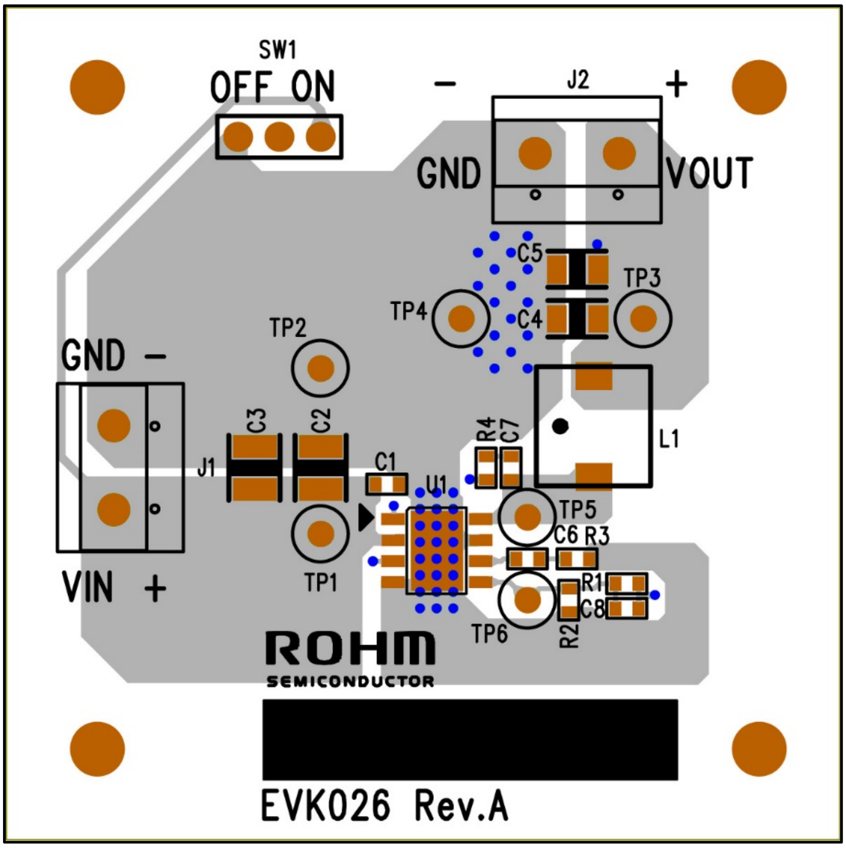

Figure 4. Top Silk Screen and Layout (Top view)

