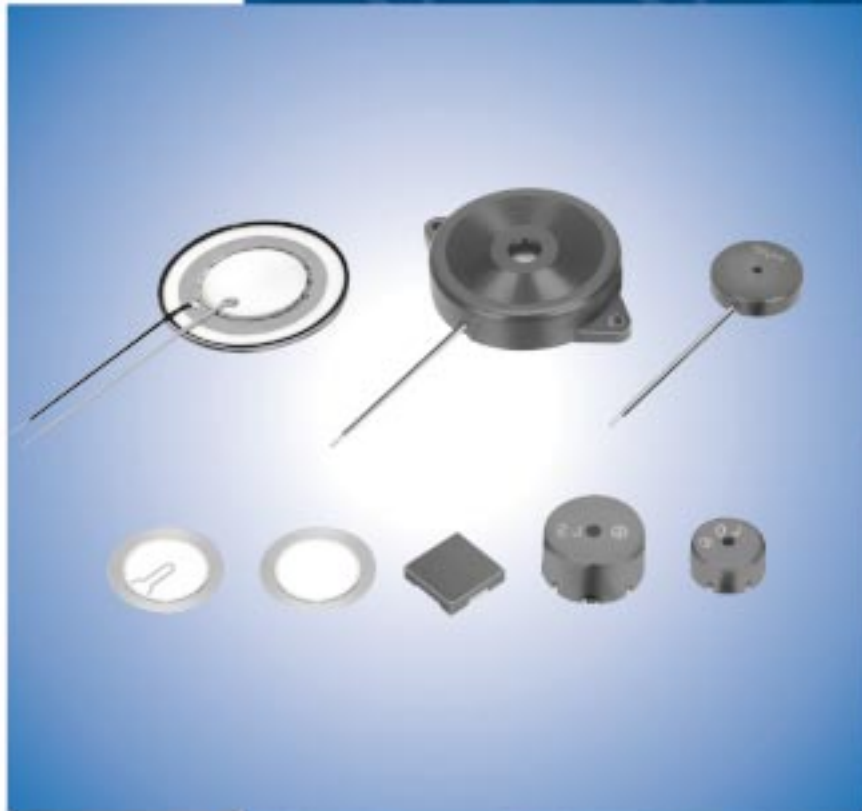


# Piezoelectric Sound Components



# CONTENTS

PIEZORINGER®, CERAMITONE®, CERAMIPHONE® and "PIEZORINGER" in this catalog are the trademarks of Murata Manufacturing Co., Ltd.

<b>Part Numbering</b>	_____	2	
<b>Application Matrix</b>	_____	5	
<b>1 Piezoelectric Diaphragms</b>	_____	6	<b>1</b>
<b>External Drive Type</b>	_____	6	
<b>Self Drive Type</b>	_____	7	
● <b>Piezoelectric Diaphragms Notice</b>	_____	8	
<b>2 Piezoelectric Sounders External Drive Pin Type</b>	_____	9	<b>2</b>
<b>3 Piezoelectric Sounders External Drive Pin Type Taping</b>	_____	14	<b>3</b>
<b>4 Piezoelectric Sounders External Drive Lead Wire Type</b>	_____	16	<b>4</b>
<b>5 Piezoelectric Sounders External Drive SMD Type</b>	_____	18	
● <b>Piezoelectric Sounders (External Drive) Circuit/Notice</b>	_____	19	
<b>6 Piezoelectric Ringers (PIEZORINGER®)</b>	_____	20	<b>5</b>
<b>Pin Type</b>	_____	20	
<b>Lead Wire Type</b>	_____	20	
● <b>Piezoelectric Ringers (PIEZORINGER®) Notice</b>	_____	22	
<b>7 Piezoelectric Sounders Self Drive Pin Type</b>	_____	23	<b>6</b>
● <b>Piezoelectric Sounders (Self Drive) Notice</b>	_____	24	
<b>8 Piezoelectric Buzzers</b>	_____	25	
<b>Pin Type</b>	_____	25	<b>7</b>
<b>Lead Wire Type</b>	_____	25	
● <b>Piezoelectric Buzzers Notice</b>	_____	27	
<b>9 Piezoelectric Receiver (CERAMIPHONE®)</b>	_____	28	<b>8</b>
● <b>Piezoelectric Receiver Circuit/Notice</b>	_____	29	
<b>10 Piezoelectric Speakers (CERAMITONE®)</b>	_____	30	
● <b>Piezoelectric Speakers (CERAMITONE®) Notice</b>	_____	32	
<b>Piezoelectric Sound Components Notice</b>	_____	33	<b>9</b>
<b>Package</b>	_____	34	

• The RoHS compliance means that we judge from EU Directive 2002/95/EC the products do not contain lead, cadmium, mercury, hexavalent chromium, PBB and PBDE, except exemptions stated in EU Directive 2002/95/EC annex and impurities existing in natural world.  
 • This statement does not insure the compliance of any of the listed parts with any laws or legal imperatives developed by any EU members individually with regards to the RoHS Directive.

● Part Numbering

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

(Part Number) 

PK	M	13	E	P	YH	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> <input type="checkbox"/>	Standing Type
<b>P</b> <input type="checkbox"/>	Flat Type Auto-assemble
<b>Y</b> <input type="checkbox"/>	Flat Type/Available for Taping
<b>C</b> <input type="checkbox"/>	Flat Type/Semi-auto-assemble
<input type="checkbox"/>	Exclude above mentioned

means specification of outer electrode.

⑦ Oscillating Frequency Type

Code	Oscillating Frequency Type
<b>40</b>	Expressed resonant frequency by two-digit alphanumerics. The unit is in 100 hertz (Hz). In case of 4kHz (4000Hz), expressed as "40".

⑧ Individual Specification Code

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

⑨ Special Quality Guarantee

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

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.

Packaging Code is blank in the case of types for which radial taping or magazines are not available.

### 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>	Expressed resonant frequency by two-digit alphanumerics. The unit is in 100 hertz (Hz). In case of 4kHz (4000Hz), expressed as "40".

#### 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 (CERAMIPHONE®)

(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>	Expressed resonant frequency by two-digit alphanumerics. The unit is in 100 hertz (Hz). In case of 1kHz (1000Hz), expressed as "10".

#### 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	H	07	01	B
①	②	③	④	⑤	⑥	⑦	⑧	⑨

### 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 Specification of Outer Electrode

Code	Specification of Outer Electrode
H	available for RoHS

### ⑦ Resonant Frequency Type

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

### ⑧ Individual Specification Code

Code	Individual Specification Code
01	Characteristics, Style, others

### ⑨ 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		L	10
①	②	③	④	⑤	⑥	⑦	⑧	⑨

### ① Product ID

Product ID	
7	Ceramic Material

### ② Material

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

### ③ Product

Code	Product
B	Piezoelectric Diaphragms

### ④ Metal Plate Diameter

Code	Metal Plate Diameter
-31R2	A hyphen (-) plus four digits 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 digits 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
L	With lead (available for RoHS)
—	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																
		Part Number	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	
Piezoelectric Diaphragm	External Drive Type	7BB-12-9		●	●	●		●	●			●						
		7BB-15-6			●	●		●	●			●						
		7BB-20-3	●	●	●	●			●	●								
		7BB-20-6			●	●			●	●			●					
		7BB-20-6L0			●	●			●	●			●					
		7BB-27-4	●		●	●			●	●								
		7BB-27-4L0	●		●	●			●	●								
		7BB-35-3	●		●	●			●	●								
		7BB-35-3L0	●		●	●			●	●								
		7BB-41-2	●															
		7BB-41-2L0	●															
	7NB-31R2-1					●	●											
	Self Drive Type	7BB-20-6C	●						●	●								
		7BB-20-6CL0	●						●	●								
		7BB-27-4C	●					●	●	●								
		7BB-27-4CL0	●					●	●	●								
		7BB-35-3C	●					●	●	●								
		7BB-35-3CL0	●					●	●	●								
7BB-41-2C		●																
7BB-41-2CL0		●																
7SB-34R7-3C						●												
Piezoelectric Sounder	External Drive Type	PKM13EPYH4000-A0	●		●	●		●	●	●	●	●		●	●	●		
		PKM13EPYH4002-B0	●		●	●		●	●	●	●	●	●	●	●	●		
		PKM17EPP-2002-B0	●		●	●			●	●	●	●	●	●	●	●	●	
		PKM17EPPH4001-B0	●		●	●			●	●	●	●	●	●	●	●	●	
		PKM17EWH2001	●		●	●			●	●	●	●	●	●	●	●	●	
		PKM22EPH2001							●	●	●	●	●	●	●	●	●	
		PKM22EPPH2001-B0	●		●	●			●	●	●	●	●	●	●	●	●	
		PKM22EPPH4001-B0	●		●	●			●	●	●	●	●	●	●	●	●	
		PKM22EPPH4005-B0	●		●	●			●	●	●	●	●	●	●	●	●	
		PKM22EPPH4007-B0	●		●	●			●	●	●	●	●	●	●	●	●	
		PKM22EPTH2001-B0							●	●	●	●	●	●	●	●	●	
		PKM17EWH4000	●		●	●			●	●	●	●	●	●	●	●	●	
	PKLCS1212E4001-R1	●			●			●	●	●	●	●	●	●	●	●		
	PKLCS1212E40A1-R1															●		
	Self Drive Type	PKM24SPH3805	●					●	●	●	●	●	●	●	●	●	●	
PKM30SPH2001-B0								●	●	●	●	●	●	●	●	●		
PKM30SPH2501-B0								●	●	●	●	●	●	●	●	●		
Piezoelectric Buzzer	PKB24SPCH3601-B0	●			●			●	●	●	●	●	●	●	●	●		
	PKB24SWH3301	●		●				●	●	●	●	●	●	●	●	●		
	PKB30SPCH2001-B0	●					●	●	●	●	●	●	●	●	●	●		
	PKB30SPCH3001-B0	●					●	●	●	●	●	●	●	●	●	●		
Piezoelectric Ringer	PKM33EPH1201C	●																
	PKM34EWH1101C	●																
	PKM34EWH1201C	●																
	PKM44EWH1001C	●																
Piezoelectric Receiver	PKLCD1212R1000-R1	●																
Piezoelectric Speaker	VSB35EWH0701B	●						●	●	●	●	●	●	●	●	●		
	VSB50EWH0301B	●						●	●	●	●	●	●	●	●	●		

