Isolated Flyback Type PWM Mode BM1P10CFJ 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 BM1P10CFJ evaluation board (BM1P10CFJ-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.

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AC/DC Converter

Isolated Flyback Type PWM Mode 48W 24V Output BM1P10CFJ Evaluation Board

BM1P10CFJ-EVK-001

General Description

(1) Standby mode significantly reduces standby power consumption.

(2) Spacing-saving is realized by MOSFET, start circuit incorporation.

(3) It realizes the high flexibility because current sense resistance adjustment is possible.

(4) Voltage = 45V or less one second after the cutting are realized by X condenser electric discharge function incorporation.

(5) Electricity is reduced at no load time by power save function incorporation.

(6) Efficiency in the light load is improved largely by burst movement, a frequency reduction mode.



Figure 1. BM1P10CFJ-EVK-001

Performance Specification

Operating Range

Parameter	Symbol	Min	Typ	Max	Units	Conditions
Input Voltage Range	V_{IN}	90	230	264	V	
Input Frequency	f_{LINE}	47	-	63	Hz	
Operating Temperature Range	Top	-10	+25	+65	°C	

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Performance Specification – Continued

Electrical characteristic

Not guarantee the characteristics is representative value.

Unless otherwise specified V_{IN} = 230 Vac , I_{OUT} = 2 A , V_{STBY} = 5V , Ta = 25 °C

Parameter	Symbol	Min	Typ	Max	Units	Conditions
Operating Start Input Voltage	V_{INST}	-	70	-	V	
Output Voltage	V_{OUT}	22.8	24	25.2	V	
Maximum Output Power	P_{OUT}	-	-	48	W	I_{OUT} = 2 A
Output Current Range *(Note 1)*	I_O	0	-	2	A	
Output Voltage at Standby	$V_{OUTSTBY}$	7.1	7.5	7.9	V	V_{STBY} = 0 V
Output Current at Standby	I_{OSTBY}	0		2	A	V_{STBY} = 0 V
Wait electricity	P_{INSTBY}	-	40	-	mW	I_{OUT} = 0 A V_{STBY} = 0 V
Power supply efficiency	η	86	89.6	-	%	
Output Ripple Voltage *(Note 2)*	V_{PP}	-	60	240	mVpp	

(Note 1) Please adjust operating time , within any parts surface temperature under 105 ℃.

(Note 2) Not include spikes noise

Derating

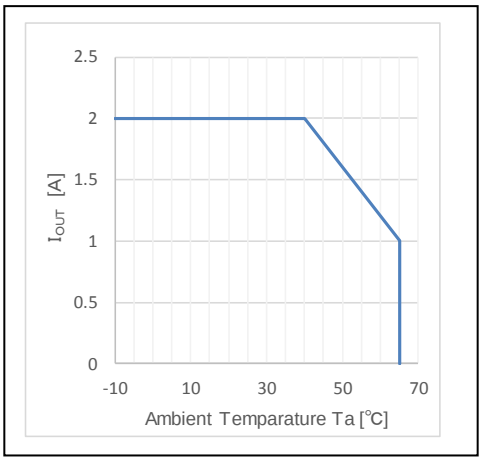


Figure 2. Derating

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Operation Procedure

1 Necessary Equipment

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

(2) Load equipment (5 A at maximum value)

(3) DC voltmeter

(4) Wattmeter

(5) 5V power supply (10 mA)

2 Connect to Each Equipment

(1) Connect a measuring instrument to Figure 3 reference as each power supply OFF.

(2) Set the AC power supply to 90 Vac to 264 Vac, and power supply ON.

(3) In the case of electronic load, load sets it between 0 A to 2A, and power supply ON.

(4) The DC voltmeter of the output connects with directly outputting it, and confirm the voltage.

(5) Connect STBY pin and GND pin to DC power supply. and apply +5V. The output voltage is 24V.

The output voltage becomes 7.5V when it is 0V. Set the input voltage of the STBY pin on less than +-8V.

