



Isolation Fly-back Converter PWM method
Output 40W 24V
BM2P060MF-EVK-001

User's Guide

<High Voltage Safety Precautions>

◇ Read all safety precautions before use

Please note that this document covers only the **BM2P060MF** evaluation board (BM2P060MF-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 be 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 24 V 1.67 A 40 W BM2P060MF Evaluation Board

BM2P060MF-EVK-001

General Description

This evaluation board outputs an isolated voltage of 24 V from an input of 90 Vac to 264 Vac, and the maximum output current is 1.67 A.

BM2P060MF which is PWM method DC/DC converter IC built-in 650 V MOSFET is used.

Low on-resistance 0.7 Ω 650 V MOSFET built-in contributes to high efficiency (91 % typ).

PWM controller for AC / DC power supplies, the BM2P060MF provides the optimum system for all products with outlets.



Figure 1. BM2P060MF-EVK-001

Performance Specification

Not guarantee the characteristics is representative value.

Unless otherwise specified $V_{IN} = 230 \text{ Vac}$, $I_{OUT} = 1.67 \text{ A}$, $T_a = 25 \text{ }^\circ\text{C}$

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	V_{OUT1}	22.8	24.0	25.2	V	
Output Current Range ^(Note 1)	I_{OUT1}	0	-	1.67	A	
Maximum Output Power	P_{OUT}			40.0	W	
Standby Input Power	P_{INSTBY}	-	47	100	mW	$I_{OUT} = 0 \text{ A}$ $V_{IN} = 230 \text{ V}$
Power supply efficiency	η	88.0	91.0	-	%	
Output Ripple Voltage ^(Note 1)	V_{RIPPLE}	-	0.10	0.24	Vpp	
Operating Temperature		-10	+25	+65	$^\circ\text{C}$	

(Note 1) Not include spikes noise.

Derating

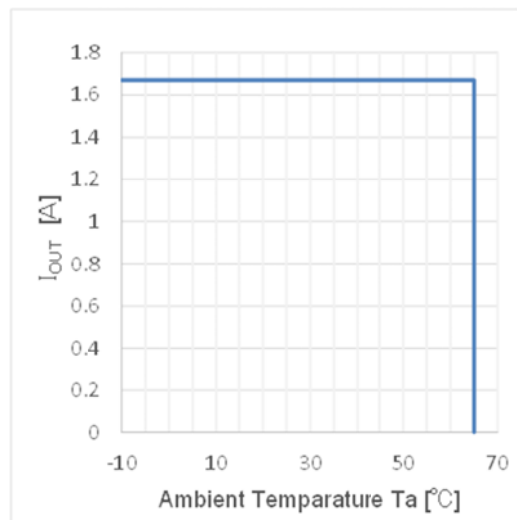


Figure 2. Temperature derating curve

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 (24 V).
- (9) Electronic load switch is ON.

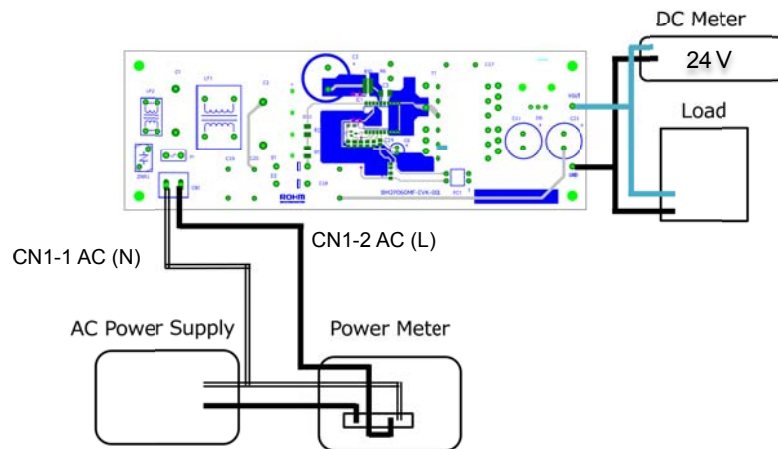


Figure 3. Diagram of How to Connect

BM2P060MF General Description

Features

- AC Low Voltage Protection Function (AC UVLO)
- X Capacitor Discharge Function
- VCC Pin Low Voltage Protection (VCC UVLO)
- PWM Type Current Mode Control
- Frequency Reduction Function
- Burst Operation at Light Load
- External Burst voltage setting function
- Minimum ON width adjustment at light load
- Soft Start Function
- FB Pin Overload Protection Function (FB OLP)
- Over Current Protection Function by cycle
- Over Current Compensation by AC voltage detection.
- External Stop Function
- Dynamic Over Current Protection
- Leading Edge Blanking

