RTKA271084DE0000BU

7-channel Automotive PMIC Evaluation Board and GUI

Description

The RTKA271084DE0000BU evaluates the performance of the RAA271084 Automotive PMIC with a high voltage primary buck/boost controller, a low voltage synchronous buck controller, and five low-dropout liner regulators (LDO), two of which can be used as trackers. The evaluation board is intended for providing MCU power in automotive applications.

In addition to four output voltages, the evaluation board also contains an SPI interface.

The RAA271084 is offered in a 7mm×7mm 48-lead Step Cut QFN (SCQFN) package or 9mm×9mm 48-lead thin QFP (LQFP) with an exposed pad. The RAA271084 is qualified to AEC-Q100, Grade1.

Features

- V_{IN} operating range from 2.7 to 42V including cold crank
- Start range 4.5 to 42V
- Two DC/DC controllers with integrated drivers
  - Buck-Boost DCDC1 5.7V at 2.2A
    Buck DCDC2 resister programmable (5V at 1.2A, 3.3V at 1.8A, 1.09V at 4.2A)
- Five linear regulators
  - LDO0 (VCC), 5V (always on)
  - LDO1-4, programmable 3.3V/5V (LDO1-2 at 350mA, LDO3-4 at 200mA)
  - LDO3-4, configurable as trackers with short-to-battery/short-to-ground and reverse current protection
- Configurable Frequency 440kHz/2.2MHz
- Over-temperature, overcurrent, overvoltage, and negative overcurrent protection

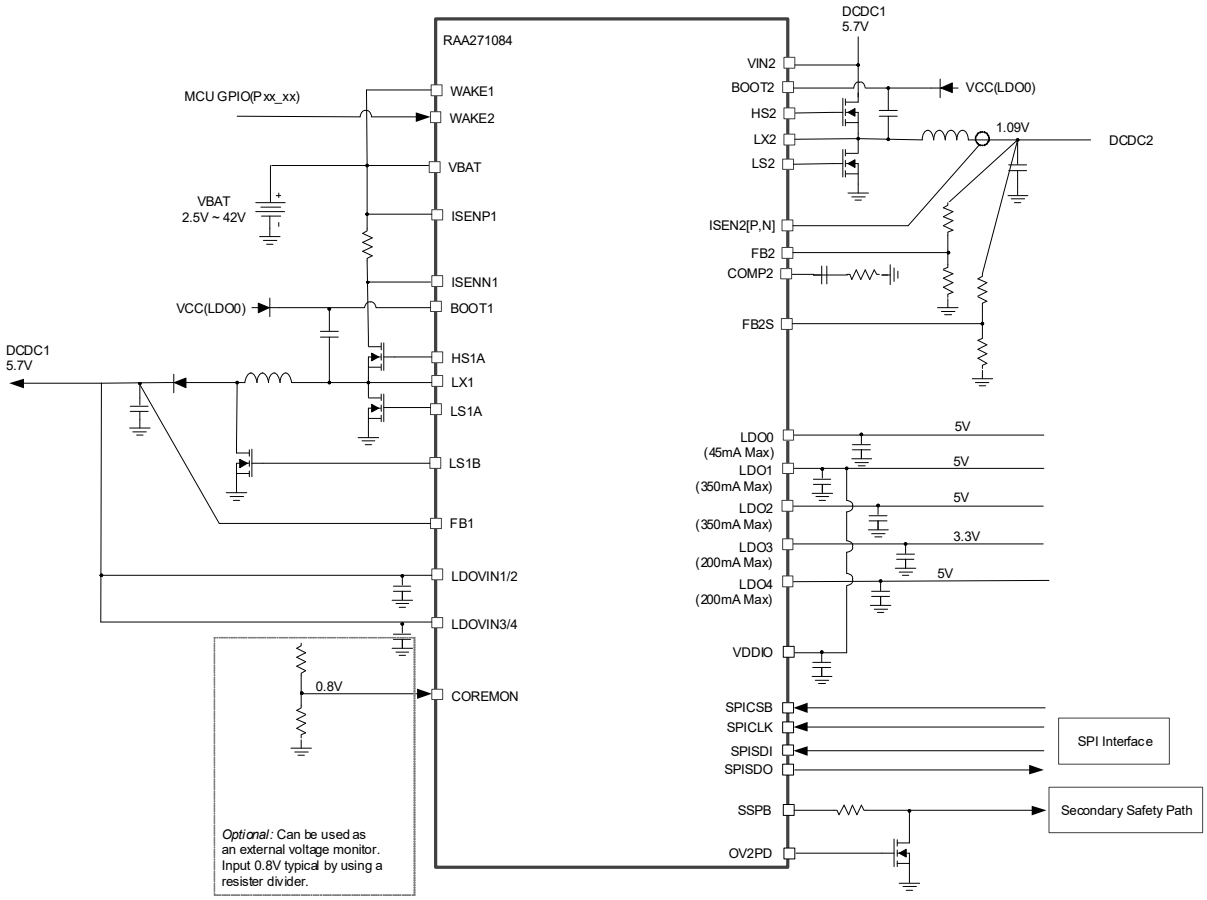

Figure 1. Block Diagram

Contents

1. Functional Description

The evaluation board with connections, headers, and test points is shown in Figure 2.

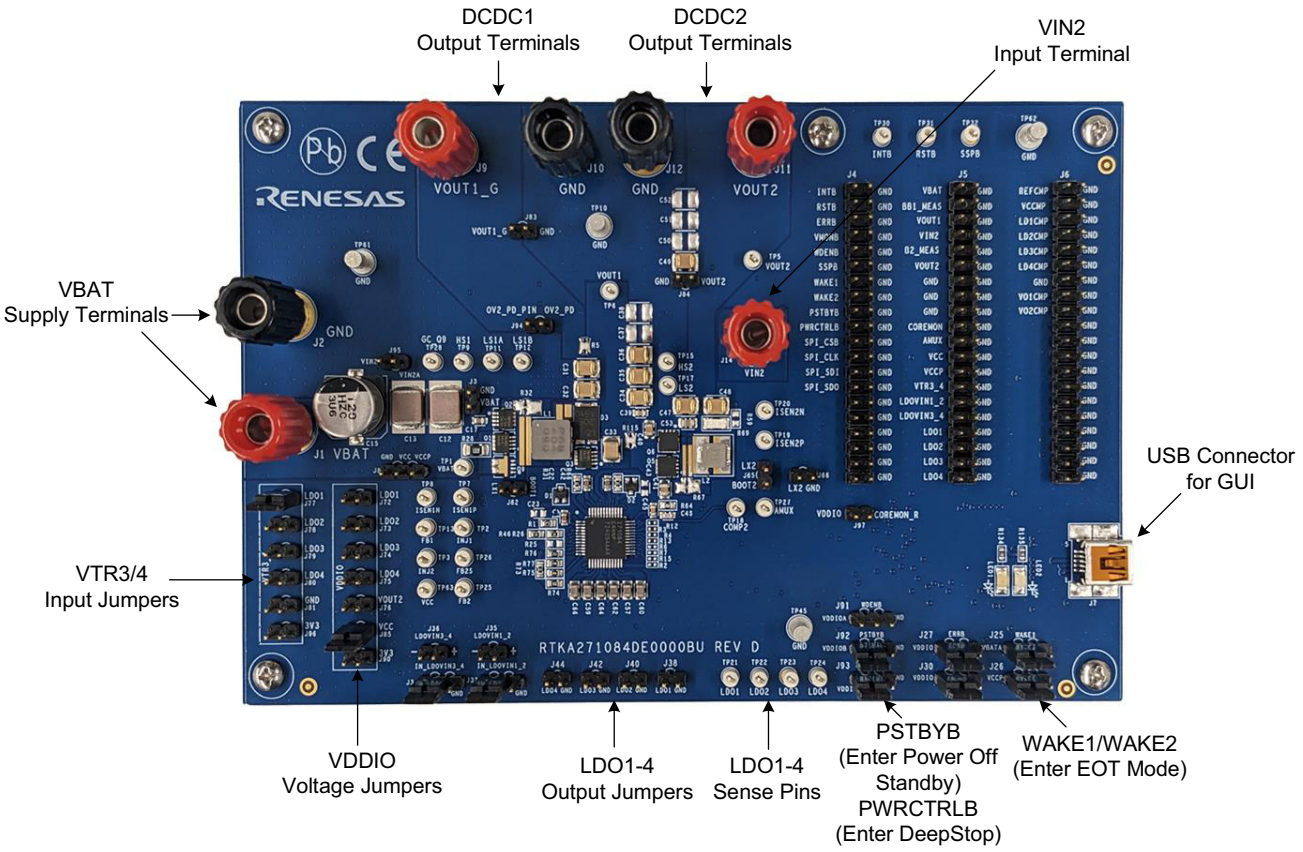

Figure 2. RAA271084 Evaluation Board: Connections, Headers, and Test Points

- To start the board, apply the input voltage(2.7V < VIN < 42) to the VIN supply terminals J1(+) and J2(-) (see Figure 2).
- For EN control, use WAKE1 and WAKE2 at J25 and J26 (see Figure 2).
- For VDDIO voltage supply, use the VDDIO voltage jumpers to select the supply source (see Figure 2).
- For tracker reference input, use the VTR3/4 Input jumpers to select the supply source (see Figure 2).

1.1 Manual Output Control using WAKE1 and WAKE2

For manual control of EN, ensure that the J25 and J26 jumpers are not installed. WAKE1/WAKE2 enables the IC (see Figure 2).

The following are the states of WAKE1/WAKE2:

- WAKE1/WAKE2 < 0.4V
  - The IC is off and in its lowest power state.
- WAKE1 or WAKE2 > 1.4V
  - The IC is enabled.

The status of the regulators depends on the PMIC STATE and settings. Refer to the *RAA271084 Datasheet*, section *Operation of the PMIC*.