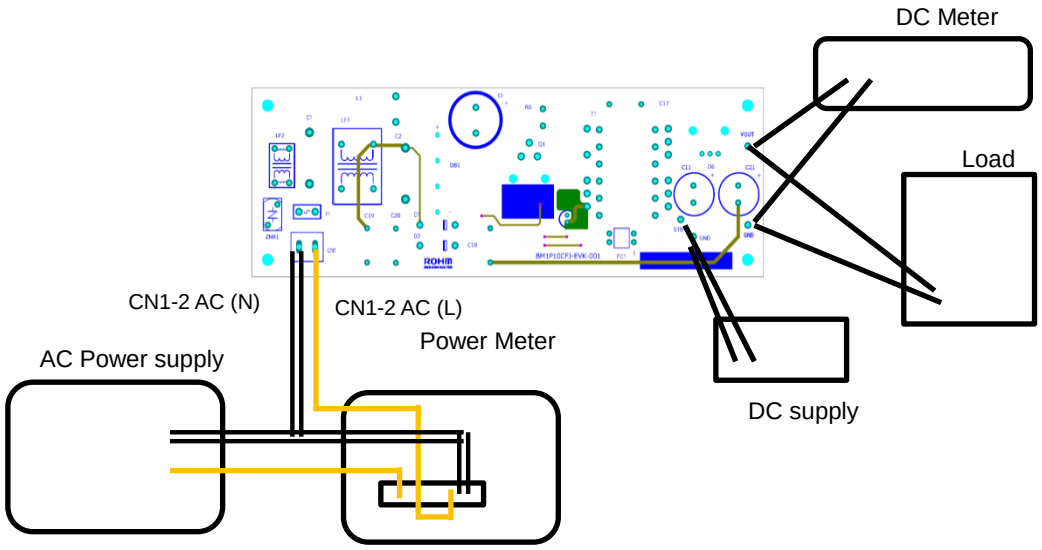


Figure 3. Diagram of How to Connect

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Application Circuit

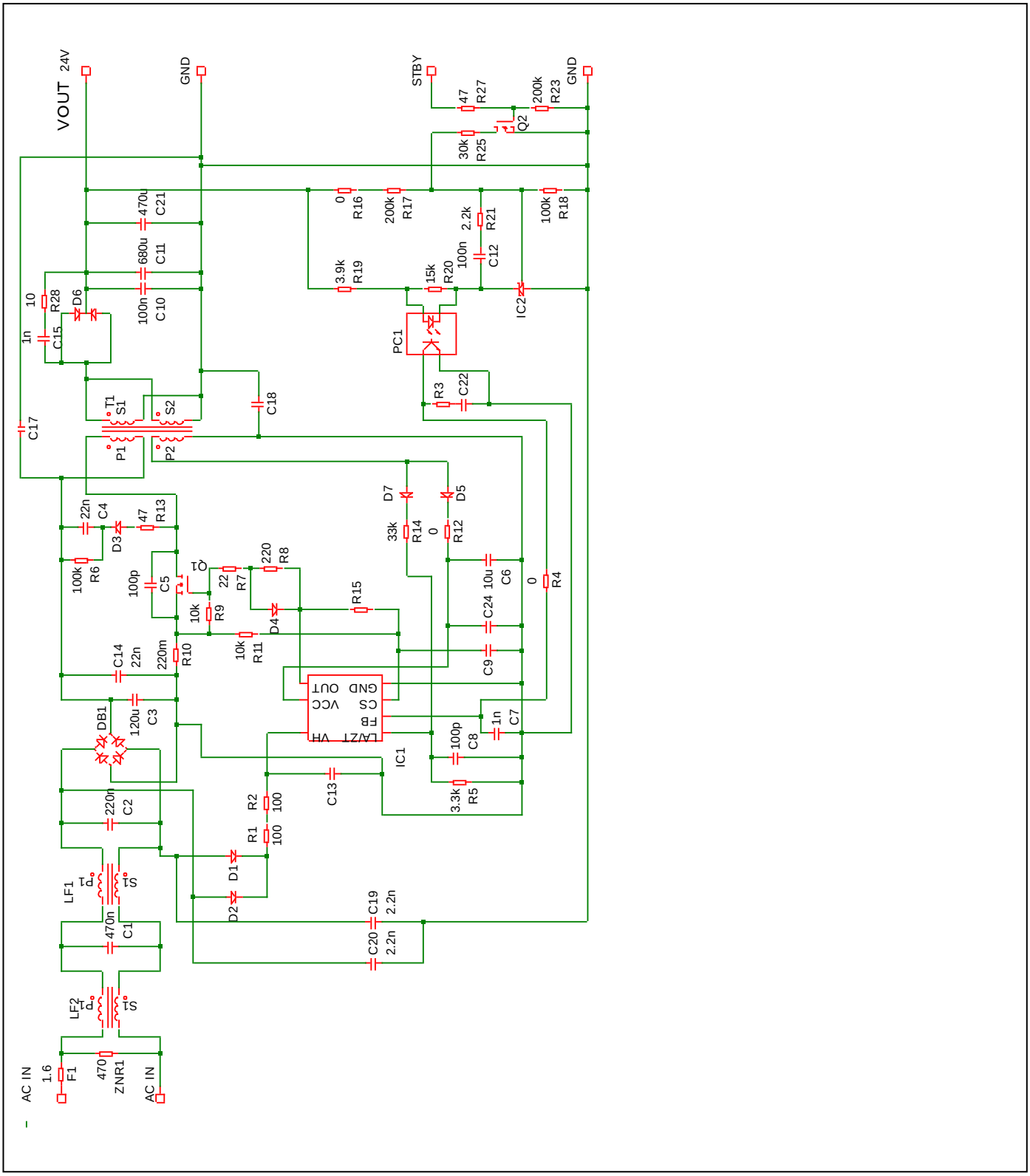


Figure 4. Application Circuit

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Parts List

Materials may be changed without notifying.

	Item	Specifications	Parts name	Manufacture
Capacitor	C1	470 n, 310 Vac	890334025039CS	WURTH ELECTRONIK
	C2	220 n, 310 Vac	890334025027CS	WURTH ELECTRONIK
	C3	120 µ, 450 V	450CXW120MEFC18x31.5	RUBYCON
	C4	22 nF, 630 V	885342208014	WURTH ELECTRONIK
	C5	100 p, 1000 V	885342208022	WURTH ELECTRONIK
	C6	10 µF, 63 V	860080772001	WURTH ELECTRONIK
	C7	1000 pF, 100 V	HMK107B7102KA-T	TAIYO YUDEN
	C8	100 p, 100 V	885012206102	WURTH ELECTRONIK
	C10	0.1 µF, 100 V	HMK107B7104KA-T	TAIYO YUDEN
	C11	680 µF, 35 V	860080578019	WURTH ELECTRONIK
	C12	0.1 µF, 100 V	HMK107B7104KA-T	TAIYO YUDEN
	C9,C13,C18,C22,C24	NON MOUNTED	-	-
	C14	22 nF, 630 V	885342208014	WURTH ELECTRONIK
	C15	1 n, 630 V	885342208011	WURTH ELECTRONIK
	C17	2200 pF, AC 500 V	DE1E3RA222MA4BP01F	MURATA
	C19	2200 pF, AC 500 V	DE1E3RA222MA4BP01F	MURATA
	C20	2200 pF, AC 500 V	DE1E3RA222MA4BP01F	MURATA
	C21	470 µF, 35 V	860080575017	WURTH ELECTRONIK
Diode	D1	1 A, 1000 V	1N4007	MCCSEMI
	D2	1 A, 1000 V	1N4007	MCCSEMI
	D3	FRD, 0.8 A, 700 V	RFN1LAM7S	ROHM
	D4	FRD, 0.5 A, 200 V	RF05VAM2S	ROHM
	D5	FRD, 600 V, 0.2 A	RFU02VSM6S	ROHM
	D6	FRD, 200 V, 20 A	RF2001T2DNZ	ROHM
	D7	FRD, 600 V, 0.2 A	RFU02VSM6S	ROHM
Opto-Coupler	PC1		LTV-817-B	LITEON
MOSFET	Q1	800 V, 9 A	R8009KNX	ROHM
	Q2	20 V, 0.1 A	RU1C001UN	ROHM
Diode-Brigde	DB1	800 V, 10 A	D10XB80	SHINDENGEN