Key Specifications

- Operation Power Supply Voltage Range
VCC Pin Voltage: 11 V to 60 V
- DRAIN Pin Voltage: 650 V (Max)
- Current at Switching Operation: 850 μA (Typ)
- Current at Burst Operation: 400 μA (Typ)
- Switching Frequency: 65 kHz (Typ)
- MOSFET ON Resistor: 0.70 Ω (Typ)
- Operation Temperature Range: -40 °C to +105 °C

Package

SOP20A

W (Typ) x D (Typ) x H (Max)

12.8 mm x 10.3 mm x 2.65 mm



Applications

AC Adapters, Each Household Applications and Power Supplies for Motor

Pin Configuration

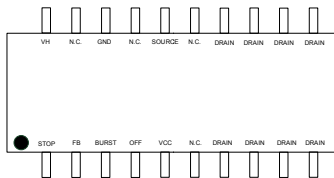


Figure 4. Pin Configuration

Pin Descriptions

No.	Pin name	I/O	Function	No.	Pin name	I/O	Function
1	STOP	I	External stop pin	11	DRAIN	I/O	MOSFET Drain pin
2	FB	I/O	Feedback pin	12	DRAIN	I/O	MOSFET Drain pin
3	BURST	I	Burst setting pin	13	DRAIN	I/O	MOSFET Drain pin
4	OFF	I	MIN on setting pin	14	DRAIN	I/O	MOSFET Drain pin
5	VCC	I/O	Power supply input pin	15	N.C.	-	No connection
6	N.C.	-	No connection	16	SOURCE	I/O	MOSFET source pin
7	DRAIN	I/O	MOSFET Drain pin	17	N.C.	-	No connection
8	DRAIN	I/O	MOSFET Drain pin	18	GND	I/O	GND pin
9	DRAIN	I/O	MOSFET Drain pin	19	N.C.	-	No connection
10	DRAIN	I/O	MOSFET Drain pin	20	VH	I	AC voltage start-up pin

