# RTKA212832DR0000BU

The RTKA212832DR0000BU provides a simple platform to demonstrate the performances of the RAA212832. The RAA212832 is an integrated 72V input voltage, 0.5A output load one synchronous buck regulator with a fixed switching frequency from 350kHz, and two 100mA and 50mA output load linear regulators LDOs. The buck can support a wide input voltage range of 14V to 72V, and a fixed output voltage of 12V. The LDO_3V3 can support a wide input voltage range of 6V to 12V, and the output voltage is fixed at 3.3V. The LDO_5 can support a wide input voltage range of 6V to 12V, and the output voltage is fixed at 5V. It is designed for small size and high integration electric-bike control board power management. Integrated buck and LDOs minimize the system components.

The buck converter adopts peak current mode control, providing 500mA current for load and downstream LDO regulators, while the following LDOs provide 5V and 3.3V regulated power source to system. The current-mode buck converter provides fast transient response and cycle-by-cycle switching current limit. All output voltages are fixed internally with few external components.

The RAA212832 has fixed frequency operation, even the output terminal is light load condition; therefore, the switching frequency is fixed during the load variation. The RAA212832 also has a pin STBY to enable or disable the standby function to control the buck output voltage as 6V or 12V. When the STBY pin is high and enabled, the standby function to control buck output voltage is changed from 12V down to 6V to save more energy with LDOs operations only.

## Features

- Buck Converter:
  - 4.5V to 72V input voltage
  - Fixed output voltage 12V
  - 500mA output load capability
  - 0.6Ω high-side MOSEFT $r_{DS(ON)}$
  - Fixed switching frequency 350kHz operation
  - 6V standby function by STBY pin setting
  - High-side OCP, UVP, UVLO, OTP fault protection
- 5V LDO Regulator:
  - 6V to 12V input voltage
  - Fixed output voltage 5V
  - 100mA output load capability
  - Current limit foldback function
- 3.3V LDO Regulator:
  - 6V to 12V input voltage
  - Fixed output voltage 3.3V
  - 50mA output load capability
  - Current limit foldback function

## Specifications

This board is configured and optimized for the following operating conditions:

- $V_{IN}$ = 14V to 72V (For VOUT is operated at 6V~12V)
- $V_{OUT}$ = 12V (STBY pin is low) and 6V (STBY pin is high)
- IOUT_MAX = 0.5A
- VLDO_5V = 5V
- LDO_5V_MAX = 0.1A
- VLDO_3V3 = 3.3V
- ILDO_3V3_MAX = 0.05A

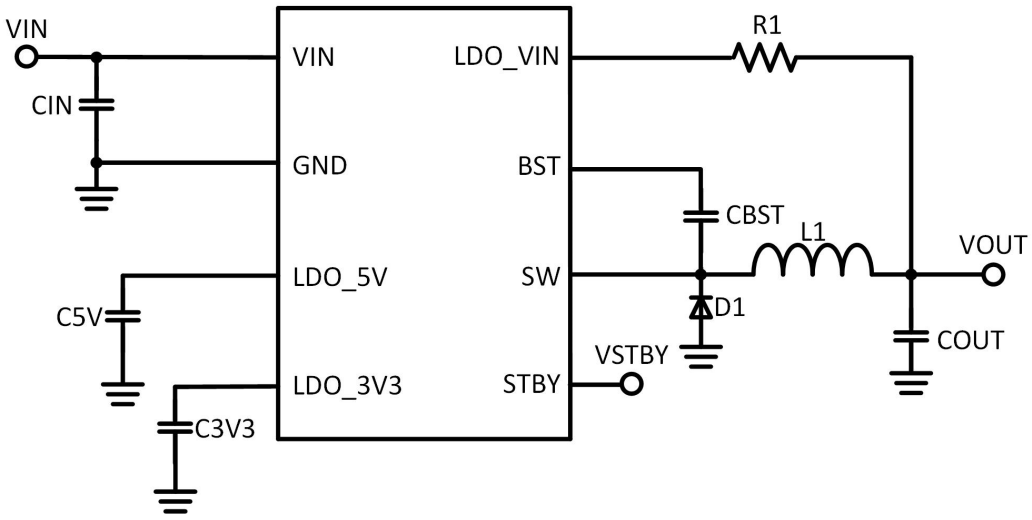


**Figure 1. Typical Application Diagrams**

# Contents

# 1. Functional Description

The RTKA212832DR0000BU demonstration board provides a simple platform to demonstrate the features of the RAA212832. The RTKA212832DR0000BU has a functionally optimized RAA212832 circuit layout that allows efficient operation up to the maximum output current.

The RTKA212832DR0000BU demonstration board is shown in Figure 3 and Figure 4. Figure 5 shows the schematic. The bill of materials and PCB layout information are also provided for your reference. Figure 8 through Figure 31 show performance data taken using this hardware.

## 1.1 Operation Range

The RTKA212832DR0000BU demonstration board input voltage range is 14V to 72V. The output voltage is fixed at 12V when the STBY pin is low and 6V when STBY pin is high. Therefore, the RAA212832 does not need an external feedback resistor design, it is a simple setting for use. For the LDO_5V rail, the output voltage is 5V (default) with a 100mA maximum output current. For the LDO_3V3 rail, the output voltage is 3.3V (default) with a 50mA maximum output current.

## 1.2 Setup and Configuration

See Figure 2 and complete the following steps:

1. Connect the power supply to the input terminals, VIN (J1) and GND (J6). Connect the load to the output terminals, VOUT (J3) and GND (T2). Connect the load to the LDO_5V output terminals, LDO_5V (J2) and GND(J8). Connect the load to the LDO_3V3 output terminals, LDO_3V3 (J2) and GND (J8).
2. Ensure the setup is correctly connected before applying any power or load to the board.
3. Turn on the power supply, and the part should start operating.
4. Verify that the buck output voltage is 12V when STBY is low, and phase node waveforms can be monitored at TP1. Verify that the LDO_5V output voltage is 5V and the LDO_3V3 output voltage is 3.3V.

