AC Voltage Zero Cross Detection IC
BM1Z002FJ Evaluation Board

User's Guide

＜High Voltage Safety Precautions＞

◇ Read all safety precautions before use

Please note that this document covers only the BM1Z002FJ evaluation board (BM1Z002FJ-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.

AC/DC Converter

AC Voltage Zero Cross Detection IC

BM1Z002FJ Evaluation Board

BM1Z002FJ-EVK-001

General Description

This evaluation board outputs a signal indicating when there is a zero voltage crossing from an input AC voltage from 90 VAC to 264 VAC. The BM1Z002FJ with the very few external components, will output a signal which is synchronous and offset in time if configured to do so, indicating when the two phases of the input AC signals are crossing 0V relative to one another. The advantage of the BM1Z002FJ is that it will provide the desired output signal while consuming less than 1/10 of the current, using fewer components, and at higher precision and repeatability as compared to a conventional zero cross detection circuit

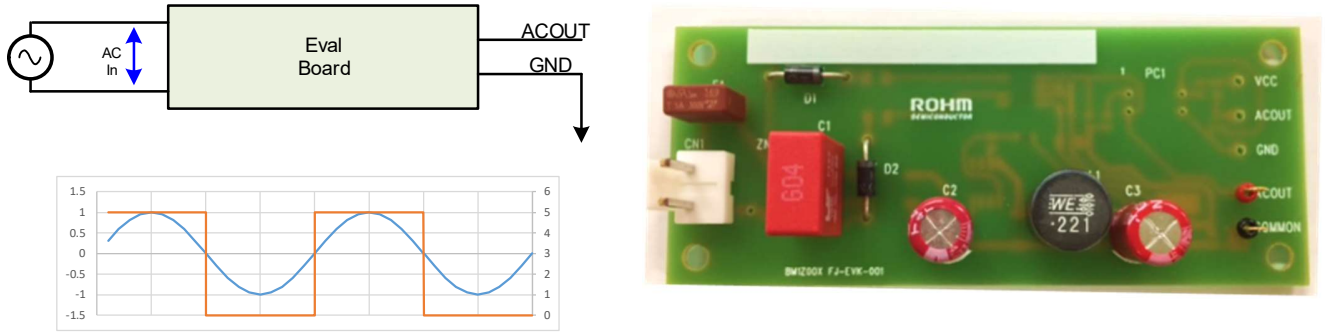

Figure 1. BM1Z002FJ-EVK-001

Performance Specification

Not guarantee the characteristics is representative value. Ta = 25 °C

Parameter	Min	Typ	Max	Units	Conditions
Input Voltage Range	90	230	264	V	
Input Frequency	47	-	63	Hz	
Output Voltage (High Level)	4.75	5.00	5.25	V	
Output Voltage (Low Level)	0.0	-	0.1	V	
Delay Time	-	0.0	-	µs	
Operating Temperature Range	-10	+25	+65	°C	

Operating Procedure

1 Necessary Equipment

(1) Isolation Transformer to isolate main AC from AC into the eval board

Or Isolated AC power source (90 Vac to 264 Vac, 10 W or more)

(2) Oscilloscope

2 Connecting Equipment

(1) With the ouput of the isolated AC power supply off, set the output to 90 VAC to 264 VAC .

(2) Connect the output pin (ACOUT-pin, COMMON pin as ground reference) to an Oscilloscope

(Keep the ground isolated from AC Inputs and probes).

(3) Connect the AC Input pins of the eval baord (CN1) to AC power supply output with pair of wires.

(4) Connect oscilloscope probes to each of the AC Input pins, and connect the grounds for each probe to the Common or GND (Clarify which node per the notes about the schematic) pins on the eval board

(5) Set the Oscilloscope to display the AOUT probe so that a 5V rail to rail signal displays correctly and so that AC probe1 - AC probe2 is displayed

(6) Turn on the AC power supply

(7) Confirm the output waveform ACOUT is synchronized with the AC input voltage.

Caution：To avoid the electrical shock , please keep AC Power supply being isolated.

