

RTKA211412DE0000BU

The RTKA211412DE0000BU board demonstrates and quickly evaluates the RAA211412, a DC/DC step-down regulator with 630kHz switching frequency.

The RAA211412 is a DC/DC step-down (Buck) regulator that supports a wide operating input voltage range (from 5.8V to 45V) and adjustable output voltage. It can deliver up to continuous 1A output current with premium load regulation and line regulation performance.

The evaluation board implements a complete buck regulator using the RAA211412. The output voltage is set to 3.3V by default but can be adjusted by changing the resistor values in the feedback network.

Features

- Simple and flexible design
- Wide input voltage range: 5.8V to 45V
- Adjustable output voltage
- Convenient power conversion

Specifications

- Input voltage (V_{IN}): 5.8V to 45V
- Output voltage (V_{OUT}): 3.3V
- Maximum output current: 1A
- 630kHz switching frequency

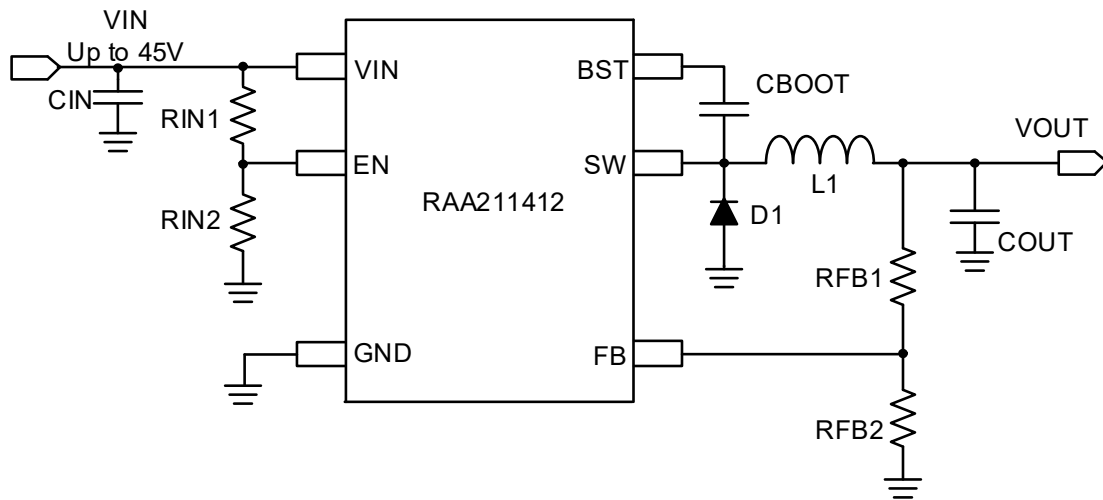


Figure 1. Block Diagram

Contents

1. Functional Description	3
1.1 Setting the Output Voltage	3
1.2 Input Undervoltage Lockout	3
1.3 Recommended Equipment	3
1.4 Setup and Configuration	4
2. Board Design	5
2.1 Bill of Materials	5
2.2 Schematic Diagrams	6
2.3 Board Layout	7
2.4 Layout Guidelines	7
3. Typical Performance Graphs	7
4. Ordering Information	8
5. Revision History	8

1. Functional Description

The RAA211412 is an easy-to-use buck switching regulator with an integrated 600mΩ high-side MOSFET. The RTKA211412DE0000BU board demonstrates the operations of the device. It allows the user to evaluate the performance of the IC with different application setups. It also provides you a reference for board layout.

1.1 Setting the Output Voltage

The output voltage is set to 3.3V by default and can be adjusted by changing the values of R_4 and R_5 in the feedback resistor network based on [Equation 1](#):

$$(EQ. 1) \quad R_4 = R_5 \cdot \frac{V_{out} - 0.8}{0.8}$$

For applications where the $V_{IN}-V_{OUT}$ is larger than 3V, Renesas recommends using a 20kΩ resistor for R_5 and choose R_4 based on [Equation 1](#). For applications where $V_{IN}-V_{OUT}$ is less than 3V, Renesas recommends using smaller R_4 and R_5 such that there is a larger than 50mA load at V_{OUT} .

