Evaluation Board Manual

RTKP6815xDE00000BC, RTKP6815xDE00010BC

RRP6815x Half-Bridge Driver Evaluation Boards with GaN/MOSFET in Buck System

Description

The RTKP6815xDE00000BC and RTKP6815xDE00010BC evaluation boards facilitate a rapid and thorough evaluation of the RRP6815x family devices (RRP68150, RRP68151). These half-bridge drivers provide 2A source and 5.3 A sink gate-drive capability. The boards effectively drive the GaN FETs (RTKP6815xDE00000BC) or silicon FETs (RTKP6815xDE00010BC) in a buck system configuration.

Each evaluation board integrates two GaN FETs or two logic level N-channel MOSFETs along with an inductor-capacitor (LC) filter, thereby supporting full system-level assessment under realistic operating conditions.

The RRP6815x half-bridge drivers are available in two compact package options:

- 12-ball WLCSP (2mm×2mm)
- 14-lead FCQFN (3mm×3mm) with wettable flanks

The family includes two variants:

- RRP68150 – with anti-shoot-through protection
- RRP68151 – without anti-shoot-through protection

For evaluation purposes:

- RTKP6815xDE00000BC integrates the WLCSP package with two GaN FETs
- RTKP6815xDE00010BC combines the QFN package with two MOSFETs.

This product differentiation provides tailored solutions to meet diverse application requirements, enabling flexibility across design scenarios.

Features

- 2A source and 5.3A sink driver for GaN/MOSFET
- Accept 3.3V/5V logic level PWM inputs
- Fast propagation delay (19/17ns typical)
- Excellent propagation delay matching (1.5ns typ.)
- 4.5ns typical rise time, 2.7ns typical fall time with 1nF Load
- Separately adjustable turn-on and turn-off speed
- Anti-shoot-through protection (RRP68150)

Specifications

The following input and output parameters are based on evaluation tests. See the specifications and check the recommended test conditions in Table 1 for more details.

Parameter	Rating
VDD Voltage	5V
Input Voltage	Up to 80V[1]
Input Current	Up to 5A
PWM Switching Frequency	Up to 1.5MHz[1]
PWM Input Voltage	3.3V/5V
Output Voltage	Up to 72V
Output Current	Up to 5A[1]

1. Trade-offs are required among high input voltage, high output current, and high switching frequency. During testing, monitor the temperatures of the RRP6815x, inductor, and FETs to ensure all components operate within the limits specified in their datasheets.

Caution: High voltage is present during operation of the evaluation board. Observe safety precautions.

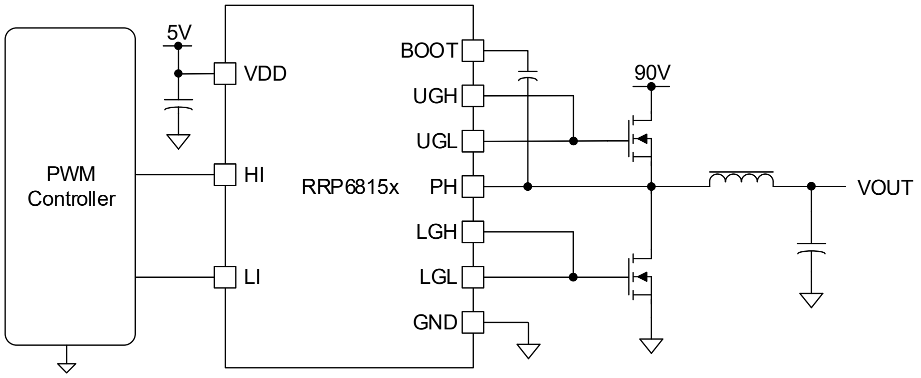

Figure 1. RRP6815x Typical Application Block Diagram

Contents

1. Functional Description

The RRP6815x evaluation boards (RTKP6815xDE00000BC, RTKP6815xDE00010BC) evaluate a buck system with either two GaN FETs or two logic level N-channel MOSFETs. The RRP6815x half-bridge drivers are provided in 12-ball WLCSP (2mm×2mm) and 14-lead FCQFN (3mm×3mm) packages. This series of evaluation boards operates with a 5V DC supply and is specifically optimized for assessing open-loop synchronous buck DC/DC converter performance, where the output voltage is regulated by adjusting the duty cycle of the PWM input signals.

1.1 Operating Range and Recommended Test Condition

The RRP6815x evaluation boards are configured for 80V half-bridge applications, with a 5V supply provided to bias the VDD of the RRP6815x IC. While the bootstrap and PH voltage ratings of the RRP6815x are much higher, transient voltages at the switching nodes must be carefully monitored in applications exceeding 80V on the half-bridge to ensure compliance with the absolute maximum ratings of the drivers.

As the board operates within a buck topology, adjust the V_{IN} (V_{BUS}) and LOAD settings according to V_{OUT}, I_{OUT}, switching frequency, and PWM duty cycle. The LC filter inductance and capacitance values are selected based on a 500kHz switching frequency for evaluation purposes; these components can be replaced with alternative values if a different switching frequency is required. Table 1 outlines the recommended test conditions to evaluate the buck system application.

Table 1. Recommended Test Condition

PWM Duty	V_{IN}/V_{BUS}(V)	I_{IN} (A)	V_{OUT} (V)	Max I_{OUT}(A)[1]
10%	80	5.0	8	5.0
50%	80	5.0	30	5.0
90%	80	5.0	54	5.0

1. This condition is evaluated using the components and f_{SW} specified on the EVB, with fan-assisted cooling. I_{OUT} is limited to ensure evaluation board safety. When conducting tests, the switching frequency must also be taken into account. At higher operating frequencies, reduce the value of I_{OUT} to V_{IN} accordingly.

1.2 Recommended Equipment

- A power supply that can deliver 5V or higher with at least 1A source current capability to supply VDD
- A power supply that can deliver 60V or higher with at least 6A source current capability to supply V_{IN}(V_{BUS})
- A dual-channel square wave or pulse generator with 0V to 3.3V/5V logic levels output and 500kHz capability (coaxial cables with a BNC male connector on one end and an SMA male connector on the other end)
- A DC electronic load to draw current on output with up to 80V/6A capability
- A minimum 4-channel oscilloscope to monitor V_{IN}(V_{BUS}), V_{OUT}, SW and VDD signals

1.3 Setup and Configuration

1. Connect a 5V power supply with a current limit of 1A to the VDD (TP1) and GND (TP24).
2. Connect a power supply that can provide 60V or higher voltage, with a current limit of 6A, to the V_{IN}(V_{BUS}) (TP39 for RTKP6815xDE00000BC or TP44 for RTKP6815xDE00010BC) and GND (TP40 for RTKP6815xDE00000BC or TP45 for RTKP6815xDE00010BC).
3. Configure a dual-channel function generator to deliver two square-wave outputs with an amplitude range of 0V to 3.3V/5V, operating at a frequency of 500kHz with the required duty cycles. Route the signals to the PWM SMA connectors J5 (HI) and J7 (LI), and set both generator channels to 50Ω impedance.
   IMPORTANT: It is critical to set an appropriate dead time between the two signals to prevent cross-conduction, especially for RRP68151 because it does not include shoot-through protection.
4. Connect an electronic load to the VOUT pin and set the E-load to 0A.
5. Connect an oscilloscope to monitor V_{OUT}, V_{IN}, SW and I_{OUT} signals.

6. Turn on the electronic load, setting it to 0.5A for safety purposes.
7. Turn on the power supply connected to VDD, setting it to 5V.
8. Turn on the function generator configured to output signals with 0V to 3.3V/5V amplitude, 500kHz frequency, appropriate duty cycles, and defined dead time.
9. Turn on the supply connected to $V_{IN}(V_{BUS})$, setting it to 60V.
10. Verify that the SW signal operates according to the configured duty cycle, and confirm that the output voltage corresponds to the product of the input voltage and the HI duty cycle.
11. Gradually increase the electronic load and verify the signal behavior using an oscilloscope.

