AC/DC Convertor
Non-Isolated Flyback Convertor
PWM type 10 W (5 V/2 A)
BM2PDA1Y-Z Evaluation Board

User's Guide

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＜High Voltage Safety Precautions＞

◇ Read all safety precautions before use

Please note that this document covers only the BM2PDA1Y-Z evaluation board (BM2PDA1Y-EVK-002) 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.

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AC/DC Converter

Non-Isolated PWM type Flyback Convertor 10W 5 V Output BM2PDA1Y-Z Evaluation Board

BM2PDA1Y-EVK-002



Figure 1. BM2PDA1Y-EVK-002

Feature

(1) Adjustable Output Voltage with External Resistor

(2) High Accuracy Output by Output Direct Monitor of Output Voltage

(3) 65 kHz Frequency

(4) Internal Start up Circuit 730 V (peak)

(5) Internal Super Junction FET 730 V (peak) (Ron = 1.2 Ω)

(6) Internal Current Sense Resistor (Detection Current 0.93 A)

(7) Contributes to Low EMI by Internal Hopping Function

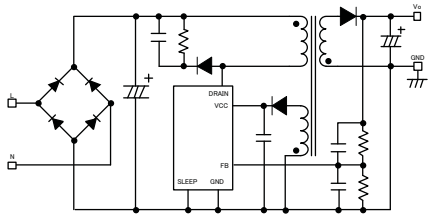


Figure 2. BM2PDA1Y-EVK-002 Simple Schematic

Specification

Table 1. Input Range

Parameter	Min	Typ	Max	Units	Conditions
Input Voltage Range	90	230	264	Vac	
Input Frequency Range	47	50 / 60	63	Hz	
Operating Temperature	-10	+25	+65	°C	

Table 2. Evaluation board specification

These are representative values and not a guarantee of the characteristics, unless stated otherwise use VIN = 230 Vac, IOUT = 0.2 A, Ta: 25 ° C.

Parameter	Min	Typ	Max	Units	Conditions
Output Voltage	4.75	5.0	5.25	V	I_{OUT} = 0.2 A
Output Maximum Power	-	-	10	W	I_{OUT} = 2.0 A
Output Current Range *(Note 1)*	0	-	2.0	A	
No Load Power Consumption	-	-	100	mW	I_{OUT} = 0 A
Efficiency	-	79	-	%	
Output Ripple Voltage *(Note 2)*	-	250	-	mVpp	

(Note 1) Adjust the operating time so that surface temperature of no component exceeds 105 ° C

(Note 2) Do not consider spike nois

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Operation Procedure

1. Operation equipment

(1) AC power supply 90 Vac to 264 Vac, 15 W or more

(2) Electronic Load capacity 2.0 A

(3) Multimeter

2. Connection Instruments

(1) Turn off each power supply and connect the measuring instrument as shown Figure 3. .

(2) Turn on the power supply setting between 90 Vac to 264 Vac

(3) Turn on the electrical load setting between 0 to 2.0 A.

(4) Connect the multimeter directly to the output and check the voltage by sensing.



Figure 3. Connection Circuit

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Circuit

V_{IN} = 90 Vac to 264 Vac, V_{OUT} = 5 V

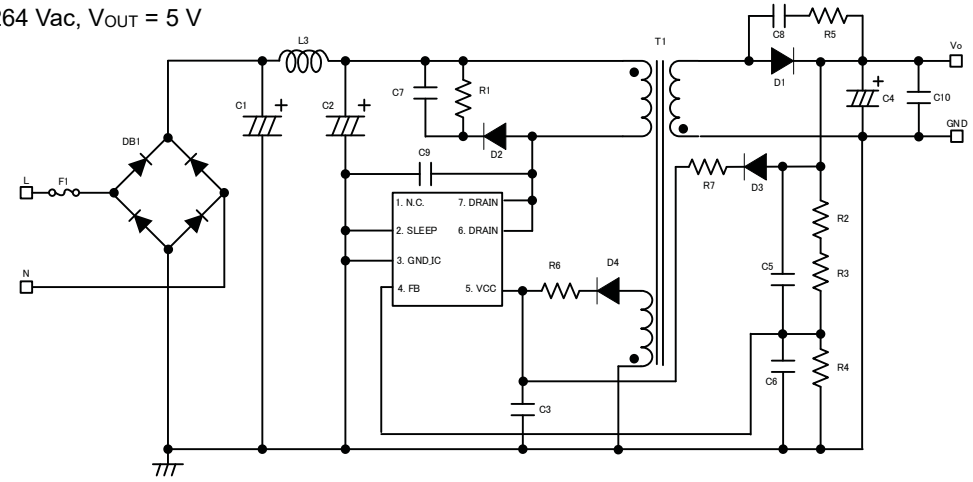


Figure 4. Application Circuit

Attention: Place C6 connected between FB and GND_IC terminals as close to the terminal as possible.