1.2 Testing the Outputs

When the WAKE1 or WAKE2 inputs are configured, the outputs can be loaded to perform tests such as load regulation, startup and shutdown, and load transients.

1.2.1 Input and Output Connections and Test Points

The input and output connections are shown in Figure 1 and Table 1.

Table 1. Connections and Test Points

Connection	(+) Test Point	GND Test Point	Default Value (V)
VBAT (input)	TP1	TP61	12 (2.7V to 42V, 4.5V to start)
Vout1	TP6	TP10	5.7
Vout2	TP5	TP10	5.0 or 3.3 or 1.09
LDO0 (VCC)	J5 (VCC)	TP62	5.0
LDO1	TP21	TP45	5.0 or 3.3
LDO2	TP22	TP45	5.0 or 3.3
LDO3/TRACKER3	TP23	TP45	5.0 or 3.3
LDO4/TRACKER4	TP24	TP45	5.0 or 3.3

The following are more test points (see Figure 1):

- RSTB and INTB test points, located on the upper-side of J4.
- WAKE1 and WAKE2 test points, located on the middle of J4.

2. GUI Operation

The RAA271084 GUI can be used to configure feature sets by creating an OTP file, which generates customer samples. For initial samples of the RAA271084, the Renesas Application Engineering Team provides a short-form questionnaire for customer inputs on major options. (The customer can also review the datasheet and specify additional configuration options as required.)

The RAA271084 OTP Initial Configuration:

- Input voltage range
- DCDC1 (Buck/Boost) and DCDC2 (Buck) switching frequency
- DCDC1 (Buck/Boost) output current
- DCDC2 (Buck) output voltage and current
- Output voltage and current for LDO1-4
- Output rails startup and shutdown timing and sequencing requirements
- LDO3/LDO4 usage (LDO or tracker)

The following are requirements before starting the GUI software:

- A USB interface cable must be connected between the host computer and the EVB.
- The VDDIO supply to the EVB must be 3.3V minimum.

Figure 3 shows the list of the GUI files to be downloaded. Double-click the **RAA271084.exe** file to start the GUI software.

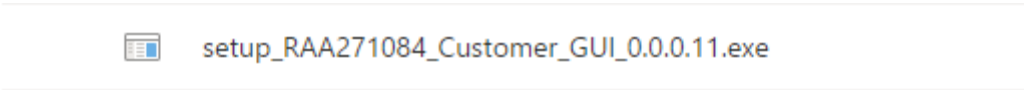

Figure 3. GUI Files

When powered up, the GUI appears as shown in Figure 4.

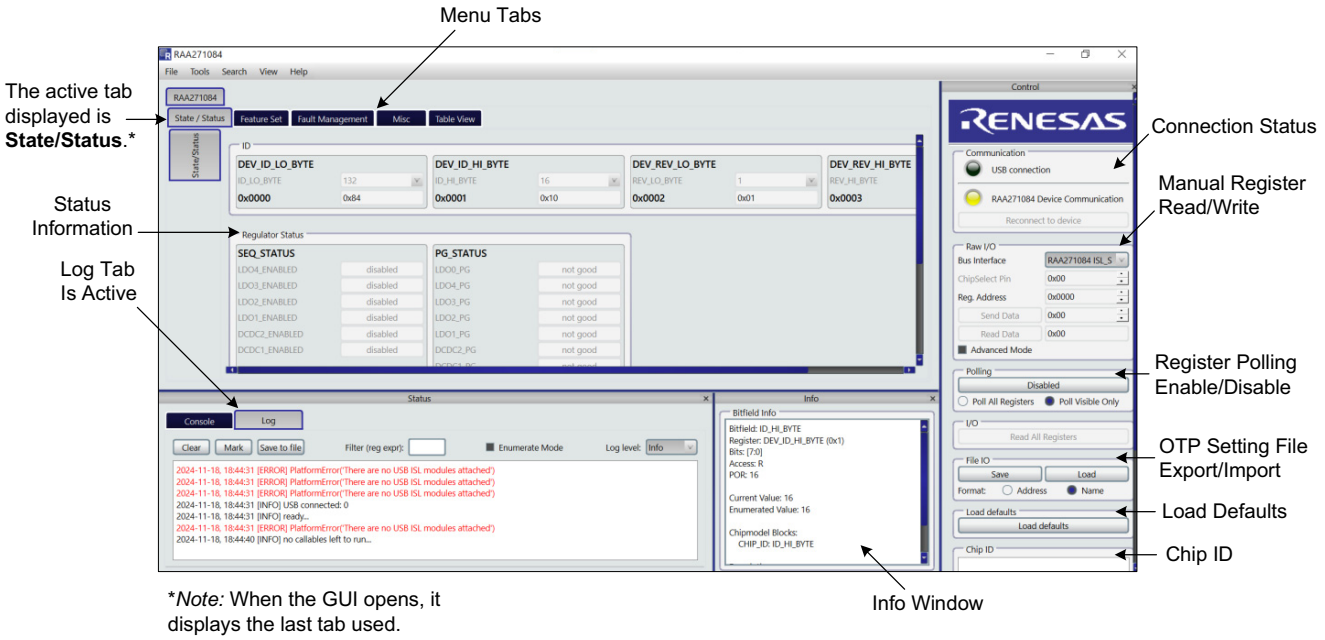

Figure 4. State/Status Tab with Labels

The GUI functions are grouped into rows or columns. Figure 4 displays the **State/Status** tab, which is detailed in this section along with other tabs such as the **Feature Set**, **Fault Management**, **Misc**, and **Table View**.

In the center of Figure 4, the **Status Information** label points to data that is grouped into rows.
Note: These rows are shown for the **State/Status** tab, and other tabs show different options. The rows are explained as follows:

- **Tab Select** – This row contains buttons for the different tabs in the GUI. Each tab controls a set of functions. When the tab is selected, the GUI displays the dropdowns and options associated with that tab.
- **Connection Status** – This row shows the Connection Status with the GUI tool and EVB. Green signals a correct connection. Yellow signals no connection. Red signals an incorrect connection.
- **Manual register Read / Write** – This row contains the Bus interface, ChipSelect Pin, Reg. Address, Send Data, Read Data, and Advanced Mode column. A bus interface can be used to select RAA271084_ISL_SPI or RAA271084_SAM3U_SPI. Select to suit for the EVB and GUI connection. (If the EVB and PC are connected directly, select RAA271084_ISL_SPI. For a register read/write, input the register address and use Send Data to write or Read Data to read. To control the Frequency, Dev Num, CLK Mode, Write Flag, Dummy Bytes, and CRC Flag, check the **Advanced Mode** box.
- **Register Polling Enable / Disable** – This row contains the register polling function. Set the button to enable or disable the register polling function.
- **File IO** – This row contains file related functions. The GUI can export or import the OTP setting from a CSV or TXT file.

Complete the following steps to create an OTP file:

1. Make the selections for these tabs: **Feature Set**, **Fault Management**, and **Misc**.
2. Review the selections using the **Table View** tab.
3. Start the OTP programming widget located in the **Tools** dropdown menu (Figure 5).

From the main menu, select **Tools** > **RAA271084 OTP Programmer** to start the OTP Programmer Widget.

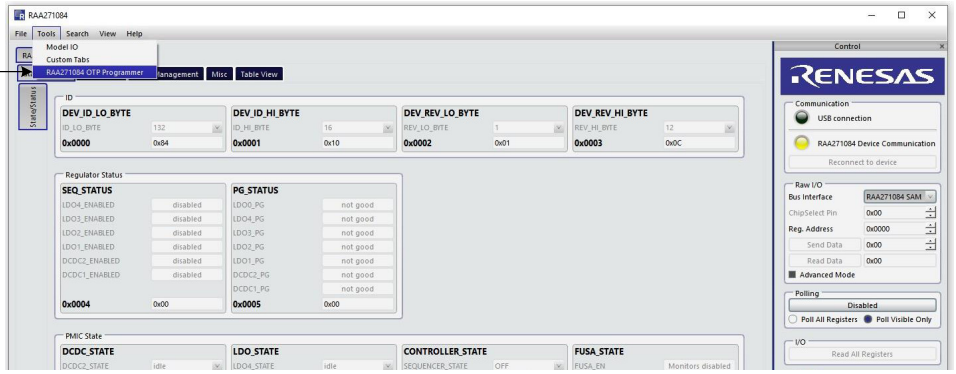

Figure 5. OTP Programming Sequence

4. In the OTP programmer screen, click **Load From Registers** (Figure 6).

Click **Load from Registers** to update changes made to the default settings.