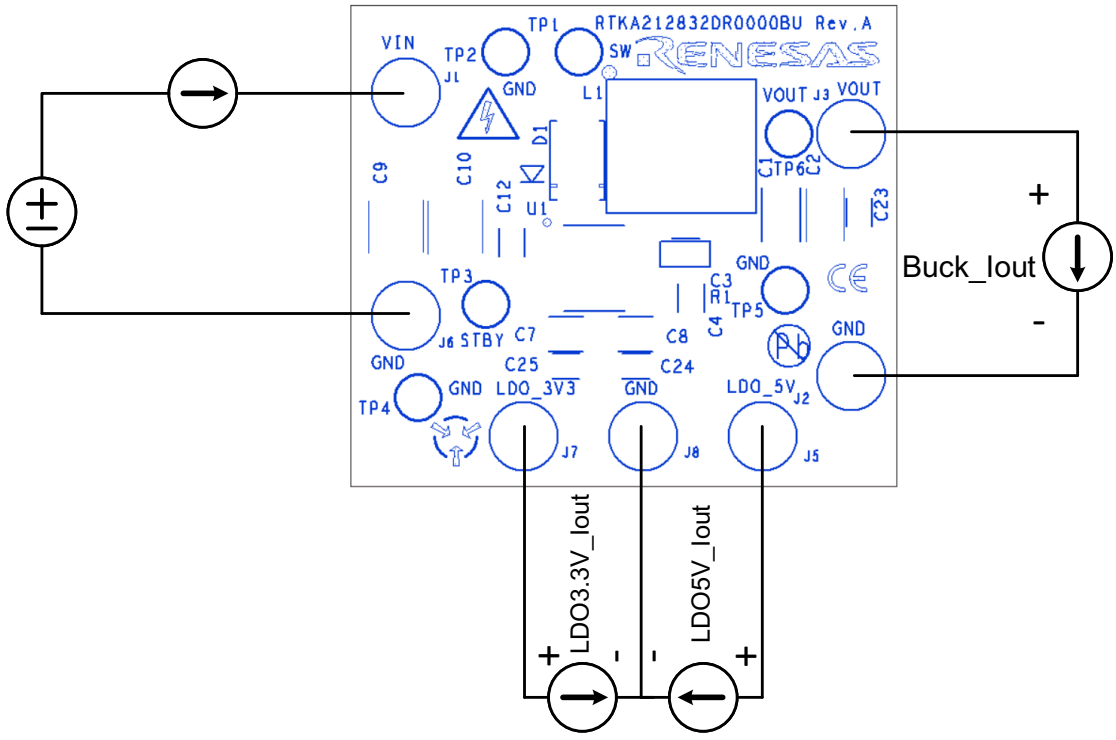


**Figure 2. RTKA212832DR0000BU Board Setup**

# 2. Board Design

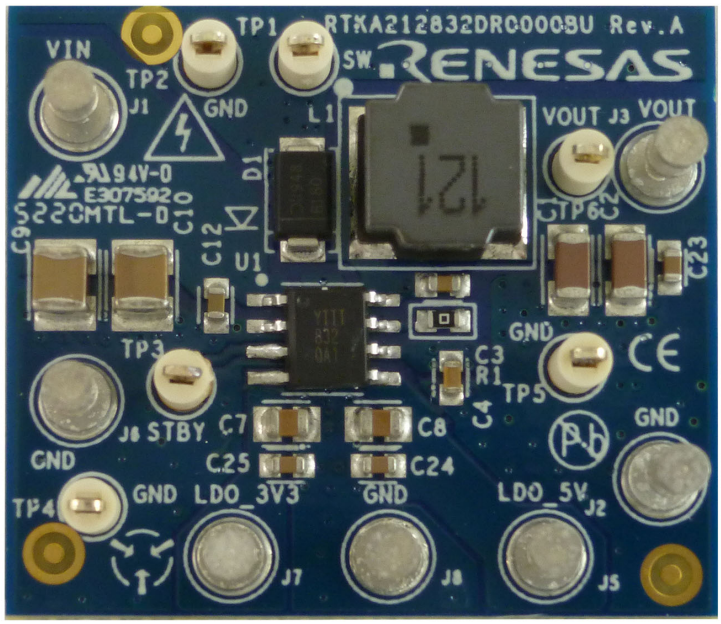


**Figure 3. RTKA212832DR0000BU Demonstration Board (Top)**


**Figure 4. RTKA212832DR0000BU Demonstration Board (Bottom)**

## 2.1 Layout Guidelines

A good PCB layout is important to achieve expected performance. Consideration should be taken when placing the components and routing the trace to minimize the ground impedance and keep the parasitic inductance low. The input and output capacitors should have a good ground connection and be placed as close to the IC as possible. Place the LDO_VIN pin trace away from noisy planes and traces. The via pattern under the RAA212832 is connected to a large ground copper plane on the bottom layer for effective thermal dissipation.