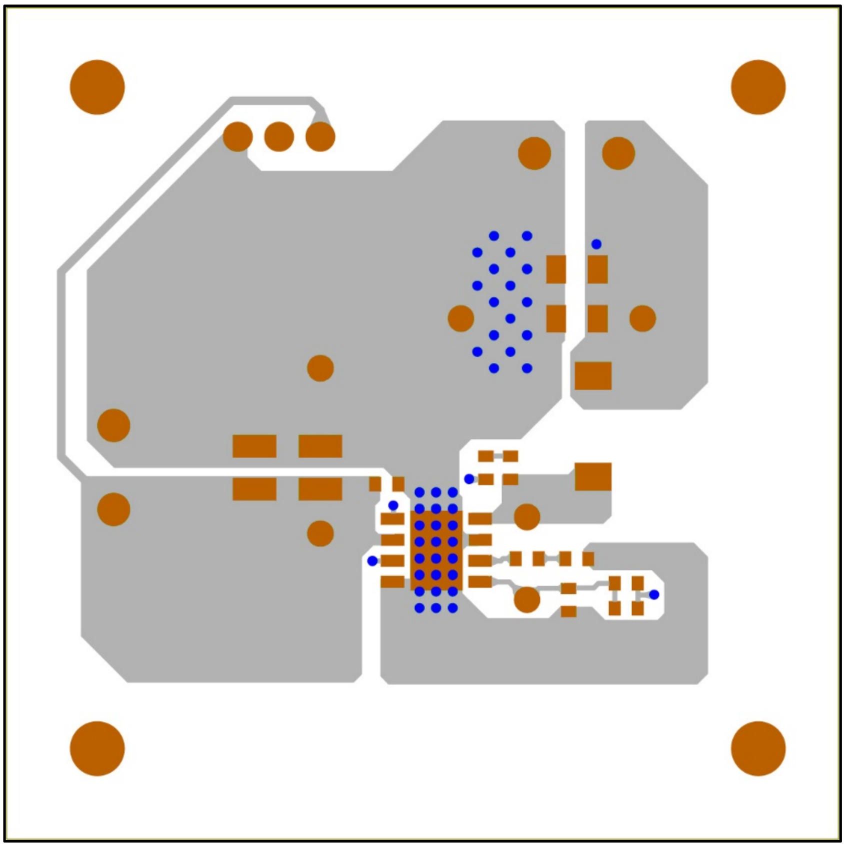

Figure 5. Top Side Layout (Top view)

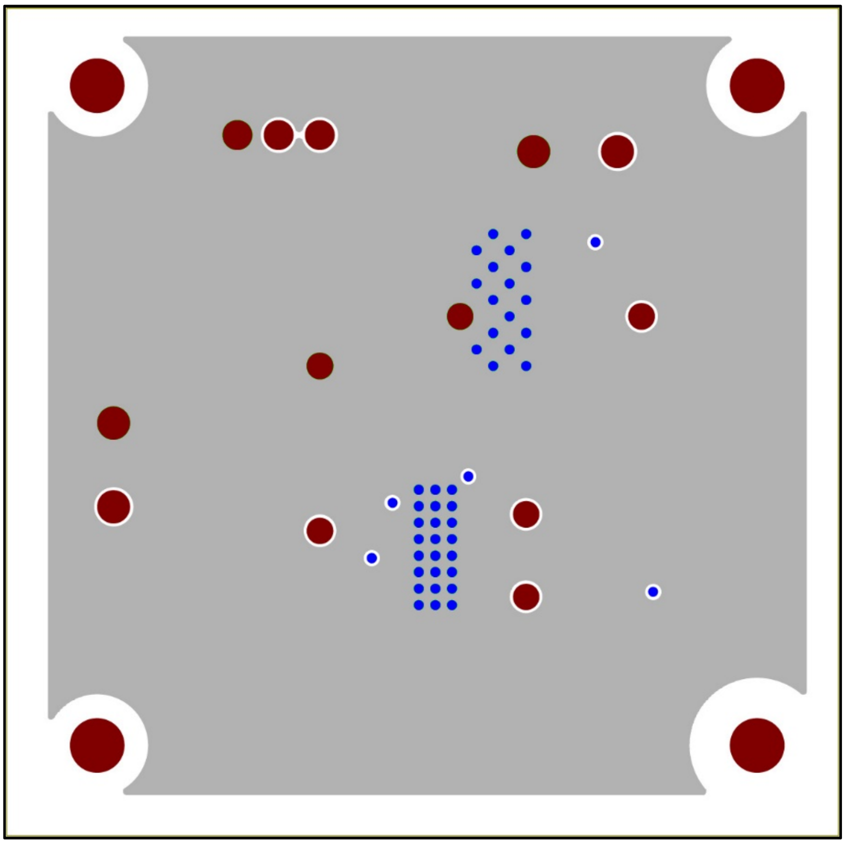

Figure 6. L2 Layout (Top view)