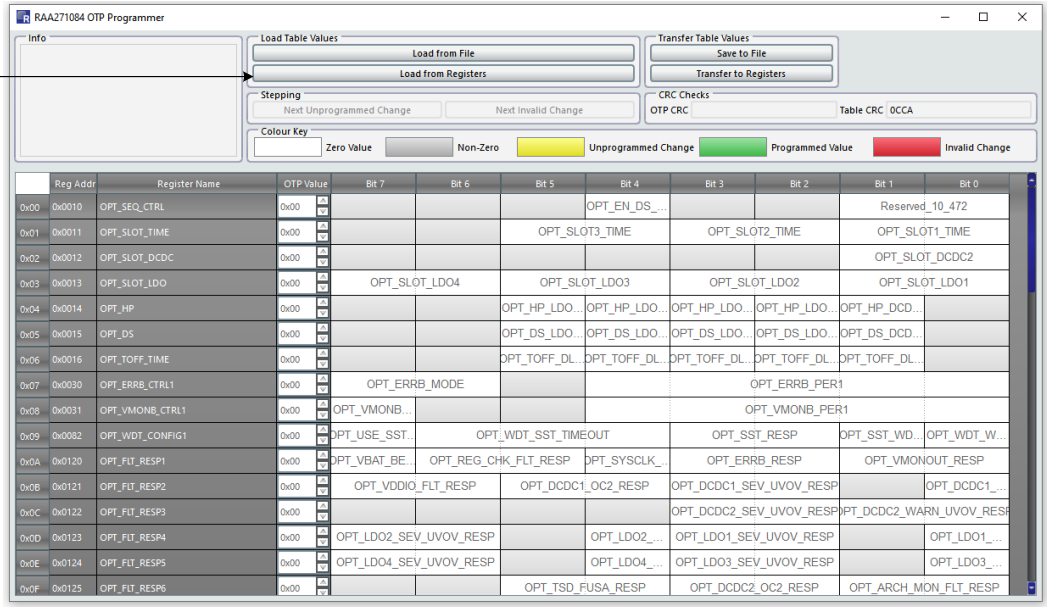

Figure 6. Import OTP Changes from Default Configuration

5. Save the configuration using the **.ini** format (Figure 7).

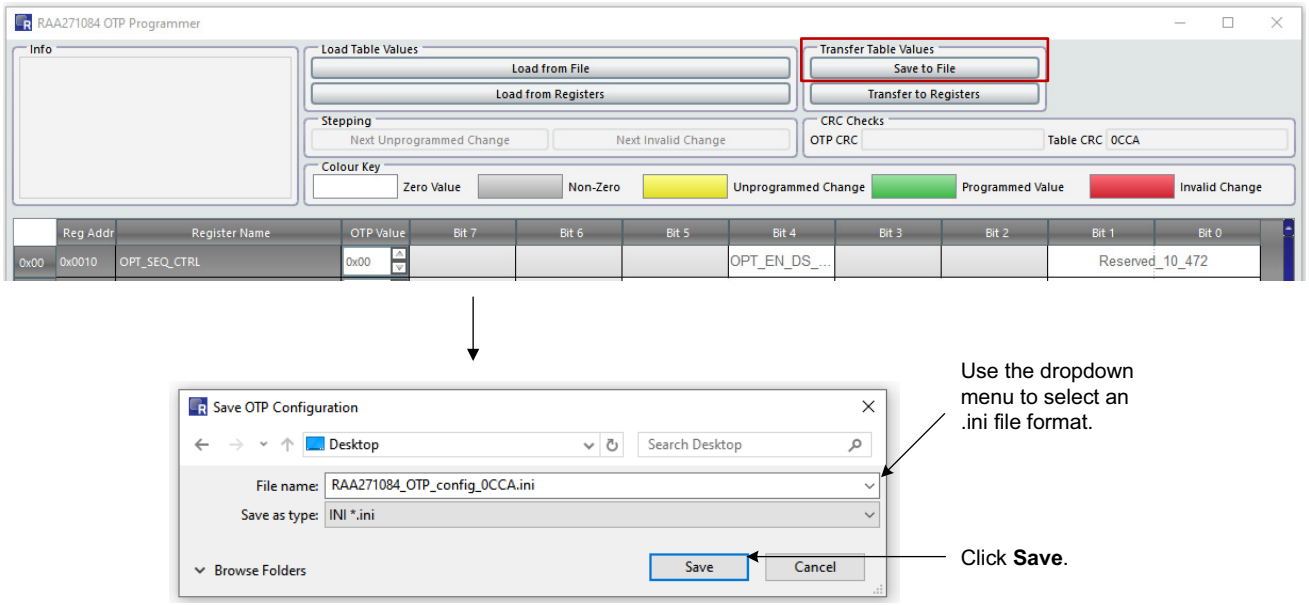

Figure 7. Save the OTP Configuration as .ini File

- **Load defaults** – Use this button to update the register values to default.
- **Info** window – This row describes information (see Figure 4).
- **Status** menu tabs – These tabs are the **Console** tab, used for scripts, and the **Log** tab, used to view activity logs.
- **Status** information – This indicates the register settings. The value can be changed by clicking.
- **Chip ID** – Reads the device ID and silicon revision.

When powered up, the GUI should initially appear as in Figure 4. When the IC is enabled and connected with a USB, the GUI automatically detects the EVB.

2.1 Changing Programming Options

Complete the following steps to make changes in the options on this tab such as Output Voltage and V_{OUT} OV Threshold:

1. Input the VBAT and WAKE1 or WAKE2 to place the IC in enabled. All the options on the **State/Status** tab can be changed only when the device is Enabled.
2. Select the options by clicking the relevant menu button.

   Note: There are options not shown on this **State/Status** tab. These other options are located on the **Feature Set**, **Misc**, and **Table View** tabs. Changes on that tab can be made by moving to that tab and selecting the required options.
3. Changes are applied immediately when the button is clicked.

Note: While options can be selected, the accuracy of the selected options can be slightly outside the datasheet specifications. Datasheet accuracy limits are assured only for the factory-programmed settings. As an example, if LDO1 is selected to the default value of 5.0V, the output value is finely adjusted at the factory for LDO1 set to 5.0V. If V_{OUT1} is later changed to a different voltage setting, the new V_{OUT1} voltage might be slightly less accurate than the default setting. However, the change in accuracy is minor and should not significantly affect system or board level testing. After the required options are chosen, the device can be ordered and factory-adjusted with those specific options to provide the best accuracy available.

Note: If any option is set to a value other than the factory-programmed value and OPT_SPI_CRC is enabled, this creates a CRC Recheck fault. This CRC Recheck error is ignored if the OPT_SPI_CRC is disabled.

2.2 Feature Set Tab

View the **Feature Set** information by clicking the **Feature Set** button in the tab row.

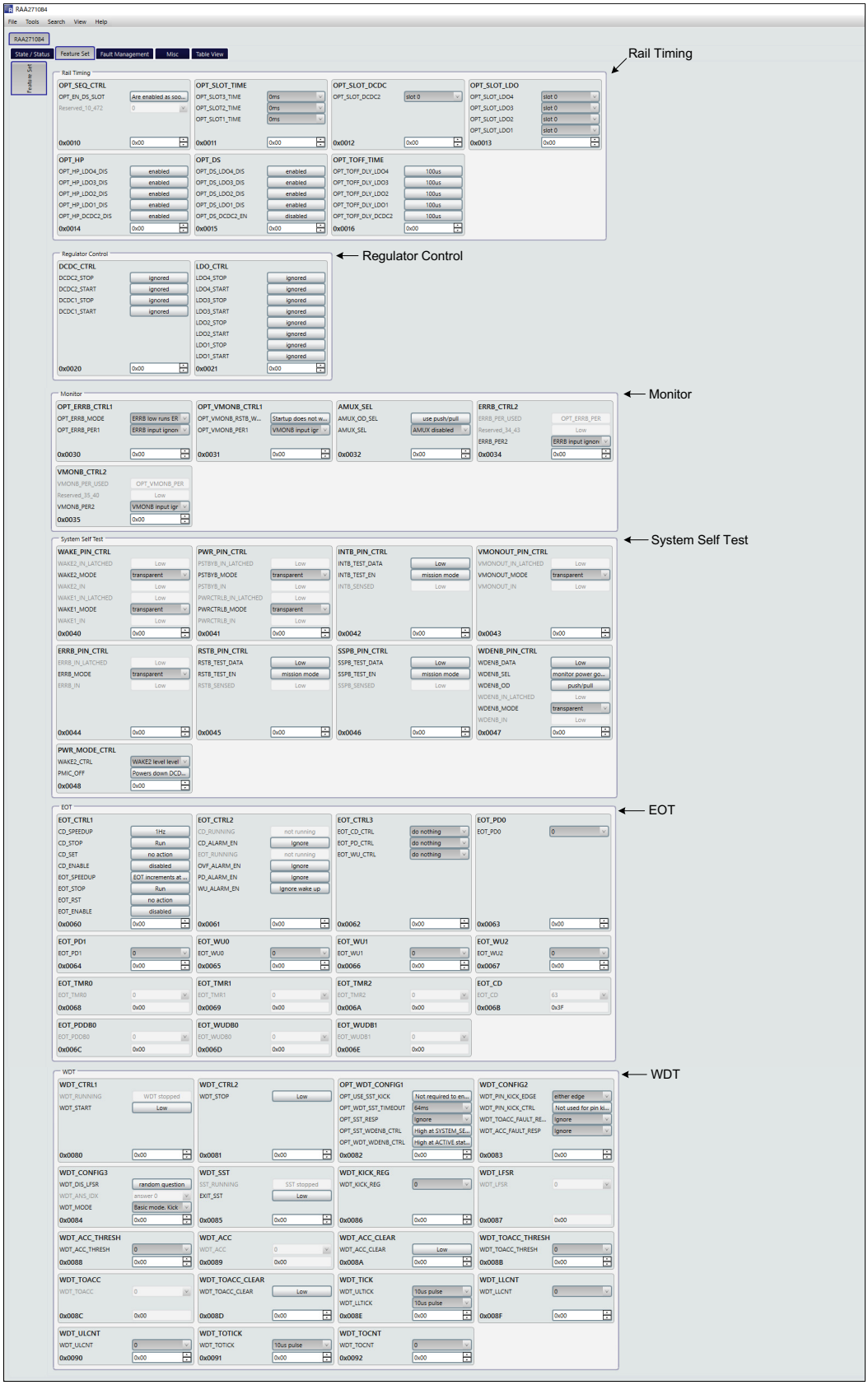

Figure 8. Feature Set Tab

The **Feature Set** tab information is arranged in columns as follows: Rail Timing, Regulator Control, Monitor, System Self Test, EOT, and WDT. The first column on top, Rail Timing lists OPT settings related to sequence timings, such as SLOT selection and delay time of each regulators and signals. For details on the sequence timing, refer to the *RAA271084 Datasheet*, section *Timing Summary*.

The remaining columns are described as follows:

- The Regulator Control column lists the start and stop settings of each regulator.
- The Monitor column lists monitoring function settings: such as the ERRB, VMONB, and AMUX monitoring mode settings.
- The System Self Test column lists the IC pin settings, such as WAKE1, WAKE2, PSTBYB, PWRCTRLB, INTB, VMONOUT, ERRB, RSTB, SSPB, and WDENB.

