

RTKA223881DE0000BU

Dual-Output 15W Universal Input Flyback Evaluation Board using RAA223881

The RTKA223881DE0000BU is a dual-output, 15W universal input flyback evaluation board that features the [RAA223881](#) 700V regulator. The board demonstrates a low-cost, high-performance isolated AC/DC solution from a universal input of 85V_{AC} to 265V_{AC} for 12V and 5.9V outputs.

The RTKA223881DE0000BU features an input EMI filter that is pre-compliant with EN55022/CISPR 22 Class B conducted EMI limits, and it is designed to pass the 4kV surge capability with an IEC61000-4-5 standard.

Features

- Universal input from 85V_{AC} to 265V_{AC}
- Low BOM cost design
- EMI compliance for EN55022/CISPR22
- Surge test compliance to IEC61000-4-5 up to 4kV

Specifications

This board is optimized for the following operating conditions:

- Input voltage: 85V_{AC}~265V_{AC}
- Operating temperature: -20C~50C
- Output (max): 12V/0.9A; 5.9V/0.9A
- Output power (max): 16W
 - 15W - 85V_{AC}~265V_{AC} input
 - 16W - 230V_{AC} input
- Efficiency:
 - >76% at 100% load
 - >78% at 50% load
- Board dimension: 48mm×29mm



Figure 1. RTKA223881DE0000BU Evaluation Board

Contents

1. Functional Description 3

1.1 Recommended Equipment 3

1.2 Quick Start Guide 3

2. Board Design 4

2.1 Schematic Diagrams 5

2.2 Bill of Materials 5

2.3 Board Layout 7

3. Typical Performance Graphs 8

3.1 EMI Test Results 9

4. Ordering Information 9

5. Revision History 9

1. Functional Description

The RTKA223881DE0000BU consists of a low-cost input stage (F1, Z1, NTC1, D2, C7, L3, C18, and optional L2), the power stage (C9, T1, D1, D8, C14, C16, D4, D9, C15, and C17), and the control circuit surrounding the RAA223881 Flyback controller.

The input stage ensures that the power supply meets the UL safety requirement, IEC surge immunity, IEC conducted standards, and radiated EMI standards. The power converter is fed with a rectified voltage buffered by C9. The voltage regulation of two outputs is implemented by a secondary side TL431 circuit and an opto-coupler, U2, with weighted feedback through R3, R1, and R5. In this design, 12V has a dominant feedback (~85% weight) and 5.9V has a lighter feedback (~15% weight). R13 sets the maximum power for the chosen transformer.

1.1 Recommended Equipment

- An AC power supply capable of generating an AC voltage from 85V_{AC} to 265V_{AC} at 60Hz/50Hz with at least 100mA output current capability.
- A load resistor box with adjustable value of 13.3Ω and up, or an electronics load that can emulate a resistor load or current load up to 0.9A for a 12V output. A load resistor box with an adjustable value of 6.5Ω and up, or an electronics load that can emulate a resistor load or current load up to 0.9A for a 5.9V output.
- Multi-meters to measure the output voltage and current.
- A power meter to measure the AC input power.

1.2 Quick Start Guide

1. Program the AC power supply with a voltage between 85V_{AC} and 265V_{AC} at the corresponding frequency of 60Hz or 50Hz.
2. While the AC power supply is off, connect the output cables of the AC power supply to the L and N terminal of the RTKA223881DE0000BU. An optional power meter can be added in between the AC power supply output and input of the board.
3. Connect the corresponding load to the output terminal: 12VOUT to GND and 5.9VOUT to GND, respectively.
4. Connect a voltage meter to VOUT and GND, and connect a current meter between the board outputs and the load.
5. Turn on the AC power supply.

