Shock Sensor Evaluation Module

Operating Manual

Edition 02

2015/5/13

Part Number

PKGX-14-4010

1 Outline

This document describes the evaluation module for the Piezo Ceramic Shock Sensor (PKGS-25SXAP1-R) produced by Murata Manufacturing Co., Ltd. on its configuration, usage and other information.

1.1 Features

The evaluation module is shipped with the required peripherals on the board and you can start to evaluate the module easily to use Shock Sensor. The features of this evaluation board are:

-Able to evaluate easily the sensor by supplying power to the evaluation module.

-It is possible to detect acceleration in frequency band up to 1KHz.

-PKGS-25SXA P1-R Shock Sensor (1 axis of detection) has been installed.

-Due to the compactness (16.8mm x 10.8mm x 3.55mm), it is easy to install the module in your evaluation environment.

-The portions of sensor and circuits are shielded by countermeasure against external noise.

-With supplied connector, the connection between module and your equipment is easy.

-An output terminal, provided after the first stage amplifier, is used as an operability checkpoint.

-It is an analog output. As it is equipped with a comparator, the output of comparison result against threshold value is also possible.

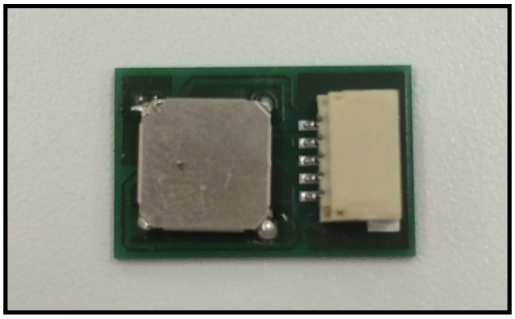

Fig. 1. Appearance of the Evaluation Module

1.2 Application Examples

Below show some application examples that use this evaluation module.

1.Anti-thief Vibration Detection 2.Abnormal Motor Vibration Detection 3.Input Devices

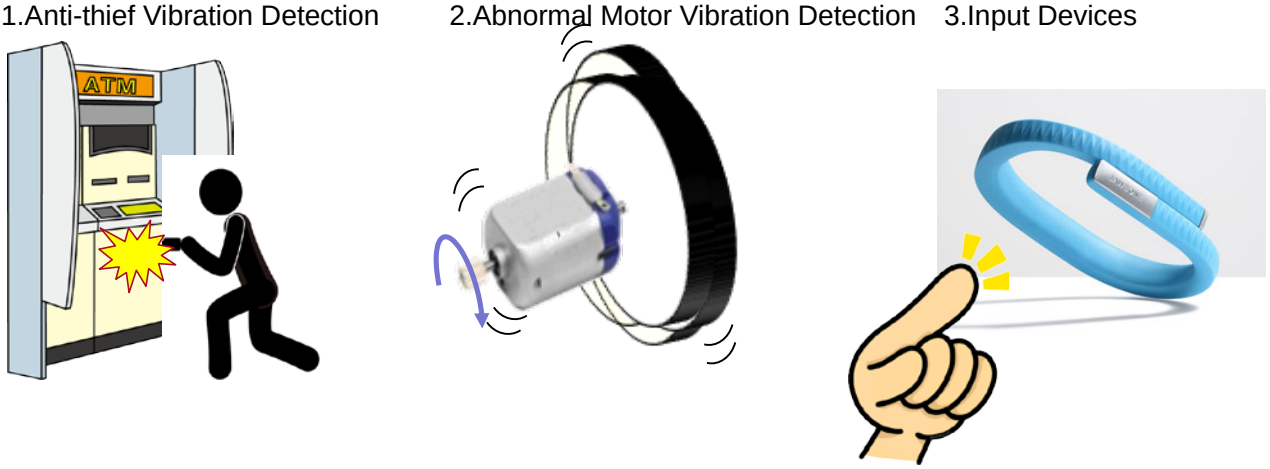

Fig. 2. Application Examples

1.3 Functional Block Diagram

Fig. 3 shows the functional block diagram of the evaluation module.