## 2.2 Schematic Diagram

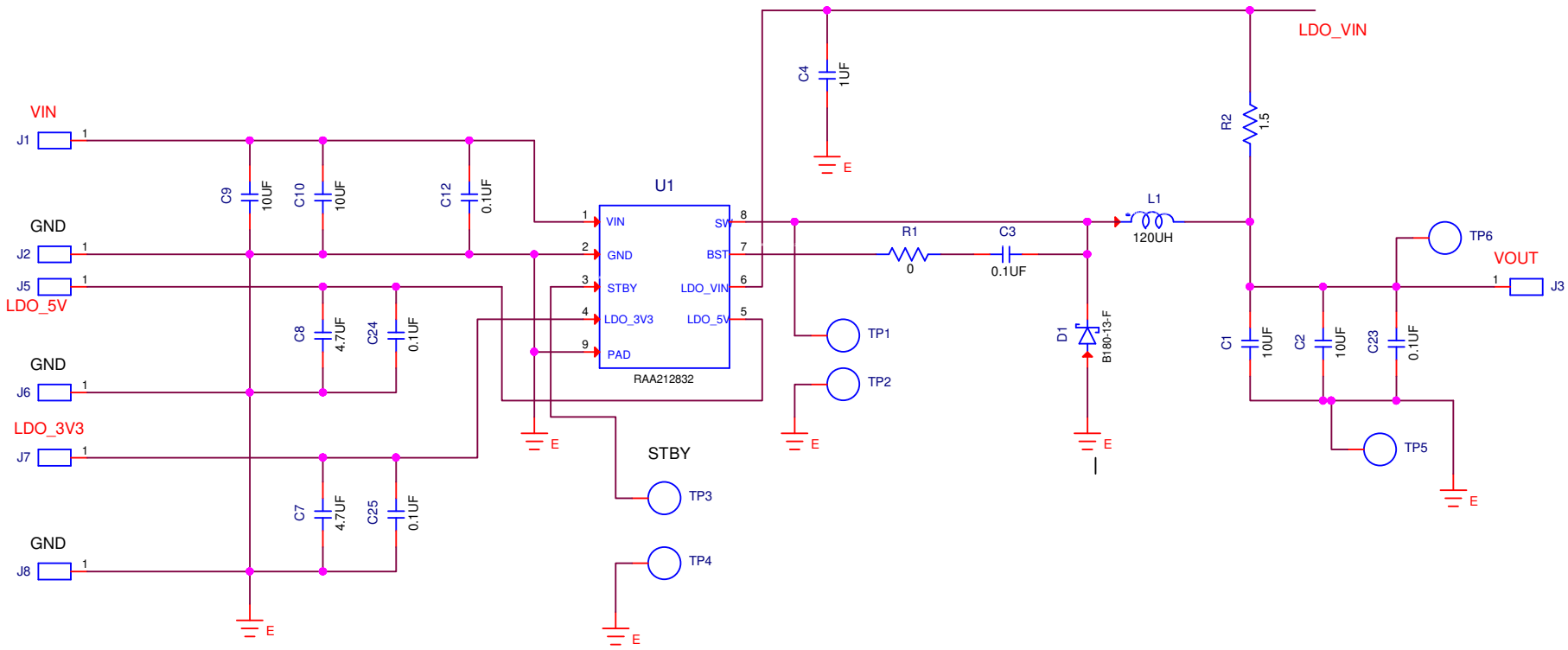


**Figure 5. RTKA212832DR0000BU Board Circuit Schematic**

## 2.3 Bill of Materials

| Qty | Ref Des | Description | Manufacturer | Part Number |
|---|---|---|---|---|
| 1 | U1 | IC SWITCHING REGULATOR,8P, PSOP-8E, ROHS | Renesas | RAA212832GSP#AA0 |
| 1 | L1 | COIL PWR INDUCTOR, SM, 8mm, 120µH, 20%, 1.15A, ROHS | Wurth | 74404084121 |
| 1 | D1 | 1A 80V SCHOTTKY BARRIER RECTIFIER | Diodes | B180-13-F |
| 2 | C1, C2 | CAP, SMD,1206, 10µF, 35V, 10%, X7R, ROHS | TDK | CGA5L1X7R1V106K160AC |
| 4 | C3, C23-C25 | CAP, SMD, 0603, 0.1µF, 16V, 10%, X7R, ROHS | Murata | GCM188R71C104KA37D |
| 2 | C7, C8 | CAP, SMD, 0805, 4.7µF, 10V, 10%, X7R, ROHS | Murata | GRM21BR71A475KA73 |
| 1 | C4 | CAP, SMD, 0603, 1µF, 25V, 10%, X7R, ROHS | Murata | GCM188R71E105KA64D |
| 2 | C9, C10 | CAP, SMD, 1210, 10µF, 100V, 10%, X7S, ROHS | Murata | GRM32EC72A106KE05L |
| 1 | C12 | CAP, SMD, 0603, 0.1µF, 100V, 10%, X7R, ROHS | Murata | GRM188R72A104KA35J |
| 1 | R2 | RES, SMD, 0603, 1.5Ω, 1/10W, 1%, ROHS | Various | VARIOUS |
| 1 | R1 | RES, SMD, 0603, 0Ω, 1/10W, 1%, ROHS | Various | VARIOUS |
| 6 | TP1-TP6 | CONN MINI TEST POINT, VERTICAL, WHITE, ROHS | Keystone | 5002 |
| 7 | J1-J3, J5-J8 | CONN DBL TURRET, TH,0.218x0.078 PCB MNT, TIN/BRASS, ROHS | Keystone | 1502-2 |

