RTKA211320DE0030BU

The RAA211320 is an integrated 30V, 2A synchronous buck regulator with current mode Constant On-Time (COT) control. It supports a wide input voltage range from 4.5V to 30V. The RTKA211320DE0030BU evaluation board provides a quick and comprehensive platform for evaluating the performance features of RAA211320 buck regulator.

Specifications

The RTKA211320DE0030BU evaluation board is configured and optimized for the following operating conditions:

- Input voltage range: 4.5V to 30V
- Output voltage: 3.3V
- Up to 2A output current capability
- Operating temperature range: -40°C to +125°C

Features

- 4.5V to 30V input supply range
- Up to 2A output current
- Integrated high-side (125mΩ) and low-side (75mΩ) MOSFETs
- 400µA quiescent current
- Minimum on-time of 70ns
- Minimum off-time of 225ns
- 0.765V reference voltage with 2% accuracy
- PFM mode under light load condition
- Current mode Constant On-Time (COT) control with internal compensation
- Internal 0.8ms soft start time
- Protection: Low-Side Overcurrent (LSOC) limit, input Undervoltage Lockout (UVLO), Over-Temperature Protection (OTP), Output Undervoltage Protection (OUVP) with Hiccup Mode
- Accurate EN threshold
- 6 LD TSOT23 package

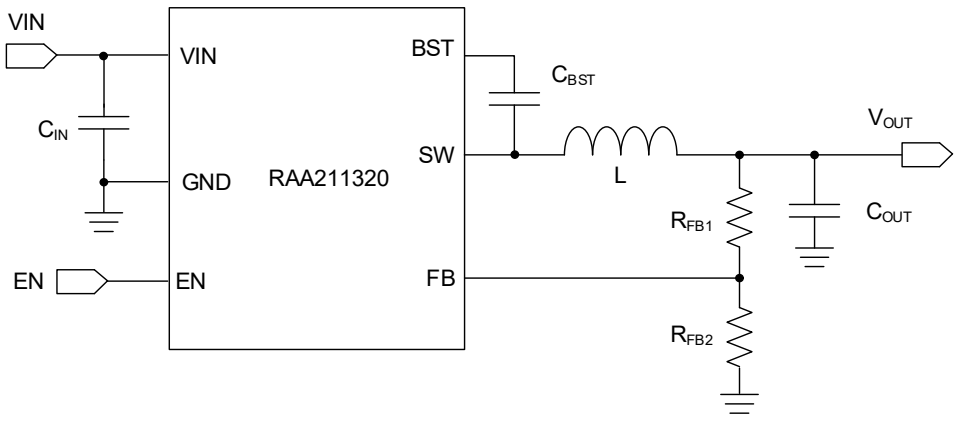


Figure 1. RTKA211320DE0030BU Circuit Diagram

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1. Functional Description

The RTKA211320DE0030BU evaluation board provides a comprehensive and versatile platform to assess functionality and prototype an application with the integrated 30V, 2A synchronous buck regulator RAA211320. This board includes options for evaluating most of the features of the RAA211320 and has test points that facilitate probing.

1.1 Operating Range

The RTKA211320DE0030BU evaluates the RAA211320 with VIN from 4.5V to 30V and a continuous load of 2A. For proper functioning of the evaluation board, Renesas recommends operating the board within these specifications.

The inductance, capacitance, and feedback resistor values of the regulator were chosen for 3.3V V_{OUT} and 475kHz switching frequency. You can replace these components with different values if a different operating condition is required.

EN is connected to VIN through a 0Ω resistor. You can also connect EN to an external logic voltage to enable and disable by disconnecting jumper JP1. Alternatively, you can replace R1 with an appropriate resistor to obtain V_{IN} UVLO protection (JP1 connected between 2 and 3).

Updates on the FB resistor divider, inductor, and output capacitor may be required with changes in the operating load and output voltage.

