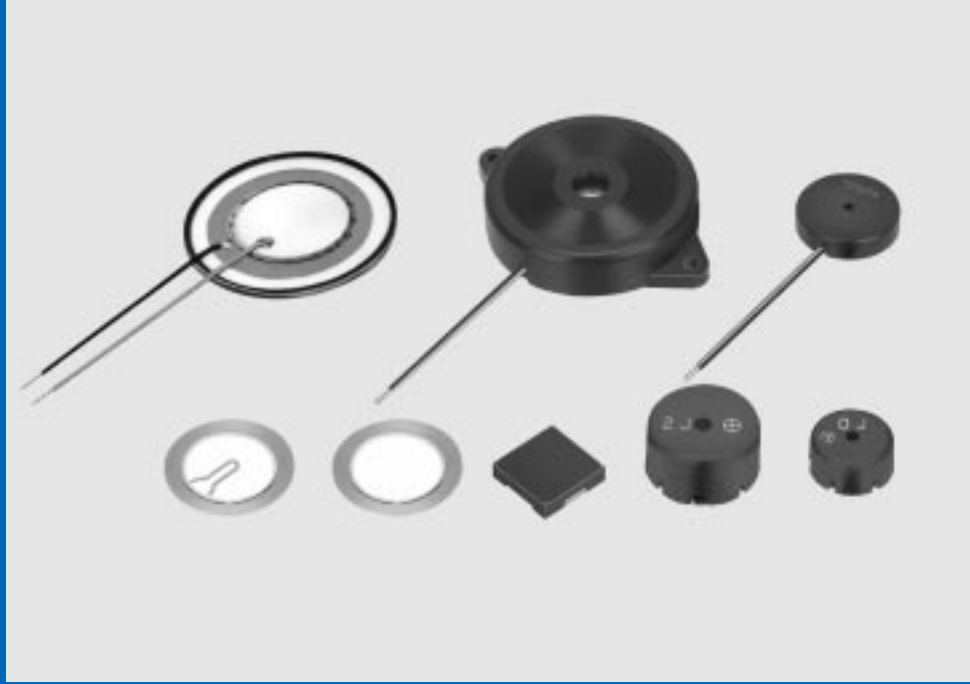


# Piezoelectric Sound Components

## PIEZOELECTRIC SOUND COMPONENTS



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● Part Numbering

Piezoelectric Sounders/Piezoelectric Buzzers/Piezoelectric Ringers (PIEZORINGER®)

(Part Number) 

PK	M	13	E	P	Y	-40	00	P	-A0
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① Product ID

Product ID	
<b>PK</b>	Piezoelectric Sound Components

② Product

Code	Product
<b>M</b>	Sounder, Ringer
<b>B</b>	Buzzer

③ Outer Dimensions

Expressed by two figures in mm.

Ex.)

Code	Outer Dimensions
<b>13</b>	ø12.6mm

④ Drive

Code	Drive
<b>E</b>	External-Drive
<b>S</b>	Self-Drive

⑤ Outer Electrode Style

Code	Outer Electrode Style
<b>P</b>	Pin Type
<b>W</b>	Lead Wire Type

⑥ Structure

Code	Structure
<b>T</b>	Standing Type
<b>P</b>	Flat Type Auto-assemble
<b>Y</b>	Flat Type/Available for Taping
<b>C</b>	Flat Type/Semi-auto-assemble

⑦ Oscillating Frequency Type

Code	Oscillating Frequency Type
<b>-40</b>	A hyphen (-) plus two-digit figures express Oscillating Frequency type.

If there is no decimal point, the decimal point is omitted.

⑧ Individual Specification Code

Code	Individual Specification Code
<b>00</b>	Two digits express specific specification in characteristics.

⑨ Special Quality Guarantee

Code	Special Quality Guarantee
<b>P</b>	Post Plated Terminal
-	Omitted

⑩ Packaging

Code	Packaging
<b>-B0</b>	Bulk
<b>-A0</b>	Radial Taping
<b>-M0</b>	Magazine

Radial taping or magazines are not available for all types. Please contact us.

### SMD Piezoelectric Sounder

(Part Number)

<b>PK</b>	<b>LCS</b>	<b>1212</b>	<b>E</b>	<b>40</b>	<b>01</b>	<b>-R1</b>
①	②	③	④	⑤	⑥	⑦

#### ① Product ID

Product ID	
<b>PK</b>	Piezoelectric Sound Components

#### ② Product

Code	Product
<b>LCS</b>	SMD Sounder

#### ③ Dimensions

Code	Outer Dimensions
<b>1212</b>	□12mm

#### ④ Drive

Code	Drive
<b>E</b>	External Drive

#### ⑤ Oscillating Frequency Type

Code	Oscillating Frequency Type
<b>40</b>	A hyphen (-) plus two-digit figures express Oscillating Frequency type.

#### ⑥ Individual Specification Code

Code	Individual Specification Code
<b>01</b>	Two digits express specific specification in characteristics.

#### ⑦ Packaging

Code	Packaging
<b>-R1</b>	Plastic taping

### SMD Piezoelectric Receiver

(Part Number)

<b>PK</b>	<b>LCD</b>	<b>1212</b>	<b>R</b>	<b>10</b>	<b>00</b>	<b>-R1</b>
①	②	③	④	⑤	⑥	⑦

#### ① Product ID

Product ID	
<b>PK</b>	Piezoelectric Sound Components

#### ② Product

Code	Product
<b>LCD</b>	SMD Receiver

#### ③ Dimensions

Code	Outer Dimensions
<b>1212</b>	□12mm

#### ④ Drive

Code	Drive
<b>R</b>	Receiver

#### ⑤ Oscillating Frequency Type

Code	Oscillating Frequency Type
<b>10</b>	A hyphen (-) plus two-digit figures express Oscillating Frequency type.

#### ⑥ Individual Specification Code

Code	Individual Specification Code
<b>00</b>	Two digits express specific specification in characteristics.

#### ⑦ Packaging

Code	Packaging
<b>-R1</b>	Plastic taping

### Piezoelectric Speakers (CERAMITONE®)

(Part Number)

VS	B	35	E	W	-07	01	B
①	②	③	④	⑤	⑥	⑦	⑧

#### ① Product ID

Product ID	
VS	Piezoelectric Speakers

#### ② Product

Code	Product
B	Piezoelectric Diaphragms

#### ③ Outer Dimensions

Code	Outer Dimensions
35	ø35mm
50	ø50mm

#### ④ Drive

Code	Drive
E	External Drive

#### ⑤ Outer Electrode Style

Code	Outer Electrode Style
W	Lead Wire Type

#### ⑥ Resonant Frequency Type

Code	Resonant Frequency
-03	1st Resonant Frequency : 300Hz
-07	1st Resonant Frequency : 700Hz

#### ⑦ Individual Specification Code

Code	Individual Specification Code
01	Characteristics, Style, others

#### ⑧ Numbers of Ceramic

Code	Numbers of Ceramic
B	Two Elements (The code is omitted when there is only one element.)

### Piezoelectric Diaphragms

(Part Number)

7	N	B	-31R2	DM	-1R5		A	10
①	②	③	④	⑤	⑥	⑦	⑧	⑨

#### ① Product ID

Product ID	
7	Ceramic Material

#### ② Product (1)

Code	Metal Plate Material
B	Brass
N	Nickel Alloy
M	Ni Plated Iron
S	SUS

#### ③ Product (2)

Code	Product
B	Piezoelectric Diaphragms

#### ④ Metal Plate Diameter

Code	Metal Plate Diameter
-31R2	A hyphen (-) plus four-digit alphanumerics express metal plate outer dimensions. A decimal point is expressed by the capital letter "R".

If there is no decimal point, the decimal point code is omitted.

#### ⑤ Form of Piezoelectric Style

Code	Form of Piezoelectric Style
DM	Two digits express shape of ceramics.

For an Ag electrode, this digit remains blank, the corresponding code is omitted.

#### ⑥ Resonant Frequency Type

Code	Resonant Frequency (kHz)
-1R5	A hyphen (-) and three-digit alphanumerics express resonant frequency. A decimal point is expressed by the capital letter "R".

If there is no decimal point, the decimal point is omitted.

#### ⑦ With Feedback Electrode

Code	With Feedback Electrode
C	With Feedback Electrode
-	without Feedback Electrode

#### ⑧ Product Specification

Code	Product Specification
A	With lead
-	No lead (omitted)

#### ⑨ Individual Specification Code

Code	Individual Specification Code
10	These digits express a lead length, lead number, and presence/absence of a connector.

If the product has no individual specification, the corresponding code is omitted.

## Application Matrix

		Application	Tele- phone	Watch	Clock	Medical Equip- ment	Gas Alarm	Digital Camera	Toy	Bar Code Scanner	Printer	Note- PC PDA	DVD- Player	Micro- wave Oven	Air Condi- tioner	Fan Heater	Instru- ment Cluster		
		Part Number																	
Piezoelectric Diaphragm	External Drive Type	7BB-12-9		●	●	●		●	●			●							
		7BB-15-6			●	●			●	●			●						
		7BB-20-3	●	●	●	●				●	●								
		7BB-20-6			●	●			●	●			●						
		7BB-20-6A0			●	●				●			●						
		7BB-27-4	●		●	●				●	●								
		7BB-27-4A0	●		●	●				●	●								
		7BB-35-3	●		●					●	●								
		7BB-35-3A0	●		●					●	●								
		7BB-41-2	●																
		7BB-41-2A0	●																
	7MB-20-5R5		●			●													
	7NB-31R2-1					●	●												
	Self Drive Type	7BB-20-6C	●						●	●									
		7BB-20-6CA0	●						●	●									
		7BB-27-4C	●					●		●	●								
		7BB-27-4CA0	●					●		●	●								
		7BB-35-3C	●					●			●								
		7BB-35-3CA0	●					●			●								
		7BB-41-2C	●																
		7BB-41-2CA0	●																
7SB-34R7-3C						●													
Piezoelectric Sounder	External Drive Type	PKM13EPY-4000-A0	●		●	●		●	●	●	●	●	●		●	●	●		
		PKM13EPY-4002-B0	●		●	●			●	●	●	●	●	●	●	●	●	●	
		PKM17EPP-2002-B0	●		●	●				●	●	●	●	●	●	●	●	●	
		PKM17EPP-4001-B0	●		●	●				●	●	●	●	●	●	●	●	●	
		PKM17EPT-4001-B0								●		●	●	●	●	●	●		
		PKM17EW-2001	●		●	●			●	●	●	●	●	●		●			
		PKM22EP-2001								●		●		●	●	●	●	●	
		PKM22EPP-2001-B0	●		●	●				●		●		●	●	●	●	●	
		PKM22EPP-4001-B0	●		●	●				●		●		●	●	●	●	●	
		PKM22EPP-4005-B0	●		●	●				●		●		●	●	●	●	●	
		PKM22EPP-4007-B0	●		●	●				●		●		●	●	●	●	●	
		PKM22EPT-2001-B0								●		●		●	●	●	●		
		PKM22EPT-4001-B0								●		●		●	●	●	●		
		PKM17EW-4000	●		●	●				●	●	●	●	●		●			
	PKLCS1212E4001-R1	●				●			●	●	●	●			●				
	PKLCS1212E40A1-R1																●		
	Self Drive Type	PKM24SP-3805	●					●		●					●	●	●		
PKM30SPT-2001-B0									●		●	●		●					
PKM30SPT-2501-B0									●		●	●		●					
Piezoelectric Buzzer	PKB24SPC-3601-B0	●			●				●		●	●	●		●	●			
	PKB24SW-3301	●		●					●		●	●		●	●	●			
	PKB30SPC-2001-B0	●					●		●		●	●		●	●	●			
	PKB30SPC-3001-B0	●					●		●		●	●		●	●	●			
Piezoelectric Ringer	PKM33EP-1201C	●																	
	PKM34EW-1101C	●																	
	PKM34EW-1201C	●																	
	PKM44EP-0901	●																	
	PKM44EW-1001C	●																	
Piezoelectric Receiver	PKLCD1212R1000-R1	●																	
Piezoelectric Speaker	VSB35EW-0701B	●							●										
	VSB50EW-0301B	●							●										

There are various applications besides those listed in the above table, including:

Fire Alarm, Burglar Alarm, Laundry Machine, Bath, Interphone, Chime, Pager, Back Buzzer, ME Instruments, Measuring Instruments, Vending Machine, Calculator, Automobile, Communication Radio, Hemadynamometer, Thermometer, Running Meter, Facsimile, Audio Timer, Automatic Controlling Devices.

