
RTKA223011DR0080BU

Flyback Demonstration Board

The RAA223011 demonstration board (RTKA223011DR0080BU) is an offline flyback converter; it is designed to demonstrate a low-cost high performance isolated AC/DC conversion from a universal input of 85V_{AC} to 265V_{AC} directly to a 12V output with an output current up to 400mA.

The board uses primary side regulation without using an optocoupler. It has built-in overcurrent, short-circuit, input brownout, and over-temperature protection, and it is designed on a two layer PCB.

RTKA223011DR0080BU comes with a RAA223011 in a SOIC-8 package.

Features

- Universal input
- Primary side regulation
- Low cost components
- No audible noise

Specifications

This board is optimized for the following operating conditions:

- Input voltage: 85V_{AC} ~ 265V_{AC}
- Output voltage: 12V_{DC}
- Output current: 400mA max (at 230V_{AC} or higher)
- Output power: 4.7W
- Efficiency: >75% at 100% load; 70% to 75% at 50% load
- Operating temperature: -45°C to 65°C
- Board dimension: 25mm x 70mm.

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1. Functional Description

The RTKA223011DR0080BU is an isolated flyback regulator with switching frequency up to 33kHz. Its input has a bridge rectifier. FR is a 1W fusible resistor providing input overcurrent protection and inrush current limiting.

C1, L1, C3, and C2 consist of the input filter that provides the energy buffer after rectification and reduces conducted EMI noises to the input. T1, D1, and COUT are the flyback converter components. D4, D3, D2, RFB1, CFB1, CFB2, and RFB2 provide the feedback signal to the IC by sampling the auxiliary winding voltage. D4 and R1 provide VCC biasing current after startup to increase the efficiency. R1 can be optional for low-cost low power applications. CVCC is the IC supply capacitor.

1.1 Recommended Equipment

- AC Power supply capable of generating AC voltage from 85V_{AC} to 265V_{AC} at 60Hz/50Hz with at least 100mA output current capability.
- Load resistor box with adjustable value of 30Ω and up or an electronic load than can emulate a resistor load or current load up to 400mA.
- Multi-meters to measure the output voltage and current.
- Power meter to measure the AC input power.

1.2 Setup and Configuration

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 RTKA223011DR0080BU. An optional power meter can be added in between the AC power supply output and the input of the board.
3. Connect the load to the output terminals VOUT and GND.
4. Connect a voltage meter to VOUT and GND and connect a current meter between board outputs and the load.
5. Turn on AC power supply.

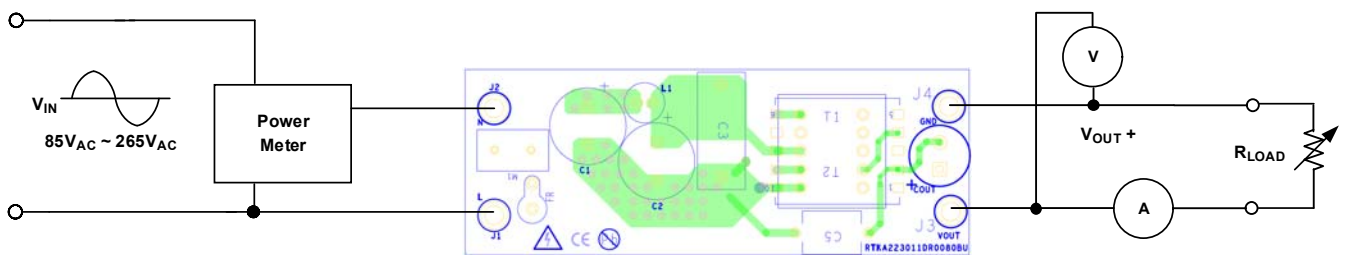


Figure 1. RTKA223011DR0080BU Connection Diagram

1.3 Transformer Design

The output voltage is sampled by the IC through the aux winding. To get good regulation, the aux winding voltage spikes caused by the leakage inductance should be reduced. So, transformer should be designed in a way to reduce aux winding leakage.

Dividing the secondary winding into two sections and winding the aux winding in between them will help improve the aux-secondary coupling. Other way is to use a long bobbin such that only single layer of each winding is required; and the aux winding is wound between the primary and the secondary. Another approach is to split the primary and the secondary into multiple sections and winding the auxiliary winding between them.

