Flyback method

Isolated Output Power 48W

BD28C57HFJ-EVK-001

User's Guide

＜High Voltage Safety Precautions＞

◇ Read all safety precautions before use

Please note that this document covers only the BD28C57HFJ evaluation board (BD28C57HFJ-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.

© 2024 ROHM Co., Ltd. All rights reserved.

AC/DC Converter

Flyback method
Isolated 48 W 24 V 2 A
BD28C57HFJ Evaluation Board

BD28C57HFJ-EVK-001

General Description

This evaluation board outputs an isolated voltage of 24 V from an input of 300 VDC to 900 VDC,
and the maximum output current is 2 A.
A SiC MOSFET (SCT12H12NZ) with 1700 V, RdsON = 1.1 Ω typ is used so that an input voltage of up to 900 VDC can be applied.
The control IC used is the BD28C57HFJ, which is suitable for driving SiC MOSFET.
The control method is current mode. The oscillation frequency is approximately 65 kHz, and the duty max is 50%.

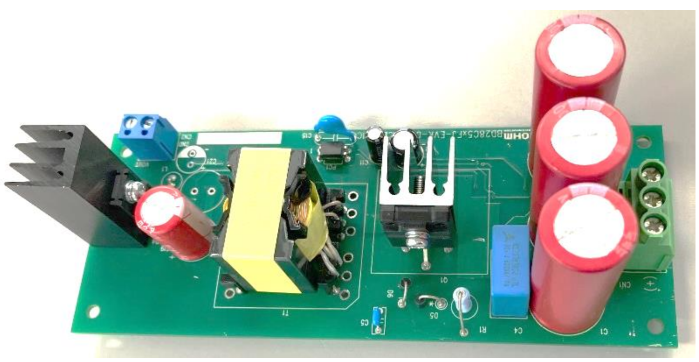


Figure 1. BD28C57HFJ-EVK-001

© 2024 ROHM Co., Ltd.

No. 67UG086E Rev.001
NOVEMBER2024

Performance Specification

Electrical characteristic

Not guarantee the characteristics is representative value.

Unless otherwise specified V_{IN} = 400V_{DC}, I_{OUT} =2 A , Ta = 25 °C

Parameter	Symbol	Min	Typ	Max	Units	Conditions
Input Voltage Range	V_{IN}	300	400	900	V	
Input Frequency	f_{LINE}	47	-	63	Hz	
Output Voltage	V_{OUT}	22.6	24.0	25.2	V	
Output Current Range (Note 1)	I_{OUT1}	0	-	2.0	A	
Maximum Output Power (Note 1)	P_{OUT}			48	W	
Standby Input Power	P_{INSTBY}	-	0.67	-	W	I_{OUT} = 0 A V_{IN} = 230V
Power supply efficiency	η	86	89.0	-	%	
Output Ripple Voltage (Note 2)	V_{ripple}	-	0.21	0.48	Vpp	
Opareting Temperature		-10	+25	+60	℃	

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

(Note 2) Do not consider spike noise

Derating

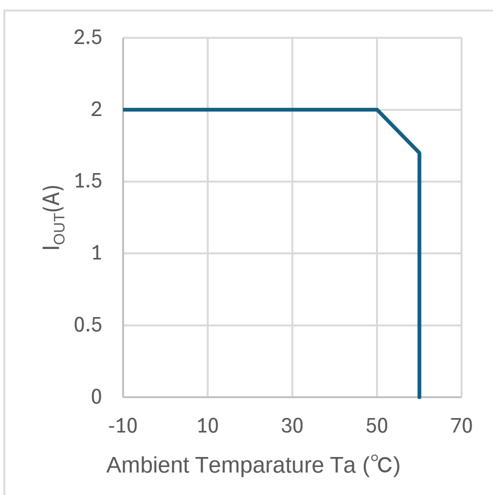


Figure 2. Temperature derating curve

Operation Procedure

1 Necessary Equipment

(1) DC power supply (90 VDC to 1 k VDC, 200 W or more)

(2) Load equipment (3 A at maximum value)

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

(4) Connect load to VOUT terminal from the positive terminal and to GND terminal 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 terminal of the DC voltmeter to VOUT terminal and the negative terminal to GND terminal for output voltage measurement.

(7) DC 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.