# Piezoelectric Sound Components



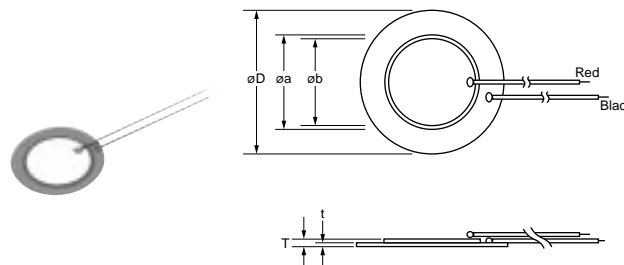
## Piezoelectric Diaphragms

### ■ Features

1. Low power consumption
2. No contacts therefore, no noise and highly reliable

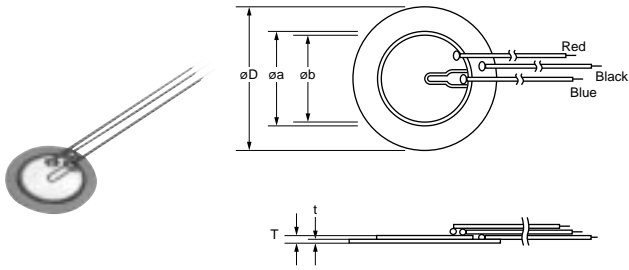
### ■ Applications

1. Telephone ringers
2. Various office equipment such as PPCs, printers and keyboards
3. Various home appliances such as microwave ovens
4. Confirmation sound of various audio equipment



### External Drive Type

Part Number	Resonant Frequency (kHz)	Resonant Impedance (ohm)	Capacitance (nF)	Plate Size dia. D (mm)	Element Size dia. a (mm)	Electrode Size dia. b (mm)	Thickness T (mm)	Plate Thickness t (mm)	Plate Material
7BB-12-9	9.0 ±1.0kHz	1000 max.	8 ±30% [1kHz]	12.0	9.0	8.0	0.22	0.10	Brass
7BB-15-6	6.0 ±1.0kHz	350 max.	10 ±30% [1kHz]	15.0	10.0	9.0	0.22	0.10	Brass
7BB-20-3	3.6 ±0.6kHz	500 max.	20 ±30% [1kHz]	20.0	14.0	12.8	0.22	0.10	Brass
7BB-20-6	6.3 ±0.6kHz	350 max.	10 ±30% [1kHz]	20.0	14.0	12.8	0.42	0.20	Brass
7BB-20-6A0	6.3 ±0.6kHz	1000 max.	10 ±30% [1kHz]	20.0	14.0	12.8	0.42	0.20	Brass (with Lead Wire :AWG32 Length 50mm)
7BB-27-4	4.6 ±0.5kHz	200 max.	20 ±30% [1kHz]	27.0	19.7	18.2	0.54	0.30	Brass
7BB-27-4A0	4.6 ±0.5kHz	300 max.	20 ±30% [1kHz]	27.0	19.7	18.2	0.54	0.30	Brass (with Lead Wire :AWG32 Length 50mm)
7BB-35-3	2.8 ±0.5kHz	200 max.	30 ±30% [1kHz]	35.0	25.0	23.0	0.53	0.30	Brass
7BB-35-3A0	2.8 ±0.5kHz	200 max.	30 ±30% [1kHz]	35.0	25.0	23.0	0.53	0.30	Brass (with Lead Wire :AWG32 Length 50mm)
7BB-41-2	2.2 ±0.3kHz	250 max.	30 ±30% [1kHz]	41.0	25.0	23.0	0.63	0.40	Brass
7BB-41-2A0	2.2 ±0.3kHz	300 max.	30 ±30% [1kHz]	41.0	25.0	23.0	0.63	0.40	Brass (with Lead Wire :AWG32 Length 50mm)
7MB-20-5R5	5.5 ±1.5kHz	1000 max.	6 ±35% [1kHz]	20.0	10.0	9.0	0.37	0.20	Nickel Plated Iron
7NB-31R2-1	1.3 ±0.5kHz	300 max.	40 ±30% [120Hz]	31.2	19.7	18.2	0.22	0.10	Iron Nickel Alloy



**Self Drive Type**

Part Number	Resonant Frequency (kHz)	Resonant Impedance (ohm)	Capacitance (nF)	Plate Size dia. D (mm)	Element Size dia. a (mm)	Electrode Size dia. b (mm)	Thickness T (mm)	Plate Thickness t (mm)	Plate Material
<b>7BB-20-6C</b>	6.3 ±0.6kHz	500 max.	8.5 ±30% [1kHz]	20.0	14.0	12.8	0.42	0.20	Brass
<b>7BB-20-6CA0</b>	6.3 ±0.6kHz	800 max.	8.5 ±30% [1kHz]	20.0	14.0	12.8	0.42	0.20	Brass (with Lead Wire :AWG32 Length 50mm)
<b>7BB-27-4C</b>	4.6 ±0.5kHz	200 max.	18 ±30% [1kHz]	27.0	19.7	18.2	0.54	0.30	Brass
<b>7BB-27-4CA0</b>	4.6 ±0.5kHz	350 max.	18 ±30% [1kHz]	27.0	19.7	18.2	0.54	0.30	Brass (with Lead Wire :AWG32 Length 50mm)
<b>7BB-35-3C</b>	2.8 ±0.5kHz	200 max.	26 ±30% [1kHz]	35.0	25.0	23.0	0.53	0.30	Brass
<b>7BB-35-3CA0</b>	2.8 ±0.5kHz	200 max.	26 ±30% [1kHz]	35.0	25.0	23.0	0.53	0.30	Brass (with Lead Wire :AWG32 Length 50mm)
<b>7BB-41-2C</b>	2.2 ±0.3kHz	250 max.	24 ±30% [1kHz]	41.0	25.0	23.0	0.63	0.40	Brass
<b>7BB-41-2CA0</b>	2.2 ±0.3kHz	350 max.	24 ±30% [1kHz]	41.0	25.0	23.0	0.63	0.40	Brass (with Lead Wire :AWG32 Length 50mm)
<b>7SB-34R7-3C</b>	3.1 ±0.3kHz	150 max.	24 ±30% [1kHz]	34.7	25.0	23.4	0.50	0.25	Stainless

■ Node Diameter

Part Number	Node Diameter (mm)
<b>7BB-20-6C</b>	φ13.5
<b>7BB-27-4C</b>	φ17.5
<b>7BB-35-3C</b>	φ22.5
<b>7BB-41-2C</b>	φ26.5

• Sound diaphragms without feedback electrode also have the same node diameters.

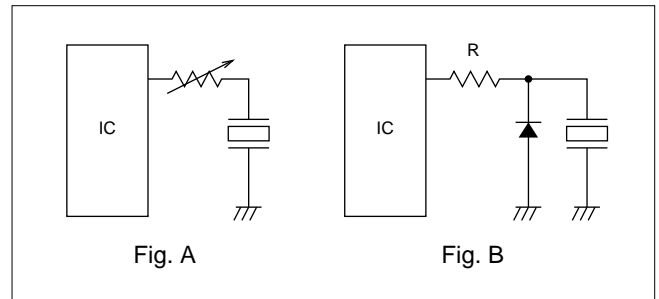
## Piezoelectric Diaphragms Notice

### ■ Notice (Soldering and Mounting)

1. Applying load on the center area of the diaphragm may cause cracking in the ceramic element. When the diaphragm is supported by the edge, the load should be only applied around the edge.
2. Please consult with Murata or Murata representative, if soldering of the component is needed.

### ■ Notice (Handling)

1. Please do not touch the component with bare hand because electrode may be corroded.
2. The component may be damaged if mechanical stress exceeding specifications is applied.
3. Take care to protect operating circuit from surge voltage resulting from excessive force, falling, shock or temperature change.
4. If DC voltage is applied to the component, silver migration may occur. Please pay full attention to avoid subjecting the component to DC voltage for long periods.
5. The resistor should be used as shown in Fig. A. A suitable resistance value should be chosen, preferably  $1k\Omega$  to  $2k\Omega$ . Instead of this measure, a diode may also be applied as shown in Fig. B.



6. Avoid excessive pulling of lead wire because wire may break or soldering point may come off.

# Piezoelectric Sound Components



## Piezoelectric Sounders External Drive Pin Type

Now microcomputers are widely used for microwave ovens, air conditioners, cars, toys, timers, and other alarm equipment. Externally driven piezoelectric sounders are used in digital watches, electronic calculators, telephones and other equipment. They are driven by a signal (ex: 2048Hz or 4096Hz) from an LSI and provide melodious sound.

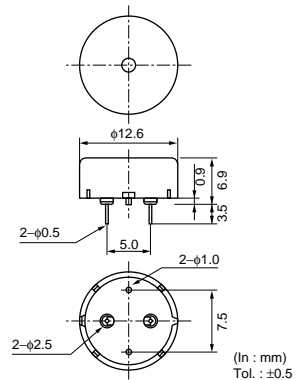
### ■ Features

1. Low power consumption
2. No contacts therefore, no noise and highly reliable

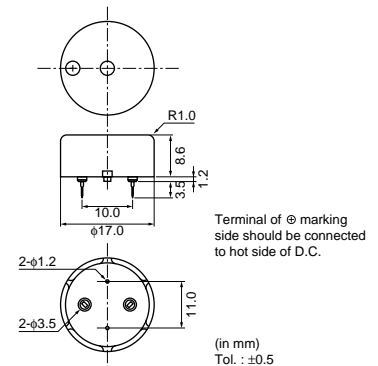
### ■ Applications

1. Telephone ringers
2. Various office equipment such as PPCs, printers and keyboards
3. Various home appliances such as microwave ovens
4. Confirmation sound of various audio equipment

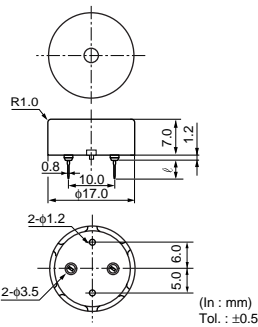
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PKM17EPP-2002-B0

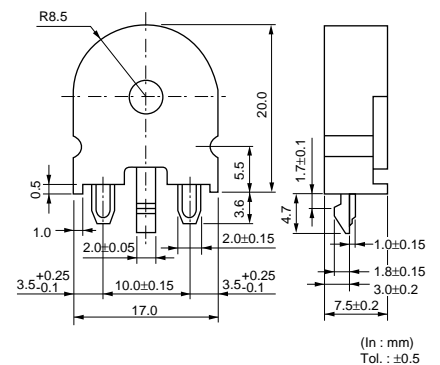


PKM17EPP-4001-B0

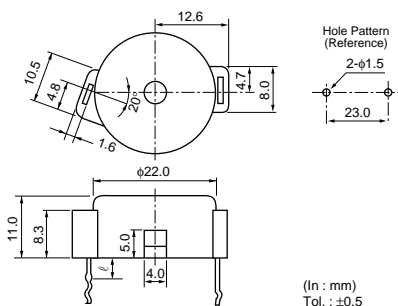


Part Number	ℓ
PKM17EPP-4001-B0	6.5
PKM17EPP-4002-B0	3.5

PKM17EPT-4001-B0

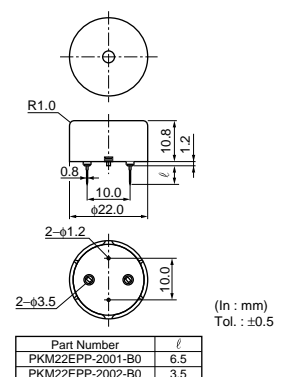


PKM22EP-2001



Part Number	ℓ
PKM22EP-2001	4.0
PKM22EP-2002	8.0
PKM22EP-2003	12.0

PKM22EPP-2001-B0



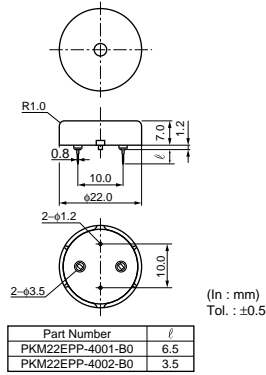
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PKM22EPP-2002-B0	3.5

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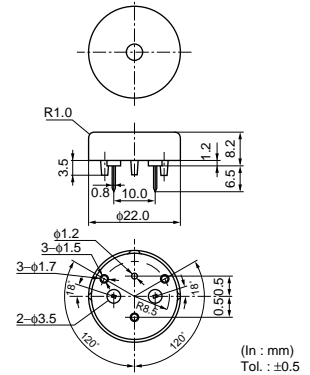
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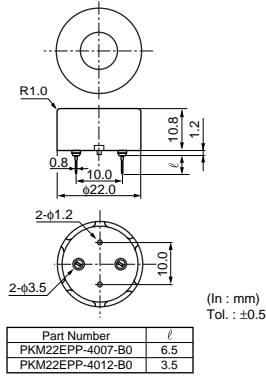
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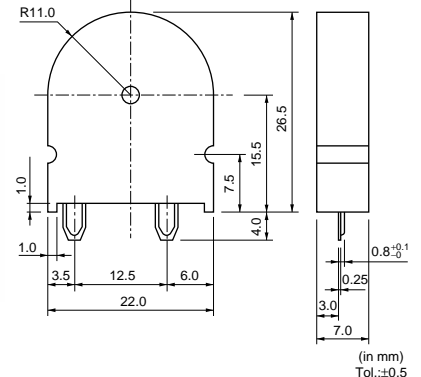
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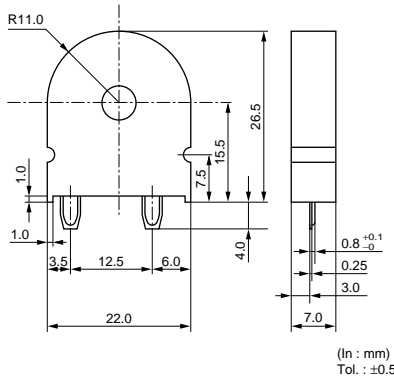
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PKM22EPT-2001-B0