2. Board Design

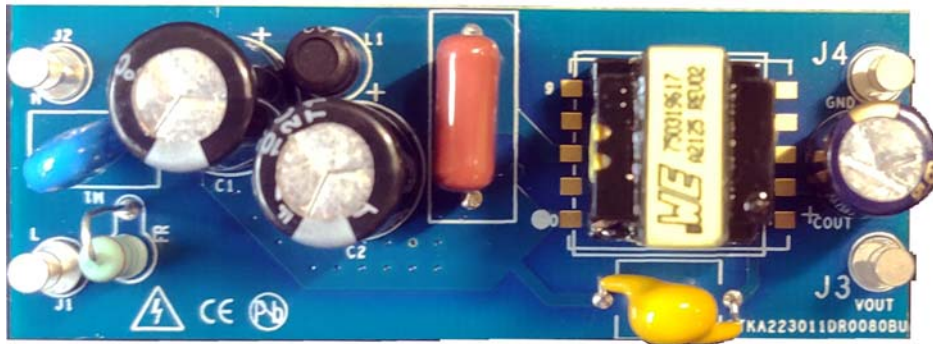


Figure 2. RTKA223011DR0080BU Evaluation Board (Top)

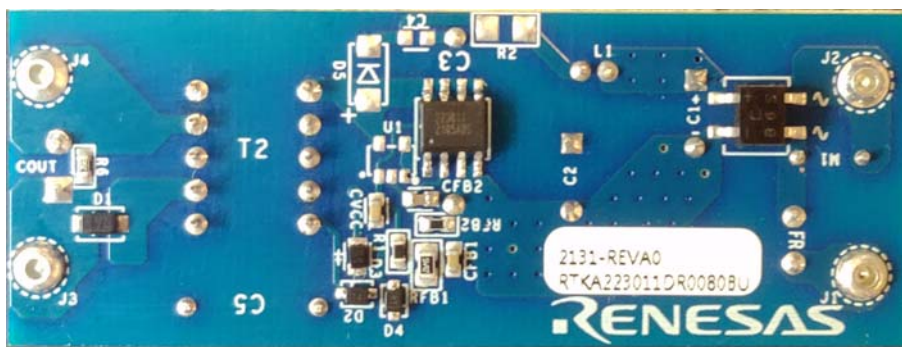


Figure 3. RTKA223011DR0080BU Evaluation Board (Bottom)

2.1 Layout Guidelines

For detailed PCB guidelines, see the RAA223011 datasheet.

