User's Guide

AC/DC Converter

Flyback Type PWM Mode Isolated 13.5 V 1.3 A Non-Isolated 20 V 0.1 A BM2P0161-Z Evaluation Board

BM2P0161-EVK-004

General Description

This evaluation board outputs an isolated voltage of 13.5 V from an input of 90 Vac to 264 Vac, and the maximum output current is 1.3 A.

It outputs a non-insulated 20 V voltage and can output a maximum output current of 0.1 A.

Developed mainly as a power supply for air conditioners.

The non-insulated output can be used as a control power source for inverters and the like.

PWM controller for AC / DC power supplies, the BM2P0161-Z provides the optimum system for all products with outlets.

Figure 1. BM2P0161-EVK-004

Performance Specification

Not guarantee the characteristics is representative value.

Unless otherwise specified V_{IN} = 230 Vac , I_{OUT} = 1.3 A , I_{OUT2} = 0.1 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	-	63	Hz	
Output Voltage 1	V_{OUT1}	12.96	13.5	14.04	V	
Output Current 1 Range *(Note 1)*	I_{OUT1}	0	-	1.3	A	
Output Voltage 2	V_{OUT2}	18	20	22	V	
Output Current 2 Range	I_{OUT2}	0		0.1	A	
Maximum Output Power	P_{OUT}			19.55	W	
Standby Input Power	P_{INSTBY}	-	55	-	mW	I_{OUT1} = 0 A I_{OUT2} = 0 A V_{IN} = 230 V
Power supply efficiency	η	85	86.9	-	%	
Output Ripple Voltage 1 *(Note 2)*	$V_{RIPPLE1}$	-	0.06	0.27	Vpp	
Output Ripple Voltage 2 *(Note 2)*	$V_{RIPPLE2}$	-	0.05	0.40	Vpp	
Oprating Temperature		-10	+25	+65	°C	

(Note 1) Adjust the load application time so that the component surface temperature does not exceed 105 °C.

(Note 2) Not include spikes noise.

Derating

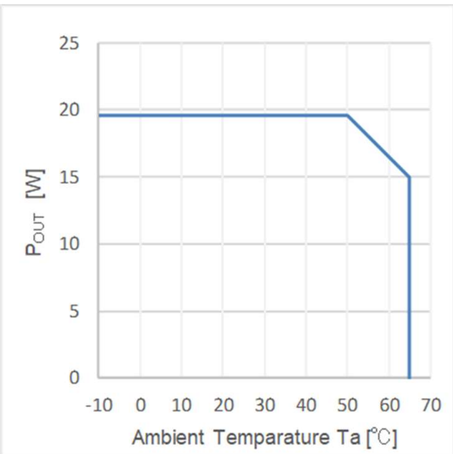


Figure 2. Temperature derating curve

Operation Procedure

1. Necessary Equipment

(1) AC power supply (90 Vac to 264 Vac, 50 W or more)

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

DC voltmeter

2. Connect to Each Equipment

(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 each VOUT pin from the positive pin and to each 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 each VOUT pin and the negative pin to each 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 (13.5 V or 20 V).

(9) Electronic load switch is ON.