2.2.1 Fault Management

To view any detected faults, use the **Fault Management** tab. Any detected faults highlight with a green background such as in Figure 9 where the detected faults are the Overvoltage on LDO1 and LDO2.

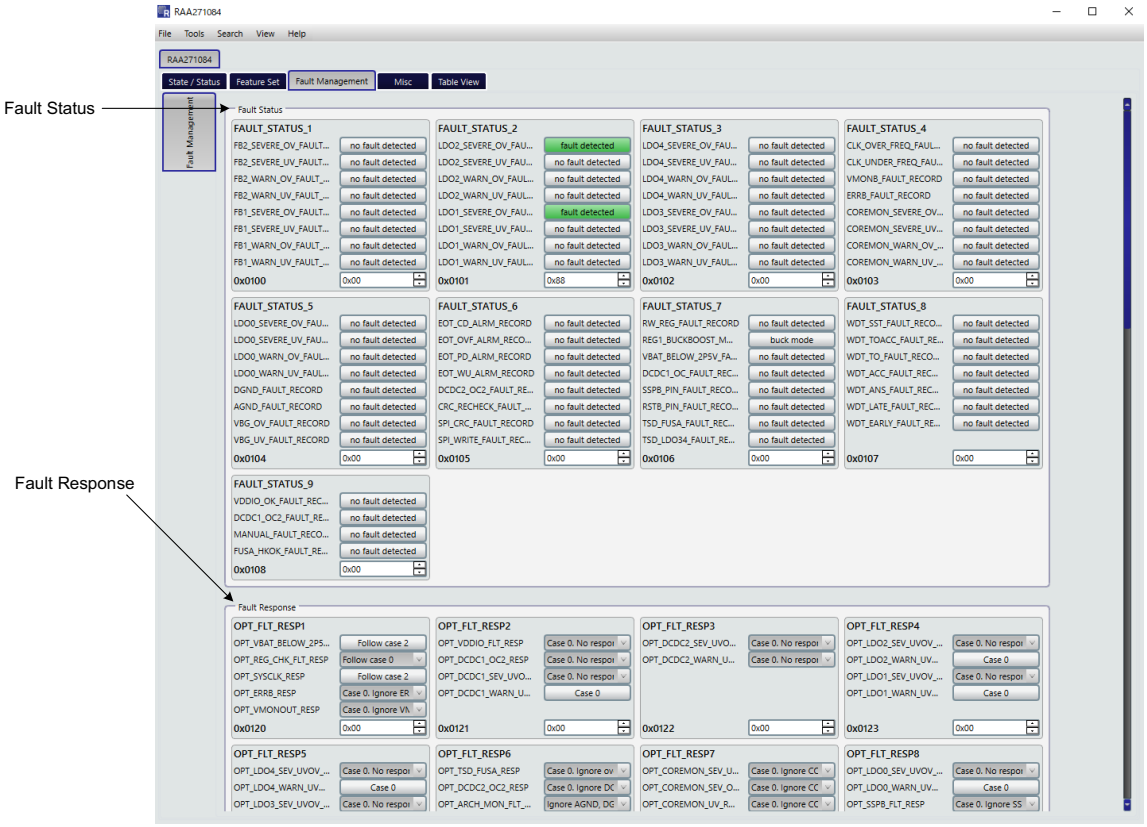

Figure 9. Fault Management (LDO1 and LDO2 Severe OV Detected)

Note: If a fault is detected, the fault status bit for that fault is set to logic 1 and stays at logic 1 until the bit is cleared.

To clear a fault, go to the **Fault Management** dropdown and click the relevant button. This button changes to **no fault detected**, and the button background now appears white.

2.3 Misc Tab

The **Misc** tab is selected by clicking the **Misc** button in the tab row (see Figure 10). This tab controls miscellaneous options that are not contained in the **Feature Set** tab and **Fault Management** tab. The control method is the same as the other tabs.

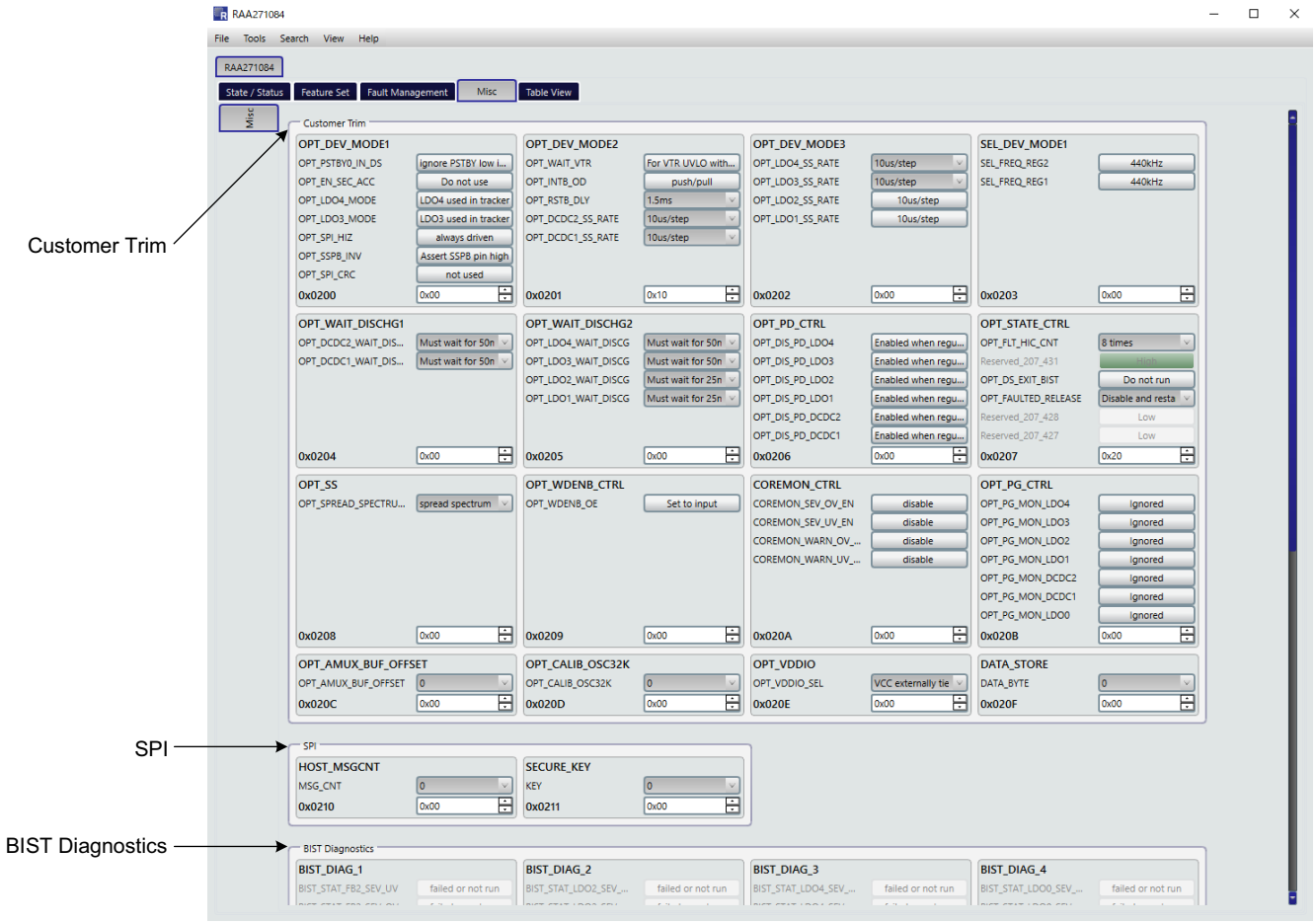

Figure 10. Misc Tab

2.4 Table View Tab

The **Table View** tab is selected by clicking the **Table View** button in the tab row (see Figure 11). This tab contains all the registers that are shown in other tabs.

