

Switching Regulator Series

# Isolated DC/DC Converter

## BD7F100HFN Evaluation Board

BD7F100HFN-EVK-001

### General Description

BD7F100HFN-EVK-001 Evaluation Board outputs 5.0V voltage from 24V input using IC BD7F100HFN, an isolated DC/DC converter. It supplies 800mA output current at maximum.

**Performance specifications** (The values listed here are representative values, which does not assure the characteristics.)

Unless otherwise is specified:  $V_{IN} = 24V$ ,  $V_{OUT} = 5.0V$

Parameter	Min	Typ	Max	Units	Conditions
Input voltage range		24		V	
Output voltage		5.0		V	R4=3.9k $\Omega$ , R5=80.6k $\Omega$
Output current range	13.8		800	mA	Maximum Output Power:4W
Input ripple voltage		80		mVpp	$I_o = 500mA$
Output ripple voltage		80		mVpp	$I_o = 500mA$
Output rise time		6		ms	
Operating frequency		400		kHz	
Maximum efficiency		76.7		%	$I_o = 800mA$

Operation Procedures

1. Required equipment

- (1) DC power supply for 24V, 0.5A
- (2) 800mA load at maximum
- (3) DC voltmeter

2. Connect the equipment.

- (1) Preset DC voltage to 24V and power supply output to OFF.
- (2) Set load below 800mA to disable load.
- (3) Connect the power supply positive terminal to VIN + terminal, and the negative terminal to GND - terminal, using a pair of wires.
- (4) Connect the load positive terminal to VOUT + terminal, and the negative terminal to GND - terminal, using a pair of wires.
- (5) To measure input voltage, connect the DC voltmeter 1 positive terminal to TP1, and the negative terminal to TP2.
- (6) To measure output voltage, connect the DC voltmeter 2 positive terminal to TP4, and the negative terminal to TP3.
- (7) Turn ON DC voltage output.
- (8) Check that the DC voltmeter 2 reads 5.0V.
- (9) Enable load.

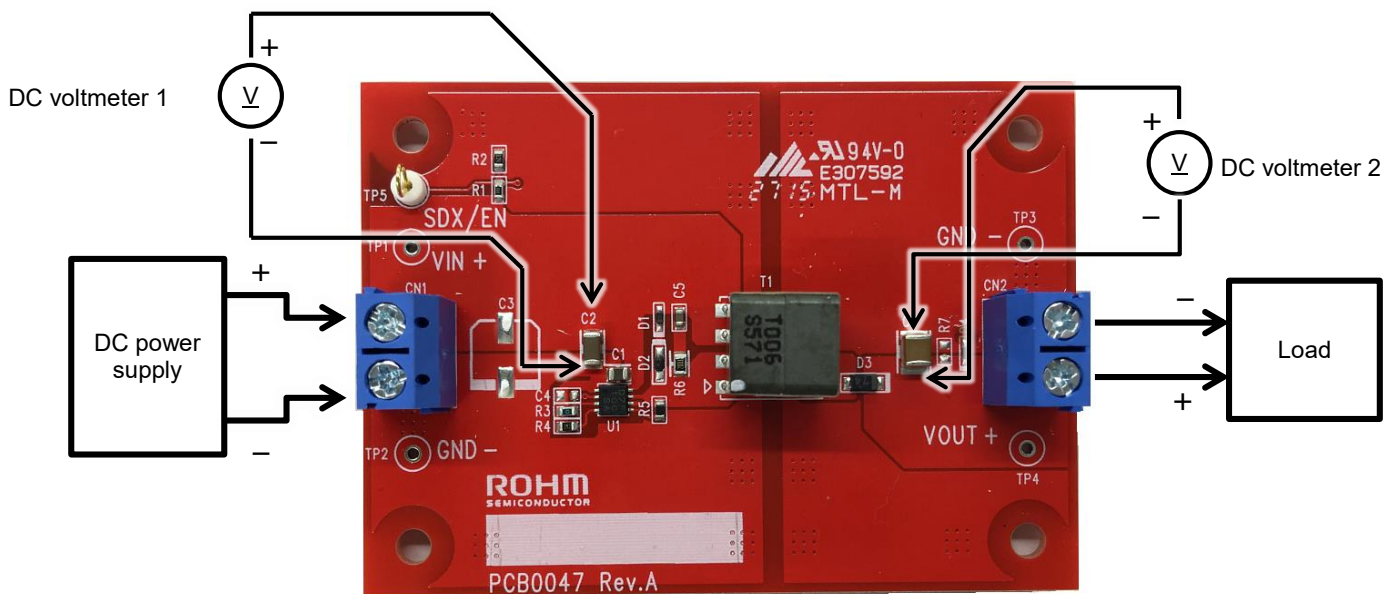


Figure 1. Connection Diagram

**Setting Enable Voltage**

As an IC operating condition, it is required to operate the converter with duty of 50% or less when the input power supply is either ON or OFF.

If duty exceeds 50%, a phenomenon such as overshoot or overboosting happens. To avoid this, the condition of following formula must be satisfied:

$$V_{DISABLE} > \frac{N_p}{N_s} \times (V_{OUT} + V_f)$$

$V_{DISABLE}$ : Stopping voltage

$N_p$ : Number of turns of transformer on the primary side

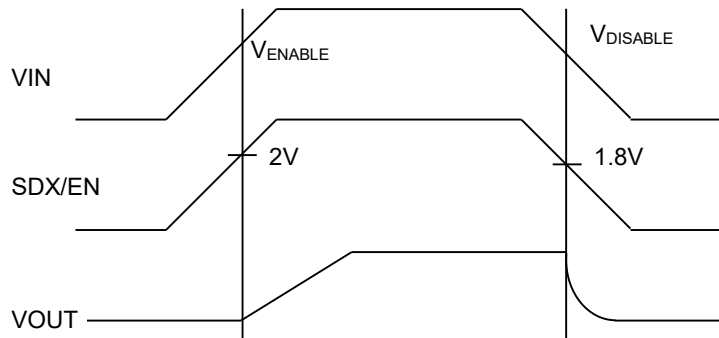
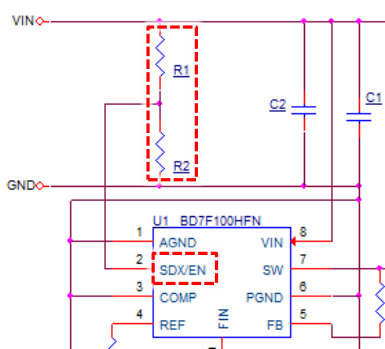
$N_s$ : Number of turns of transformer on the secondary side