2.2 Schematic Diagrams

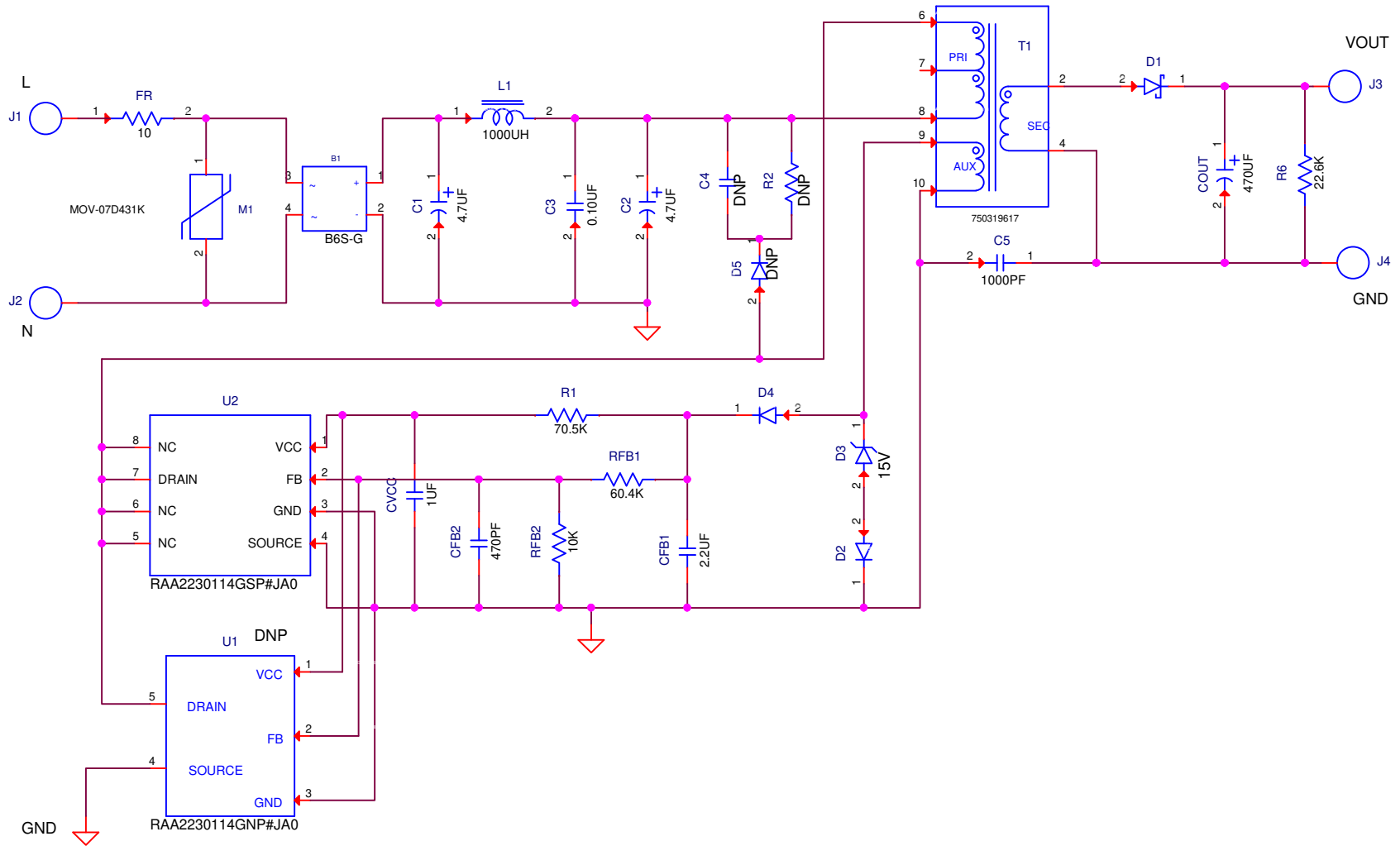


Figure 4. RTKA223011DR0080BU Schematic

2.3 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Part Number
4	J1, J2, J3, J4	Test Point Turret 0.150 Pad 0.100 Thole	Keystone	1514-2
1	COU	MBZ Series Miniature Aluminum Elect Cap, 470 μ F, 20%, 16V, Radial	Rubycon	16MBZ470M8X11.5
4	B1	Bridge Rectifier, 0.8A, 600V, MBS	Comchip	B6S-G
2	D2, D4	Fast Switching Diode, SOD323	Diodes	1N4148WS
1	T1	TH CUSTOM Transformer, 2.5mH	Würth	750319617
1	D3	15V 500mW Zener Diode, 5%, SOD-323F	Nexperia	PZU15B,115
1	C3	ECQE Series Plastic Film Capacitor, 0.1 μ F, 400V, 5%	Panasonic	ECQE4104KF
0	D5	DNP		
2	C1, C2	CAP ALUM, 4.7 μ F, 20%, 400V, RADIAL	Kemet	ESG475M400AH2AA
1	FR	Flame Proof and Fusible Safety Wire Wound Resistor, 10 Ω , 5%, 1W, Axial	Yageo	FKN1WSJR-52-10R
0	C4	DNP		
1	CFB1	Multilayer Ceramic Capacitor, 2.2 μ F, 10%, 16V, 0603	Generic	
1	CVCC	Multilayer Cap, 1 μ F, 105, 16V, 0603	Generic	
1	CFB2	Multilayer Cap, 470PF, 5%, 50V, 0603	Generic	
1	RFB2	Thick Film Chip Resistor, 10k, 1%, 1/16W, 0603	Generic	
1	R6	Thick Film Chip Resistor, 22.6k, 1%, 1/10W, 0603	Generic	
1	R1	Thick Film Chip Resistor, 70.5K, 1%, 1/16W, 0603	Generic	
0	R2	DNP		
1	RFB1	Thick Film Chip Resistor, 60.4K, 1%, 1/10W, 0805	Generic	
1	M1	7mm Disk Varistor, 430V, 1.2KA, PTH	BOURNS	MOV-07D431K
1	U2	700V AC/DC Buck Regulator with Ultra-Low Standby Power, SOT23-5	Renesas	RAA2230114GSP#JA0
0	U1	DNP		
1	D1	100V 2A Schottky Barrier Diode, SOD123	MCC	SL210PL-TP
1	L1	RLB Series Radial Lead Inductor 1000 μ H, 10%, 100mA, Type2	BOURNS	RLB0608-102KL
1	C5	AC Line Rated Class Y1 Ceramic Disk Capacitor, 1000PF, 20%, 500V _{AC} , Radial	Vishay	VY1102M29Y5VQ63V0