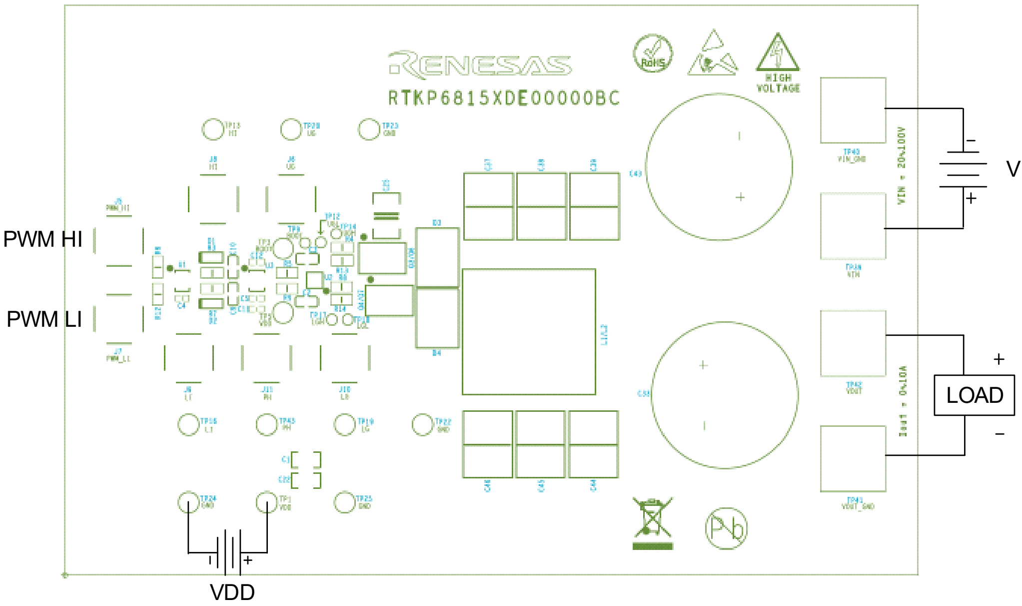

Figure 2. RTKP6815XDE00000BC Setup Connection

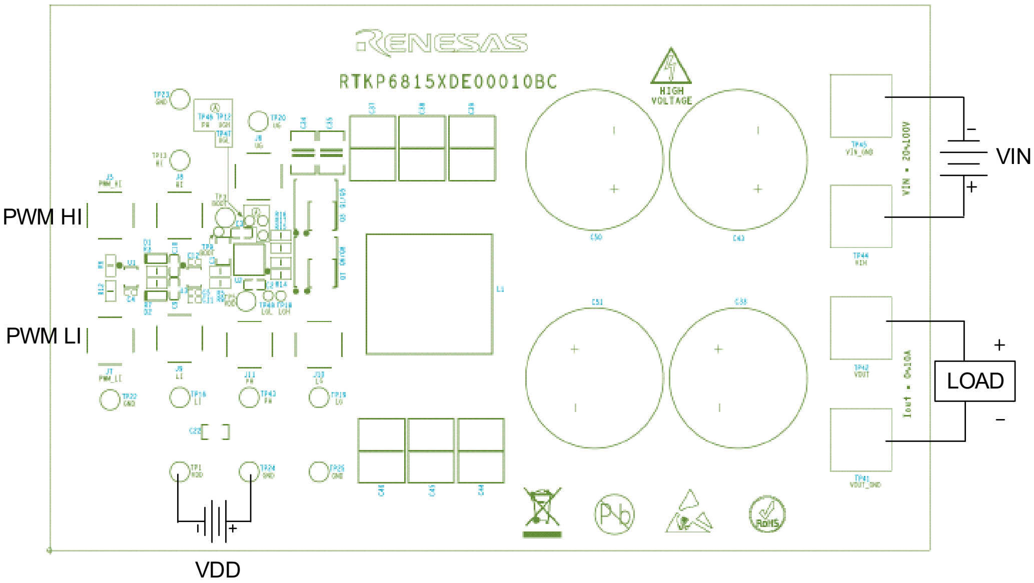

Figure 3. RTKP6815XDE00010BC Setup Connection

2. Board Design

2.1 PCB Layout Guidelines

For best thermal performance, connect the driver thermal pad to a low thermal impedance ground plane. Use as many vias as possible to connect the top layer PCB thermal land to the ground planes on other PCB layers. For best electrical performance, connect the PGND and AGND pins through the thermal pad to maintain a low impedance connection between the two pins.

Place the VDD decoupling capacitors close to the VDD-GND respectively. Use decoupling capacitors to reduce the influence of parasitic inductors. To be effective, these capacitors must also have the shortest possible lead lengths. If vias are used, connect several paralleled vias to reduce the inductance.

In addition:

- Keep power loops as short as possible by paralleling the source and return traces.
- Adding resistance might be necessary to dampen resonating parasitic circuits. In PCB designs with long leads on the outputs, add series gate resistors to dampen the oscillations.
- Large power components (such as power FETs, electrolytic capacitors, and power resistors) have internal parasitic inductance, which cannot be eliminated. This must be accounted for in the PCB layout and circuit design.
- If you simulate your circuits, consider including parasitic components.

2.2 RTKP6815xDE00000BC

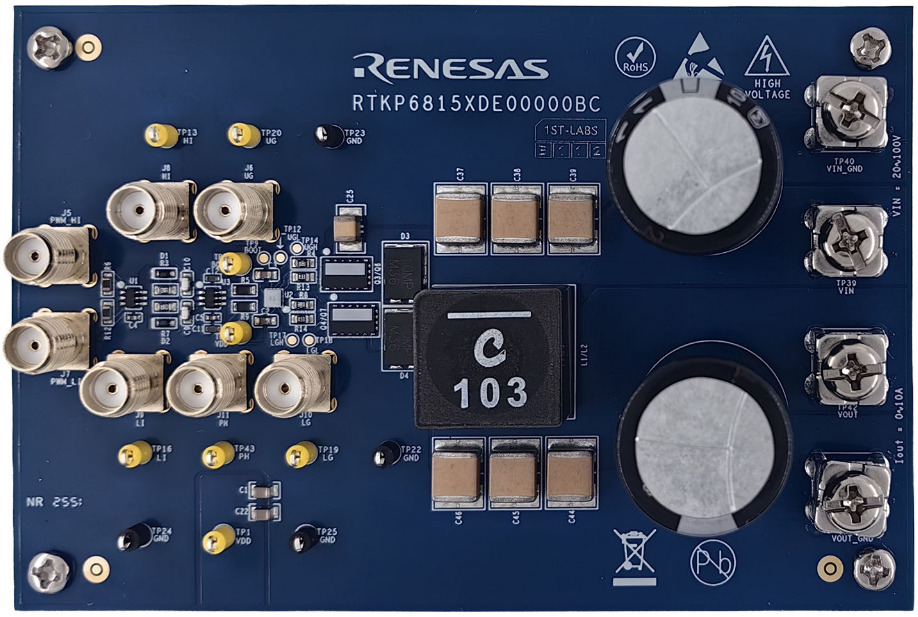

Figure 4. RTKP6815xDE00000BC Evaluation Board (Top)

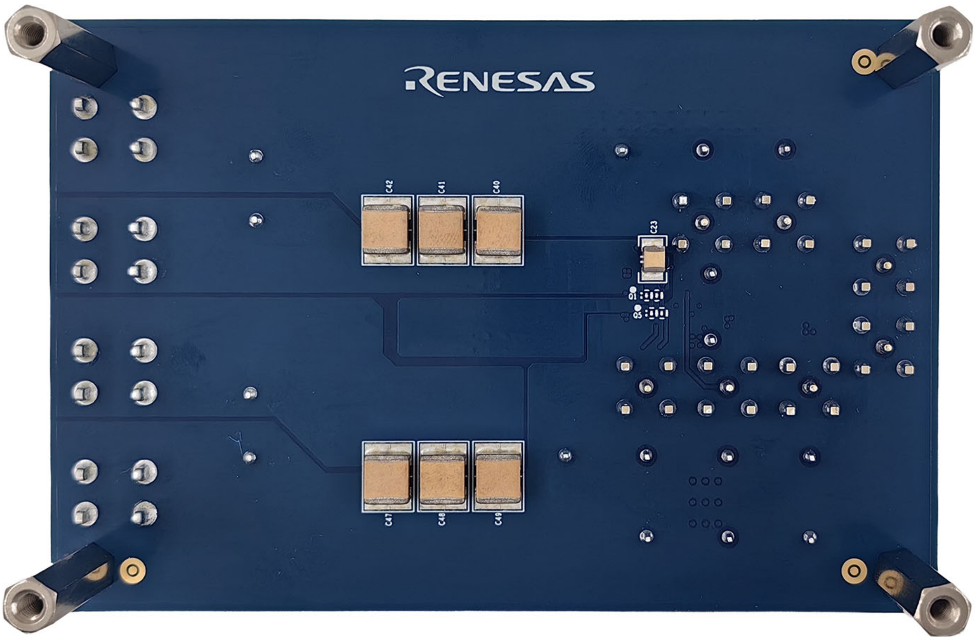

Figure 5. RTKP6815xDE00000BC Evaluation Board (Bottom)