Measurement Data

1. Load Regulation

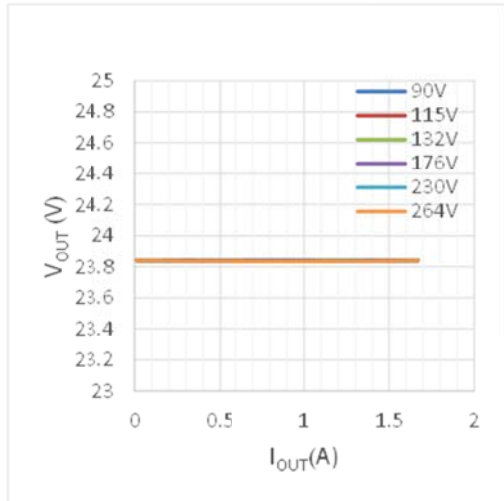


Figure 5. Output Voltage vs Output Current

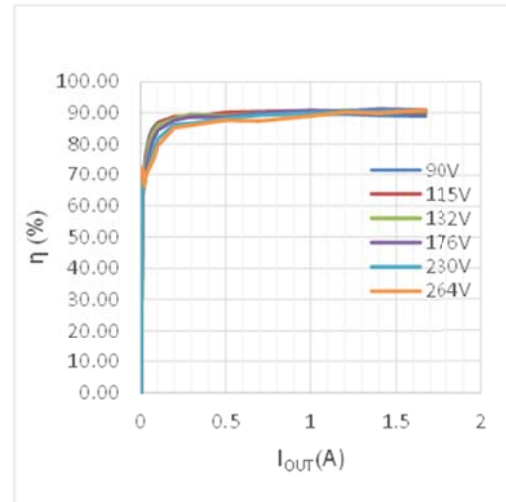


Figure 6. Efficiency vs Output Current

2. Line Regulation

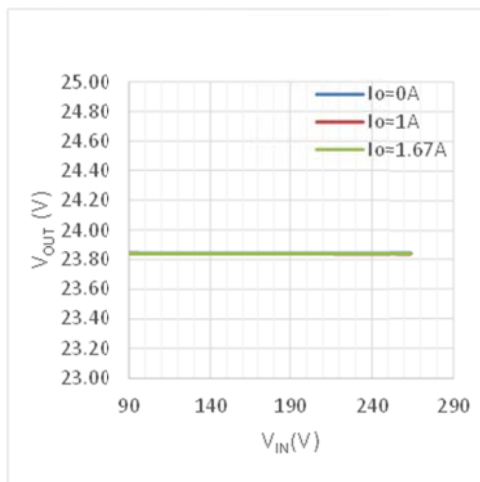


Figure 7. Output Voltage vs V_{IN}

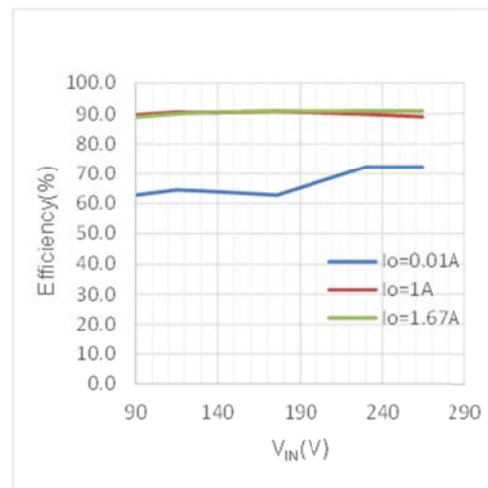


Figure 8. Efficiency vs Input Voltage

Measurement Data – continued

3. Switching Frequency

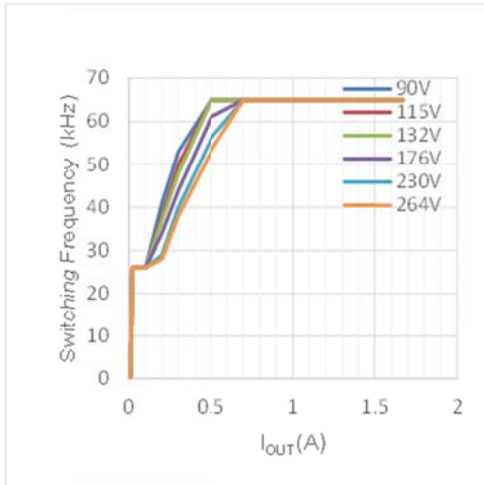


Figure 9. Frequency vs Output Power

4. Input Voltage Slowup

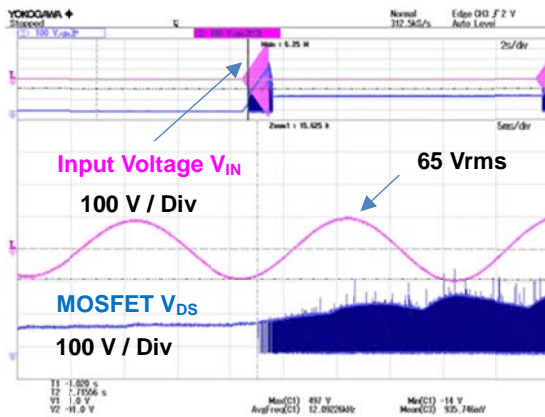


Figure 10. V_{IN} 0 V to 230 V

Measurement Data – continued

5. Switching Wave Form

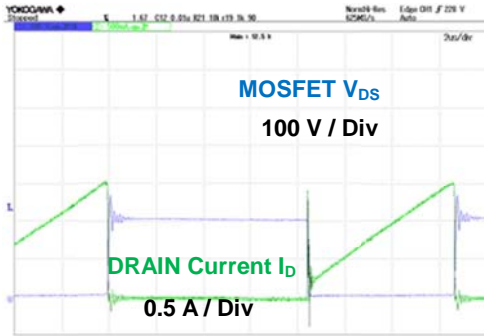


Figure 11. V_{DS}, I_D $V_{IN} = 90\text{Vac}, I_{OUT} = 1.67\text{A}$