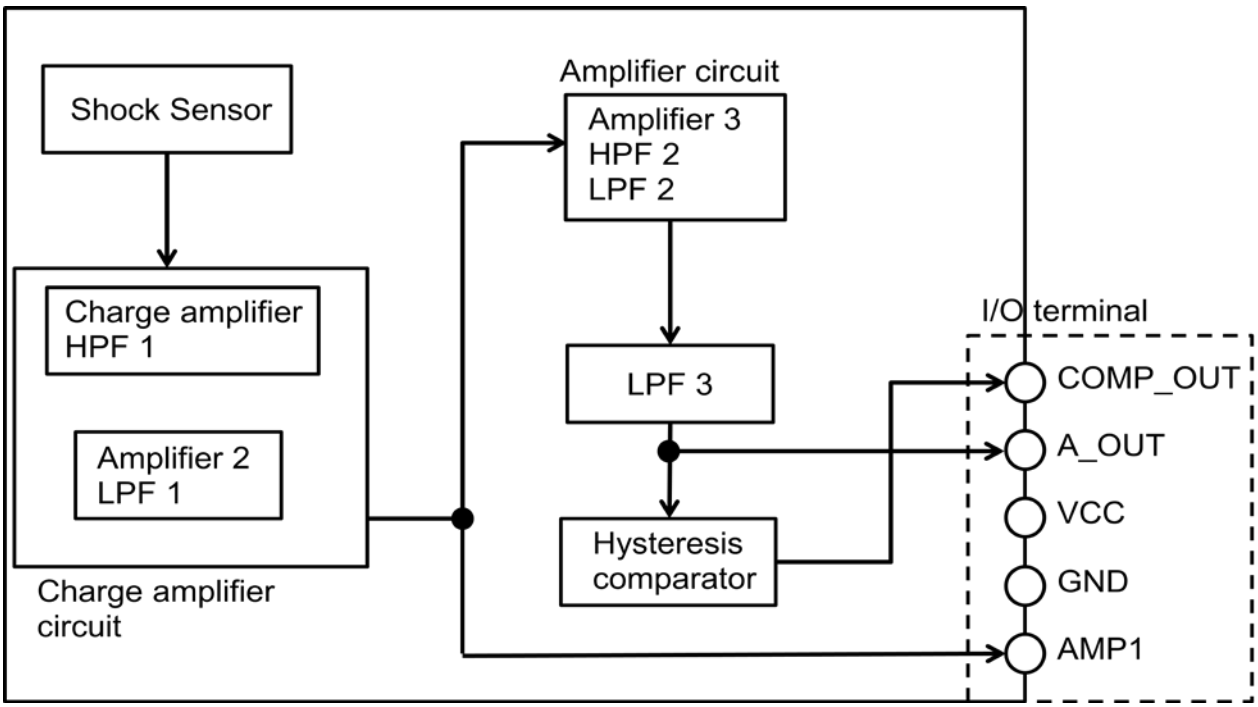

Fig. 3. Functional Block Diagram

Note 1: Refer to chapter 3.1 details about「I/O Terminal」

1.4 Functional Block Layout Diagram

Fig. 4. shows a functional block layout of the evaluation module.

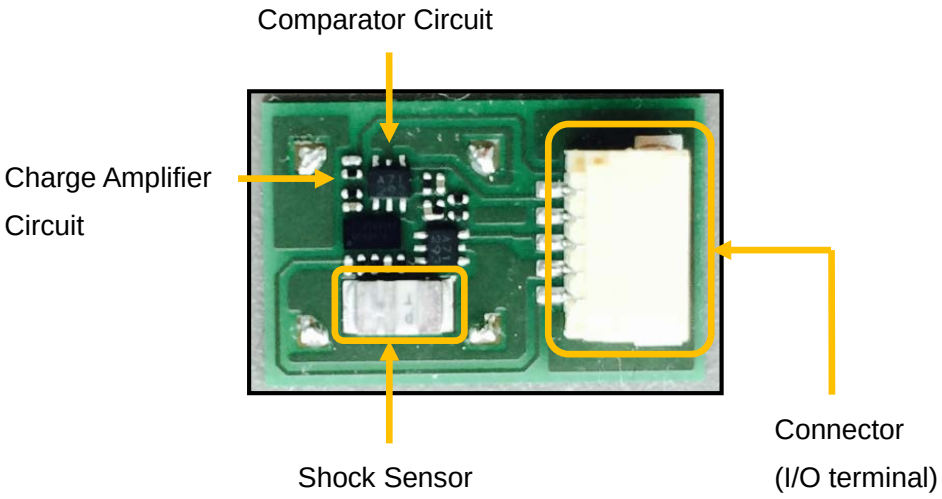

Fig. 4. Functional Block Layout Diagram

2 Evaluation Procedures

The following shows an example of the evaluation procedures for using this evaluation module.

① Attach this module to the target of measurement.

(Usually at our company, we use the Double-side tape shown below. Note 2.)

<Reference>

Fig 5. Double-side Tape of Nichiban Co., Ltd

Note 2: Please put the Double-side tape in whole surface of back side evaluation module and put uniformly-flat, in order that the acceleration which you want to get can transact to the evaluation module.

② Supply predefined voltage (e.g.3.3V) to the board through VCC and GND at I/O Terminal.

③ When observing the waveform of the analog signal output, connect oscilloscope to AOUT .

When checking comparator circuit signal output, connect to COUT..