2.4 Board Layout

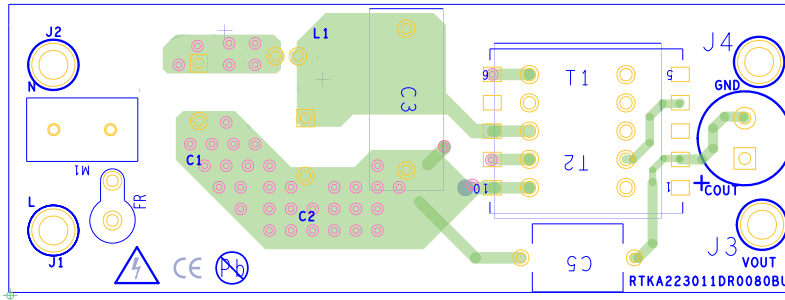


Figure 5. Top Layer (with Silkscreen)

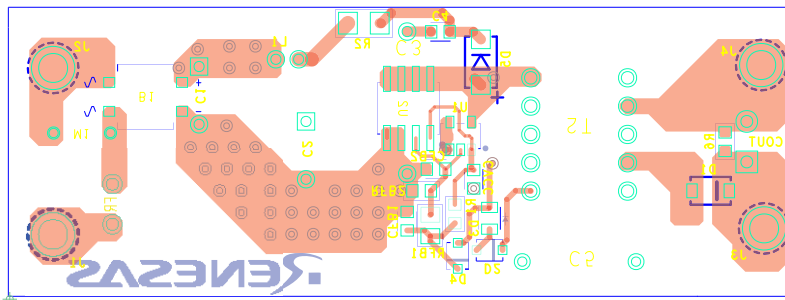


Figure 6. Bottom Layer

3. Typical Performance Curves

$V_{in} = 85V_{AC} \sim 265V_{AC}$, $V_{OUT} = 12V$, $I_{OUT} = 400mA$ (maximum), $T_A = +25^{\circ}C$

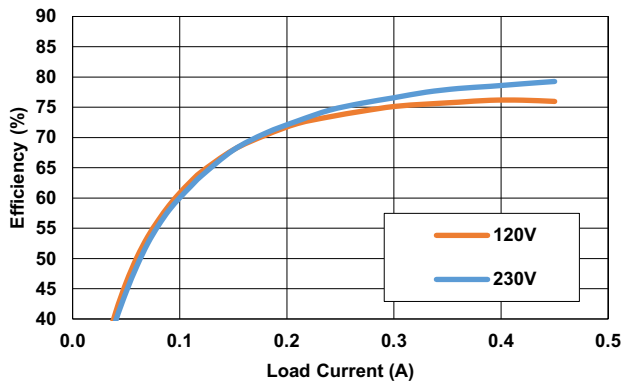


Figure 7. Efficiency over Load Current

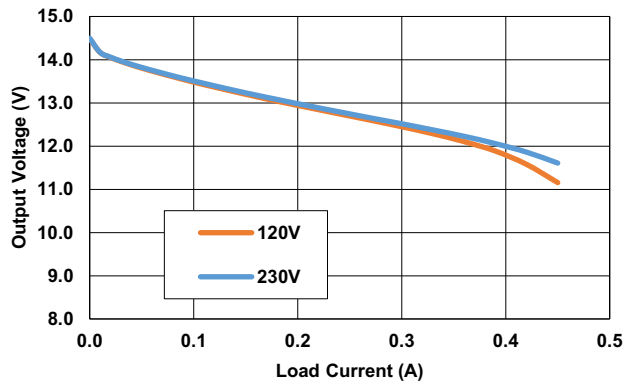


Figure 8. Load Regulation

3.1 EMI Test Results

RTKA223011DR0080BU is compliant to the conducted EMI requirements of FCC Part15 and CISPR22 Class B.