$V_{out}$ : Output voltage

$V_f$ : Forward voltage of output diode on the secondary side

To satisfy the input OFF voltage condition, put resistors R1 and R2 between the input and ground for the division and connect SDX/EN terminal. This will enable start/stop with arbitrary input voltage.

The threshold at the time of SDX/EN terminal rise is set to 2.0V (Typ). At fall time, 0.2V (Typ) hysteresis voltage is applied.



Starting voltage can be set using the following formula:

$$V_{ENABLE} = \frac{2.0V \times (R1 + R2)}{R2}$$

Stopping voltage can be set using the following formula:

$$V_{DISABLE} = \frac{1.8V \times (R1 + R2)}{R2}$$

\* Example

24V input: Connect R1=1MΩ and R2=120kΩ.

Starting voltage: 18.7V (Typ)

Stopping voltage: 16.9V (Typ)

Circuit Diagram

$V_{IN} = 24V, V_{OUT} = 5.0V$

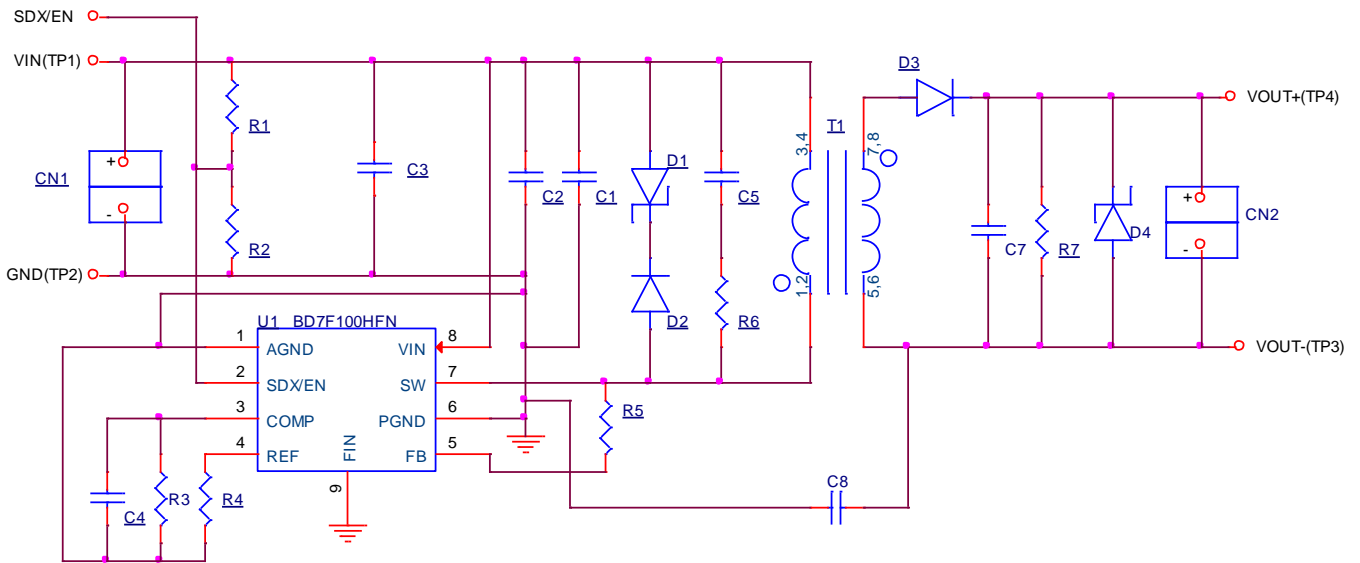


Figure 2. BD7F100HFN-EVK-001 Circuit Diagram

Parts List

No.	Value	Description	Size	Part Number / Series	Manufacture
C1	1μF	Capacitor, Chip, 50V, X7R	2012	GRM21BR71H105KA12	MURATA
C2	4.7μF	Capacitor, Chip, 50V, X7R	3216	GRM31CR71H475KA12	MURATA
C3	-	-	-	-	-
C4	-	-	-	-	-
C5	1000pF	Capacitor, Chip, 50V, CH	1608	GRM1882C1H102JA01	MURATA
C6	-	-	-	-	-
C7	47μF	Capacitor, Chip, 10V, X7R	3225	GRM32ER71A476KE15	MURATA
C8	-	-	-	-	-
D1	EDZV20B	Diode, Zener	1608	EDZV20B	ROHM
D2	RB160SS-40	Diode, Schottky	2512	RB160SS-40	ROHM
D3	RB160M-40	Diode, Schottky	3516	RB160M-40	ROHM
D4	VDZ6.2B	Diode, Zener	1406	VDZ6.2B	ROHM
R1	1MΩ	Resistor, Chip, 1/10W, 1%	1608	MCR03EZPF1004	ROHM
R2	120kΩ	Resistor, Chip, 1/10W, 1%	1608	MCR03EZPF1203	ROHM
R3	0Ω	Resistor, Chip, 1/10W, 1%	1608	MCR03EZPJ000	ROHM
R4	3.9kΩ	Resistor, Chip, 1/10W, 1%	1608	MCR03EZPF3901	ROHM
R5	80.6kΩ	Resistor, Chip, 1/10W, 1%	1608	MCR03EZPF8062	ROHM
R6	2kΩ	Resistor, Chip, 1/8W, 1%	2012	MCR10EZH2001	ROHM
R7	1kΩ	Resistor, Chip, 1/10W, 1%	1608	MCR03EZPF1001	ROHM
T1	63μH	Transformer, Np:Ns=3:1, ±20%	10.0 x 10.0 x 11.5mm	CEP911B-2405051R	sumida
U1	BD7F100HFN	I.C. BD7F100HFN	HSO8	BD7F100HFN	ROHM