PKM22EPT-4001-B0



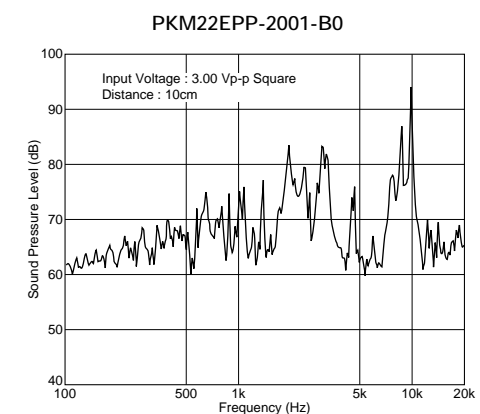
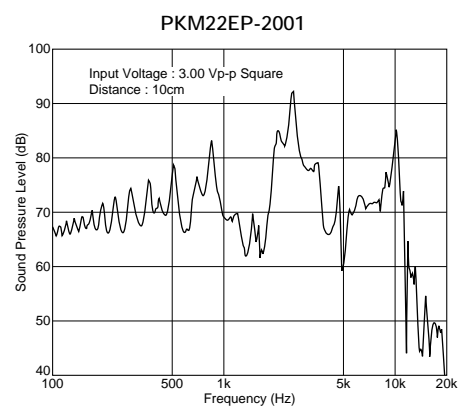
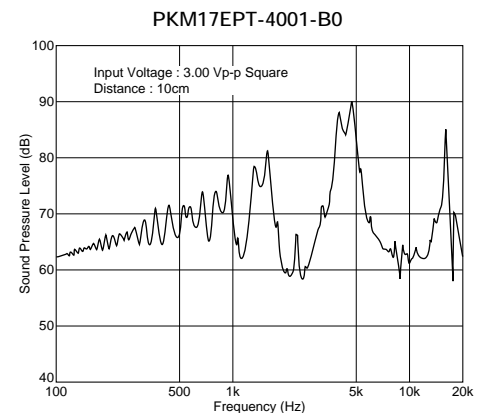
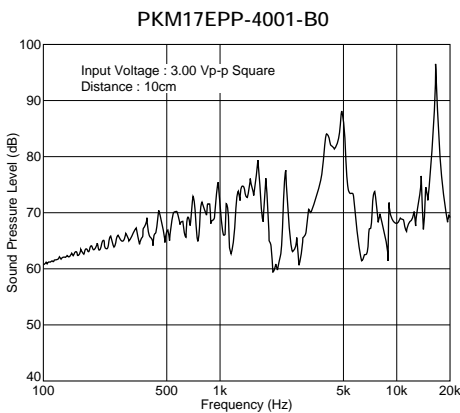
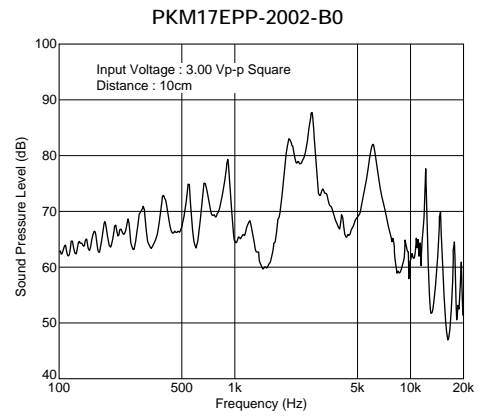
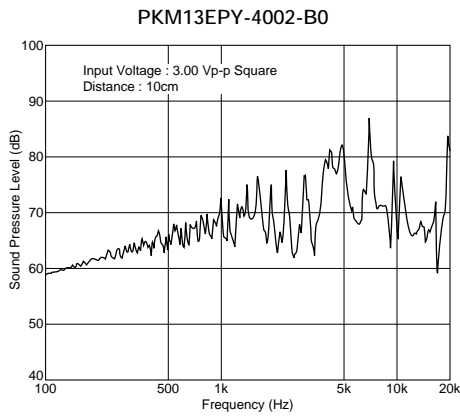
Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Min. of Operating Voltage Range	Capacitance (nF)	Operating Temp. Range	Storage Temp. Range
<b>PKM13EPY-4002-B0</b>	70 min. [3Vp-p, 4kHz, square wave, 10cm]	70 min. [1Vrms, 4kHz, sine wave, 10cm]	30 Vp-p max.	5.5 $\pm 30\%$ [1kHz]	-20 to +70°C	-30 to +80°C
<b>PKM17EPP-2002-B0</b>	70 min. [3Vo-p, 2kHz, square wave, 10cm]	70 min. [1Vrms, 2kHz, sine wave, 10cm]	25 Vo-p max. [with polarity]	34 $\pm 30\%$ [120Hz]	-20 to +70°C	-30 to +80°C
<b>PKM17EPP-4001-B0</b>	72 min. [3Vp-p, 4kHz, square wave, 10cm]	72 min. [1Vrms, 4kHz, sine wave, 10cm]	25 Vp-p max.	7 $\pm 30\%$ [1kHz]	-20 to +70°C	-30 to +80°C
<b>PKM17EPT-4001-B0</b>	75 min. [3Vp-p, 4kHz, square wave, 10cm]	75 min. [1Vrms, 4kHz, sine wave, 10cm]	25 Vp-p max.	9.5 $\pm 30\%$ [1kHz]	-20 to +70°C	-30 to +80°C
<b>PKM22EP-2001</b>	75 min. [3Vp-p, 2kHz, square wave, 10cm]	75 min. [1Vrms, 2kHz, sine wave, 10cm]	25 Vp-p max.	17 $\pm 30\%$ [120Hz]	-20 to +70°C	-30 to +80°C
<b>PKM22EPP-2001-B0</b>	70 min. [3Vp-p, 2kHz, square wave, 10cm]	70 min. [1Vrms, 2kHz, sine wave, 10cm]	25 Vp-p max.	19 $\pm 30\%$ [120Hz]	-20 to +70°C	-30 to +80°C
<b>PKM22EPP-4001-B0</b>	75 min. [3Vp-p, 4kHz, square wave, 10cm]	75 min. [1Vrms, 4kHz, sine wave, 10cm]	25 Vp-p max.	12 $\pm 30\%$ [1kHz]	-20 to +70°C	-30 to +80°C
<b>PKM22EPP-4005-B0</b>	75 min. [3Vp-p, 4kHz, square wave, 10cm]	75 min. [1Vrms, 4kHz, sine wave, 10cm]	25 Vp-p max.	12 $\pm 30\%$ [1kHz]	-20 to +70°C	-30 to +80°C
<b>PKM22EPP-4007-B0</b>	85 min. [3Vp-p, 4kHz, square wave, 10cm]	85 min. [1Vrms, 4kHz, sine wave, 10cm]	25 Vp-p max.	12 $\pm 30\%$ [1kHz]	-20 to +70°C	-30 to +80°C

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Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Min. of Operating Voltage Range	Capacitance (nF)	Operating Temp. Range	Storage Temp. Range
<b>PKM22EPT-2001-B0</b>	70 min. [3Vp-p,2kHz,square wave,10cm]	70 min. [1Vrms,2kHz,sine wave,10cm]	25 Vp-p max.	19 ±30% [120Hz]	-20 to +70°C	-30 to +80°C
<b>PKM22EPT-4001-B0</b>	85 min. [3Vp-p,4kHz,square wave,10cm]	85 min. [1Vrms,4kHz,sine wave,10cm]	25 Vp-p max.	10 ±30% [1kHz]	-20 to +70°C	-30 to +80°C

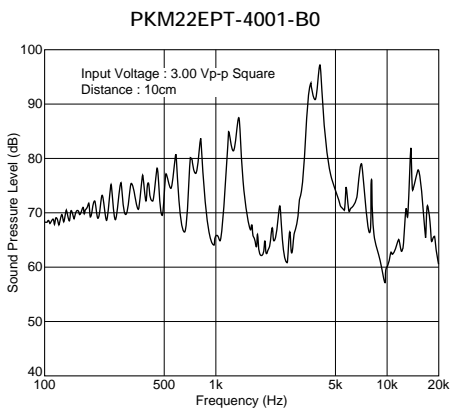
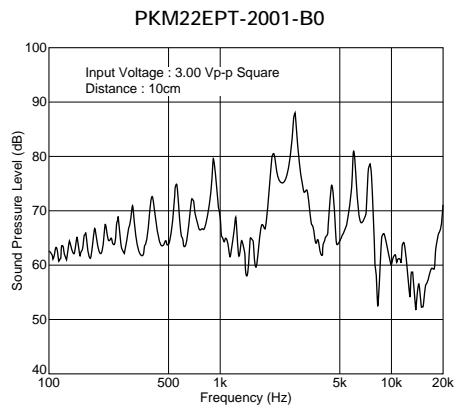
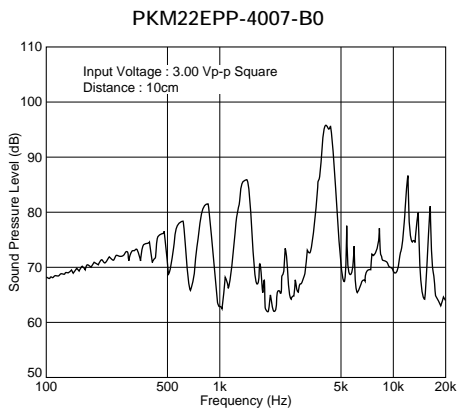
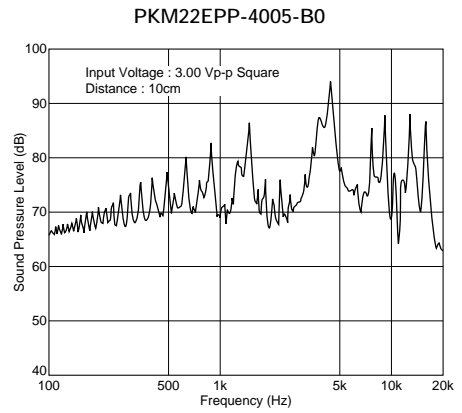
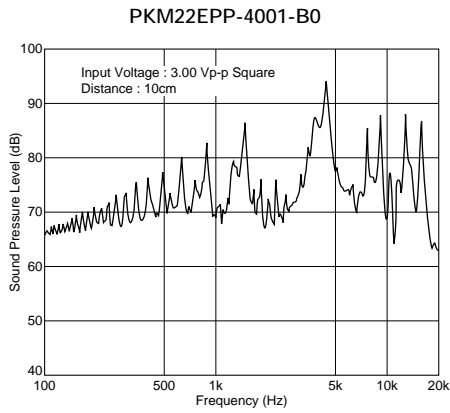
■ Freq. Response (Square Wave 3Vp-p, 10cm)



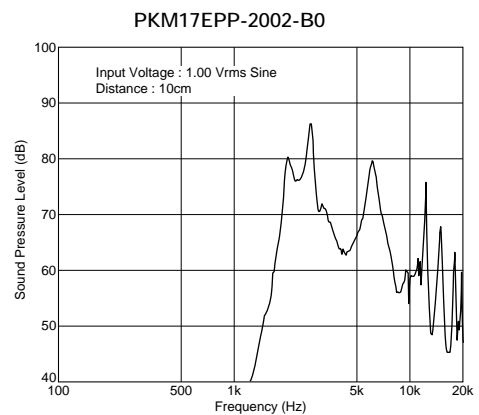
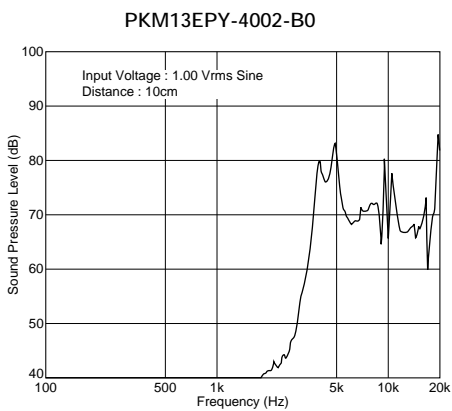
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**■ Freq. Response (Square Wave 3Vp-p, 10cm)**



**■ Freq. Response (Sine Wave 1Vrms, 10cm)**

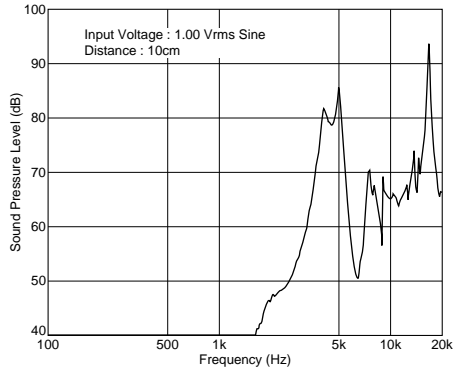


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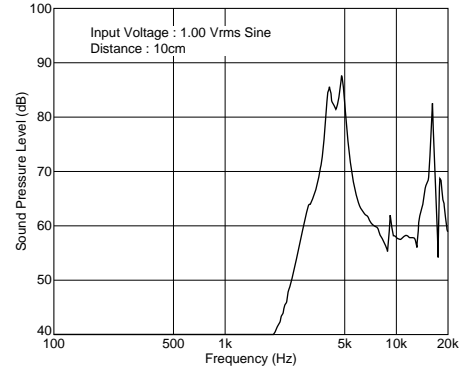
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**Freq. Response (Sine Wave 1Vrms, 10cm)**