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Parts List - continued

	Item	Specifications	Parts name	Manufacture
Resistor	R1	100 Ω	ESR18EZPJ101	ROHM
	R2	100 Ω	ESR18EZPJ101	ROHM
	R3,R15	NON MOUNTED	-	-
	R4	0 Ω	MCR03EZPJ000	ROHM
	R5	3.3 kΩ	MCR03EZPJ332	ROHM
	R6	100 kΩ	MOS2CT52R104J	KOA
	R7	22 Ω	ESR18EZPJ220	ROHM
	R8	220 Ω	MCR03EZPJ221	ROHM
	R9	10 kΩ	MCR03EZPJ103	ROHM
	R10	220 mΩ	LTR50EZPZFLR220	ROHM
	R11	10 kΩ	ESR18EZPJ103	ROHM
	R12	0 Ω	MCR18EZPJ000	ROHM
	R13	47 Ω	ESR18EZPJ470	ROHM
	R14	33 kΩ	MCR03EZPJ333	ROHM
	R16	0 Ω	MCR03EZPJ000	ROHM
	R17	200 kΩ	MCR03EZPFX2003	ROHM
	R18	100 kΩ	MCR03EZPFX1003	ROHM
	R19	3.9 kΩ	MCR03EZPJ392	ROHM
	R20	15 kΩ	MCR03EZPJ153	ROHM
	R21	2.2 kΩ	MCR03EZPJ222	ROHM
	R23	200 kΩ	MCR03EZPJ204	ROHM
	R25	30 kΩ	MCR03EZPFX3002	ROHM
	R27	47 Ω	MCR03EZPJ470	ROHM
	R28	10 Ω	ESR18EZPJ100	ROHM
Fuse	F1	1.6 A, 300 V	36911600000	LITTELFUSE
Varistor	ZNR1	300 V, 400 A	V470ZA05P	LITTELFUSE
Coil	LF1	34.5 mH	SSR21NV-M12345	KMENT
	LF2	60 µH	LF1246Y	ALPHA TRANS
Transfomer	T1	PQ 26	XE2395Y	ALPHA TRANS
IC	IC1		BM1P10CFJ	ROHM
	IC3		NCP431AVSNT1G	ONSEMI

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Parts List - continued

	Item	Specifications	Parts name	Manufacture
Heatshink	HEAT1	22.9 k/W	IC-1625-STL	SANKYO THRMOTECH
	HEAT2	22.9 k/W	IC-1625-STL	SANKYO THRMOTECH
Connector	CN1		B02P－NV	JST
Pin	TP1～4		CD-10-15	MAC8

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Layout

Size: 160 mm x 55 mm

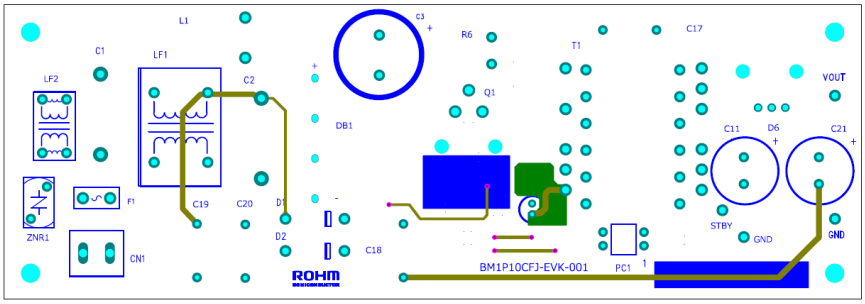


Figure 5. TOP Silkscreen (Top view)

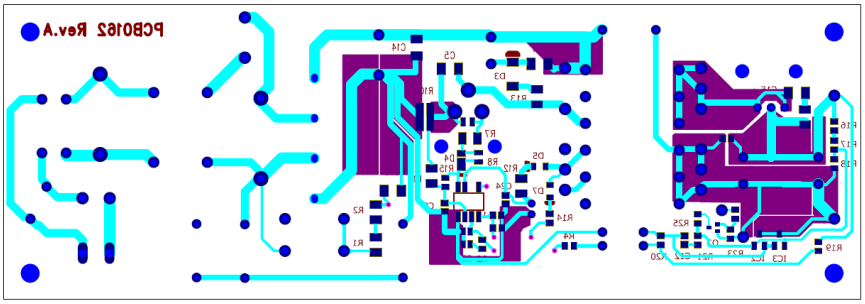


Figure 6 .Bottom Layout (Top View)

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BM1P10CFJ - 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
- Switching Function of Operation Modes
- Power Save Function
  (Low Consumption Current at no load)
- Soft Start Function
- FB Pin Overload Protection Function (FB OLP)
- CS Pin Overload Protection Function (CS OLP)
- Switching Function of CS OLP Detection Voltage
- CS Pin Over Current Protection Function (CS OCP)
- CS Pin Leading Edge Blanking Function
- LA/ZT Pin Over Voltage Protection Function (ZT OVP)
- OUT Pin Gate Clamp Circuit

Key Specifications

- Operation Power Supply Voltage Range
  VCC Pin Voltage: 9.3 V to 55.0 V
  VH Pin Voltage: 650 V (Max)
- Current at Switching Operation: 0.70 mA (Typ)
- Current at Burst Operation 0.35 mA (Typ)
- Current at Power Save Operation 0.11 mA (Typ)
- Switching Frequency 100 kHz (Typ)
- Operation Temperature Range -40 °C ～ +105 °C

Package

	W (Typ) x D (Typ) x H (Max)
SOP-J7S	4.9 mm x 6.0 mm x 1.65 mm
	Pitch: 1.27 mm (Typ)

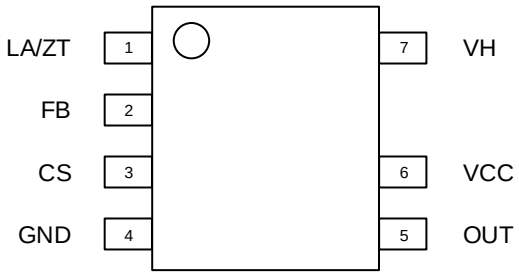


Applications

OA Equipment, AC Adapters, Each Household Applications and Power Supplies for Motor

Pin Configuration

(TOP VIEW)



Pin Descriptions

No.	Pin Name	I/O	Function
1	LA/ZT	I	Monitor auxiliary winding / Latch stop pin
2	FB	I	Feedback signal input pin
3	CS	I	Primary current detection pin
4	GND	-	GND pin
5	OUT	O	External MOSFET drive pin
6	VCC	I	Power supply input pin
7	VH	I	Startup power supply input / AC input voltage monitor pin

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BM1P10CFJ General Description – continued

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
Bobbin: 12PIN
Core: PQ2620

- Primary Inductance: 0.50mH± 10 % (100 kHz, 1 V)
- Voltage Endurance
  - Between Primary and Secondary : AC1500 V
  - Between Primary and Core: AC1500 V
  - Between Secondary and Core: AC500 V
- Isolated Resistor 100 MΩ or more (DC500 V)

