



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 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

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

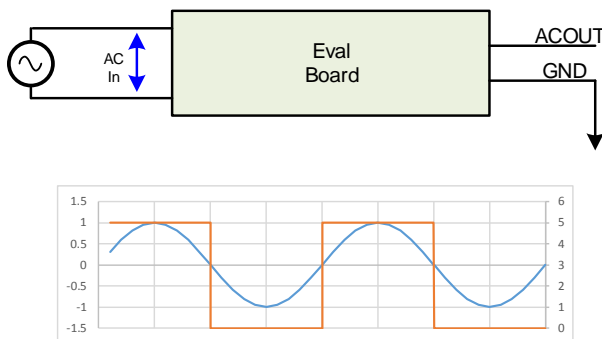


Figure 1. BM1Z002FJ-EVK-001

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 output 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 board (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 ACOUT 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.

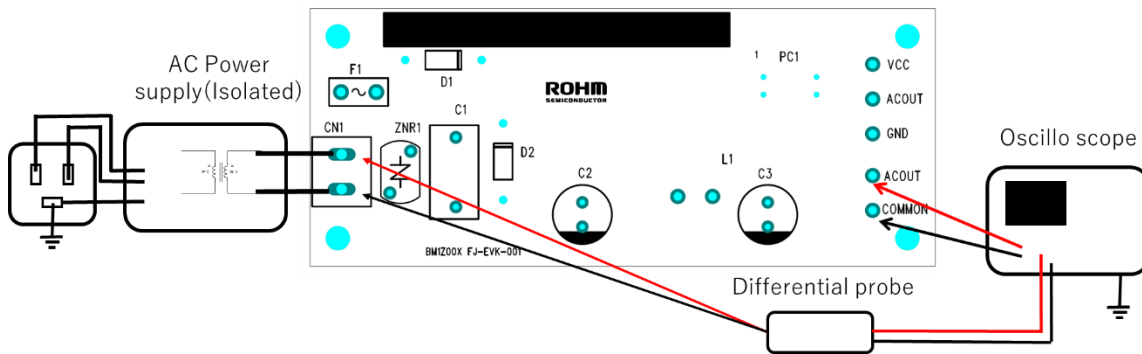


Figure 2. Diagram of How to Connect

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 reliability 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.