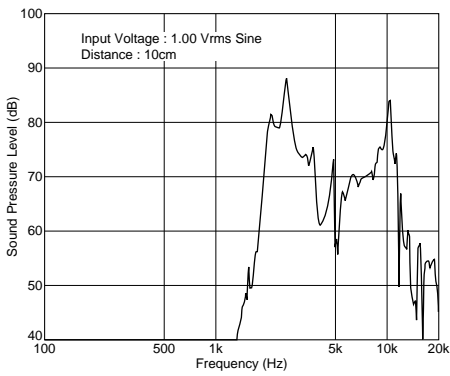
PKM17EPP-4001-B0



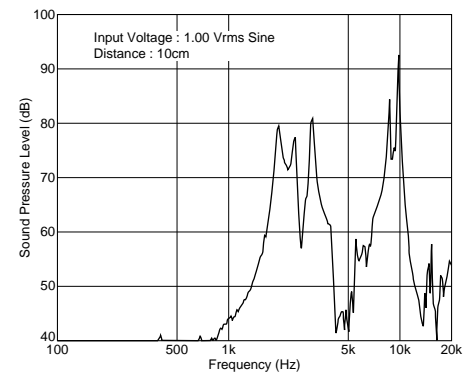
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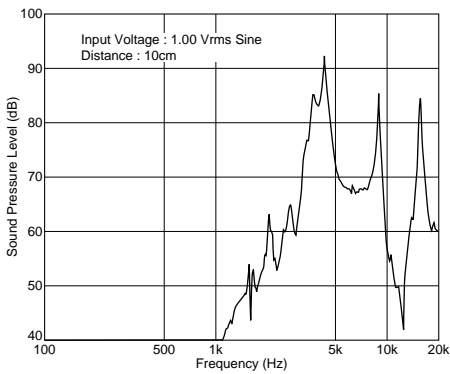
PKM22EP-2001



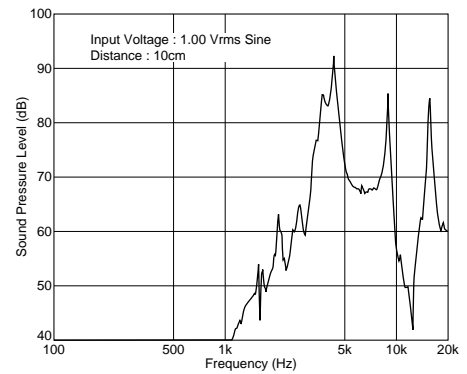
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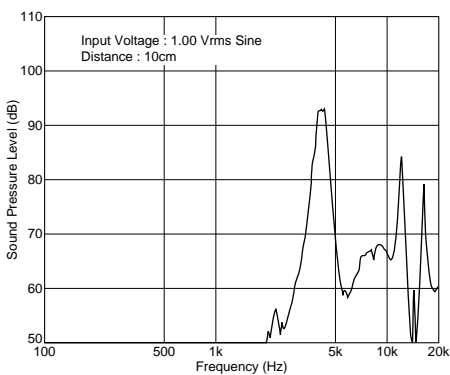
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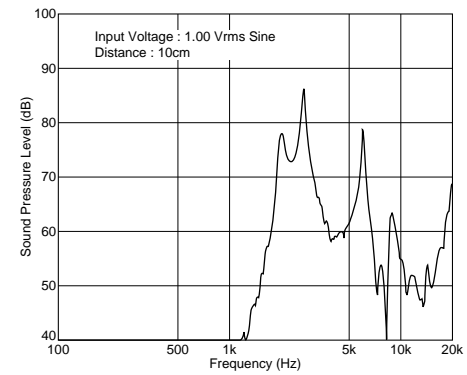
PKM22EPP-4005-B0



PKM22EPP-4007-B0



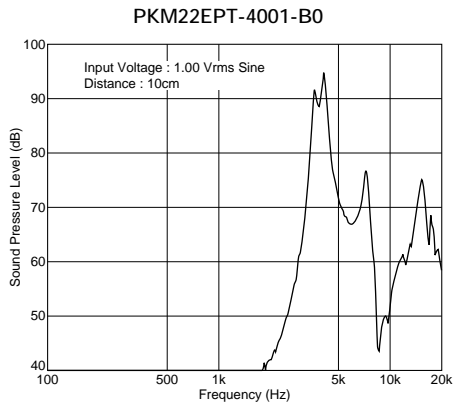
PKM22EPT-2001-B0



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### ■ Freq. Response (Sine Wave 1Vrms, 10cm)



2

# Piezoelectric Sound Components



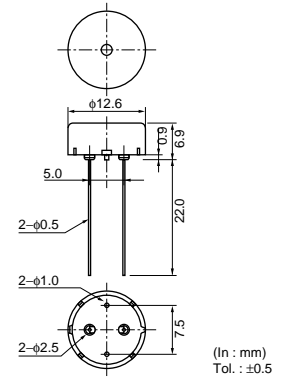
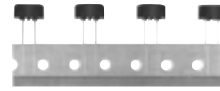
## Piezoelectric Sounders External Drive Pin Type Taping

Taking advantage of extensive automatic insertion design technology and materials experience, Murata has developed standard taping type piezoelectric sounder.

This Murata technology supports labor and cost saving activities.

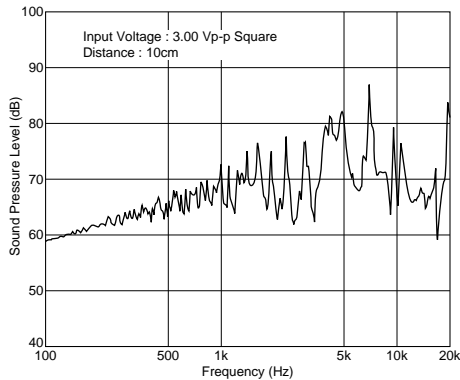
### ■ Features

1. High and stable mountability
2. Ammo packaging
3. Minimum quantity (order in sets only): 500 pcs.

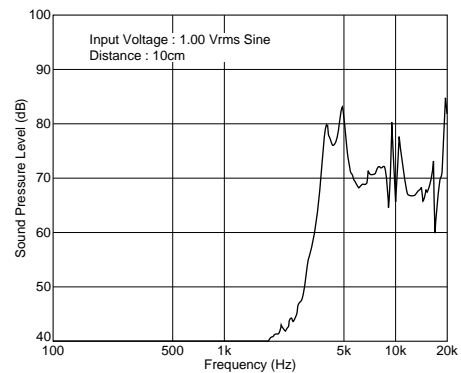


Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Min. of Operating Voltage Range	Capacitance (nF)	Operating Temp. Range	Storage Temp. Range
<b>PKM13EPY-4000-A0</b>	70 min. [3Vp-p,4kHz,square wave,10cm]	70 min. [1Vrms,4kHz,sine wave,10cm]	30 Vp-p max.	5.5 ±30% [1kHz]	-20 to +70°C	-30 to +80°C

### ■ Freq. Response (Square Wave 3Vp-p, 10cm)



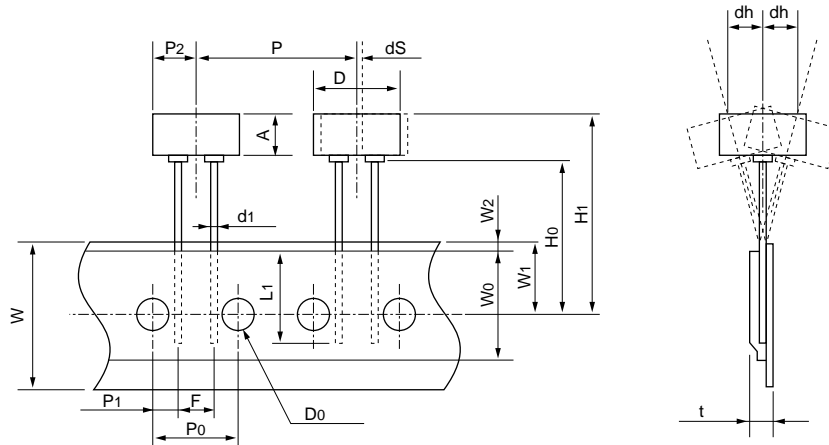
### ■ Freq. Response (Sine Wave 1Vrms, 10cm)



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### Taping Dimension



Item	Code	Nominal Value	Tol.	Remarks
Width of diameter	D	ø12.6	±0.5	
Height of component	A	6.9	±0.5	
Dimensions of terminal	d1	ø0.5	±0.1	
Lead length under the hold down tape	L1	8.0 min.	—	
Pitch of component	P	25.4	±0.5	
Pitch of sprocket	P0	12.7	±0.2	Tolerance for Pitches 10×P0=127±2mm
Length from hole center to lead	P1	3.85	±0.7	
Length from hole center to component center	P2	6.35	±0.7	
Lead spacing	F	5.0	±0.5	
Slant to the forward or backward	dh	0	±1.0	360° : 1mm max.
Width of carrier tape	W	18.0	±0.5	
Width of hold down tape	W0	12.5 min.	—	Hold down tape does not exceed the carrier tape.
Position of sprocket hole	W1	9.0	±0.5	
Gap of hold down tape and carrier tape	W2	2.0 max.	—	
Distance between the center of sprocket hole and lead stopper	H0	18.0	±0.5	
Total height of component	H1	26.0 max.	—	
Diameter of sprocket hole	D0	ø4.0	±0.2	
Total thickness of tape	t	0.6	±0.2	
Body tilt	dS	0	±1.0	

(in mm)

# Piezoelectric Sound Components



## Piezoelectric Sounders External Drive Lead Wire Type

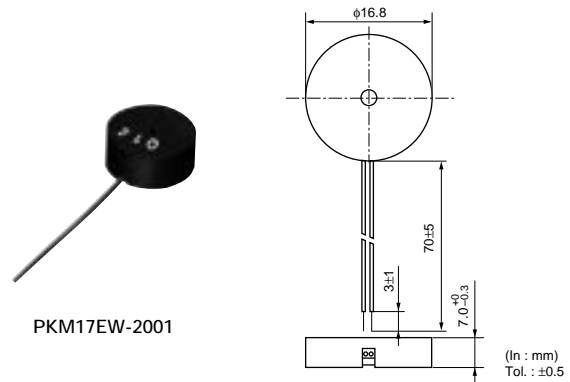
Now microcomputers are widely used for microwave ovens, air conditioners, cars, toys, timers, and other alarm equipment. Externally driven piezoelectric sounders are used in digital watches, electronic calculators, telephones and other equipment. They are driven by a signal (ex: 2048Hz or 4096Hz) from an LSI and provide melodious sound.

### ■ Features

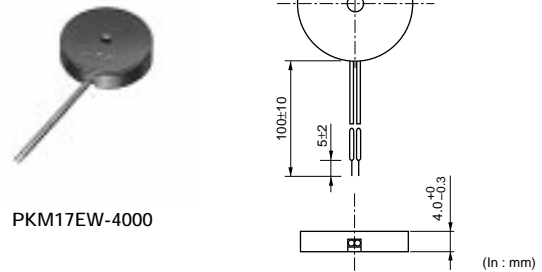
1. Low power consumption
2. No contacts therefore, no noise and highly reliable

### ■ Applications

1. Telephone ringers
2. Various office equipment such as PPCs, printers and keyboards
3. Various home appliances such as microwave ovens
4. Confirmation sound of various audio equipment



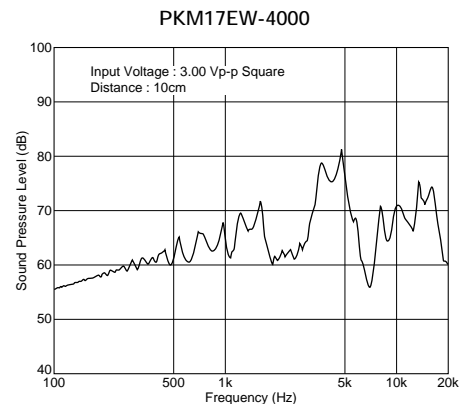
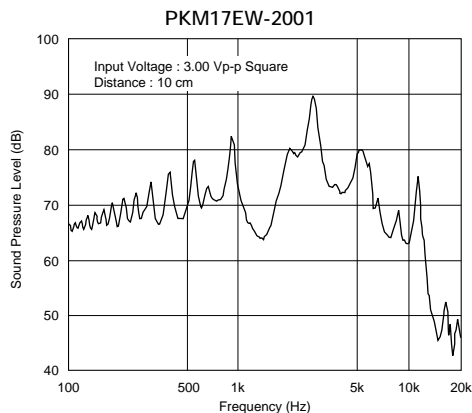
PKM17EW-2001