BOM List

Item		Specifications	Parts name	Manufacture
Capacitor	C1	12 µF, 450 V	UCY2W120MP01TD	NICHICON
	C2	12 µF, 450 V	UCY2W120MP01TD	NICHICON
	C3	2.2 µF, 50 V	UMK316B7225KL-T	TAIYO YUDEN
	C4	1000 µF, 25 V	25ZLJ1000M10x20	RUBYCON
	C5	1000 pF, 100 V	HMK107B7102KA-T	TAIYO YUDEN
	C6	1000 pF, 100 V	HMK107B7102KA-T	TAIYO YUDEN
	C7	2200 pF, 630 V	SMK316BJ222KF-T	TAIYO YUDEN
	C8	-	NON MOUNTED	-
	C9	-	NON MOUNTED	-
	C10	10 µF, 35 V	GMK316AB7106ML-TR	TAIYO YUDEN
Connector	CN1	-	B02P-NV	JST
Diode	D1	SBD, 15 A, 60 V	RBR15BM60A	ROHM
	D2	FRD, 0.8 A, 700 V	RFN1LAM7S	ROHM
	D3	-	NON MOUNTED	-
	D4	FRD, 0.5 A, 200 V	RF05VAM2S	ROHM
	DB1	1 A, 800 V	D1UBA80	SHINDENGEN
Fuse	F1	1.6 A, 300 V	36911600000	LITTELFUSE
IC	IC1	-	BM2PDA1Y-Z	ROHM
Inductor	L3	470 µH	7447471471	WURTH ELECTRONIK
Resistor	R1	47 kΩ	KTR18EZPJ473	ROHM
	R2	0 Ω	MCR03EZPJ000	ROHM
	R3	300 kΩ	MCR03EZPFX3003	ROHM
	R4	200 kΩ	MCR03EZPFX2003	ROHM
	R5	-	NON MOUNTED	-
	R6	10 Ω	MCR10EZPJ100	ROHM
	R7	-	NON MOUNTED	-
Transformer	T1	EE19	XE2512Y C	ALPHA TRANS
Test Pin	TP1	BLACK	LC-2-G-BLACK	MAC8
	TP2	RED	LC-22-G-RED	MAC8

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Layout

Size 60 mm x 40 mm

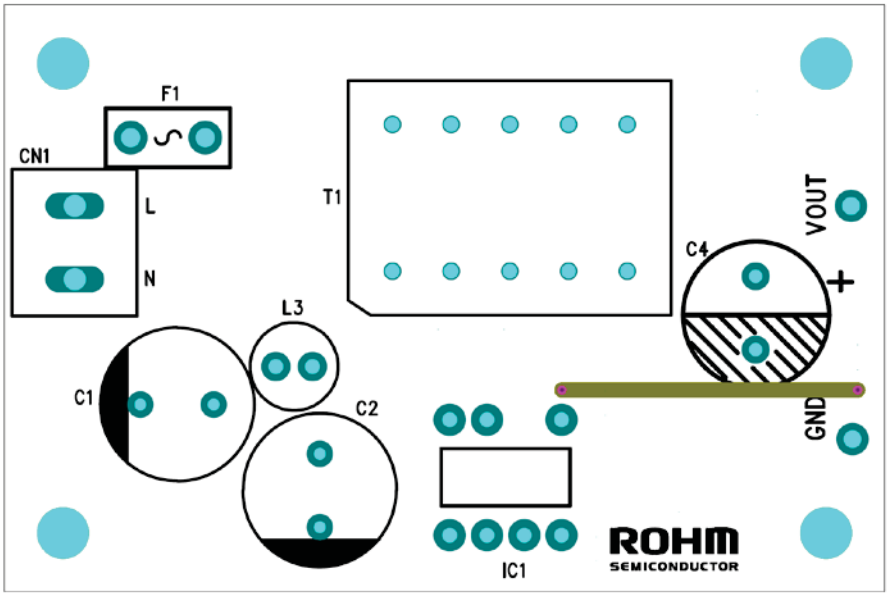


Figure 5. Top Silkscreen (Top view)

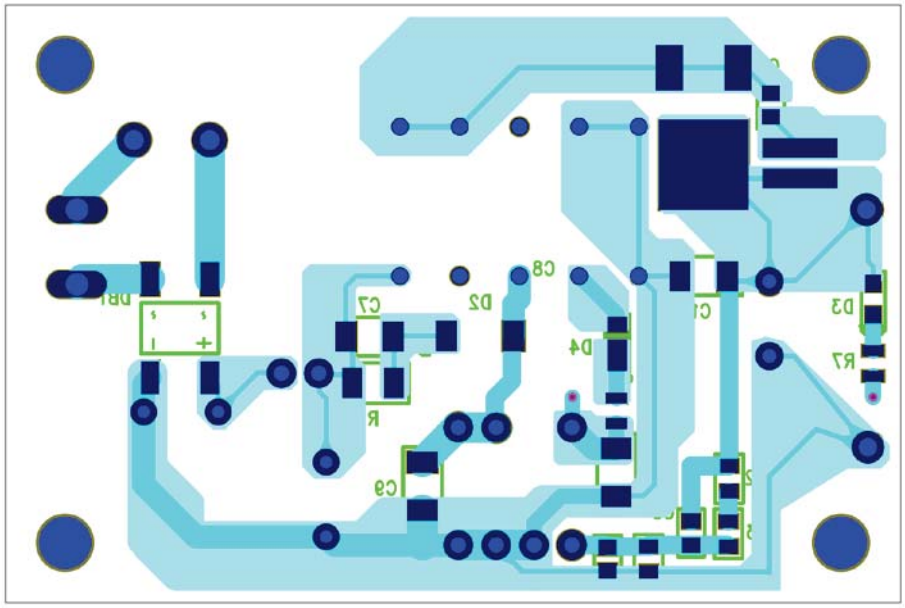


Figure 6. Bottom Layout (Bottom view)

Attention: Place C6 connected between FB and GND_IC terminals as close to the terminal as possible.

