Isolation Fly-back Conveter PWM method

Output 24W 12V

BM2P10B1J-EVK-001

User's Guide

＜High Voltage Safety Precautions＞

◇ Read all safety precautions before use

Please note that this document covers only the BM2P10B1J evaluation board (BM2P10B1J-EVK-001) and its functions. For additional information, please refer to the datasheet.

To ensure safe operation, please carefully read all precautions before handling the evaluation board

Depending on the configuration of the board and voltages used,

Potentially lethal voltages may be generated.

Therefore, please make sure to read and observe all safety precautions described in the red box below.

Before Use

[1] Verify that the parts/components are not damaged or missing (i.e. due to the drops).
[2] Check that there are no conductive foreign objects on the board.
[3] Be careful when performing soldering on the module and/or evaluation board to ensure that solder splash does not occur.
[4] Check that there is no condensation or water droplets on the circuit board.

During Use

[5] Be careful to not allow conductive objects to come into contact with the board.
[6] **Brief accidental contact or even bringing your hand close to the board may result in discharge and lead to severe injury or death.**

Therefore, DO NOT touch the board with your bare hands or bring them too close to the board.

In addition, as mentioned above please exercise extreme caution when using conductive tools such as tweezers and screwdrivers.

[7] If used under conditions beyond its rated voltage, it may cause defects such as short-circuit or, depending on the circumstances, explosion or other permanent damages.
[8] Be sure to wear insulated gloves when handling is required during operation.

After Use

[9] The ROHM Evaluation Board contains the circuits which store the high voltage. Since it stores the charges even after the connected power circuits are cut, please discharge the electricity after using it, and please deal with it after confirming such electric discharge.
[10] Protect against electric shocks by wearing insulated gloves when handling.

This evaluation board is intended for use only in research and development facilities and should by handled **only by qualified personnel familiar with all safety and operating procedures.**

We recommend carrying out operation in a safe environment that includes the use of high voltage signage at all entrances, safety interlocks, and protective glasses.

AC/DC Converter

Flyback Type PWM Mode Isolated 12 V 2.0 A 24 W BM2P10B1J Evaluation Board

BM2P10B1J-EVK-001

General Description

This evaluation board outputs an isolated voltage of 12 V from an input of 90 Vac to 264 Vac, and the maximum output current is 2.0 A.

BM2P10B1J-Z which is PWM method DC/DC converter IC built-in 730 V MOSFET is used.

Built-in the low on resistor (1.0 Ω) and high voltage tolerant MOSFET (730 V) make designs easy.

PWM controller for AC / DC power supplies, the BM2P10B1J provides the optimum system for all products with outlets.

Figure 1. BM2P10B1J-EVK-001

Performance Specification

Not guarantee the characteristics is representative value.

Unless otherwise specified V_{IN} = 230 Vac , I_{OUT} = 2.0 A , Ta = 25 °C

Parameter	Symbol	Min	Typ	Max	Units	Conditions
Input Voltage Range	V_{IN}	90	230	264	V	
Input Frequency	f_{LINE}	47	50/60	63	Hz	
Output Voltage	V_{OUT}	11.64	12.0	12.36	V	
Output Current Range *(Note 1)*	I_{OUT}	0		2	A	
Maximum Output Power	P_{OUT}	-	-	24	W	I_{OUT} = 2A
Standby Input Power	P_{INSTBY}	-	80	-	mW	I_{OUT} = 0 A
Power supply efficiency	η	-	86.5	-	%	
Output Ripple Voltage *(Note 1)*	V_{RIPPLE}	-	0.13	0.24	Vpp	BW=20MHz
Oprating Temperature	Top	-10	+25	+65	°C	

(Note 1) Not include spikes noise.

Derating

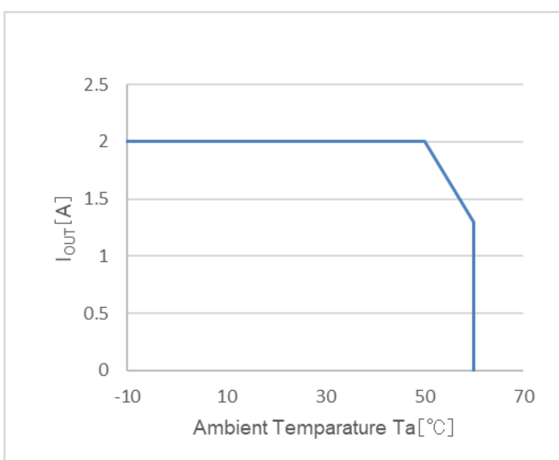


Figure 2. Temperature derating curve

Operation Procedure

1. Operation Equipment

(1) AC power supply (90 Vac to 264 Vac, 100 W or more)

(2) Load equipment (2 A at maximum value)

(3) DC voltmeter

2. Connect method

(1) Preset the AC power to 90 Vac to 264 Vac and turn off the power output.

(2) Set the load below the rated current of each output to disable the load.

(3) Connect the N pin of the power supply to the CN1-1: AC (N) pin and the L pin to the CN1-2: AC (L) pin with a pair of wires.

(4) Connect each load to VOUT pin from the positive pin and to GND pin with a pair of wires.

(5) When connecting a power meter, connect as follows. (For details, refer to the User's Manual of the electricity meter you are using.)

(6) Connect the positive pin of the DC voltmeter to VOUT pin and the negative pin to GND pin for output voltage measurement.

(7) AC power supply switch is ON.

(8) Make sure that the DC voltmeter reading is at the set voltage (12 V).

(9) Electronic load switch is ON.