2.2.1 Schematic

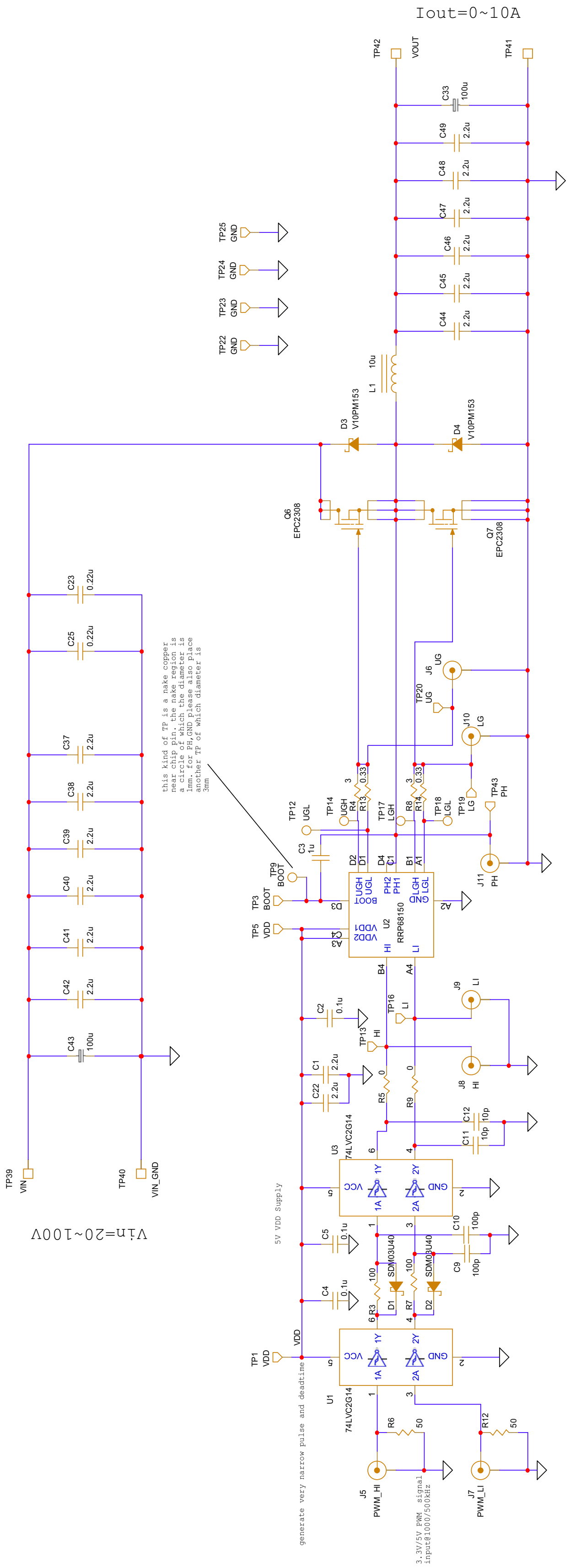

Figure 6. RTKP6815xDE00000BC Schematic

2.2.2 Bill of Materials

Table 2. RTKP6815xDE00000BC BOM

Qty	Designator	Description	Part Number	Manufacturer
1	PCB	-	RTKP6815XDE00000BCREVAPCB	
1	PLACE ASSY IN BAG	BAG, STATIC, 5X8, ZIPLOC, ROHS	5X8-STATIC-BAG	
2	C1, C22	CAP, SMD, 0805, 2.2µF, 10V, 10%, X7R, ROHS	GRM21BR71A225KA01K	Murata
1	C2	CAP, SMD, 0603, 0.1µF, 16V, 10%, X7R, ROHS	EMK107B7104KA-T	Taiyo Yuden
1	C3	CAP, SMD, 0603, 1µF, 16V, 10%, X7R, ROHS	EMK107B7105KA-T	Taiyo Yuden
2	C4, C5	CAP, SMD, 0402, 0.1µF, 16V, 10%, X7R, ROHS	EMK105B7104KV-F	Taiyo Yuden
2	C9, C10	CAP, SMD, 0603, 100p, 25V, 5%, C0G/NPO, ROHS	CC0603JRNPO8BN101	YAGEO
2	C11, C12	CAP, SMD, 0402, 10p, 16V, 5%, THIN FILM, ROHS	0402YJ100JBWTR	KYOCERA AVX
2	C23, C25	CAP, SMD, 1210, 0.22µF, 200V, 10%, X7R, ROHS	KGM32LR72D224KU	KYOCERA AVX
2	C33, C43	CAP-RADIAL, TH, 18mm DIA, 100µF, 160V, 20%, ROHS	EEUEB2C101SB	Panasonic
12	C37, C38, C39, C40, C41, C42, C44, C45, C46, C47, C48, C49	CAP, SMD, 2220, 2.2µF, 250V, 10%, X7R, ROHS	FS55X225K251EGG	Prosperity Dielectrics Co. Ltd
2	D1, D2	DIODE-RECTIFIER, SMD, 2P, SOD-523, 30V, 30mA, ROHS	SDM03U40-7	DIODES
2	D3, D4	DIODE-SHOTTKY, SMD, 150V, 3.6A, TO-227A, ROHS	V10PM153HM3/H	VISHAY
7	J5, J8, J6, J7, J9, J10, J11	CONN-COAXIAL, 1 INNER HOLE, POSITIVE PIN, 50Ω, ROHS	BWSMA-KE-Z001	BAT Wireless
1	L1	COIL-FIXED, SMD, 10µH, 22A, 20%, AEC-Q200, ROHS	XAL1510-103ME	Coil Craft
2	Q6, Q7	TRANS-GAN, SMD, QFN, N-CHAN, 150V, 63A, ROHS	EPC2308	EPC
2	R3, R7	RES, SMD, 0603, 100Ω, 1/10W, 1%, ROHS	RC0603FR-10100RL	YAGEO
2	R4, R8	RES, SMD, 0603, 3Ω, 1/10W, 1%, ROHS	RC0603FR-073RL	YAGEO
2	R5, R9	RES, SMD, 0603, 0Ω, 1/2W, ROHS	PA0603-R-070RL	YAGEO
2	R6, R12	RES, SMD, 0603, 50Ω, 1/8W, 1%, ±25ppm, ROHS	FC0603E50R0FTBST1	VISHAY
2	R13, R14	RES, SMD, 0603, 0.33Ω, 1/10W, 1%, ROHS	RL0603FR-070R33L	YAGEO
8	TP1, TP5, TP3, TP13, TP16, TP19, TP20, TP43	CONN-MINI TEST POINT, VERTICAL, YEL, ROHS	RH	5004

Table 2. RTKP6815xDE00000BC BOM (Cont.)