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



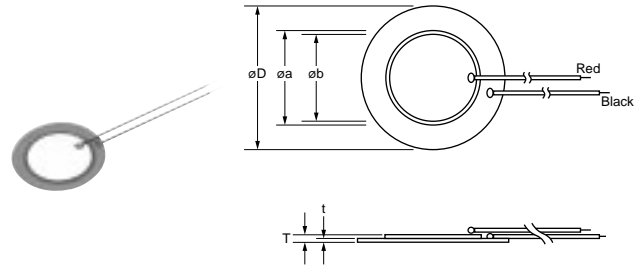
## Piezoelectric Diaphragms

### ■ Features

1. Extremely clear sound
2. Ultra thin and lightweight
3. No contacts: therefore, no noise and highly reliable
4. Low power consumption for voltage type

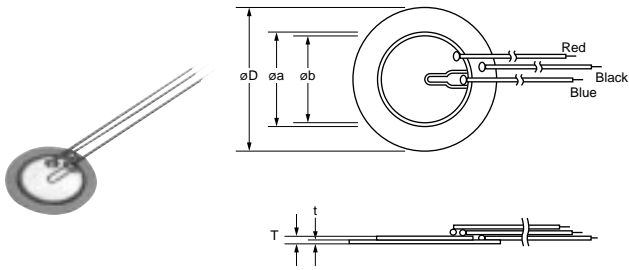
### ■ Applications

Clocks/Pagers/Calculators/Washing machine/  
Various alarms (Burglar alarms, etc.)



### 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-20-6L0	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-27-4L0	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-35-3L0	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-41-2L0	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)
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-20-6CLO</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-27-4CLO</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-35-3CLO</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-41-2CLO</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.



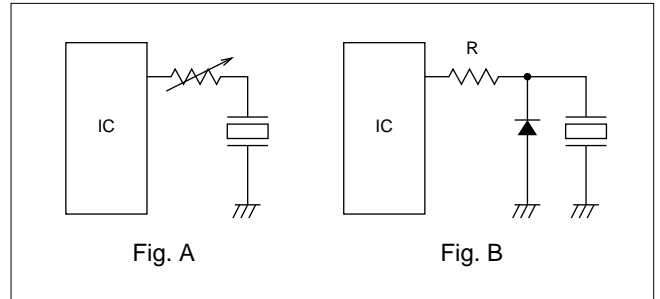
## Piezoelectric Diaphragms Notice

### ■ 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

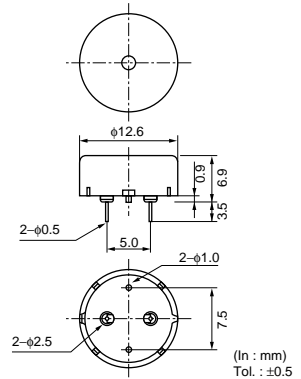
### ■ Applications

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

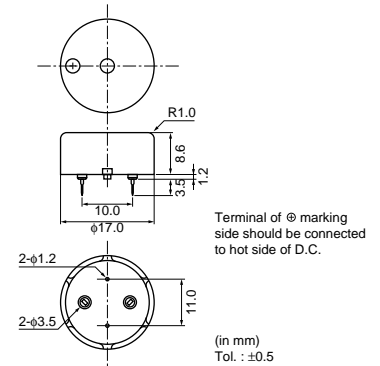
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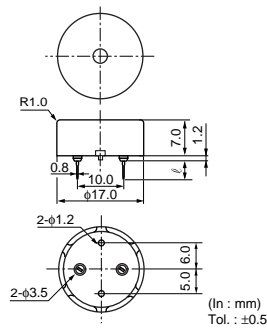
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PKM17EPP-2002-B0



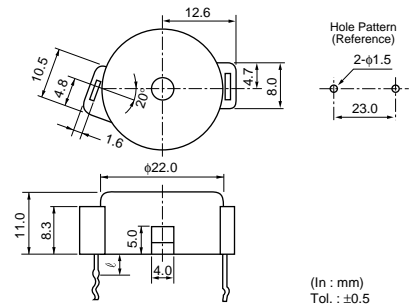
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Part Number	ℓ
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PKM17EPPH4002-B0	3.5



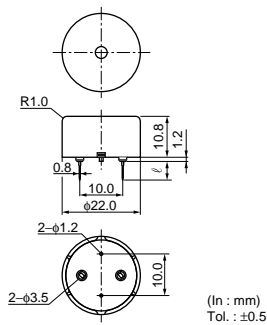
PKM22EPH2001



Part Number	ℓ
PKM22EPH2001	4.0
PKM22EPH2002	8.0
PKM22EPH2003	12.0



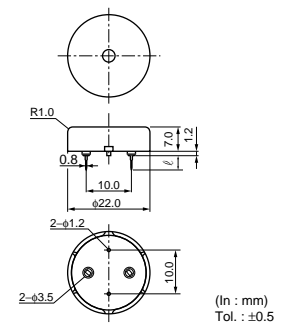
PKM22EPPH2001-B0



Part Number	ℓ
PKM22EPPH2001-B0	6.5
PKM22EPPH2002-B0	3.5



PKM22EPPH4001-B0



Part Number	ℓ
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PKM22EPPH4002-B0	3.5

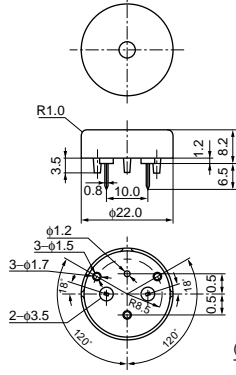
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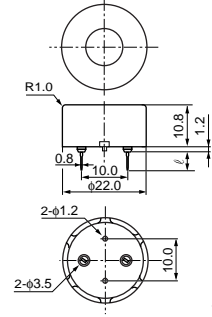
PKM22EPPH4005-B0



(In : mm)  
Tol. : ±0.5



PKM22EPPH4007-B0

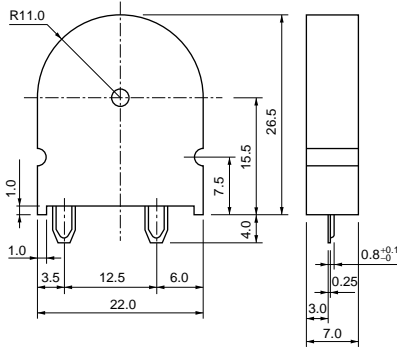


(In : mm)  
Tol. : ±0.5

Part Number	ℓ
PKM22EPPH4007-B0	6.5
PKM22EPPH4012-B0	3.5



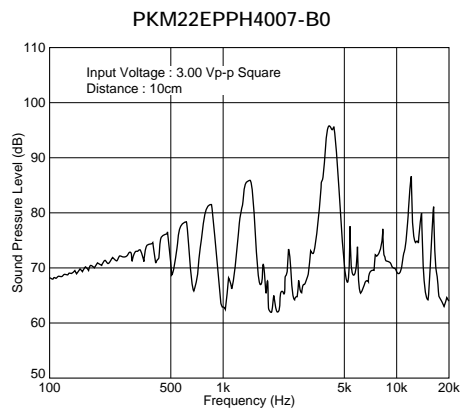
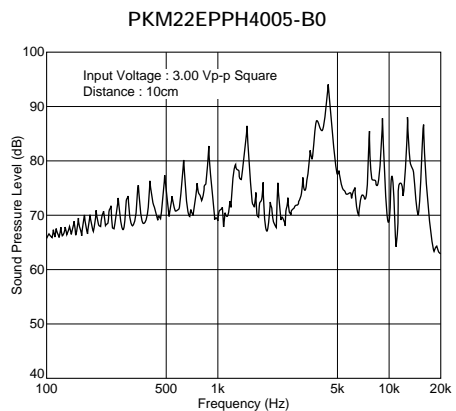
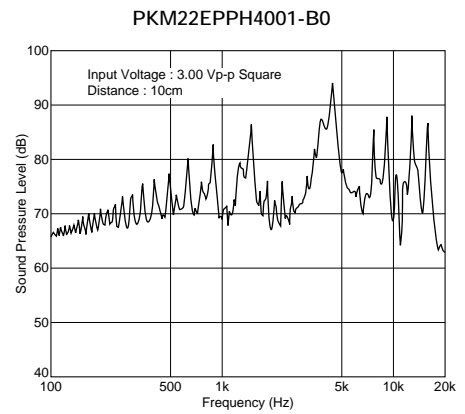
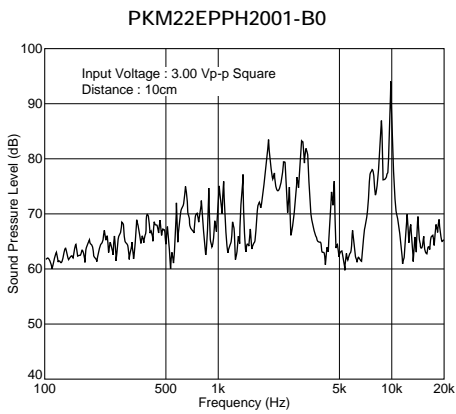
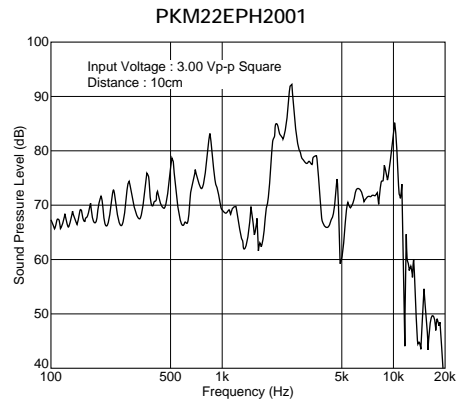
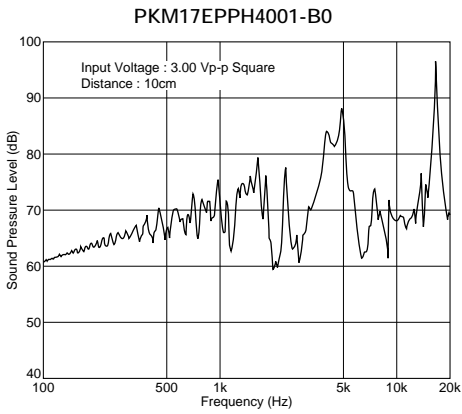
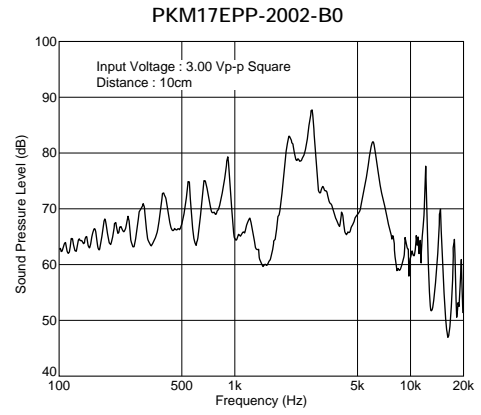
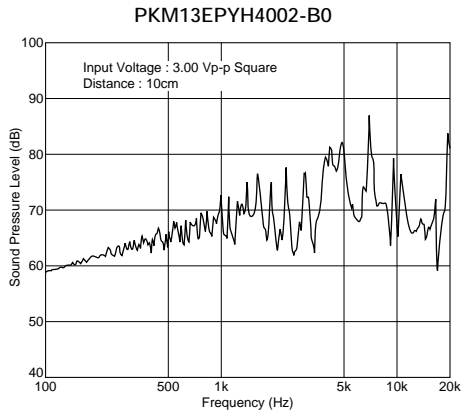
PKM22EPH2001-B0