## 2.4 Board Layout

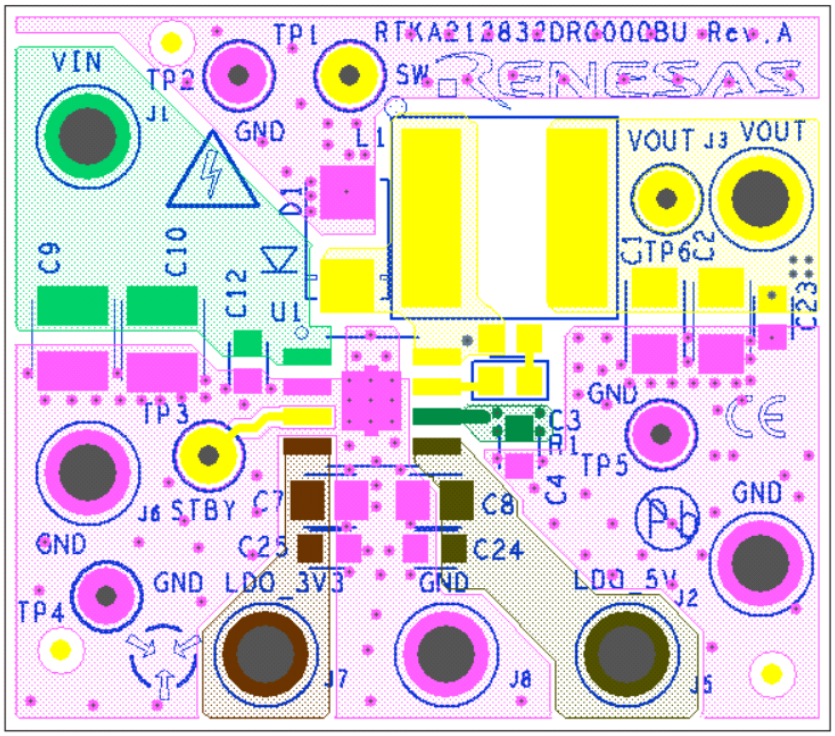


**Figure 6. Top Layer**

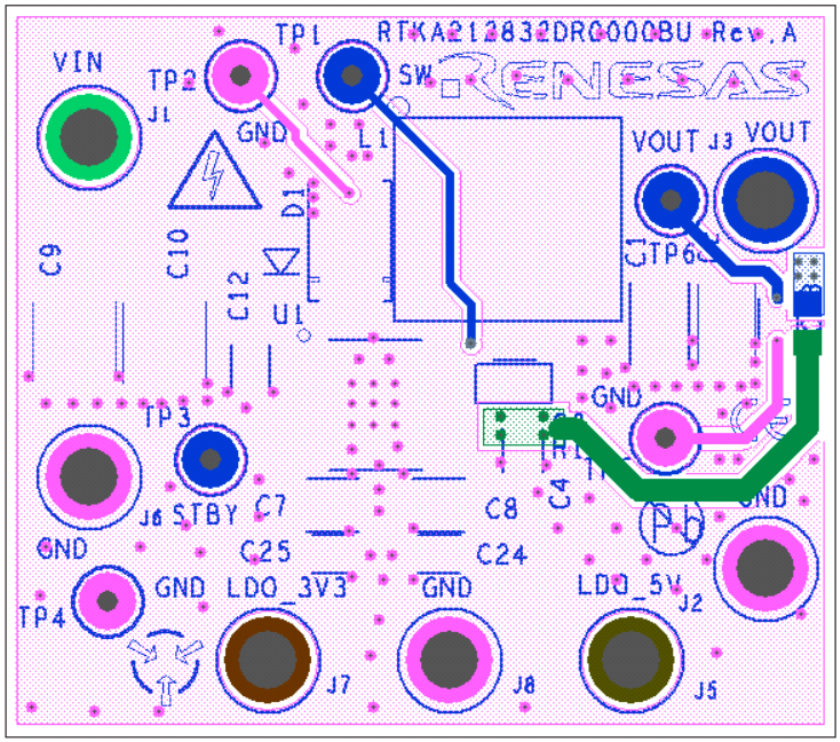


**Figure 7. Bottom Layer**

# 3. Typical Performance Graphs

$V_{IN}$ = 56V, $V_{OUT}$ = 6V, $T_A$ = +25°C, unless otherwise noted.

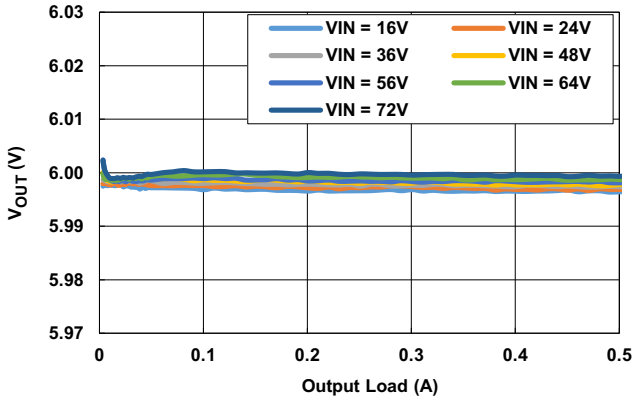


**Figure 8. Load Regulation**

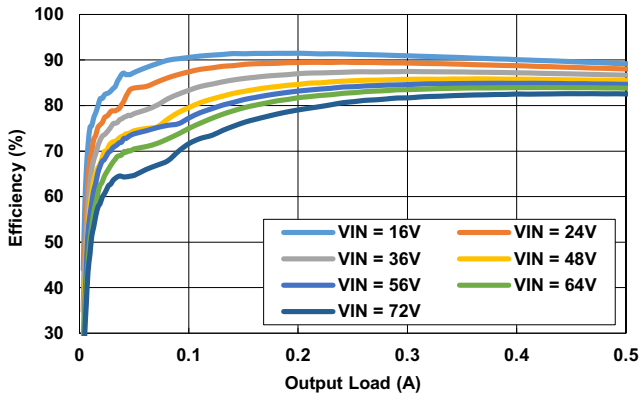


**Figure 9. Efficiency**

$V_{IN}$ = 56V, $V_{OUT}$ = 6V, $T_A$ = +25°C, unless otherwise noted.