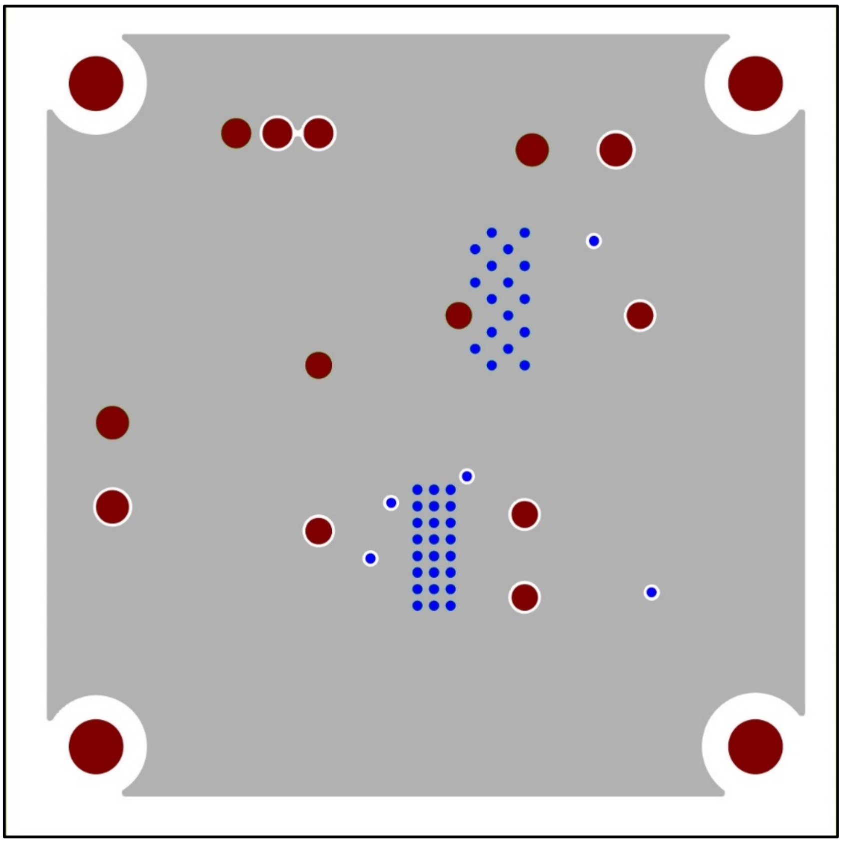

Figure 7. L3 Layout (Top view)

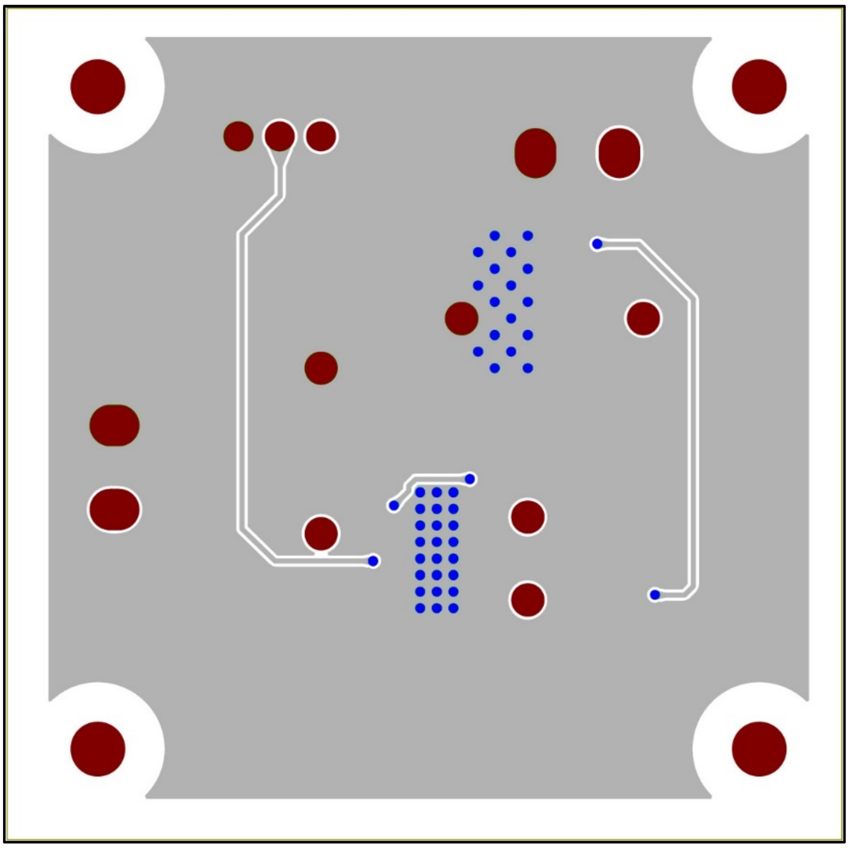

Figure 8. Bottom Side Layout (Top view)