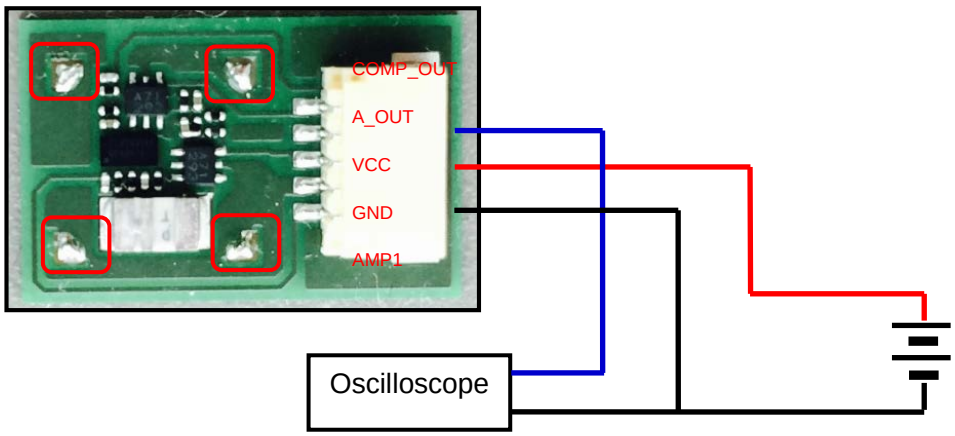

Fig. 6. Connection Diagram of Evaluation Module

④ If necessary, attach the included shield cover. (Solder to the red frame of Diagram 6)

3 Specifications & Board Information

The following show the electrical specifications and the board information of the evaluation module when shipped..

3.1 Input & Output Terminals

Fig. 7 shows detailed information of input-output terminals (I/O Terminal) on the evaluation module.

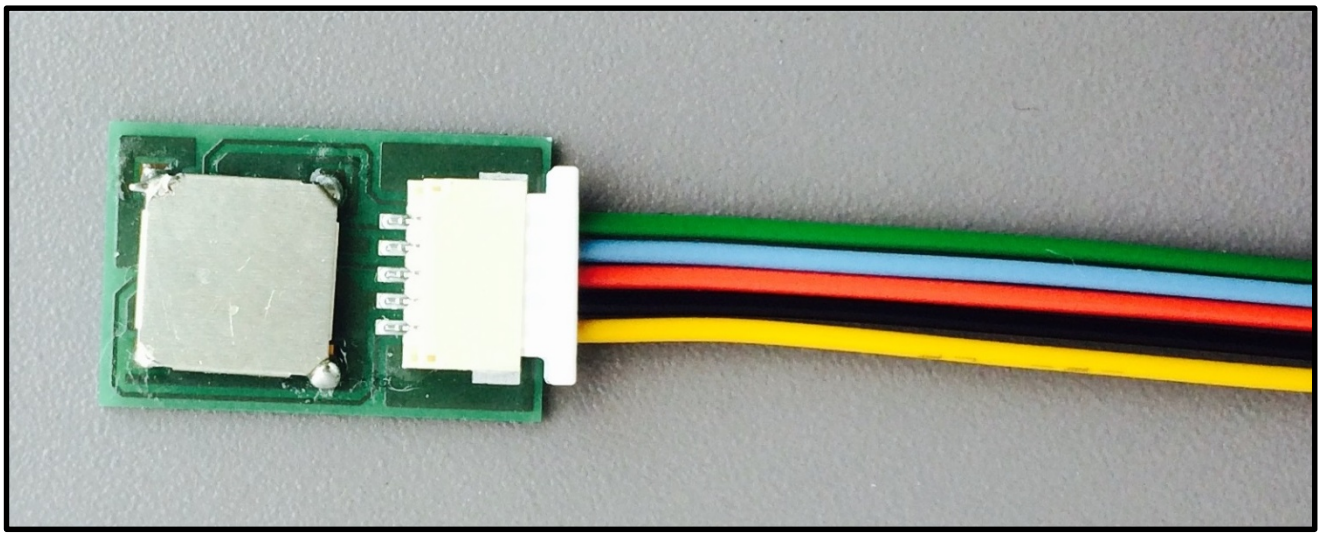

Fig. 7. Appearance of Input-Output Terminals

Table 1. I/O Terminal List

Symbol	Wire Color	Description
COMP_OUT	Green	Comparator Output Terminal of Sensor (after signal amplification). Output is HIGH when detected. Output is LOW when not detected.
A_OUT	Blue	Analog Output Terminal of Sensor (after signal amplification).
V_{CC}	Red	The Power Supplying Terminal of Evaluation Module.
GND	Black	The Ground Terminal of Evaluation Module.
AMP1	Yellow	Analog Output Terminal of Sensor (after first stage amplification).

3.2 Electrical Specifications & Mechanical Specifications

The following shows the electrical and mechanical specifications of this evaluation module.