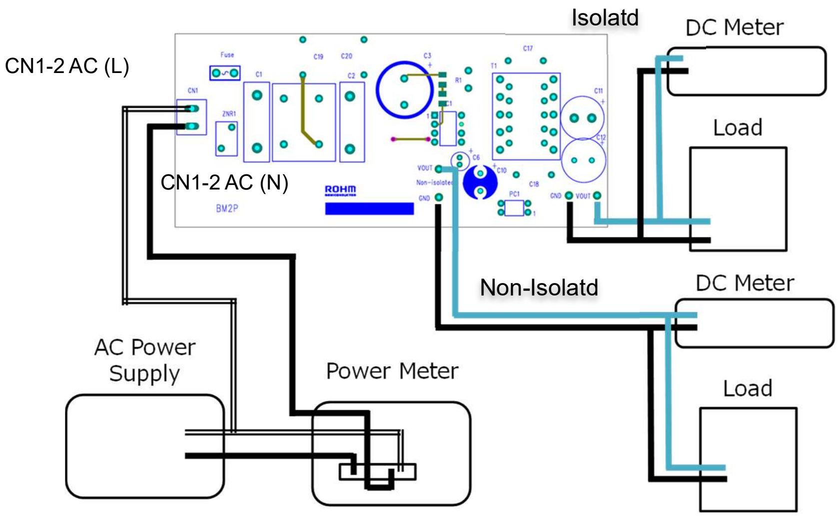


Figure 3. Diagram of How to Connect

Application Circuit

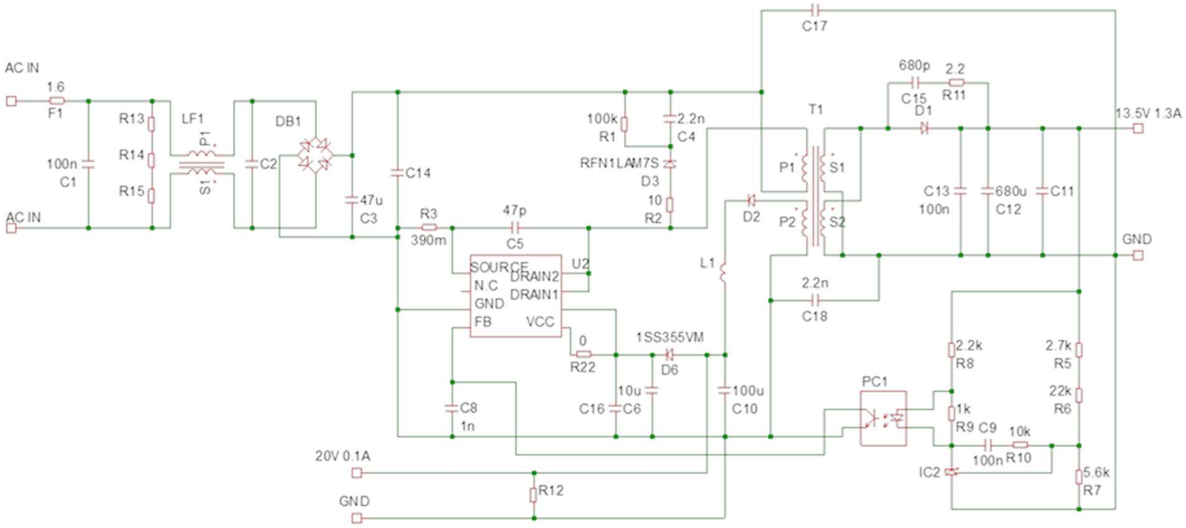
This evaluation board operates in flyback mode at a maximum frequency of around 65 kHz..

The output (13.5 V) voltage is monitored by a feedback circuit and fed back to the FB terminal of BM2P0161-Z through a opto - coupler.

The voltage of the non-insulated output (20 V) is determined by the turns ratio (Nd / Ns) of the transformer, and the number of turns is set to output 20 V.

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 14.



BM2P0161-Z General Description

Features

- PWM Frequency : 65 kHz
- PWM Current Mode Control
- Built-in Frequency Hopping Function
- Burst Operation When Load is Light
- Frequency Reduction Function
- Built-in 730 V Starter Circuit
- Built-in 730 V Switching MOSFET
- VCC Pin Under-Voltage Protection
- VCC Pin Over-Voltage Protection
- SOURCE Pin Open Protection
- SOURCE Pin Short Protection
- Per-Cycle Protection Circuit
- Over Current Protection AC Voltage Compensation Circuit
- Soft Start
- Secondary Over-Current Protection Circuit

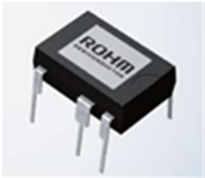
Key Specifications

- Operation Power Supply Voltage Range
  - VCC Pin Voltage: 8.9 V to 26.0 V
  - DRAIN Pin Voltage: 730 V (Max)
- Current at Switching Operation: 0.90 mA (Typ)
- Current at Burst Operation 0.30 mA (Typ)
- Current at Power Save Operation 0.11 mA (Typ)
- Switching Frequency 65 kHz (Typ)
- Operation Temperature Range -40 °C to +105 °C

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 (Typ)



Pin Configuration

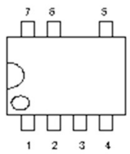


Figure 4. Pin Configuration

Applications

AirConditioner, ACAdapters, EachHousehold Applications and Power Supplies for Motor

Pin Descriptions

No.	Pin Name	I/O	Function
1	SOURCE	I/O	MOSFET SOURCE pin
2	FADJ	I	Burst frequency setting pin
3	GND	-	GND pin
4	FB	I	Feedback signal input 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

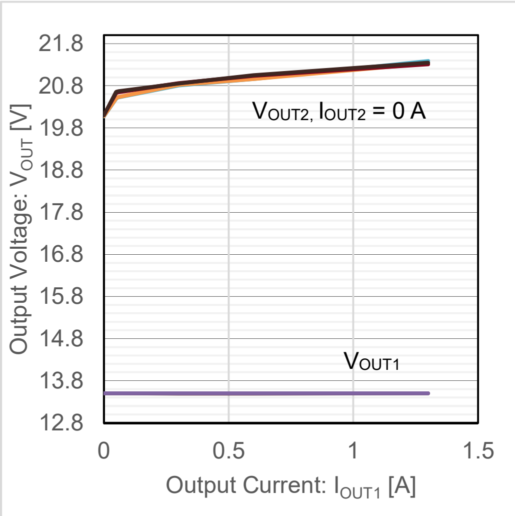


Figure 5. Output Voltage vs Output Current

(V_{OUT1} ,V_{OUT2} vs I_{OUT1})