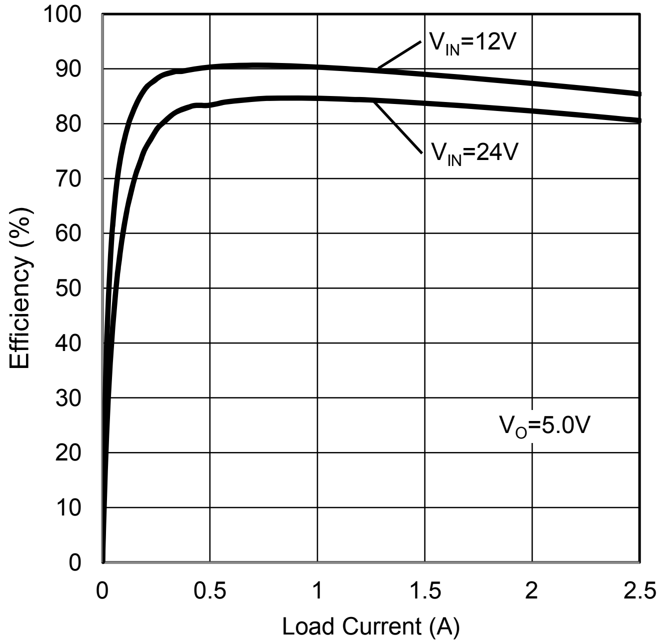

Figure 9. Efficiency vs Load Current

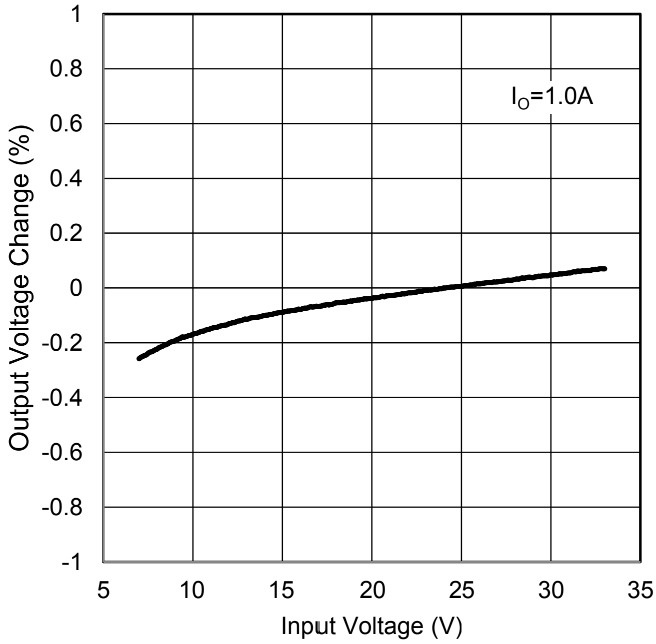

Figure 10. Line Regulation

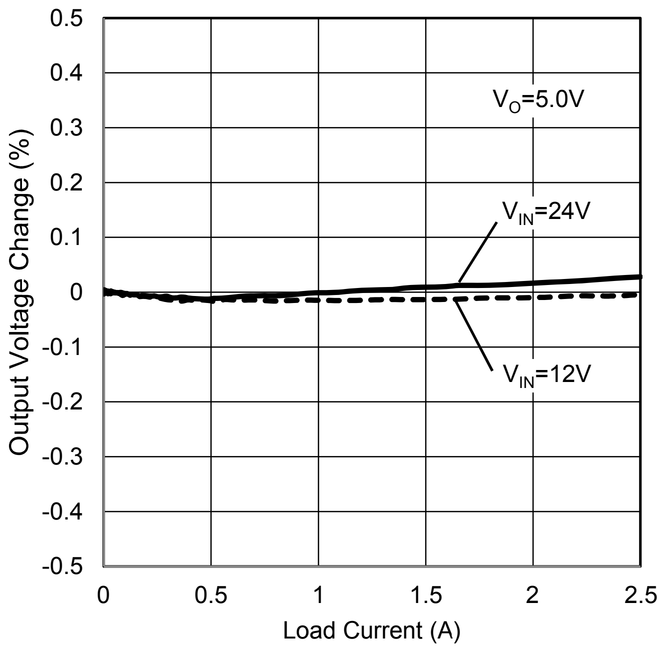

Figure 11. Load Regulation

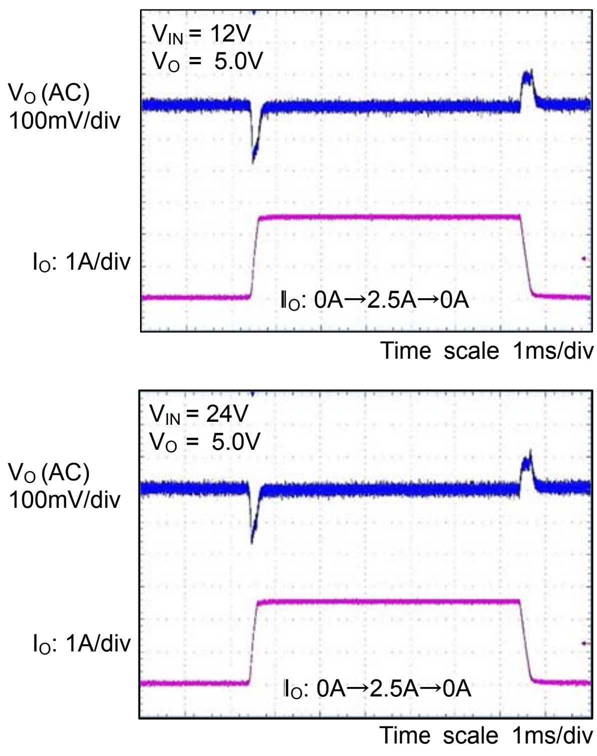

Figure 12. Load Transient Characteristics

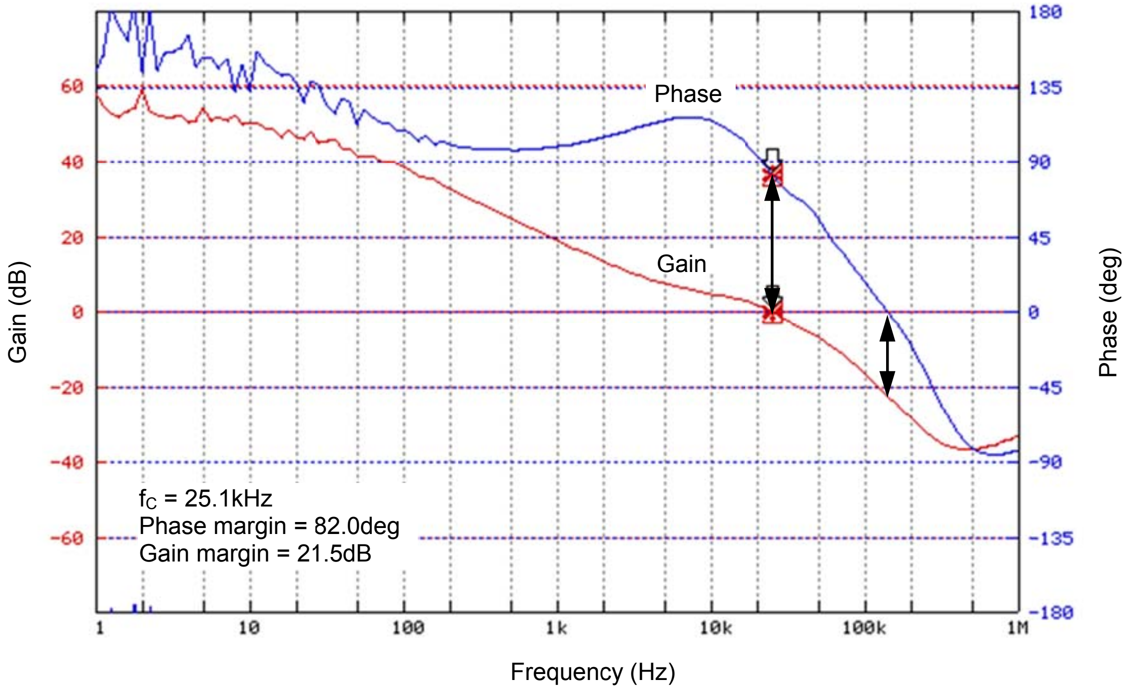