PKM17EW-4000

Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Min. of Operating Voltage Range	Capacitance (nF)	Operating Temp. Range	Storage Temp. Range
<b>PKM17EW-2001</b>	72 min. [3Vp-p, 2kHz, square wave, 10cm]	70 min. [1Vrms, 2kHz, sine wave, 10cm]	7 Vp-p max.	40 ±30% [120Hz]	-20 to +70°C	-30 to +80°C
<b>PKM17EW-4000</b>	75 min. [3Vp-p, 4kHz, square wave, 10cm]	70 min. [1Vrms, 4kHz, sine wave, 10cm]	25 Vp-p max.	9.5 ±30% [1kHz]	-20 to +70°C	-30 to +80°C

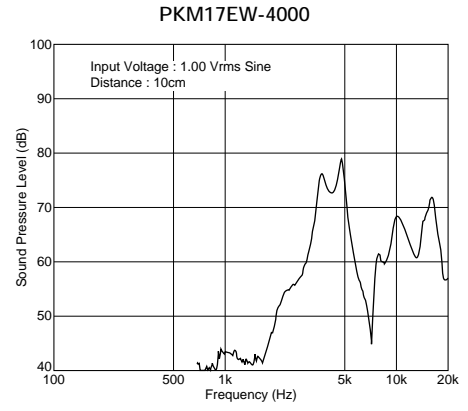
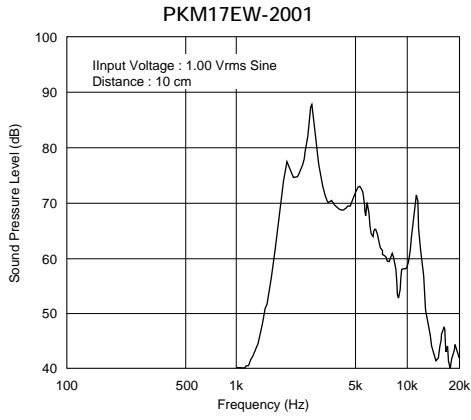
### ■ Freq. Response (Square Wave 3Vp-p, 10cm)



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### ■ Freq. Response (Sine Wave 1Vrms, 10cm)



# Piezoelectric Sound Components

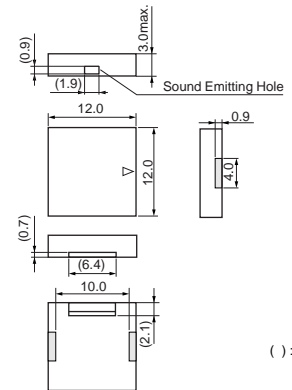


## Piezoelectric Sounders External Drive SMD Type

Taking advantage of extensive acoustic and mechanical design technology and high performance ceramics, Murata has developed SMD piezoelectric sounders that suite the thin, high-density design of electronic equipment.

### ■ Features

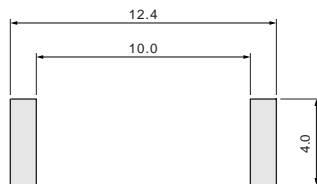
1. High S.P.L. and clear sound
2. Reflowable
3. Tape & Reel supply
4. Minimum quantity (order in sets only): 1,000 pcs.



( ) : Ref. only  
Tol. ±0.2  
in mm

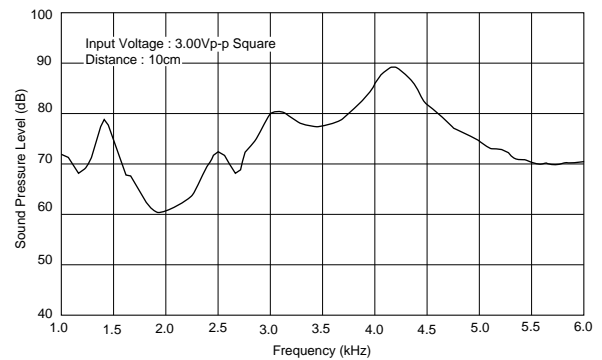
Part Number	Sound Pressure Level (dB)	Max. of Operating Voltage Range (Vp-p)	Operating Temp. Range	Storage Temp. Range	Use
PKLCS1212E4001-R1	75 min.[3Vp-p,4kHz,square wave,10cm]	25 max.	-20 to +70°C	-30 to +80°C	For consumer electronics
PKLCS1212E40A1-R1	75 min.[3Vp-p,4kHz,square wave,10cm]	25 max.	-40 to +85°C	-40 to +85°C	For automotive electronics

### ■ Standard Land Pattern Dimensions



(in mm)

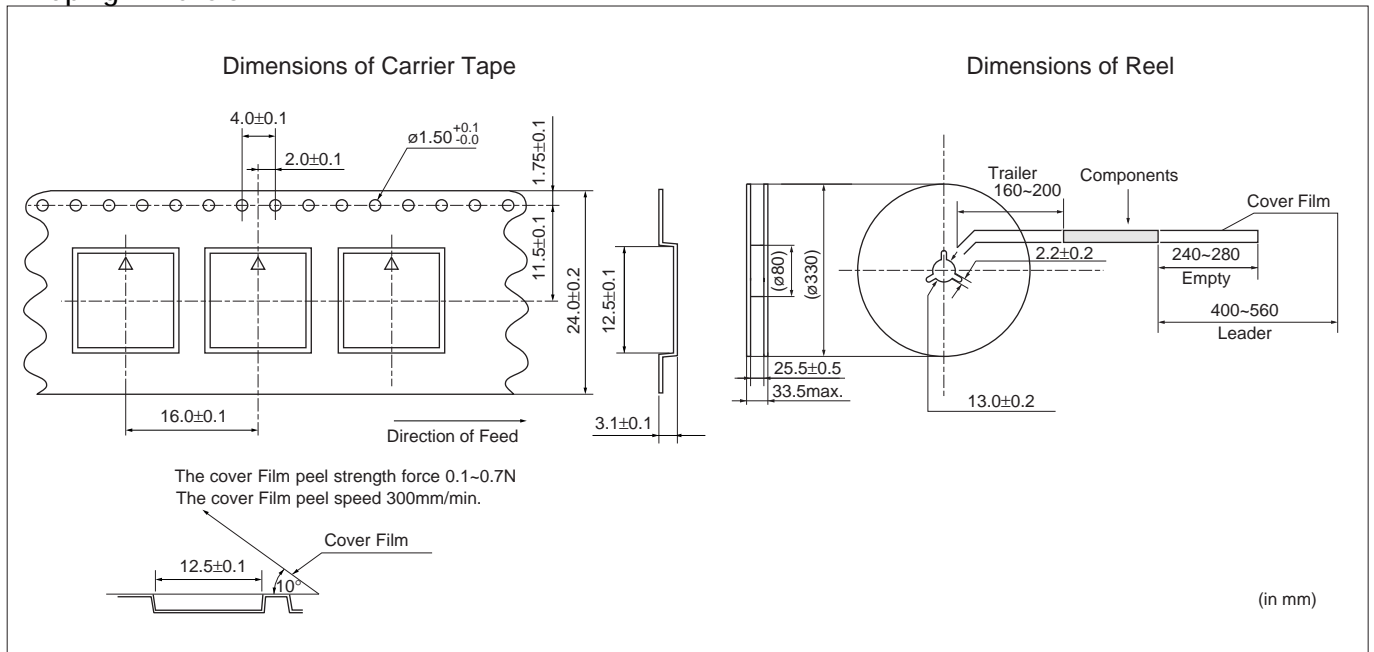
### ■ Freq. Response (Square Wave 3Vp-p, 10cm)



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**Taping Dimension**

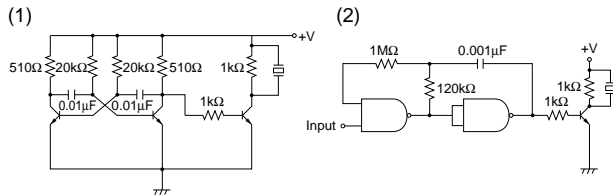


## Piezoelectric Sounders (External Drive) Circuit/Notice

### ■ Circuit

The following are examples of externally driven circuits.

- (1) Unstable multi-vibrator using Tr.  
(2) Circuits using inverters or NAND gates.

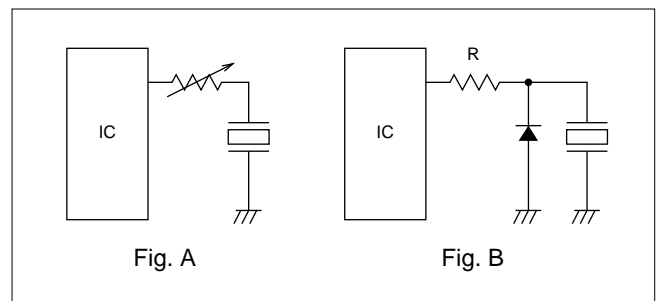


### ■ Notice (Soldering and Mounting)

Washing of the component is not acceptable, because it is not sealed.

### ■ Notice (Handling)

1. The component may be damaged if mechanical stress exceeding specifications is applied.
2. Take care to protect operating circuit from surge voltage resulting from excessive force, falling, shock or temperature change.
3. If DC voltage is applied to the component, silver migration may occur. Please pay full attention to avoid subjecting the component to DC voltage for long periods.
4. The resistor should be used as shown in Fig. A.  
A suitable resistance value should be chosen, preferably 1kΩ to 2kΩ. Instead of this measure, a diode may also be applied as shown in Fig. B.



5. Avoid excessive pulling of lead wire because wire may break or soldering point may come off.

# Piezoelectric Sound Components



## Piezoelectric Ringers (PIEZORINGER®)

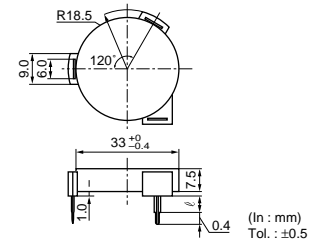
As the result of rapid development of ICs in telephones, demand for piezoelectric sounders as telephone ringers has also rapidly increased. To effectively satisfy this rising demand, Murata provides a suitable piezoelectric sounder called "PIEZORINGER" with the following features.

### ■ Features

1. Extremely clear sound
2. Since it is voltage driven, the power consumption is quite negligible.
3. It can be driven directly from ICs.
4. Extremely thin and light



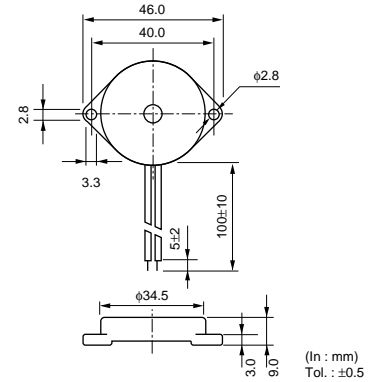
PKM33EP-1201C



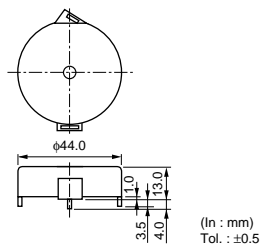
Part Number	ℓ
PKM33EP-1201C	5.0
PKM33EP-1202C	0



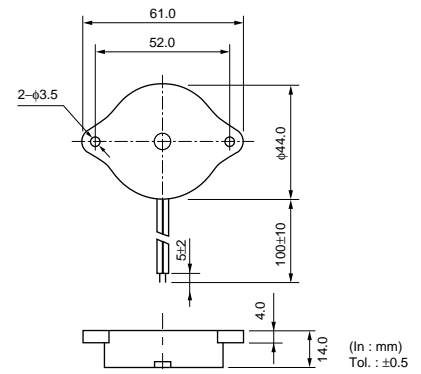
PKM34EW-1101C/1201C



PKM44EP-0901



PKM44EW-1001C



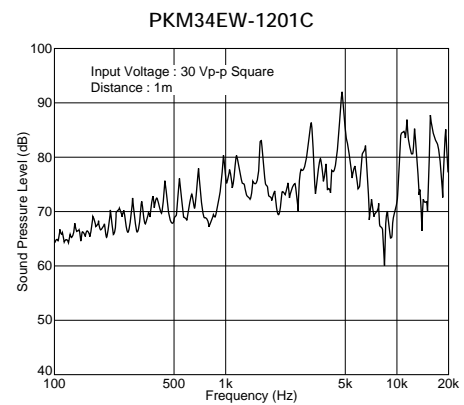
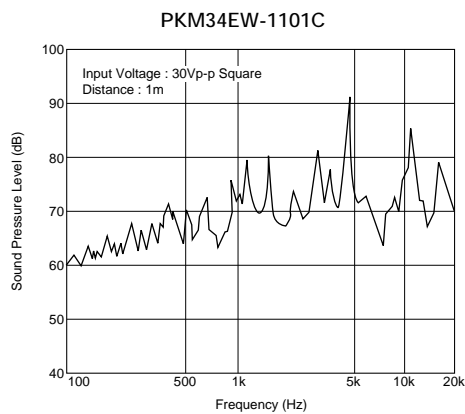
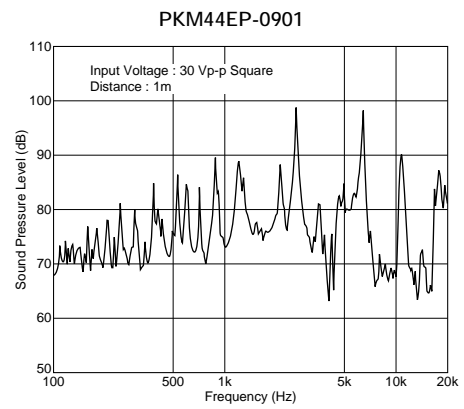
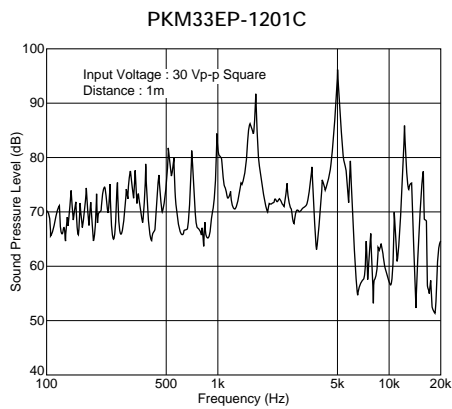
## Pin Type

Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Min. of Operating Voltage Range	Capacitance (nF)	Operating Temp. Range	Storage Temp. Range
<b>PKM33EP-1201C</b>	68 min. [30Vp-p, 1.2kHz, square wave, 1m]	65 min. [1Vrms, 1.2kHz, sine wave, 10cm]	40 Vp-p max.	40 ±30% [120Hz]	-20 to +70°C	-30 to +80°C
<b>PKM44EP-0901</b>	70 min. [30Vp-p, 1kHz, square wave, 1m]	60 min. [1Vrms, 1kHz, sine wave, 10cm]	40 Vp-p max.	68 ±30% [120Hz]	-20 to +70°C	-30 to +80°C

## Lead Wire Type

Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Min. of Operating Voltage Range	Capacitance (nF)	Operating Temp. Range	Storage Temp. Range
<b>PKM34EW-1101C</b>	70 min. [30Vp-p, 1.1kHz, square wave, 1m]	60 min. [1Vrms, 1.1kHz, sine wave, 10cm]	40 Vp-p max.	40 ±30% [120Hz]	-20 to +70°C	-30 to +80°C
<b>PKM34EW-1201C</b>	70 min. [30Vp-p, 1.2kHz, square wave, 1m]	60 min. [1Vrms, 1.2kHz, sine wave, 10cm]	60 Vp-p max.	32 ±30% [120Hz]	-20 to +70°C	-30 to +80°C
<b>PKM44EW-1001C</b>	75 min. [30Vp-p, 1kHz, square wave, 1m]	70 min. [1Vrms, 1kHz, sine wave, 10cm]	30 Vp-p max.	68 ±30% [120Hz]	-20 to +70°C	-30 to +80°C

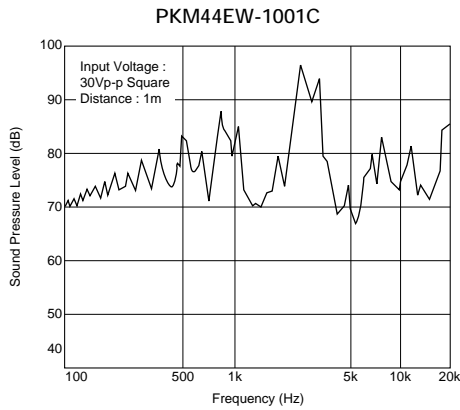
### ■ Freq. Response (Square Wave 30Vp-p, 1m)



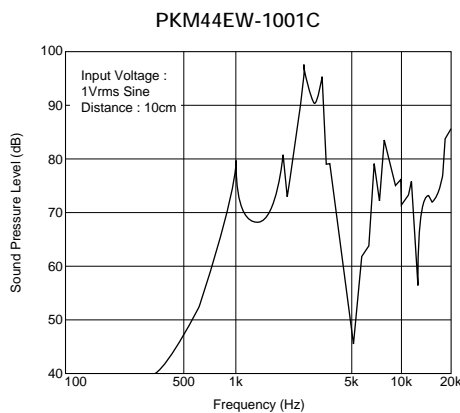
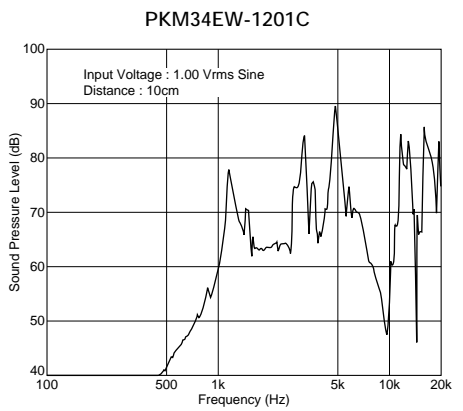
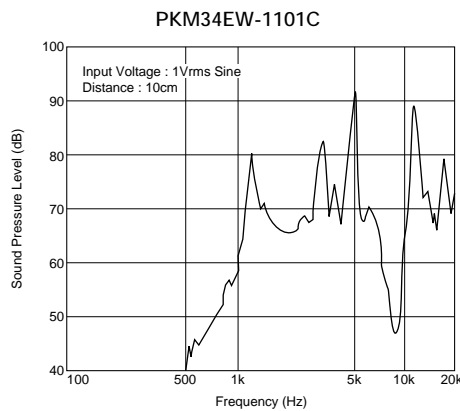
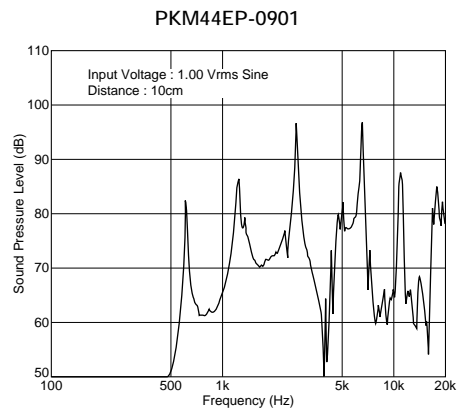
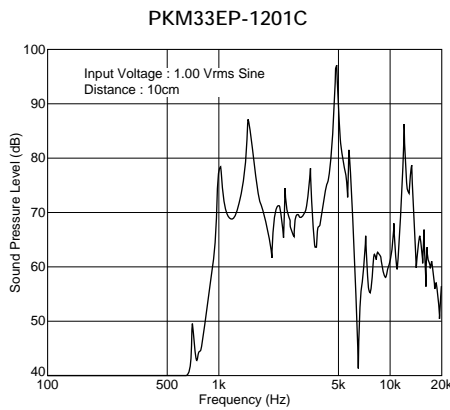
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### ■ Freq. Response (Square Wave 30Vp-p, 1m)



### ■ Freq. Response (Sine Wave 1Vrms, 10cm)



6

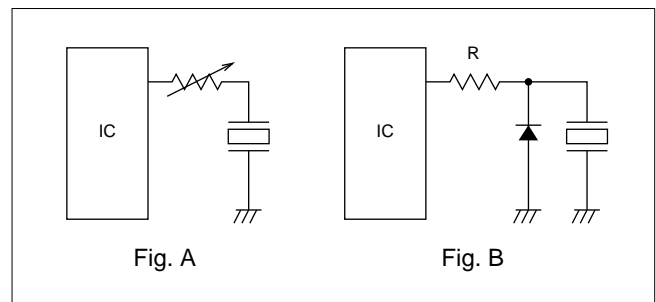
## Piezoelectric Ringers (PIEZORINGER®) Notice

### ■ Notice (Soldering and Mounting)

Washing of the component is not acceptable, because it is not sealed.

### ■ Notice (Handling)

1. The component may be damaged if mechanical stress exceeding specifications is applied.
2. Take care to protect operating circuit from surge voltage resulting from excessive force, falling, shock or temperature change.
3. If DC voltage is applied to the component, silver migration may occur. Please pay full attention to avoid subjecting the component to DC voltage for long periods.
4. The resistor should be used as shown in Fig. A.  
A suitable resistance value should be chosen, preferably  $1\text{k}\Omega$  to  $2\text{k}\Omega$ . Instead of this measure, a diode may also be applied as shown in Fig. B.



5. Avoid excessive pulling of lead wire because wire may break or soldering point may come off.

# Piezoelectric Sound Components

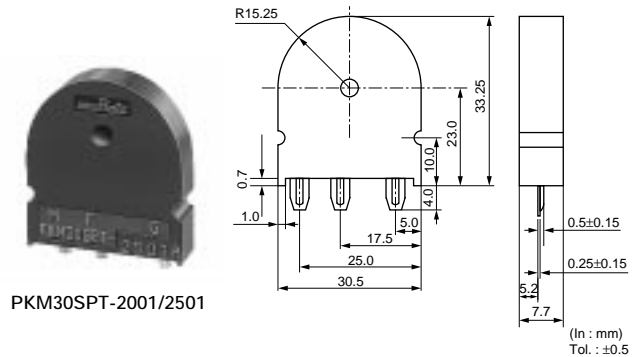
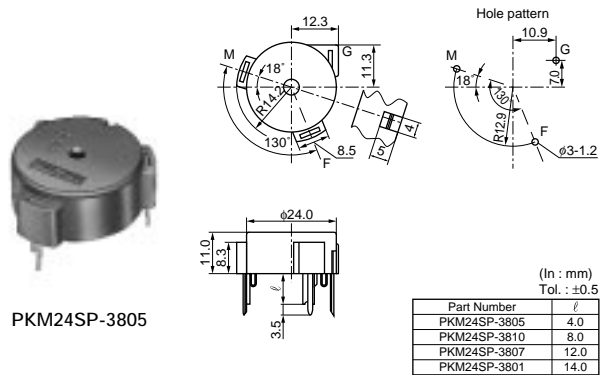


## Piezoelectric Sounders Self Drives Pin Type

Piezoelectric sounder self drive type requires only simple circuit and DC power supply. Since this type uses resonant system, it is also available for alarms which need large sound volume.

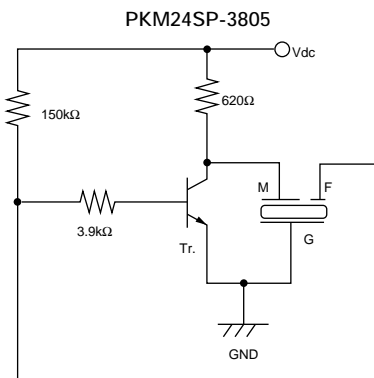
### Applications

1. Gas alarms, burglar alarms, smoke detectors
2. Air conditioners, microwave ovens, washing machines and other home-electronic appliances controlled by microcomputers
3. Bicycles, toys, game machines

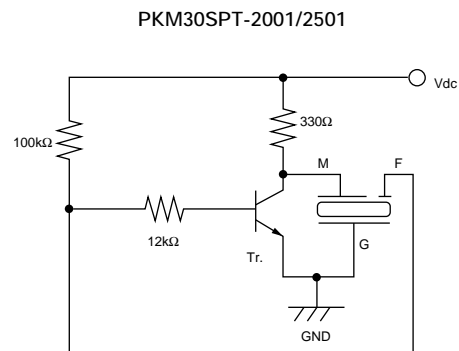


Part Number	Sound Pressure Level (dB)	Oscillating Frequency (kHz)	Current Consumption (mA)	Min. of Operating Voltage Range	Operating Temp. Range	Storage Temp. Range
<b>PKM24SP-3805</b>	90 min. [12Vdc, 10cm]	3.8 ±0.4kHz [12Vdc]	12 max. [12Vdc]	3.0Vdc to 20.0 Vdc	-20 to +70°C	-30 to +80°C
<b>PKM30SPT-2001-B0</b>	75 min. [12Vdc, 10cm]	2.0 ±0.3kHz [12Vdc]	20 max. [12Vdc]	3.0Vdc to 20.0 Vdc	-20 to +70°C	-30 to +80°C
<b>PKM30SPT-2501-B0</b>	75 min. [12Vdc, 10cm]	2.5 ±0.3kHz [12Vdc]	20 max. [12Vdc]	3.0Vdc to 20.0 Vdc	-20 to +70°C	-30 to +80°C

### Standard Circuit Examples



Tr: 2SC1815Y or equivalent



Tr: 2SC1815Y or equivalent

## Piezoelectric Sounders (Self Drive) Notice

### ■ Notice (Soldering and Mounting)

1. Washing of the component is not acceptable, because it is not sealed.
2. Please do not cover the hole with tape or other obstacle as this will produce irregular oscillation.
3. There should not be any obstacle within 15mm from top of the component as this will produce irregular oscillation.

### ■ Notice (Handling)

1. The component may be damaged if mechanical stress exceeding specifications is applied.
2. Take care to protect operating circuit from surge voltage resulting from excessive force, falling, shock or temperature change.
3. If DC voltage is applied to the component, silver migration may occur. Please pay full attention to avoid subjecting the component to DC voltage for long periods.
4. The standard self-driven circuits utilizes transistor switching. The circuit constants for hfe of the transistor are optimally chosen to maintain stable oscillation. So please follow it when you design a circuit.

# Piezoelectric Sound Components



## Piezoelectric Buzzers

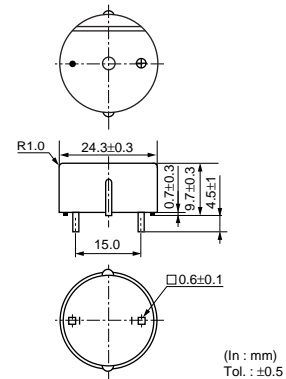
This is a unified piezoelectric sounder which has a piezoelectric diaphragm of 3 terminals connected to a self drive circuit, and it easily generates sound with only a DC power supply (DC3.0-20V). Using suitably designed resonant system, this type can be used where large sound volumes are needed.