1.2 Connectors, Test Points, Selection Switches, and Jumper Descriptions

The RTKA211320DE0030BU evaluation board includes I/O connectors, test points, a selection switch, and jumpers to provide a comprehensive and versatile platform for evaluating the RAA211320 (see Table 1).

Table 1. Connectors, Test Points, Selection Switches, and Jumper Descriptions

Reference Designator	Description
J1	Input voltage positive connection
J2	Input voltage return connection
J3	Output voltage positive connection
J4	Output voltage return connection
TP1	VIN test point
TP2	Ground test point
TP3	ENABLE test point
TP4	VSW test point
TP5	VOUTN test point
TP6	VOUT test point
TP7	Ground test point
TP8	Ground test point
JP1	Jumper pin for Enable/Disable

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1.2.1 Enable

When JP1 is connected between terminals 2 and 3, VIN is connected to EN through a 0Ω resistor (R1). Connecting JP1 to terminals 1 and 2 causes EN to connect to ground, and the part disables.

The default VIN UVLO (R1 = 0Ω) is set to 4.3V with a hysteresis of 350mV. To obtain programmable V_{IN} UVLO protection, JP1 can be connected to terminals 2 and 3, and R1 is selected using Equation 1, where VIN_{UVLO} is the required UVLO point. Choose R1 and R2 such that R1 ‖ R2 is less than 10kΩ.

(EQ. 1) $$R1 = \left(\frac{VIN_{UVLO} - 1.3}{1.3}\right) \times 10^4$$

1.2.2 Soft-Start

The RTKA211320DE0030BU is set for an internal soft-start of 0.8ms.

1.2.3 Switching Frequency

The RTKA211320DE0030BU is set for a nominal switching frequency of 450kHz. Under light load conditions, the part operates in PFM mode (variable frequency).

1.2.4 VOUT Programming

Program the output voltage by adjusting the values of the feedback resistors, R5 and R6 (see Equation 2), where V_{OUT} is the required output voltage.

(EQ. 2) $$\frac{R5}{R6} = \frac{V_{OUT} - 0.765}{0.765}$$

1.3 Recommended Equipment

- Power supply that can deliver 4.5V or higher with at least 2A source current capability.
- Electronic load capable of sinking at least 2A current.
- 4-channel oscilloscope with voltage and current probes.

1.4 Quick Start Guide

Use the following Quick Setup Guide to configure and power-up the board for proper operation.

1. Set the power supply voltage to 30V and turn off the power supply. Connect the positive output of the power supply to J1 (VIN) and the negative output to J2 (GND).
2. Connect a jumper connector across jumper pins 2 and 3 (JP1). (Disconnect jumper connector if using external logic for enable.)
3. Connect an electronic load to J3 (V_{OUT}) for the positive connection and J4 (GND) for the negative connection.
4. Place scope probes to VOUT (TP6), VSW (TP3), and/or other test points of interest.
5. Set the load current to 0.1A and turn on the power supply. The output voltage should be in regulation with nominal 3.3V output.
6. Slowly increase the load up to 2A. The output voltage should remain in regulation with nominal 3.3V output.
7. Slowly sweep VIN from 30V to 4.5V. The output voltage should remain in regulation with nominal 3.3V output.
8. Decrease the input voltage to 0V to shut down the regulator.