Table 2. Electrical Specifications

※Unless otherwise specified, temperature of measurement is 25ºC and supply voltage is 3.3V

Parameters		Value			Unit
		Min.	Typ.	Max.	
Operating Temperature Range		-40	-	85	℃
V_{CC} Input Voltage Range		2.5	-	5.0	V
A_OUT Output Voltage Range		0.0	-	V_{CC}	V
COMP_OUT Output Voltage Range	When detected	-	-	V_{CC}	V
	When not detected	0.0	-	-	V
Reference Voltage		T.B.D	1.65	T.B.D	V
Gain	Charge AMP		13.9		dB
	AMP 2		9.6		dB
	AMP 3		35.0		dB
Cutoff frequency(-3dB)	HPF 1		106		Hz
	HPF 2		106		Hz
	LPF 1		2340		Hz
	LPF 2		2340		Hz
	LPF 3		1061		Hz
Comparator Threshold Value			2.24		V
Current Consumption (Note 3)			1.55		mA

Note 3: Current Consumption is depending on Current Consumption of OP-AMP and Current Consumption generated of Reference Voltage portion.

Table3. Mechanical Specifications

※Unless otherwise specified, temperature of measurement is 25ºC and supply voltage is 3.3V

Parameters	Value			Unit
	Min.	Typ.	Max.	
Circuit Sensitivity	T.B.D	0.35	T.B.D	V/G
Sensor Resonance Frequency	21	27		kHz
Number of Axis		1		
Inclination Angle of Sensor Shaft	24	25	26	°

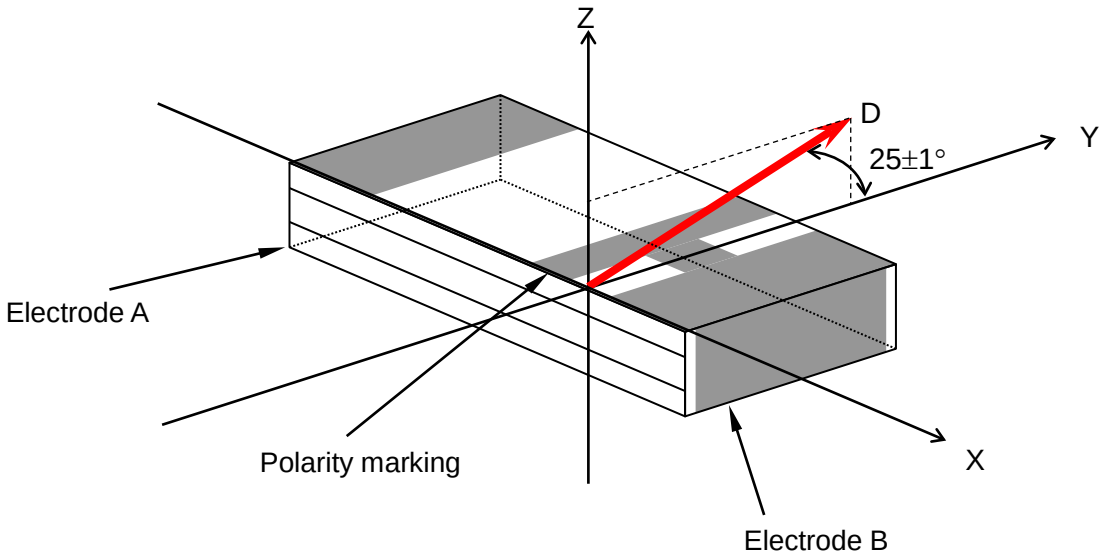

Fig 8. Inclination of Shock Sensor Shaft (PKGS-25SXAP1-R)

Axis D : This axis (Inclination) is an acceleration applied direction, when electric charge sensitivity is checked. It tolerance is within ±1º.

3.3 Circuit Diagram

Following shows the circuit diagram of evaluation module.