Qty	Designator	Description	Part Number	Manufacturer
4	TP22, TP23, TP24, TP25	CONN-MINI TEST PT, VERTICAL, BLK, ROHS	RH	5001
4	TP39, TP40, TP41, TP42	PLUGIN, WELDING TERMINAL, ROHS	T44008	XFCN
2	U1, U3	IC-INVERTER, SMD, 2 INPUT, 1.65-5.5V, 6-TSSOP, ROHS	74LVC2G14GW, 125	Nexperia
1	U2	IC-FET DRIVER, 5V, 2A, 12 Ball, 2x2-WLCSP, ROHS	RRP68150-BH0 for RTKP68150DE00000BC board	Renesas
			RRP68151-BH0 for RTKP68151DE00000BC board	
4	4 CORNERS OF PCB	SCREW, 4-40×1/4in, PHILLIPS, PANHEAD, SS, ROHS	4-40X1/4-SCREW-SS	APM Hexseal
4	4 CORNERS OF PCB	STANDOFF, 4-40×3/4in, F/F, HEX, ALUMINUM, ROHS	970200324-STANDOFF	Wurth

2.2.3 Board Layout

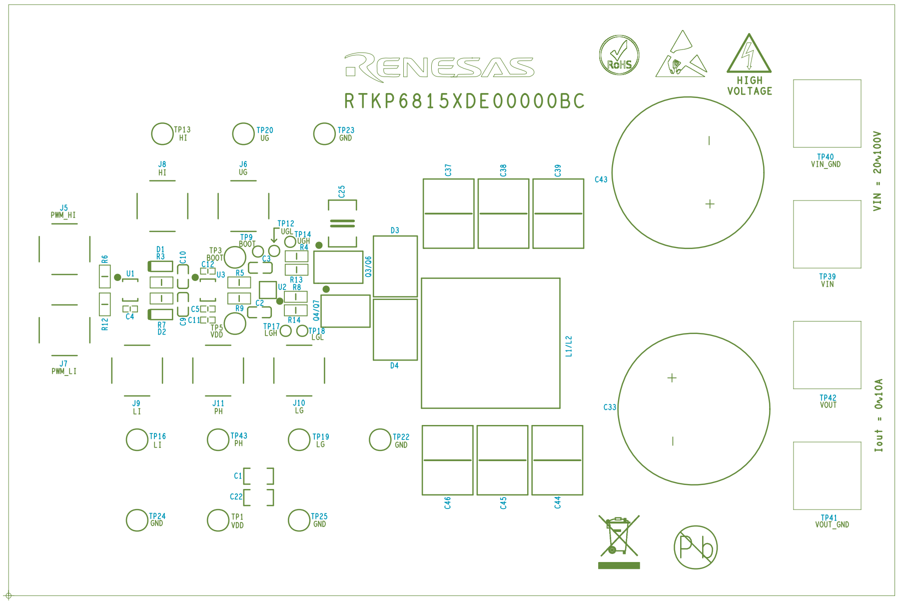

Figure 7. Silkscreen Top Layer

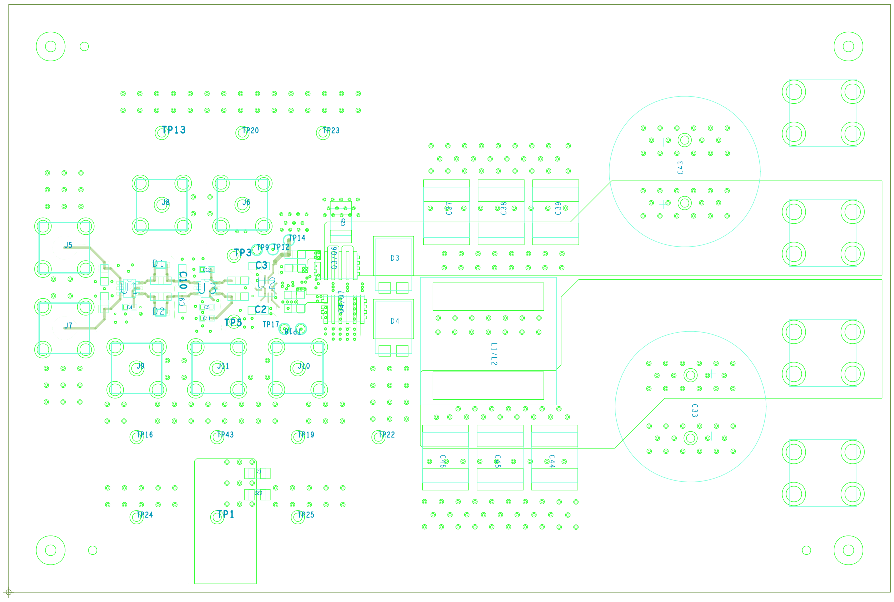

Figure 8. Layer 1

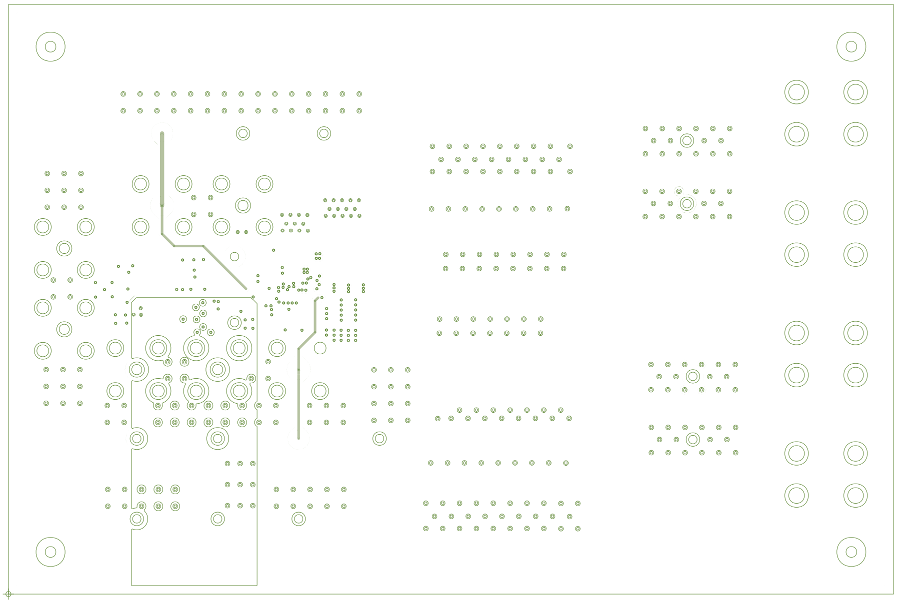

Figure 9. Layer 2

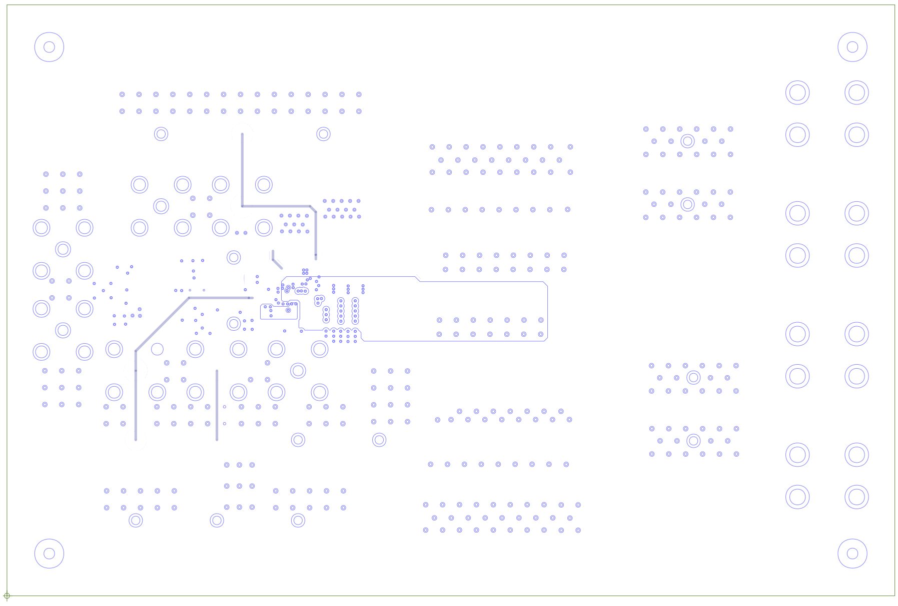

Figure 10. Layer 3

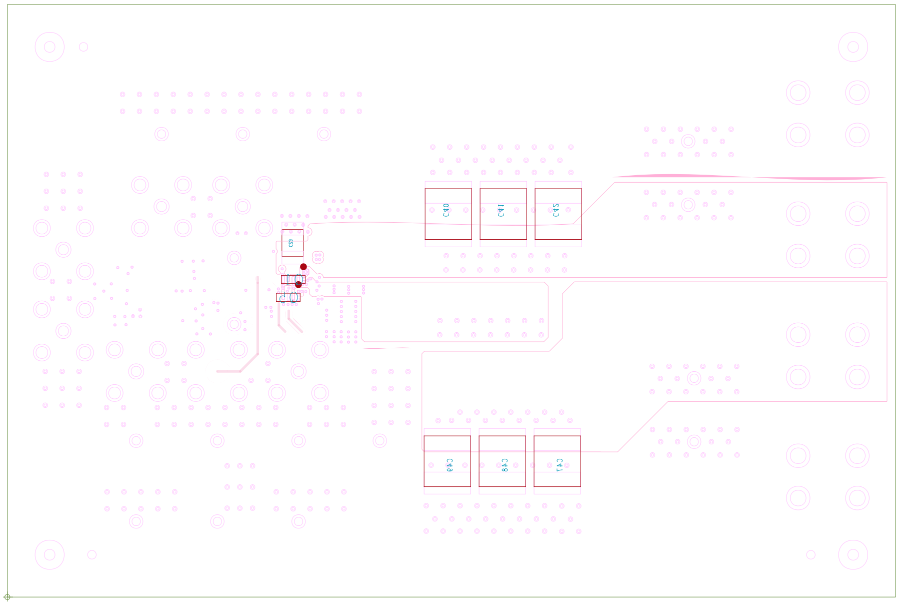

Figure 11. Layer 4

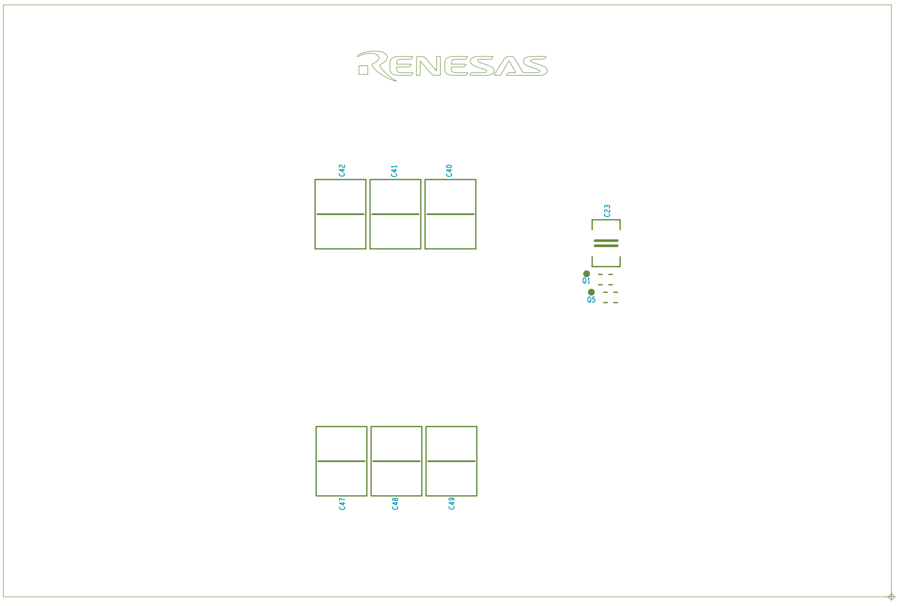

Figure 12. Silkscreen Bottom Layer

2.3 RTKP6815xDE00010BC

Figure 13. RTKP6815xDE00010BC Evaluation Board (Top)

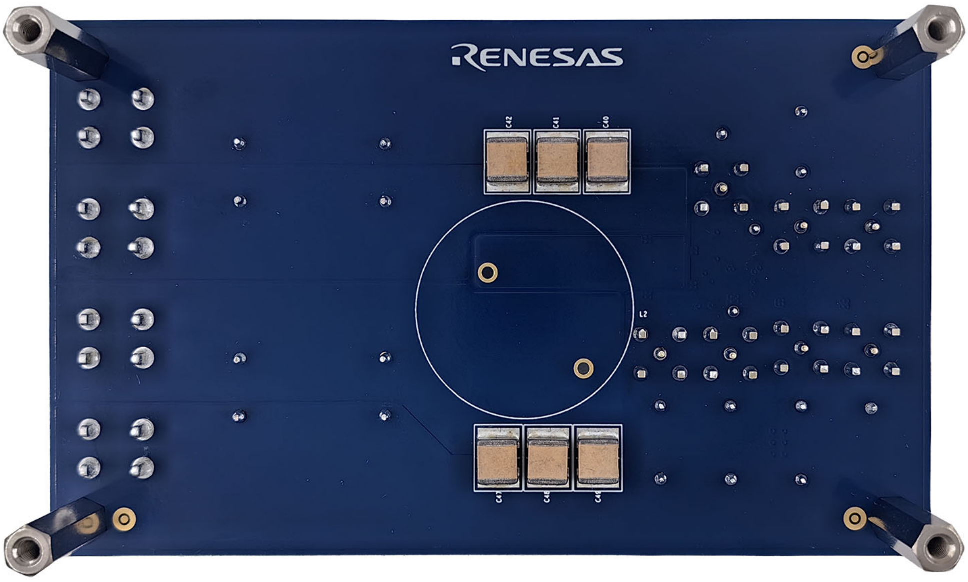

Figure 14. RTKP6815xDE00010BC Evaluation Board (Bottom)