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2. Board Design

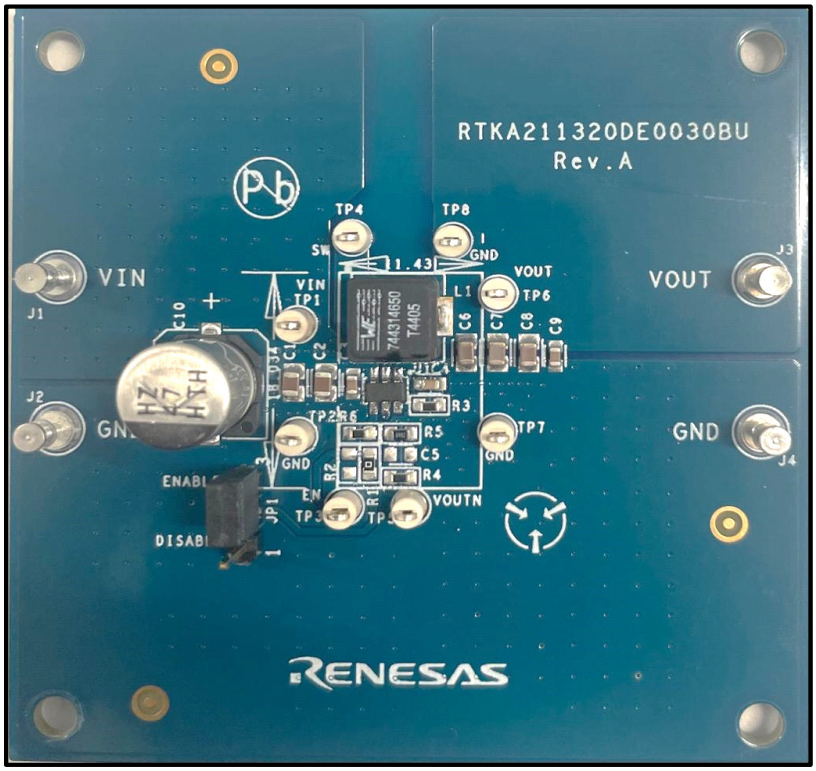


Figure 2. RTKA211320DE0030BU Evaluation Board (Top)

2.1 PCB Layout Guidelines

The printed circuit board (PCB) layout is critical for proper operation of the RAA211320. Renesas recommends the following guidelines to achieve an optimal performance.

- Use a double-sided (two layer) PCB. 2oz copper. Use the bottom side as ground. Place the ceramic input capacitors on the same side of the PCB as the IC.
- Use a combination of a bulk capacitor and smaller ceramic capacitors with low ESL for input capacitors and place them as close as possible to the IC.
- Place bootstrap capacitors close to the IC between BST and SW pins on the same side of the PCB as the IC. Use a 0.1µF ceramic capacitor.
- Route the output voltage feedback signal away from SW and BST. Place feedback resistors close to the FB pin of the regulator.
- The copper area of the SW node should not be more than needed. Place the inductor close to regulator.
- Place an output capacitor close to the inductor.

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2.2 RTKA211320DE0030BU Circuit Schematic