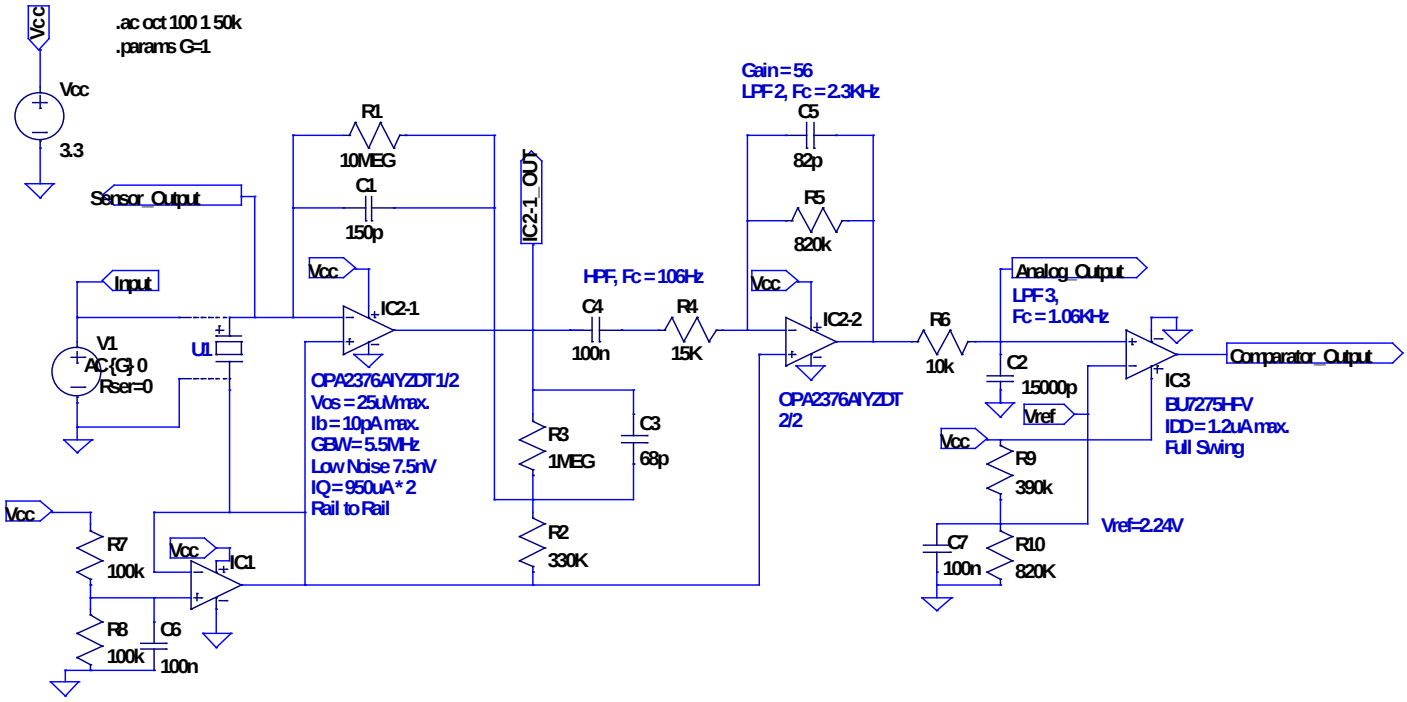

Fig 9. Circuit Diagram

(Formulas Descriptions)

Charge AMP	= $20\log_{10}$ (Cf/C1)	[dB]	(In case of PKGS-25SXA、Cf=740pF)
AMP2	= $20\log_{10}$ (R3/R2)	[dB]	
AMP3	= $20\log_{10}$ (R5/R4)	[dB]	
HPF1	= 1/(2×π×C1 ×R1)	[Hz]	
HPF2	= 1/(2×π×C4 ×R4)	[Hz]	
LPF1	= 1/(2×π×C3 ×R3)	[Hz]	
LPF2	= 1/(2×π×C5 ×R5)	[Hz]	
LPF3	= 1/(2×π×C2 ×R6)	[Hz]	

Below is the simulated frequency response curve of above circuitry (Fig.9).