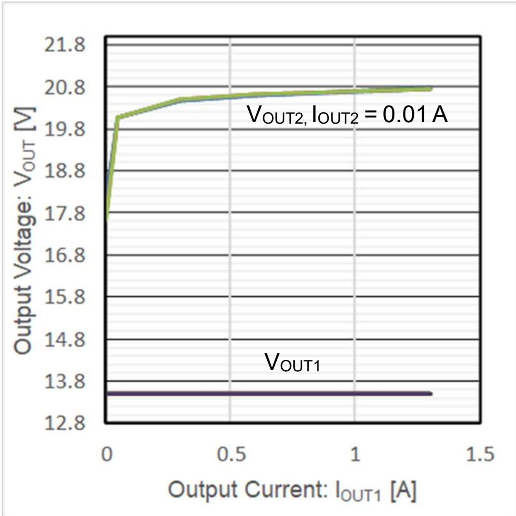


Figure 6. Output Voltage vs Output Current

(V_{OUT1} ,V_{OUT2} vs I_{OUT1})

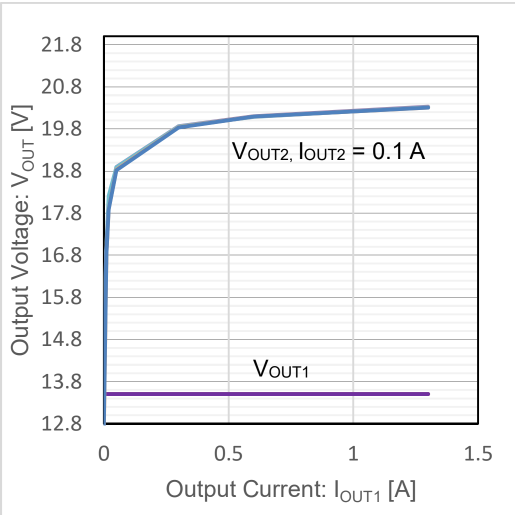


Figure 7. Output Voltage vs Output Current

(V_{OUT1} ,V_{OUT2} vs I_{OUT1})

Measurement Data – continued

2. Efficiency

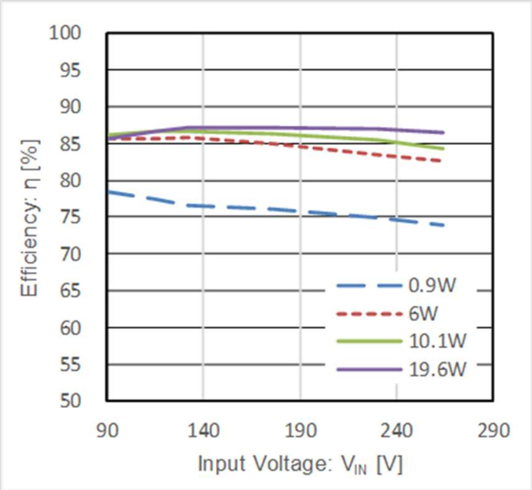


Figure 8. Efficiency (Efficiency vs V_{IN})

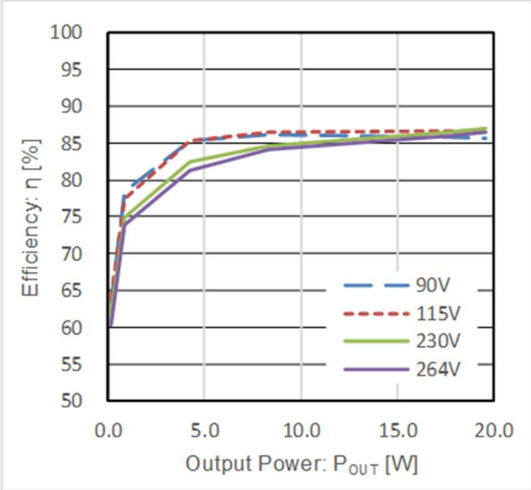


Figure 9. Efficiency (η vs P_{OUT})