PCB Layout

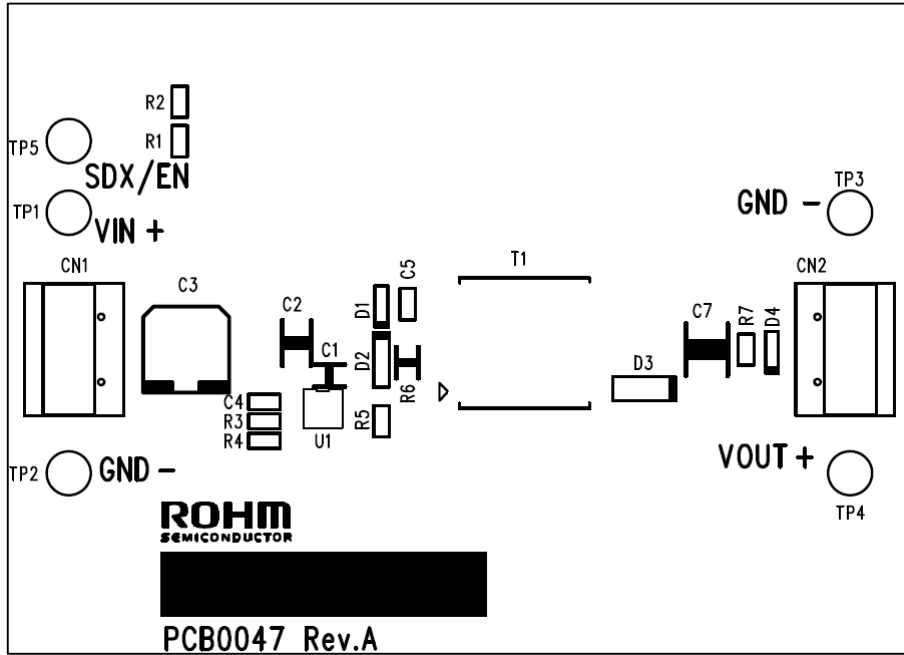


Figure 3. Top Silk Screen (Top view)

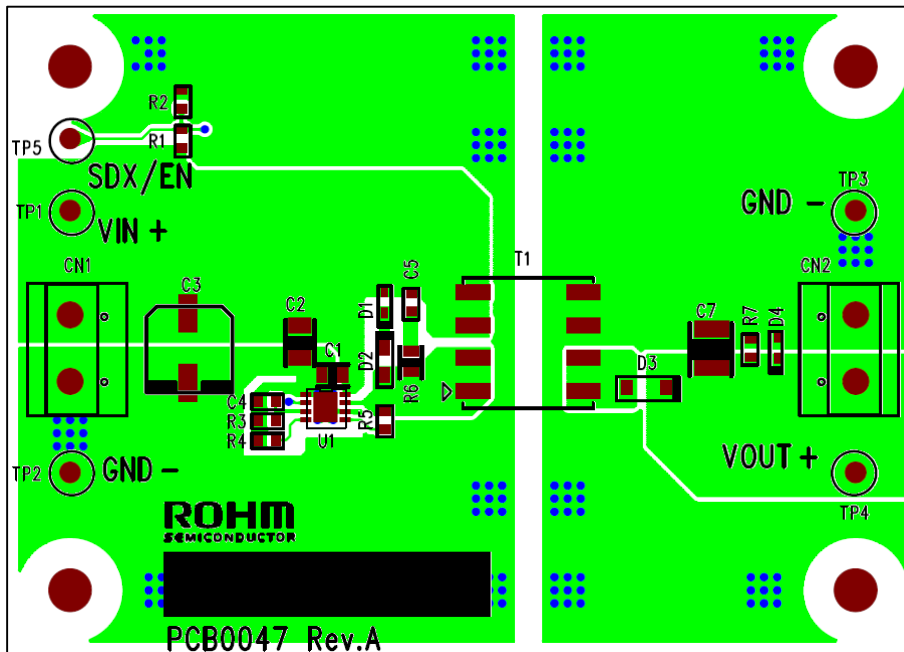


Figure 4. Top Silk Screen and Layout (Top view)

PCB Layout

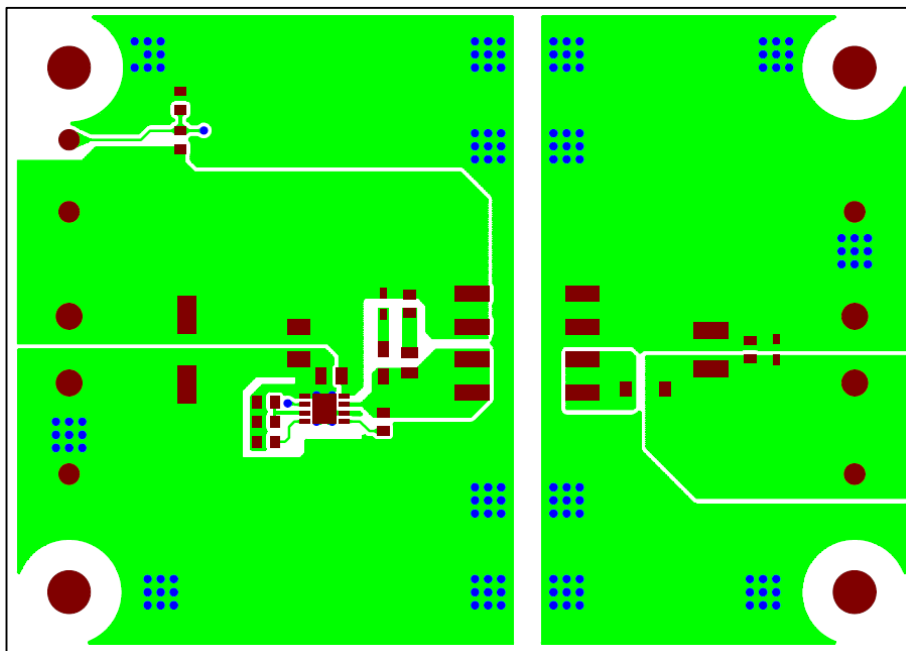


Figure 5. Top Layout (Top view)