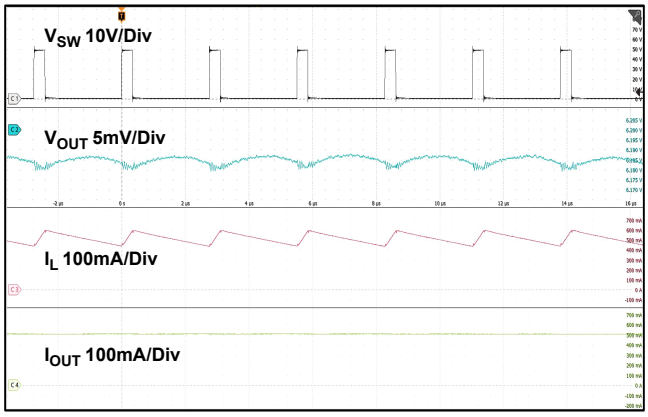


Figure 10. Buck Output Ripple at Full Load

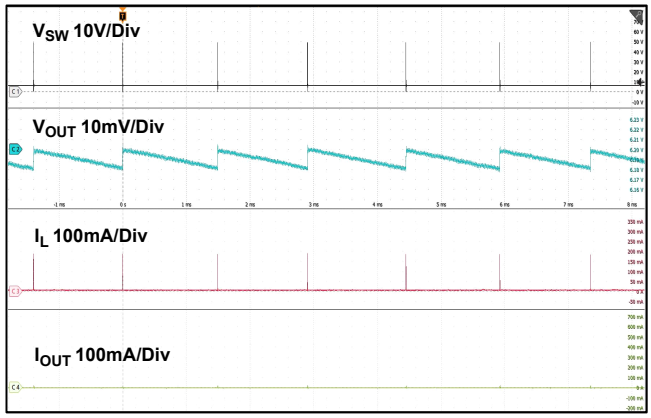


Figure 11. Buck Output Ripple at No Load

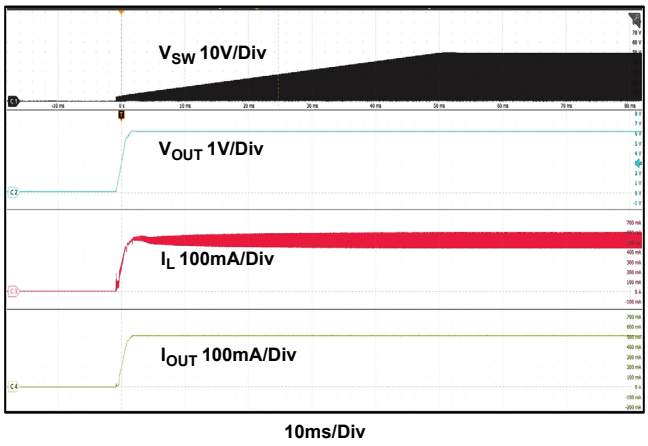


Figure 12. Power-On at Full Load

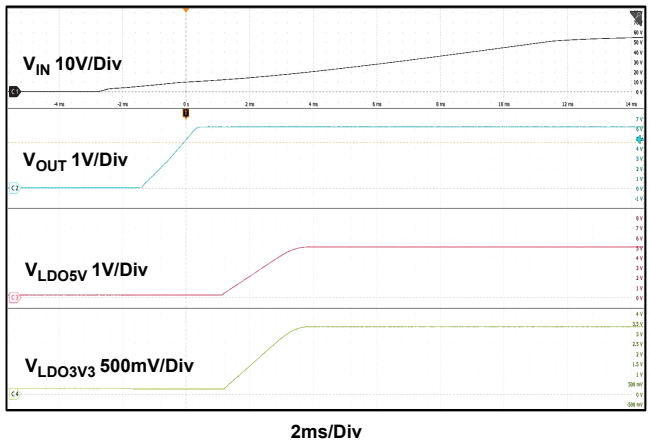


Figure 13. Power-On at Full Load with LDO Channels

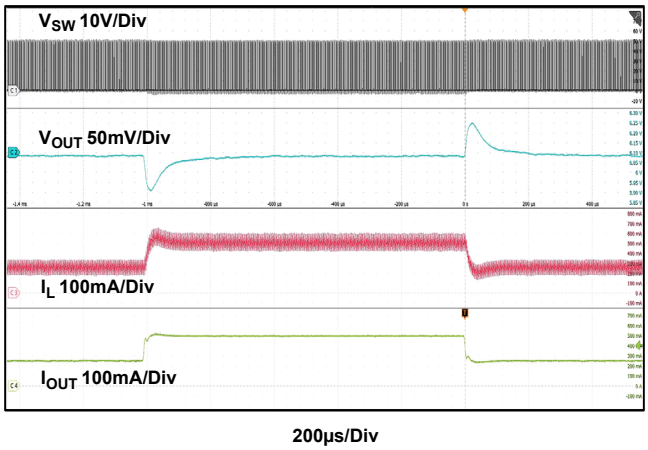


Figure 14. Load Transient between 0.25A to 0.5A

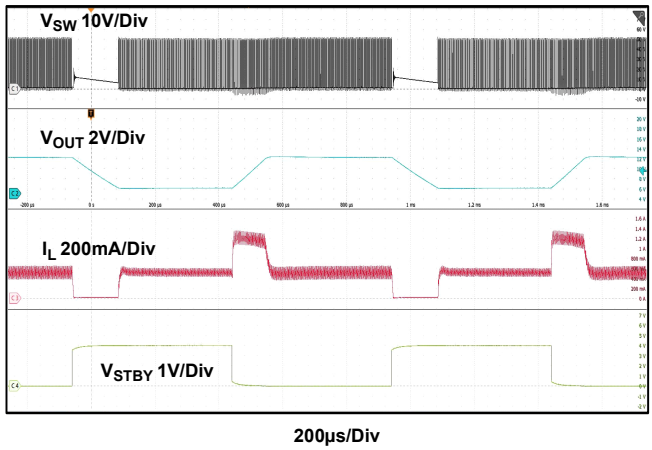


Figure 15. Standby Function at Full Load

$V_{IN}$ = 56V, $V_{OUT}$ = 12V, $T_A$ = +25°C, unless otherwise noted.