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BM2Pxx1Y Overview

Features

- PWM Current Mode
- Built-in Frequency Hopping Function
- Burst Operation at Light Load
- Built-in 730 V(peak) Starter Circuit
- Built-in 730 V(peak) Super Junction MOSFET
- VCC UVLO (Under Voltage Lockout)
- VCC OVP (Over Voltage Protection)
- Over Current Limiter Function per Cycle
- Soft Start Function
- Sleep Mode

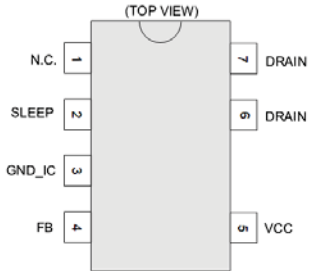


Figure 7. Pin Configuration

Line Up

Model Name	Switching Frequency	Frequency Reduction	OCP Current
BM2PAA1Y-Z	65 kHz	O	1.76 A
BM2PAB1Y-Z	25 kHz	-	
BM2PDA1Y-Z	65 kHz	O	0.93 A
BM2PDB1Y-Z	25 kHz	-	

Key Specifications

- Operating Power Supply Voltage Range
  - VCC: 11.10 V to 26.00 V
  - DRAIN: 730 V (peak)(Max)
- Operating Current (Normal): 650 µA (Typ)
- Operating Current (Burst): 350 µA (Typ)
- Operating Current (Sleep): 65 µA (Typ)
- Switching Frequency: 25 kHz / 65 kHz (Typ)
- Operation Temperature: -40 °C to +105 °C
- MOSFET ON Resistance: 1.2 Ω (Typ)

Application

Washing machine, Air conditioner, Other white goods

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

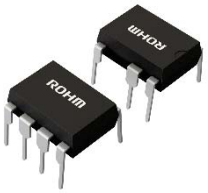


Table 3. BM2Pxx1Y-Z Pin Description

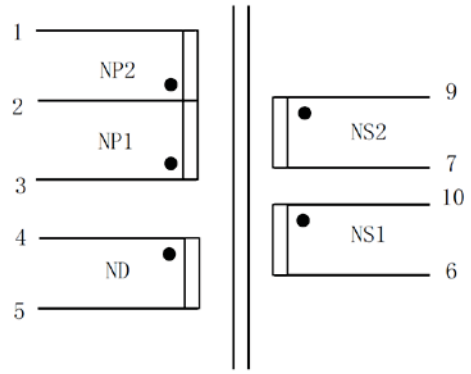
No.	Name	I/O	Function
1	N.C.	-	Non connection
2	SLEEP	I	Sleep/Normal modes witching pin
3	GND_IC	I/O	GND pin
4	FB	I	Output voltage feedback pin
5	VCC	I	Input voltage pin
6	DRAIN	I/O	MOSFET drain pin
7	DRAIN	I/O	MOSFET drain pin

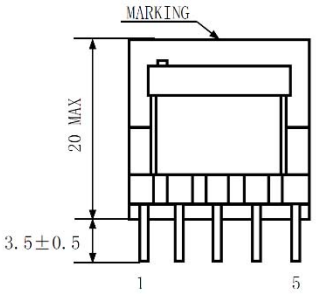
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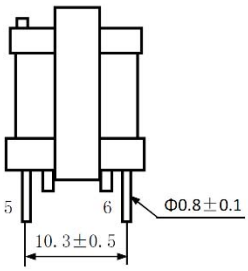
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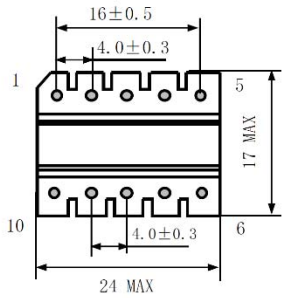
Transformer Specification

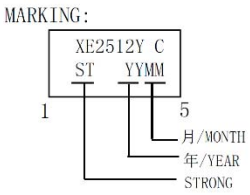
Manufacture
Alphatrans Co., Ltd. (1-7-2, Bakurou-cho, Chuo-ku, Osaka City, 541-0059, Japan)
http//www.alphatrans.jp/



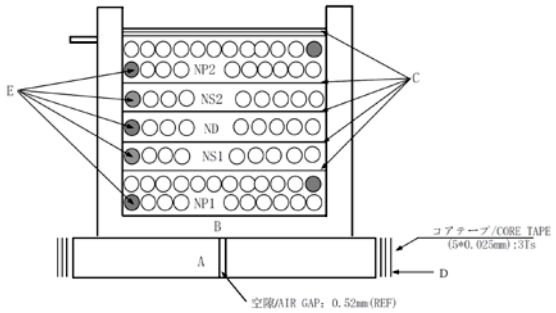








3. 構造/WINDING CONSTRUCTION



4. 巻線仕様/WINDING SPECIFICATION

NO.	WINDING	TERMINAL START	TERMINAL FINISH	WIRE SIZE	TURNS	TAPE LAYERS	WINDING METHOD	NOTE
1	NP1	3	2	2UEW/Φ0.30mm*1	48	1	COMPACT	
2	NS1	10	6	TEX-E/Φ0.25mm*2	9	1	COMPACT	(Note 1)
3	ND	4	5	2UEW/Φ0.26mm*1	27	1	COMPACT	
4	NS2	9	7	TEX-E/Φ0.25mm*2	9	1	COMPACT	(Note 1)
5	NP2	2	1	2UEW/Φ0.30mm*1	48	3	COMPACT	
				PART NO.	XE2512Y			
				DESCRIPTION	EE19 TRANSFORMER			