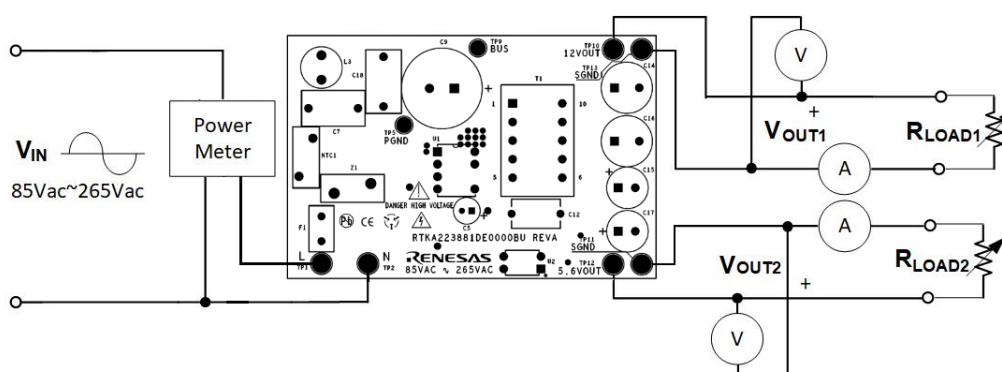


Figure 2. RTKA223881DE0000BU Connection Diagram

2. Board Design



Figure 3. RTKA223881DE0000BU Evaluation Board (Top)

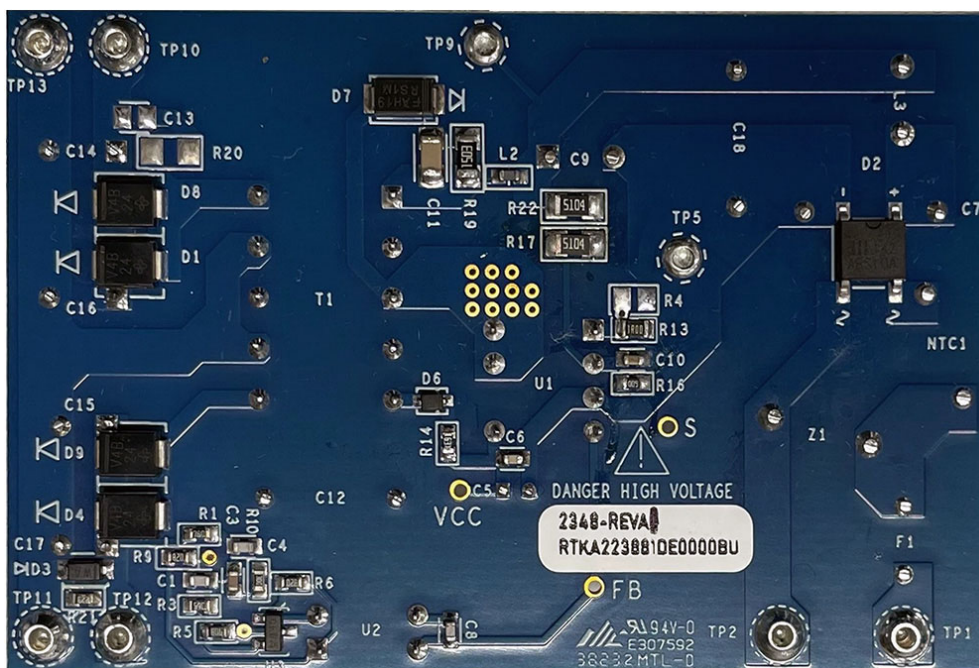


Figure 4. RTKA223881DE0000BU Evaluation Board (Bottom)