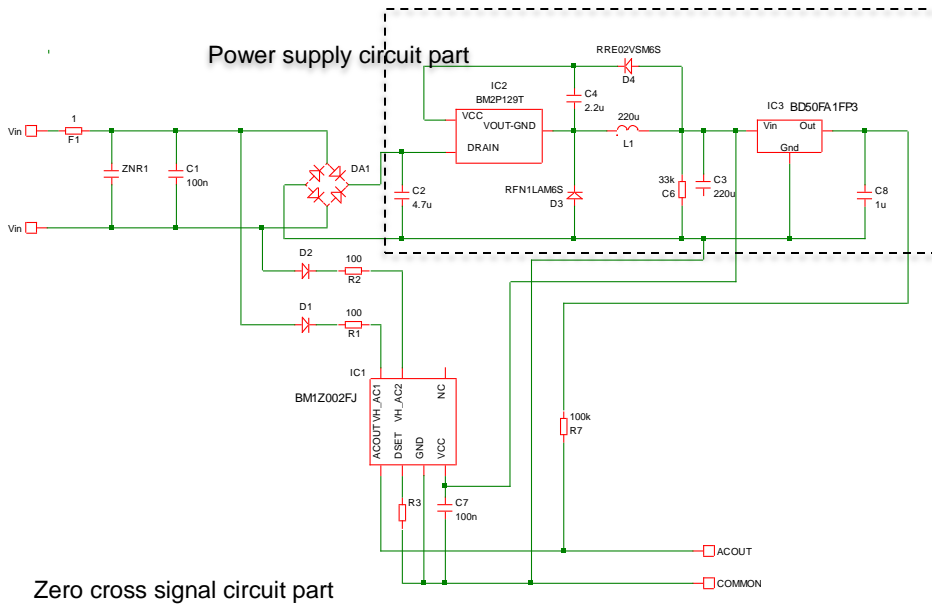


Figure 3. Application Circuit

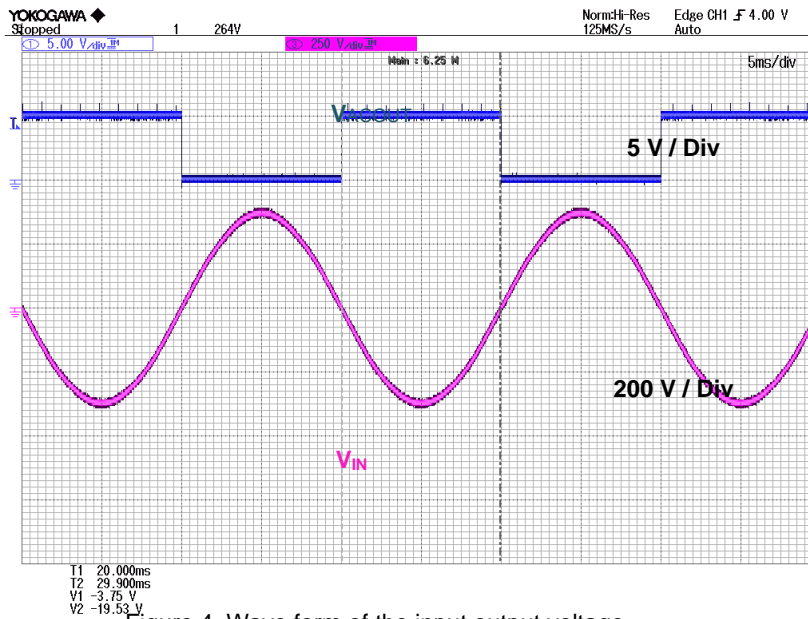


Figure 4. Wave form of the input output voltage

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 implementation as compared to conventional methods. The IC allows for a dramatic reduction in the number of parts and improves reliability, accuracy, and precision. In addition, this IC can reduce standby power consumption as compared to a conventional implementation.

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

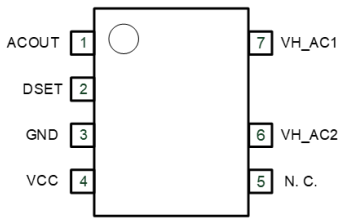


Figure 5. Pin Configuration

Package

SOP-J7S

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

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 k Ω	200 μs
68 k Ω	-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