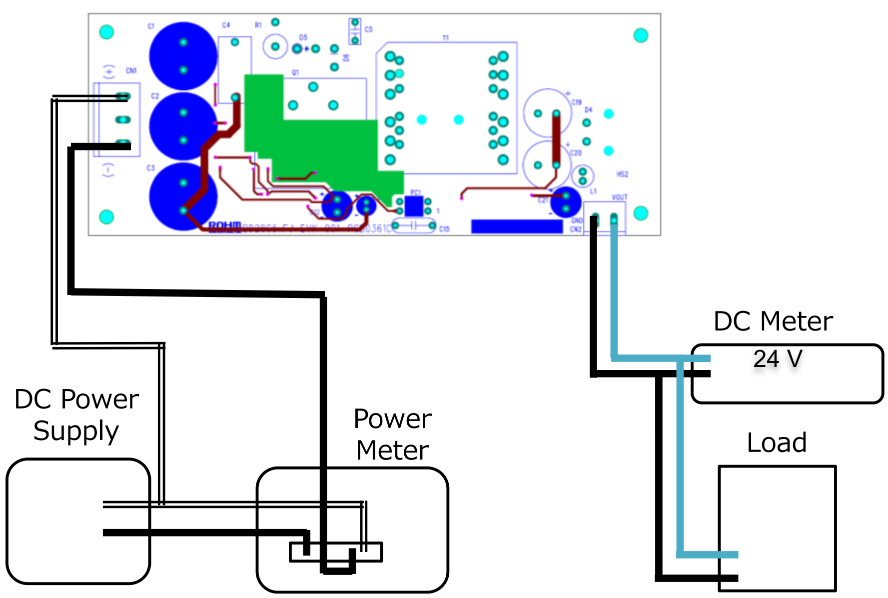


Figure 3. Diagram of How to Connect

Application Circuit

This evaluation board uses a flyback type PWM method. The oscillation frequency is set to approximately 65kHz.

The output (24V) voltage is monitored by a feedback circuit and fed back to the COM terminal of the BD28C57HFJ through a photocoupler.

At startup, the VDD terminal voltage rises as a result of the voltage being supplied to the VDD terminal through the startup circuit (Q5, Q6).

When the VDD terminal voltage exceeds the UVLO release voltage of 18.8V (Typ), the BD28C57HFJ starts operating.

When operation starts, 5V is output from the VREF terminal. This voltage turns Q8 ON, Q6 OFF, and the supply from Q6 is cut off, contributing to reducing standby power.

The oscillation frequency is determined by R21 (12kΩ) and C9 (1000pF). It is set to approximately 65kHz.

A leading edge blanking circuit is installed to prevent malfunction due to noise.

The leading edge blanking circuit consists of Q2, R27, C14, and R28.

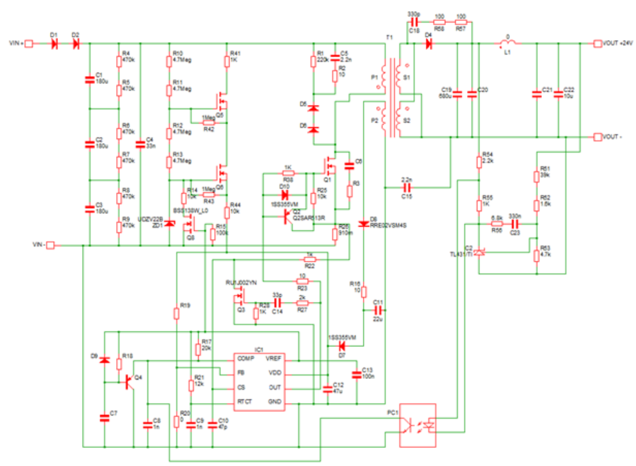


Figure 4. Application Circuit

© 2024 ROHM Co., Ltd.

BD28C57HFJ General Description

Features

- PWM Type Current Mode Control
- Low power consumption
- UVLO function for VDD pin
- Overcurrent protection circuit for each cycle
- Switching frequency setting pin

Key Specifications

- Operating Power Supply Voltage Range 6.90 V to 28.00 V
- Circuit Current 2.0 mA (Max.)
- Starting Current : 60 µA (Typ)
- Operating Temperature Range -40°C to +125 °C

Pin Configuration

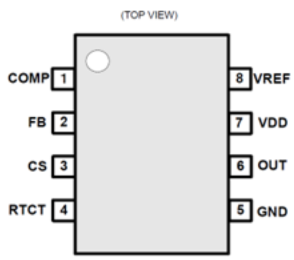


Figure 5. Pin Configuration

Package	W (Typ) x D (Typ) x H (Max)
SOP-J8	4.9 mm x 8.0 mm x 1.65 mm Pitch: 1.27 mm (Typ)