2.1 Schematic Diagrams

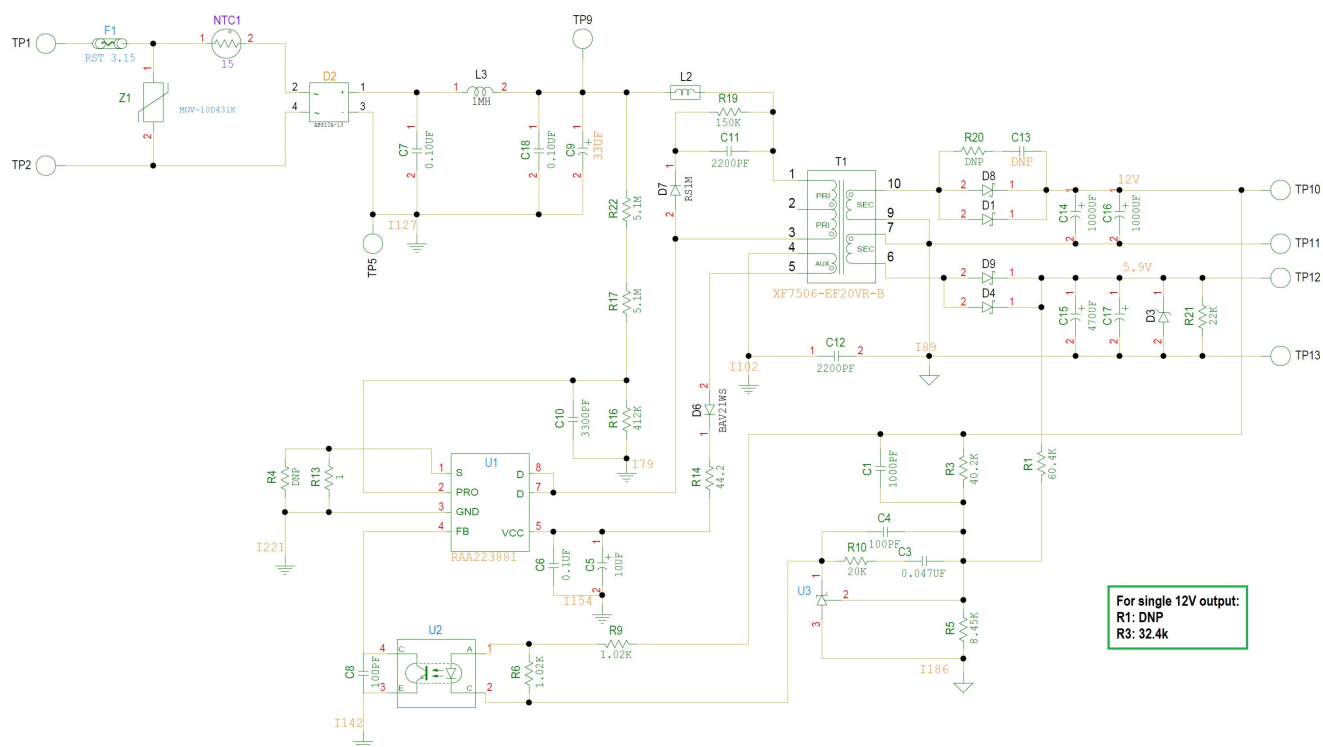


Figure 5. Schematic

2.2 Bill of Materials

Qty	Reference Designator	Description	Value	Manufacturer	Manufacturer Part Number
1	F1	Fuse	4A, 250V _{AC} , Radial	Bel Fuse	RST 3.15
1	D2	1A 1000V Bridge Rectifier	1A, 1000V, ABS	Diodes Inc	ABS10A-13
1	D3	Zener Diode	6.2V, 500mW, SOD-123	Micro commercial	BZT52C6V2-TP
1	D6	General Purpose Diode	0.2A, 200V, SOD-323	Micro commercial	BAV21WS-TP
1	D7	Fast Recovery Diode	1A, 1kV, SMA	Onsemi	RS1M
4	D1, D4, D8, D9	Schottky Rectifier	4A, 100V, DO-219AD	Vishay	VSSB410S-M3
1	L2	Ferrite Bead, SMD	60Ω at 100MHz, 0603	Murata	BLM18PG600SN1D
1	L3	Fixed Inductor	1mH, 5%, 0.49A, Axial	Sumida	RCH8011NP-102L
1	C1	Multilayer Ceramic Cap	1000pF, 10%, 50V, 0603	Various	Generic
1	C3	Multilayer Ceramic Cap	47nF, 10%, 50V, 0603	Various	Generic
2	C4, C8	Multilayer Ceramic Cap	100pF, 10%, 50V, 0603	Various	Generic
1	C5	Aluminum Cap, radial	10μF, 20%, 25V, 0603	Nichicon	UMV1E100MFD1TP