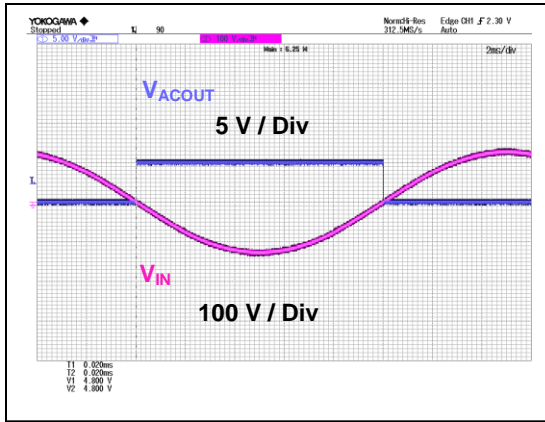


Figure 7. Input output waveform $V_{IN} = 90 \text{ Vac}$

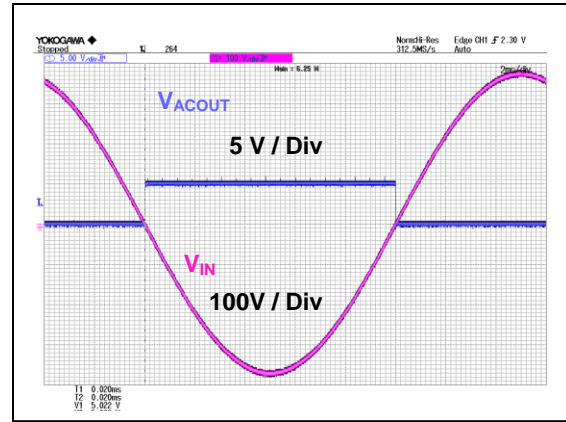


Figure 8. Input output waveform $V_{IN} = 264 \text{ Vac}$

R3 : 330 kΩ

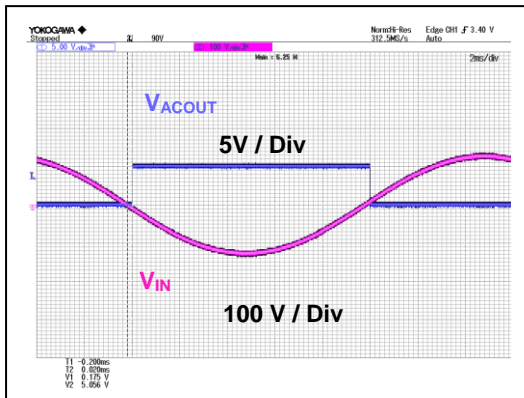


Figure 9. Input output waveform $V_{IN} = 90 \text{ Vac}$

R3 : 8 kΩ

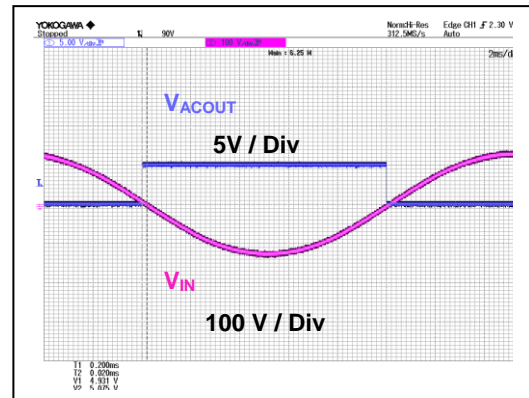


Figure 10. Input output waveform $V_{IN} = 90 \text{ Vac}$

R3 : 0 Ω

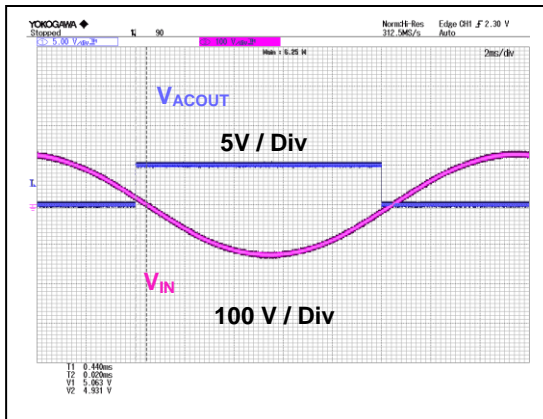


Figure 11. Input output waveform $V_{IN} = 90 \text{ Vac}$

Parts List

Item		Specifications	Parts name	Manufacture
Connector	CN1		B02P-NV	JST
Capacitor	C1	0.1 μ F / 275 V	890 324 023 023 CS	WURTH
	C2	4.7 μ F / 400 V	860 021 374 008	WURTH
	C3	220 μ F / 25 V	860 080 474 010	WURTH
	C4	2.2 μ F / 35 V	UMK212BB7225KG-T	Taiyo Yuden
	C5	0.1 μ F / 35 V	HMK107B104MA-T	Taiyo Yuden
	C6	33k	MCR03PZPJ333	Rohm
	C7	0.1 μ F / 35 V	HMK107B7104MA-T	Taiyo Yuden
	C8	1 μ F / 35 V	UMK212BJ7105KG-T	Taiyo Yuden
Diode-Bridge	DA1	800V/1A	D1UBA80-7062	Shindengen
Diode	D1	800V/0.1A	1N4007	
	D2	800V/0.1A	1N4007	
	D3	FRD 600V 0.8A	RFN1LAM6S	Rohm
	D4	600V 0.2A	RRE02VSM6S	Rohm
Fuse	F1	1A / 300V	36911000000	LITTELFUSE
IC	IC1		BM1Z102FJ	Rohm
	IC2		BM2P129TF	Rohm
	IC3		BD50FA1FP3-ZTL	Rohm
Coil	L1	220uH	7447471221	WURTH
Transistor	Q1	-	Non-Mounted	-
Resistor	R1	100 Ω	MCR18EZPJ101	Rohm
	R2	100 Ω	MCR18EZPJ101	Rohm
	R3	-	Non-Mounted	
	R4	-	Non-Mounted	
	R5	-	Non-Mounted	
	R6	-	Non-Mounted	
	R7	100k Ω	MCR03EZPJ104	Rohm
	R8	-	Non-Mounted	
Opto-coupler	PC1	-	Non-Mounted	
Varistor	ZNR1	-	Non-Mounted	
Pin	TP	Black	LC-2-G	
	TP	RED	LC-2-G	