Pin Descriptions

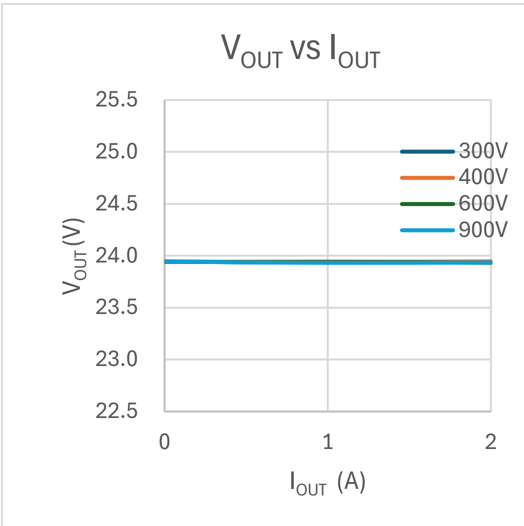
Table 1.BD28C57HFJ Pin Configuration

Pin No.	Pin Name	I/O	Function
1	COMP	O	Error amplifier output pin
2	FB	I	Feedback signal output pin
3	CS	I	Primary side current sense pin
4	RTCT	I/O	Switching frequency setting pin
5	GND	-	GND pin
6	OUT	O	Exernal MOS drive terminal pin
7	VDD	I	Power supply input pin
8	VREF	V	5VOutput pin

© 2024 ROHM Co., Ltd.

Measurement Data

1 Load Regulation



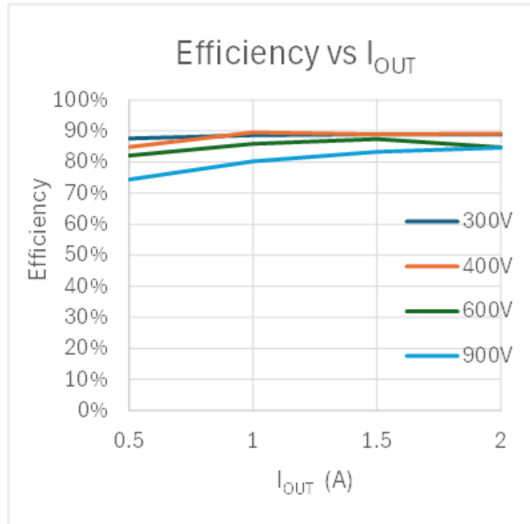
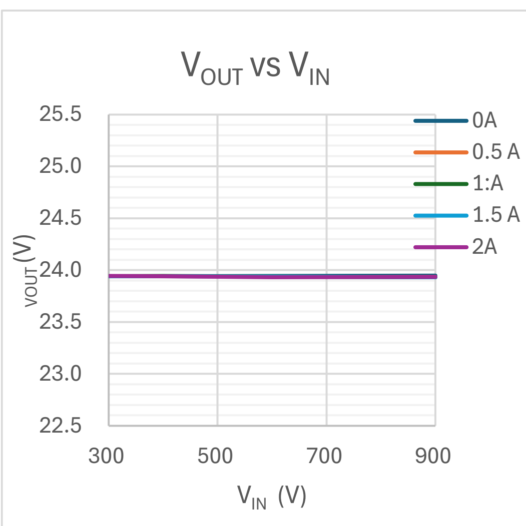


Figure 6. Load Regulation (V_{OUT} vs I_{OUT})

Figure 7. Efficiency vs I_{OUT}

2. Line Regulation



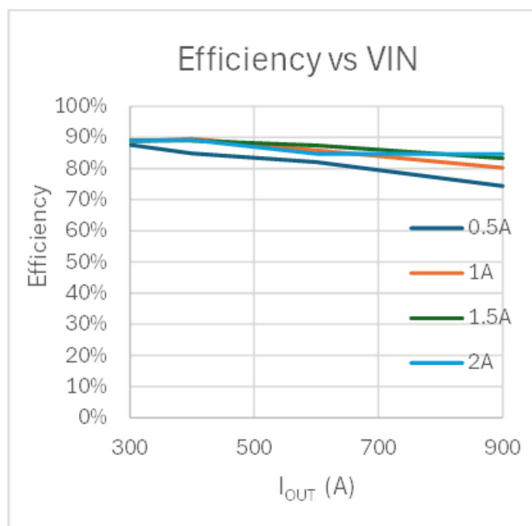


Figure 8. Line Regulation (V_{OUT} vs V_{IN})

Figure 9. Efficiency vs Input Voltage

© 2024 ROHM Co., Ltd.