3. Switching Frequency

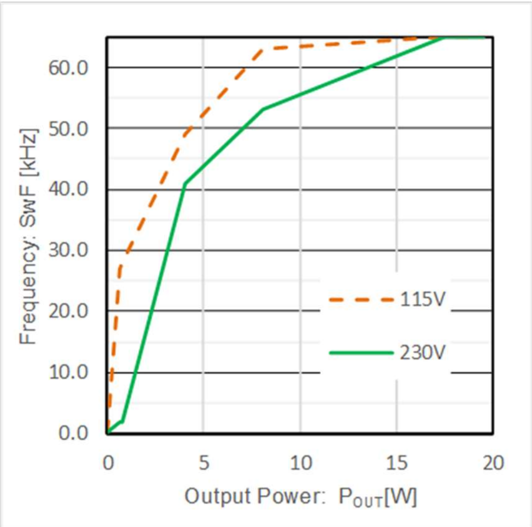


Figure 10. Frequency vs Output Power

SwF vs P_{OUT}

Measurement Data – continued

4. Switching Wave Form

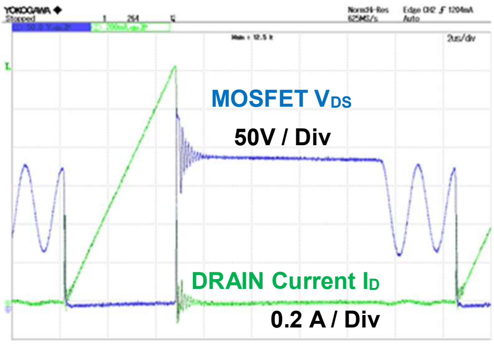


Figure 11. V_{DS},I_D V_{IN} = 90Vac,I_{OUT1}=1.3A

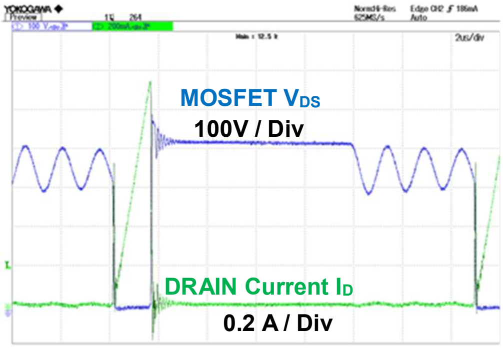


Figure 12. V_{DS},I_D V_{IN} = 264Vac,I_{OUT1}=1.3A

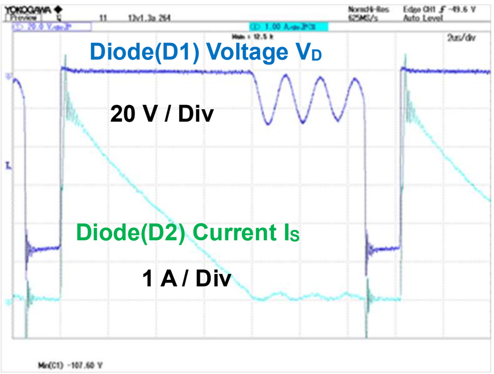


Figure 13. V_{DS},I_D V_{IN} = 90Vac,I_{OUT1}=1.3A

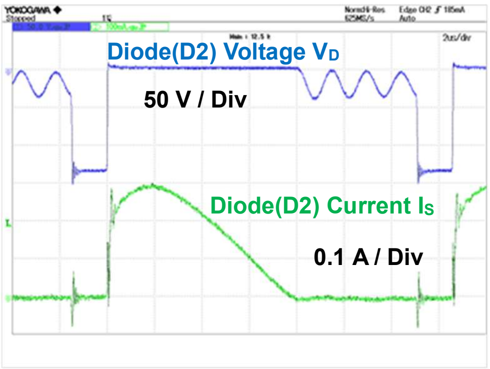


Figure 14. Switching Frequency (swF vs I_{OUT})