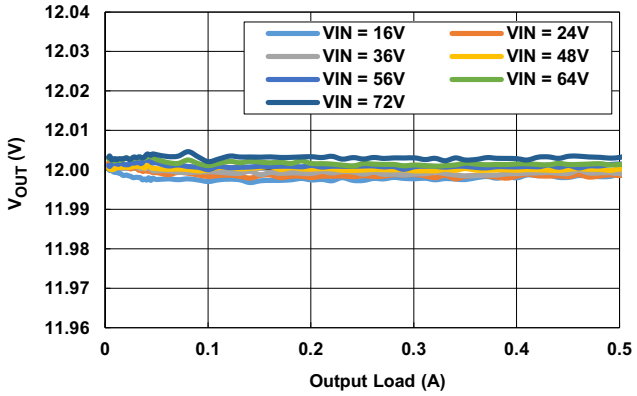


Figure 16. Load Regulation

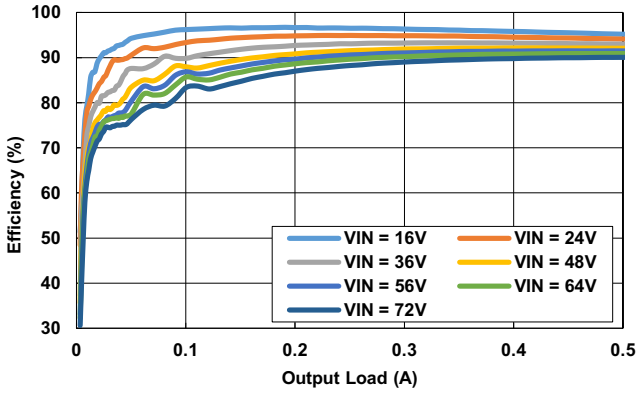


Figure 17. Efficiency

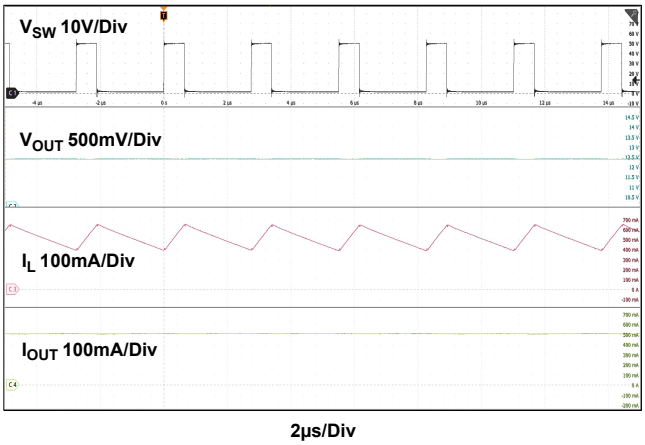


Figure 18. Buck Output Ripple at Full Load

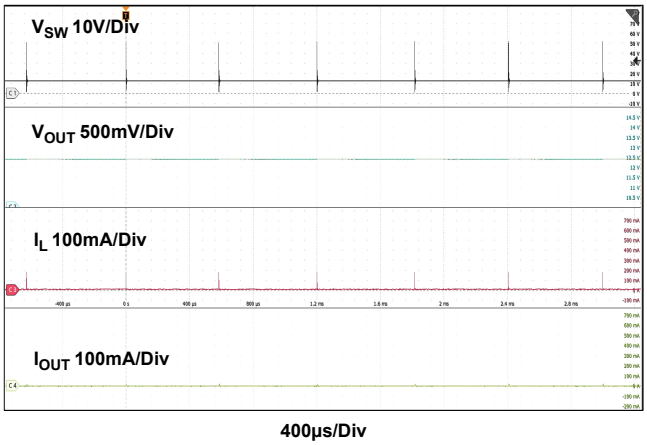


Figure 19. Buck Output Ripple at No Load

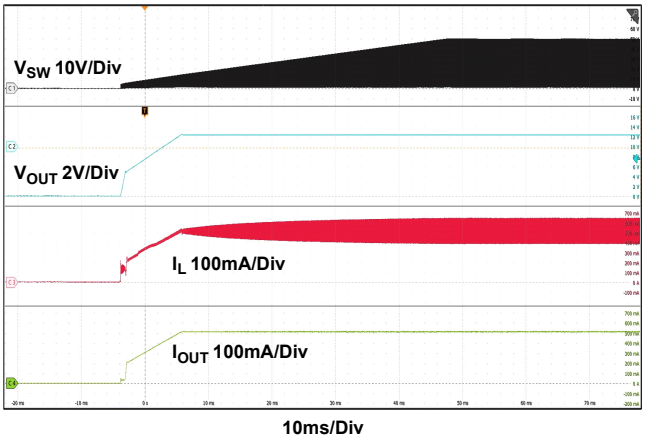


Figure 20. Power-On at Full Load

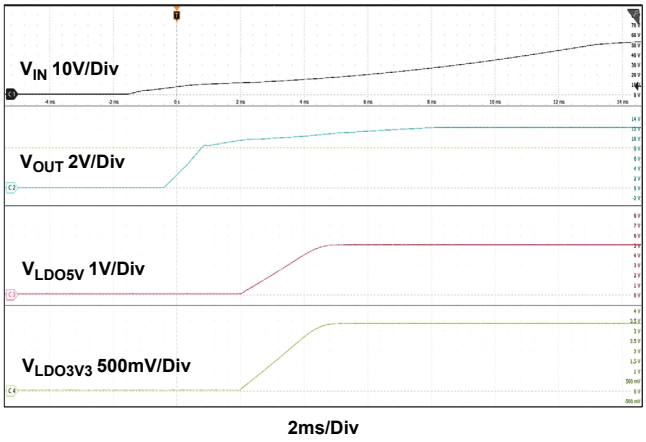


Figure 21. Power-On at Full Load with LDO Channels

$V_{IN}$ = 56V, $V_{OUT}$ = 12V, $T_A$ = +25°C, unless otherwise noted.

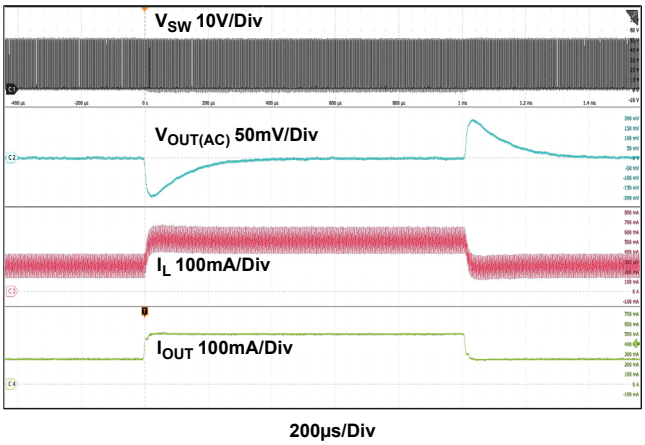


Figure 22. Load Transient between 0.25A to 0.5A

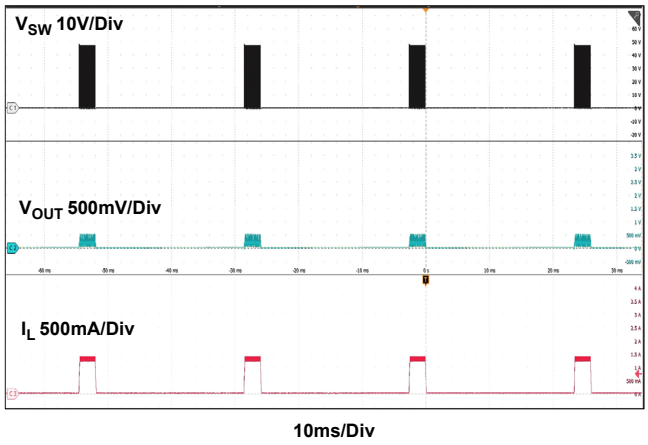


Figure 23. UVP Fault with Hiccup

$V_{OUT}$ = VINLDO = 6V, VLDO5V = 5V, VLDO3V3 = 3.3V, $T_A$ = +25°C, unless otherwise noted.