6. 電気特性/ELECTRICAL CHARACTERISTICS:

NO.	項 ITEM	測定端子 TERMINAL	仕様 SPECIFICATION	測定条件 TEST CONDITION	検査方法 INSPECTION STANDARD
1	インダクタンス INDUCTANCE	3---1	628.5uH±10%	f=100kHz, v=1V (CH-1062A 内阻50Ω)	全検 ALL
2	耐電圧 HI-POT TEST	P---S	AC1000V, 1mA, 1MIN	f=50Hz	抜取 SAMPLING (製造工程全検ALL 電圧 *120%, 2秒)
		S---C	AC1000V, 1mA, 1MIN		
		P---C	AC1000V, 1mA, 1MIN		
3	絶縁抵抗 INSULATION RESISTANCE	P---S	100MΩ MIN	DC 500V	抜取 SAMPLING
		P---C			
		S---C			
4	巻き数比 TURNS RATIO	3---2	48.0±0.2 TS	f=1-100kHz, INPUT: T(3-1)=96TS	全検 ALL
		10---6	9.0±0.2 TS		
		4---5	27.0±0.2 TS		
		9---7	9.0±0.3 TS		
		2---1	48.0±0.2 TS		

(Note 1) TEX is used this time because of the versatility of the transformer. There is no need to use TEX for non-isolated applications.

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Measurement Data

Constant Load Regulations

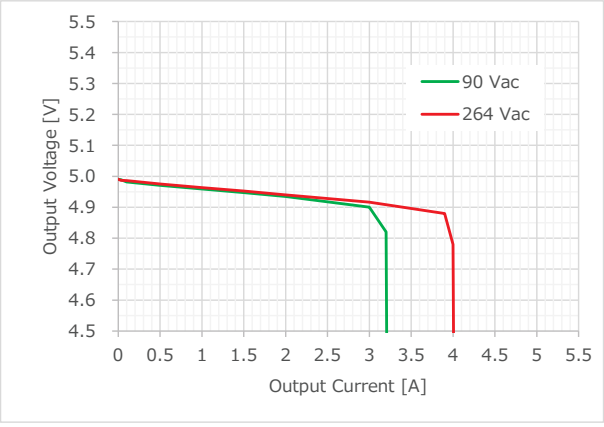


Figure 8. VOUT vs. IOUT

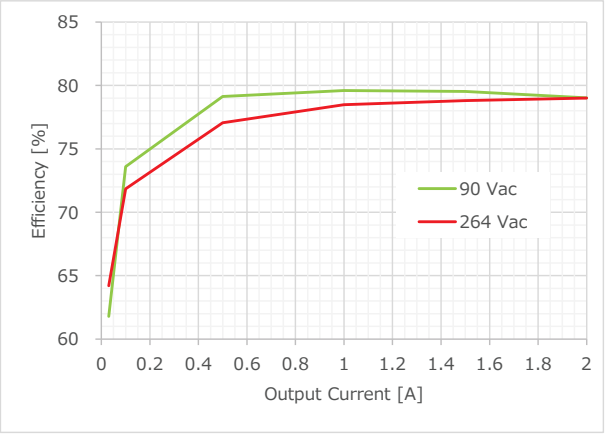


Figure 9. Efficiency vs. IOUT

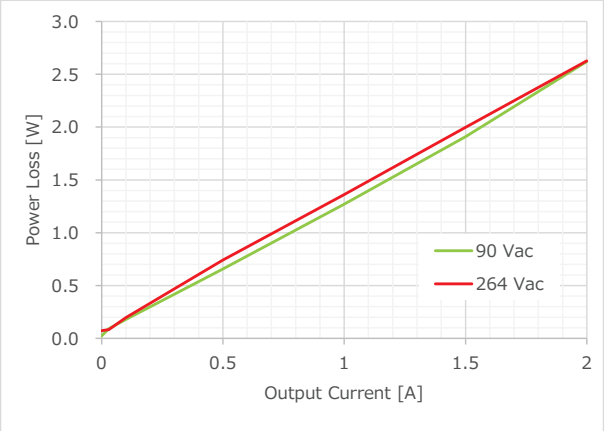


Figure 10. Power Loss vs. IOUT

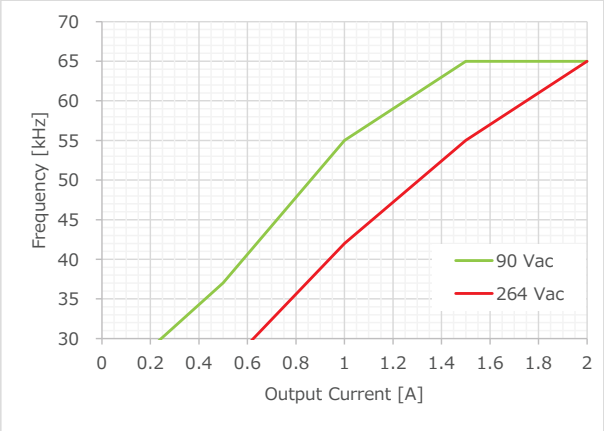


Figure 11. Frequency vs. IOUT

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Measurement Data - Continued