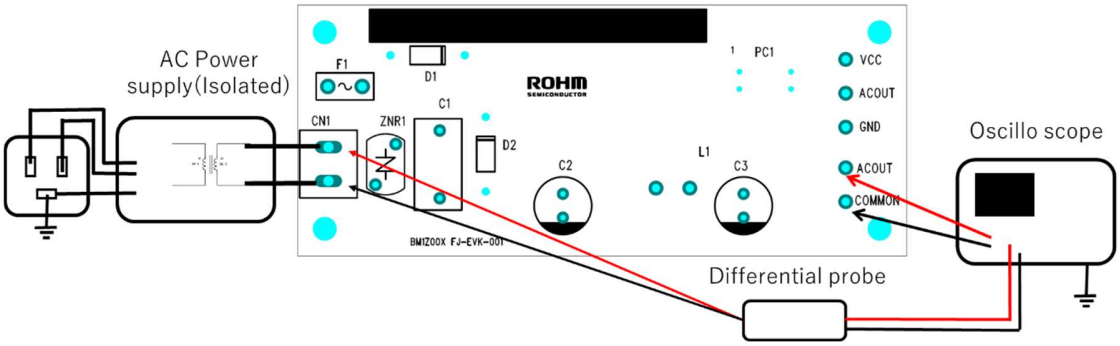

Figure 2. Diagram of How to Connect

Application Circuit

This evaluation board outputs a zero cross signal on ACOUT that is synchronous to the difference in the voltages between the VH_AC1 and VH_AC2 signals on the BM1Z002FJ (IC1).
Output a zero cross point of the AC voltage from ACOUT pins by monitoring the voltage between VH_AC1 pins and the VH_AC2 pins of IC1.
The input pins VH_AC1 and VH_AC2 can tolerate up to 600V relative to one another. This results in a high reliabitity circuit using very little power. The ACOUT output pin of the eval board has 5V as it's high output level and 0V as it's low level. This voltage level is set by the output of the Power supply circuit. It can be modified to span a different voltage range. Please request guidance from your local Rohm support person if a different operating voltage range is required.