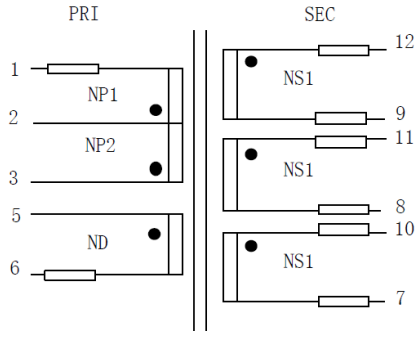


Figure 7. Circuit Diagram

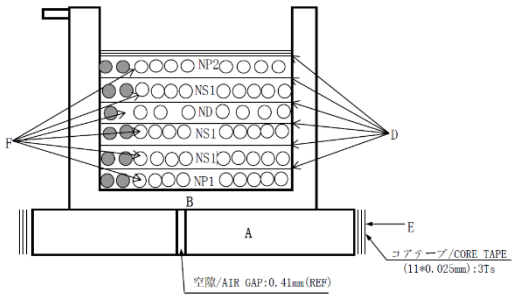


Figure 8. Structure Diagram

Table 1. Product Specification of XE2395Y

No.	Transformer	Winding Pin		Wire	Turn Number	Tape Layer	Wire Specification
		Start	Finish				
1	NP1	3	2	2UEW / Φ0.29 x 2	19	1	COMPACT
2	NS1	10	7	TEX / Φ0.32 x 2	11	1	COMPACT
3	NS1	11	8	TEX / Φ0.32 x 2	11	1	COMPACT
4	ND	5	6	2UEW / Φ0.15 x 1	20	1	COMPACT
5	NS1	8	7	TEX / Φ0.32 x 2	11	1	COMPACT
6	NP2	2	1	2UEW / Φ0.29 x 2	19	3	COMPACT

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Measurement Data

1 Load Regulation

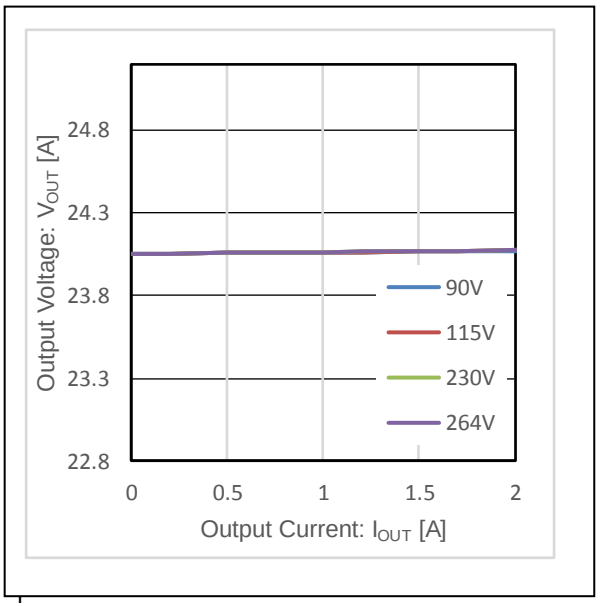


Figure 9. Regulation (V_{OUT} vs I_{OUT})

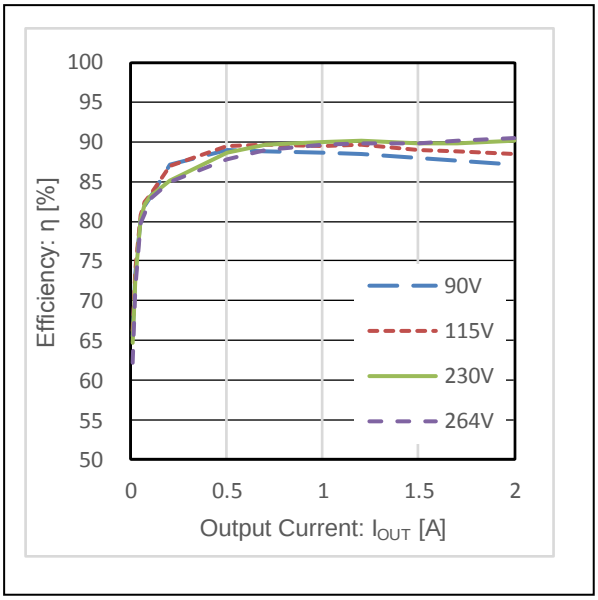


Figure 10. Load Regulation (Efficiency vs I_{OUT})

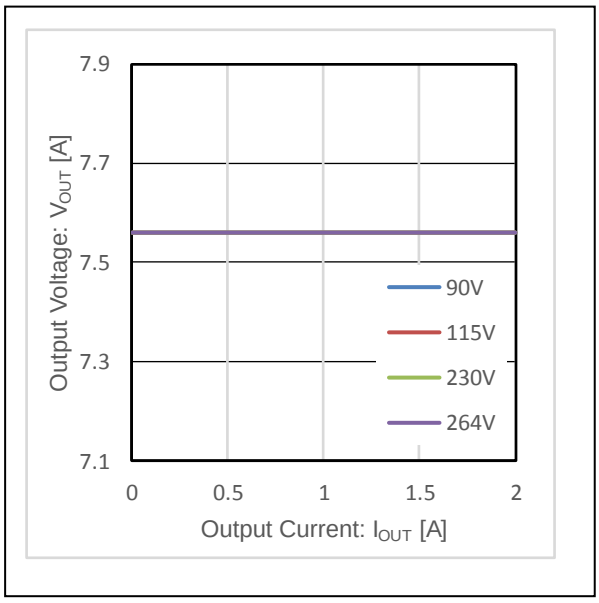


Figure 11. Load Regulation (V_{OUT} vs I_{OUT})

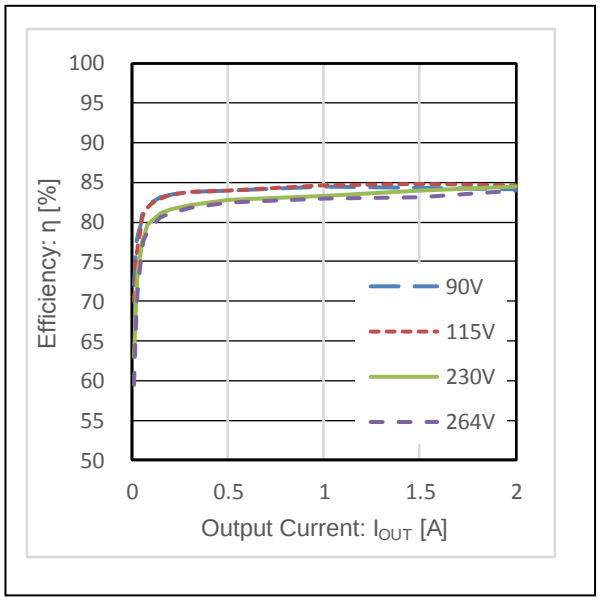


Figure 12. Load Regulation (Efficiency vs I_{OUT})