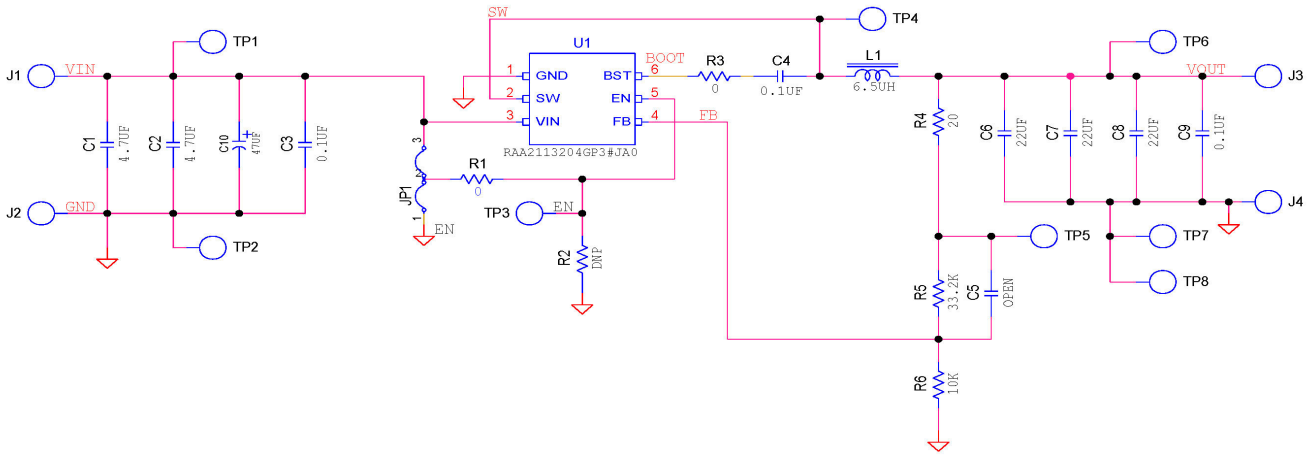


Figure 3. RTKA211320DE0030BU Schematic

2.3 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
4	J1, J2, J3, J4	Brass Test Point Turret 0.150 Pad 0.100 Thole PCB Depth < 0.078 in	Keystone	1502-1
8	TP1-TP8	Miniature White Test Point 0.100 Pad 0.040 Thole	Keystone	5002
1	C10	THV Series Aluminum Electrolytic Capacitor, 47µF, 20%, 50V, SMD	Rubycon	50THV47M8X10.5
1	L1	WE-HCI SMD High Current Inductor, 6.5µH, 20%	-	744314650
3	C6, C7, C8	Ceramic Chip Cap, 22µF, 20%, 25V, 0805	Murata	GRT21BR61E226MR13L
2	C3, C9	Multilayer Cap, 0.1µF, 20%,50V,0603	TDK	C1608X7R1H104M
1	R2	DNP		
1	R4	Thick Film Chip Resistor, 20, 1%, 1/10W, 0603	Panasonic	ERJ-3EKF20R0V
1	C4	Multilayer Cap, 0.1µF, 10%, 50V, 0603	Various	Generic
0	C5	DNP		
2	R1, R3	Thick Film Chip Resistor, 0Ω, 1%, 1/16W, 0603	Various	Generic
1	R6	Thick Film Chip Resistor, 10k, 1%, 1/16W, 0603	Various	Generic
1	R5	Thick Film Chip Resistor, 33.2k, 1%, 1/16W, 0603	Various	Generic
1	JP1	Three Pin Jumper, THOLE	Generic	JUMPER-3-100
1	U1	30V Input Voltage 2A Integrated Switching Regulator, TSOT6	Renesas	RAA2113204GP3#JA0
2	C1, C2	Ceramic Cap, 4.7µF,10%, 50V, 0805	TDK	C2012X7R1H475K125AC