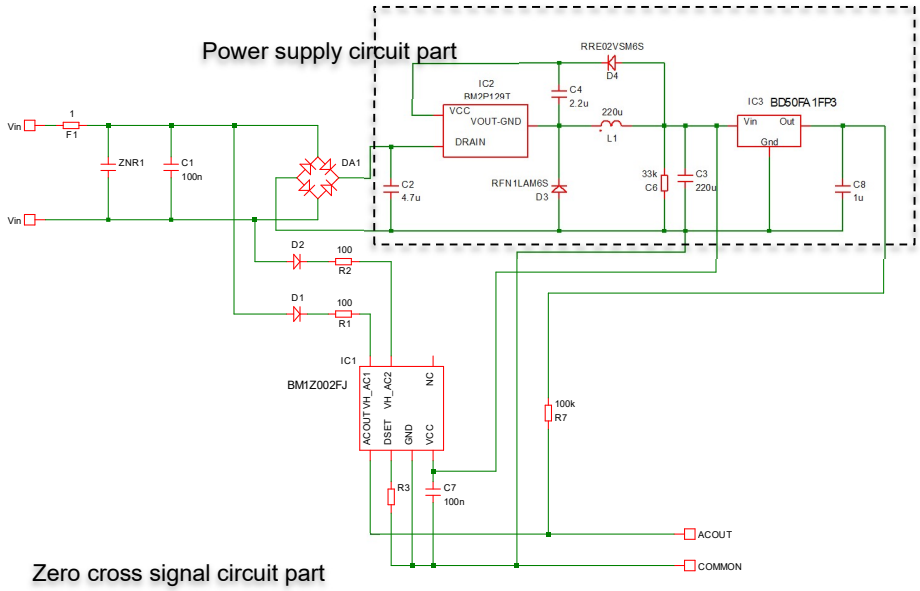

Figure 3. Application Circuit

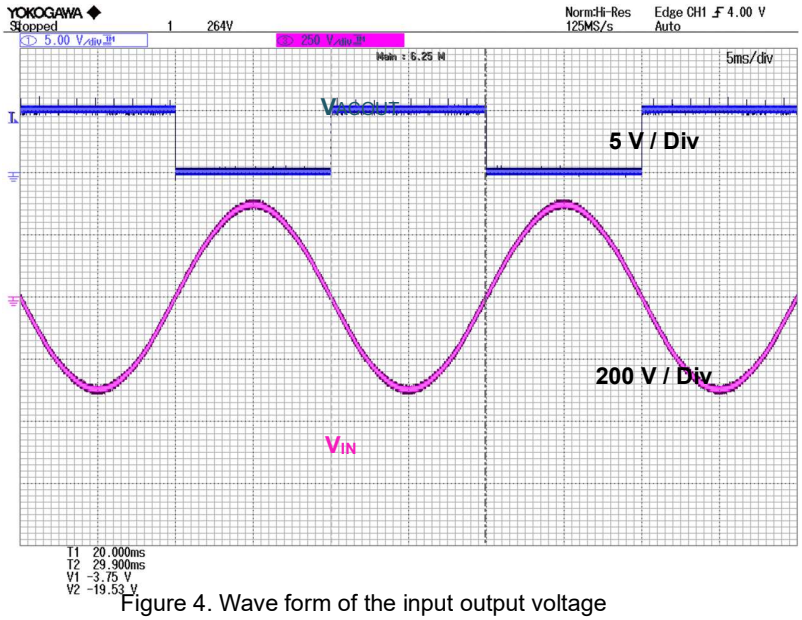

Figure 4. Wave form of the input output voltage

BM1Z002FJ·General Description

Features

This IC outputs a signal synchronous to the zero crossing of an input AC signal with high accuracy.
Using this IC allows for a much simpler implimentation as compared to conventional methods. The IC allows for a dramatic reducion in the number of parts and improves reliability, accuracy, and precisoion. In addition, this IC can reduce standby power consumption as compared to a conventional implemenation.

Key Specifications

- VCC Input Power Supply Voltage Range: -0.3 V to +29.0 V
- VH_AC1 and VH_AC2 Pins Operation Voltage: 600 V (Max)
- Circuit Current at Standby: 50 µA (Typ)
- Circuit Current at Operation: 160 µA (Typ)
- Operating Temperature Range: -40 °C to +105 °C

Pin Configuration

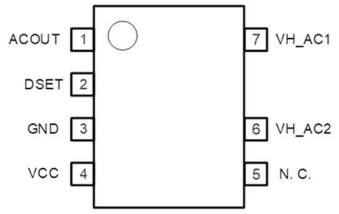

Figure 5. Pin Configuration

Package

	W (Typ) x D (Typ) x H (Max)
SOP-J7S	4.90 mm x 6.00 mm x 1.65 mm
	Pitch (Typ): 1.27 mm

Figure 6. SOP-J7S Package

Pin Descriptions

No.	Pin Name	I/O	Function
1	ACOUT	O	AC voltage zero cross timing output pin
2	DSET	I	AC voltage zero cross delay time setting pin
3	GND	-	Ground pin
4	VCC	I	Power supply pin
5	N.C	-	Non connection (Do not connect to any pins.)
6	VH_AC2	I	AC voltage input 2 pin
7	VH_AC1	I	AC voltage input 1 pin

BM1Z002FJ·General Description - continued

Important Parameter

Parameter	Symbol	Min	Typ	Max	Units	Conditions
Input Voltage Range	V_{IN}	90	230	264	V	
Output Voltage (High Level)	V_{OUTH}	4.75	5.00	5.25	V	
Output Voltage (Low Level)	V_{OUTL}	0.0	0.0	0.1	V	
Delay Time	T_{DELAY}	-	0.0	-	µs	

Zero cross delay time is adjustable by the external (R3) between DSET pins and COMMON pins.

R3	Setting delay time
OPEN	0 µs
330 kΩ	200 µs
68 kΩ	-200 µs
0 Ω	-480 µs

R3 is not populated on the Eval Board as shipped so the typical delay between the Zero Crossing on the AC input and ACOUT pin is 0 µsec. Populating the R3 location with the values shown above will result in a shift in time between the detected Zero Crossing and when the ACOUT signal changes state. Note that the ACOUT change can be advanced or occur before (negative delay) the zero crossing.