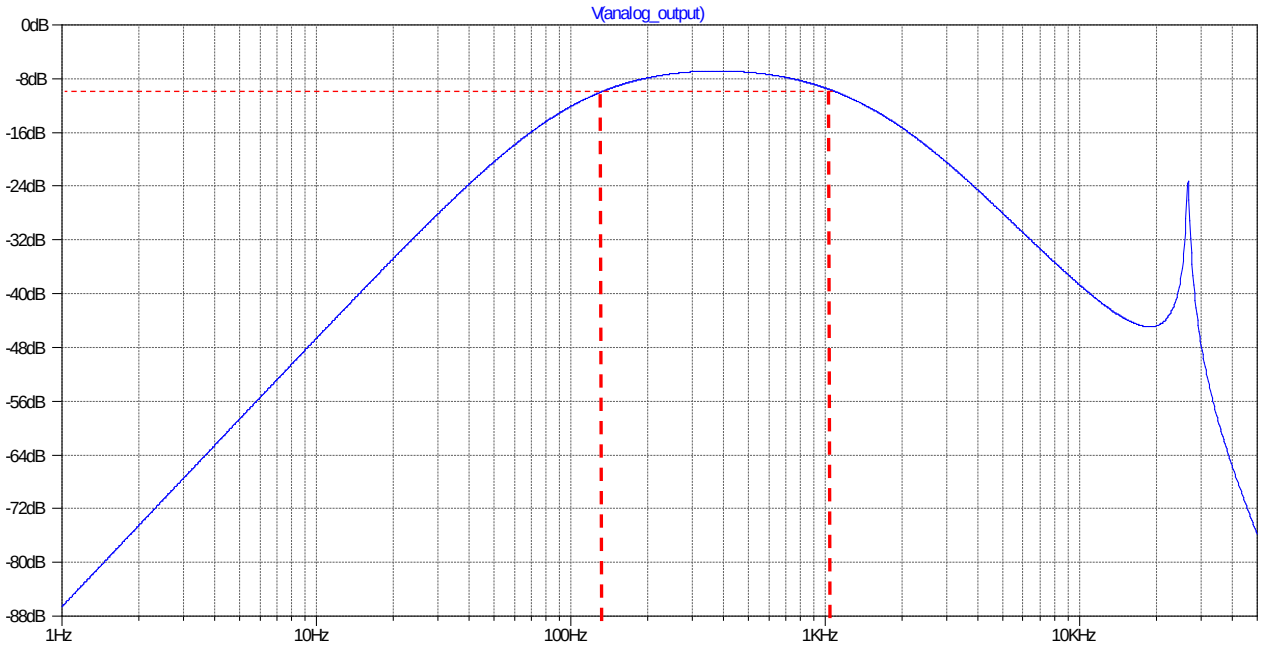

Fig 10. Frequency Response Curve of PKGX-14-4010

Note 4: This Frequency Response Curve serves as referencing purpose only. In this simulation, the frequency response ranges from 133 Hz to 1,080 KHz (-3dB points). Actual frequency response curve varies according to the actual characteristics of circuitry and components.

3.4 Bill of Material

The following show the bill of materials of the evaluation module when shipped.

Ref.	Mfg.	Part No.	Description
C1	Murata	GRM0332C1H151JA01	capacitor, 150pF
C2	Murata	GRM033C80J153KE01	capacitor, 15nF
C3	Murata	GRM0332C1H680JA01	capacitor, 68pF
C4	Murata	GRM033C80G104KE19	capacitor, 100nF
C5	Murata	GRM0332C1H820JA01	capacitor, 82pF
C6	Murata	GRM033C80G104KE19	capacitor, 100nF
C7	Murata	GRM033C80G104KE19	capacitor, 100nF
CN1	JST	SM05B-SRSS-TB(LF) (SN)	Connector
IC1	General	BU7205HFV-TR	Op-Amplifier
IC2	General	OPA2376AIYZDT	Op-Amplifier
IC3	General	BU7275HFV-TR	Op-Amplifier
R1	KOA	RK73B1HTTCM106J	resistor, 10M
R2	KOA	RK73B1HTTCM334J	resistor, 330K
R3	KOA	RK73B1HTTCM105J	resistor, 1M
R4	KOA	RK73B1HTTCM153J	resistor, 15K
R5	KOA	RK73B1HTTCM824J	resistor, 820K
R6	KOA	RK73B1HTTCM103J	resistor, 10K
R7	KOA	RK73B1HTTCM104J	resistor, 100K
R8	KOA	RK73B1HTTCM104J	resistor, 100K
R9	KOA	RK73B1HTTCM394J	resistor, 390K
R10	KOA	RK73B1HTTCM824J	resistor, 820K
U1	Murata	PKGS-25SXAP1-R	Shock Sensor

Table 4. Bill of Material

3.5 External Dimensions

The outline dimensions of the evaluation module are shown in the drawing below.