(in mm)  
Tol.±0.5

Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Operating Voltage Range	Capacitance (nF)	Operating Temp. Range (°C)	Storage Temp. Range (°C)
<b>PKM13EPYH4002-B0</b>	70 min. [3Vp-p,4kHz,square wave,10cm]	70 min. [1Vrms,4kHz,sine wave,10cm]	30 Vp-p max.	5.5 ±30% [1kHz]	-40 to +85	-40 to +85
<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 ±30% [120Hz]	-20 to +70	-30 to +80
<b>PKM17EPPH4001-B0</b>	72 min. [3Vp-p,4kHz,square wave,10cm]	72 min. [1Vrms,4kHz,sine wave,10cm]	25 Vp-p max.	7 ±30% [1kHz]	-20 to +70	-30 to +80
<b>PKM22EPH2001</b>	75 min. [3Vp-p,2kHz,square wave,10cm]	75 min. [1Vrms,2kHz,sine wave,10cm]	25 Vp-p max.	17 ±30% [120Hz]	-20 to +70	-30 to +80
<b>PKM22EPPH2001-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	-30 to +80
<b>PKM22EPPH4001-B0</b>	75 min. [3Vp-p,4kHz,square wave,10cm]	75 min. [1Vrms,4kHz,sine wave,10cm]	25 Vp-p max.	12 ±30% [1kHz]	-20 to +70	-30 to +80
<b>PKM22EPPH4005-B0</b>	75 min. [3Vp-p,4kHz,square wave,10cm]	75 min. [1Vrms,4kHz,sine wave,10cm]	25 Vp-p max.	12 ±30% [1kHz]	-20 to +70	-30 to +80
<b>PKM22EPPH4007-B0</b>	85 min. [3Vp-p,4kHz,square wave,10cm]	85 min. [1Vrms,4kHz,sine wave,10cm]	25 Vp-p max.	12 ±30% [1kHz]	-20 to +70	-30 to +80
<b>PKM22EPH2001-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	-30 to +80

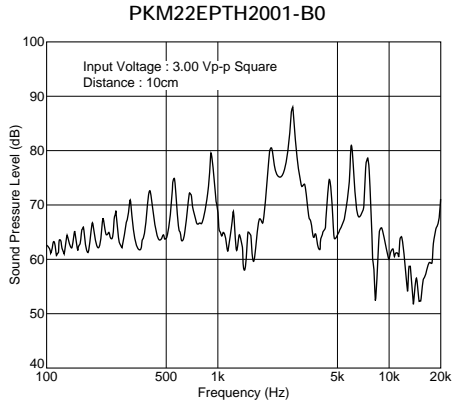
■ Freq. Response (Square Wave 3Vp-p, 10cm)



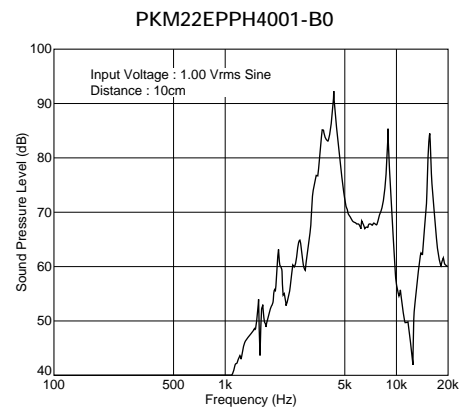
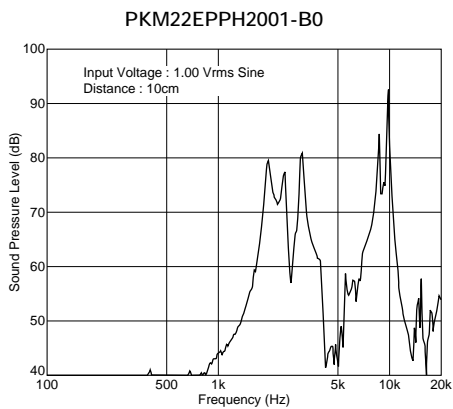
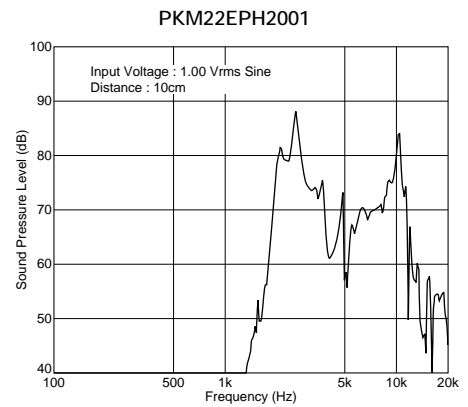
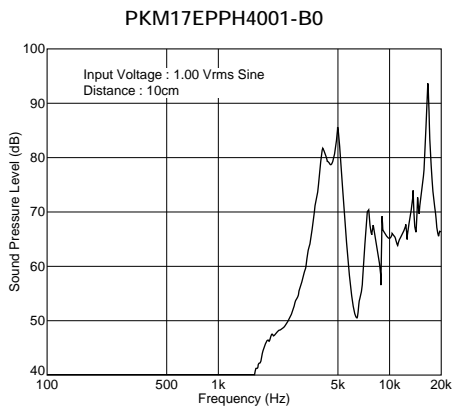
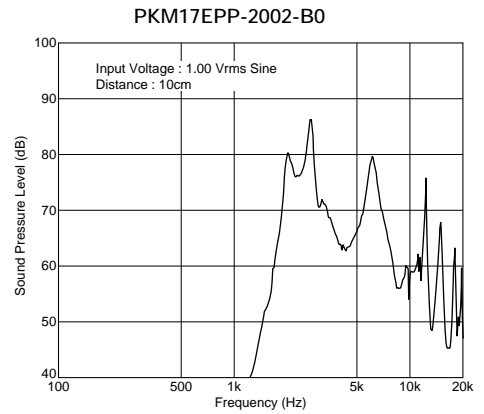
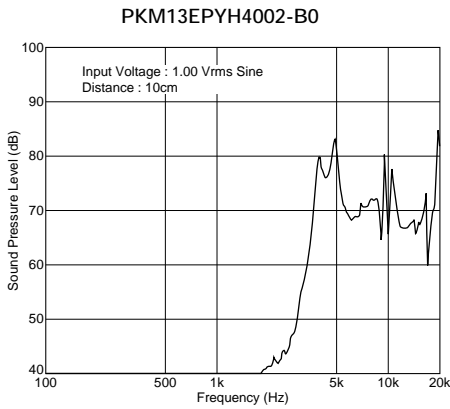
2

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



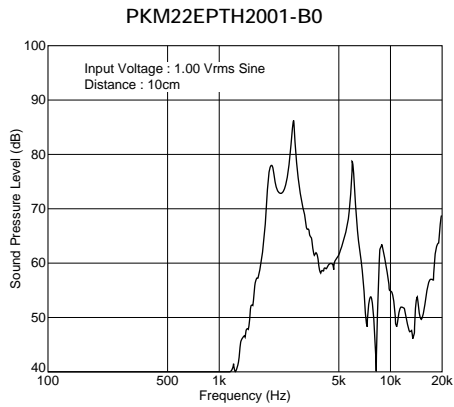
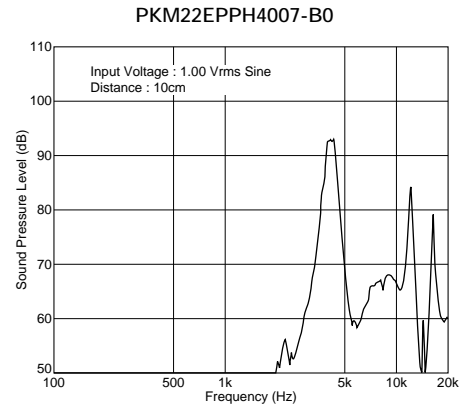
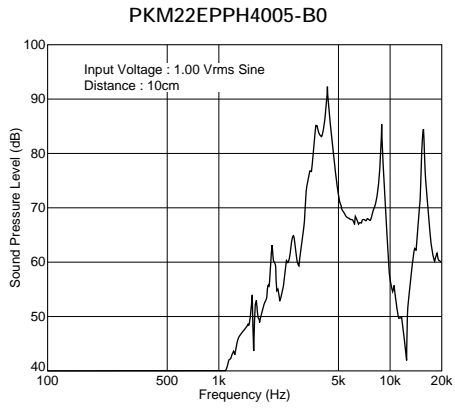
■ Freq. Response (Sine Wave 1Vrms, 10cm)