Measurement Data – continued

4. Switching Wave Form- continued

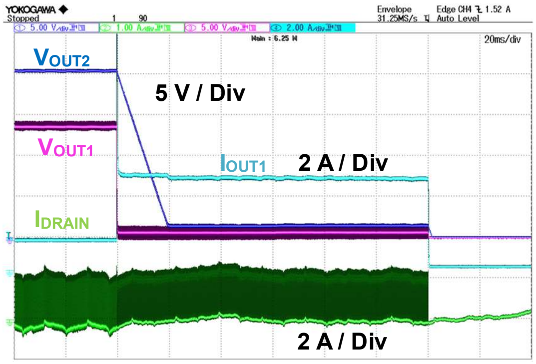


Figure 15. VIN = 90 Vac, V_{OUT1} Shorted

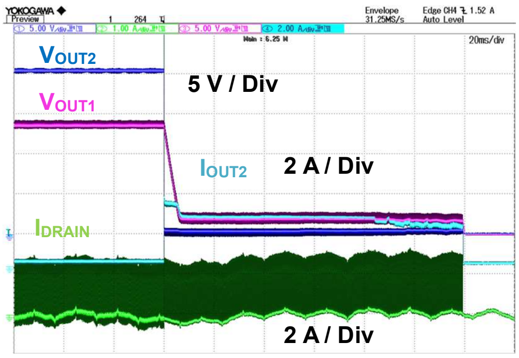


Figure 16. V_{IN} = 90 Vac, V_{OUT2} Shorted

5. Startup Wave Form

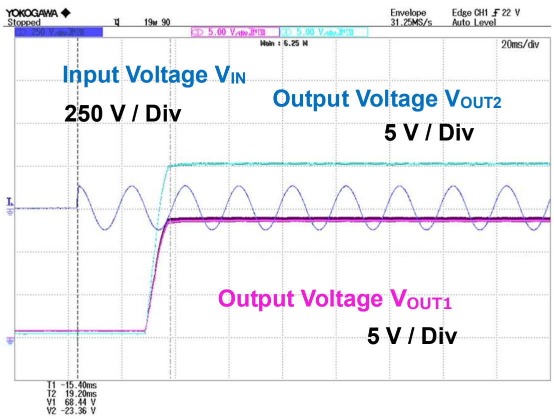


Figure 17. V_{IN} = 90 Vac, I_{OUT} = 1.3 Aa

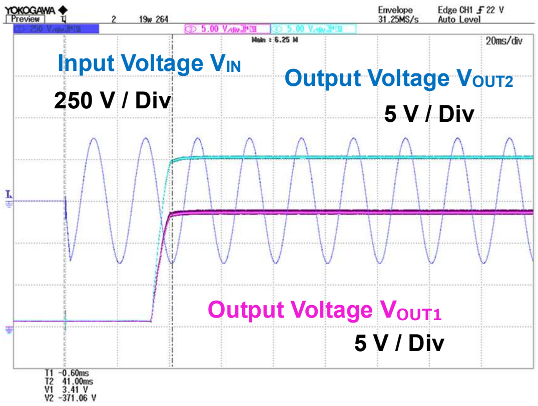


Figure 18. V_{IN} = 264 Vac, I_{OUT} = 1.3 A

Measurement Data – continued

6. Dynamic Load Fluctuation

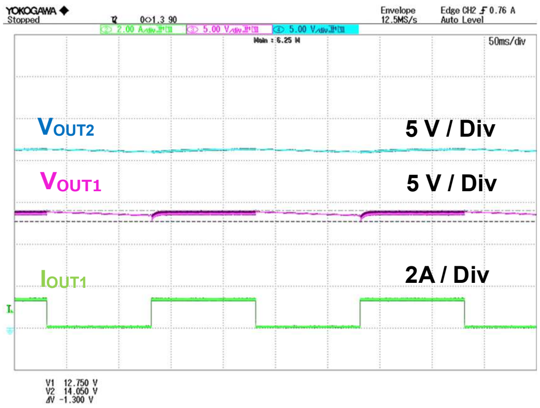


Figure 19. V_{IN} = 115 Vac,I_{OUT1} = Switch 0 A / 1.3 A

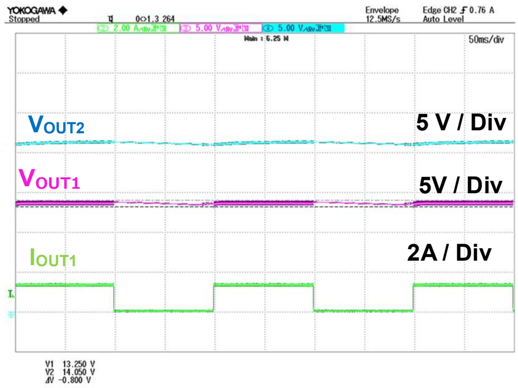


Figure 20. V_{IN} = 230 Vac,I_{OUT1} = Switch 0 A / 1.3 A

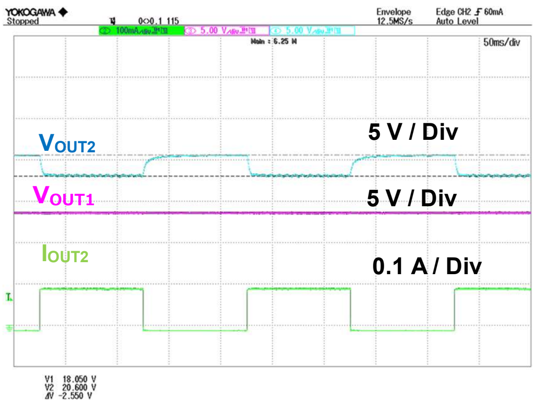