Note: Appropriate inductor and output capacitor values need to be selected for different output voltages. See [Table 1](#) for recommended component selection.

Table 1. Recommended Component Selection for Typical Applications

V_{OUT} (V)	R_{FB1} (kΩ)	R_{FB2} (kΩ)	L (μH)	C_{OUT}
0.8	0	20	3.3	56μF/10V/X7R/X5R
1.5	17.4	20	4.7	33μF/10V/X7R/X5R
3.3	61.9	20	10	22μF/10V/X7R/X5R
5	105	20	15	10μF/10V/X7R/X5R
12	280	20	33	4.7μF/50V/X7R/X5R
24	576	20	68	4.7μF/50V/X7R/X5R

1.2 Input Undervoltage Lockout

The input undervoltage lockout level can be set with a resistor divider from V_{IN} to EN pin to GND based on [Equation 2](#) where V_{INR} is the minimum input voltage for the part to turn on.

$$(EQ. 2) \quad R_{IN1} = R_{IN2} \times \frac{V_{INR} - 1.275}{1.275}$$

The resulting input voltage V_{INF} for the part to be turned off is calculated using [Equation 3](#).

$$(EQ. 3) \quad V_{INF} = 1.15 \times \frac{R_{IN1} + R_{IN2}}{R_{IN2}}$$

1.3 Recommended Equipment

- Power supply that can deliver up to 45V with at least 1A source current capability.
- DC electronic load to draw current out of the buck regulator. High wattage resistor load can be used as well.
- (Optional) Second power supply that can deliver up to 45V to be used as Enable.
- Oscilloscope to monitor output voltage, SW node voltage, inductor current, etc.

1.4 Setup and Configuration

1. Connect the power supply to the VIN terminal (T1 and T2).
2. If an external EN signal is needed, connect the second power supply to the EN terminal (TP1 and TP2).
3. Alternatively, put a jumper on J1 to tie EN to VIN such that no additional power supply is needed for EN.
Note: To set the input UVLO level, do not connect an external signal or use a jumper on J1. Select the appropriate R_1 and R_2 values to set the required UVLO levels. See [Input Undervoltage Lockout](#) for details, where R_{IN1} and R_{IN2} correspond to R_1 and R_2 on the board, respectively.
4. Set the output voltage by adjusting the resistor divider in the feedback network. See [Setting the Output Voltage](#) for details.
5. Connect the DC load or the resistor load to the output terminal (T3 and T4).
6. Turn on VIN supply at a voltage between 5.8V and 45V.
7. If applicable, turn on EN power supply above the EN UVLO rising threshold (typically 1.275V), up to 45V.
8. Verify output voltage and switching waveforms on the oscilloscope. (J2 and J3 are convenient probing points for VOUT and SW node, respectively.)