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



2

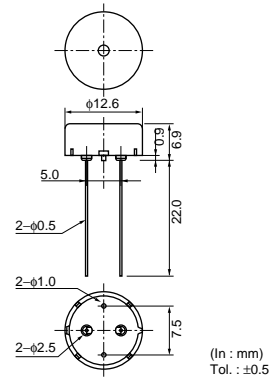
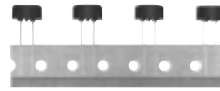
# Piezoelectric Sound Components



## 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.



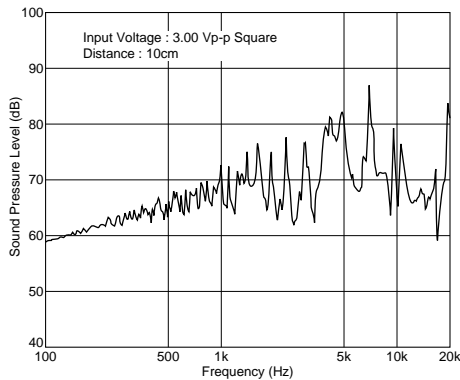
3

### ■ Features

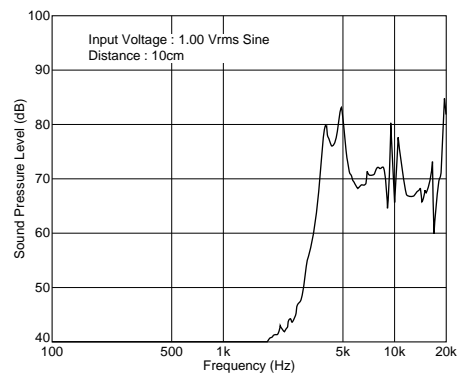
1. High and stable mountability
2. Ammo packaging
3. Minimum quantity (order in sets only): 500 pcs.

Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Operating Voltage Range	Capacitance (nF)	Operating Temp. Range (°C)	Storage Temp. Range (°C)
<b>PKM13EPYH4000-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]	-40 to +85	-40 to +85

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



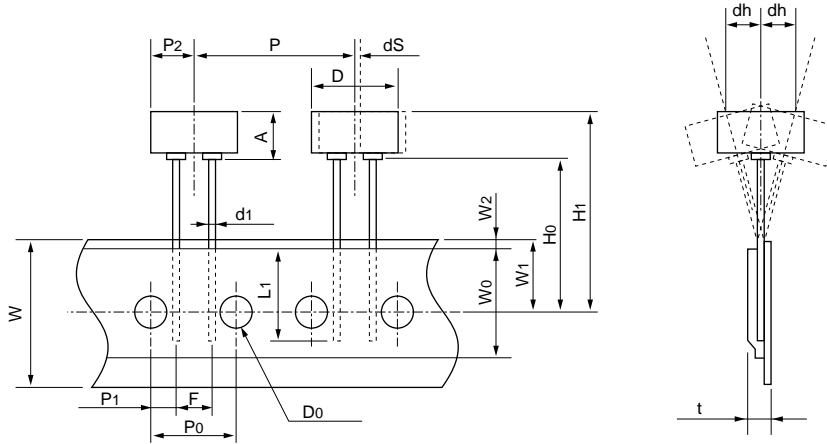
### ■ Freq. Response (Sine Wave 1Vrms, 10cm)



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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 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

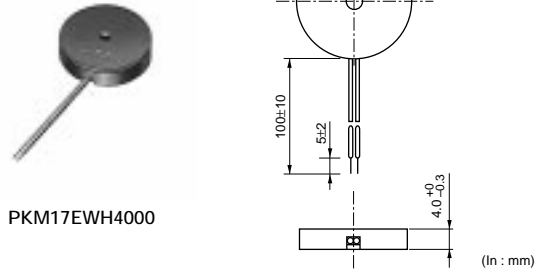
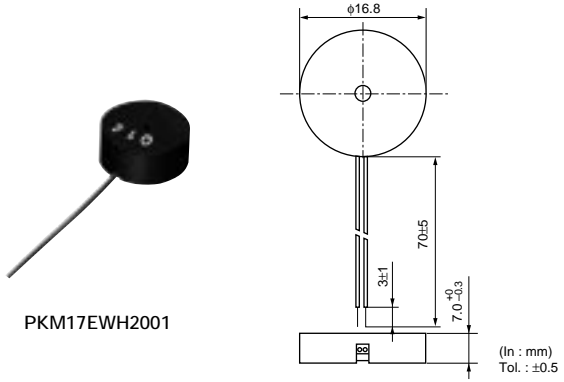
Now microcomputers are widely used for microwave ovens, air conditioners, cars, toys, timers, and other alarm equipment. Externally driven piezoelectric sounders are used in digital watches, electronic calculators, telephones and other equipment. They are driven by a signal (ex.: 2048Hz or 4096Hz) from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

### ■ Features

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

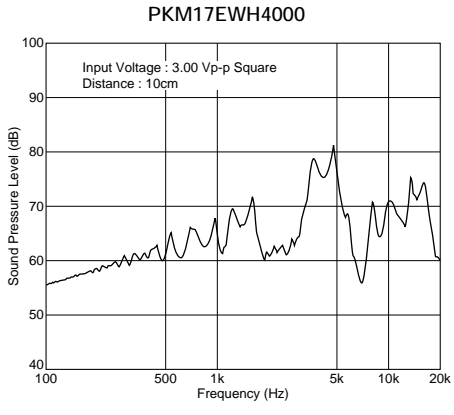
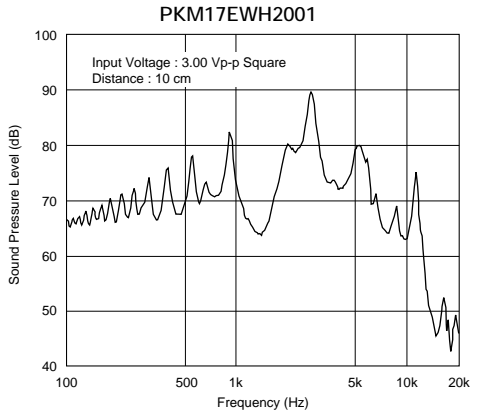
### ■ Applications

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



Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Operating Voltage Range	Capacitance (nF)	Operating Temp. Range (°C)	Storage Temp. Range (°C)
<b>PKM17EWH2001</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	-30 to +80
<b>PKM17EWH4000</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	-30 to +80

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



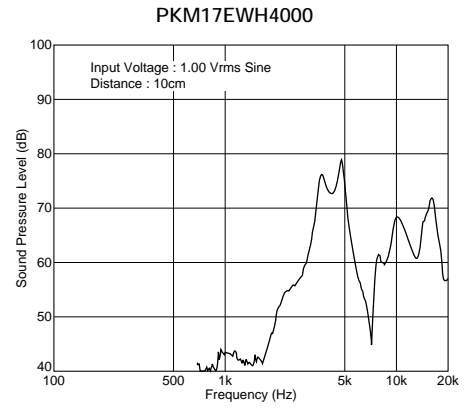
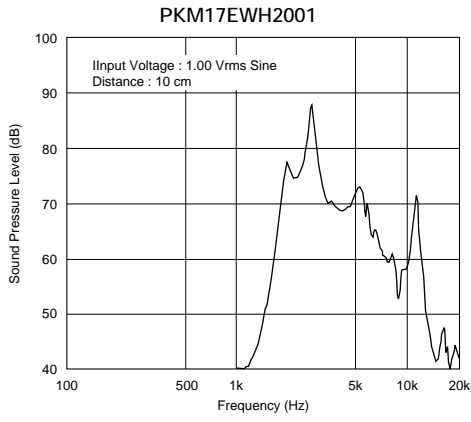
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■ Freq. Response (Sine Wave 1Vrms, 10cm)



# Piezoelectric Sound Components

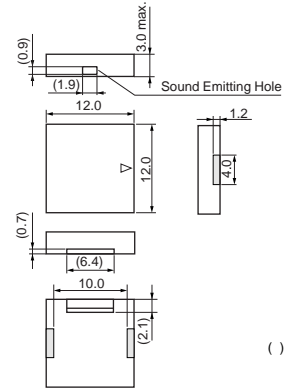


## Piezoelectric Sounders External Drive SMD Type

Taking advantage of extensive acoustic and mechanical design technology and high performance ceramics, Murata has developed SMD piezoelectric sounders that suit 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.