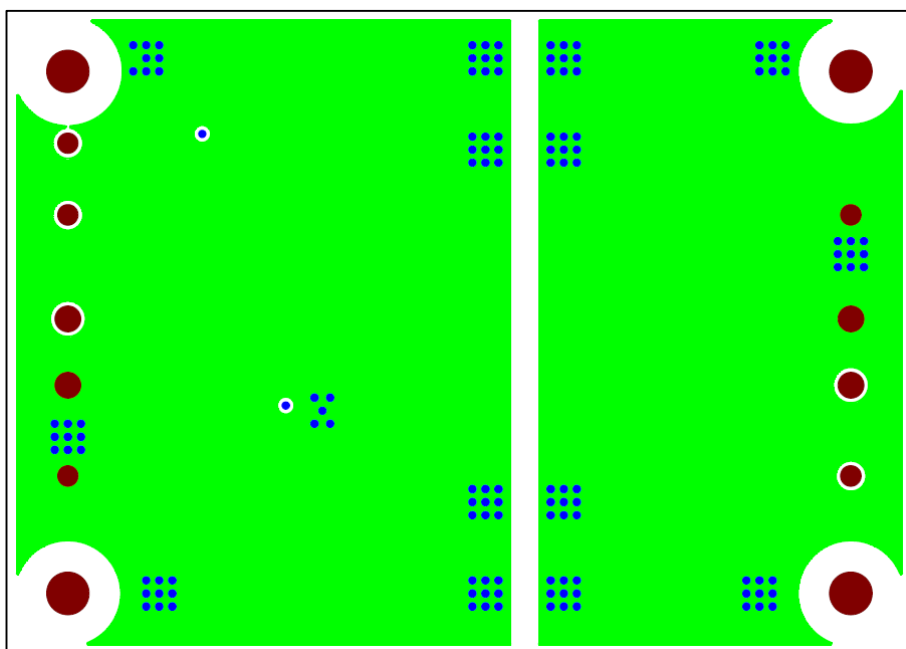


Figure 6. L2 Layout (Top view)

PCB Layout

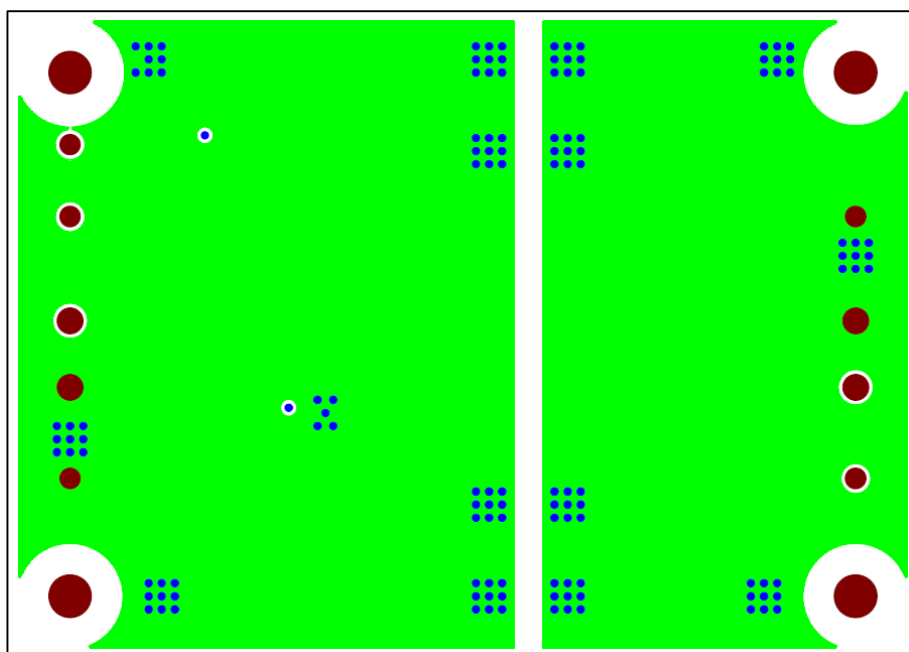


Figure 7. L3 Layout (Top view)

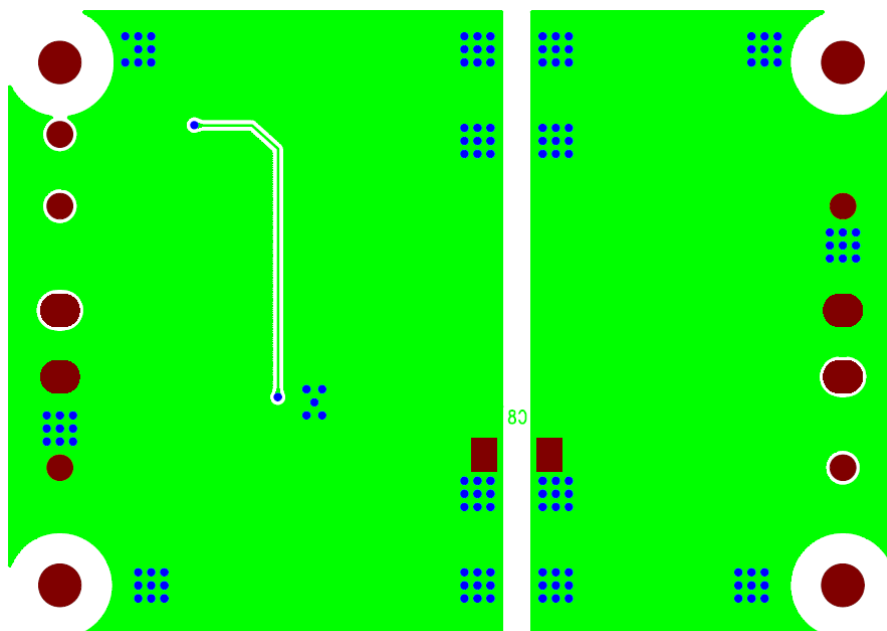


Figure 8. Bottom Layout (Top view)