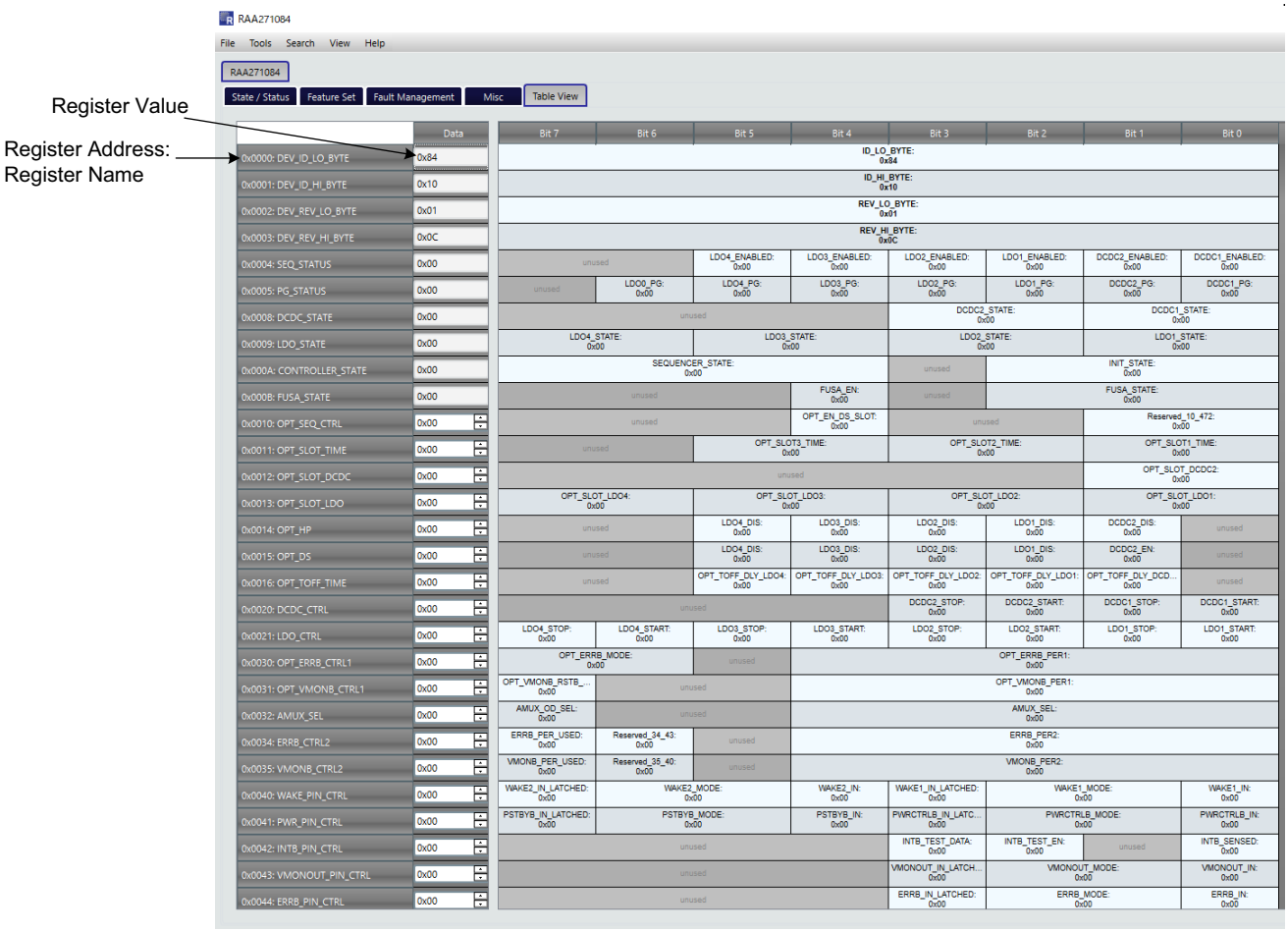

Figure 11. Table View

On the left side, the register address, name, and its value are described; on the right side, the settings for each bit are described. By clicking a bit, the value can be changed.

2.5 Reg Map link

The Reg Map (register map) link is selected by clicking **Help** from the main menu (see Figure 12). The GUI can show the register map in an HTML file by clicking the link.

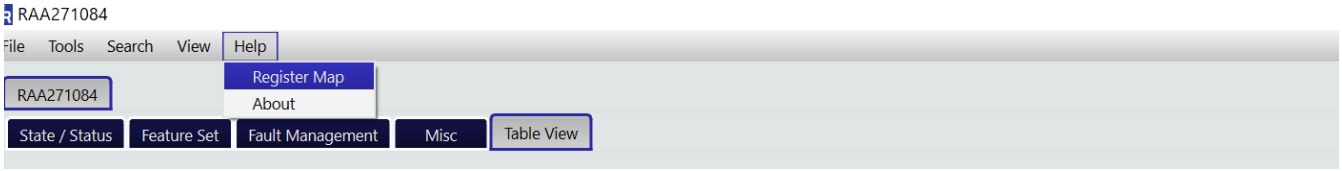

Figure 12. Reg Map link

2.6 Log Tab

The **Log** tab is selected by clicking the **Log** tab in the tab row (see Figure 13). This tab maintains a log of read/write operations completed between the GUI and the RAA271084, which is useful for analyzing and understanding the register read/write operations used to configure the device options. For example, clicking **Read All** at any time initiates a read of many registers, and this series of register reads is displayed in the Log window. This Log feature can be useful when tracking the relationship between selecting device options and the registers associated with those options.

The **Log** tab also contains a **Clear Log** button that clears away all previous read/write information. This is helpful in tracking individual register operations.

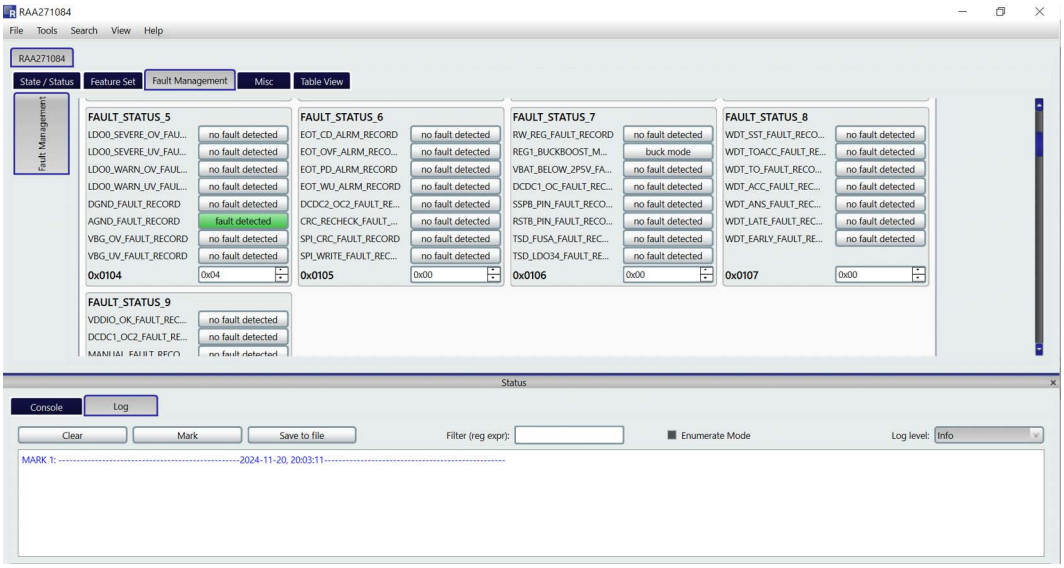

Figure 13. Log Tab

3. Board Design

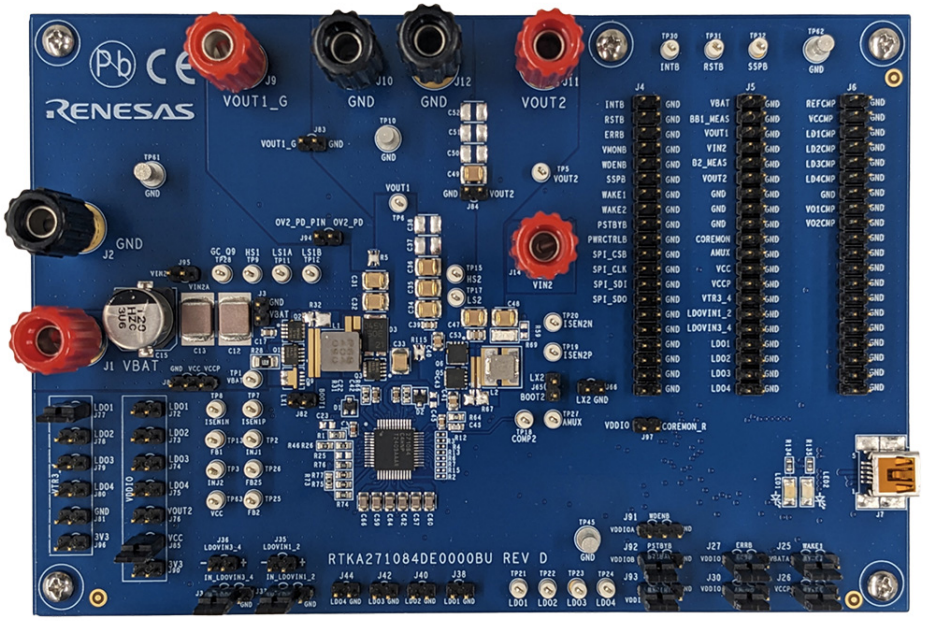

Figure 14. RTKA271084DE0000BU Evaluation Board (Top)

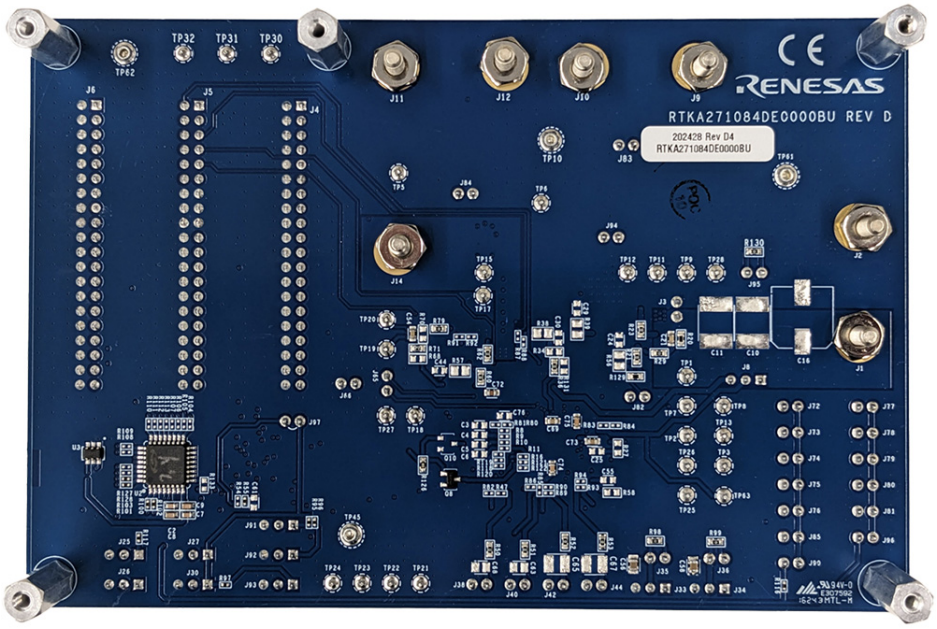

Figure 15. RTKA271084DE0000BU Evaluation Board (Bottom)