Measurement Data

1 Input output waveform (Measurement Diagram of is Figure 2.)

R3 : OPEN

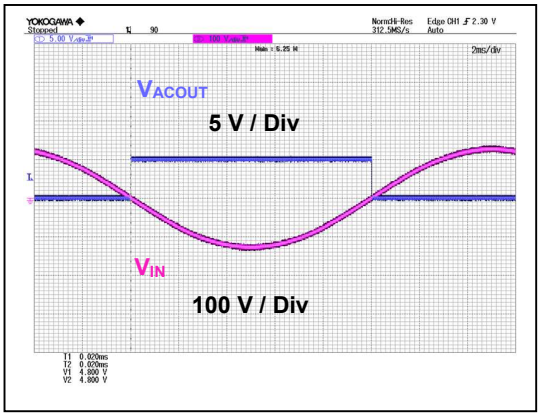

Figure 7. Input output waveform V_{IN} = 90 Vac

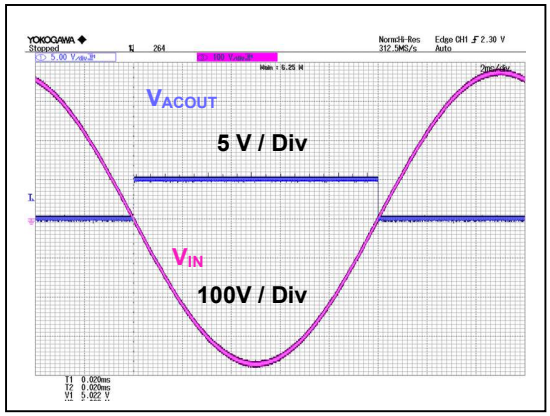

Figure 8. Input output waveform V_{IN} = 264 Vac

R3 : 330 kΩ

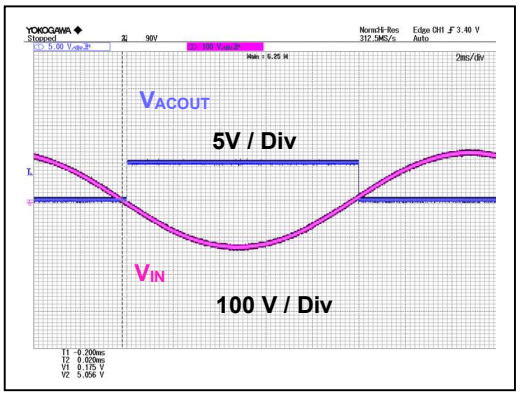

Figure 9. Input output waveform V_{IN} = 90 Vac

R3 : 8 kΩ

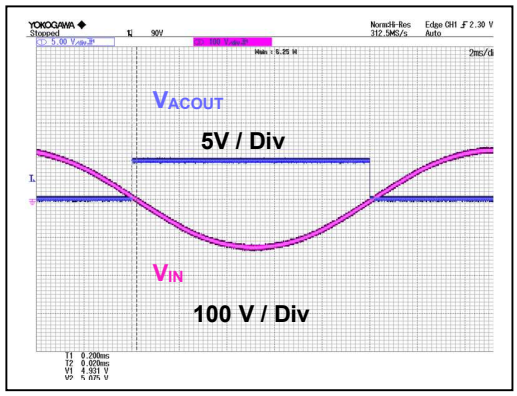

Figure 10. Input output waveform V_{IN} = 90 Vac

R 3 :0 Ω

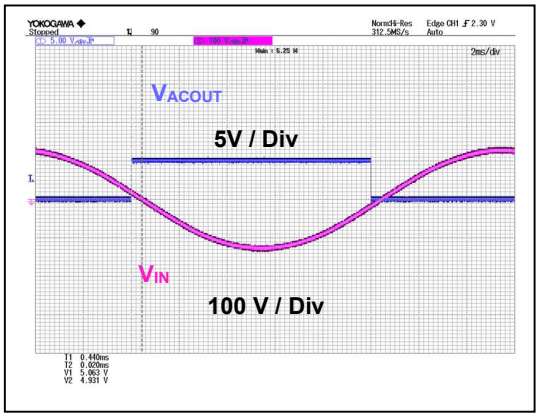

Figure 11. Input output waveform V_{IN} = 90 Vac

Application Circuit

(Condition) V_{IN} = 90 Vac to 264 Vac

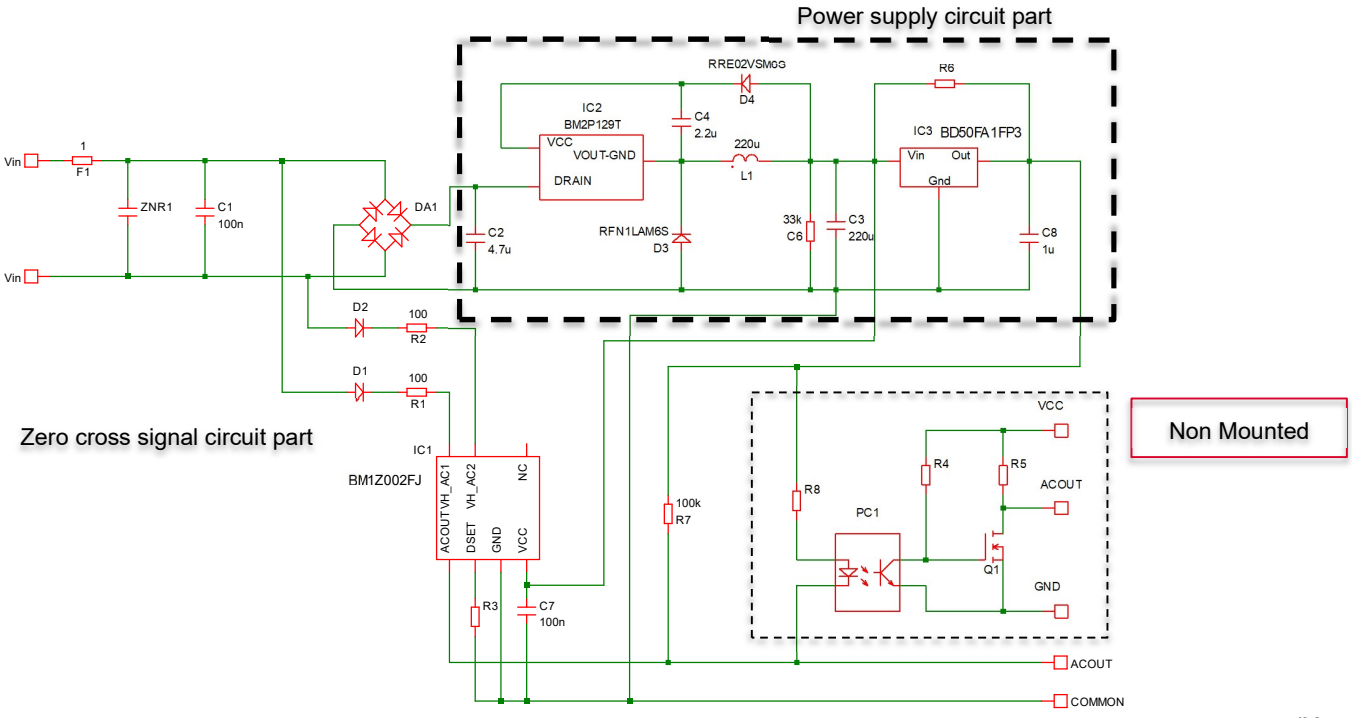

Figure 12. BM1Z002FJ-EVK-001 Application Circuit

R3,R4,R5,R6,R8,Q1,PC1:Non-Mounted

Parts List