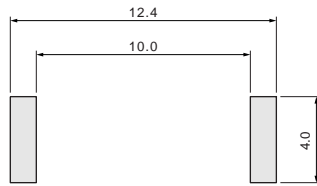


( ) : Ref. only  
( ) (in mm)  
Tol. ±0.2

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

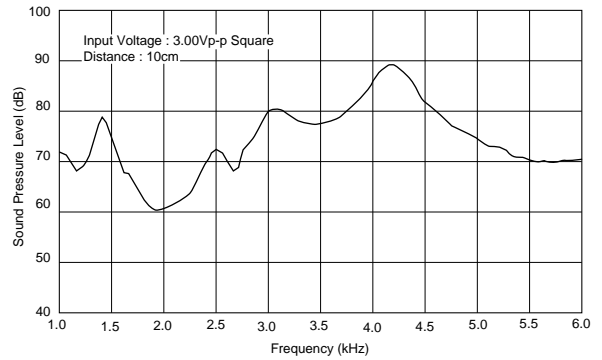
5

### ■ Standard Land Pattern Dimensions

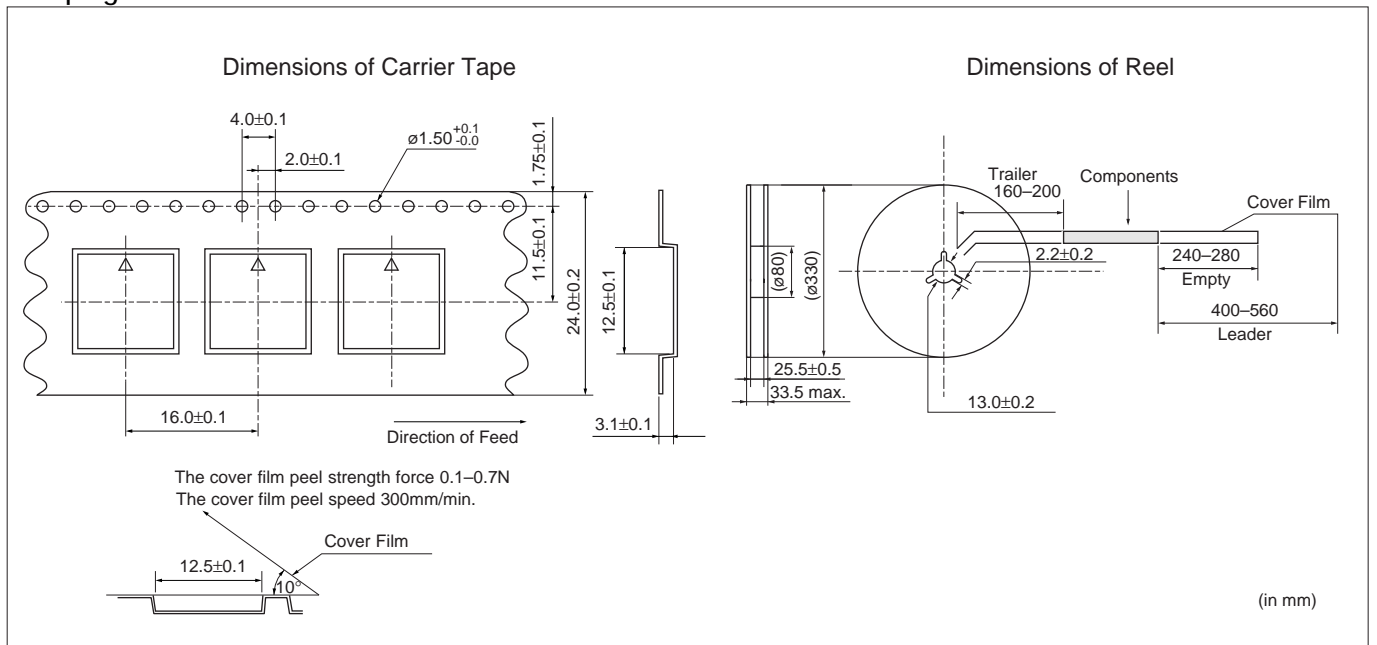


(in mm)

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



### ■ Taping Dimension



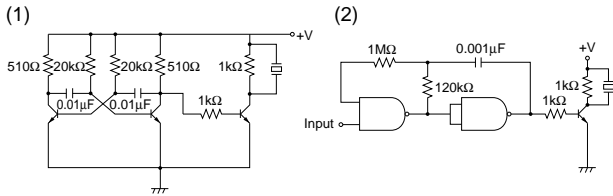
(in mm)

## 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.

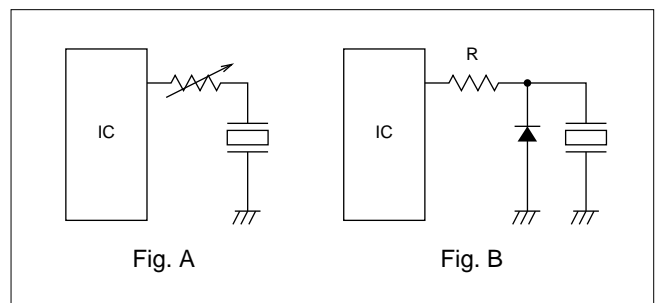


### ■ Notice (Soldering and Mounting)

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®)

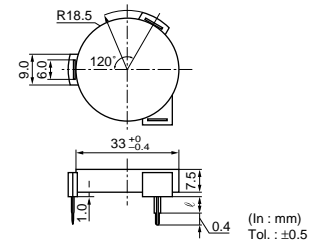
As the result of rapid development of ICs in telephones, demand for piezoelectric sounders as telephone ringers has also rapidly increased. To effectively satisfy this rising demand, Murata provides a suitable piezoelectric sounder called "PIEZORINGER" with the following features.

### ■ 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



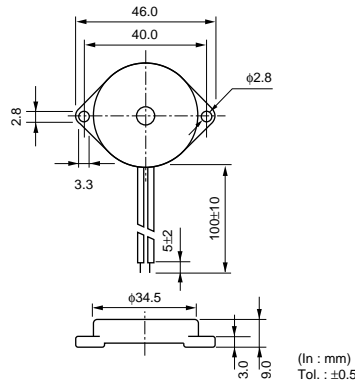
PKM33EPH1201C



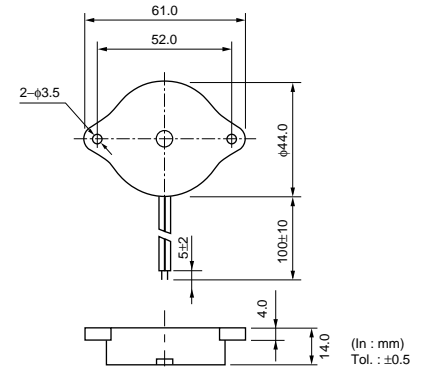
Part Number	ℓ
PKM33EPH1201C	5.0
PKM33EPH1202C	0



PKM34EWH1101C/1201C



PKM44EWH1001C



6

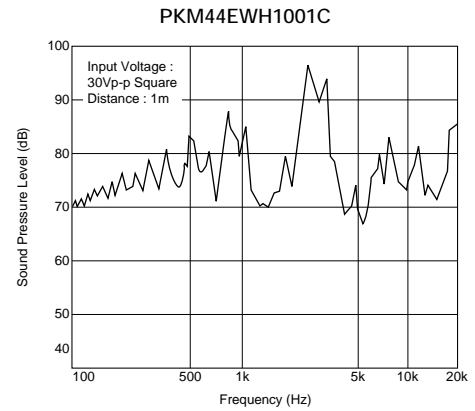
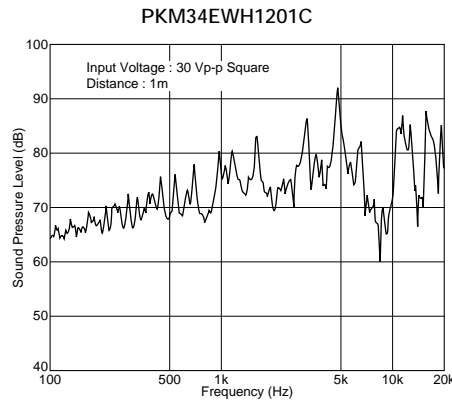
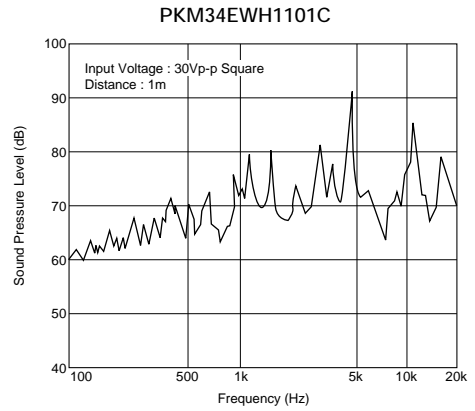
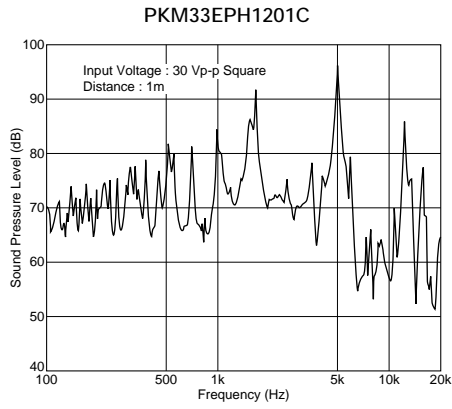
### Pin Type

Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Operating Voltage Range	Capacitance (nF)	Operating Temp. Range (°C)	Storage Temp. Range (°C)
PKM33EPH1201C	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	-30 to +80