(Note 1) Materials may be changed without notifying.

Layout

Size: 36 mm x 90 mm

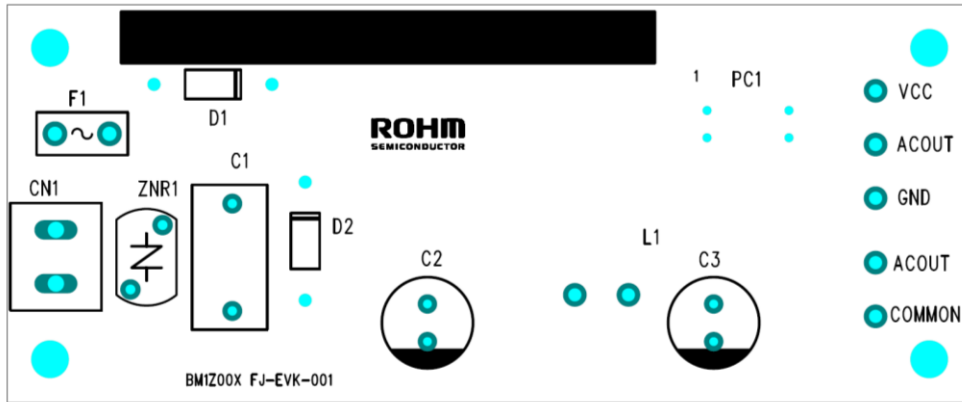


Figure 13. TOP Silkscreen (Top view)

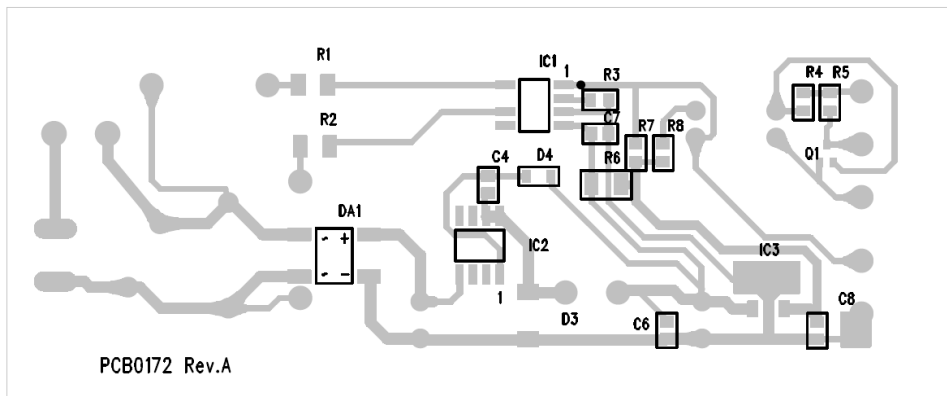


Figure 14. Bottom Layout (Top View)

Revision History

Date	Rev.	Changes
30.Mar.2020	001	New Release
13.July.2020	002	Figure 1, Figure 2, Figure 12, Figure 14

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.
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- 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.
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