KYOCERA
Piezoelectric Acoustic Generators
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Piezoelectric Acoustic Generators

**Introduction**

AVX-Kyocera manufactures a wide variety of piezoelectric acoustic generator elements. These include external drive and self-oscillating buzzers, beepers, ringers and receivers.

Piezoelectric acoustical transducers are non-mechanical contact devices and feature the following advantages:

- Free from RF noise and contact sparking
- Simple, compact and light weight
- Consume little power and have long life
- Generate various timbres of pitches

Examples of applications are: telephones, watches, calculators, appliances, automobiles, smoke detectors and a wide variety of other electronic equipment.

The basic element in all of these is a piezoelectric ceramic mounted on a metal diaphragm. When AC voltage is applied across the electrodes of the piezoelectric ceramic it expands and contracts at the frequency applied. This causes the metal diaphragm to bend, producing sound waves (Figures 1 and 2).

The metal diaphragm is usually brass or stainless steel and less than 0.5 mm thick. PZT ceramic material is used as the piezoelectric element. This element is designed so that the mechanical resonant frequency matches the frequency of the driving signal.

**Piezoelectric Acoustic Generators**

Piezoelectric Acoustic Generators are available in two types:

1. **Two-terminal type**
2. **Three-terminal type**

The two-terminal type works when signal voltage is applied on the metal diaphragm as one electrode and the conductive-material-screened piezoelectric element as the other electrode.

The three-terminal type has a split electrode on the piezoelectric element. When the signal is applied between 2 and 1 in Figure 3, the phase shifted signal will be induced between 3 and 1 so that it works as a piezoelectric transformer. The phase shifted signal can be used as the feedback component in a simple oscillation circuit which operates automatically at the natural resonant frequency of the element.

---

**Impedance Characteristics**

The equivalent circuit of piezoelectric acoustic generators (2-terminal type) can be explained by the same equivalent circuit used for quartz crystal resonators and ceramic resonators. The mechanical resonance is shown by the series resonance circuit of $R_0$, $L_0$, $C_0$, and its resonant frequency ($f_r$) is determined as follows:

$$f_r = \frac{1}{2\pi \sqrt{L_0 C_0}}$$

In the case of the piezoelectric transducer the shunt capacitance is larger than that of other resonators. Therefore, the total impedance is capacitive.
Piezoelectric Acoustic Generators

Mounting

The various mounting methods for piezoelectric acoustic elements are discussed below:

Simple Mounting Method

The simplest method is to stick the piezo acoustic element to the plate using double-sided adhesive tape. However, the sound pressure will not be optimum.

Circumference Fixing Method

This method is to fix the outside circumference of the element to the supporting ring of the plate. Considerable sound pressure can be obtained covering a wide frequency range around the resonant frequency.

Nodal Mounting Method

This method is to fix the nodal diameter of the element to the supporting ring of the plate. Loud sound pressure can be obtained at the resonant frequency. The sound pressure will drastically drop when the frequency is shifted from the resonant frequency.

Designing the Fixture

Factors affecting the sound pressure of the piezoelectric acoustic element are as follows:

1) resonance frequency of the element
2) cavity resonance (cavity design of the case/casing method)
3) resonance of sound body (mass after casing)

Maximum sound pressure level can be achieved at the point where the 3 factors overlap. Taking the oscillation frequency fluctuation into consideration, the fixture is designed so that peak points are slightly overlapping with one another.

Case Design for Circumference Mounting Method

When designing a case for circumference mounting, the cavity resonant frequency of the case (f₀) is determined by the following formula:

\[ f₀ = \frac{C}{2\pi} \sqrt{\frac{S}{V(1+1.5\sqrt{\frac{S}{\pi}})}} \text{ (Hz)} \]

where:

- \( V \): cavity volume (m³)
- \( V = \frac{\pi D^2 T}{4} \)
- \( S \): area of open hole (m²)
- \( S = \frac{\pi d^2}{4} \)
- \( t \): Length of open hole (m)
- \( C \): sound velocity
- \( C = 344 \text{ m/sec} \)

For example, when KBS-35DA-3A (resonant frequency \( f_r = 2.9 ± 0.5 \text{ kHz} \)) is mounted in a case where the size is:

- \( D = 33.5 \text{ mm} \)
- \( d = 5.5 \text{ mm} \)
- \( T = 2 \text{ mm} \)
- \( t = 1 \text{ mm} \)

the formula for \( f₀ \) is explained as follows:

\[ f₀ = \frac{Cd}{2\pi D} \sqrt{\frac{1}{T(t+0.75d)}} \]

Then, the cavity resonant frequency shall be 2,807 Hz.