2.3.1 Schematic

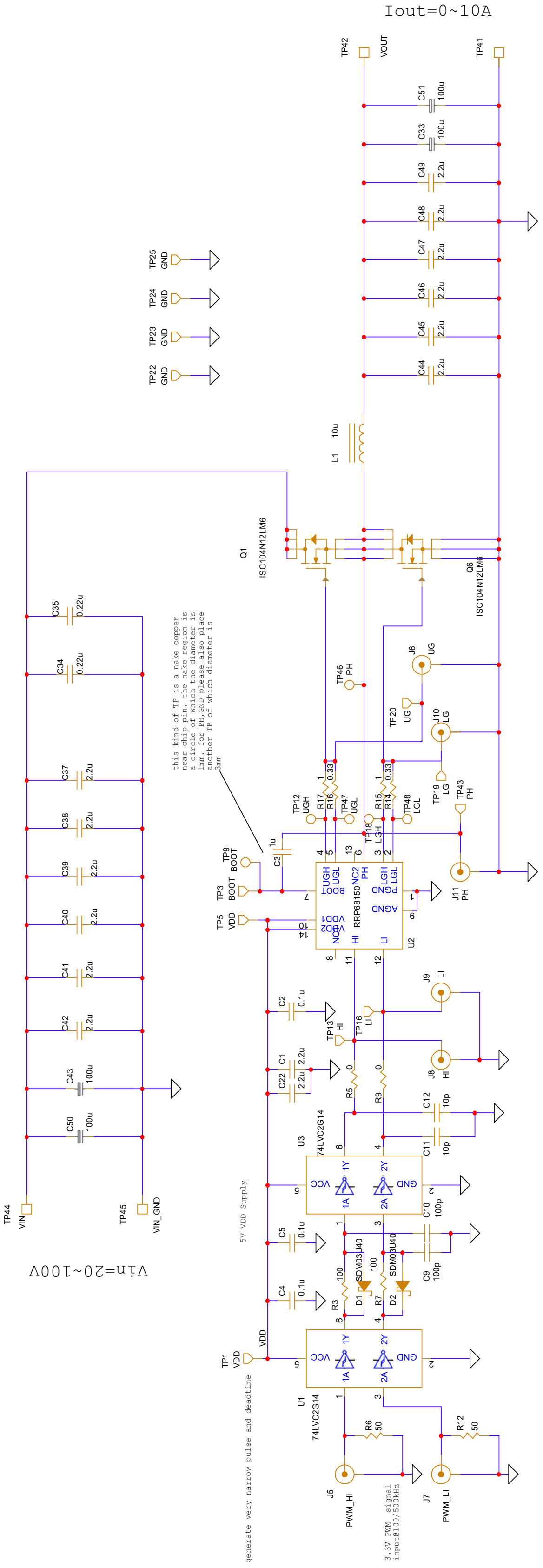

Figure 15. RTKP6815xDE00010BC Schematic

2.3.2 Bill of Materials

Table 3. RTKP6815xDE00010BC BOM

Qty	Designator	Description	Part Number	Manufacturer
1	PCB	-	RTKP6815XDE00010BCREVAPCB	-
1	PLACE ASSY IN BAG	BAG, STATIC, 5×8, ZIPLOC, ROHS	5X8-STATIC-BAG	-
2	C1, C22	CAP, SMD, 0805, 2.2µF, 10V, 10%, X7R, ROHS	GRM21BR71A225KA01K	Murata
1	C2	CAP, SMD, 0603, 0.1µF, 16V, 10%, X7R, ROHS	EMK107B7104KA-T	Taiyo Yuden
1	C3	CAP, SMD, 0603, 1µF, 16V, 10%, X7R, ROHS	EMK107B7105KA-T	Taiyo Yuden
2	C4, C5	CAP, SMD, 0402, 0.1µF, 16V, 10%, X7R, ROHS	EMK105B7104KV-F	Taiyo Yuden
2	C9, C10	CAP, SMD, 0603, 100p, 25V, 5%, C0G/NPO, ROHS	CC0603JRNPO8BN101	YAGEO
2	C11, C12	CAP, SMD, 0402, 10p, 16V, 5%, THIN FILM, ROHS	0402YJ100JBWTR	KYOCERA AVX
4	C33, C43, C50, C51	CAP-RADIAL, TH, 18mm DIA, 100µF, 160V, 20%, ROHS	EEUEB2C101SB	Panasonic
2	C34, C35	CAP, SMD, 1210, 0.22µF, 200V, 10%, X7R, ROHS	KGM32LR72D224KU	KYOCERA AVX
12	C37, C38, C39, C40, C41, C42, C44, C45, C46, C47, C48, C49	CAP, SMD, 2220, 2.2µF, 250V, 10%, X7R, ROHS	FS55X225K251EGG	Prosperity Dielectrics Co. Ltd
2	D1, D2	DIODE-RECTIFIER, SMD, 2P, SOD-523, 30V, 30mA, ROHS	SDM03U40-7	DIODES
7	J5, J8, J6, J7, J9, J10, J11	Brass 50Ohm female SMA co-axis connector	BWSMA-KE-Z001	BAT Wireless
1	L1	COIL-FIXED, SMD, 10µH, 22A, 20%, AEC-Q200, ROHS	XAL1510-103ME	Coil Craft
2	Q1, Q6	TRANS-MOSFET, N-CHAN, SMD, 120V, 11A, 63A, ROHS	ISC104N12LM6ATMA1	Infineon
2	R3, R7	RES, SMD, 0603, 100Ω, 1/10W, 1%, ROHS	RC0603FR-10100RL	YAGEO
2	R5, R9	RES, SMD, 0603, 0Ω, 1/2W, ROHS	PA0603-R-070RL	YAGEO
2	R6, R12	IRES, SMD, 0603, 50Ω, 1/8W, 1%, ±25ppm, ROHS	FC0603E50R0FTBST1	VISHAY
2	R14, R16	RES, SMD, 0603, 0.33Ω, 1/10W, 1%, ROHS	RL0603FR-070R33L	YAGEO
2	R15, R17	RES, SMD, 0603, 1Ω, 1/10W, 1%, ROHS	RC0603FR-071RL	YAGEO
8	TP1, TP5, TP3, TP13, TP16, TP19, TP20, TP43	CONN-MINI TEST POINT, VERTICAL, YEL, ROHS	5004	RH
4	TP22, TP23, TP24, TP25	CONN-MINI TEST PT, VERTICAL, BLK, ROHS	5001	RH
4	TP41, TP42, TP44, TP45	PLUGIN, WELDING TERMINAL, ROHS	T44008	XFCN
2	U1, U3	IC-INVERTER, SMD, 2 INPUT, 1.65-5.5V, 6-TSSOP, ROHS	74LVC2G14GW, 125	Nexperia
1	U2	IC-FET DRIVER, 5V, 2A, 14 Ld, 3x3-FCQFN, ROHS	RRP68150-NH0 for RTKP68150DE00010BC board	Renesas
		IC-FET DRIVER, 5V, 2A, 14 Ld, 3x3-FCQFN, ROHS	RRP68151-NH0 for RTKP68151DE00010BC board	Renesas

Table 3. RTKP6815xDE00010BC BOM (Cont.)

Qty	Designator	Description	Part Number	Manufacturer
4	4 CORNERS OF PCB	SCREW, 4-40×1/4in, PHILLIPS, PANHEAD, SS, ROHS	4-40X1/4-SCREW-SS	APM Hexseal
4	4 CORNERS OF PCB	STANDOFF, 4-40×3/4in, F/F, HEX, ALUMINUM, ROHS	970200324-STANDOFF	Wurth