Qty	Reference Designator	Description	Value	Manufacturer	Manufacturer Part Number
1	C9	Aluminum Electrolytic 105C rated 10khrs	33 μ F, 20%, 400V, Radial	Nichicon	UCS2G330MHD
1	C10	Multilayer Ceramic Cap	3300pF, 10%, 50V, 0603	Various	Generic
1	C11	Multilayer Ceramic Cap	2.2nF, 10%, 630V, 1206	MuRata	GRM31BR72J222KW01L
1	C12	AC Rated Class Y1 Ceramic Disk Capacitor	2200pF, 20%, 500V _{AC}	Vishay	VY1222M37Y5VQ63V0
0	C13	DNP	DNP	-	-
2	C7, C18	Film Cap, Radial	0.1 μ F, 10%, 400V, Radial	Panasonic	ECQE4104KF
2	C14, C16	Aluminum Electrolytic 105C rated 10khrs	1000 μ F, 20%, 16V, RADIAL	Rubycon	16YXJ1000MT810X16
2	C15, C17	Aluminum Electrolytic 105C rated 6khrs	470 μ F, 20%, 10V, RADIAL	Rubycon	10YXF470MEFCT78X11.5
1	R1	Thick Film Chip Resistor	60.4k, 1%, 1/10W, 0603	Various	Generic
1	R3	Thick Film Chip Resistor	40.2k, 1%, 1/10W, 0603	Various	Generic
0	R4	Thick Film Chip Resistor	DNP	Various	Generic
1	R5	Thick Film Chip Resistor	8.45k, 1%, 1/10W, 0603	Various	Generic
2	R6, R9	Thick Film Chip Resistor	1.02k, 1%, 1/10W, 0603	Various	Generic
1	R10	Thick Film Chip Resistor	20k, 1%, 1/10W, 0603	Various	Generic
1	R13	Thick Film Chip Resistor	1, 1%, 1/8W, 0805	Bourns	-
1	R14	Thick Film Chip Resistor	44.2, 1%, 1/10W, 0603	Various	Generic
1	R16	Thick Film Chip Resistor	412k, 1%, 1/10W, 0603	Various	Generic
3	R17, R22	Thick Film Chip Resistor	5.1M, 1%, 1/4W, 1206	Various	Generic
1	R19	Thick Film Chip Resistor	150k, 1%, 1/4W, 1206	Various	Generic
0	R20	DNP	DNP	Various	Generic
1	T1	Transformer	750 μ H, 10%, EF20, PTH	XFMRs	XF7506-EF20VR-B
1	U1	700V, Offline Flyback Regulator	RAA223881, DIP-7	Renesas	RAA2238814GSP#AA1
1	U2	Opto-coupler	CTR: 80-160, PTH	Lite-On	LTV-817-A
1	U3	Shunt Regulator	TL431, SOT23, 1%	Nexperia	TL431AQDBZR,215
1	Z1	Varistor	750V 2.5kA PTH	Bourns	MOV-10D431K