Measurement Data – continued

3 Switching Frequency

Figure 10. VDS、ID V_{IN} = 300 VDC,I_{OUT}=2A

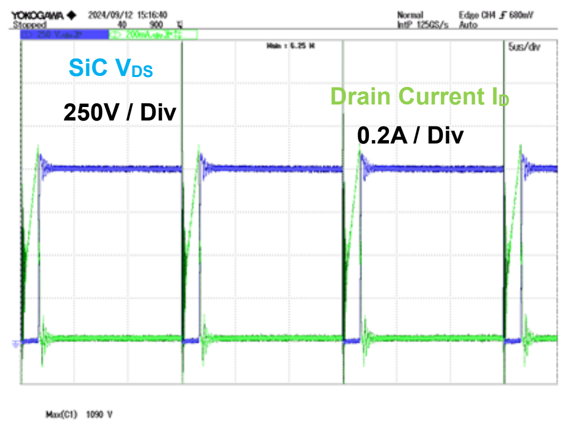


Figure11. VDS、ID V_{IN} = 900 VDC,I_{OUT}=2A

4 Switching Wave Form

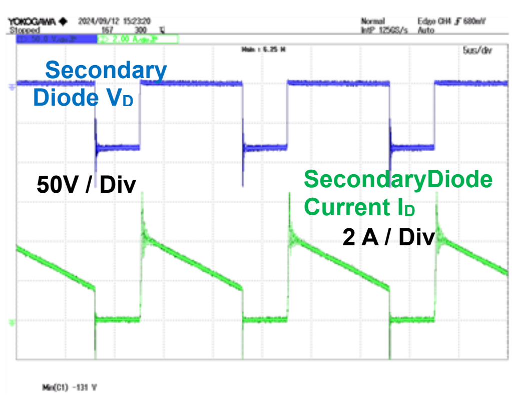


Figure 12. Secondary Diode at V_{IN} = 300 VDC, I_{OUT} = 2.0 A

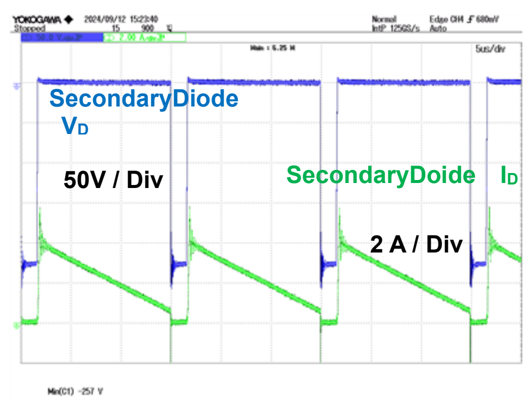


Figure 13. Secondary Diode at V_{IN} = 900 VDC, I_{OUT} = 2.0 A

© 2024 ROHM Co., Ltd.

Measurement Data - continued

4 Output current waveform during short circuit

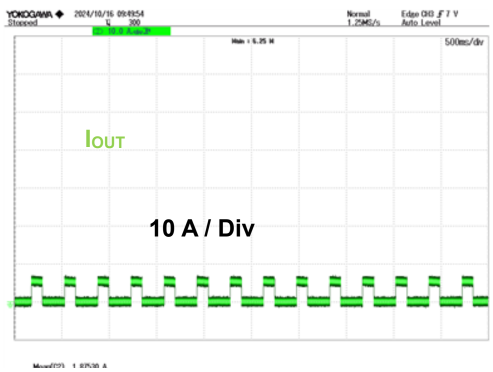


Figure 14. Output waveform during short circuit V_{IN} = 300 Vdc

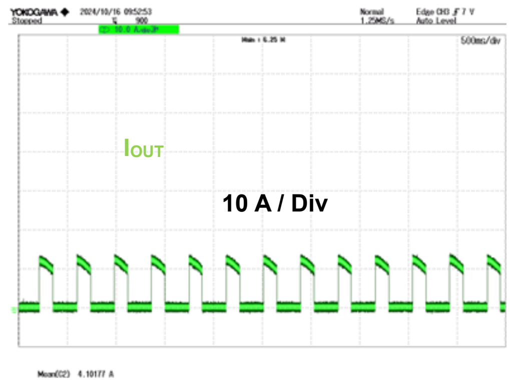


Figure 15. Output waveform during short circuit V_{IN} = 900 Vdc

© 2024 ROHM Co., Ltd.