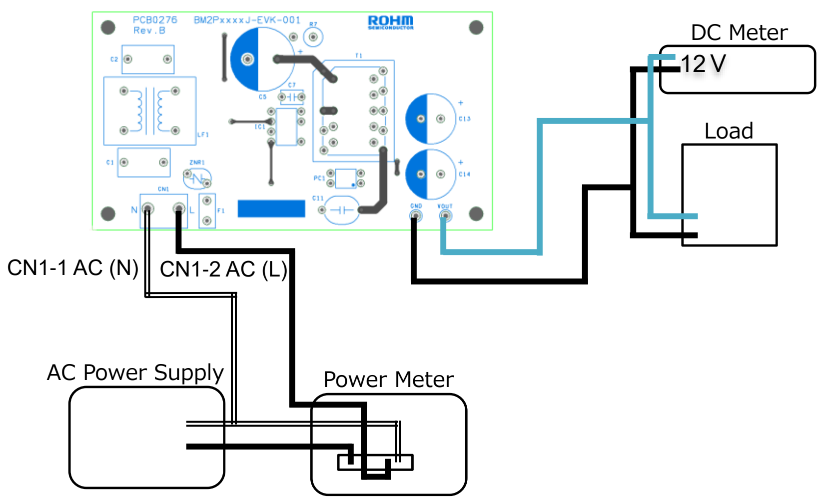


Figure 3. Diagram of How to Connect

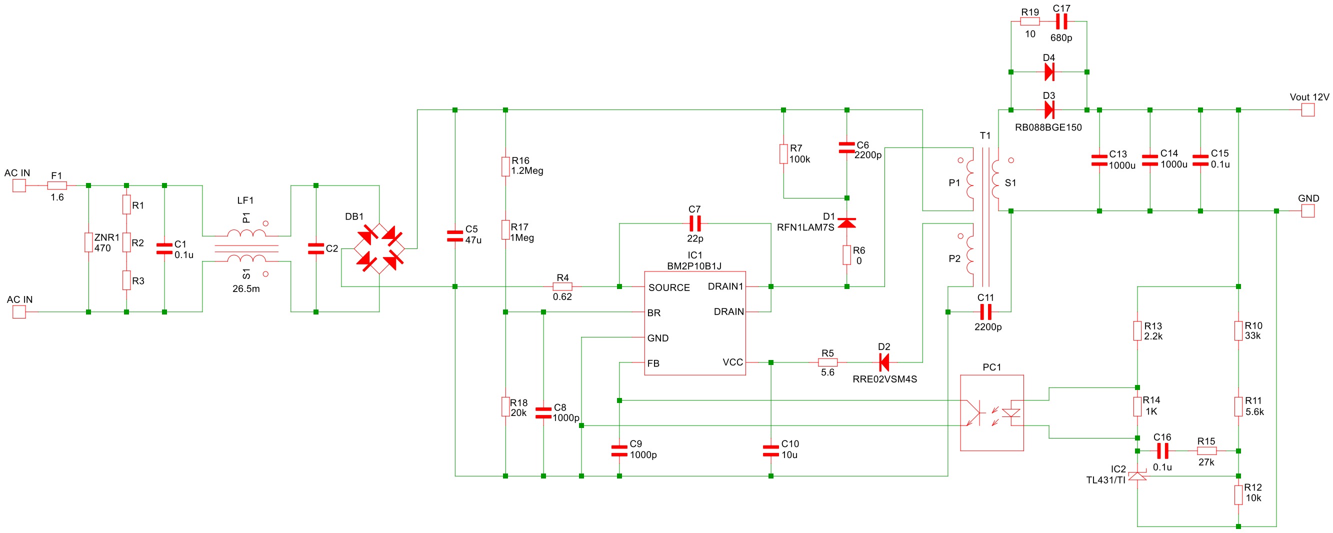
Application Circuit

This evaluation board operates in flyback mode at a maximum frequency of around 100 kHz..

The output (12 V) voltage is monitored by a feedback circuit and feed back to the FB pin of BM2P10B1J through a opto - coupler.

At startup, the voltage at the VCC pin rises as the voltage is supplied from the DRAIN pin to the VCC pin through the start circuit.

The demo board schematic is shown in Figure below and the list of parts is tabulated on page 13.



BM2P10B1J General Description

Features

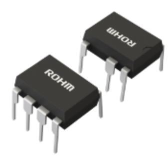
- PWM Current Mode
- Frequency Hopping Function
- Burst Operation at Light Load
- Frequency Reduction Function
- Built-in 730 V Startup Circuit
- Built-in 730 V Switching MOSFET
- VCC UVLO (Under Voltage Lockout)
- VCC OVP (Over Voltage Protection)
- SOURCE Pin Open Protection
- SOURCE Pin Function of Leading Edge Blanking
- Over Current Detection Function per Cycle
- Over Current Detection AC Compensation Function
- Soft Start Function
- Secondary Over Current Protection Circuit

Key Specifications

- Operating Power Supply Voltage Range :
  VCC Pin : 8.9 V to 26.0 V
  DRAIN Pin : 730 V (Max)
- Circuit Current (ON) 1:
  BM2P10x1J-Z: 0.90 mA (Typ)
  BM2P10x3J-Z: 0.65 mA (Typ)
- Circuit Current (ON) 2: 0.30 mA (Typ)
- Frequency Range 1: 100 kHz (Typ)
- Operating Temperature Range : -40 °C to +105 °C
- MOSFET ON Resistance:
  BM2P10x1J-Z: 1.0 Ω (Typ)
  BM2P10x3J-Z: 3.0 Ω (Typ)

Package

Package	W (Typ) x D (Typ) x H (Max)
DIP7K	9.27 mm x 6.35 mm x 8.63 mm pitch 2.54 mm



Pin Configuration

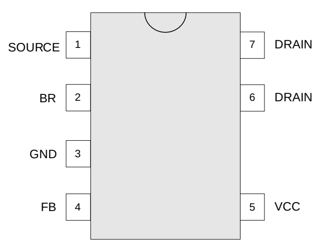


Figure 4. Pin Configuration

Applications

AC Adapter, TV, Various Home Appliances (Vacuum Cleaner, Humidifier, Air purifier, Air Conditioner, IH Cooking Heater, Rice Cooker, etc.)