### ■ Applications

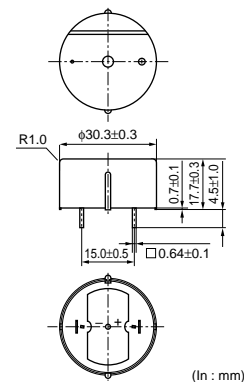
1. Gas alarms, burglar alarms
2. Air conditioners, microwave ovens and various types of microcomputer controlled home-electronic appliances
3. Automobile speed alarms, navigators, car stereos and other automobile equipment
4. Toys, games, and other simple electronic devices such as teaching aids



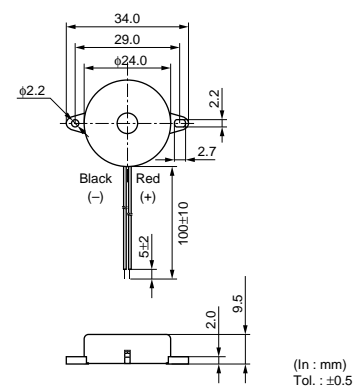
PKB24SPC-3601



PKB30SPC-2001/3001



PKB24SW-3301



## Pin Type

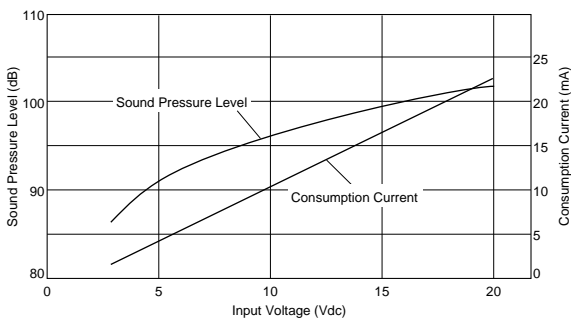
Part Number	Sound Pressure Level (dB)	Oscillating Frequency (kHz)	Current Consumption (mA)	Min. of Operating Voltage Range	Operating Temp. Range	Storage Temp. Range
PKB24SPC-3601-B0	90 min. [12Vdc, 10cm]	3.6 ±0.5kHz [12Vdc]	16 max. [12Vdc]	3.0Vdc to 15.0 Vdc	-20 to +70°C	-30 to +80°C
PKB30SPC-2001-B0	92 min. [12Vdc, 10cm]	2.0 ±0.4kHz [12Vdc]	15 max. [12Vdc]	3.0Vdc to 15.0 Vdc	-20 to +70°C	-30 to +80°C
PKB30SPC-3001-B0	92 min. [12Vdc, 10cm]	2.7 ±0.4kHz [12Vdc]	15 max. [12Vdc]	3.0Vdc to 15.0 Vdc	-20 to +70°C	-30 to +80°C

## Lead Wire Type

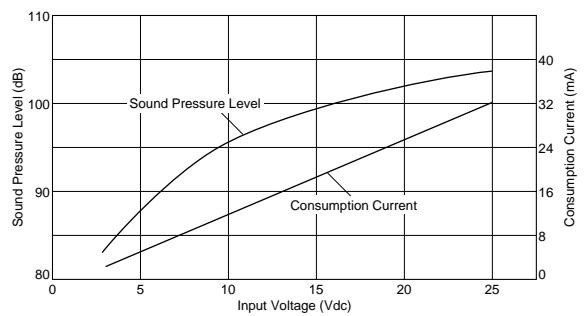
Part Number	Sound Pressure Level (dB)	Oscillating Frequency (kHz)	Current Consumption (mA)	Min. of Operating Voltage Range	Operating Temp. Range	Storage Temp. Range
PKB24SW-3301	80 min. [12Vdc, 10cm]	3.3 ±0.5kHz [12Vdc]	12 max. [12Vdc]	3.0Vdc to 20.0 Vdc	-20 to +70°C	-30 to +80°C

### ■ Voltage-Sound Pressure Level/Voltage-Consumption Current

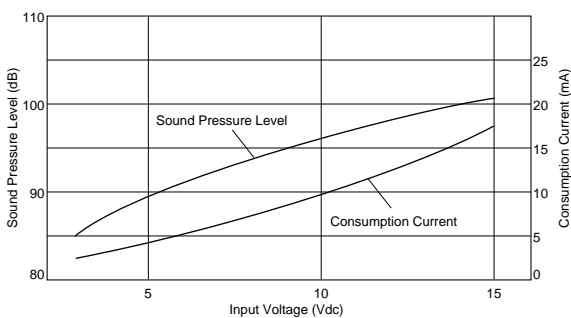
PKB30SPC-2001



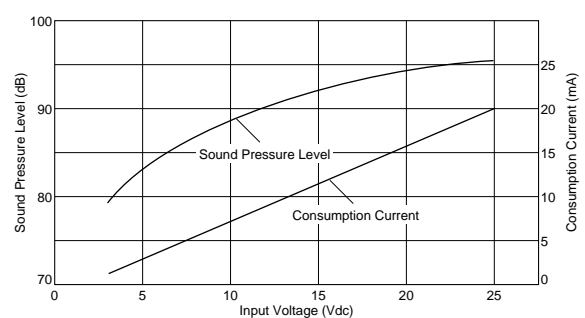
PKB30SPC-3001



PKB24SPC-3601



PKB24SW-3301



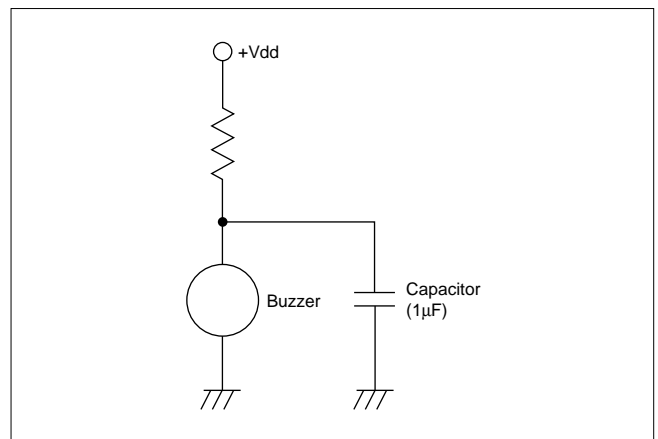
## Piezoelectric Buzzers Notice

### ■ Notice (Soldering and Mounting)

1. Washing of the component is not acceptable, because it is not sealed.
2. Please do not cover the hole with tape or other obstacle as this will produce irregular oscillation.
3. There should not be any obstacle within 15mm from top of the component as this will produce irregular oscillation.

### ■ Notice (Handling)

1. The component may be damaged if mechanical stress exceeding specifications is applied.
2. Resistors should not be connected in series to the power supply as this will produce irregular oscillation. When resistor is necessary to control sound volume, use capacitor (1 $\mu$ F) parallel with the buzzer.

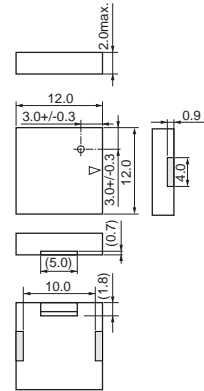
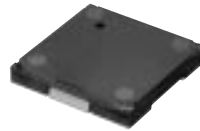


# Piezoelectric Sound Components



## Piezoelectric Receiver

Taking advantage of extensive acoustic, mechanical designing technology and high performance ceramics, Murata has developed the SMD piezoelectric receiver. This Murata technology supports labor and cost saving activities.



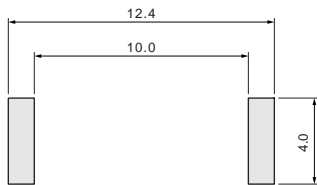
( ) : Ref. only  
Tol. ±0.2  
in mm

### ■ Features

1. Thin shape, lightweight
2. Low current consumption and good matching impedance for a voltage drive
3. Reflowable
4. Tape & Reel supply
5. Minimum quantity (order in sets only): 1,500 pcs.

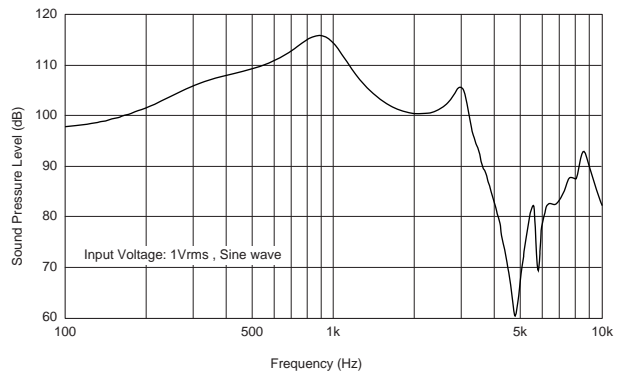
Part Number	Sound Pressure Level (1) (dB)	Sound Pressure Level (2) (dB)	Operating Voltage Range (Vp-p)	Operating Temperature Range	Storage Temperature Range
<b>PKLCD1212R1000-R1</b>	106.0 +4.0/-2.5 [at 300Hz]	114.0 +2.5/-4.0 [at 1kHz]	7 max.	-20 to +70°C	-30 to +80°C

### ■ Standard Land Pattern Dimensions



(in mm)

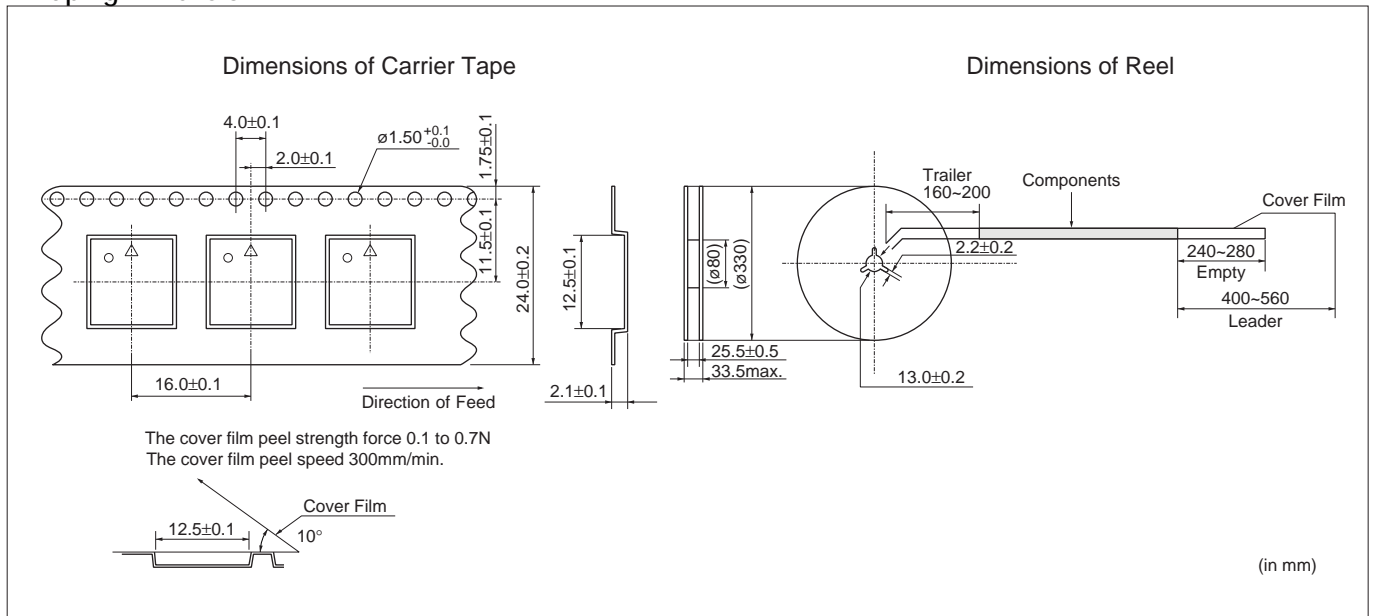
### ■ Freq. Response (Sine Wave 1Vrms)



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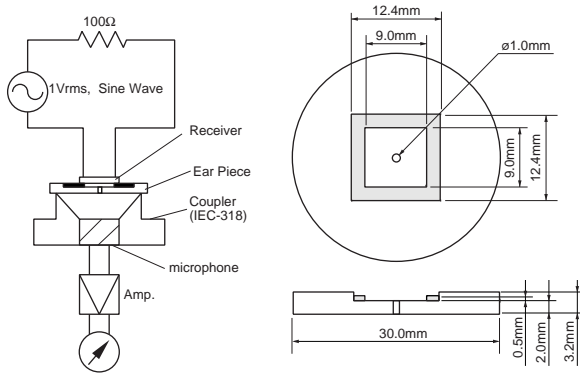
Continued from the preceding page.

**Taping Dimension**



## Piezoelectric Receiver Circuit/Notice

### ■ Circuit



### ■ Notice (Soldering and Mounting)

Washing of the component is not acceptable, because it is not sealed.