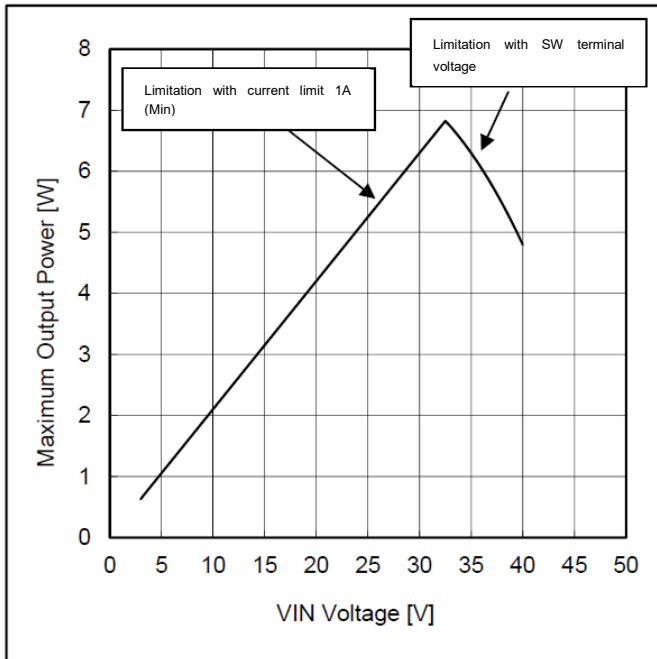


Figure 9. Maximum Output Power

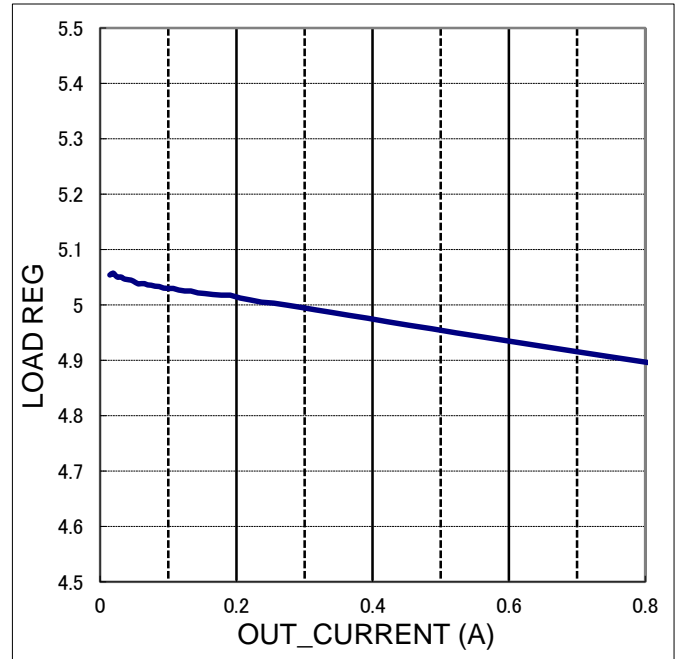


Figure 10. Load Regulation

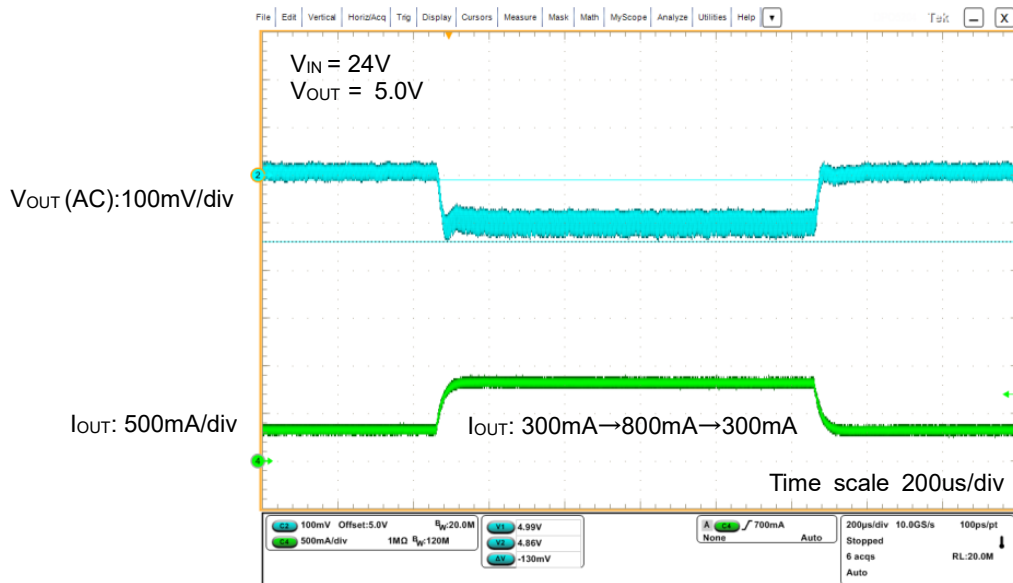


Figure 11. Load Transient Characteristics