Waveform

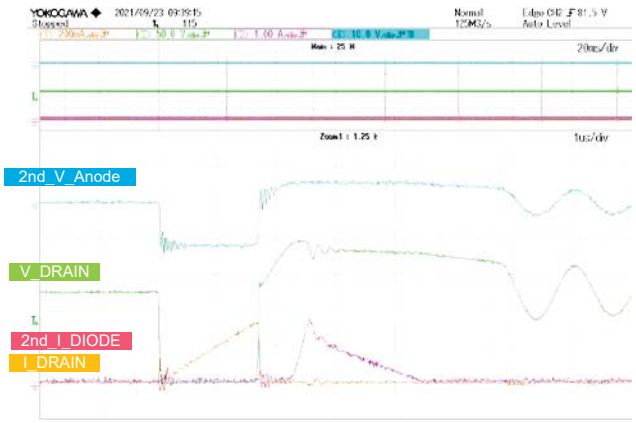


Figure 12. Vds and IL
VIN = 90 Vac, IOUT = 0 A



Figure 13. Vds and IL
VIN = 264 Vac, IOUT = 0 A

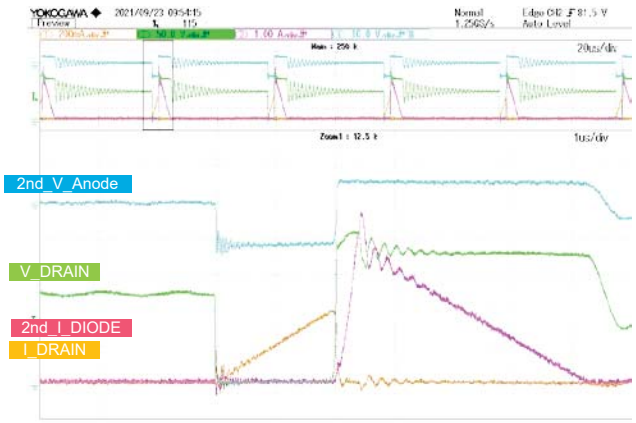


Figure 14. Vds and IL
VIN = 90 Vac, IOUT = 0.2 A

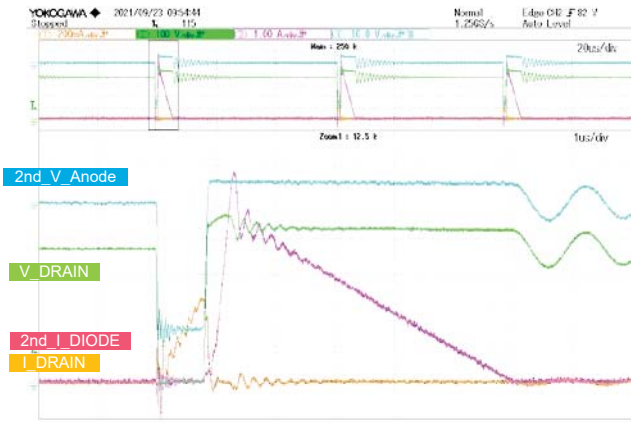


Figure 15. Vds and IL
VIN = 264 Vac, IOUT = 0.2 A

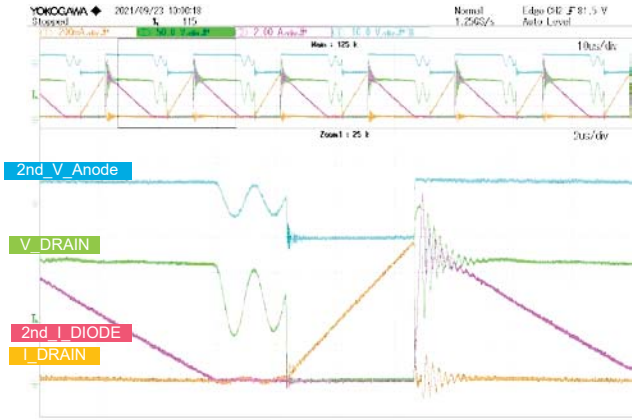


Figure 16. Vds and IL
VIN = 90 Vac, IOUT = 2.0 A

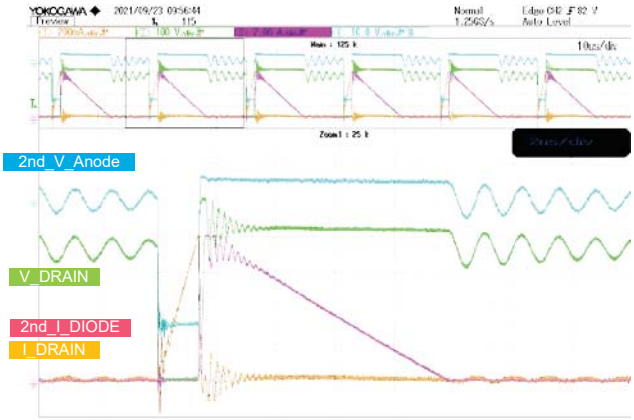


Figure 17. Vds and IL
VIN = 264 Vac, IOUT = 2.0 A

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Measurement Data - Continued