Pin Descriptions

No.	Pin name	I/O	Function
1	SOURCE	I/O	MOSFET SOURCE pin
2	BR	I	BROWNOUT pin
3	GND	I/O	GND pin
4	FB	I/O	Feedback-signal-in pin
5	VCC	I	Power supply input pin
6	DRAIN	I/O	MOSFET DRAIN pin
7	DRAIN	I/O	MOSFET DRAIN pin

Measurement Data

1. Load Regulation

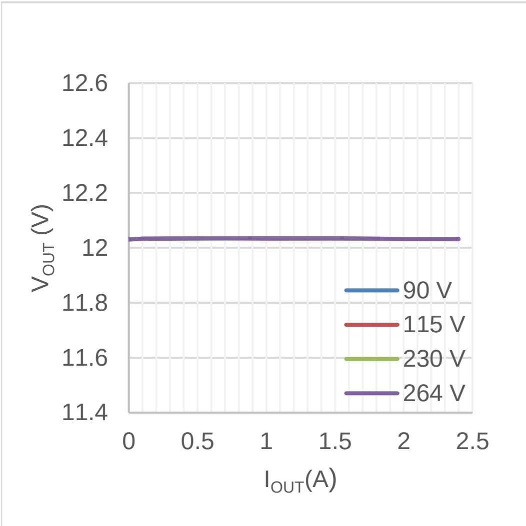


Figure 5. Output Voltage vs Output Current

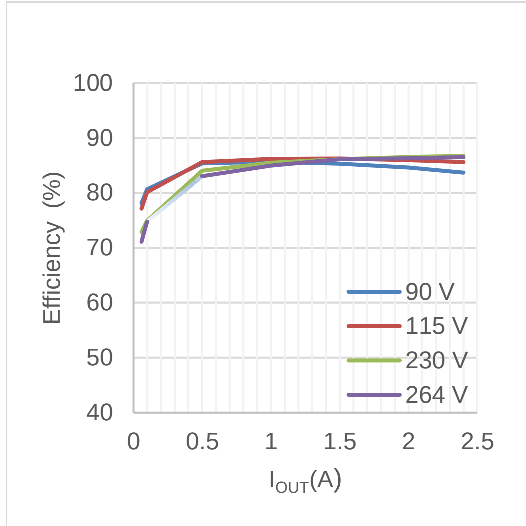


Figure 6. Efficiency vs Output Current

2. Line Regulation

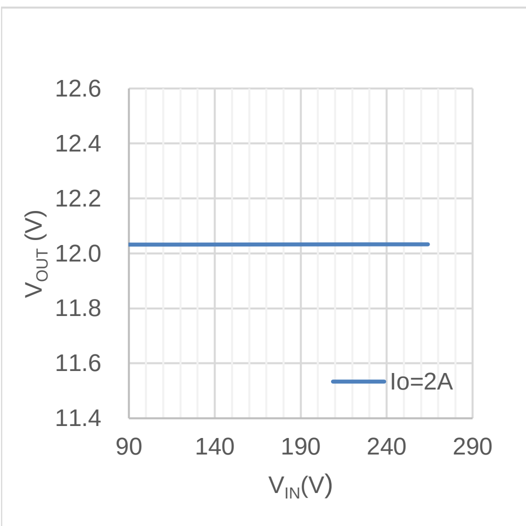


Figure 7. Output Voltage vs Input Voltage

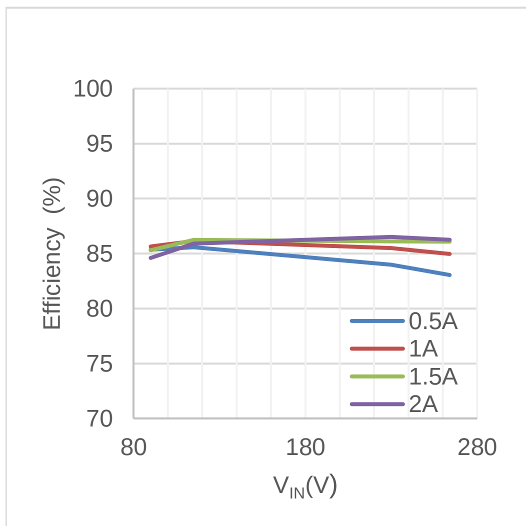


Figure 8. Efficiency vs Input Voltage

Measurement Data – continued

3. Switching Frequency

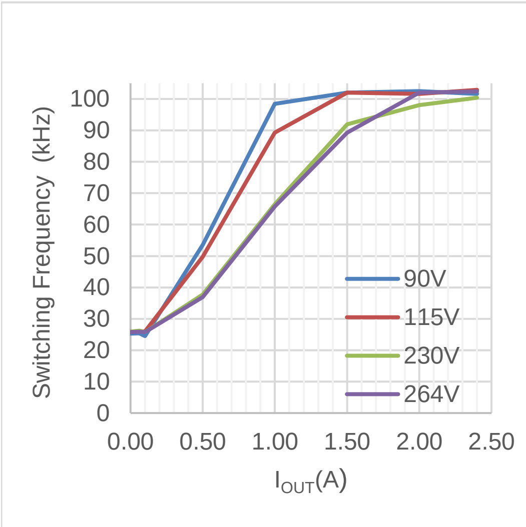


Figure 9. Frequency vs Output Power

4. Input Voltage Slowup