2.3 Board Layout

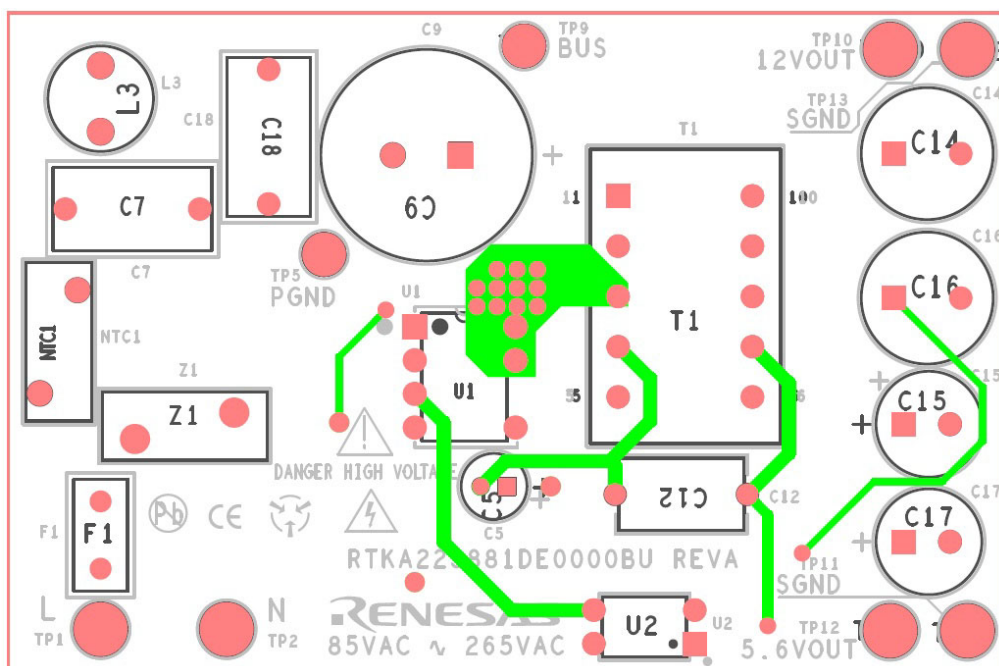


Figure 6. Top Layer

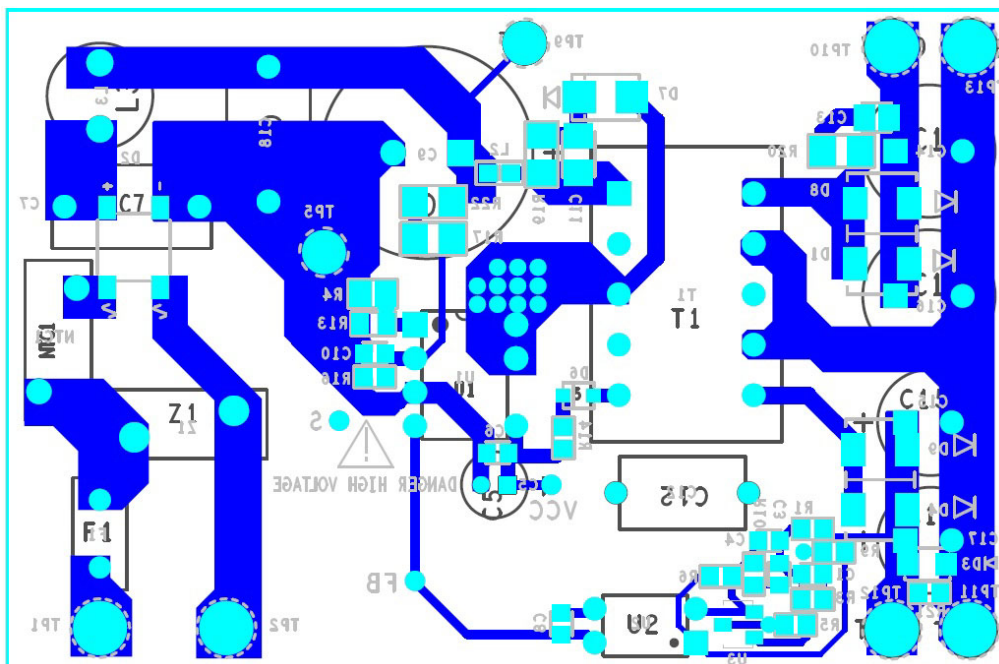


Figure 7. Bottom Layer

3. Typical Performance Graphs

$V_{IN} = 85V_{AC} \sim 265V_{AC}$, $V_{O1} = 12V$, $I_{O1} = 0.9A$ (max), $V_{O2} = 5.9V$, $I_{O2} = 0.9A$ (max), $T_A = +25^{\circ}C$