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2.4 Board Layout

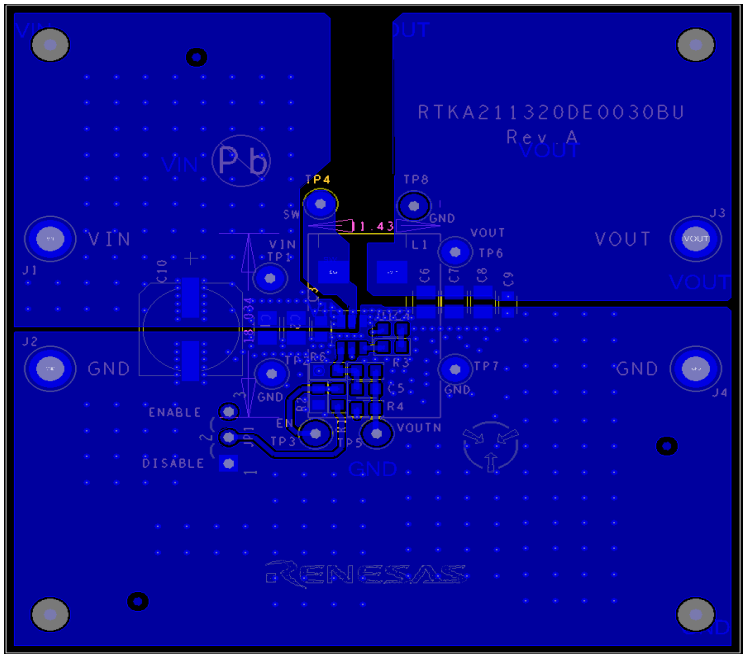


Figure 4. Top Layer

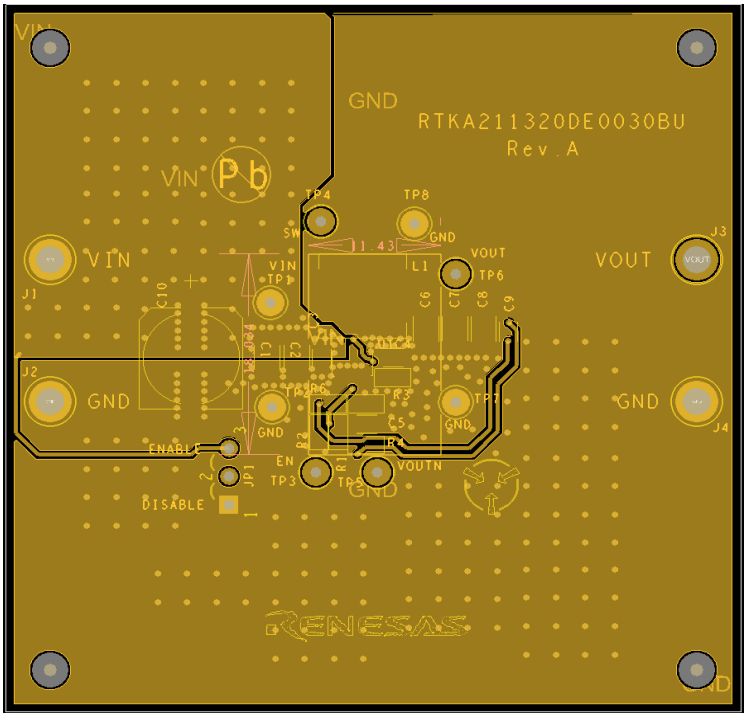


Figure 5. Bottom Layer

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3. Typical Performance Graphs

V_{IN} = 12V, V_{OUT} = 3.3V, $T_{\overline{A}}$ = +25°C, EN connected to VIN unless otherwise stated.