Measurement Data - continued

5 Startup Wave Form

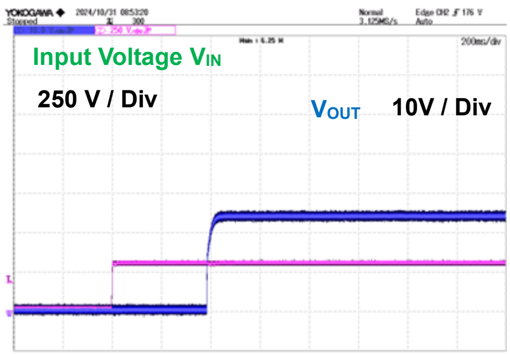


Figure 16. V_{IN} = 300 VDC, I_{OUT} = 0 A

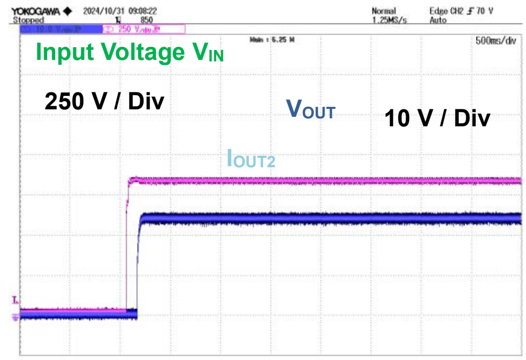


Figure 17. V_{IN} = 900 VDC, I_{OUT} =0 A

6 Dynamic Load Fluctuation

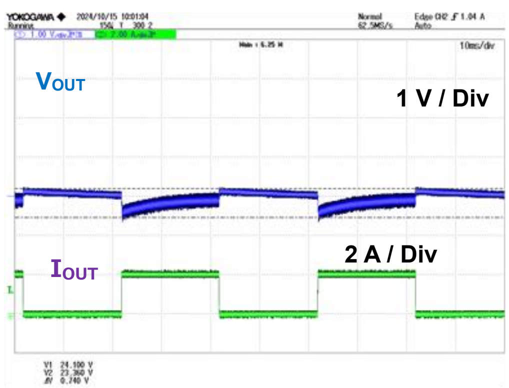


Figure 18. V_{IN} = 930 VDC, I_{OUT} = switch 0 A / 2.0 A

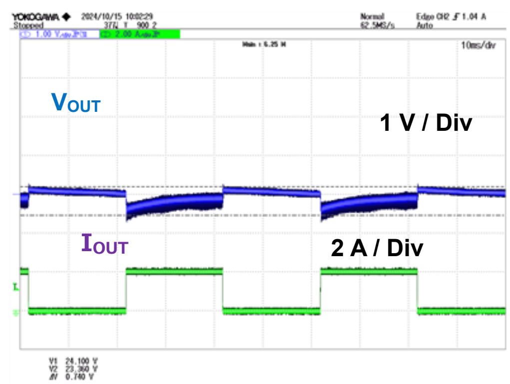


Figure 19. V_{IN} = 900 VDC, I_{OUT} = switch 0 A / 2 A

© 2024 ROHM Co., Ltd.