2.3.3 Board Layout

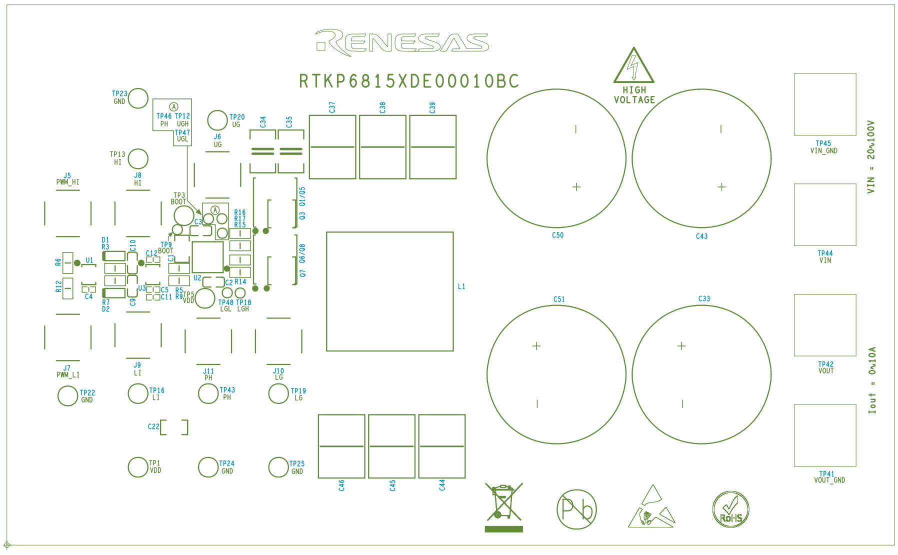

Figure 16. Silkscreen Top Layer

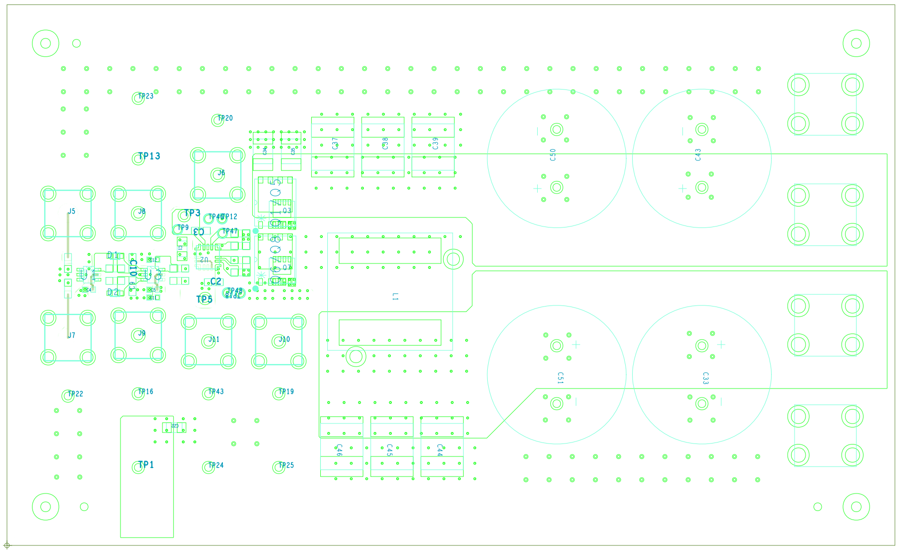

Figure 17. Layer 1

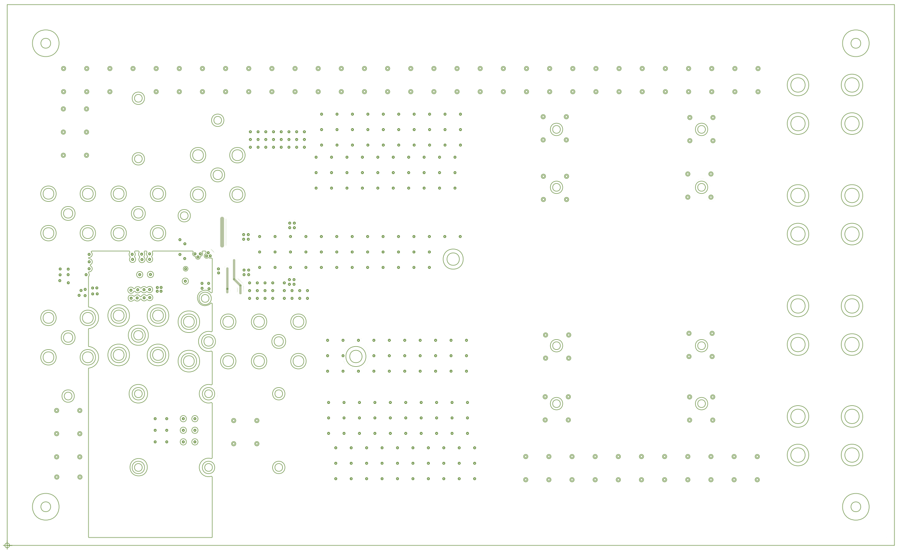

Figure 18. Layer 2

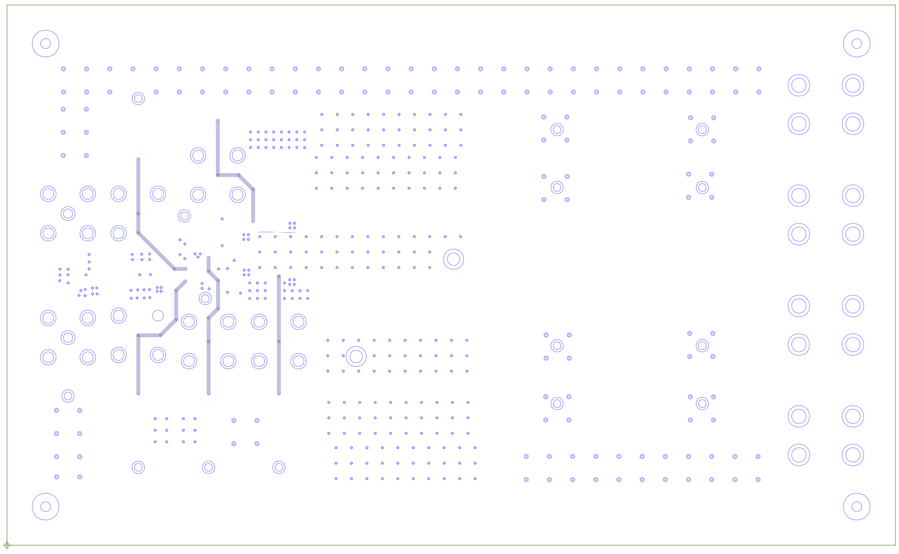

Figure 19. Layer 3

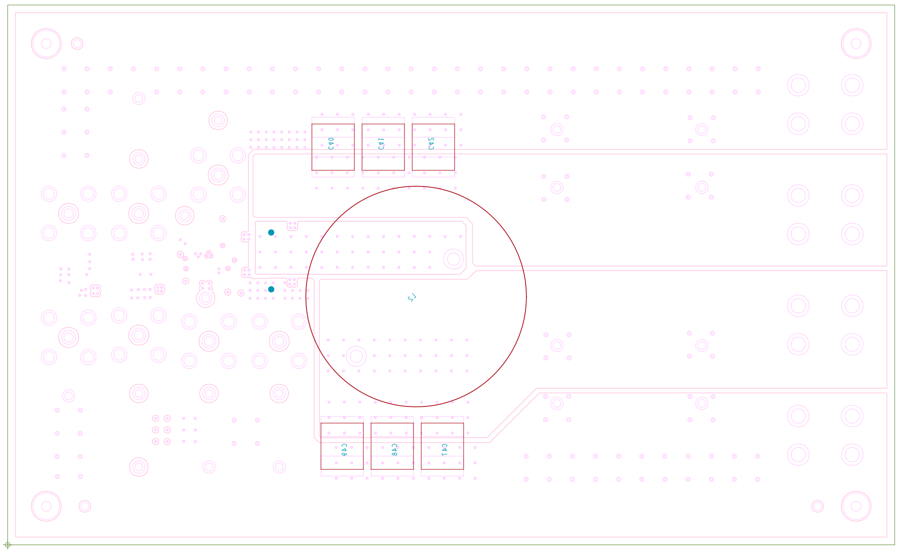

Figure 20. Layer 4

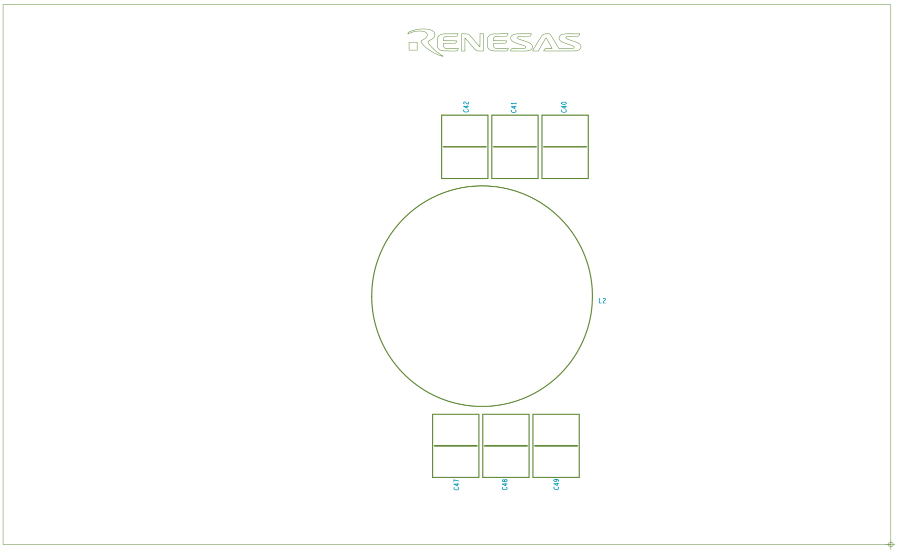

Figure 21. Silkscreen Bottom Layer

3. Design Reference

3.1 Input, Output and Duty Cycle

Key parameters must be determined before choosing components.

- V_{IN}: Input voltage (minimum, typical, maximum)
- V_{OUT}: Required output voltage
- I_{IN}: Input current (maximum)
- I_{OUT}: Output current (maximum)

When the parameters above are decided, use Equation 1 to calculate the duty cycle (D).

(EQ. 1) $$D = V_{OUT}/V_{IN}$$

3.2 Switching Frequency and Switching Current

The switching frequency (f_{SW}) is a crucial parameter, as it influences system efficiency and performance. An increased switching frequency can result in reduced efficiency.

It is also essential to consider the switching current when selecting power FETs and other components.

3.3 Inductor Selection

Inductor selection is critical due to the unavoidable presence of ripple current. A smaller inductance might result in higher ripple current, whereas a larger inductance can slow load transient response and reduce efficiency. Equation 2 provides a useful reference for inductor selection, with I_{ripple_peak} referring to the peak inductor ripple current.