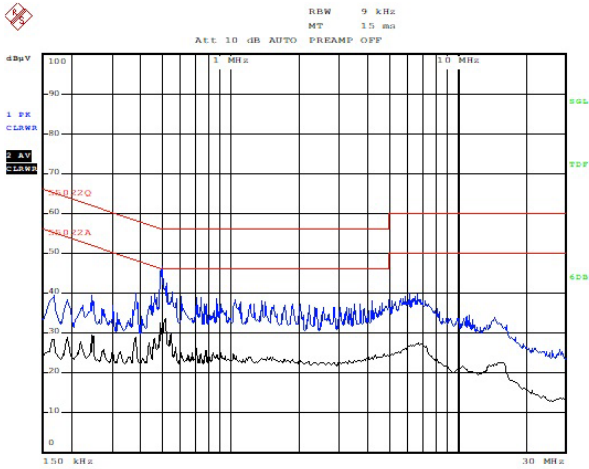


Figure 9. 120V_{AC} - Line

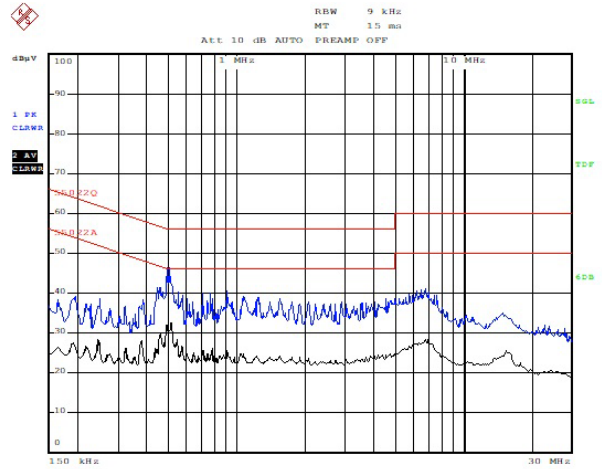


Figure 10. 120V_{AC} - Neutral

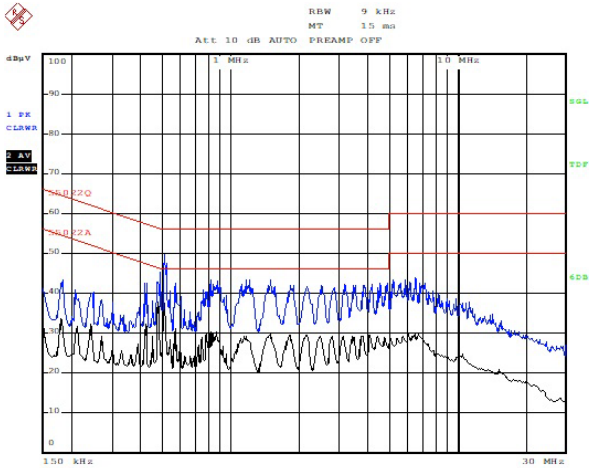


Figure 11. 230V_{AC} - Line

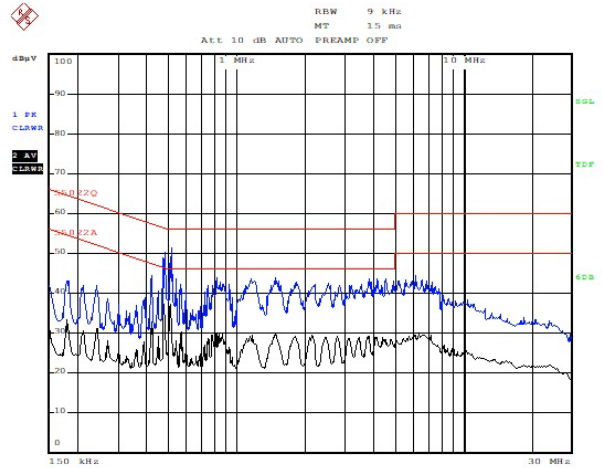


Figure 12. 230V_{AC} - Neutral

4. Ordering Information

Part Number	Description
RTKA223011DR0080BU	RAA223011 Flyback Demonstration Board

5. Revision History

Revision	Date	Description
1.01	Dec 10, 2021	Updated the Bill of Materials. Updated Figures 1, 4, and 7 to 12. Added 1.3, Transformer Design.
1.00	Jun 25, 2021	Initial release.

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