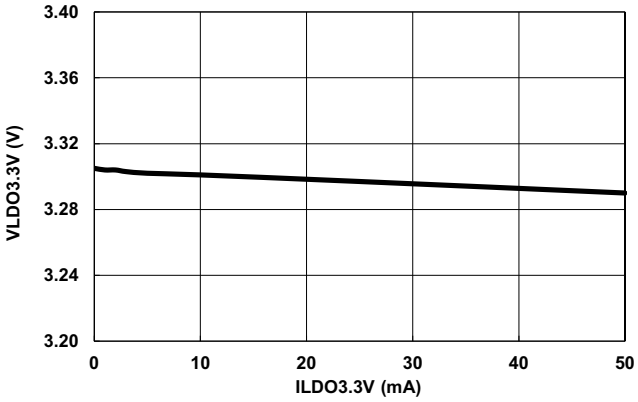


Figure 24. VLDO3V3 Load Regulation

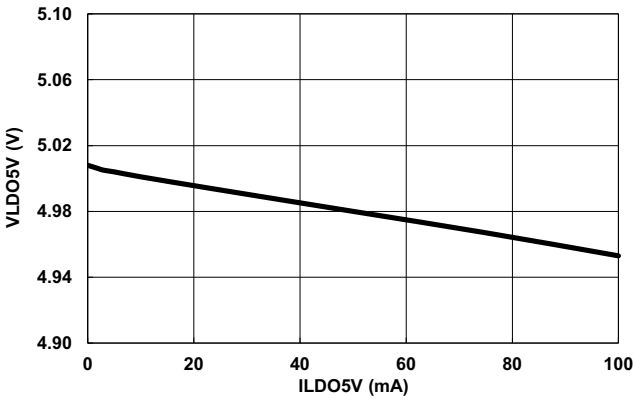


Figure 25. VLDO5V Load Regulation

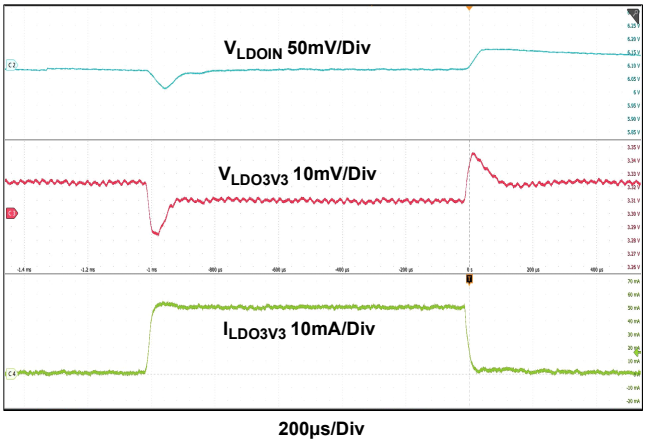


Figure 26. VLDO3V3 Load Transient between 0A to 0.05A

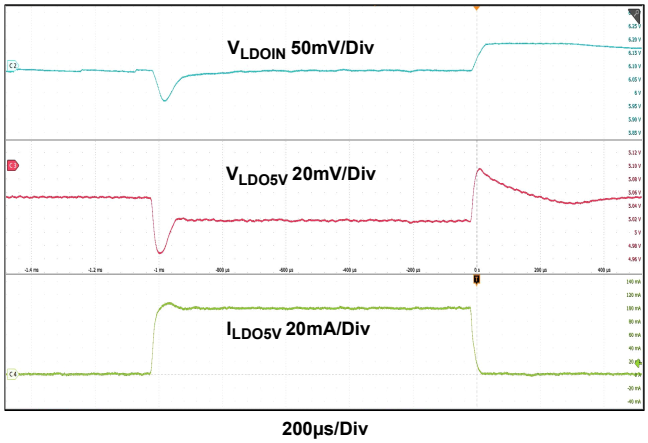


Figure 27. VLDO5V Load Transient between 0A to 0.1A

$V_{OUT}$ = VINLDO = 6V, VLDO5V = 5V, VLDO3V3 = 3.3V, $T_A$ = +25°C, unless otherwise noted. (Cont.)

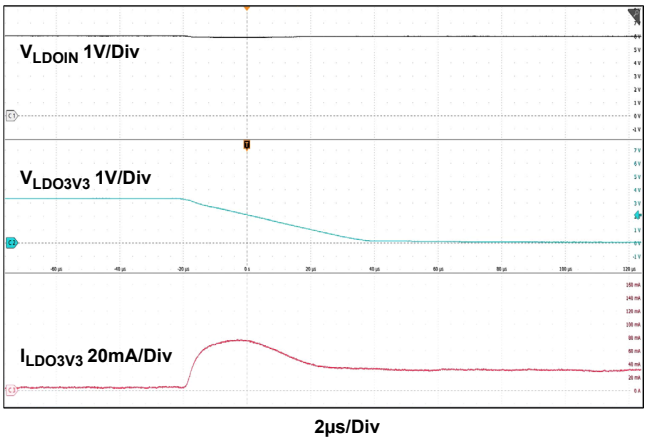


Figure 28. VLDO3V3 OCP Fault with Current Foldback