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Measurement Data – continued

1 Load Regulation

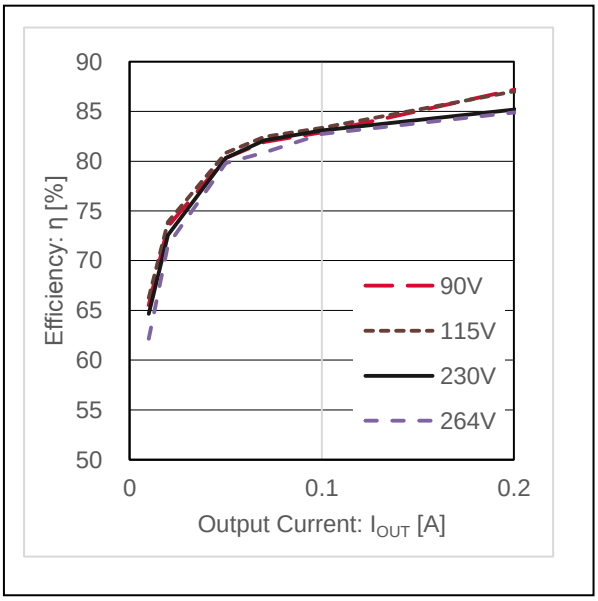


Figure 13. Load Regulation (V_{OUT} vs I_{OUT} at V_{OUT} 24 V)

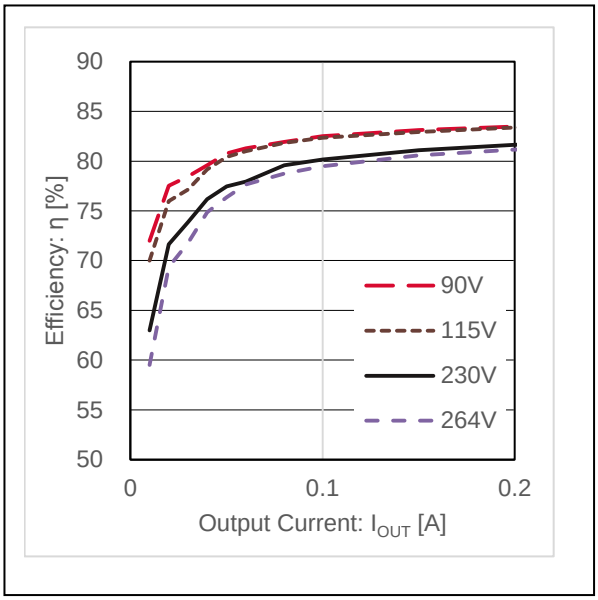


Figure 14. Load Regulation (Efficiency vs I_{OUT} at V_{OUT} 7.5V)

2 Line Regulation

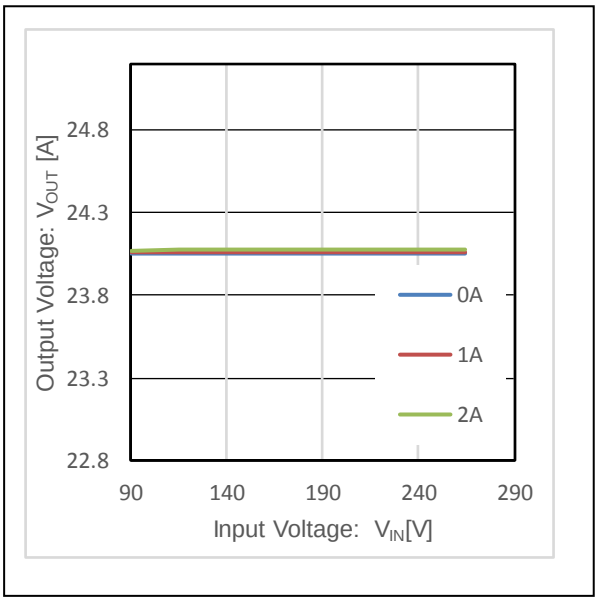


Figure 15. Line Regulation (V_{OUT} vs V_{IN})

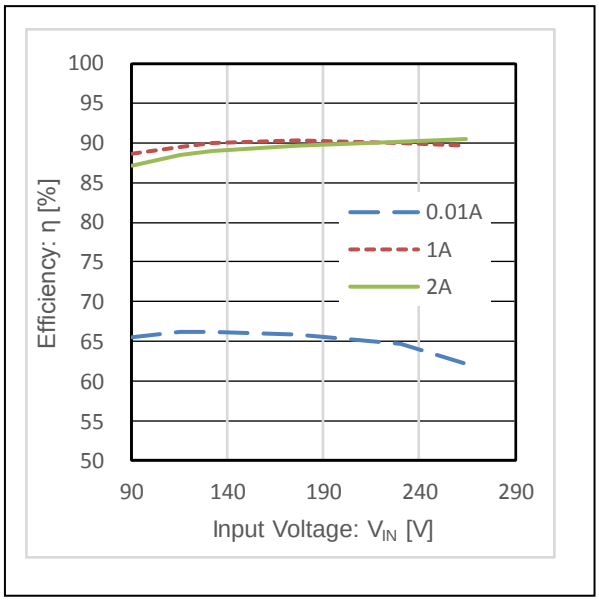


Figure 16. Line Regulation (Efficiency vs V_{IN})

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Measurement Data - continued