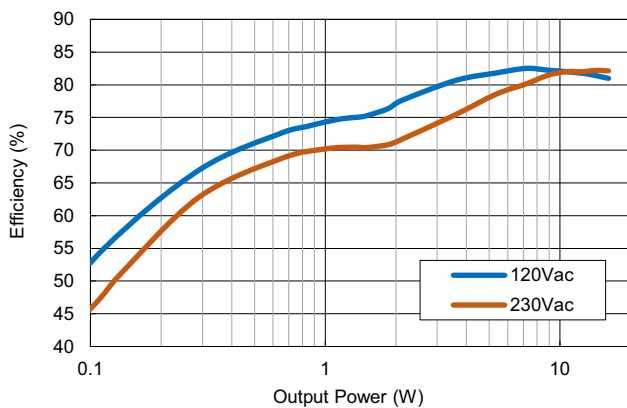


Figure 8. Efficiency

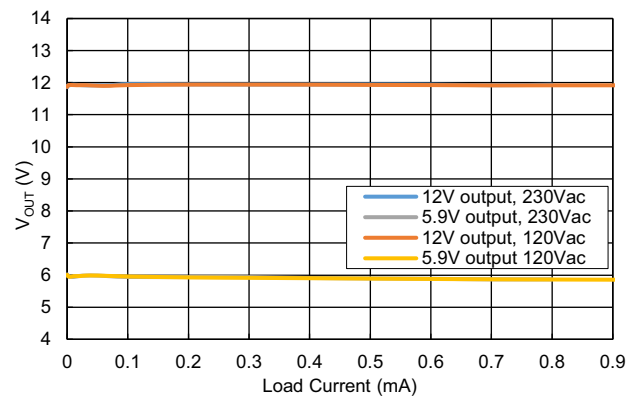


Figure 9. Load Regulation

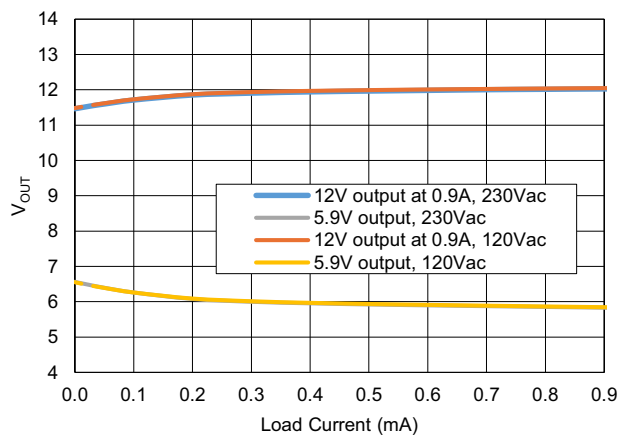


Figure 10. Load Regulation with 5.9V Load Sweep

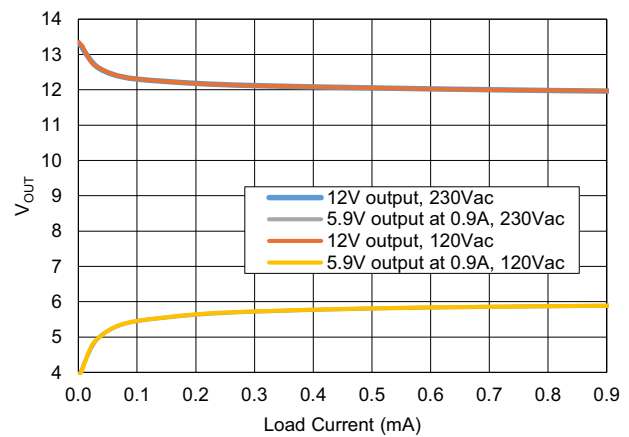


Figure 11. Load Regulation with 12V Load Sweep

Table 1. Typical No-load Power Consumption (25°C Ambient)

Input Voltage	Standby Power
120V _{AC} /60Hz	47mW
230V _{AC} /50Hz	60mW

3.1 EMI Test Results

RTKA223881DE0000BU is compliant to the conducted EMI requirements of FCC Part 15 and CISPR22 Class B.