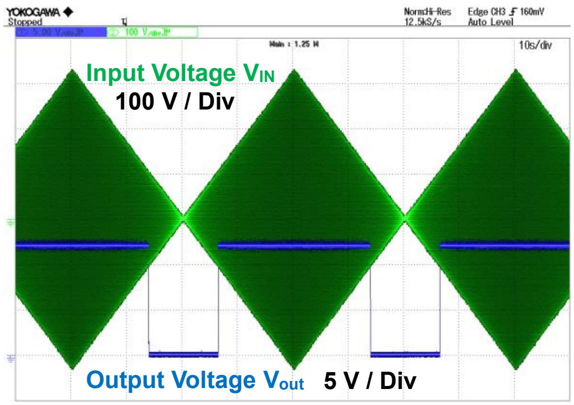


Figure 10. VIN 0 V to 230 V

Measurement Data – continued

5. Switching Wave Form

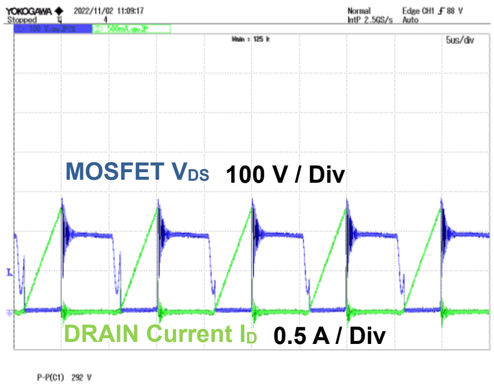


Figure 11. V_{DS}, I_D V_{IN} = 90 Vac, I_{OUT}= 2 A

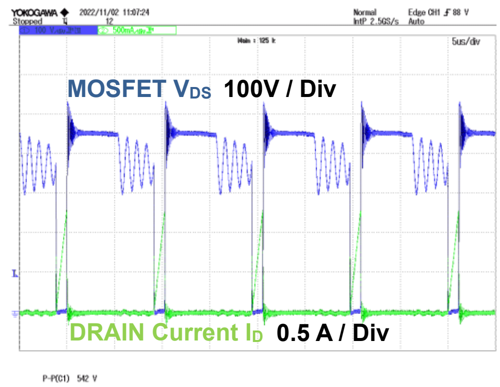


Figure 12. V_{DS}, I_D V_{IN} = 264 Vac, I_{OUT}= 2 A

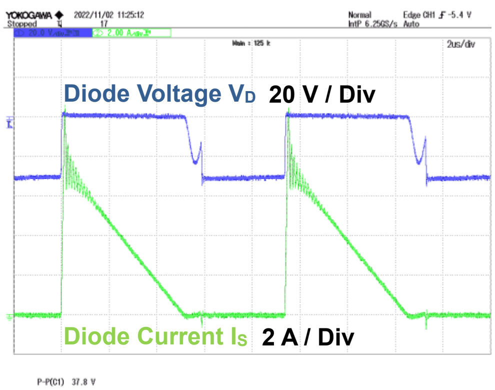


Figure 13. V_D, I_S V_{IN} = 90 Vac, I_{OUT}= 2 A

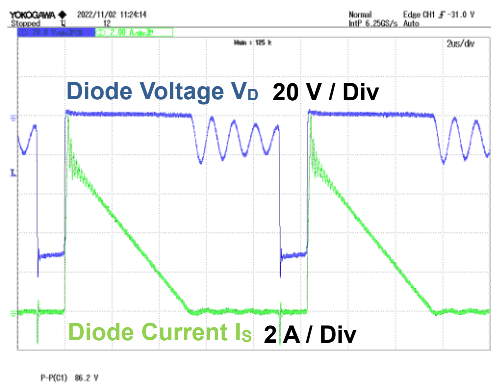


Figure 14. V_D, I_S V_{IN} = 264 Vac, I_{OUT}= 2 A

Measurement Data – continued

5. Switching Wave Form- continued

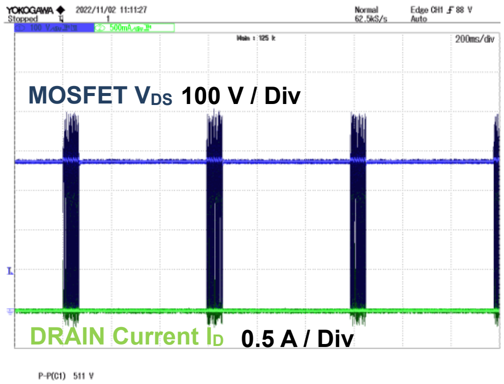


Figure 15. V_{DS}, I_D VIN = 90 Vac, V_{OUT} Shorted

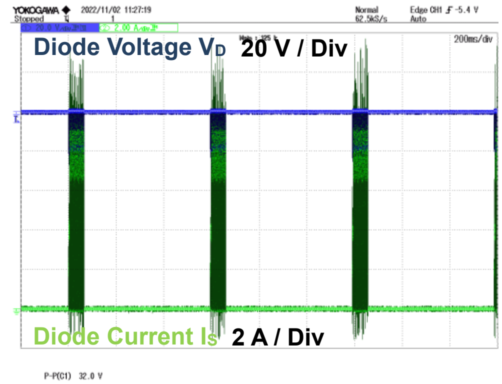


Figure 16. V_D, I_S VIN = 264 Vac, V_{OUT} Shorted

6. Startup Wave Form