2 Line Regulation

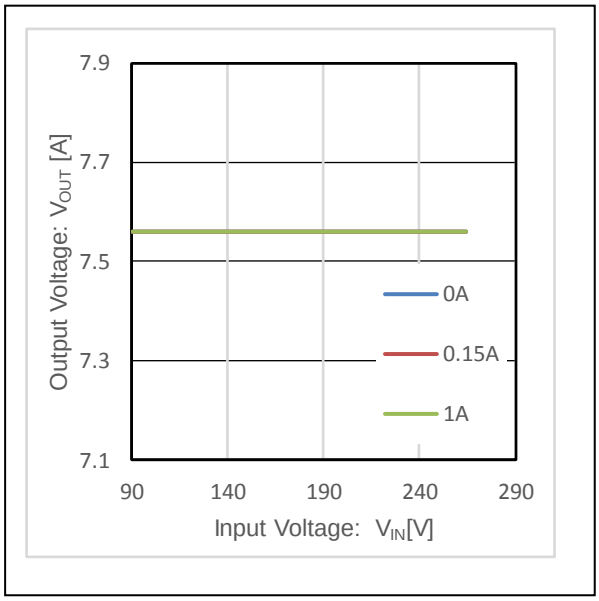


Figure 17. Line Regulation (V_{OUT} vs V_{IN})

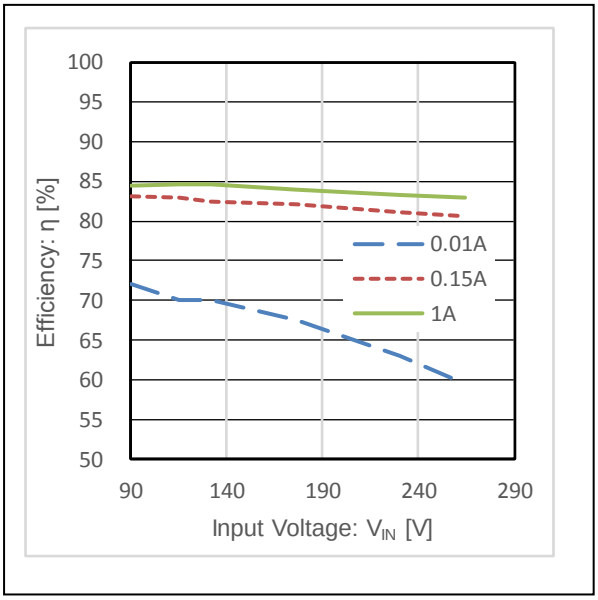


Figure 18. Line Regulation (Efficiency vs V_{IN})

3 Switching Frequency

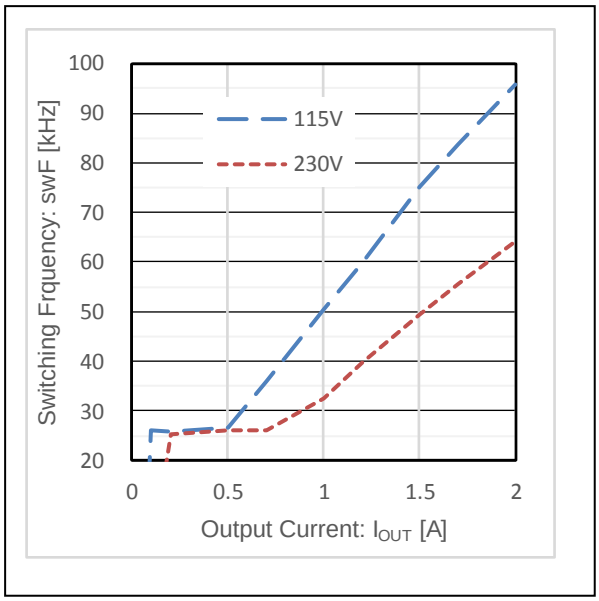


Figure 19. Switching Frequency (swF vs I_{OUT})

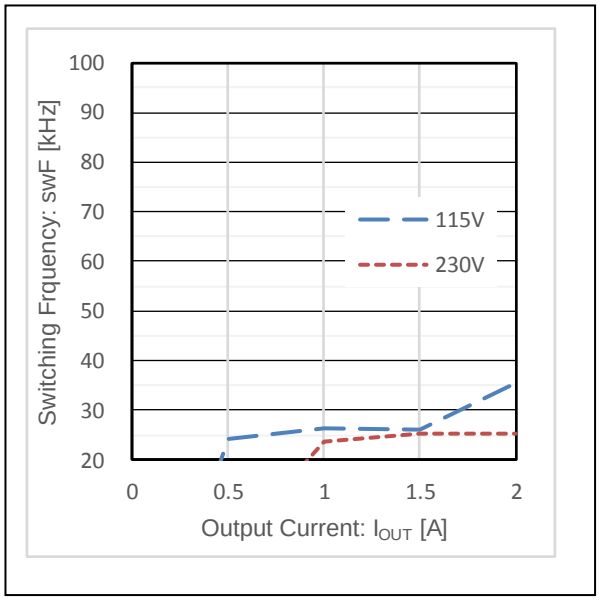


Figure 20. Switching Frequency (swF vs I_{OUT})

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Measurement Data - continued

4 Switching Wave Form

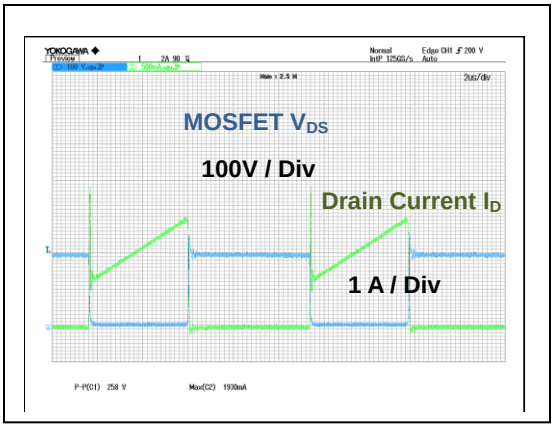


Figure 21. MOSFET Wave Form (V_{IN} = 90 Vac, I_{OUT} = 2 A)

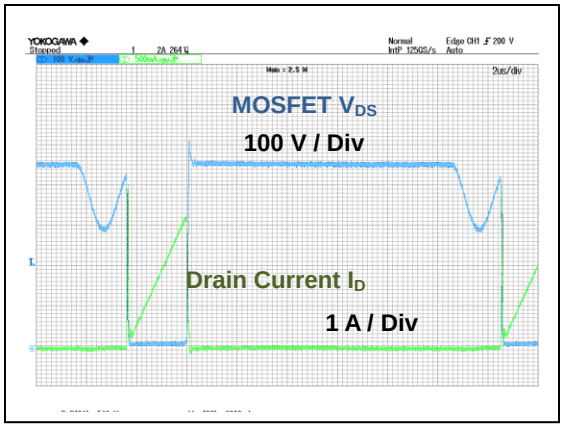


Figure 22. MOSFET Wave Form (V_{IN} = 264 Vac, I_{OUT}= 2 A)