Table 5. External Dimensions

External Dimensions（Length × Width × Height）[mm]
16.8×10.8×4.0

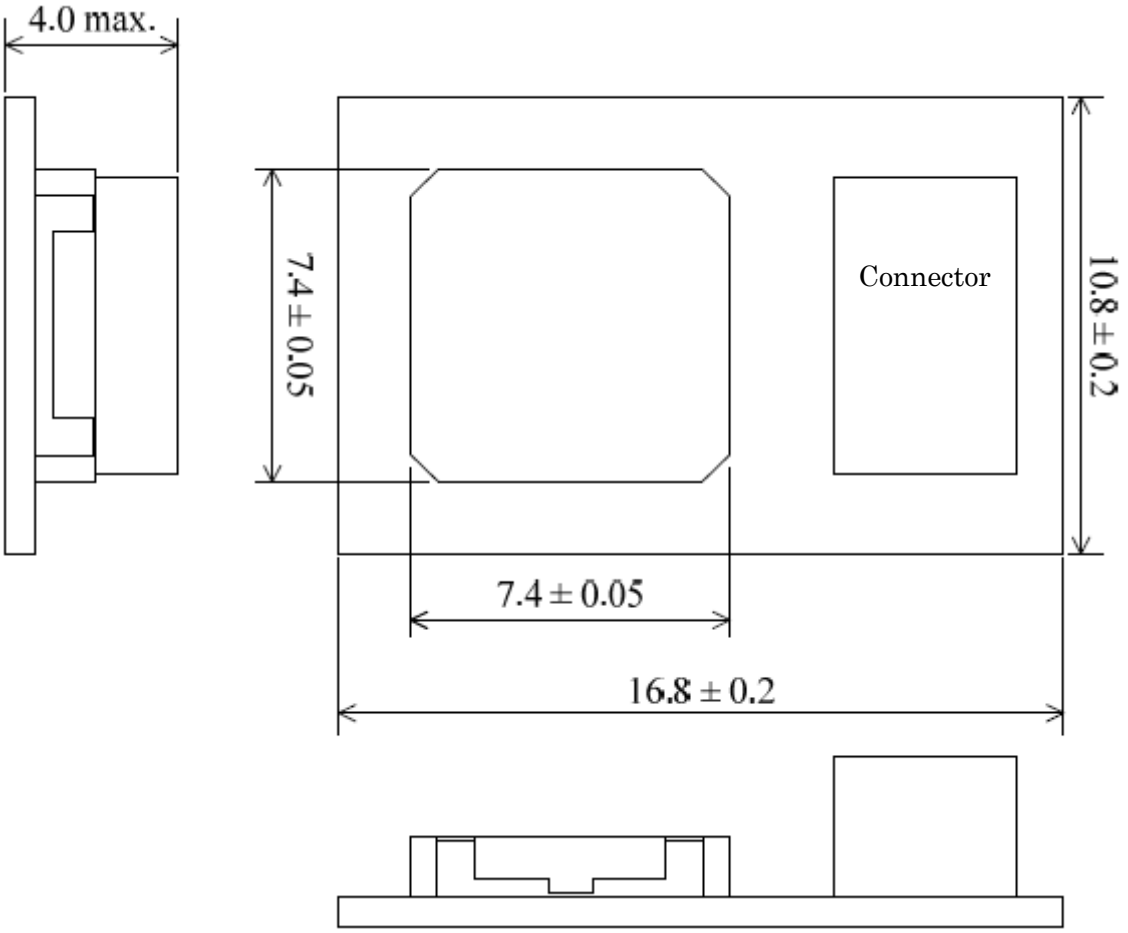

Fig11. External Dimension Drawing

Note 4. The height of Connector’s portion is 3.55mm.

3.6 Board Layout

The following shows the board layout of this evaluation module.

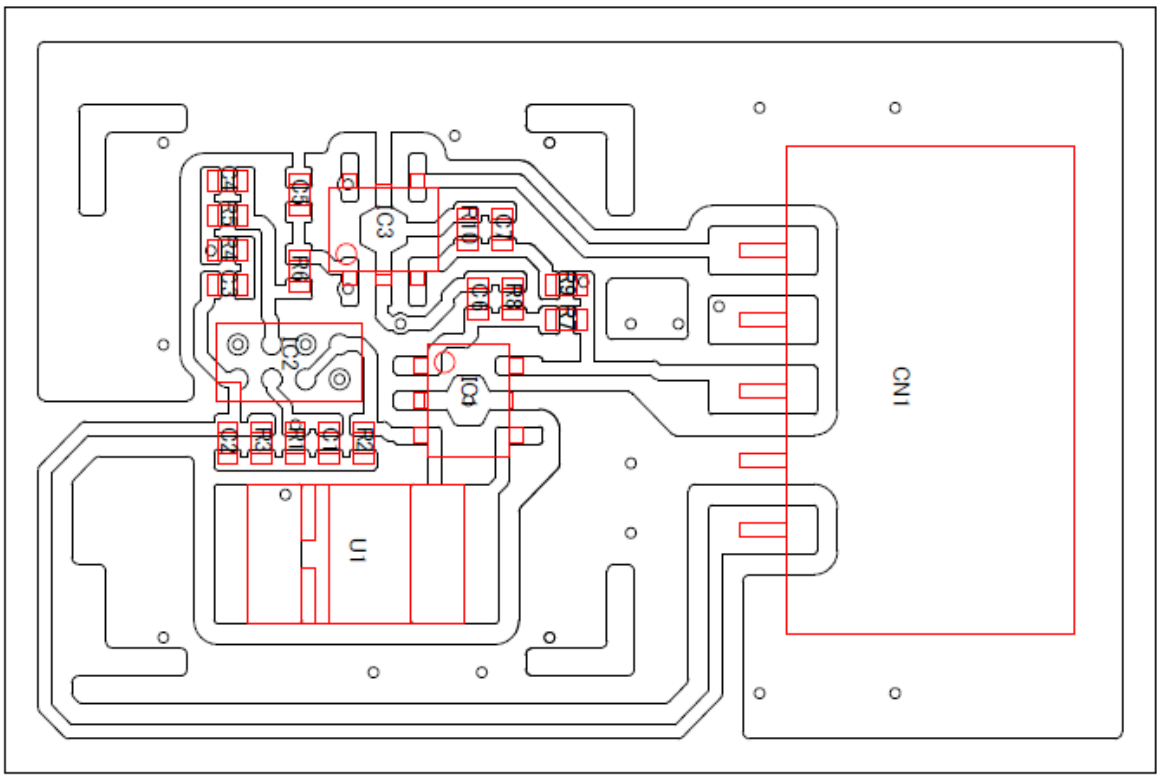

Fig 11. Board Layout (Top Copper Layer)