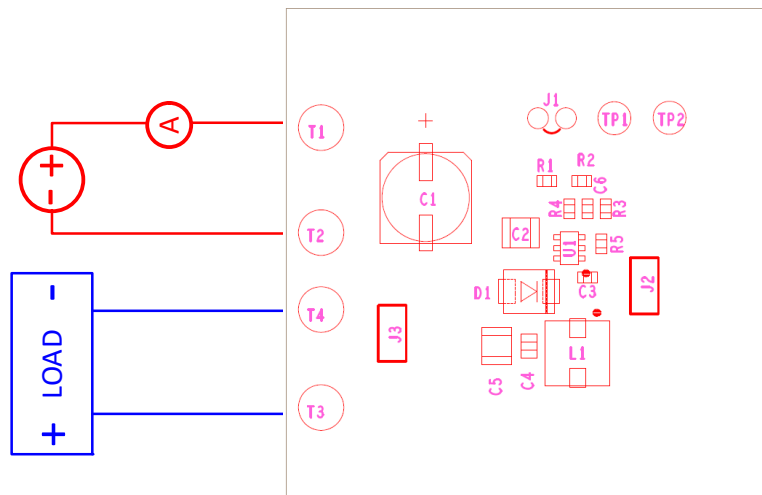


Figure 2. RTKA211412DE0000BU Board Setup

2. Board Design

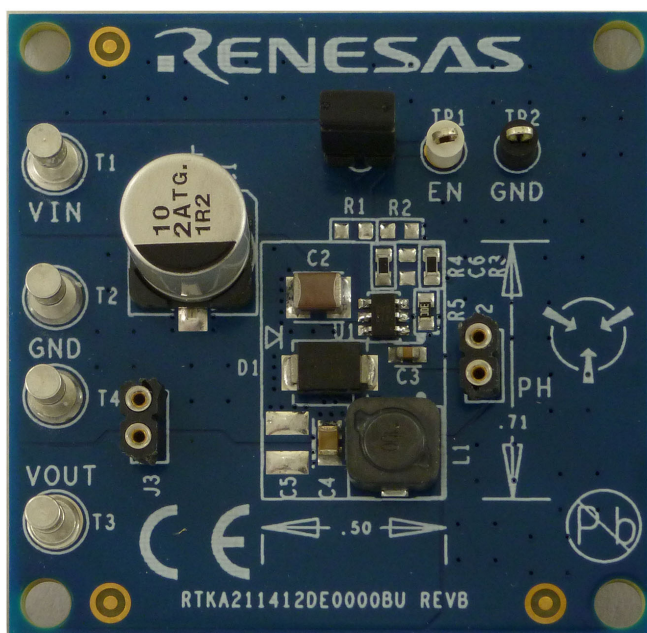


Figure 3. RTKA211412DE0000BU Evaluation Board (Top)

2.1 Bill of Materials

Ref Des	Description	Manufacturer	Part Number
T1-T4	Brass Test Point Turret 0.150 Pad 0.100 Thole PCB Depth <0.078 in	Keystone	1502-1
J2, J3	Gold 2 Pin Socket Strip 0.100 in. Pitch (64 per strip)	Mil-Max	310-93-164-41-001000_1X2
TP2	Miniature Black Test Point 0.100 Pad 0.040 Thole	Keystone	5001
TP1	Miniature White Test Point 0.100 Pad 0.040 Thole	Keystone	5002
L1	WE-PD SMT Shielded Power Inductor 10 μ H	Würth Elektronik	744778610
D1	60V 3A Schottky Barrier Rectifier	Diodes	B360B
C1	Aluminum Electrolytic Capacitor 100V 10 μ F	Panasonic	EEETG2A100P
R3	Thick Film Chip Resistor 20 Ω	Panasonic	ERJ-3EKF20R0V
R4	FILM CHIP RESISTOR 62k Ω	Panasonic	ERJ-3EKF6202V
C4	CERAMIC CAP 10V 47 μ F	Murata	GRM21BR61A476ME15L
C3	Multilayer Cap 0.1 μ F 16V	Various	Generic
C2	Ceramic Chip Cap 2.2 μ F 100V	Various	Generic
R5	Thick Film Chip Resistor 20k Ω	Various	Generic
J1	Two Pin Jumper	Various	Generic
U1	5.8V to 45V 1A Standard Buck Regulator with Peak Current Mode Operation	Renesas	RAA211412