Figure 13. Loop Response V_{IN} = 12V, V_O = 5.0V, I_O = 2.5A

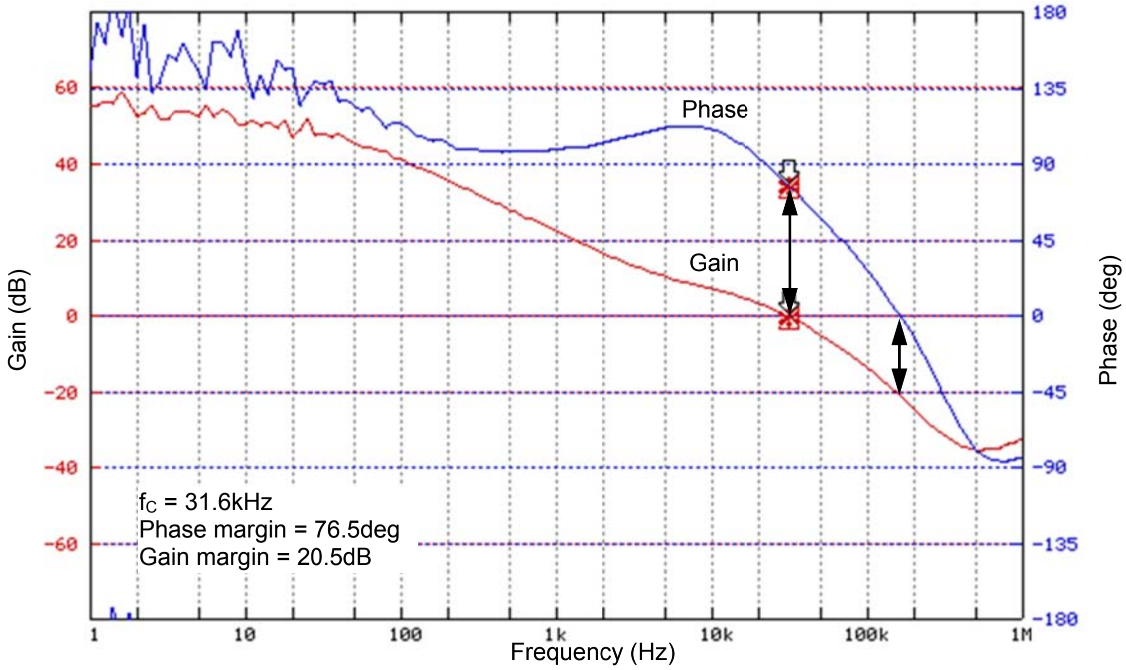

Figure 14. Loop Response V_{IN} = 24V, V_O = 5.0V, I_O = 2.5A

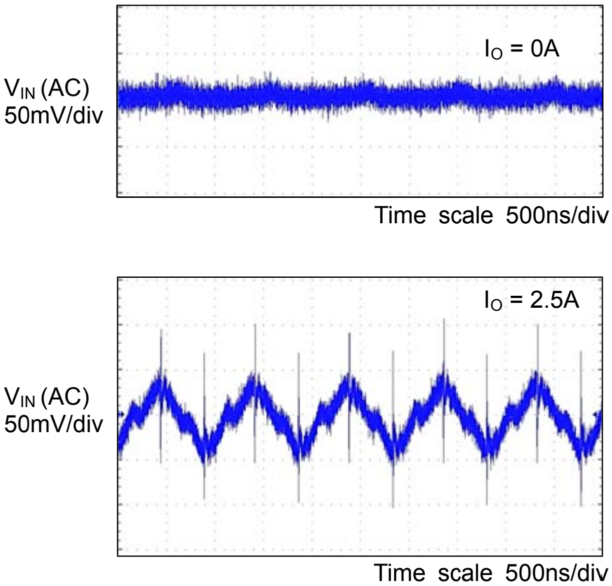

Figure 15. Input Voltage Ripple Wave
V_{IN} = 12V, V_O = 5.0V

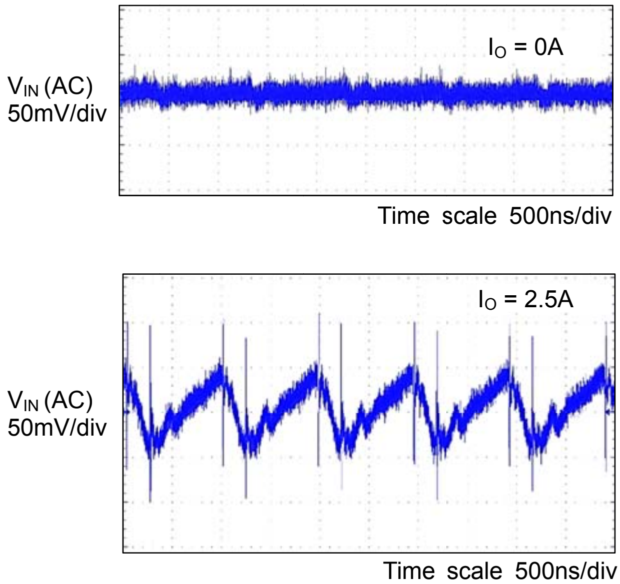

Figure 16. Input Voltage Ripple Wave
V_{IN} = 12V, V_O = 5.0V