Measurement Data - continued

7 Output Voltage Ripple Wave Form

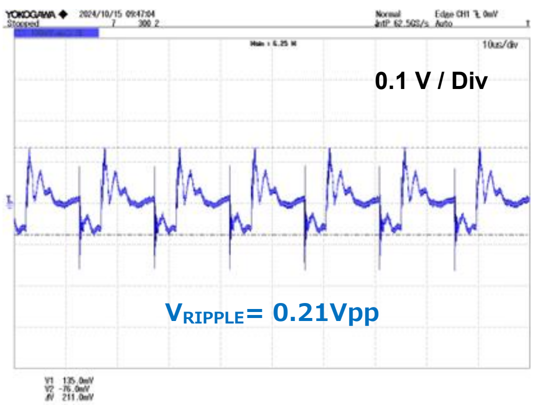


Figure 20. V_{IN} = 300 VDC, I_{OUT}=2.0 A

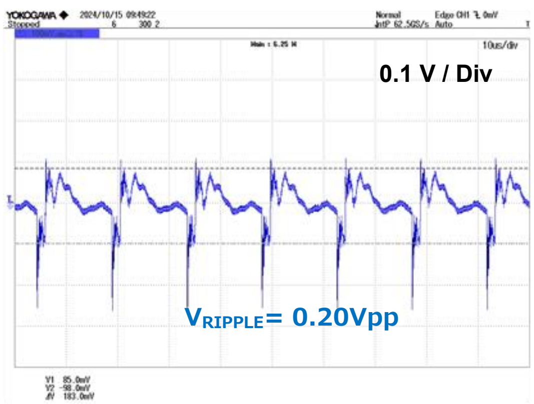


Figure 21. V_{IN} = 900 VDC, I_{OUT} = 2.0 A

8 Temperature of Parts Surface

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

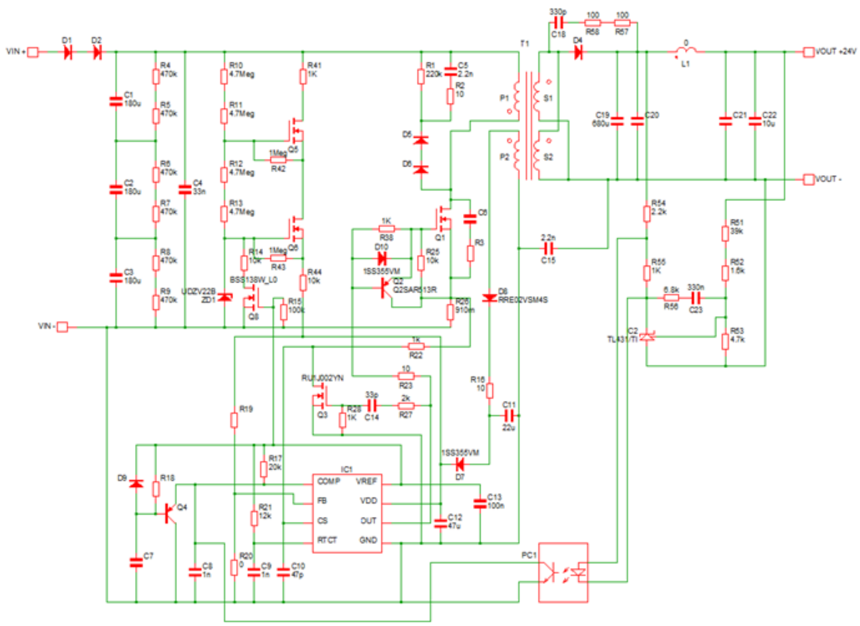
VIN(VDC)	IOUT(A)	Q1(°C)	T1(°C)	D4(°C)
300	2	48.7	64.0	65.4
600	2	61.0	71.1	66.0
900	2	80.2	91.3	71.7

Table 2. Surface Temperature of Parts (Ta = 24.8 °C)

© 2024 ROHM Co., Ltd.