Figure 21. V_{IN} = 115 Vac,I_{OUT2} = Switch 0 A / 0.1 A

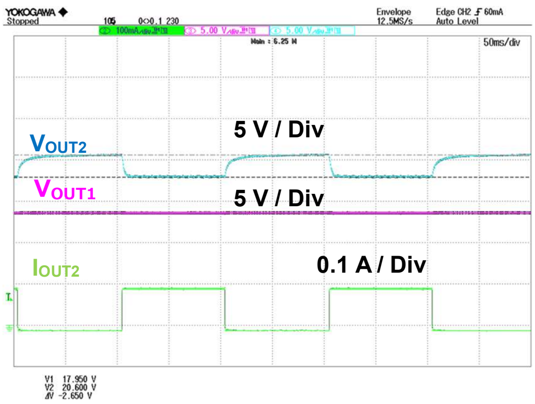


Figure 22. V_{IN} = 230 Vac,I_{OUT2} = Switch 0 A / 0.1 A

Measurement Data – continued

7. Output Voltage Ripple Wave Form

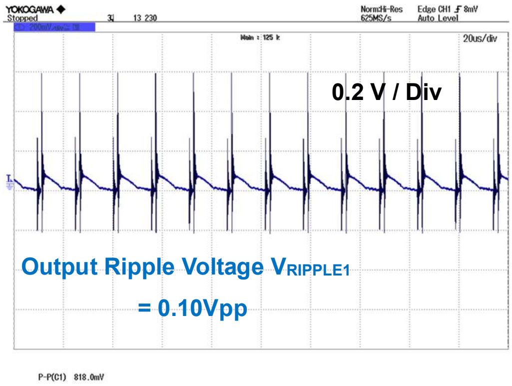


Figure 23. V_{IN} = 230 Vac, I_{OUT1} = 1.3 A

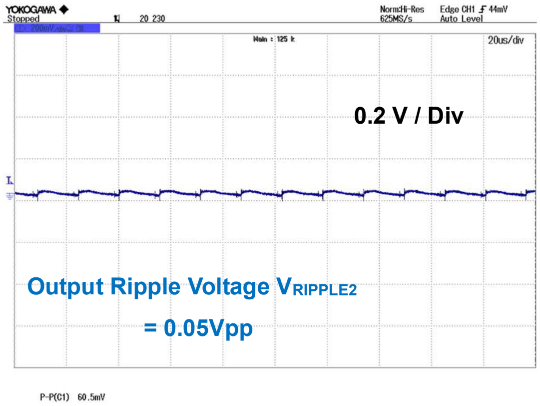


Figure 24. V_{IN} = 230 Vac, I_{OUT2} = 0.1 A

8. Temperature of Parts Surface

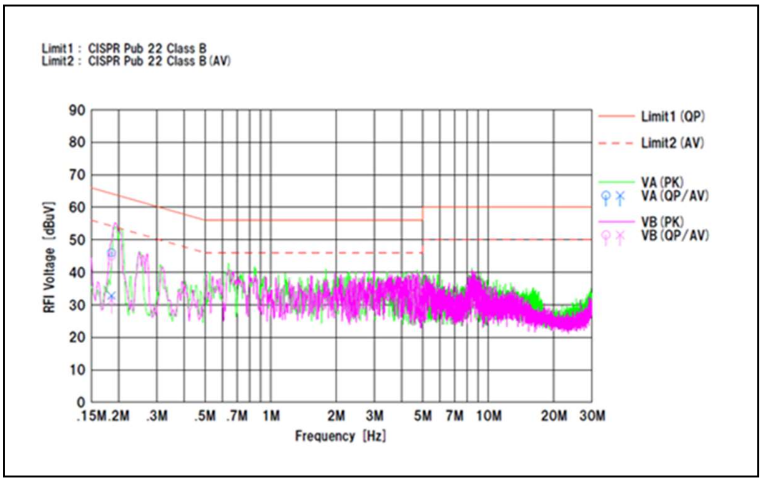
They are measured after 15 minutes from applying a power supply.

Table 1. Surface Temperature of Parts (Ta = 20 °C)

Part	Condition	
	V_{IN} = 90 Vac, I_{OUT1} = 1.3 A	V_{IN} = 264 Vac, I_{OUT1} = 1.3 A
IC1	59.6 °C	73.2 °C
Diode D1	60.4 °C	73.2 °C