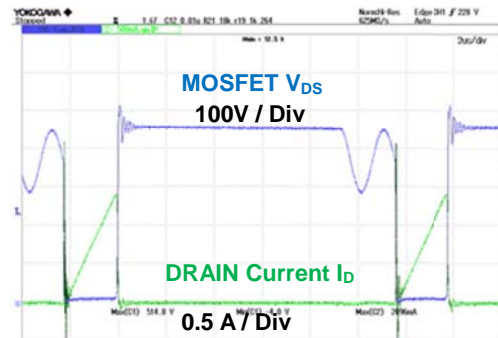


Figure 12. V_{DS}, I_D $V_{IN} = 264\text{Vac}, I_{OUT} = 1.67\text{A}$

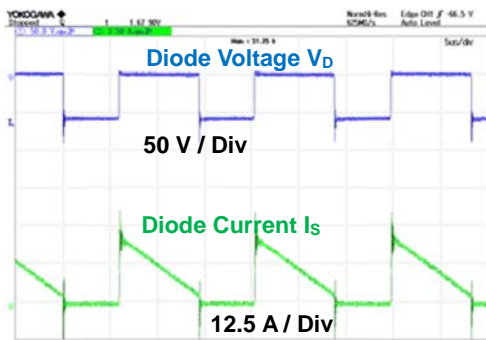


Figure 13. V_{DS}, I_D $V_{IN} = 90\text{Vac}, I_{OUT} = 1.67\text{A}$

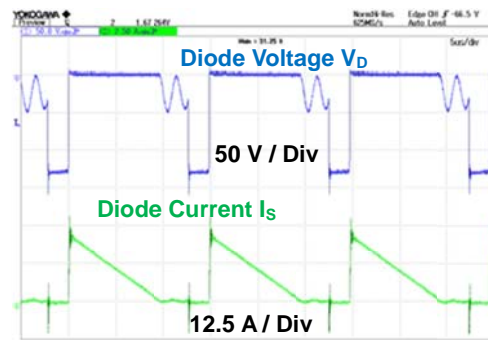


Figure 14. V_{DS}, I_D $V_{IN} = 264\text{Vac}, I_{OUT} = 1.67\text{A}$

Measurement Data – continued

5. Switching Wave Form- continued

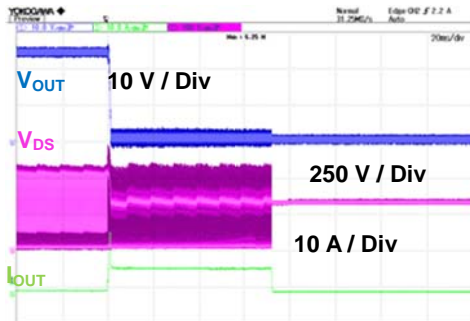


Figure 15. $V_{IN} = 90 \text{ Vac}$, V_{OUT} Shorted

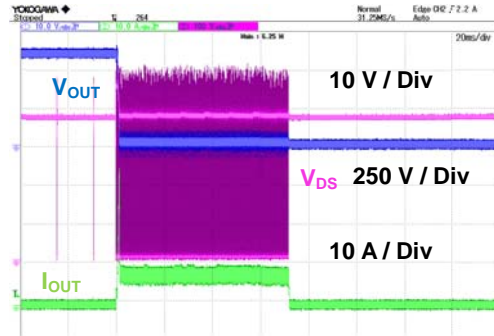


Figure 16. $V_{IN} = 264 \text{ Vac}$, V_{OUT} Shorted

6. Startup Wave Form

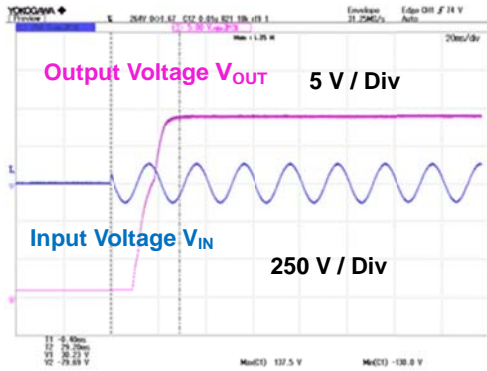


Figure 17. $V_{IN} = 90 \text{ Vac}$, $I_{OUT} = 1.67 \text{ A}$

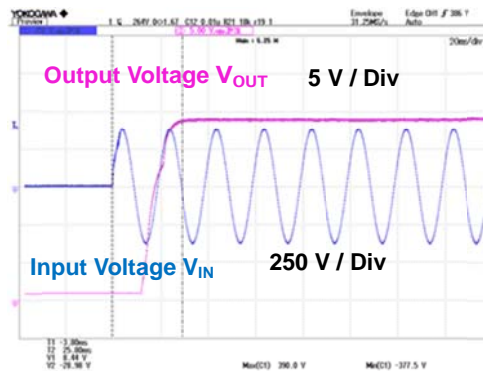