The adhesive agent used between the element and the support ring should be elastic, such as silicon rubber.
Case Design for Nodal Mounting Method

The piezoelectric acoustic element with feedback tab (3-terminal type) should be oscillated in the basic mode and supported at the nodal point to obtain stability.

The nodal point of the disc which has diameter “a” is located at the point of 0.224a from the edge of the disc. However, the element has a smaller ceramic disc than metal disc, which results in the nodal point being located at 0.15a to 0.20a from the metal disc edge.

A popular case design is shown in figure 10. The cavity is designed in front of the transducer together with a short pipe for the sound output release. The resonant frequency is determined by the same formula as for the circumference design.

Sound Pressure Level
Resonant Frequency (fr), Resonant Impedance (Ro)

The resonant frequency (fr) is defined as the reading at the point where impedance is at its minimum. Its impedance is defined as the resonant impedance.

Static Capacitance (Cd)

Static Capacitance measuring frequency is 1 kHz, except for low resonant frequency devices which are measured at 120 Hz. (See individual specifications.)
Suggestions for Handling

In order to maximize the quality of piezoelectric elements, it is necessary that proper handling procedures be used.

Do not operate or store for a long time under conditions of high temperature and high humidity.

- Piezoelectric characteristics may degrade when kept at more than 80°C for a long time.
- The electrodes may be shorted if a drop of water falls onto the silver electrode area of the transducer.

Keep soldering time to a minimum.

- Soldering operation must be less than 320°C and completed within 1.5 seconds.
- 2% silver solder for silver electrodes must be used to prevent leaching.
- Piezoelectric acoustic elements are supplied with leads for our customers' convenience. The specifications are as follows:
  1) Standard lead specification AWG#28 and AWG#32 (7 strand copper wires covered with red color vinyl insulation)
  2) Standard length (mm) 50, 75, 100, 125, 150

3) How leads may be soldered:

Do not apply unnecessary weight to the element

- The transducer consists of a one hundred micron thick metal plate and also a one hundred micron thick ceramic plate. The ceramic plate will crack when too much weight is applied to the device.

Mechanical Shock

- If equipment (with a piezo-electric transducer) receives a mechanical shock, resulting in stress to the piezoelectric element, an electric feedback can result, damaging other components in the circuits.

Attention must be paid to the assembled location in order to generate maximum sound output.

Remember that the 3-terminal type is a part of the oscillation circuit.

- Do not place a cover in front of the buzzer, if possible.
- When assembling, do not deform or bend the transducer fixture. Deformation of the transducer changes the oscillation condition.

NOTE: Wherever possible, the piezo devices should be capacitive coupled to avoid permanent DC bias and possible long term damage.

Drive Circuits

Because the impedance of the piezoelectric buzzer (2-terminal type) is capacitive, the drive circuit can be designed utilizing the transducer as a capacitor.

Drive circuits are classified into two types. One type is the amplification type which amplifies and supplies input signal (from IC, etc.) to the transducer. The other is the oscillation type, in which the transducer constitutes a part of the circuit together with other active elements.