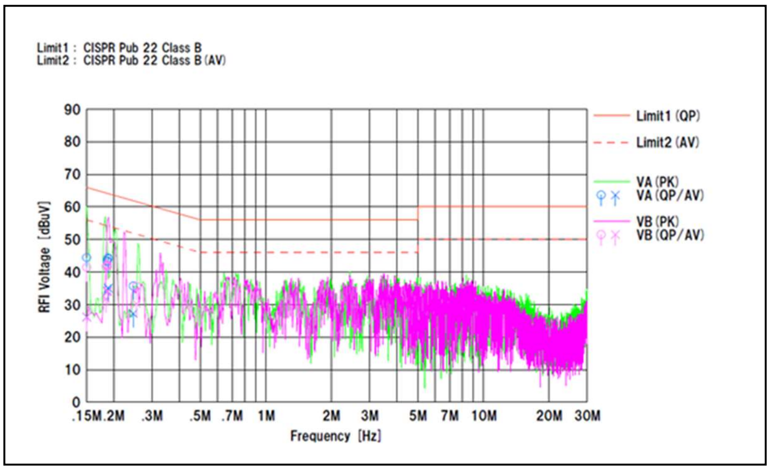
Measurement Data – continued

9. EMI Conducted Emission:CISPR22 Pub 22 Class B



QP margin: 18.2 dB
AVE margin: 21.4 dB

Figure 25. V_{IN}: 115 Vac / 60 Hz, I_{OUT1}: 1.3 A I_{OUT2}:0.1 A



QP margin: 19.8 dB
AVE margin: 18.9 dB

Figure 26. V_{IN}: 230 Vac / 50 Hz, I_{OUT1}: 1.3 A I_{OUT2}:0.1 A

Schematics

V_{IN} = 90 Vac to 264 Vac、V_{OUT1} = 13.5 V 1.3 A 、V_{OUT2} = 20 V 0.1 A

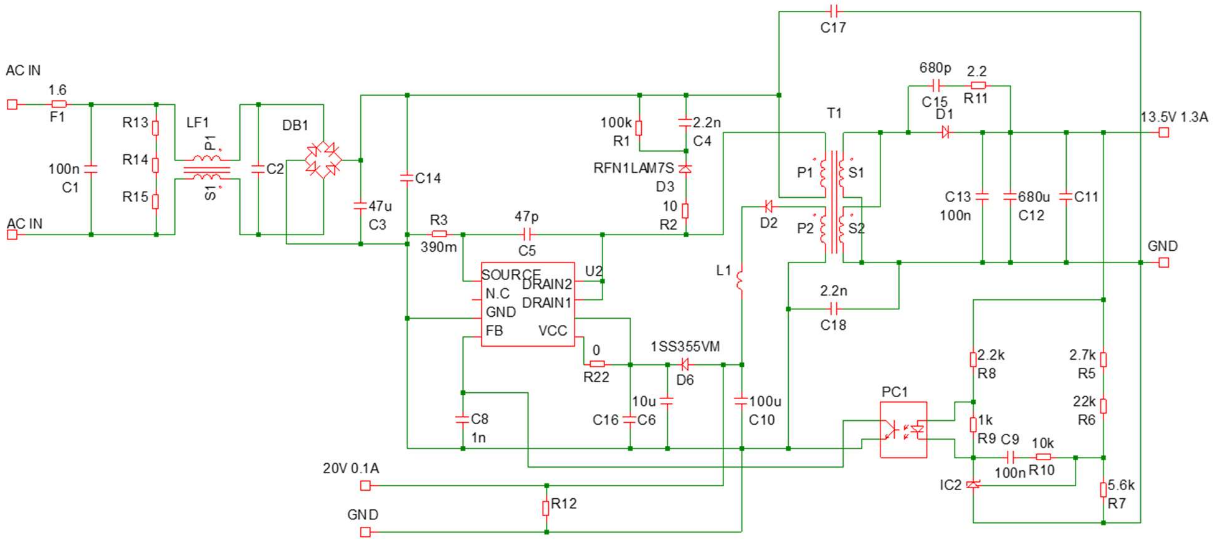


Figure 27. BM2P0161-EVK-004 Schematics

Parts List

Item	Specifications	Parts name	Manufacture
C1	100 n, 310 Vac	890324023023CS	WURTH ELECTRONIK
C2,C11,C14,C16,C17	Non maunted	-	-
C3	47 μ, 450 V	450BWX47MEFR16×25	RUBYCON
C4	2200 pF, 1000 V	GRM31BR73A222KW01	MURATA
C5	47 p, 630 V	GRM31A5C2JA470JW01D	MURATA
C6	10 μF, 50 V	860160672009_	WURTH ELECTRONIK
C8	1000 pF, 100 V	HMK107B7102KA-T	TAIYO YUDEN
C9	0.1 μF, 100 V	HMK107B7104KA-T	TAIYO YUDEN
C10	100 μF, 50 V	860080674009_	WURTH ELECTRONIK
C12	680 μF, 35 V	860080578019_	WURTH ELECTRONIK
C13	0.1 μF, 100 V	HMK107B7104KA-T	TAIYO YUDEN
C15	680 pF, 200 V	GRM31B5C2J681FW01L	MURATA
C18	2200 pF, AC 300 V	DE1E3KX222MB4BP01F	MURATA
CN1		B02P－NV	JST
DB1	1 A, 800 V	D1UBA80-7062	SHINDENGEN
D1	SBD, 6 A, 150 V	RB098BM150	ROHM
D2	FRD, 0.7 A,400 V	RF071LAM4S	ROHM
D3	FRD, 0.8 A, 700 V	RFN1LAM7S	ROHM
D6	0.1 A,0.1 A	1SS355VAM	ROHM
PC1		LTV-817-B	LITEON
R1	100 kΩ	MOS2CT52R104J	KOA
R2	10 Ω	LTR18EZPJ100	ROHM
R3	390 mΩ	ESR25EZPZFLR390	ROHM
R5	2.7 kΩ	MCR03EZPFX2701	ROHM
R6	22 kΩ	MCR03EZPFX2202	ROHM
R7	5.6 kΩ	MCR03EZPFX5601	ROHM
R8	2.2 kΩ	MCR03EZPJ222	ROHM
R9	1 kΩ	MCR03EZPJ102	ROHM
R10	10 kΩ	MCR03EZPJ103	ROHM
R11	2.2 Ω	ESR18EZPJ2R2	ROHM
R12,R13,R14,R15	Non maunted		
R22	0 Ω	MCR03EZPJ000	ROHM
F1	1.6 A, 300 V	36911600000_	LITTELFUSE
L1	600 Ω,0.5A	BLM18AG601SN1	MURATA
LF1	33 mH	SSR10V-07330	TOKIN
T1	EE22	XE2498Y_A2	ALPHA TRANS
IC1		BM2P0161-Z	ROHM
IC2		TL431BIDBZT	T.I
TP1,TP2,TP3,TP4		CD-10-15	MAC8