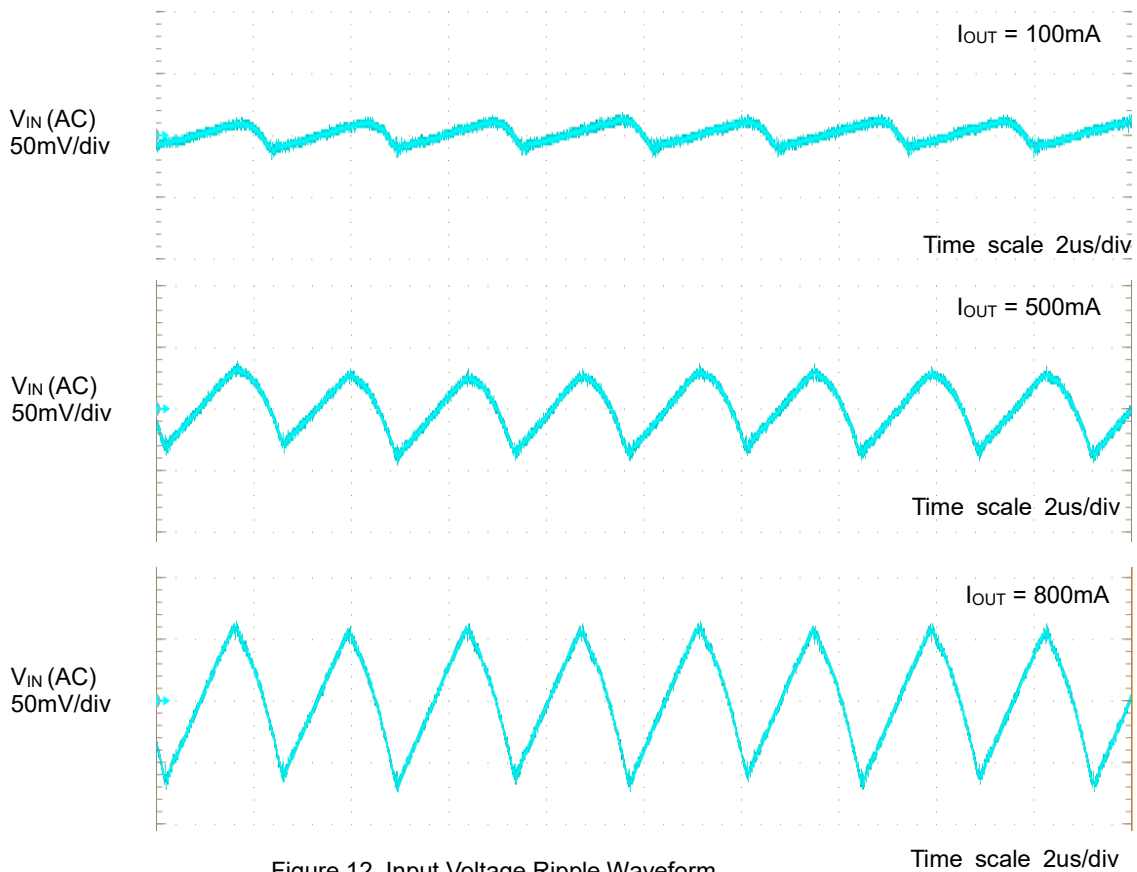


Figure 12. Input Voltage Ripple Waveform  
 $V_{IN} = 24\text{V}$ ,  $V_O = 5.0\text{V}$

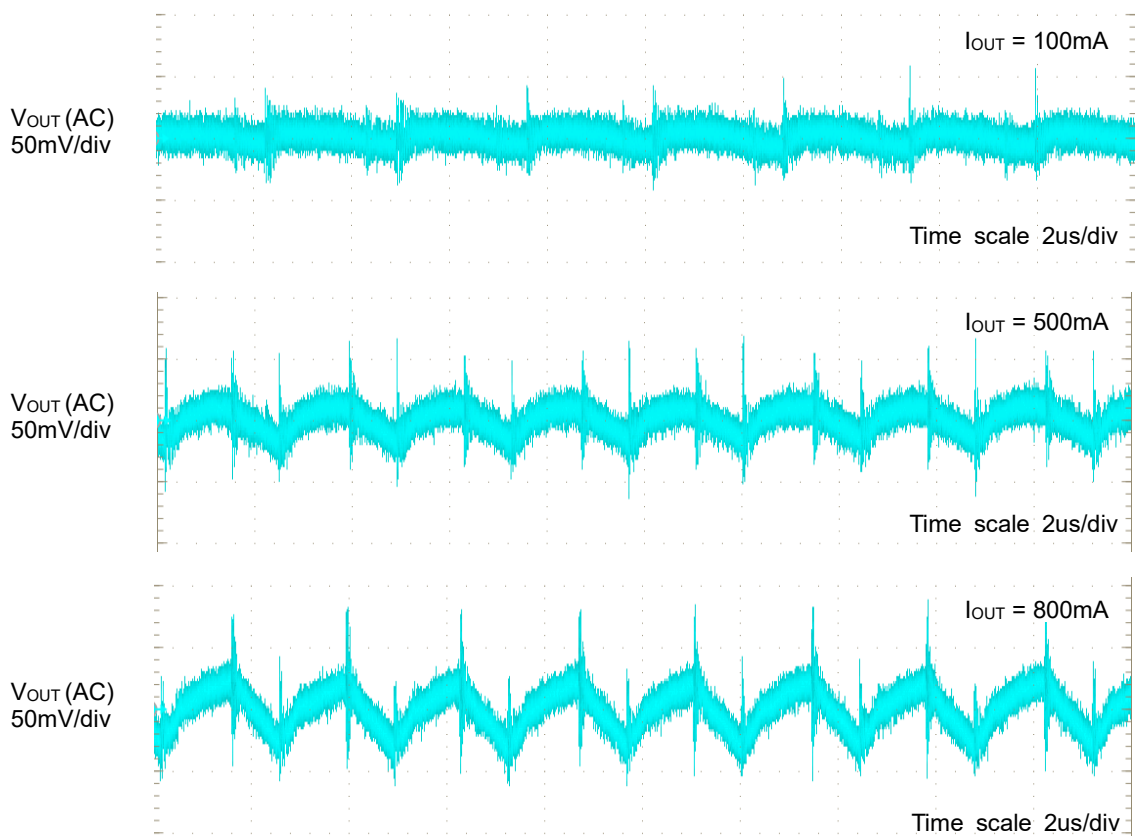


Figure 13. Output Voltage Ripple Waveform  
 $V_{IN} = 24\text{V}$ ,  $V_{OUT} = 5.0\text{V}$