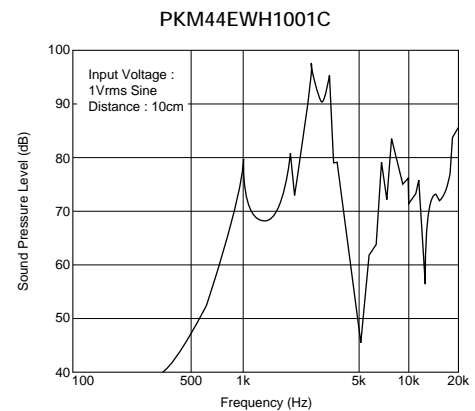
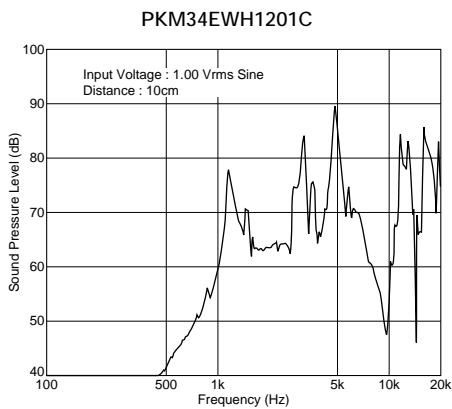
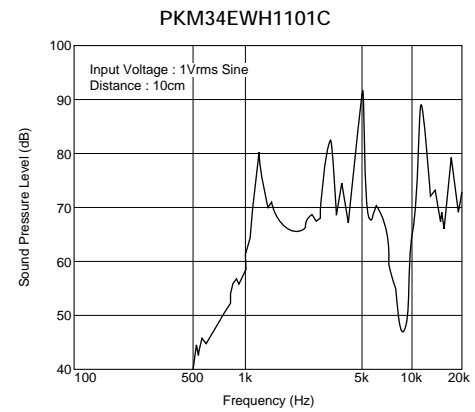
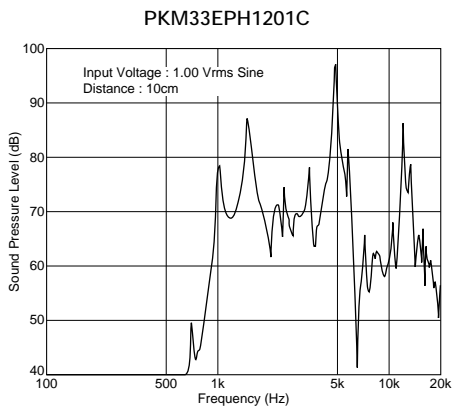
### Lead Wire Type

Part Number	Sound Pressure Level (dB)	Sound Pressure Level (Ref. only) (dB)	Operating Voltage Range	Capacitance (nF)	Operating Temp. Range (°C)	Storage Temp. Range (°C)
PKM34EWH1101C	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	-30 to +80
PKM34EWH1201C	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	-30 to +80
PKM44EWH1001C	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	-30 to +80

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



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



6

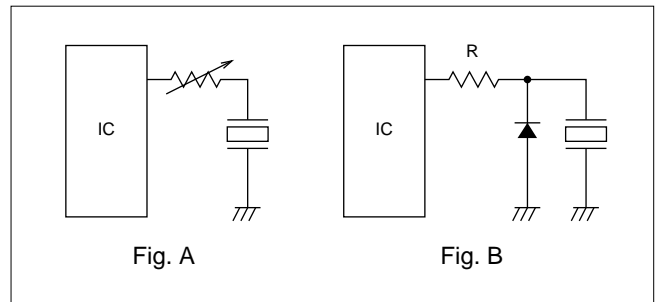
## Piezoelectric Ringers (PIEZORINGER®) Notice

### ■ 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

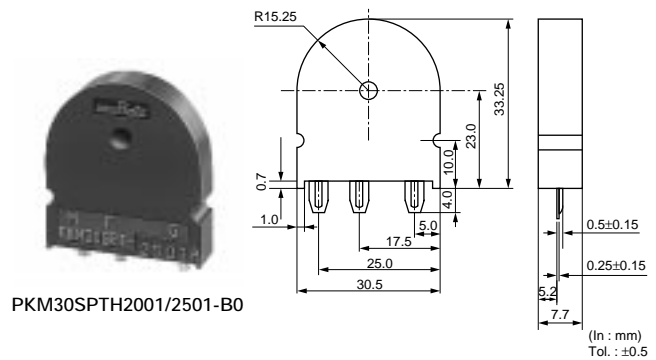
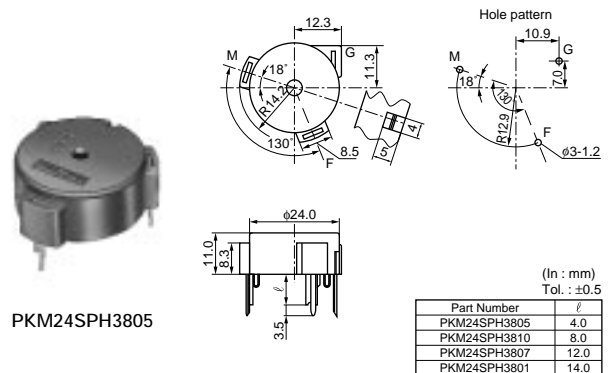


## Piezoelectric Sounders Self Drive Pin Type

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.

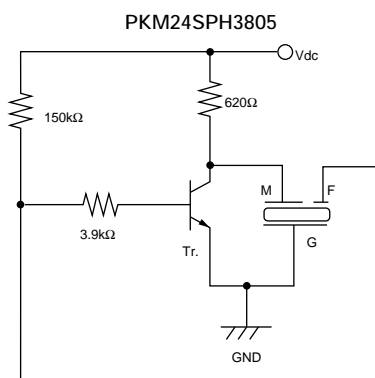
### Applications

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

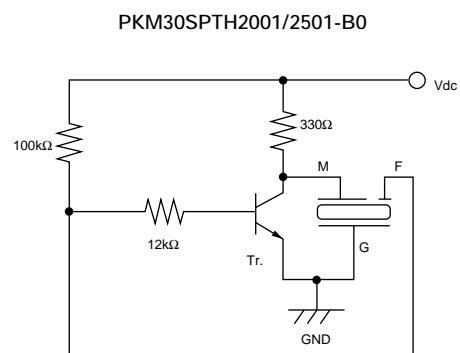


Part Number	Sound Pressure Level (dB)	Oscillating Frequency (kHz)	Current Consumption (mA)	Operating Voltage Range	Operating Temp. Range (°C)	Storage Temp. Range (°C)
<b>PKM24SPH3805</b>	90 min. [12Vdc, 10cm]	3.8 ±0.4kHz [12Vdc]	12 max. [12Vdc]	3.0Vdc to 20.0 Vdc	-20 to +70	-30 to +80
<b>PKM30SPH2001-B0</b>	75 min. [12Vdc, 10cm]	2.0 ±0.3kHz [12Vdc]	20 max. [12Vdc]	3.0Vdc to 20.0 Vdc	-20 to +70	-30 to +80
<b>PKM30SPH2501-B0</b>	75 min. [12Vdc, 10cm]	2.5 ±0.3kHz [12Vdc]	20 max. [12Vdc]	3.0Vdc to 20.0 Vdc	-20 to +70	-30 to +80

### 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. Since the circuit constants for  $h_{fe}$  of the transistor are optimally chosen to maintain stable oscillation, please design a circuit following the standard.

# Piezoelectric Sound Components



## Piezoelectric Buzzers

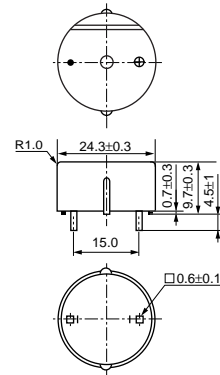
This is a unified piezoelectric sounder which has a piezoelectric diaphragm of 3 terminals connected to a self drive circuit, and it easily generates sound with only a DC power supply (DC3.0-20V). Using suitably designed resonant system, this type can be used where large sound volumes are needed.

### ■ Applications

1. Gas alarms, burglar alarms
2. Air conditioners, microwave ovens and various types of microcomputer controlled home-electronic appliances
3. Toys, games, and other simple electronic devices such as teaching aids



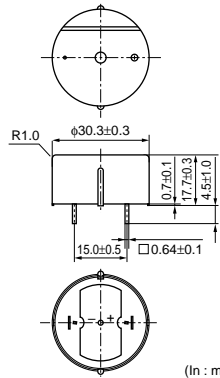
PKB24SPCH3601-B0



(In : mm)  
Tol. : ±0.5



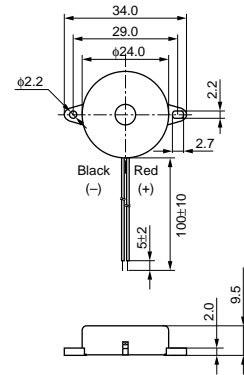
PKB30SPCH2001/3001-B0



(In : mm)



PKB24SWH3301



(In : mm)  
Tol. : ±0.5

### Pin Type

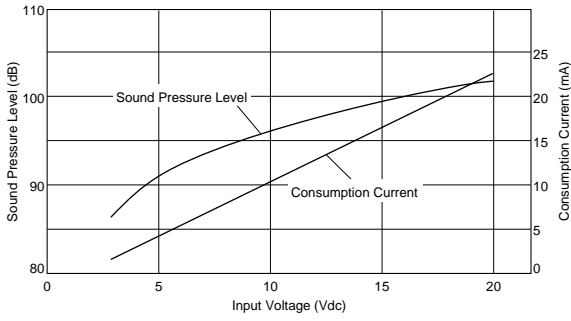
Part Number	Sound Pressure Level (dB)	Oscillating Frequency (kHz)	Current Consumption (mA)	Operating Voltage Range	Operating Temp. Range (°C)	Storage Temp. Range (°C)
PKB24SPCH3601-B0	90 min. [12Vdc, 10cm]	3.6 ±0.5kHz [12Vdc]	16 max. [12Vdc]	3.0Vdc to 15.0 Vdc	-20 to +70	-30 to +80
PKB30SPCH2001-B0	92 min. [12Vdc, 10cm]	2.0 ±0.4kHz [12Vdc]	15 max. [12Vdc]	3.0Vdc to 15.0 Vdc	-20 to +70	-30 to +80
PKB30SPCH3001-B0	92 min. [12Vdc, 10cm]	2.7 ±0.4kHz [12Vdc]	15 max. [12Vdc]	3.0Vdc to 15.0 Vdc	-20 to +70	-30 to +80