Schematics

V_{IN} = 300 VDC～900 VDC、V_{OUT} = 24 V 2.0 A



VOUT

Figure 22. BD28C57HFJ-EVK-001 Schematics

Parts List

Table 3. BoM of BD28C54HFJ-EVK-001

Item	Value		Parts name	Manufacture
C1,C2,C3	180	µF	8600021382024	Wuerth Electronik
C4	33	nF	B32672L1333J	TDK
C5	2200	pF	RDER73A222K2K1H03B	Murata
C6,C7,C20,C21,C24,C29,C30	-		Non-Maunted	
C８,C9	1000	pF	HMK107B7102KA-T	Taiyo Yuden
C10	47	pF	GRM1885C2E470JW07	Murata
C11	22	µF	UHD1H220MDD	Nichicon
C12	47	µF	7075764	RS PRO
C13	0.1	µF	HMK107B7104MA-T	Taiyo Yuden
C14	33	pF	GCM1880C1H330GA01	Murata
C15	2200	pF	DE1E3RA222MJ4BP01F	Murata
C18	330	pF/1kV	GRM31A7U3A331JW31D	Murata
C19	680	µF/35V	860080578019	
C22	10	µF	GRM31CD71H106KE11	Murata
C23	0.33	µF	GCM188R71C334KA37D	Taiyo Yuden
CN1	-		691250610003	Wuerth Electronik
CN2	-		691101710002	Wuerth Electronik
D1,D2	1	A	BYG23T-M3	VISHAY
D4	20	A	RFUH25TB3SNZ	Rohm
D5,D6	1	A	UF4007	On Semiconductor
D7,D10	0.1	A	1SS355VM	Rohm
D8	0.2	A	RRE02VSM4S	Rohm
HS1	22.9	k/W	IC-1625-STL	Sankyo Thrmotech
HS2	14	k/W	E2A-T220-38E	OHMITE
IC1			BD28C57HFJ-LB	ROHM
IC2			TL431BIDBZT	TI
L3			short	
PC1			LTV-817-B	LiteOn
Q1	3.7	A	SCT2H12NZ	Rohm
Q2	1	A	2SAR513RTL	Rohm
Q3		A	BSS138WT106	Rohm
Q5,Q6	21	mA	BSS126H6906XTSA1	Infineon
Q7	0.2	A	RU1C001UN	Rohm
R1	100	kΩ	ERG-2SJ104	
R2	10	Ω	ESR25JZPJ100	Rohm
R3,R18,R19,R30,R59,Q4	-	Ω	Non-Maunted	
R4,R5,R6,R7,R8,R9	470	kΩ	KTR18EZPJ474	Rohm
R10,R11,R12,R13	4.7	MΩ	KTR18EZPJ475	Rohm
R14,R25	10	kΩ	MCR03EZPFX1002	Rohm
R15	100	kΩ	MCR03EZPJ104	Rohm
R16,R23	10	Ω	MCR18EZPJ100	Rohm
R17	20	kΩ	MCR03EZPFX2002	Rohm
R20	0	kΩ	MCR03EZPJ000	Rohm
R21	12	kΩ	MCR03EZPFX1202	Rohm
R22	1	kΩ	MCR18EZPJ102	Rohm
R24,R28,R55	1	kΩ	MCR03EZPFX1001	Rohm
R26	0.91	Ω	LTR100PZPZFLR910	Rohm
R27	2	kΩ	MCR03EZPFX2001	Rohm
R41	1	kΩ	KTR18EZPJ102	Rohm
R42,R43	1	MΩ	MCR03EZPJ105	Rohm
R44	10	kΩ	MCR18EZPJ103	Rohm
R51	39	kΩ	MCR03EZPFX3902	Rohm
R52	1.6	kΩ	MCR03EZPFX1601	Rohm
R53	4.7	kΩ	MCR03EZPFX4701	Rohm
R54	2.2	kΩ	MCR03EZPFX2201	Rohm
R56	6.8	kΩ	MCR03EZPJ682	Rohm
R57,R58	100	Ω	ESR25JPZPZJ101	Rohm
T1	1.66	mH	XE2870YA	Alpa Trans
ZD1	22	V	UDZVTE1722B	Rohm

Materials may be changed without notifying.

Layout

Size: 155 mm x 60 mm

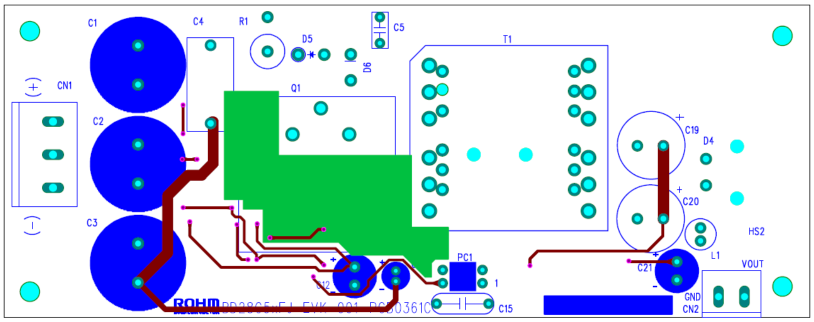


Figure 23. TOP Silkscreen (Top view)

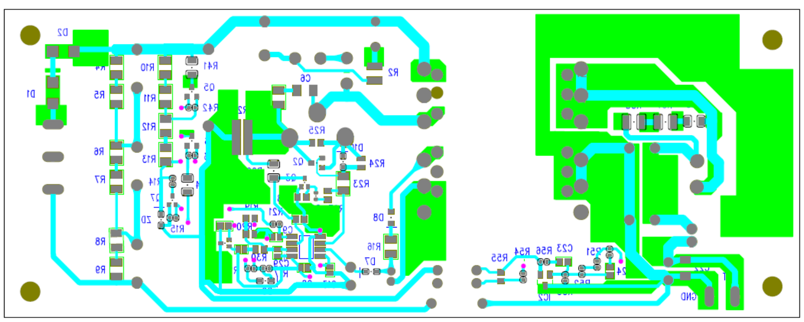


Figure 24. Bottom Layout (Top View)

© 2024 ROHM Co., Ltd.