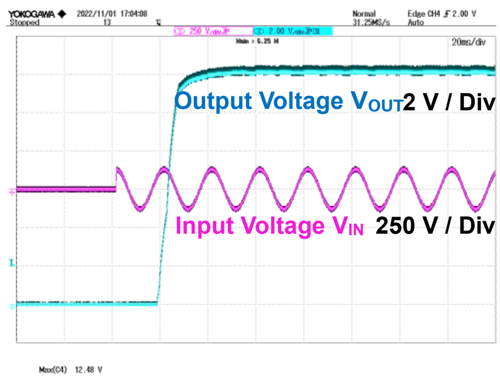


Figure 17. V_{IN} = 90 Vac, I_{OUT} = 2A

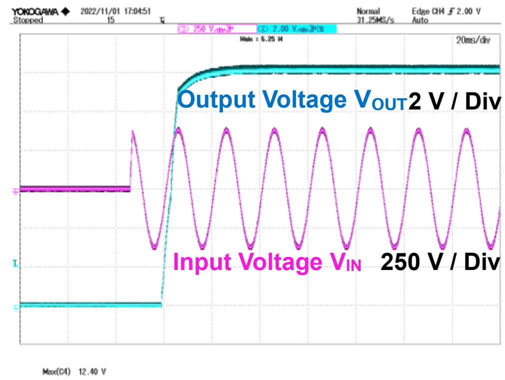


Figure 18. V_{IN} = 264 Vac, I_{OUT} = 2A

Measurement Data – continued

7. Dynamic Load Fluctuation

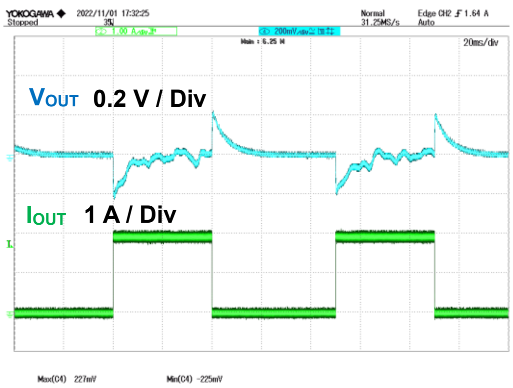


Figure 19. V_{IN} = 90 Vac, I_{OUT} = switch 0.06 A / 2 A

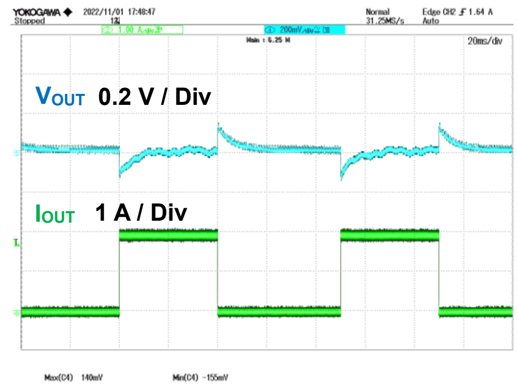


Figure 20. V_{IN} = 264 Vac, I_{OUT} = switch 0.06 A / 2 A

8. Output Voltage Ripple Wave Form

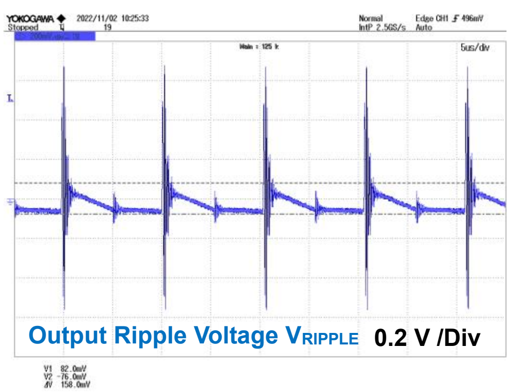


Figure 21. V_{IN} = 90 Vac, I_{OUT} = 2 A

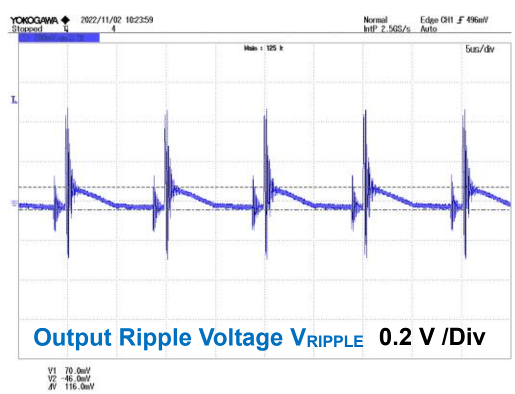


Figure 22. V_{IN} = 264 Vac, I_{OUT} = 2 A

9. Temperature of Parts Surface

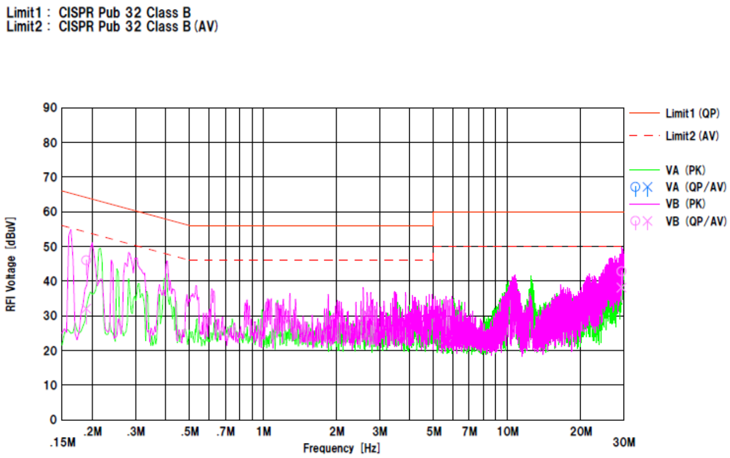
They are measured after 20 minutes from applying a power supply.