3.1 Schematic Diagrams

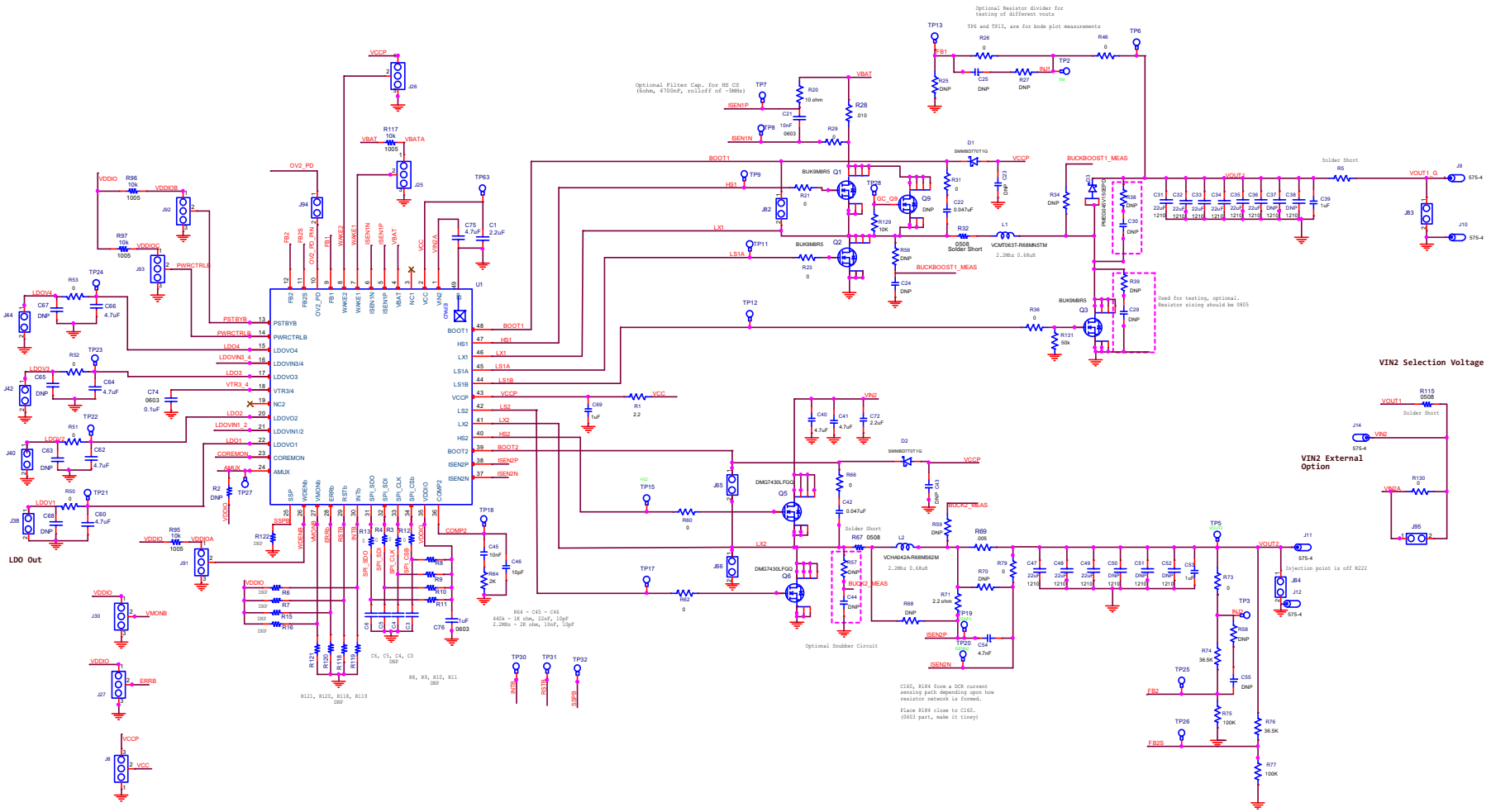

Figure 16. RTKA271084DE0000BU Schematic (1 of 2)

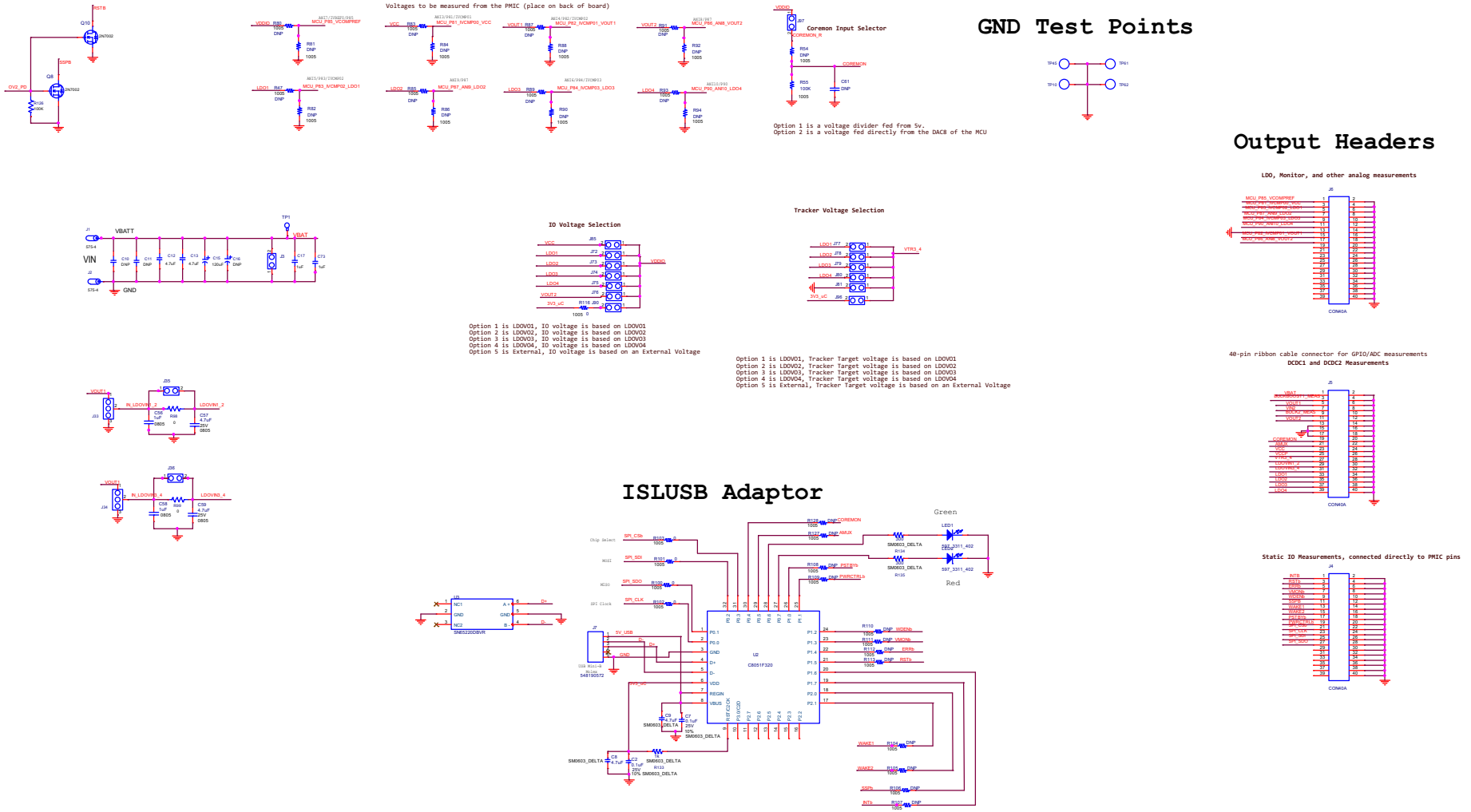

Figure 17. RTKA271084DE0000BU Schematic (2 of 2)