Typical circuit types are as follows:

<table>
<thead>
<tr>
<th>Transducer Drive Circuit</th>
<th>Amplification Type</th>
<th>Oscillation Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load Resistance Type</td>
<td>Blocking Oscillation Type</td>
<td></td>
</tr>
<tr>
<td>Complementary Type</td>
<td>Multivibrator Type</td>
<td></td>
</tr>
<tr>
<td>Load Inductance Type</td>
<td>CR Oscillation Type</td>
<td></td>
</tr>
<tr>
<td>3-Terminal Buzzer Type</td>
<td>IC Type</td>
<td></td>
</tr>
</tbody>
</table>

Table 1

![Figure 13](image-url)
Piezoelectric Acoustic Generators

Amplification Type Circuits

**Load Resistance Type**

This is the simplest circuit. Applied voltage $V_{pp}$ will be $V_{cc}$.
Loud sound pressure cannot be achieved. For example,

- $V_{cc}=5V$
- $B2=KBS-27DB-3A$
- $f=3.3kHz$
- $R_1=30k\Omega$
- $R_2=15k\Omega$
- $R_3=1k\Omega$

Two-step amplification using transistors: The transducer is connected between the collectors of each transistor making the applied voltage $(V_{pp}) \times 2xV_{cc}$.

**Complementary Type**

In this example, the sound pressure level is relatively low. It is effective for reducing current consumption, and when a highly efficient circuit is the goal.

**Load Inductance Type**

High voltage can be applied to the transducer by using load inductance. The smaller the "L" is, the higher the peak voltage. However, the current consumption will increase, also increasing the spurious oscillation, which results in degradation of the tone quality.

NOTE: Wherever possible, the piezo devices should be capacitive coupled to avoid permanent DC bias and possible long term damage.

Oscillation Type Circuits

**Blocking Oscillation Type**

This is the most effective circuit when loud sound pressure is required, and the supply voltage is low. This circuit operates in the same manner as the Load Inductance type. The duty factor will be large and the spurious oscillation will increase if the inductance of the transformer is small.

- $L_1=550T (30mH)$
- $L_2=150T$
- $Bz=KBS-27DB-3A$

<table>
<thead>
<tr>
<th>$V_{cc}$</th>
<th>Current</th>
<th>Frequency</th>
<th>$R_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5V</td>
<td>2.2mA</td>
<td>3kHz</td>
<td>38.9kΩ</td>
</tr>
<tr>
<td>3V</td>
<td>4.1mA</td>
<td>3kHz</td>
<td>63.7kΩ</td>
</tr>
<tr>
<td>4.5V</td>
<td>6.0mA</td>
<td>3kHz</td>
<td>74.8kΩ</td>
</tr>
</tbody>
</table>

**CR Oscillation Type**

It is easy to generate a sine wave when the high frequency component is small, which will result in good tone quality. However, sound pressure is low. The larger the $h_{FE}$ of the transistor is, the more stable the oscillation.

<table>
<thead>
<tr>
<th>$V_{cc}$</th>
<th>Current</th>
<th>Frequency</th>
<th>$R_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.5V</td>
<td>7.7mA</td>
<td>2.25-3.3kHz</td>
<td></td>
</tr>
<tr>
<td>12V</td>
<td>6.0mA</td>
<td>2.2 - .1kHz</td>
<td></td>
</tr>
<tr>
<td>9V</td>
<td>4.6mA</td>
<td>2.1 - 3.0kHz</td>
<td></td>
</tr>
<tr>
<td>6V</td>
<td>3.0mA</td>
<td>2.1 - 2.9kHz</td>
<td></td>
</tr>
<tr>
<td>-4.5V</td>
<td>2.2mA</td>
<td>2.0 - 2.8kHz</td>
<td></td>
</tr>
</tbody>
</table>

**Multivibrator Type**

The transducer is connected between the collectors of two transistors of a multivibrator which generates a stable square wave. The shoulders of the square wave are rounded due to this, but $V_{pp}$ will be double $V_{cc}$.

<table>
<thead>
<tr>
<th>$V_{cc}$</th>
<th>Current</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5V</td>
<td>3.3mA</td>
<td>2.8kHz</td>
</tr>
<tr>
<td>3V</td>
<td>7.1mA</td>
<td>3.2kHz</td>
</tr>
</tbody>
</table>
Piezoelectric Acoustic Generators

Oscillation Type Circuits

3-Terminal Buzzer Type

A Piezo Transducer with a feedback tab makes the circuit oscillate without inductors and capacitors. The number of components is reduced and it is possible to generate from a sine wave to a trapezoidal wave.