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: XE2870Y_A
Bobbin: PQ2625-4
Core: PQ2625

- Primary Inductance: 1.866mH± 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)

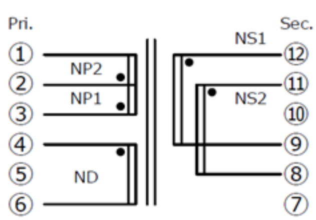


Figure 25. Circuit Diagram

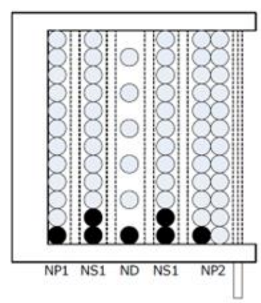


Figure 26. Structure Diagram

Table 4. Product Specification of XE2870Y_B

No.	Transformer	Winding Pin		Wire	Turn Number	Tape Layer	Wire Specification
		Start	Finish				
1	NP1	3	2	TEX-E / Φ0.30	25	2	COMPACT
2	NS1	12	9	2UEW / Φ0.35	17	2	COMPACT
3	ND	4	6	TEX-E / Φ0.20	15	2	COMPACT
4	NS1	11	8	2UEW / Φ0.35	17	2	COMPACT
5	NP2	2	1	TEX-E / Φ0.30	50	3	COMPACT

© 2024 ROHM Co., Ltd.

Revision History

Date	Rev.	Changes
12.November.2024	001	New Release

© 2024 ROHM Co., Ltd.

Notice

1) The information contained in this document is intended to introduce ROHM Group (hereafter referred to asROHM) products. When using ROHM products, please verify the latest specifications or datasheets before use.

2) ROHM products are designed and manufactured for use in general electronic equipment and applications (such as Audio Visual equipment, Office Automation equipment, telecommunication equipment, home appliances, amusement devices, etc.) or specified in the datasheets. Therefore, please contact the ROHM sales representative before using ROHM products in equipment or devices requiring extremely high reliability and whose failure or malfunction may cause danger or injury to human life or body or other serious damage (such as medical equipment, transportation, traffic, aircraft, spacecraft, nuclear power controllers, fuel control, automotive equipment including car accessories, etc. hereafter referred to as Specific Applications). Unless otherwise agreed in writing by ROHM in advance, ROHM shall not be in any way responsible or liable for any damages, expenses, or losses incurred by you or third parties arising from the use of ROHM Products for Specific Applications.

3) Electronic components, including semiconductors, can fail or malfunction at a certain rate. Please be sure to implement, at your own responsibilities, adequate safety measures including but not limited to fail-safe design against physical injury, and damage to any property, which a failure or malfunction of products may cause.

4) The information contained in this document, including application circuit examples and their constants, is intended to explain the standard operation and usage of ROHM products, and is not intended to guarantee, either explicitly or implicitly, the operation of the product in the actual equipment it will be used. As a result, you are solely responsible for it, and you must exercise your own independent verification and judgment in the use of such information contained in this document. ROHM shall not be in any way responsible or liable for any damages, expenses, or losses incurred by you or third parties arising from the use of such information.

5) When exporting ROHM products or technologies described in this document to other countries, you must abide by the procedures and provisions stipulated in all applicable export laws and regulations, such as the Foreign Exchange and Foreign Trade Act and the US Export Administration Regulations, and follow the necessary procedures in accordance with these provisions.

6) The technical information and data described in this document, including typical application circuits, are examples only and are not intended to guarantee to be free from infringement of third parties intellectual property or other rights. ROHM does not grant any license, express or implied, to implement, use, or exploit any intellectual property or other rights owned or controlled by ROHM or any third parties with respect to the information contained herein.

7) No part of this document may be reprinted or reproduced in any form by any means without the prior written consent of ROHM.

8) All information contained in this document is current as of the date of publication and subject to change without notice. Before purchasing or using ROHM products, please confirm the latest information with the ROHM sales representative.

9) ROHM does not warrant that the information contained herein is error-free. ROHM shall not be in any way responsible or liable for any damages, expenses, or losses incurred by you or third parties resulting from errors contained in this document.

Thank you for your accessing to ROHM product informations.
More detail product informations and catalogs are available, please contact us.

ROHM Customer Support System

https://www.rohm.com/contactus

© 2023 ROHM Co., Ltd. All rights reserved.