2.3 Board Layout

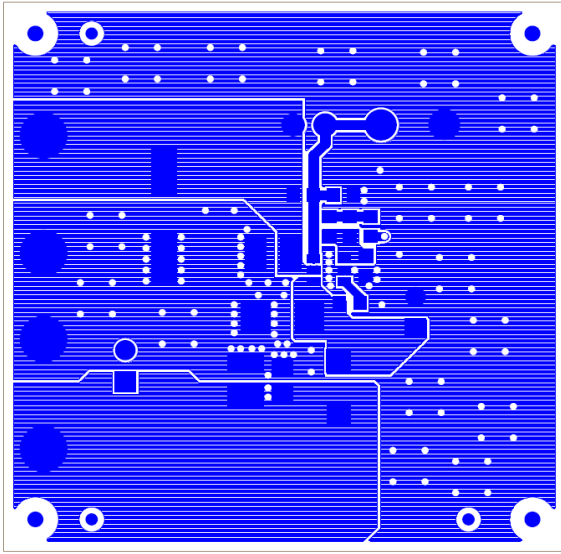


Figure 5. Top Layer

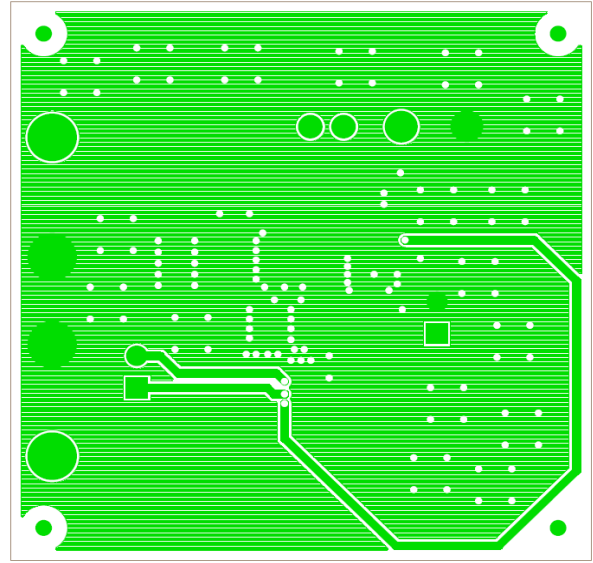


Figure 6. Bottom Layer

2.4 Layout Guidelines

For more information about layout guidelines, see the Layout Suggestions section in the RAA211412 datasheet.

3. Typical Performance Graphs

$V_{IN} = 24V$, $V_{OUT} = 3.3V$, $T_A = +25^\circ C$, unless otherwise noted.

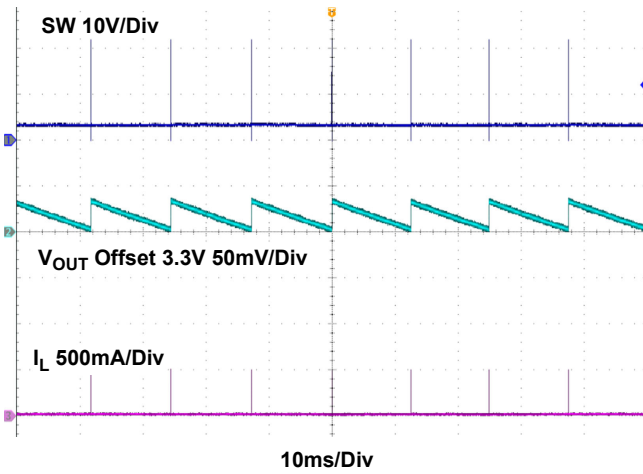


Figure 7. Output Ripple at No Load

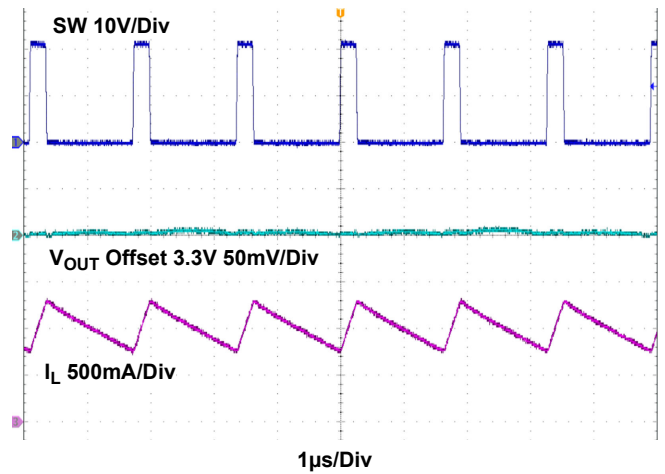


Figure 8. Output Ripple at Full Load

$V_{IN} = 24V$, $V_{OUT} = 3.3V$, $T_A = +25^{\circ}C$, unless otherwise noted. (Cont.)