Figure 18. $V_{IN} = 264 \text{ Vac}$, $I_{OUT} = 1.67 \text{ A}$

Measurement Data – continued

7. Dynamic Load Fluctuation



Figure 19. $V_{IN} = 115 \text{ Vac}$, $I_{OUT} = \text{Switch } 0 \text{ A} / 1.67 \text{ A}$

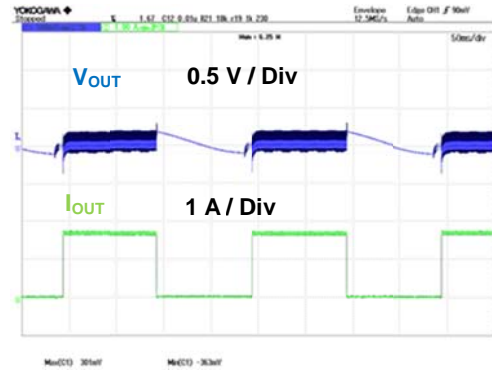


Figure 20. $V_{IN} = 230 \text{ Vac}$, $I_{OUT} = \text{Switch } 0 \text{ A} / 1.67 \text{ A}$

8. Output Voltage Ripple Wave Form

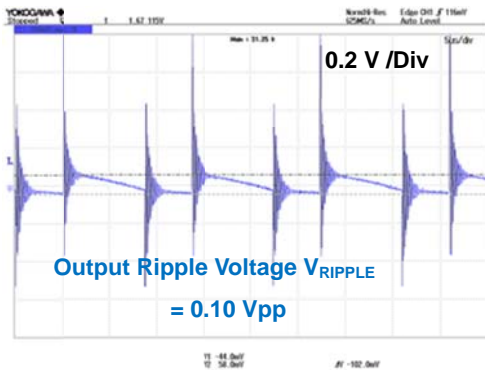


Figure 21. $V_{IN} = 115 \text{ Vac}$, $I_{OUT} = 1.67 \text{ A}$

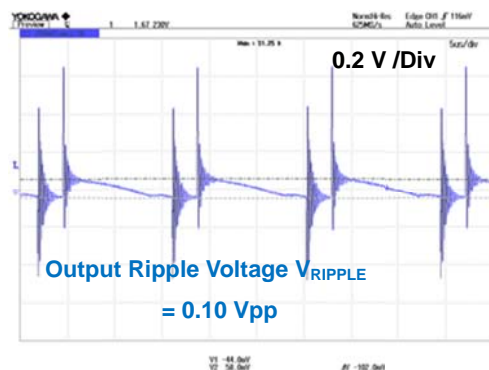


Figure 22. $V_{IN} = 230 \text{ Vac}$, $I_{OUT} = 1.67 \text{ A}$

9. Temperature of Parts Surface

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

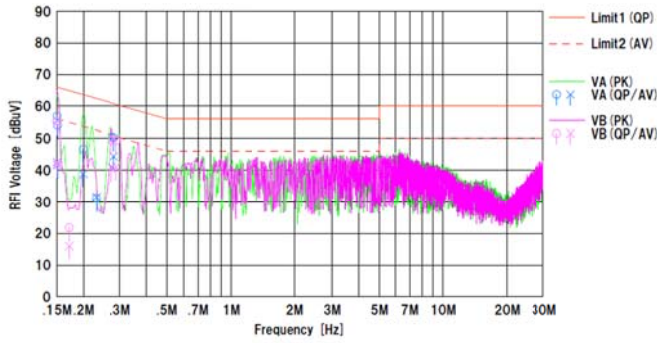
Table 1. Surface Temperature of Parts ($T_a = 20 \text{ }^\circ\text{C}$)