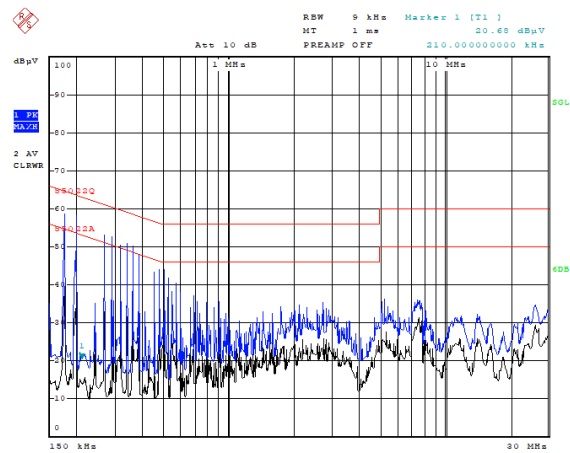


Figure 12. 120V_{AC} Line

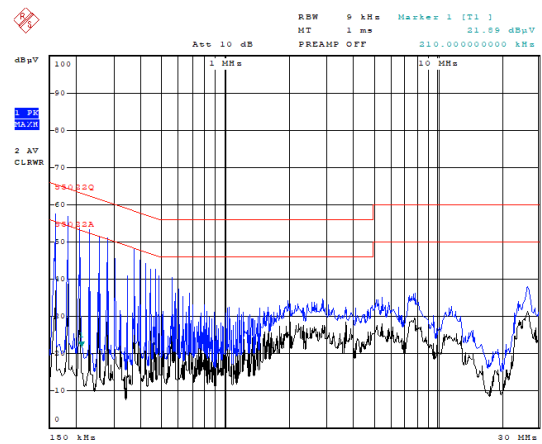


Figure 13. 120V_{AC} Neutral

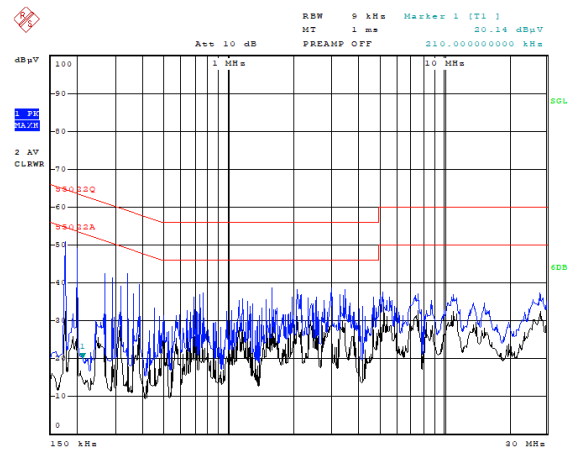


Figure 14. 230V_{AC} Line

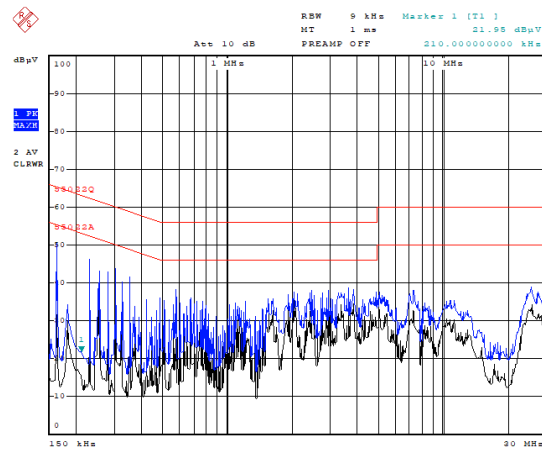


Figure 15. 230V_{AC} Neutral

4. Ordering Information

Part Number	Description
RTKA223881DE0000BU	RAA223881 Evaluation Board

5. Revision History

Revision	Date	Description
1.01	Apr 26, 2024	Updated Title. Updated Feature bullet. Updated Figure 8.
1.00	Apr 12, 2024	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 who are 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 to develop 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 from 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.

(Disclaimer Rev.1.01 Jan 2024)

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-us/.

Trademarks

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