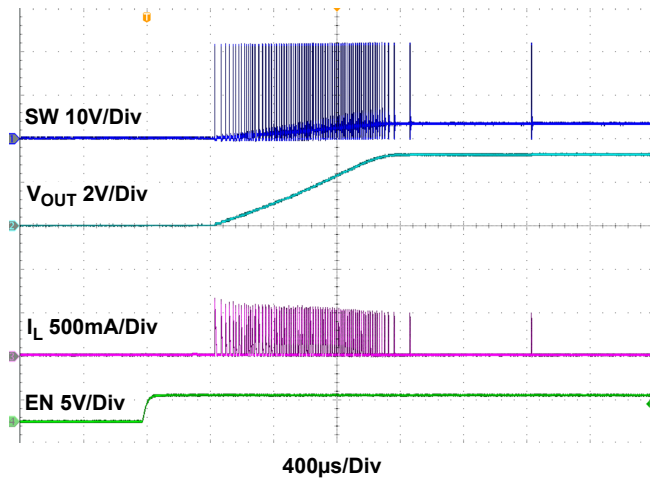


Figure 9. Enable On at No Load

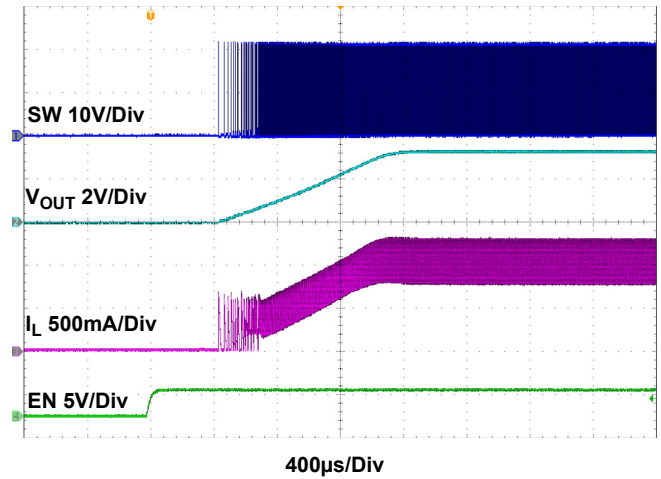


Figure 10. Enable ON at Full Load

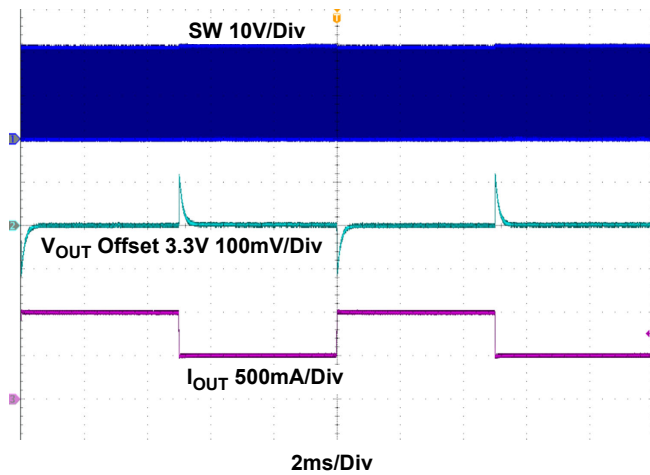


Figure 11. Load Transient between 0.5A and 1A

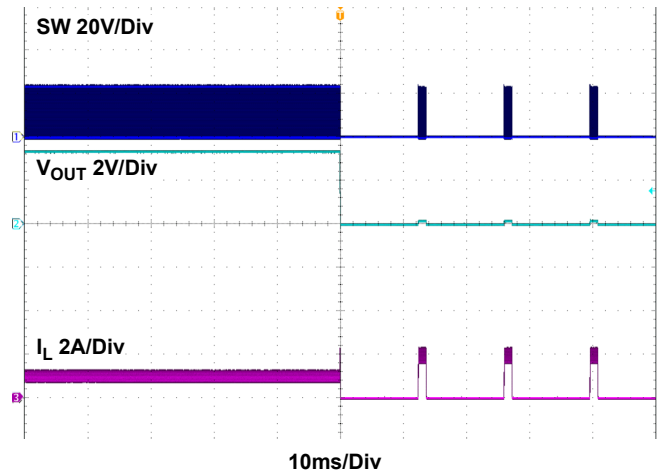


Figure 12. V_{OUT} UVP (Hiccup)

4. Ordering Information

Part Number	Description
RTKA211412DE000BU	RAA211412 evaluation board

5. Revision History

Revision	Date	Description
1.00	Jan 12, 2022	Initial release

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Rev.1.0 Mar 2020)

Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/

Trademarks

Renesas and the Renesas logo are trademarks of Renesas Electronics Corporation. All trademarks and registered trademarks are the property of their respective owners.