Waveform （Start Up）

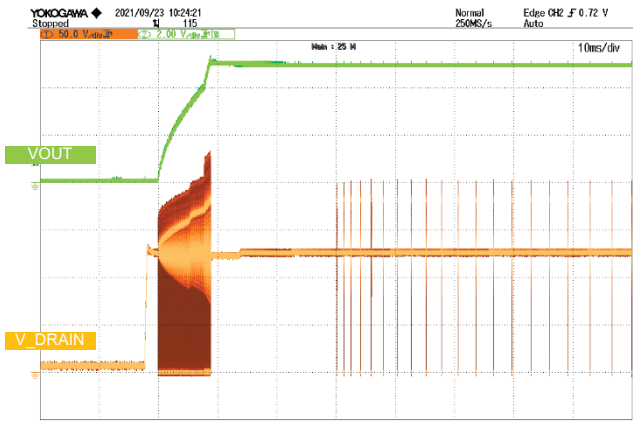


Figure 18. Vds and Vout
VIN = 90 Vac, IOUT = 0 A

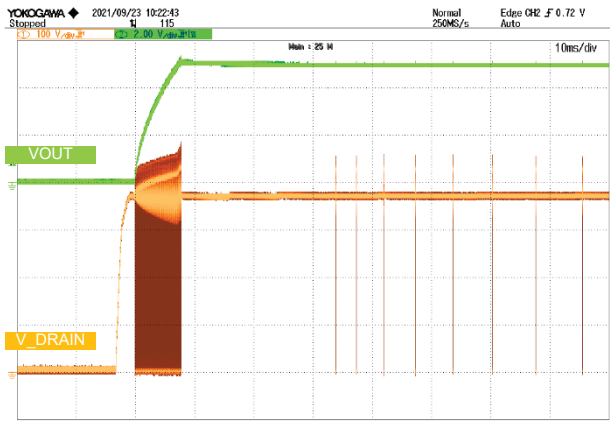


Figure 19. Vds and Vout
VIN = 264 Vac, IOUT = 0 A

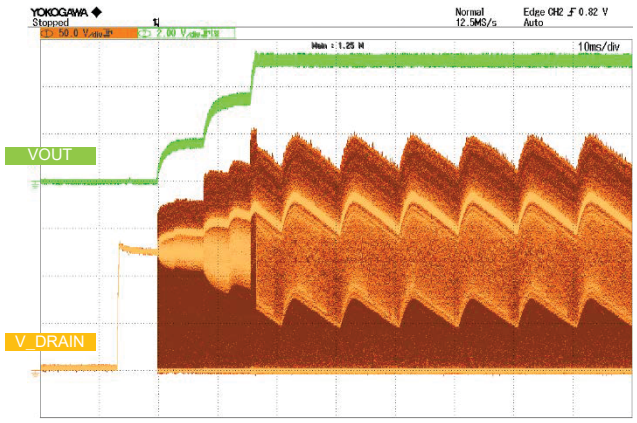


Figure 20. Vds and Vout
VIN = 90 Vac, IOUT = 2.0 A

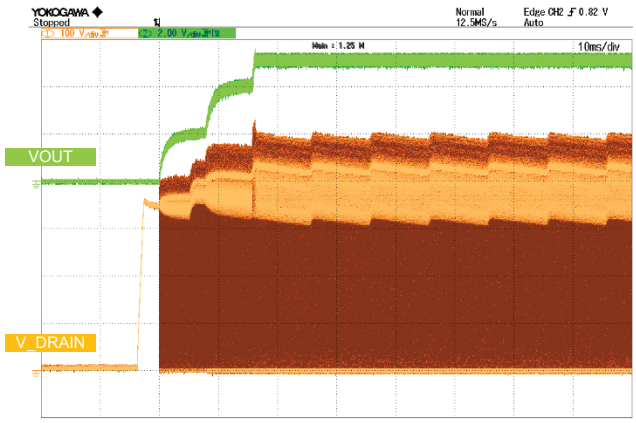


Figure 21. Vds and Vout
VIN = 264 Vac, IOUT = 2.0 A

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Measurement Data - Continued