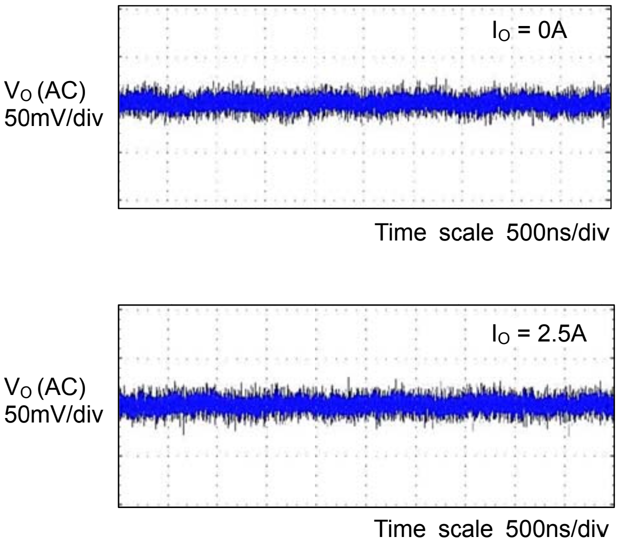

Figure 17. Output Voltage Ripple Wave
V_{IN} = 12V, V_O = 5.0V

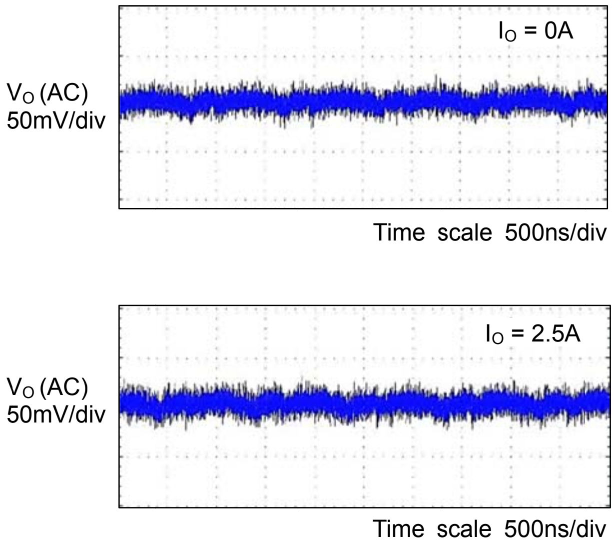

Figure 18. Output Voltage Ripple Wave
V_{IN} = 24V, V_O = 5.0V

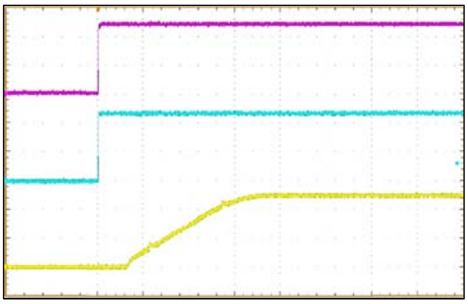

Figure 19. Start-up EN = V_{IN}
V_{IN} = 12V, V_O = 5.0V, I_O = 0A

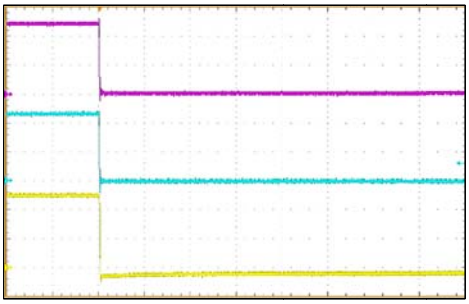

Figure 20. Power-down EN = V_{IN}