Table 1. Surface Temperature of Parts (Ta = 29 °C)

Part	Condition	
	V_{IN} = 90 Vac, I_{OUT1} = 2 A	V_{IN} = 264 Vac, I_{OUT1} = 2 A
IC1	77.8 °C	78.6 °C
Bridge Diode DB1	78.1 °C	54.9 °C

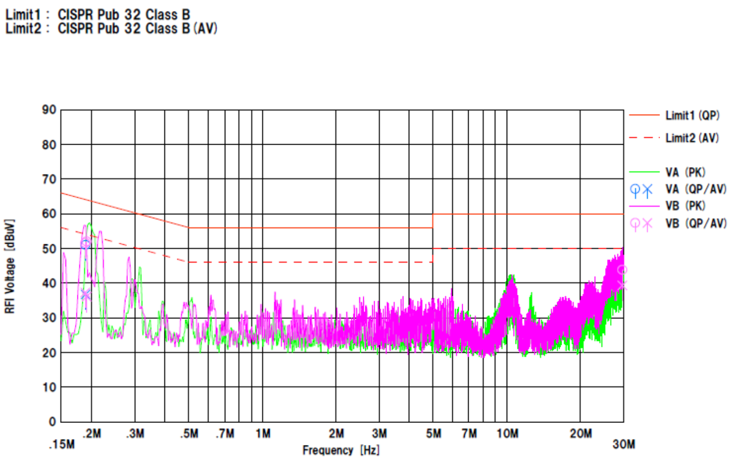
Measurement Data – continued

10. **EMI** Conducted Emission:CISPR22 Pub 22 Class B



QP margin: 17.2dB
AVE margin: 11.9dB

Figure 23. V_{IN}: 230 Vac / 50 Hz, I_{OUT}: 2 A



QP margin: 12.0dB
AVE margin: 10.7dB

Figure 24. V_{IN}: 115 Vac / 50 Hz, I_{OUT}: 2 A

Schematics

V_{IN} = 90 Vac to 264 Vac、V_{OUT} = 12 V 2 A

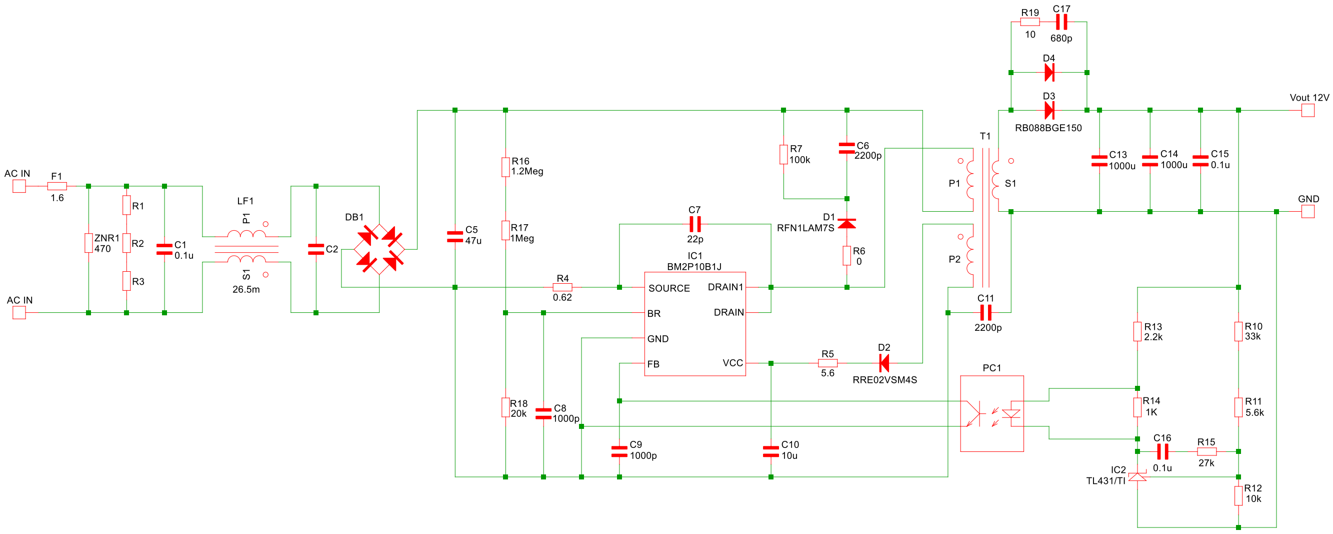


Figure 25. BM2P10B1J-EVK-001 Schematics

Parts List

Item	Specifications	Parts name	Manufacture
C1	0.1 μF, 275 V	890324023023CS	WURTH ELECTRONIK
C2	Non Mounted	-	-
C5	47 μF, 450 V	450BXW47MEFR16X25	RUBYCON
C6	2200 pF, 1000 V	GCJ31BR73A222KXJ1K	MURATA
C7	22 pF, 1000 V	RCE5C3A220J2K1H03B	MURATA
C8	1000 pF, 100 V	HMK107B7102KA-T	TAIYO YUDEN
C9	1000 pF, 100 V	HMK107B7102KA-T	TAIYO YUDEN
C10	10 μF, 35 V	GMK316AB7106KL-TR	TAIYO YUDEN
C11	2200 pF, X1:440 Vac, Y1:300 Vac	DE1E3RA222MA4BP01F	MURATA
C13	1000 μF, 25 V	UPA1E102MPD3	NICHICON
C14	1000 μF, 25 V	UPA1E102MPD3	NICHICON