	Item	Specifications	Parts name	Manufacture
CN	CN1		B02P-NV	JST
Capacitor	C1	0.1 µF, 275 V	890324023023CS	WURTH
	C2	4.7 µF, 400 V	860021374008	WURTH
	C3	220 µF, 25 V	860080474010	WURTH
	C4	2.2 µF, 35 V	UMK212BB7225KG-T	Taiyo Yuden
	C7	0.1 µF, 100 V	HMK107B7104MA-T	TaiyoYuden
	C8	1 µF, 50 V	UMK212BJ105KG-T	Taiyo Yuden
Diode-Bridge	DA1	1 A, 800 V	D1UBA80-7062	Shindengen
Diode	D1	1 A, 1 kV	1N4007	
	D2	1 A, 1 kV	1N4007	
	D3	0.8 A, 600 V	RFN1LAM6S	ROHM
	D4	0.2 A, 600 V	RRE02VSM6S	ROHM
Fuse	F1	1 A, 300 V	36911000000	LITTELFUSE
IC	IC1		BM1Z002FJ	ROHM
	IC2		BM2P129TF	ROHM
	IC3		BD50FA1FP3	ROHM
Inductor	L1	220 µH	7447471221	WURTH
Resistor	R1	100 Ω	MCR18EZPJ101	ROHM
	R2	100 Ω	MCR18EZPJ101	ROHM
	R7	100 kΩ	MCR03EZPJ104	ROHM
	C6	33 kΩ	MCR03EZPJ333	ROHM
PCB			PCB0172Rev.A	
TP			black	
TP			red	