V_{IN} = 12V, V_O = 5.0V, I_O = 0A

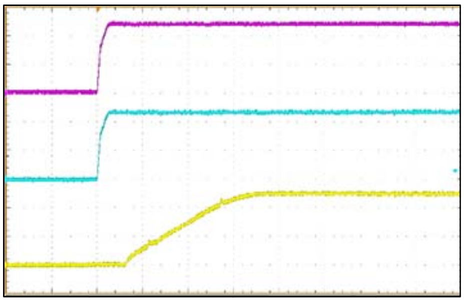

Figure 21. Start-up EN = V_{IN}
V_{IN} = 24V, V_O = 5.0V, I_O = 0A

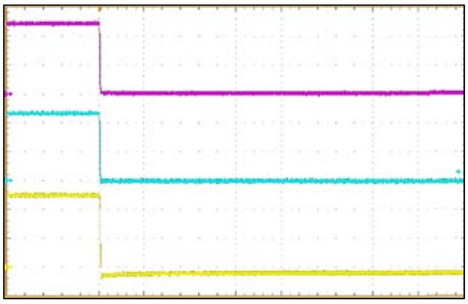

Figure 22. Power-down EN = V_{IN}
V_{IN} = 24V, V_O = 5.0V, I_O = 0A

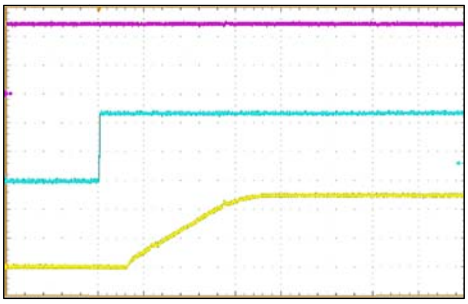

Figure 23. Start-up by EN
V_{IN} = 12V, V_O = 5.0V, I_O = 0A