C15	0.1 μF, 100 V	HMK107B7104KA-T	TAIYO YUDEN
C16	0.1 μF, 100 V	HMK107B7104KA-T	TAIYO YUDEN
C17	680 pF, 1000 V	GRM31B7U3A681JW31	MURATA
CN1		B2P3-VH	JST
D1	FRD, 0.8 A, 700 V	RFN1LAM7S	ROHM
D2	0.2 A, 400 V	RRE02VSM4S	ROHM
D3	SBD, 10 A, 150 V	RB088BGE150	ROHM
D4	Non Mounted	-	-
DB1	1 A, 800 V	D1UBA80	SHINDENGEN
F1	1.6 A, 300 V	36911600000_	LITTELFUSE
GND	BLACK	LC-2-G-BLACK	MAC8
IC1		BM2P10B1J-Z	ROHM
IC2		TL431BIDBZT	TI
LF1	26.5 mH	SSR10VS07265	TOKIN
PC1		LTV-817-B	LITEON
R1	Non Mounted	-	-
R2	Non Mounted	-	-
R3	Non Mounted	-	-
R4	0.62 Ω	LTR100JZPFLR620	ROHM
R5	5.6 Ω	MCR18EZPJ5R6	ROHM
R6	0 Ω	MCR18EZPJ000	ROHM
R7	100 kΩ	MOS2CT52R104J	KOA
R10	33 kΩ	MCR03EZPFX3302	ROHM
R11	5.6 kΩ	MCR03EZPFX5601	ROHM
R12	10 kΩ	MCR03EZPFX1002	ROHM
R13	2.2 kΩ	MCR03EZPJ222	ROHM
R14	1 kΩ	MCR03EZPJ102	ROHM
R15	27 kΩ	MCR03EZPJ273	ROHM
R16	1.2 MΩ	KTR18EZPJ125	ROHM
R17	1 MΩ	KTR18EZPJ105	ROHM
R18	20 kΩ	MCR03EZPJ203	ROHM
R19	10 Ω	ESR18EZPJ100	ROHM
T1	EE25-20	XE2674Y A	ALPHA TRANS
VOUT	WHITE	LC-2-G-WHITE	MAC8
ZNR1	470 V, 400 A, φ 5 mm	V470ZA05P	LITTELFUSE

Materials may be changed without notifying.

Layout

Size: 101 mm x 55 mm

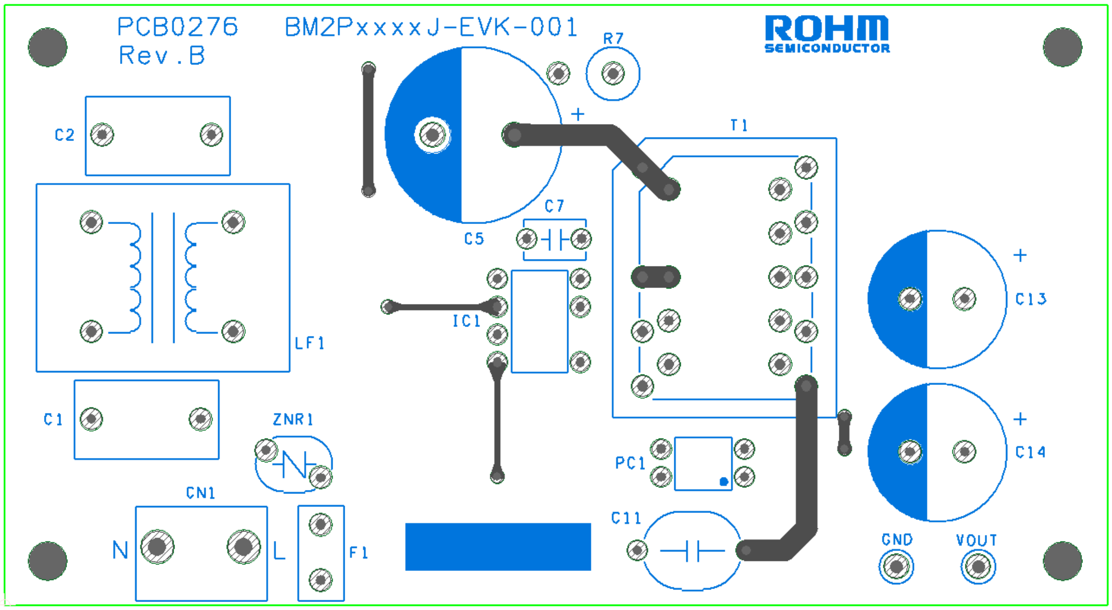


Figure 26. TOP Layout (Top view)