Part	Condition	
	$V_{IN} = 90 \text{ Vac}$, $I_{OUT1} = 1.3 \text{ A}$	$V_{IN} = 264 \text{ Vac}$, $I_{OUT1} = 1.3 \text{ A}$
IC1	60.4 $^\circ\text{C}$	61.3 $^\circ\text{C}$
Diode D1	61.6 $^\circ\text{C}$	62.3 $^\circ\text{C}$

Measurement Data – continued

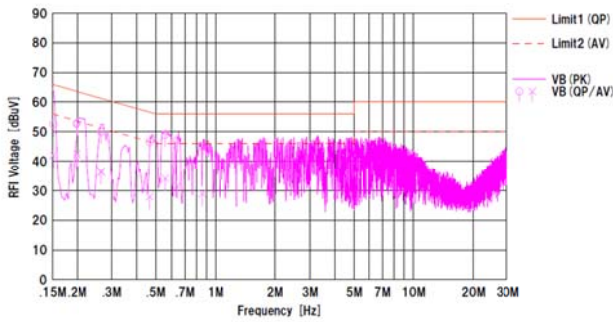
10. EMI Conducted Emission: CISPR22 Pub 22 Class B

Data Comment : BM2P060MF-EVK-001
 Limit1 : CISPR Pub 22 Class B
 Limit2 : CISPR Pub 22 Class B (AV)