Waveform （Load Response）

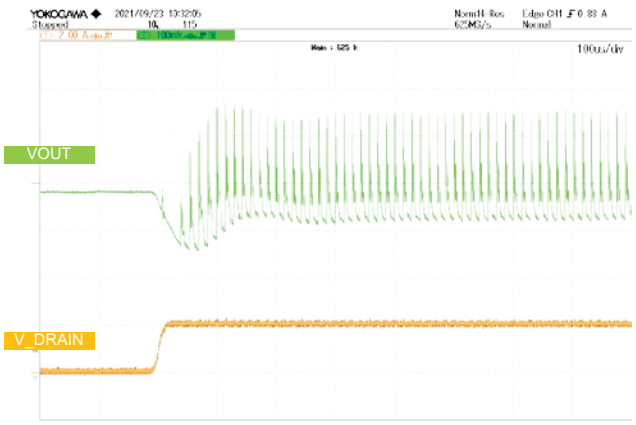


Figure 22. Iout and Vout
VIN = 90 Vac, IOUT = 0 A to 2 A

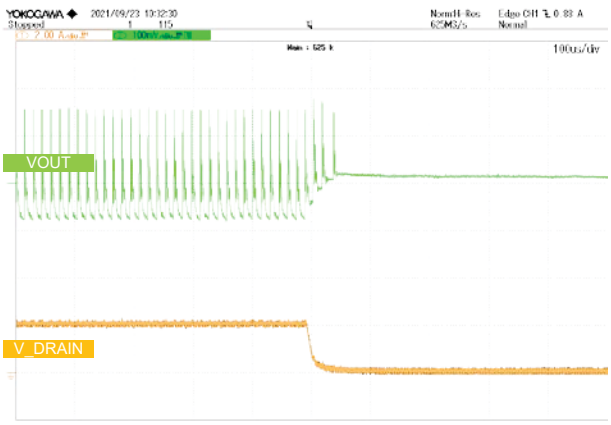


Figure 23. Iout and Vout
VIN = 90 Vac, IOUT = 2 A to 0 A

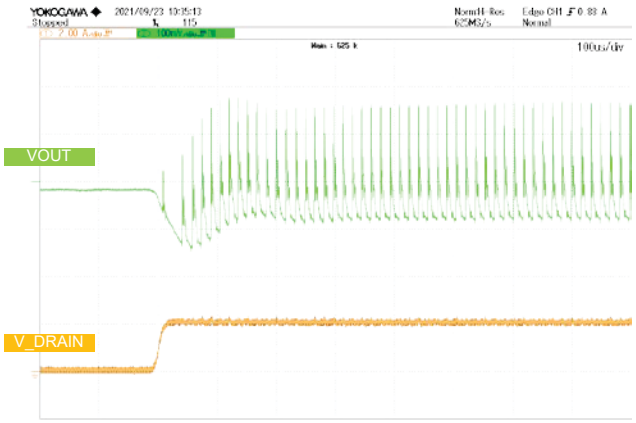


Figure 24. Iout and Vout
VIN = 264 Vac, IOUT = 0 A to 2 A

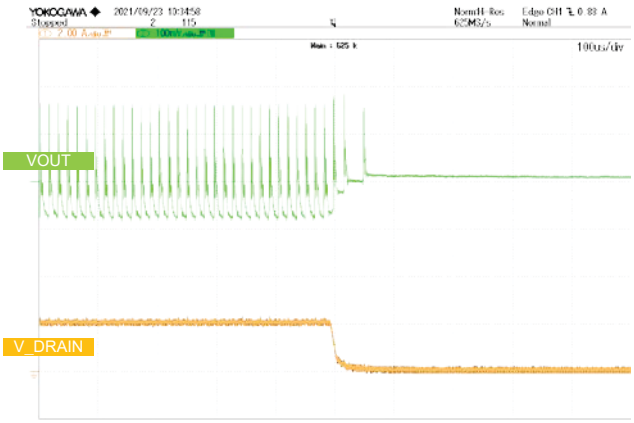


Figure 25. Iout and Vout
VIN = 264 Vac, IOUT = 2 A to 0 A

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Measurement Data - Continued

Waveform （Ripple Voltage）

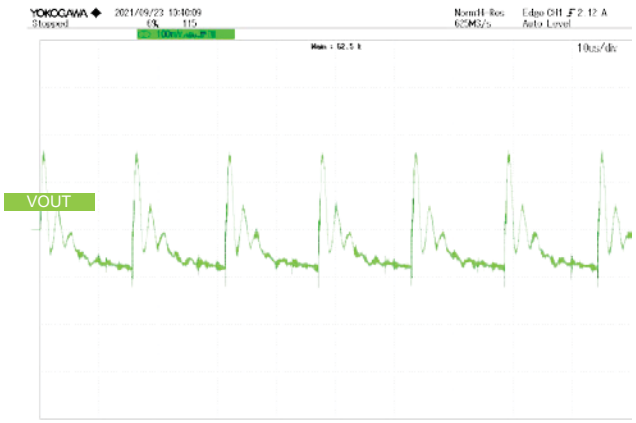


Figure 26. Vout Ripple Voltage (5 MHz Filter)
VIN = 90 Vac, IOUT = 2.0 A

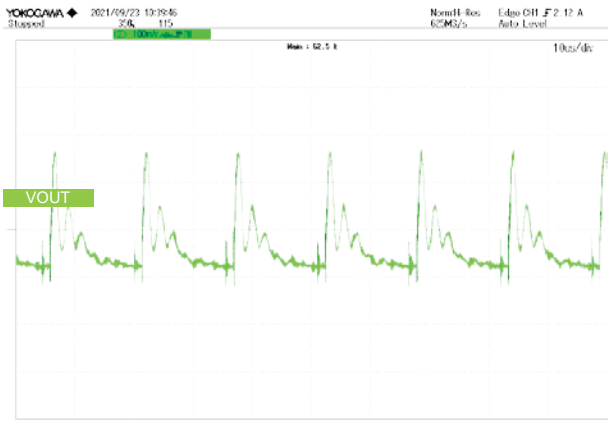
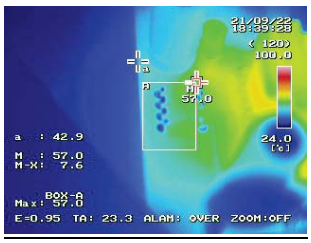


Figure 27. Vout Ripple Voltage (5MHz filter)
VIN = 264 Vac, IOUT = 2.0 A

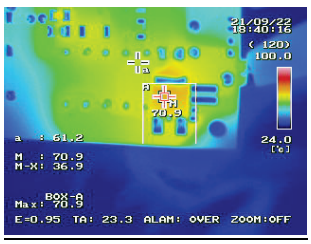
Operation Temperature

Condition Iout=2.0 A. 20 min

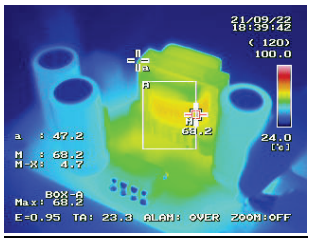
VIN=90 Vac



IC 57.0 °C

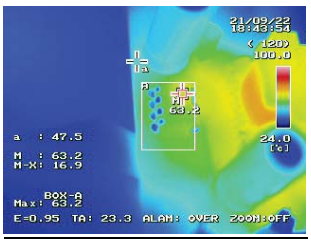


Diode 70.9 °C

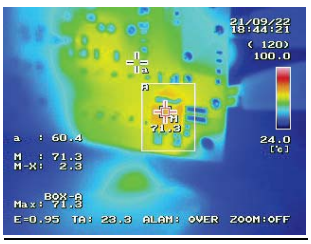


Inductor 68.2 °C

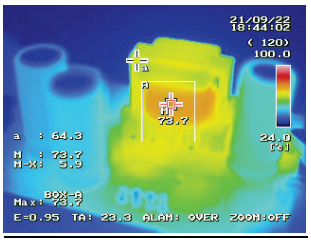
VIN= 264 Vac



IC 63.2 °C



Diode 71.3 °C



Inductor 73.7 °C

Figure 28. Each device Temperature with maximum output current

Consider selecting parts after checking the temperature range of the parts used.