3.2 Bill of Materials

Qty	Reference Designator	Description	Manufacturer Part Number
1	PCB	PWB-PCB, RTKA271084DE0000BU, REVD, ROHS	RTKA271084DE0000BURVDPCB
1	C46	CAP, SMD, 0603, 10pF, 25V, 10%, C0G/NP0, ROHS	CGA3E2C0G2A100D080AA-T
2	C1, C72	CAP-AEC-Q200, SMD, 0603, 2.2µF, 10V, 10%, X7S, ROHS	CGA3E3X7S1A225K080AE-T
2	C12, C13	CAP-AEC-Q200, SMD, 2220, 4.7µF, 100V, 10%, X7R, ROHS	CGA9N2X7R2A475K230KA-T
1	C54	CAP-AEC-Q200, SMD, 0603, 4.7nF, 100V, 10%, X7R, ROHS	GCM188R72A472KA37D-T
1	C21	CAP-AEC-Q200, SMD, 0603, 10nF, 100V, 10%, X7R, ROHS	GCM188R72A103KA37D-T
1	C45	CAP-AEC-Q200, SMD, 0603, 10000pF, 50V, X7R, ROHS	CGA3E2X7R1H103K080AA
2	C22, C42	CAP-AEC-Q200, SMD, 0603, 0.047µF, 50V, 10%, X8R, ROHS	GCM188R91H473KA37D-T
2	C56, C58	CAP-AEC-Q200, SMD, 0805, 1.0µF, 16V, 10%, X7R, ROHS	GCM219R71C105KA37D-T
6	C57, C59, C60, C62, C64, C66	CAP-AEC-Q200, SMD, 0805, 4.7µF, 25V, 10%, X7S, ROHS	GCM21BC71E475KE36L-T
9	C31, C32, C33, C34, C35, C36, C47, C48, C49	CAP-AEC-Q200, SMD, 1210, 22µF, 16V, 10%, X7R, ROHS	GCM32ER71C226KE19L-T
2	C40, C41	CAP-AEC-Q200, SMD, 0805, 4.7µF, 16V, 10%, X7R, ROHS	GCM21BR71C475KA73K-T
3	C2, C7, C74	CAP-AEC-Q200, SMD, 0603, 0.1µF, 25V, 10%, X7R, ROHS	CGA3E2X7R1E104K080AA-T
0	a) C3, C4, C5, C6, C23, C24, C25, C29, C30,	CAP, SMD, 0603, DNP-PLACE HOLDER, ROHS	H1045-DNP
0	b) C43, C44, C55, C61, C71	CAP, SMD, 0603, DNP-PLACE HOLDER, ROHS	H1045-DNP
0	C63, C68	CAP, SMD, 0805, DNP-PLACE HOLDER, ROHS	H1046-DNP
0	C37, C38, C50, C51, C52, C65, C67	CAP, SMD, 1210, DNP-PLACE HOLDER, ROHS	H1082-DNP
2	C39, C69	CAP-AEC-Q200, SMD, 0603, 1.0µF, 25V, 10%, X7R, ROHS	TMK107AB7105KAHT-T
2	C17, C73	CAP, SMD, 0603, 1.0µF, 50V, 10%, X7R, ROHS	UMK107AB7105KA-T
1	C53	CAP-AEC-Q200, SMD, 0805, 1.0µF, 50V, 10%, X7R, ROHS	UMK212B7105KGHT-T
1	C15	CAP-AEC-Q200, SMD, 10.3mm, 120µF, 50V, 20%, 28mΩ, ROHS	EEH-ZC1H121P-T
3	C8, C9, C75	CAP, SMD, 0603, 4.7µF, 25V, 10%, X5R, ROHS	GRT188R61E475KE13D-T
1	L1	COIL-PWR CHOKE, SMD, 7.3*6.8*3, 0.68µH	VCMT063T-R68MN5TM-T
1	L2	COIL-PWR INDUCTOR, SMD, 4.5*4.3*2.1, 0.68µH	VCHA042A-R68MS62M-T
4	J1, J9, J11, J14	CONN-GEN, BIND.POST, INSUL-RED, THMBNUT-GND	111-0702-001
3	J2, J10, J12	CONN-GEN, BIND.POST, INSUL-BLK, THMBNUT-GND	111-0703-001
4	TP10, TP45, TP61, TP62	CONN-TURRET, TERMINAL POST, TH, ROHS	1514-2
1	J7	CONN-RECEPTACLE, TH, 9.6x8.4, 5-CONTACT, MINI B, ROHS	UX60-MB-5S8

Qty	Reference Designator	Description	Manufacturer Part Number
28	TP1, TP2, TP3, TP5, TP6, TP7, TP8, TP9, TP11, TP12, TP13, TP15, TP17, TP18, TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP30, TP31, TP32, TP63	CONN-MINI TEST POINT, VERTICAL, WHITE, ROHS	5002
3	J4, J5, J6	CONN-HEADER, 2x20, BRKAWY-2x36, 2.54mm, ROHS	67996-272HLF-2X20
28	J3, J35, J36, J38, J40, J42, J44, J65, J66, J72, J73, J74, J75, J76, J77, J78, J79, J80, J81, J82, J83, J84, J85, J90, J94, J95, J96, J97	CONN-HEADER, 1x2, BRKAWY 1x36, 2.54mm, ROHS	68000-236HLF-1X2
10	J8, J25, J26, J27, J30, J33, J34, J91, J92, J93	CONN-HEADER, 1x3, BREAKAWY 1x36, 2.54mm, ROHS	68000-236HLF-1X3
4	R5, R32, R67, R115 *SOLDER SHORT PADS	CONN-JUMPER, SOLDER SHORT	ASSEMBLY-SOLDER JUMPER
1	D3	DIODE-SCHOTTKY, AEC-Q101, SMD, 3P, TO-277, 45V,15A, ROHS	PMEG045V150EPDZ-T
2	D1, D2	DIODE-SCHOTTKY, SMD, SOT-323, 70V, 200mA, ROHS	SMMBD770T1G-T
1	U1	IC-PMIC, AUTOMOTIVE GRADE, 48P, SCQFN, ROHS	RAA271084A4HNP#AA0
1	U2	IC-USB uCONTROLLER, 32P, LQFP, HID-REV2.4 PROGRAM, ROHS	C8051F320-GQ/HID-REV2.4
1	U3	IC-SINGLE USB PORT TVS, SMD, 6P, SOT-23-6, ROHS	SN65220DBVR-T
3	Q1, Q2, Q3	TRANSISTOR-MOS, N-CHANNEL, SMD, LFPAK-33-8, 40V, 40A, 9.5mΩ, ROHS	BUK9M9R5-40HX-T
2	Q5, Q6	TRANSISTOR-MOS, N-CHANL, SMD, 8P, PowerDI3333-8, 30V, 14A, ROHS	DMG7430LFGQ-7-T
1	Q8	TRANSISTOR, N-CHANNEL, 3LD, SOT-23, 60V, 115mA, ROHS	2N7002-7-F-T
1	R64	RES, SMD, 0603, 2K, 1/10W, 1%, TF, ROHS	AC0603JR-072KL
1	R71	RES-AEC-Q200, SMD, 0603, 2.2Ω, 1/10W, 1%, TF, ROHS	ERJ-3RQF2R2V-T
1	R20	RES-AEC-Q200, SMD, 0603, 10Ω, 1/10W, 1%, ROHS	ERJ-3EKF10R0V-T
9	R3, R4, R12, R13, R100, R101, R102, R103, R116	RES-AEC-Q200, SMD, 0402, 0Ω, 1/10W, ROHS	ERJ-2GE0R00X-T
1	R129	RES-AEC-Q200, SMD, 0603, 10K, 1/10W, 1%, TF, ROHS	ERJ-3EKF1002V-T
19	R21, R23, R26, R29, R31, R36, R46, R50, R51, R52, R53, R60, R62, R66, R73, R79, R98, R99, R130	RES-AEC-Q200, SMD, 0603, 0Ω, 1/10W, TF, ROHS	ERJ-3GEY0R00V-T
1	R1	RES-AEC-Q200, SMD, 0603, 2.2Ω, 1/10W, 1%, TF, ROHS	ERJ-3RQF2R2V-T
2	R134, R135	RES, SMD 0603, 300Ω	RK73B1JTTD301J-T
1	LED1	LED, SMD, 1206, RED, 2.0V, 6mcd, 635nm, 20mA, ROHS	SML-LX1206IW-TR-T
1	LED2	LED, SMD, 1206, GREEN, 2.2V, 10mcd, 565nm, 20mA, ROHS	SML-LX1206GW-TR-T

Qty	Reference Designator	Description	Manufacturer Part Number
0	R2, R8, R9, R10, R11, R15, R16, R47, R54, R80, R81, R82, R83, R84, R85, R86, R87, R88, R89, R90, R91, R92, R93, R94, R104, R105, R106, R107, R108, R109, R110, R111, R112, R113, R118, R119, R120, R121, R122, R127, R128	RES, SMD, 0402, DNP, DNP, DNP, TF, ROHS	-
0	R6, R7, R25, R27, R34, R58, R59, R68, R70	RES, SMD, 0603, DNP-PLACE HOLDER, ROHS	-
0	R38, R39, R56, R57	RES, SMD, 0805, DNP-PLACE HOLDER, ROHS	-
1	R55	RES, SMD, 0402, 100K, 1/16W, 1%, TF, ROHS	RC0402FR-07100KL-T
4	R95, R96, R97, R117	RES-AEC-Q200, SMD, 0402, 10K, 1/16W, 1%, TF, ROHS	RMCF0402FT10K0-T
3	R75,R77, R126	RES-AEC-Q200, SMD, 0603, 100K, 1/10W, 1%, TF, ROHS	RMCF0603FT100K-T
2	R74, R76 (ALT:RN73R1JTTD3612F50)	RES, SMD, 0603, 36.5K, 1/10W, 0.5%, 50ppm, THINFILM, ROHS	RT0603DRE0736K5L-T
1	R69	RES-AEC-Q200, SMD, 1206, 0.005Ω, 1W, 1%, METAL, CURR.SENSE, ROHS	TLR2BWDTD5L00F75-T
1	R28	RES-CURR.SENSE, SMD, 1206, 0.01Ω, 1W, 1%, 75ppm, ROHS	WSLP1206R0100FEA-T
5	Four corners top PCB + near J11	SCREW, 4-40X1/4in, PHILLIPS, PANHEAD, STAINLESS, ROHS	4-40X1/4-SCREW-SS
5	Four corners bottom PCB + near J11	STANDOFF, 4-40X3/4in, F/F, HEX, ALUMINUM, 0.25 OD, ROHS	4-40X3/4-STANDOFF-METAL
1	Place assy in bag	BAG, STATIC, 6X8, ZIPLOC, ROHS	6X8-STATIC-BAG
0	C10, C11, C16	Do not populate or purchase	DNP
0	Q9	Do not populate or purchase	DNP
2	D1, D2	DIODE-SCHOTTKY, SMD, SOT-323, 70V, 200mA,ROHS	SMMBD770T1G-T
1	Affix To Back Of PCB	LABEL-DATE CODE = LINE 1:YRWK-REV#, LINE 2:BOM NAME	LABEL-DATE CODE
10	J26.1&2, J27.1&2, J30.1&2, J25.1&2, J33.1&2, J34.1&2, J92.1&2, J77, J85, J93.1&2	CONN SHUNT 2POS 100 CLOSED TOP	880584-4
1	Bag & ship w/board	CABLE-USB 2.0, A MALE TO MINI B MALE, 1.8M, WHITE, ROHS	887328800