### Lead Wire Type

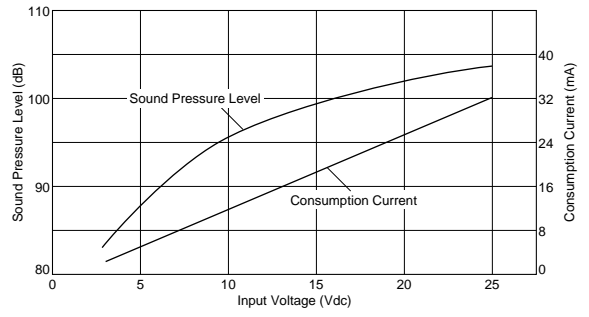
Part Number	Sound Pressure Level (dB)	Oscillating Frequency (kHz)	Current Consumption (mA)	Operating Voltage Range	Operating Temp. Range (°C)	Storage Temp. Range (°C)
PKB24SWH3301	80 min. [12Vdc, 10cm]	3.3 ±0.5kHz [12Vdc]	12 max. [12Vdc]	3.0Vdc to 20.0 Vdc	-20 to +70	-30 to +80

■ Voltage-Sound Pressure Level/Voltage-Consumption Current

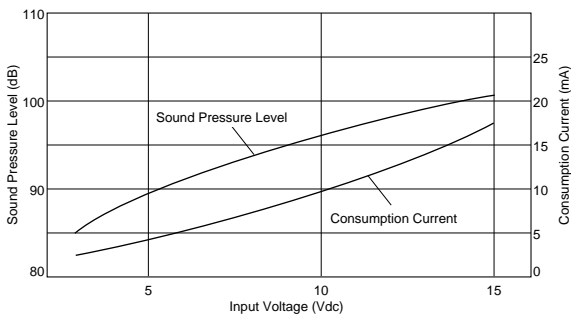
PKB24SPCH3601-B0



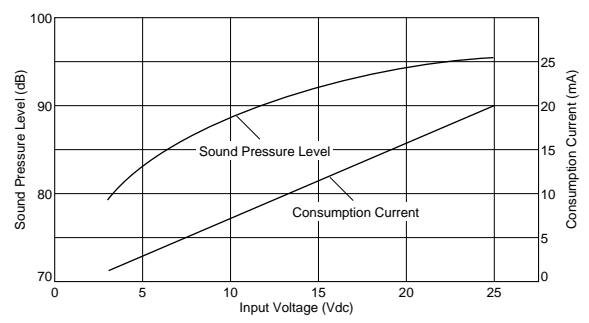
PKB30SPCH2001-B0



PKB30SPCH3001-B0



PKB24SW-3301



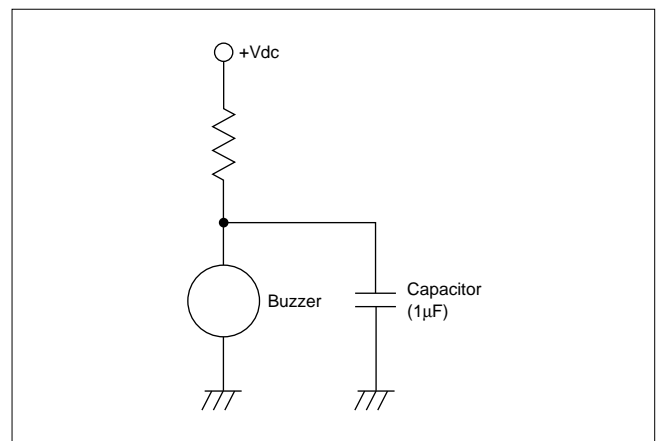
## Piezoelectric Buzzers Notice

### ■ 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 over this specification 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 together.
3. Please pay enough attention not to pull lead wire too much because wire may be broken or soldering point may come off.



# Piezoelectric Sound Components

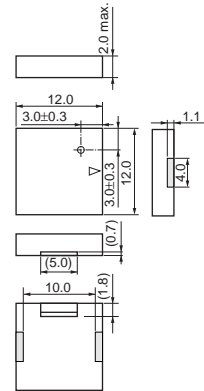
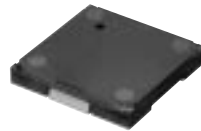


## Piezoelectric Receiver (CERAMIPHONE®)

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.

### ■ Features

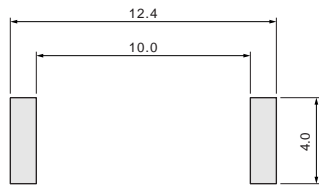
1. Thin shape, lightweight
2. Low current consumption and good matching impedance for a voltage drive
3. Reflowable
4. Tape & Reel supply
5. Minimum quantity (order in sets only): 1,500 pcs.



( ) : Ref. only  
(in mm)  
Tol. ±0.2

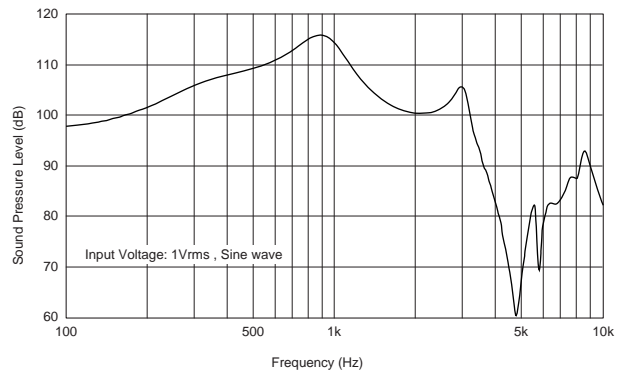
Part Number	Sound Pressure Level (1) (dB)	Sound Pressure Level (2) (dB)	Operating Voltage Range (Vp-p)	Operating Temperature Range (°C)	Storage Temperature Range (°C)
PKLCD1212R1000-R1	106.0 +4.0/-2.5 [at 300Hz]	114.0 +2.5/-4.0 [at 1kHz]	7 max.	-20 to +70	-30 to +80

### ■ Standard Land Pattern Dimensions

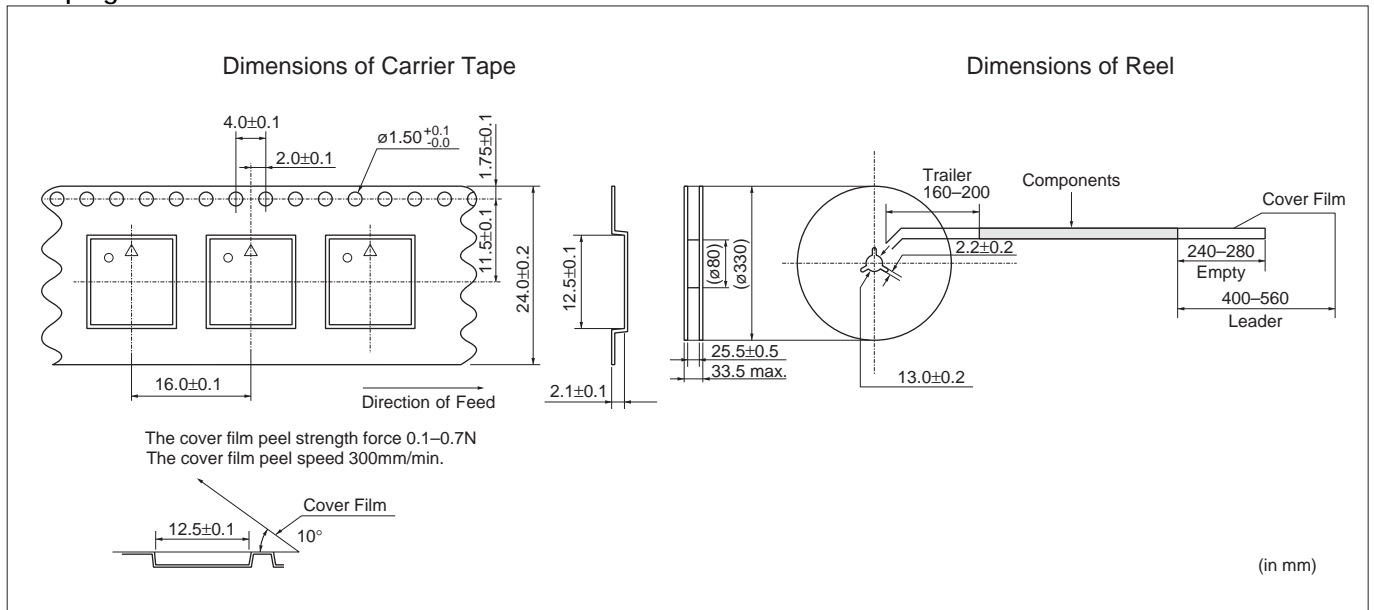


(in mm)

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

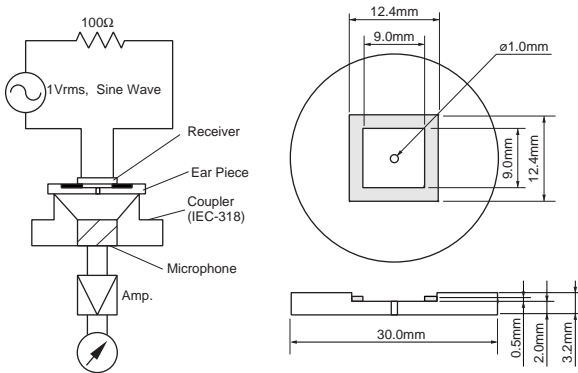


### ■ Taping Dimension



## 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®)

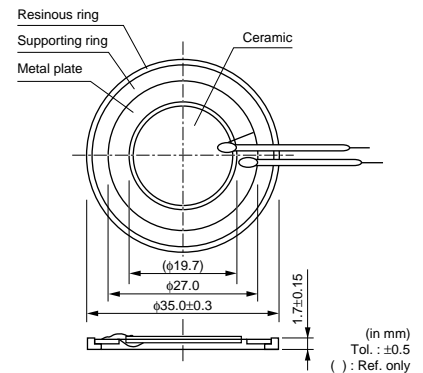
As voice synthesizing techniques with ICs and LSIs are rapidly progressing, human voice synthesizing devices are put into practical use for portable calculators, clocks, vending machines, translating machines and so forth. In order to meet the demand, Murata has developed Piezoelectric Speakers best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

### ■ Features

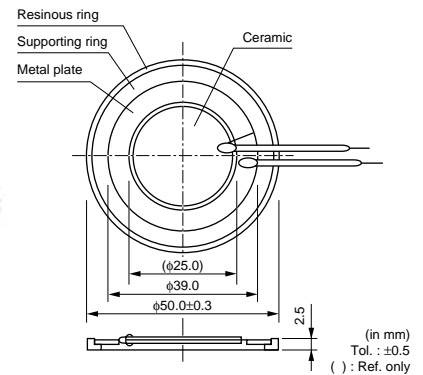
1. High efficiency compared with conventional electromagnetic type speakers
2. Ultra-thin and lightweight
3. High impedance with less power consumption
4. No electric noise, because they have no mechanical contacts.
5. Direct drive by IC is available.