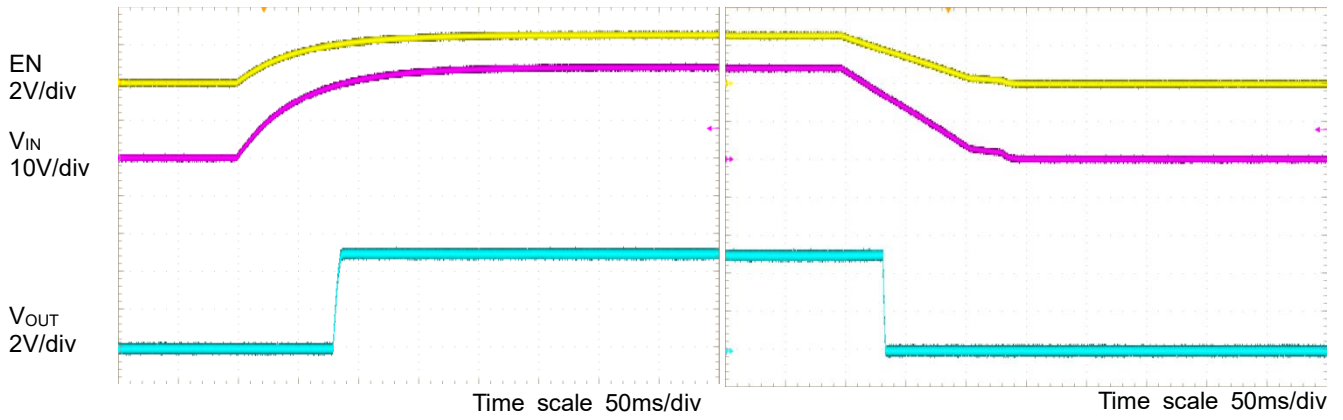


Figure 14. Startup  
 $V_{IN} = 24V, V_{OUT} = 5.0V, I_{OUT} = 100mA$

Figure 15. Power Down  
 $V_{IN} = 24V, V_{OUT} = 5.0V, I_{OUT} = 100mA$

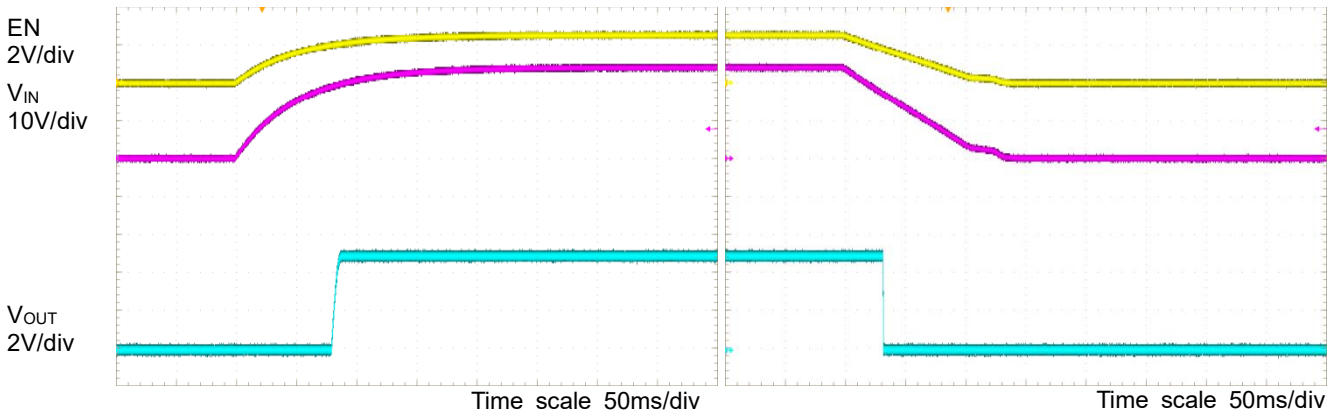


Figure 16. Startup  
 $V_{IN} = 24V, V_{OUT} = 5.0V, I_{OUT} = 500mA$

Figure 17. Power Down  
 $V_{IN} = 24V, V_{OUT} = 5.0V, I_{OUT} = 500mA$

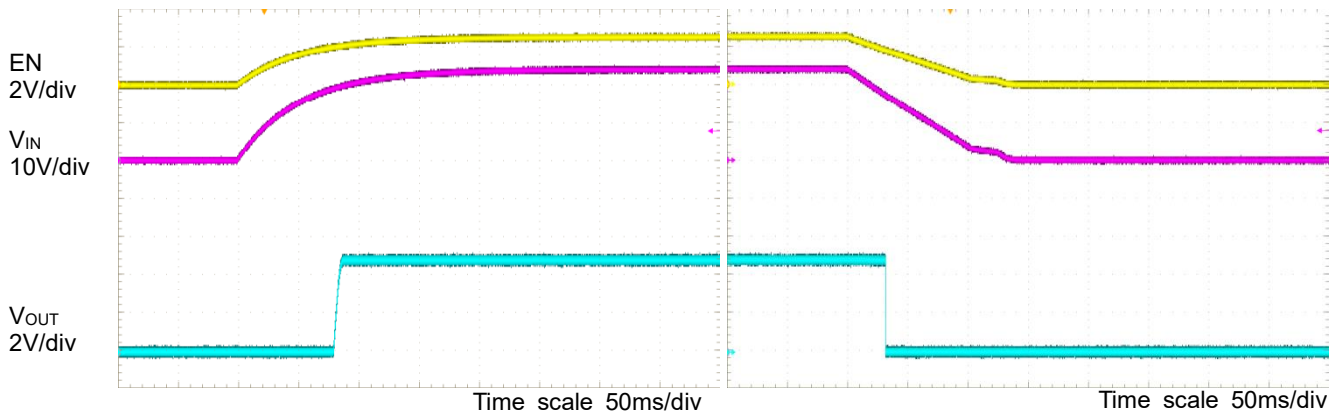


Figure 18. Startup  