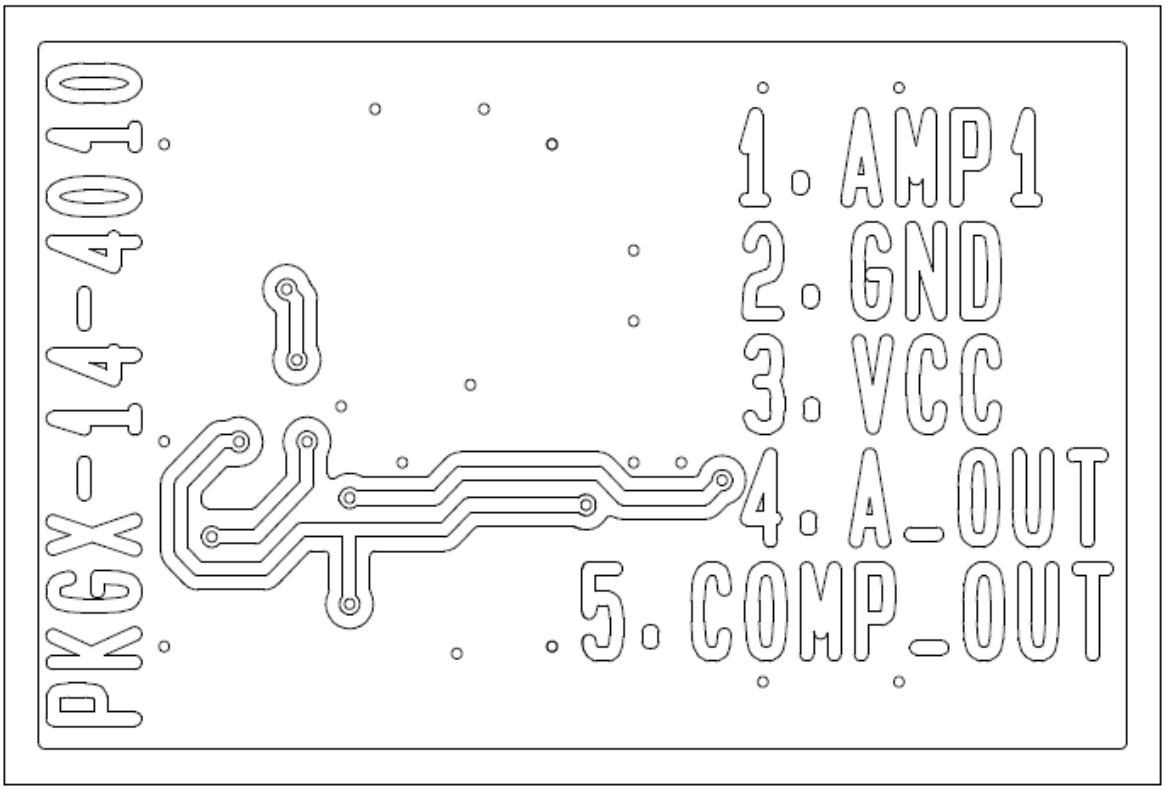

Fig 12. Board Layout (Bottom Copper Layer)

4.Precautions

4.1 Precautions when in use

-This evaluation module cannot detect gravitational acceleration and free fall.

-Please take off direct sunlight and moisture during storage of this evaluation module. There is a possibility of corrosion on the connector.

-Due to change of atmospheric pressure, the characteristics of this evaluation module may change. Please do not use in conditions where atmospheric pressure is vastly different from ground level (e.g. vacuum and water etc).

-Please do not store the evaluation module in environments which is exposed to dust, oil, corrosive gases, acid and alkaline.

-When exposed to sudden changing temperature, this evaluation module may extemporarily generate output even when there is no applying acceleration. The output is affected by different conditions of stress and individual differences of sensor. Please evaluate deeply influence of temperature change which you expect by your set.

-Depending on the environment of usage, is evaluation module may be susceptible to external electrical noise. In this case, please use the shield cover provided for noise reduction.

-Mounting of provided shield cover on this evaluation module will be performed by users as needed. Please be extreme caution not to cause short circuit during the installation of shielding.

-This evaluation module detects acceleration that is transmitted through your housing and your mounting board. Please use this module after considering characteristics of mechanical acceleration transmission in your set deeply.

-Depending on the mounting conditions of the evaluation module internal resonance of set and interferences from inherited frequencies of each component, there is a possibility that acceleration is not transmitted from this product as intended by user.

4.2 Other Precautions

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