Materials may be changed without notifying.

Layout

Size: 123 mm x 55 mm

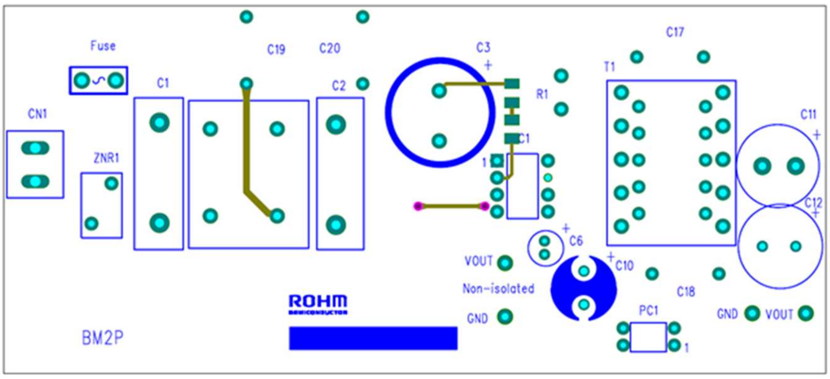


Figure 28. TOP Silkscreen (Top view)

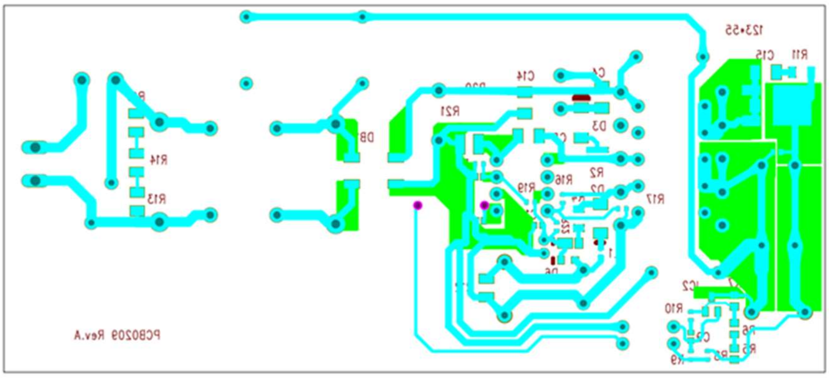


Figure 29. Bottom Layout (Top View)

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: XE2498Y_A2
Bobbin: 12PIN
Core: EE22

- Primary Inductance: 0.45mH ±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)

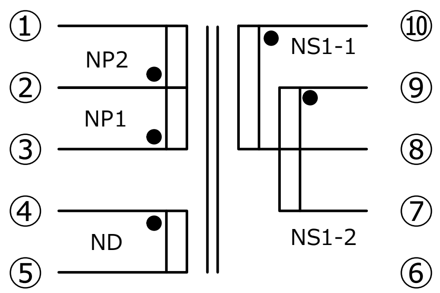


Figure 30. Circuit Diagram

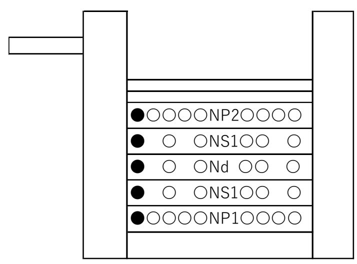


Figure 31. Structure Diagram

Table 3. Product Specification of XE2498Y_A2

No.	Transformer	Winding Pin Start	Winding Pin Finish	Wire	Turn Number	Tape Layer	Wire Specification
1	NP1	3	2	2UEW / Φ0.37 x 1	38	1	COMPACT
2	NS1	10	8	TEX / Φ0.45 x 1	12	1	COMPACT
3	ND	4	5	2UEW / Φ0.20 x 1	18	1	COMPACT
4	NS1	9	7	TEX / Φ0.45 x 1	12	1	COMPACT
5	NP2	2	1	2UEW / Φ0.37 x 1	19	2	COMPACT

Revision History

Date	Rev.	Changes
23.March.2021	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.

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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.

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ROHM SEMICONDUCTOR

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