VSB35EWH0701B

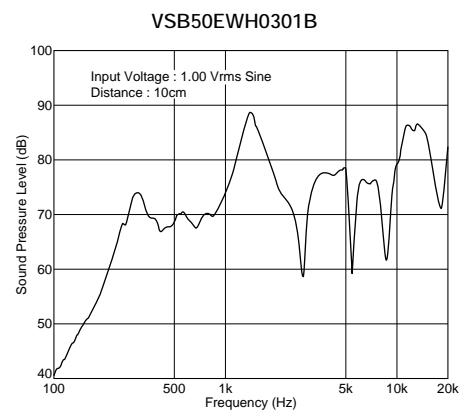
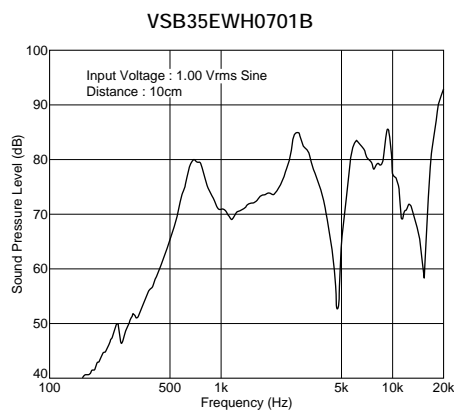


VSB50EWH0301B



Part Number	Oscillating Frequency Range	Resonant Frequency (Hz) [Lowest]	Impedance (ohm)	Capacitance (nF)	Maximum Input (mW)	Operating Temp. Range (°C)	Storage Temp. Range (°C)
<b>VSB35EWH0701B</b>	600Hz to 20kHz	950 ±150Hz	600[1kHz]	340 ±35%[120Hz]	75	-20 to +70	-30 to +80
<b>VSB50EWH0301B</b>	250Hz to 20kHz	400 ±150Hz	300[1kHz]	600 ±35%[120Hz]	150	-20 to +70	-30 to +80

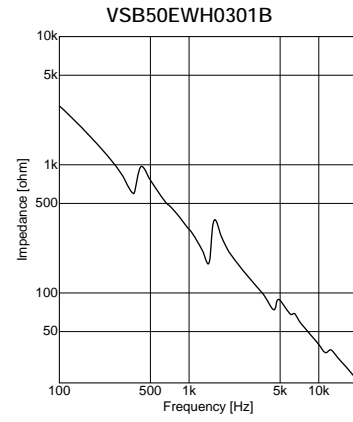
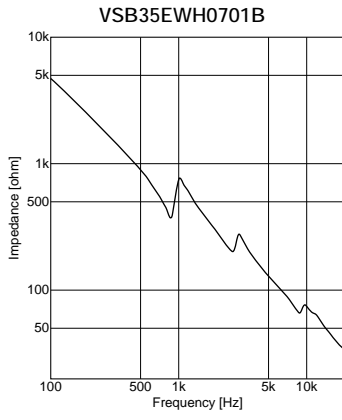
### ■ Freq. Response (Sine Wave 1Vrms, 10cm)



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### ■ Impedance-Frequency Characteristics





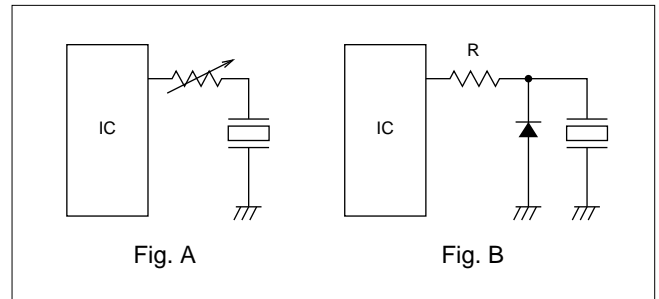
## Piezoelectric Speakers (CERAMITONE®) Notice

### ■ 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  $1k\Omega$  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 Notice

### ■ Notice (Storage and Operating Condition)

#### 1. Product Storage Condition

Please store the products in room where the temperature/humidity is stable. And avoid such places where there are large temperature changes. Please store the products under the following conditions:

Temperature: -10 to + 40 degree C

Humidity: 15 to 85% R.H.

#### 2. Expire Date on Storage

Expire date (Shelf life) of the products is six months after delivery under the conditions of a sealed and an unopened package. Please use the products within six months after delivery. If you store the products for a long time (more than six months), use caution because the products may be degraded in the solderability and/or rusty. Please confirm solderability and characteristics for the products regularly.

#### 3. Notice on Product Storage

- (1) Please do not store the products in a chemical atmosphere (Acids, Alkali, Bases, Organic gas, Sulfides and so on), because the characteristics may be reduced in quality, and/or be degraded in the solderability due to the storage in a chemical atmosphere.

- (2) Please do not put the products directly on the floor without anything under them to avoid damp places and/or dusty places.

- (3) Please do not store the products in the places such as: in a damp headed place, in a place where direct sunlight comes in, in place applying vibrations.

- (4) Please use the products immediately after the package is opened, because the characteristics may be reduced in quality, and/or be degraded in the solderability due to storage under the poor condition.

- (5) Please do not drop the products to avoid cracking of ceramic element.

#### 4. Others


Please be sure to consult with our sales representative or engineer whenever and prior to using the products.

## Package

### ■ Minimum Quantity (pcs.)


Product Names	Part Number	Minimum Quantity				
		Ø330mm Reel	Bulk (Box)	Ammo Pack	Magazine	
<b>● Piezoelectric Diaphragms*</b>						
External Drive Types	<b>7BB-12-9</b>		5120			
	<b>7BB-15-6</b>		8000			
	<b>7BB-20-3</b>		3000			
	<b>7BB-20-6</b>		1800			
	<b>7BB-20-6L0</b>		600			
	<b>7BB-27-4</b>		1500			
	<b>7BB-27-4L0</b>		600			
	<b>7BB-35-3</b>		800			
	<b>7BB-35-3L0</b>		400			
	<b>7BB-41-2</b>		400			
	<b>7BB-41-2L0</b>		250			
	<b>7NB-31R2-1</b>		3000			
	Self Drive Types	<b>7BB-20-6C</b>		1800		
		<b>7BB-20-6CL0</b>		600		
<b>7BB-27-4C</b>			1500			
<b>7BB-27-4CL0</b>			600			
<b>7BB-35-3C</b>			800			
<b>7BB-35-3CL0</b>			400			
<b>7BB-41-2C</b>			600			
<b>7BB-41-2CL0</b>			250			
<b>7SB-34R7-3C</b>			1600			
<b>● Piezoelectric Sounders*</b>						
External Drive Types	<b>PKLCS1212E4001-R1</b>	1000				
	<b>PKLCS1212E40A1-R1</b>	1000				
	<b>PKM13EPYH4000-A0</b>			500		
	<b>PKM13EPYH4002-B0</b>		330			
	<b>PKM17EPP-2002-B0</b>		200			
	<b>PKM17EPPH4001-B0</b>		200			
	<b>PKM17EPPH4002-B0</b>		200			
	<b>PKM17EWH2001</b>		250			
	<b>PKM17EWH4000</b>		500			
	<b>PKM22EPH2001</b>		360			
	<b>PKM22EPH2002</b>		270			
	<b>PKM22EPH2003</b>		270			
	<b>PKM22EPPH2001-B0</b>		750			
	<b>PKM22EPPH2002-B0</b>		750			
	<b>PKM22EPPH4001-B0</b>		900			
	<b>PKM22EPPH4002-B0</b>		900			
	<b>PKM22EPPH4005-B0</b>		750			
	<b>PKM22EPPH4007-B0</b>		750			
	<b>PKM22EPPH4012-B0</b>		750			
	<b>PKM22EPH2001-B0</b>		300		75 <sup>1)</sup>	

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>PKM24SPH3801</b>		270		
	<b>PKM24SPH3805</b>		360		
	<b>PKM24SPH3807</b>		270		
	<b>PKM24SPH3810</b>		270		
	<b>PKM30SPTH2001-B0</b>		70		
	<b>PKM30SPTH2501-B0</b>		70		
● Piezoelectric Buzzers*	<b>PKB24SPCH3601-B0</b>		650		
	<b>PKB24SWH3301</b>		200		
	<b>PKB30SPCH2001-B0</b>		80		
	<b>PKB30SPCH3001-B0</b>		80		
● Piezoelectric Ringers (PIEZORINGER®)*	<b>PKM33EPH1201C</b>		300		
	<b>PKM33EPH1202C</b>		60		
	<b>PKM34EWH1101C</b>		25		
	<b>PKM34EWH1201C</b>		25		
	<b>PKM44EWH1001C</b>		25		
● Piezoelectric Receiver	<b>PKLCD1212R1000-R1</b>	1500			
● Piezoelectric Speakers (CERAMITONE®)*	<b>VSB35EWH0701B</b>		160		
	<b>VSB50EWH0301B</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 May 2005. 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.