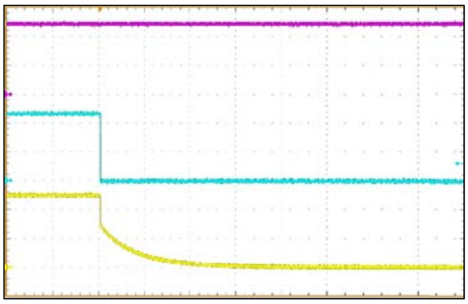

Figure 24. Power-down by EN
V_{IN} = 12V, V_O = 5.0V, I_O = 0A

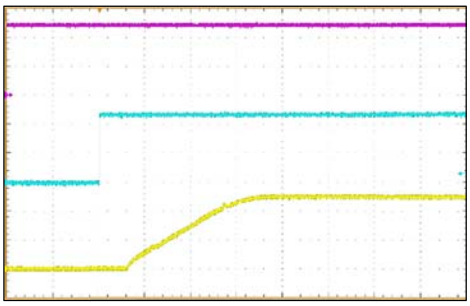

Figure 25. Start-up by EN
V_{IN} = 24V, V_O = 5.0V, I_O = 0A

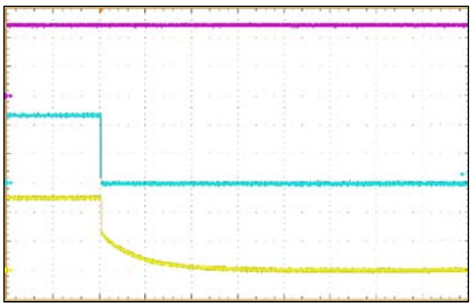

Figure 26. Power-down by EN
V_{IN} = 24V, V_O = 5.0V, I_O = 0A

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