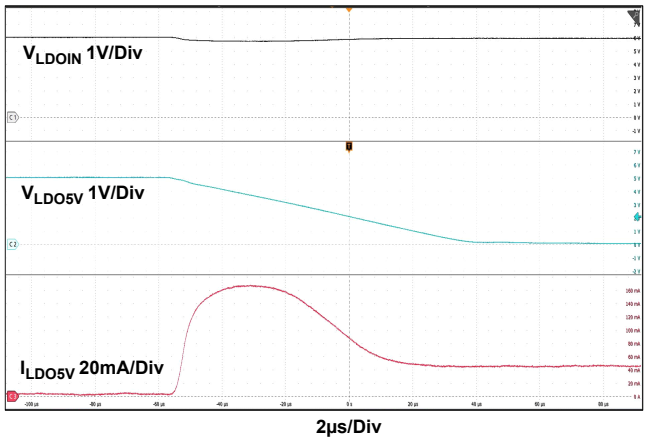


Figure 29. VLDO5V OCP Fault with Current Foldback

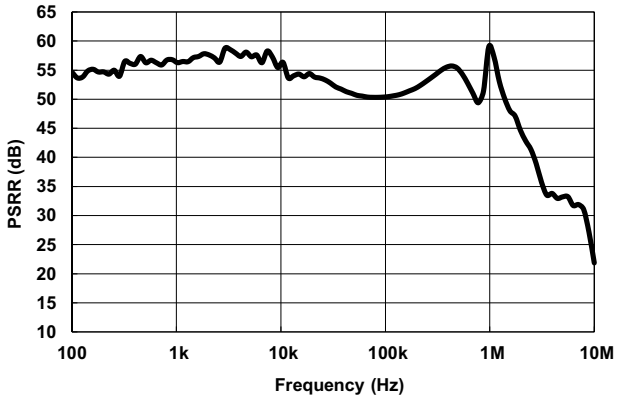


Figure 30. VLDO3V3 PSRR at Full Load

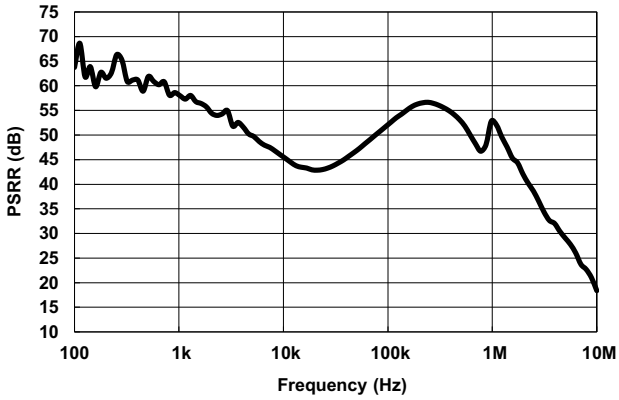


Figure 31. VLDO5V PSRR at Full Load

# 4. Ordering Information

| Part Number | Description |
|---|---|
| RTKA212832DR0000BU | RAA212832 Demonstration Board |

# 5. Revision History

| Revision | Date | Description |
|---|---|---|
| 1.00 | Sep 20, 2021 | Initial release |

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