<table>
<thead>
<tr>
<th>V_{cc}</th>
<th>Current</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 V</td>
<td>8.2mA</td>
<td>2.55kHz</td>
</tr>
<tr>
<td>12 V</td>
<td>6.4mA</td>
<td>2.55kHz</td>
</tr>
<tr>
<td>9 V</td>
<td>4.6mA</td>
<td>2.55kHz</td>
</tr>
<tr>
<td>6 V</td>
<td>3.0mA</td>
<td>2.55kHz</td>
</tr>
<tr>
<td>4.5V</td>
<td>2.0mA</td>
<td>2.55kHz</td>
</tr>
<tr>
<td>3 V</td>
<td>1.1mA</td>
<td>2.55kHz</td>
</tr>
</tbody>
</table>

In order to increase the sound pressure level, a coil can be added to the circuit.

IC Type

It is easy to build this circuit by using CMOS inverters, such as MC14049, and MC14069. The oscillation frequency is in proportion to 1/(R_1 C). It is easy to do on-off oscillation by using a CMOS NAND gate such as MC14011. When the input terminal is high, the transducer works. When the input terminal is low, it stops.

This is an example of a circuit that will generate various sounds using one MC14069. The frequency determined by R_2, C oscillates 1kHz to 5kHz and 2 times the V_{cc} is applied to the transducer as V_{pp}.

NOTE: Whenever possible, the piezo devices should be capacitive coupled to avoid permanent DC bias and possible long term damage.

NOTE: Please investigate in detail to confirm that you will not be in violation of the patents of others when using the above circuit examples in volume production.
Piezoelectric Acoustic Generators

Piezo Ceramic Elements - External Drive Type

Features:
1) Wide variety of tones possible by connection to external circuits.
2) Low power consumption, thin, lightweight
3) No-contact design makes element highly reliable and eliminates noise problems

Applications:
1) Clocks, electronic calculators, pocket alarms, cameras.
2) Equipment containing microprocessors (microcomputers, microwave ovens, TVs, stereos, automobiles, etc.)
3) Telecommunications equipment (facsimile machines, telephones)
4) Electronic medical equipment

How To Order:

KBS - 20 DA - 7 A S - 1

1  2  3  4  5  6  7

1) Model
2) Diameter (mm), eg. 20
3) Piezo Ceramic Element
4) Resonant Frequency in kHz
5) 2 Electrode Types
   A = Element only
   C = With lead wires
6) Metal Disc Material
   S = Stainless Steel
   Blank = Brass
7) Modifier code for lead wire spec.

Dimensions:
A type - 2 Electrodes

C type - 2 Electrodes with Lead Wires

Available Lead Wire Options

<table>
<thead>
<tr>
<th>W: Thickness</th>
<th>AWG-32 (UL-1571)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L: Length (mm)</td>
<td>50 \pm 5, 75 \pm 5, 100 \pm 10, 125 \pm 10, 150 \pm 15</td>
</tr>
<tr>
<td>S: Strip Part</td>
<td>3 \pm 1, 5 \pm 1</td>
</tr>
<tr>
<td>C: Color</td>
<td>red, black, blue</td>
</tr>
</tbody>
</table>

Temperature Characteristics (KBS-27DA-5A)

- RESONANT FREQUENCY \( (f_r) \)
- TEMPERATURE CHARACTERISTICS (CAPACITANCE: \( C_d \))
Piezoelectric Acoustic Generators

Piezo Ceramic Elements - External Drive Type

Specifications
(A type)