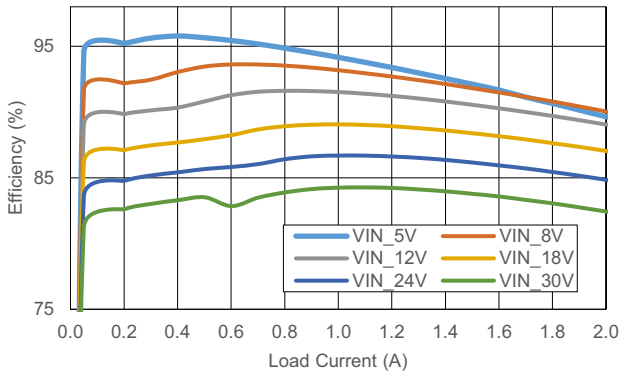


Figure 6. Efficiency vs Load Current

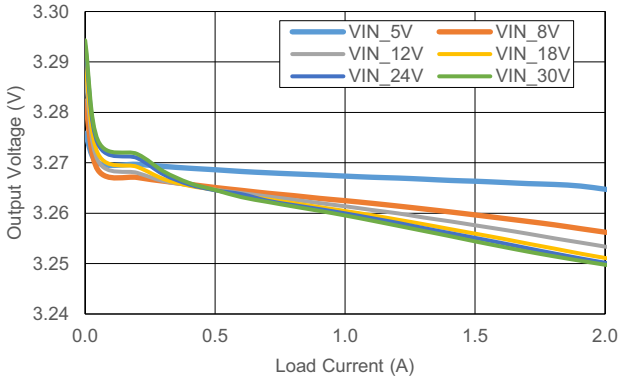


Figure 7. Load Regulation

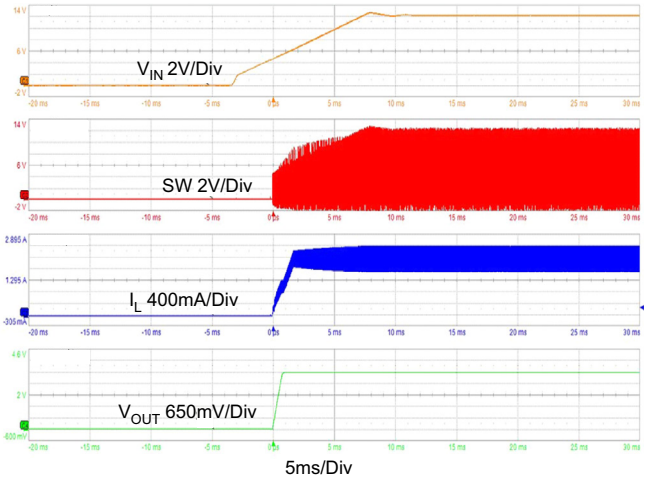


Figure 8. Start-Up, V_{IN} = 12V, I_{OUT} = 2A

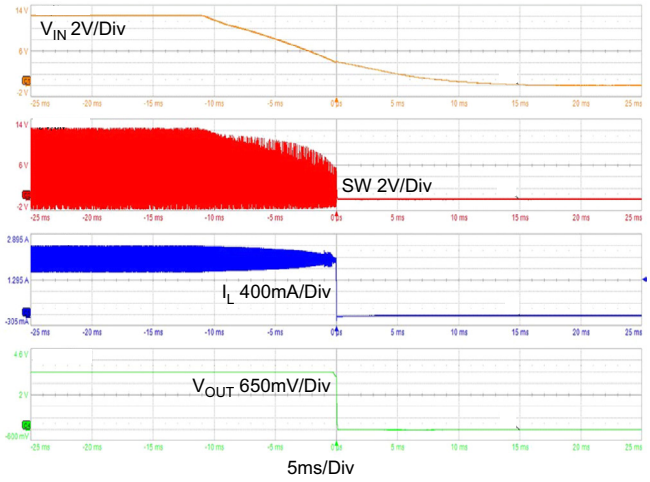


Figure 9. Shutdown, V_{IN} = 12V, I_{OUT} = 2A

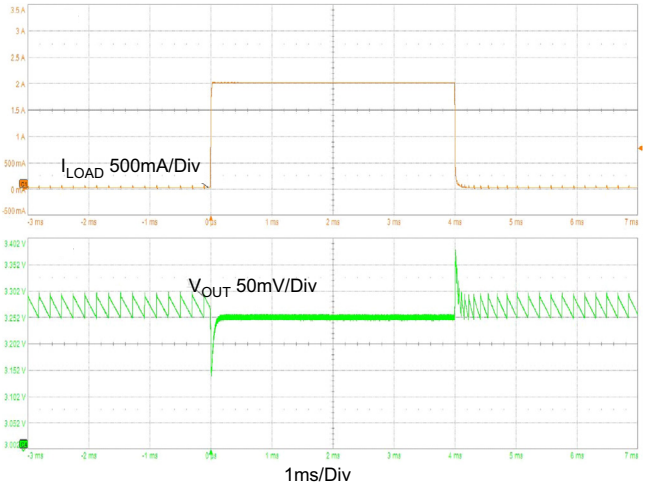


Figure 10. Load Transient (0A-2A)

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4. Ordering Information

Part Number	Description
RTKA211320DE0030BU	RAA211320 TSOT23-6 Evaluation Board

5. Revision History

Revision	Date	Description
1.00	May 8, 2023	Initial release.

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