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Measurement Data - Continued

EMI

Condition

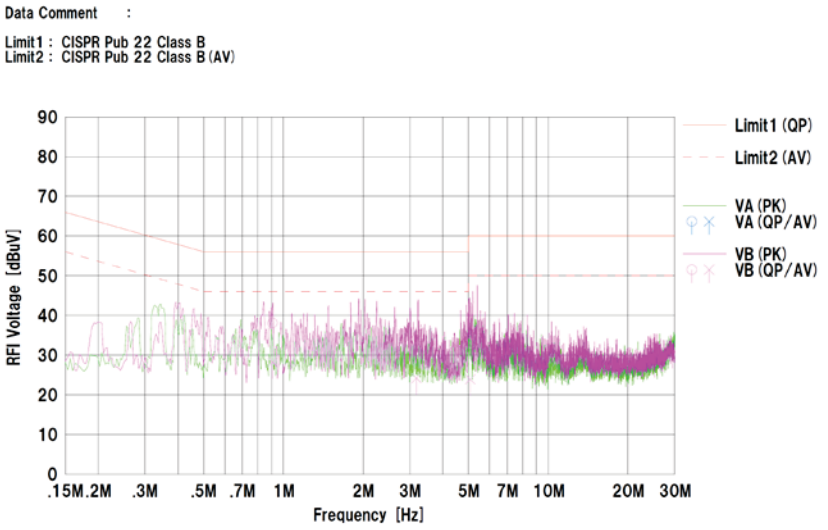
V_{IN} = 90 Vac

I_{OUT} = 2.0 A

Margin

QP=17.9 dB (0.91 MHz)

AV=17.8 dB (0.91 MHz)



No.	Freq.	Reading <QP>	Reading <AV>	C.Fac	Results <QP>	Results <AV>	Limit <QP>	Limit <AV>	Margin <QP>	Margin <AV>	Phase	Comment
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.91050	27.7	17.8	10.4	38.1	28.2	56.0	46.0	17.9	17.8	VB	
2	3.18015	23.5	13.7	10.5	34.0	24.2	56.0	46.0	22.0	21.8	VB	
3	5.07236	22.4	13.3	10.6	33.0	23.9	60.0	50.0	27.0	26.1	VB	

Figure 29. Conduction Noise VIN = 90 Vac

Condition

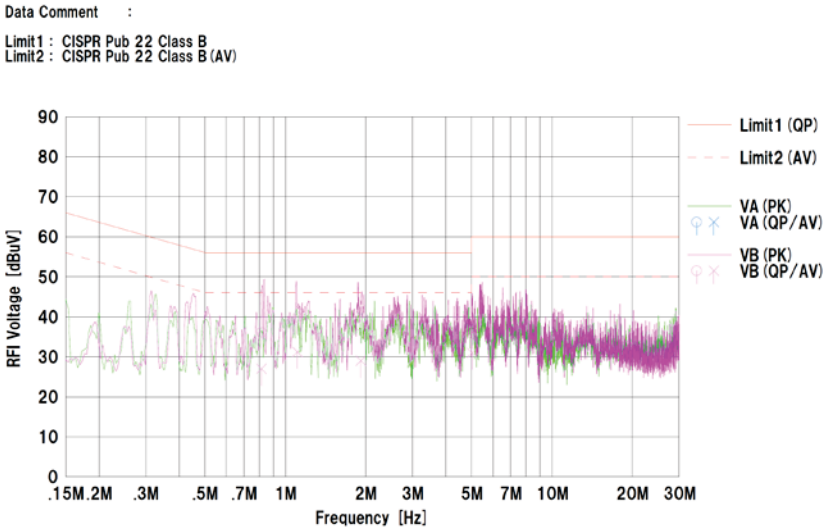
V_{IN} = 264 Vac

I_{OUT} = 2.0 A

Margin

QP=16.1 dB (1.11 MHz)

AV=14.8 dB (1.11 MHz)



No.	Freq.	Reading <QP>	Reading <AV>	C.Fac	Results <QP>	Results <AV>	Limit <QP>	Limit <AV>	Margin <QP>	Margin <AV>	Phase	Comment
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.81296	25.7	16.6	10.4	36.1	27.0	56.0	46.0	19.9	19.0	VB	
2	1.10809	29.5	20.8	10.4	39.9	31.2	56.0	46.0	16.1	14.8	VB	
3	1.91941	27.2	18.5	10.5	37.7	29.0	56.0	46.0	18.3	17.0	VB	
4	5.00623	25.7	20.4	10.6	36.3	31.0	60.0	50.0	23.7	19.0	VB	

Figure 30. Conduction Noise VIN = 264 Vac

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Revision History

Date	Rev.	Changes
30.Sep.2021	001	New Release
30.Nov.2021	002	P4 Board size added P6 Transformer electrical characteristics added P13 EMI data added

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