(Note 1) Materials may be changed without notifying.

Layout

Size: 36 mm x 90 mm

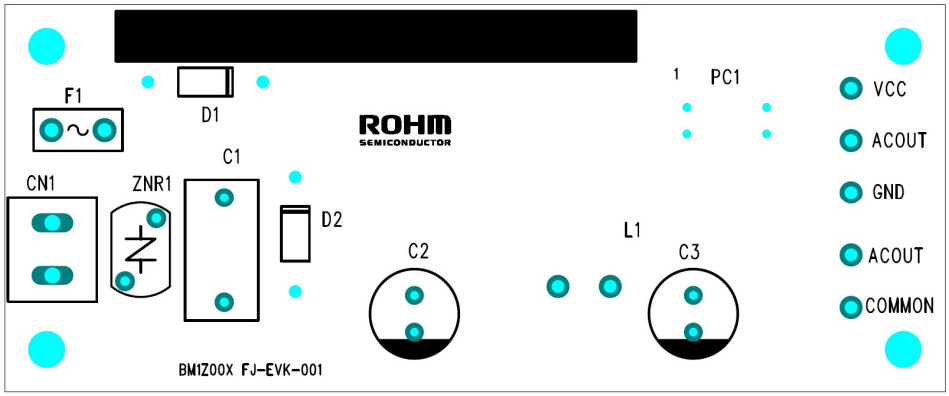

Figure 13. TOP Silkscreen (Top view)

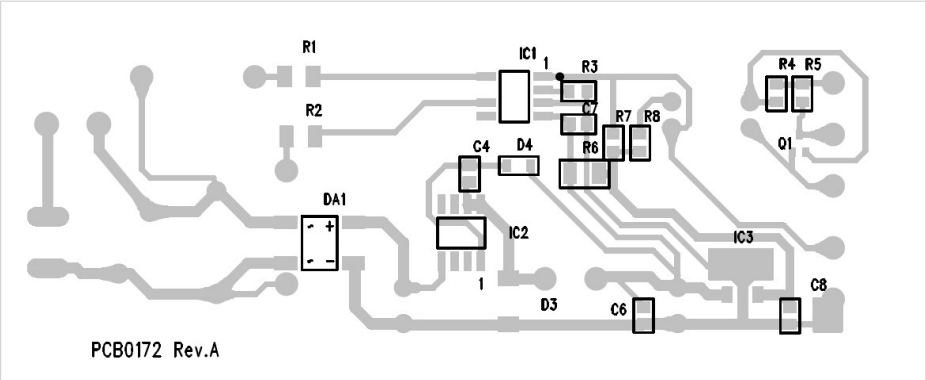

Figure 14. Bottom Layout (Top View)

Revision History

Date	Rev.	Changes
30.Mar.2020	001	New Release
13.July.2020	002	Figure 1, Figure 2, Figure 12, Figure 14
5.January.2023	003	Parts List

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.

5) The technical information specified herein is intended only to show the typical functions of and examples of application circuits for the Products. ROHM does not grant you, explicitly or implicitly, any license to use or exercise intellectual property or other rights held by ROHM or any other parties. ROHM shall have no responsibility whatsoever for any dispute arising out of the use of such technical information.

6) The Products specified in this document are not designed to be radiation tolerant.

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.

9) ROHM shall have no responsibility for any damages or injury arising from non-compliance with the recommended usage conditions and specifications contained herein.

10) ROHM has used reasonable care to ensure the accuracy of the information contained in this document. However, ROHM does not warrants that such information is error-free, and ROHM shall have no responsibility for any damages arising from any inaccuracy or misprint of such information.

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