QP margin: 9.0dB
 AVE margin: 6.4dB

Figure 23. V_{IN} : 115 Vac / 60 Hz, I_{OUT} : 1.67 A



QP margin: 7.0dB
 AVE margin: 10.4dB

Figure 24. V_{IN} : 230 Vac / 50 Hz, I_{OUT} : 1.67 A

Schematics

$V_{IN} = 90 \text{ Vac}$ to 264 Vac , $V_{OUT} = 24 \text{ V } 1.67 \text{ A}$

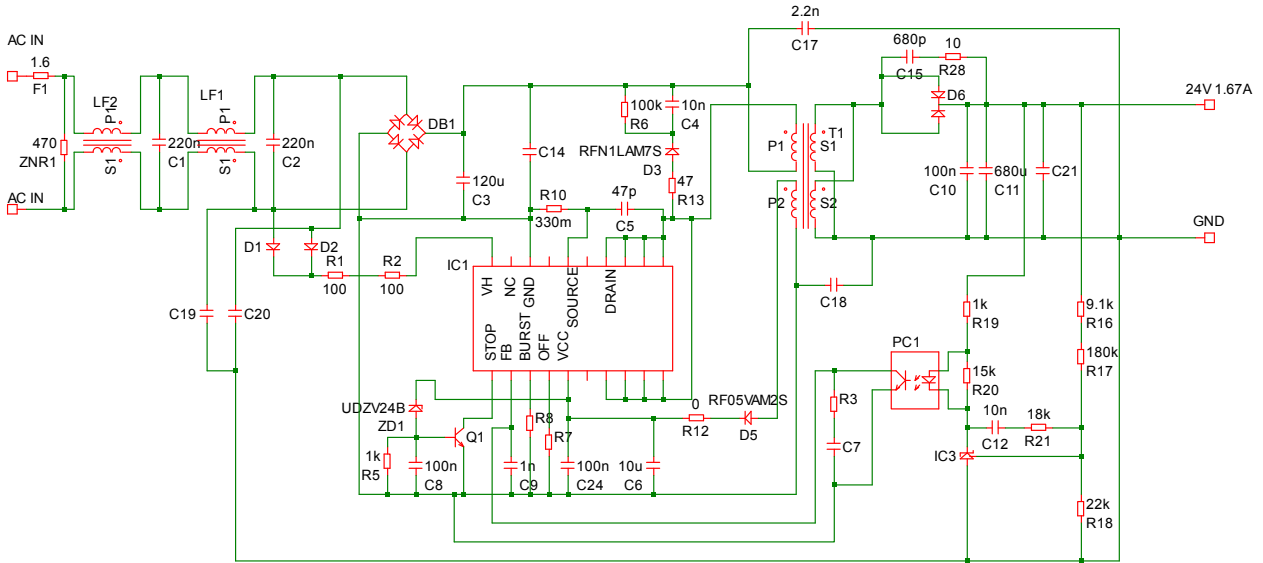


Figure 25. BM2P060MF-EVK-001 Schematics

Parts List

Item	Spec	Parts Name	Manufacturer
C1,C2	220 n, 310 Vac	890334025027CS	WURTH
C3	120 μ , 450 V	450CXW120MEFC18 \times 31.5	RUBYCON
C4	10 nF, 500 V	885342208009	WURTH
C5	47 p, 630 V	GRM31A5C2J470JW01D	MURATA
C6	10 μ F, 50 V	860160672009	WURTH
C7,C14,C18,C19,C20,C21	Non.mounted		
C8,C10,C24	0.1 μ F, 100 V	HMK107B7104KA-T	Taiyo Yuden
C9	1000 pF, 100 V	HMK107B7102MA-T	Taiyo Yuden
C11	680 μ F, 35 V	860080578019	WURTH
C12	0.01 μ F, 100 V	C0603C103K5RACTU	KEMET
C15	680 pF, 1 kV	GRM31B5C2J681FW01L	MURATA
C17	2200 pF, AC 300 V	DE1E3RA222MJ4BP01F	MURATA
D1,D2	1 A, 1000 V	1N4007	
D3	FRD, 0.8 A, 700 V	RFN1LAM7S	Rohm
D5	FRD, 200 V, 0.5 A	RF05VAM2S	Rohm
D6	FRD, 300 V, 20 A	RF2001T3D	Rohm
PC1		LTV-817-B	Liteon
Q1	TR, 50 V, 0.1 A	2SCR523UB	Rohm
DB1	600 V, 4 A	D3SBA60	Shindengen
R1,R2	100 Ω	ESR18EZPJ101	Rohm
R3,R7,R8	Non.mounted	-	Rohm
R5	1k	MCR03EZPJ102	Rohm
R6	100 k Ω	MOS2CT52R104J	Rohm
R10	330 m Ω	LTR50EZPZFLR330	Rohm
R12	0 Ω	MCR18EZPJ000	Rohm
R13	47 Ω	ESR18EZPJ470	Rohm
R16	9.1 k Ω	MCR03EZPFX9101	Rohm
R17	180 k Ω	MCR03EZPFX1803	Rohm
R18	22 k Ω	MCR03EZPFX2202	Rohm
R19	1 k Ω	MCR03EZPJ102	Rohm
R20	15 k Ω	MCR03EZPJ153	Rohm
R21	18 k Ω	MCR03EZPJ183	Rohm
R28	10 Ω	ESR18EZPJ100	Rohm
F1	1.6 A, 300 V	36911600000	Littelfuse
ZNR1	300 V, 400 A, ϕ 5 mm	V470ZA05P	Littelfuse
LF1	34.5 mH	SSR21NV-M12345	TOKIN
LF2	60 μ H	LF1246Y	アルファトランス
T1	PQ 26	XE2395Y B	アルファトランス
IC1		BM2P060MF	Rohm
IC2	Non.mounted		
IC3		NCP431AVSNT1G	Onsemi
ZD1	24V	UDZVTE-1724B	Rohm
HEAT1	22.9 k/W	IC-1625-STL	
CN1		B02P - NV(LF)(SN)	J S T
TP1,TP2		CD-10-15	M A C 8

Materials may be changed without notifying.

Layout

Size: 160 mm x 55 mm

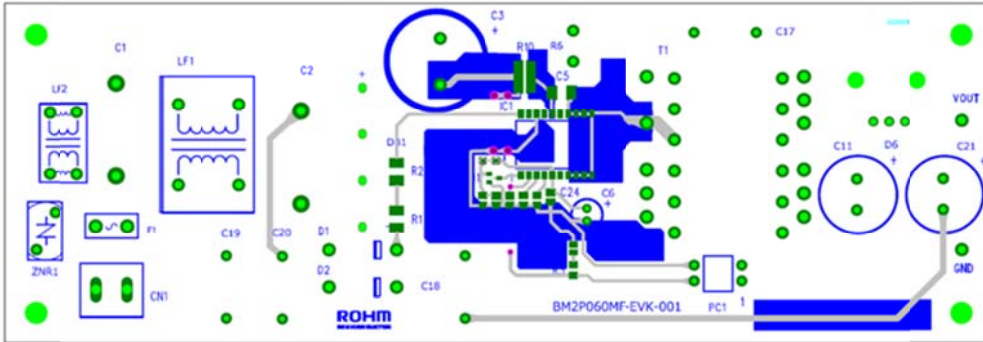


Figure 26. TOP Layout (Top view)