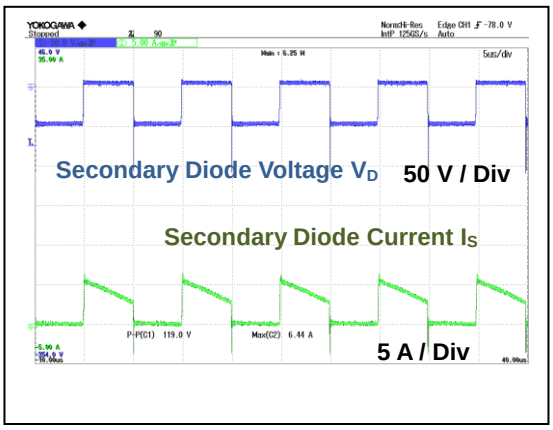


Figure 23. Diode Wave Form (V_{IN} = 90 Vac, I_{OUT} = 2 A)

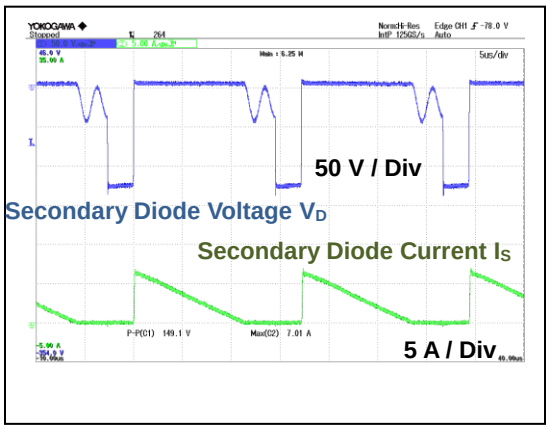


Figure 24. Diode Wave Form (V_{IN} = 264 Vac, I_{OUT} = 2 A)

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Measurement Data - continued

4 Switching Wave Form - continued

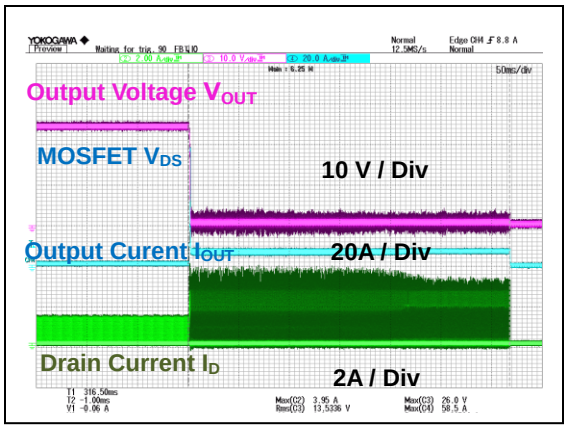


Figure 25. MOSFET Wave Form
V_{IN} = 90 Vac, Output Shorted

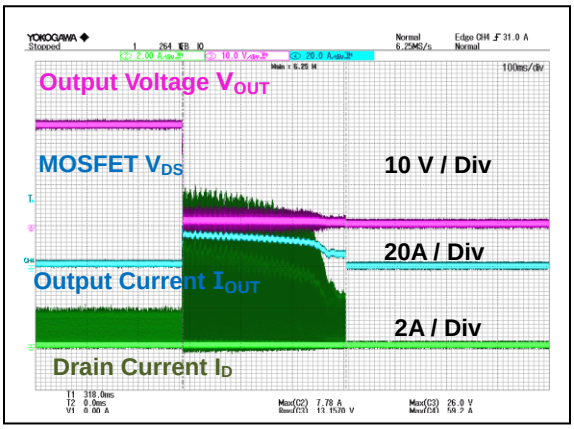


Figure 26. MOSFET Wave Form
V_{IN} = 264 Vac, Output Shorted

5 Startup Wave Form

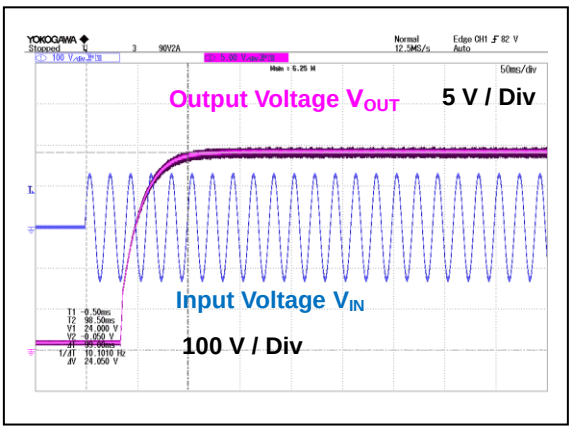


Figure 27. V_{IN} = 90 Vac, I_{OUT} = 2 A

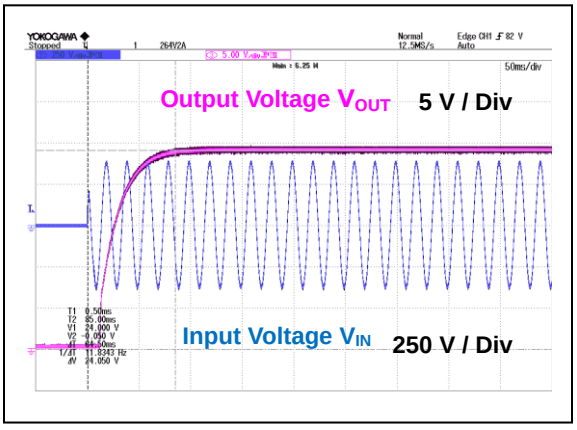


Figure 28. V_{IN} = 264 Vac, I_{OUT} = 2 A

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Measurement Data - continued