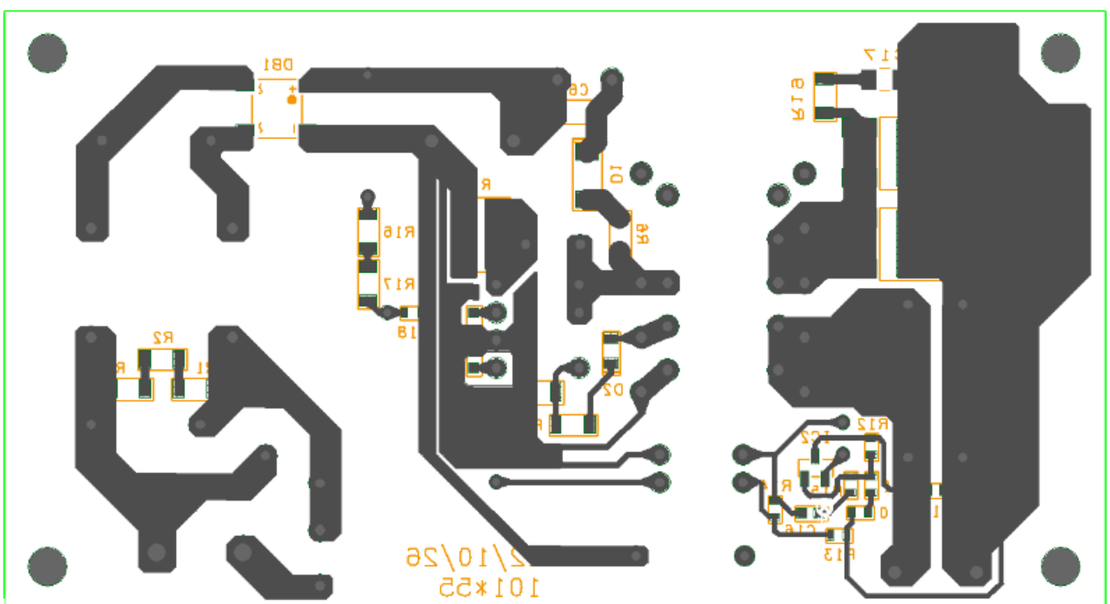


Figure 27. Bottom Layout (Top View)

Specification of the Transformer

Manufacture Alphatrans Co., Ltd. (1-7-2, Bakurou-cho, Chuo-ku, Osaka City, 541-0059, Japan)
http://www.alphatrans.jp/

Product Name: XE2674Y A
Bobbin: 10PIN
Core: EE25/20

- Primary Inductance: 311.5 μH ±10 %
  (100 kHz, 1 V)
- Withstand Voltage
  Between Primary and Secondary: AC1500 V
  Between Primary and Core: AC1500 V
  Between Secondary and Core: AC500 V
- Insulation Resistance 100 MΩ or more (DC500 V)

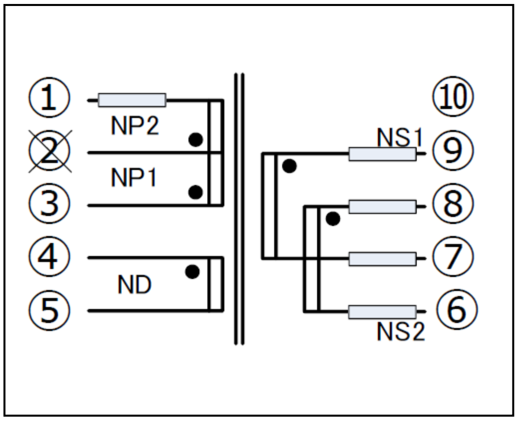


Figure 28. Circuit Diagram

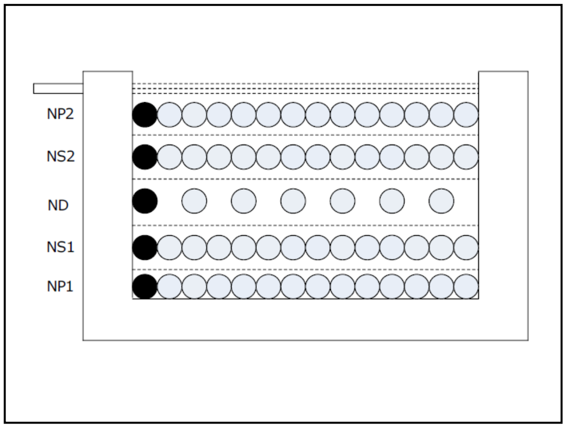


Figure 29. Structure Diagram

Table 2. Product Specification of XE2674Y A

No.	Transformer	Winding Pin		Wire	Turn Number	Tape Layer	Wire Specification
		Start	Finish				
1	NP1	3	2	2UEW / Φ0.32 x 1	25	1	COMPACT
2	NS1	9	7	TEX-E / Φ0.60 x 1	8	1	COMPACT
3	ND	4	5	2UEW / Φ0.20 x 1	10	1	SPACE
4	NS2	8	6	TEX-E / Φ0.60 x 1	8	1	COMPACT
5	NP2	2	1	2UEW / Φ0.32 x 1	25	1	COMPACT

Revision History

Date	Rev.	Changes
16.Jan.2023	001	New Release

Notes

1) The information contained herein is subject to change without notice.

2) Before you use our Products, please contact our sales representative and verify the latest specifications :

3) Although ROHM is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors.
Therefore, in order to prevent personal injury or fire arising from failure, please take safety measures such as complying with the derating characteristics, implementing redundant and fire prevention designs, and utilizing backups and fail-safe procedures. ROHM shall have no responsibility for any damages arising out of the use of our Poducts beyond the rating specified by ROHM.

4) Examples of application circuits, circuit constants and any other information contained herein are provided only to illustrate the standard usage and operations of the Products. The peripheral conditions must be taken into account when designing circuits for mass production.

5) The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM or any other parties. ROHM shall have no responsibility whatsoever for any dispute arising out of the use of such technical information.

6) The Products specified in this document are not designed to be radiation tolerant.

7) For use of our Products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a ROHM representative : transportation equipment (i.e. cars, ships, trains), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, servers, solar cells, and power transmission systems.

8) Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters.

9) ROHM shall have no responsibility for any damages or injury arising from non-compliance with the recommended usage conditions and specifications contained herein.

10) ROHM has used reasonable care to ensure the accuracy of the information contained in this document. However, ROHM does not warrants that such information is error-free, and ROHM shall have no responsibility for any damages arising from any inaccuracy or misprint of such information.

11) Please use the Products in accordance with any applicable environmental laws and regulations, such as the RoHS Directive. For more details, including RoHS compatibility, please contact a ROHM sales office. ROHM shall have no responsibility for any damages or losses resulting non-compliance with any applicable laws or regulations.

12) When providing our Products and technologies contained in this document to other countries, you must abide by the procedures and provisions stipulated in all applicable export laws and regulations, including without limitation the US Export Administration Regulations and the Foreign Exchange and Foreign Trade Act.

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