(EQ. 2) $$L = \frac{(V_{IN} - V_{OUT}) \times D}{f_{SW} \times I_{ripple\_peak}}$$

3.4 Input Capacitor and Output Capacitor

Input and output capacitors are essential for stabilizing input and output voltages. Low ESR ceramic capacitors are recommended. While larger output capacitors can effectively reduce voltage ripple, they might also increase the overall capacitor footprint. Equation 3 is provided as a reference for calculating the appropriate capacitor value, with V_{ripple_peak} referring to the peak output ripple voltage.

(EQ. 3) $$C_{OUT} = \frac{D \times I_{OUT}}{f_{SW} \times V_{ripple\_peak}}$$

3.5 Other Components

It is essential to consider the voltage and current ratings of other key components, such as power FETs (MOSFETs or GaN FETs) and diodes. These ratings must accommodate the peak operating voltage and current to ensure reliable performance.

4. Typical Performance Curves

V_{DD} = 5V, V_{IN} = 80V, GaN FET, PWM 0V to 5V, 500kHz square wave, 50% duty, load = 3A under room temperature *Note*: Tested with larger load condition

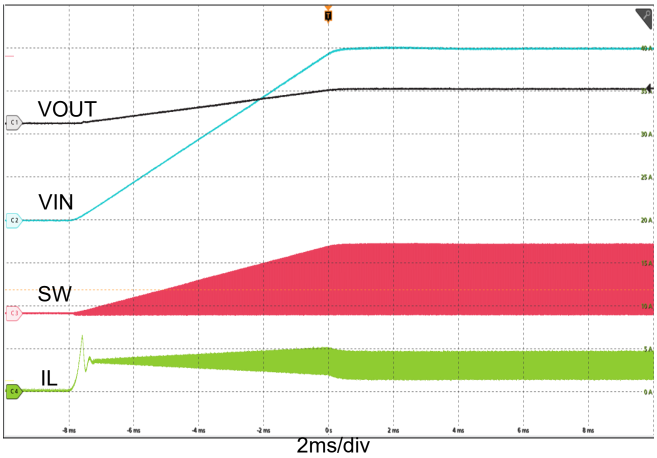

Figure 22. VIN Power Up

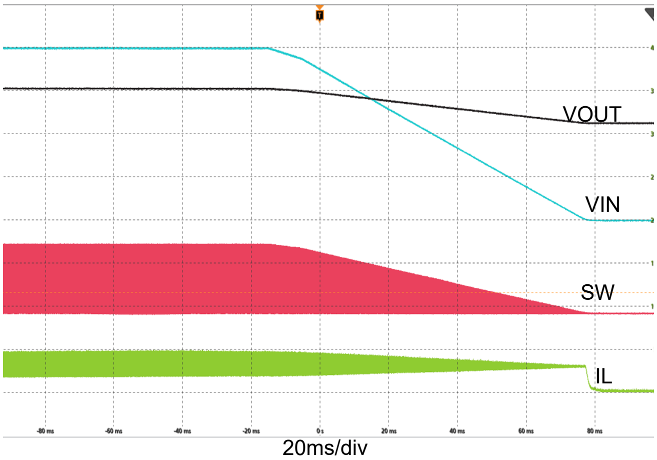

Figure 23. VIN Power Off

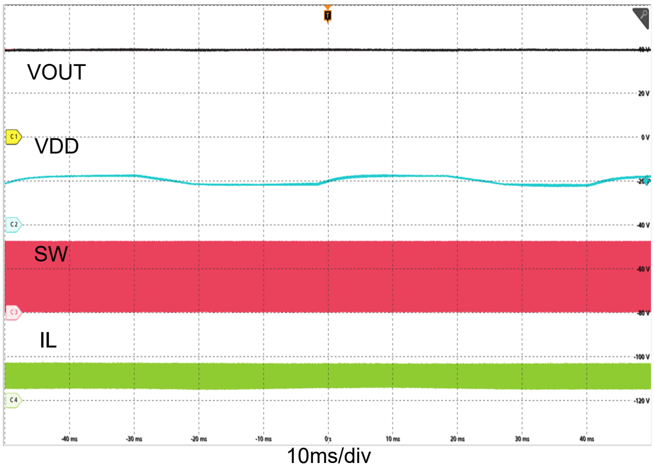

Figure 24. VDD Line Transient

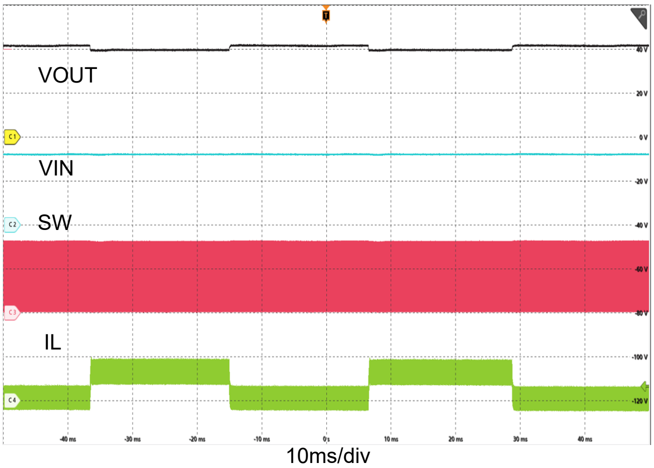

Figure 25. Load Transient

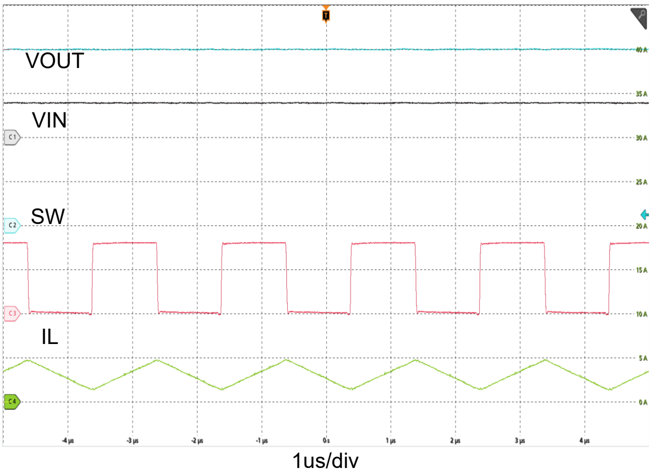

Figure 26. Steady State

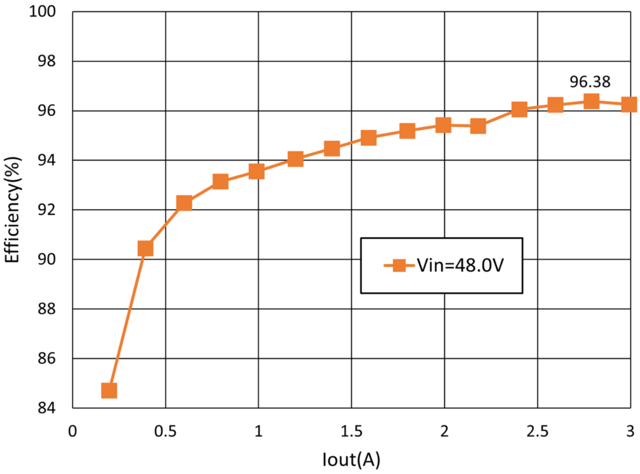

Figure 27. Efficiency

5. Ordering Information

Part Number	Description
RTKP68150DE00000BC	RRP68150-BH0 12 Balls WLCSP Evaluation Board, GaN FET Version
RTKP68150DE00010BC	RRP68150-NH0 14 Ld SC-FCTQFN Evaluation Board, MOSFET Version
RTKP68151DE00000BC	RRP68151-BH0 12 Balls WLCSP Evaluation Board, GaN FET Version
RTKP68151DE00010BC	RRP68151-NH0 14 Ld SC-FCTQFN Evaluation Board, MOSFET Version

6. Revision History

Revision	Date	Description
1.00	Jan 29, 2026	Initial release

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