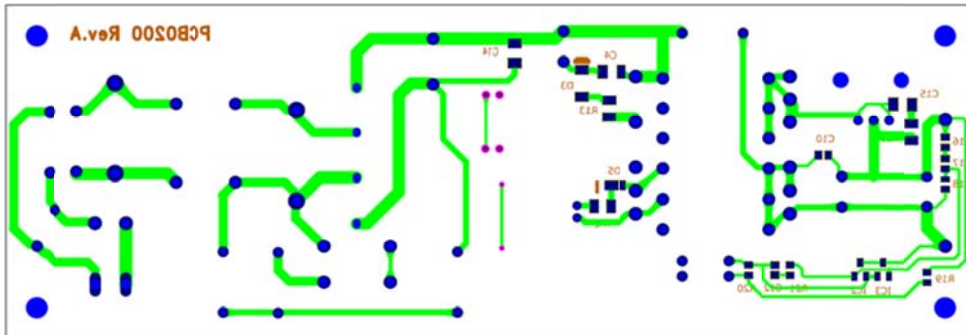


Figure 27. Bottom Layout (Top View)

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: XE2395Y_B
 Bobbin: 12PIN
 Core: PQ26

- Primary Inductance: 500 μ H \pm 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 M Ω or more (DC500 V)

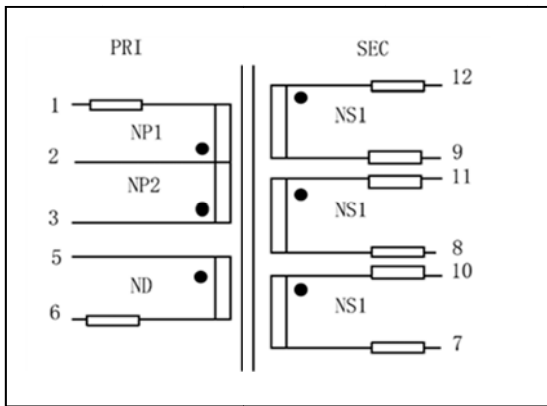


Figure 28. Circuit Diagram

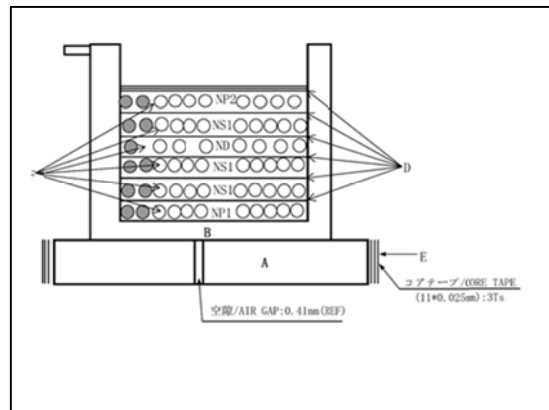


Figure 29. Structure Diagram

Table 2. Product Specification of XE2395Y_B

No.	Transformer	Winding Pin		Wire	Turn Number	Tape Layer	Wire Specification
		Start	Finish				
1	NP1	3	2	2UEW / Φ 0.29 x 2	19	1	COMPACT
2	NS1	10	7	TEX / Φ 0.32 x 2	11	1	COMPACT
3	NS1	11	8	TEX / Φ 0.32 x 2	11	1	COMPACT
4	ND	5	6	2UEW / Φ 0.15 x 1	8	1	COMPACT
C5	NS1	12	9	TEX / Φ 0.32 x 2	11	1	COMPACT
6	NP2	2	1	2UEW / Φ 0.29 x 2	19	3	COMPACT

Revision History

Date	Rev.	Changes
12.May.2021	001	New Release