 $V_{IN} = 24V, V_{OUT} = 5.0V, I_{OUT} = 800mA$

Figure 19. Power Down  
 $V_{IN} = 24V, V_{OUT} = 5.0V, I_{OUT} = 800mA$

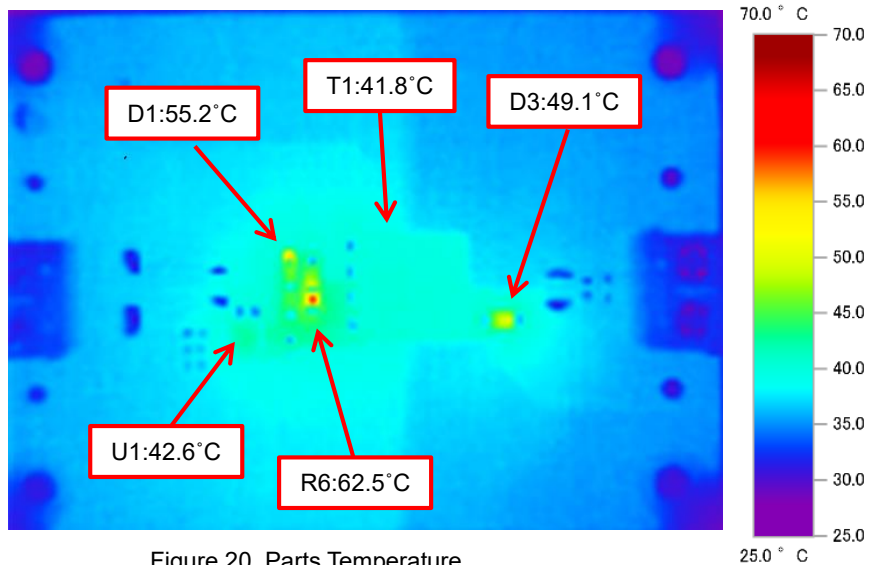
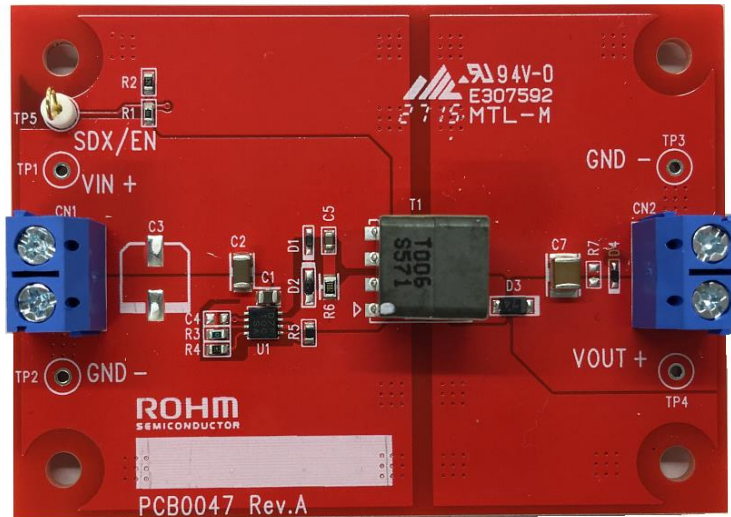


Figure 20. Parts Temperature  
 $V_{IN} = 24V$ ,  $V_O = 5.0V$ ,  $I_O = 800mA$

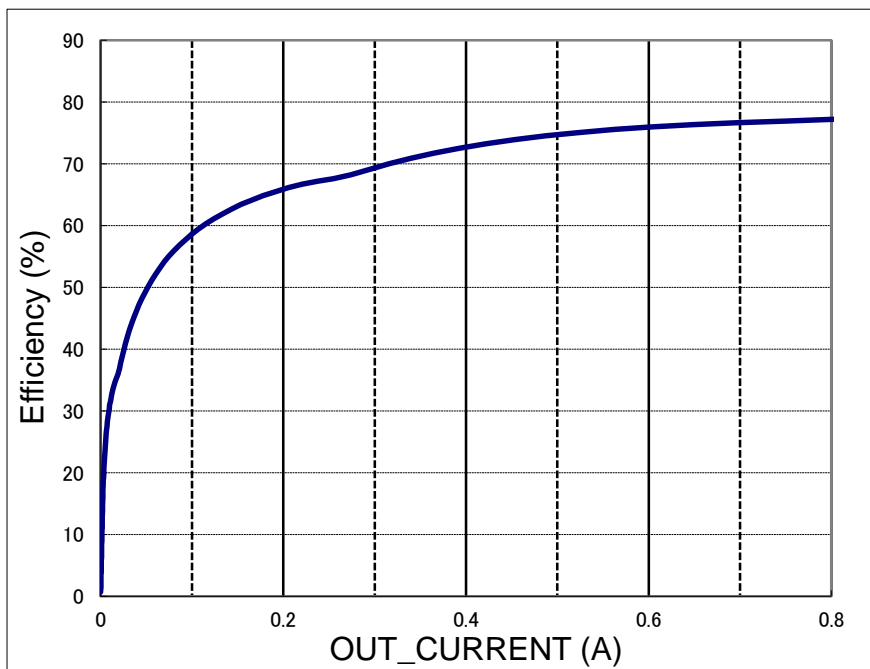


Figure 21. Efficiency  
 $V_{IN} = 24V$ ,  $V_O = 5.0V$

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