6 Dynamic Load Fluctuation

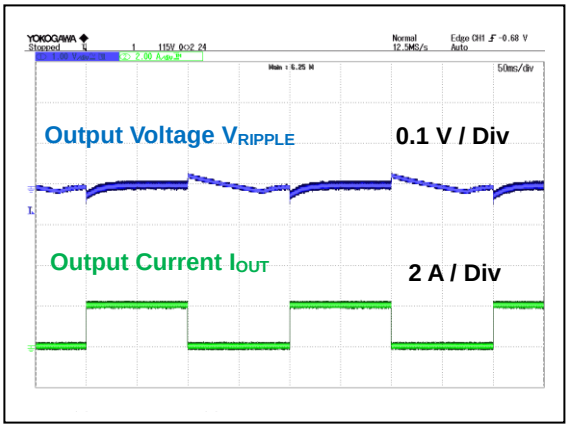


Figure 29. V_{IN} = 115 Vac, I_{OUT} = switch 0 A / 2 A

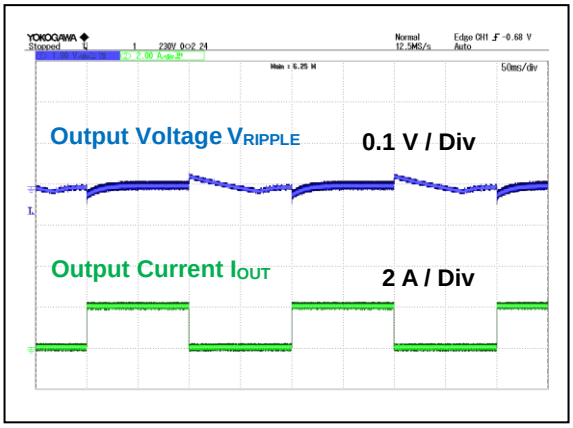


Figure 30. V_{IN} = 230 Vac, I_{OUT} = switch 0 A / 2 A

7 Output Voltage Ripple Wave Form

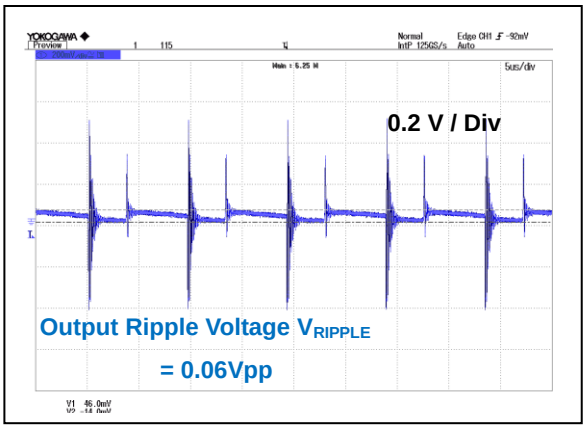


Figure 31. V_{IN} = 115 Vac, I_{OUT} = 2 A

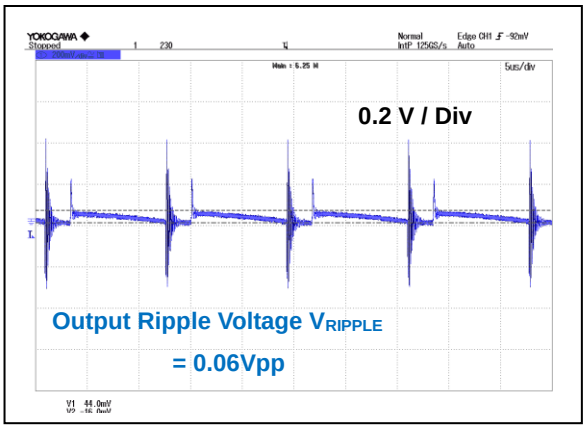


Figure 32. V_{IN} = 230 Vac, I_{OUT} = 2 A

8 Temperature of Parts Surface

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

Table 2. Surface Temperature of Parts (Ta = 25 °C)

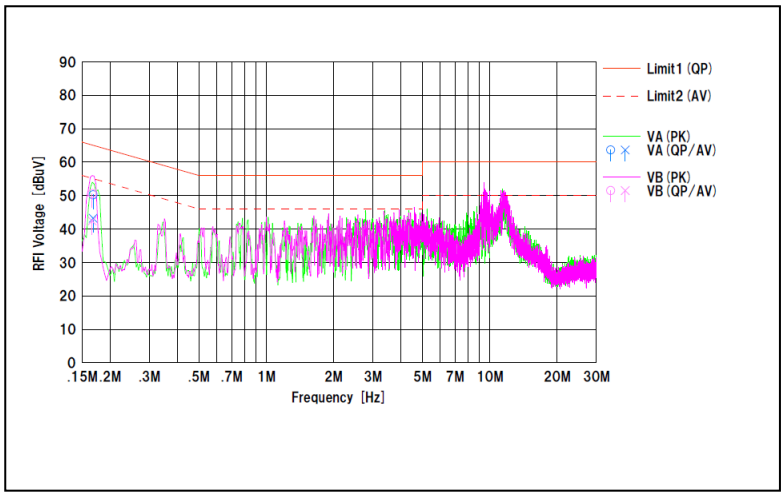
Part	Condition	
	V_{IN} = 90 Vac, I_{OUT} = 2 A	V_{IN} = 264 Vac, I_{OUT} = 0.5 A
MOSFET Q1	71.8 °C	63.5 °C

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Measurement Data – continued

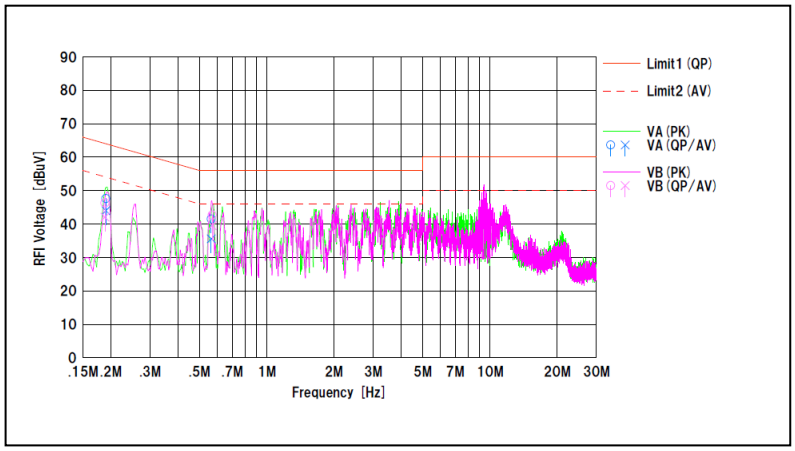
9 EMI

9.1 Conducted Emission : CISPR22 Pub 22 Class B



QP margin : 17.3 dB
AVE margin : 18.5 dB

Figure 33. V_{IN}: 115 Vac / 60 Hz, I_{OUT}: 2 A



QP margin : 10.9 dB
AVE margin : 5.5 dB

Figure 34. V_{IN}: 230 Vac / 50 Hz, I_{OUT}: 2 A

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Revision History

Date	Rev.	Changes
24.August.2020	001	New Release

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