### ■ Notice (Handling)

1. The component may be damaged if mechanical stress exceeding specifications is applied.
2. Take care to protect operating circuit from surge voltage resulting from excessive force, falling, shock or temperature change.
3. If DC voltage is applied to the component, silver migration may occur. Please pay full attention to avoid subjecting the component to DC voltage for long periods.
4. Please pay attention to the hand set design. Sound pressure level - frequency characteristics are affected by the hand set design. (Blocking the sound emitting hole or air dumping hole may degrade S.P.L.-frequency characteristics. Placing other components or obstacles close to the holes may also affect the characteristics.)

# Piezoelectric Sound Components

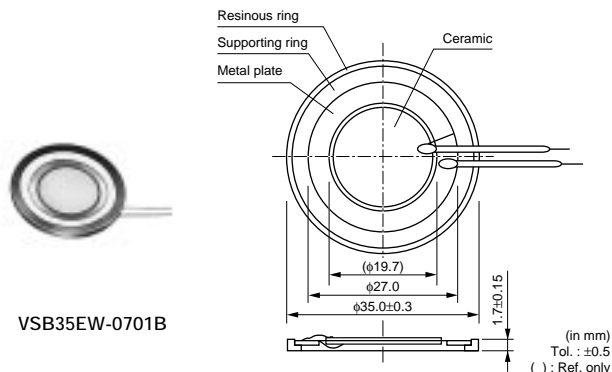


## Piezoelectric Speakers (CERAMITONE®)

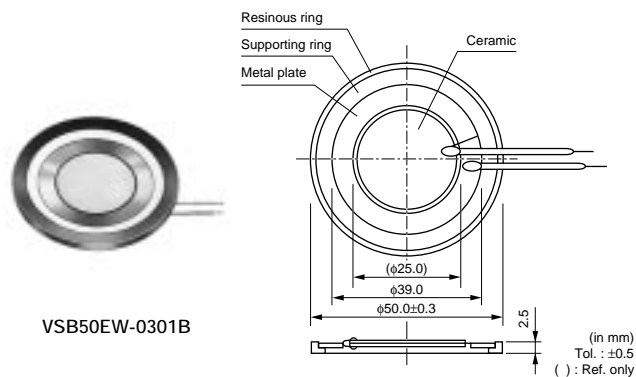
As voice synthesizing techniques with ICs and LSIs are rapidly progressing, human voice synthesizing devices are put into practical use for portable calculators, clocks, vending machines, translating machines and so forth. In order to meet the demand, Murata has developed Piezoelectric Speakers best suited for making synthesized voices or melodies.

### ■ Features

1. High efficiency compared with conventional electromagnetic type speakers
2. Ultra-thin and lightweight
3. High impedance with less power consumption
4. No electric noise, because they have no mechanical contacts.
5. Direct drive by IC is available.



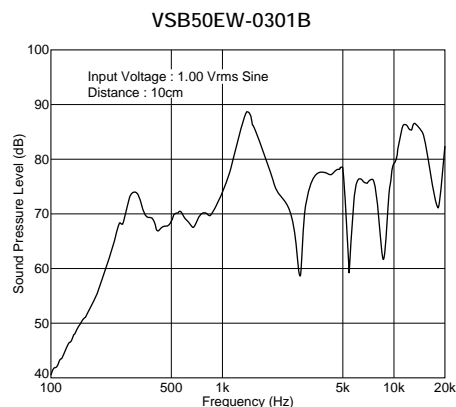
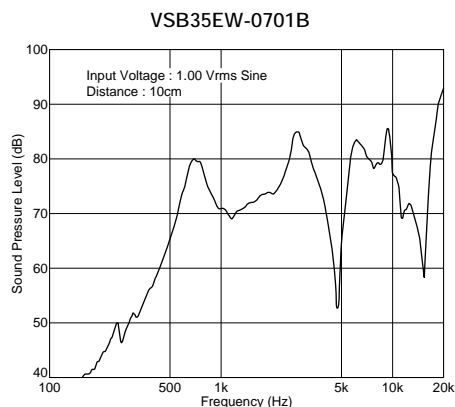
VSB35EW-0701B



VSB50EW-0301B

Part Number	Oscillating Frequency Range	Resonant Frequency (Hz) [Lowest]	Impedance (ohm)	Capacitance (nF)	Maximum Input (mW)	Operating Temp. Range	Storage Temp. Range
VSB35EW-0701B	600Hz to 20kHz	950 ±150Hz	600[1kHz]	340 ±35%[120Hz]	75	-20 to +70°C	-30 to +80°C
VSB50EW-0301B	250Hz to 20kHz	400 ±150Hz	300[1kHz]	600 ±35%[120Hz]	150	-20 to +70°C	-30 to +80°C

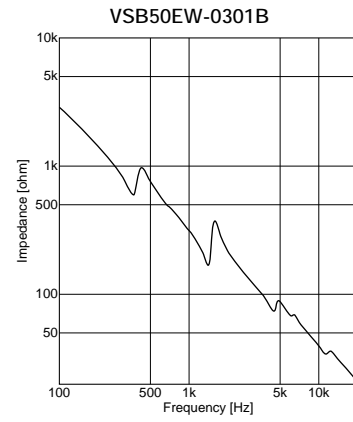
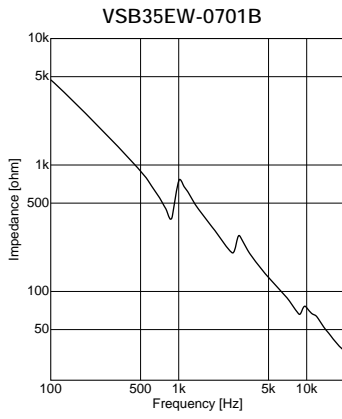
### ■ Freq. Response (Sine Wave 1Vrms, 10cm)



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### ■ Impedance-Frequency Characteristics



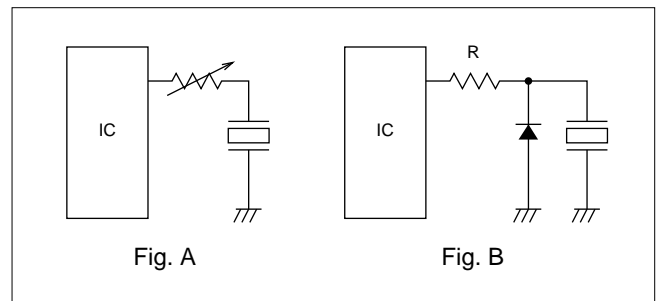
## Piezoelectric Speakers (CERAMITONE®) Notice

### ■ Notice (Soldering and Mounting)

1. Applying load on the center area of the speaker may cause cracking in the ceramic element. When the speaker is supported by the edge, the load should be only applied around the edge.
2. Washing of the component is not acceptable, because it is not sealed.

### ■ Notice (Handling)

1. Please do not touch the component with bare hand because electrode may be corroded.
2. The component may be damaged if mechanical stress exceeding specifications is applied.
3. Take care to protect operating circuit from surge voltage resulting from excessive force, falling, shock or temperature change.
4. If DC voltage is applied to the component, silver migration may occur. Please pay full attention to avoid subjecting the component to DC voltage for long periods.
5. The resistor should be used as shown in Fig. A.  
A suitable resistance value should be chosen, preferably  $1\text{k}\Omega$  to  $2\text{k}\Omega$ . Instead of this measure, a diode may also be applied as shown in Fig. B.




6. Avoid excessive pulling of lead wire because wire may break or soldering point may come off.

**Package**

**Minimum Quantity (pcs.)**

Product Names	Part Number	Minimum Quantity				
		Ø330mm Reel	Bulk (Box)	Ammo Pack	Magazine	
● Piezoelectric Diaphragms* External - Drive Types	7BB-12-9		5120			
	7BB-15-6		8000			
	7BB-20-3		3000			
	7BB-20-6		1800			
	7BB-20-6A0		600			
	7BB-27-4		1500			
	7BB-27-4A0		600			
	7BB-35-3		800			
	7BB-35-3A0		400			
	7BB-41-2		400			
	7BB-41-2A0		250			
	7MB-20-5R5		600			
	7NB-31R2-1		3000			
	Self - Drive Types	7BB-20-6C		1800		
		7BB-20-6CA0		600		
		7BB-27-4C		1500		
		7BB-27-4CA0		600		
		7BB-35-3C		800		
		7BB-35-3CA0		400		
		7BB-41-2C		600		
7BB-41-2CA0			250			
7SB-34R7-3C			1600			
● Piezoelectric Sounders* External - Drive Types	PKM13EPY-4000-A0			500		
	PKM13EPY-4002-B0		330			
	PKM17EPP-2002-B0		200			
	PKM17EPP-4001-B0		200			
	PKM17EPP-4002-B0		200			
	PKM17EPT-4001-B0		180		70 <sup>1)</sup>	
	PKM17EW-2001		250			
	PKM22EP-2001		360			
	PKM22EP-2002		270			
	PKM22EP-2003		270			
	PKM22EPP-2001-B0		750			
	PKM22EPP-2002-B0		750			
	PKM22EPP-4001-B0		900			
	PKM22EPP-4002-B0		900			
	PKM22EPP-4005-B0		750			
	PKM22EPP-4007-B0		750			
	PKM22EPP-4012-B0		750			
	PKM22EPT-2001-B0		300		75 <sup>1)</sup>	
	PKM22EPT-4001-B0		300			
	PKM17EW-4000		500			
PKLCS1212E4001-R1	1000					
PKLCS1212E40A1-R1	1000					

1) The last two digits are changed to M0.

Continued on the following page. 

"Minimum Quantity" means the number of units of each delivery or order. The quantity should be an integral multiple of the "Minimum Quantity". (As for products series with \*mark, bulk (bag) quantities shown here differ from actual delivery quantities in a package.) Please contact nearest sales office for details and for any other products not listed above.

## Package

Continued from the preceding page.

Product Names	Part Number	Minimum Quantity			
		Ø330mm Reel	Bulk (Box)	Ammo Pack	Magazine
Self - Drive Types	<b>PKM24SP-3801</b>		270		
	<b>PKM24SP-3805</b>		360		
	<b>PKM24SP-3807</b>		270		
	<b>PKM24SP-3810</b>		270		
	<b>PKM30SPT-2001-B0</b>		70		
	<b>PKM30SPT-2501-B0</b>		70		
● Piezoelectric Buzzers*	<b>PKB24SPC-3601-B0</b>		650		
	<b>PKB24SW-3301</b>		200		
	<b>PKB30SPC-2001-B0</b>		80		
	<b>PKB30SPC-3001-B0</b>		80		
● Piezoelectric Ringers (PIEZORINGER®)*	<b>PKM33EP-1201C</b>		300		
	<b>PKM33EP-1202C</b>		60		
	<b>PKM34EW-1101C</b>		25		
	<b>PKM34EW-1201C</b>		25		
	<b>PKM44EP-0901</b>		160		
	<b>PKM44EW-1001C</b>		25		
● Piezoelectric Receiver	<b>PKLCD1212R1000-R1</b>	1500			
● Piezoelectric Speakers (CERAMITONE®)*	<b>VSB35EW-0701B</b>		160		
	<b>VSB50EW-0301B</b>		80		

**⚠Note:**

1. Export Control

⟨For customers outside Japan⟩

Murata products should not be used or sold for use in the development, production, stockpiling or utilization of any conventional weapons or mass-destructive weapons (nuclear weapons, chemical or biological weapons, or missiles), or any other weapons.

⟨For customers in Japan⟩

For products which are controlled items subject to the "Foreign Exchange and Foreign Trade Law" of Japan, the export license specified by the law is required for export.

2. Please contact our sales representatives or product engineers before using the products in this catalog for the applications listed below, which require especially high reliability for the prevention of defects which might directly damage to a third party's life, body or property, or when one of our products is intended for use in applications other than those specified in this catalog.

- |                             |   |
|-----------------------------|---|
| ① Aircraft equipment        | ② Aerospace equipment   |
| ③ Undersea equipment        | ④ Power plant equipment   |
| ⑤ Medical equipment         | ⑥ Transportation equipment (vehicles, trains, ships, etc.)  |
| ⑦ Traffic signal equipment  | ⑧ Disaster prevention / crime prevention equipment  |
| ⑨ Data-processing equipment | ⑩ Application of similar complexity and/or reliability requirements to the applications listed in the above |

3. Product specifications in this catalog are as of June 2003. They are subject to change or our products in it may be discontinued without advance notice. Please check with our sales representatives or product engineers before ordering. If there are any questions, please contact our sales representatives or product engineers.

4. Please read rating and ⚠CAUTION (for storage, operating, rating, soldering, mounting and handling) in this catalog to prevent smoking and/or burning, etc.

5. This catalog has only typical specifications because there is no space for detailed specifications. Therefore, please approve our product specifications or transact the approval sheet for product specifications before ordering.

6. Please note that unless otherwise specified, we shall assume no responsibility whatsoever for any conflict or dispute that may occur in connection with the effect of our and/or a third party's intellectual property rights and other related rights in consideration of your use of our products and/or information described or contained in our catalogs. In this connection, no representation shall be made to the effect that any third parties are authorized to use the rights mentioned above under licenses without our consent.

7. No ozone depleting substances (ODS) under the Montreal Protocol are used in our manufacturing process.