3.3 Board Layout

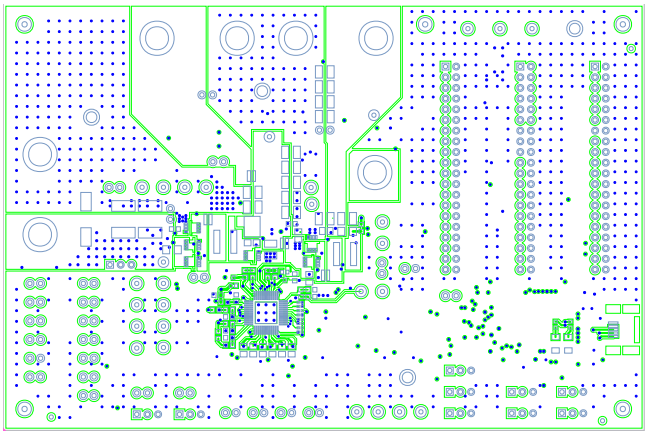

Figure 18. Top Layer

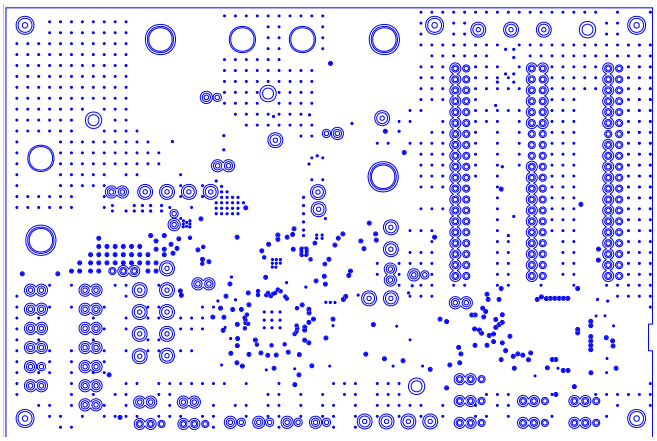

Figure 19. Layer 2

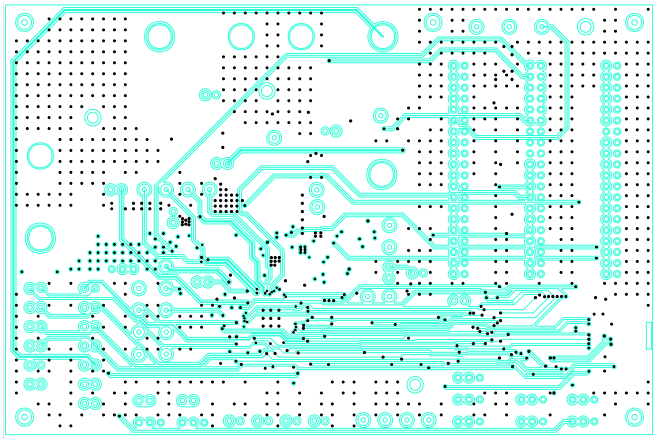

Figure 20. Layer 3

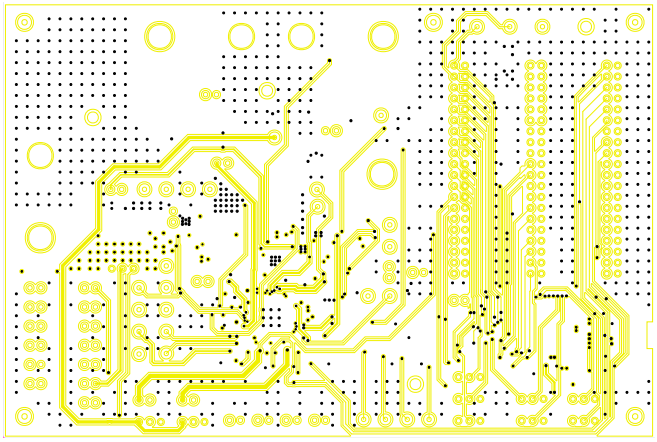

Figure 21. Layer 4

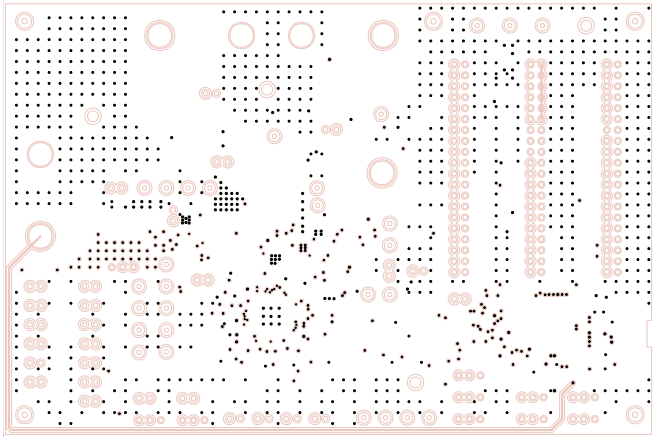

Figure 22. Layer 5

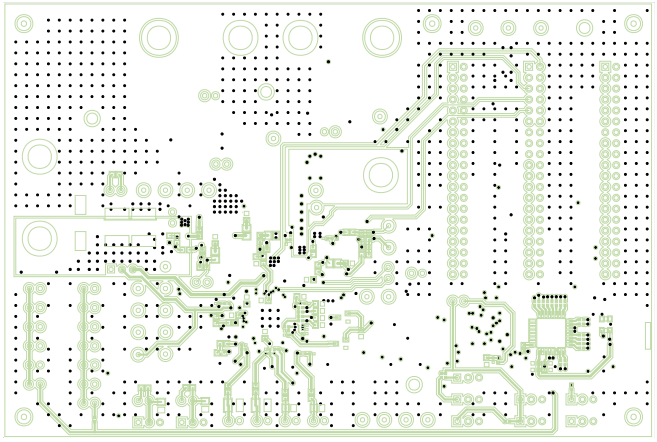

Figure 23. Bottom Layer

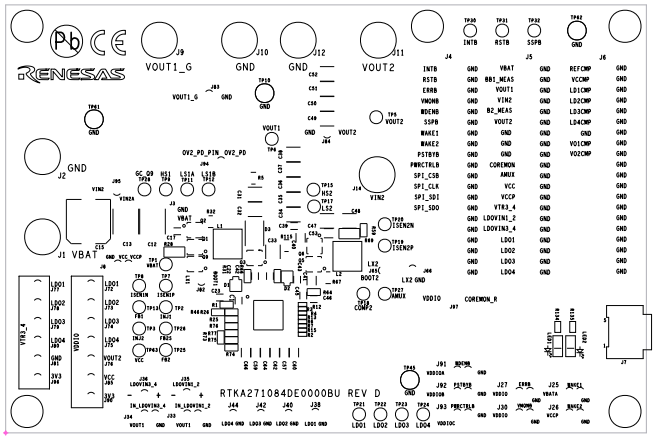

Figure 24. Silk Screen Top

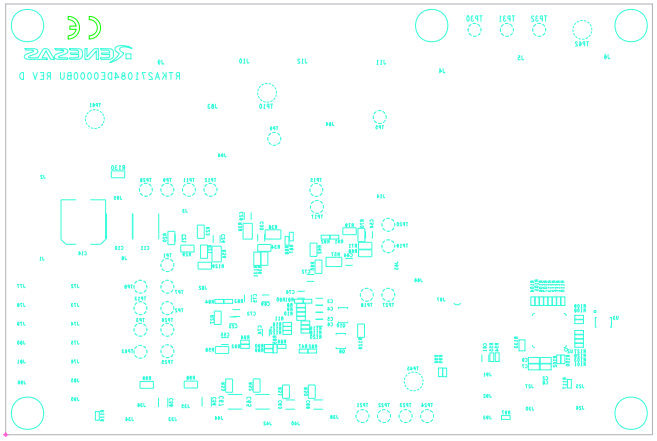

Figure 25. Silk Screen Bottom

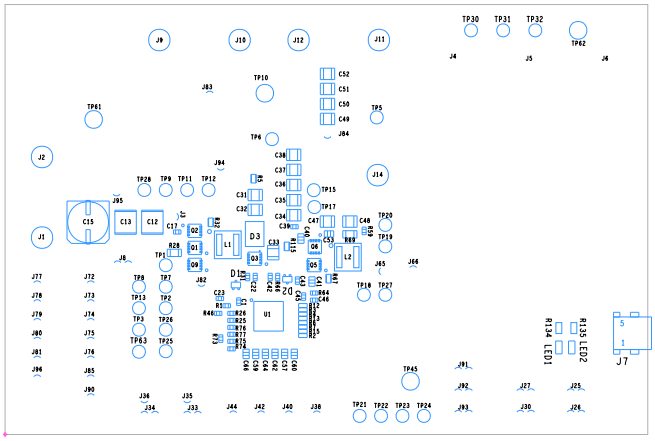

Figure 26. Assembly Top Layer

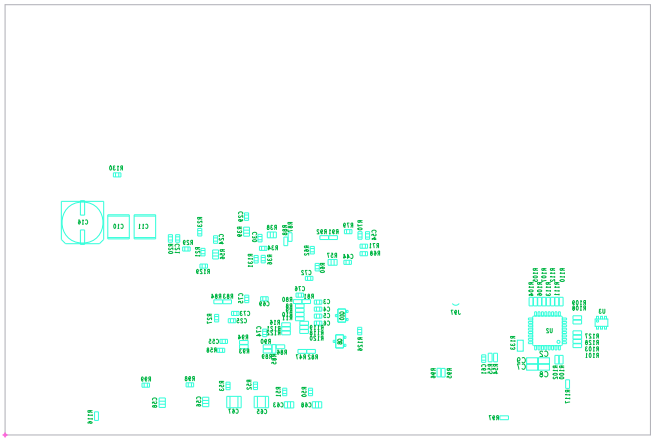

Figure 27. Assembly Bottom Layer

4. Ordering Information

Part Number	Description
RTKA271084DE0000BU	RAA271084 evaluation board

5. Revision History

Revision	Date	Description
1.00	Mar 19, 2025	Initial release.

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