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Resonant Frequency (kHz)</th>
<th>Resonant Impedance (Ω)</th>
<th>Static Capacitance (pF)</th>
<th>Dimensions (mm)</th>
<th>Metal Disc Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBS-13DA-12A</td>
<td>12.0 ± 1.2</td>
<td>700</td>
<td>5,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-15DA-9A-2</td>
<td>10.5 ± 3.0</td>
<td>600</td>
<td>8,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-20DA-7A</td>
<td>6.6 ± 1.0</td>
<td>300</td>
<td>10,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-20DA-7AS</td>
<td>7.5 ± 1.0</td>
<td>300</td>
<td>10,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-23DA-4A</td>
<td>4.0 ± 1.0</td>
<td>600</td>
<td>12,000 ± 30%</td>
<td></td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>KBS-27DA-3A</td>
<td>3.0 ± 0.5</td>
<td>1,500</td>
<td>10,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-27DA-5A</td>
<td>4.6 ± 0.5</td>
<td>200</td>
<td>20,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-27DA-5AS</td>
<td>5.0 ± 0.5</td>
<td>200</td>
<td>20,000 ± 30%</td>
<td></td>
<td>Stainless Steel</td>
</tr>
<tr>
<td>KBS-30DA-1A</td>
<td>1.4 ± 0.5</td>
<td>500</td>
<td>▲ 48,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-35DA-3A</td>
<td>2.9 ± 0.5</td>
<td>200</td>
<td>30,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-38DA-2AL</td>
<td>1.5 ± 0.3</td>
<td>300</td>
<td>▲ 36,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-47DA-06A-3</td>
<td>0.70 ± 0.20</td>
<td>700</td>
<td>▲ 120,000 MIN.</td>
<td></td>
<td>42-Alloy</td>
</tr>
<tr>
<td>KBS-50DA-06A</td>
<td>0.85 ± 0.25</td>
<td>1,500</td>
<td>▲ 120,000 MIN.</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-50DA-08A-3</td>
<td>0.87 ± 0.25</td>
<td>3,000</td>
<td>▲ 40,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-50DA-1A</td>
<td>0.90 ± 0.30</td>
<td>600</td>
<td>▲ 45,000 ± 30%</td>
<td></td>
<td>Brass</td>
</tr>
</tbody>
</table>

* Measured at 120Hz, all others at 1kHz

Application Circuits For External-Drive Oscillation Buzzer

Watch Circuit

Ringing Circuit (for telephone)

1.C. Oscillation Circuit (without feedback)

NOTE: Wherever possible, the piezo devices should be capacitive coupled to avoid permanent DC bias and possible long term damage.
Piezoelectric Acoustic Generators

Piezo Ceramic Elements - Self Oscillating Type

Features:
1) Connection to a self oscillating circuit produces clear sounds with high sound pressure level
2) Low power consumption
3) Thin, lightweight
4) No-contact design makes element highly reliable and eliminates noise problems

Applications:
1) Smoke detectors, security alarms, and other warning devices
2) Pocket pager/alarm, electronic calculators, and consumer products
3) Telephones

How To Order:

<table>
<thead>
<tr>
<th>KBS - 35</th>
<th>DA - 3</th>
<th>G</th>
<th>-</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Model</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Diameter (mm) eg. 35</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Element shape (Disc-Shaped Piezoelectric Buzzer)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Resonant Frequency: eg. 3kHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>3-Terminal Electrode Type</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FC = F-Shaped Pattern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>G = G-Shaped Pattern</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>GC = G-Shaped Pattern with lead</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Disc Material</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S = Stainless Steel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Blank = Brass</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Classification for elements of the same shape (in case of partial modification of standard specifications only)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dimensions

FC type

G type

Standard AVX/Kyocera Lead Wire (3 electrode devices)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>W: Thickness</td>
<td>AWG-32 (UL-1571)</td>
</tr>
<tr>
<td>L: Length (mm)</td>
<td>50 ± 5, 75 ± 5, 100 ± 10, 125 ± 10, 150 ± 15</td>
</tr>
<tr>
<td>S: Stripped Part Length (mm)</td>
<td>3 ± 1, 5 ± 1</td>
</tr>
<tr>
<td>C: Color</td>
<td>red, black, blue</td>
</tr>
</tbody>
</table>

GC type only. FC not available with lead wires.
Piezoelectric Acoustic Generators

Piezo Ceramic Elements - Self Oscillating Type

Specifications
(G type Self Oscillating Type)

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Resonant Frequency (kHz)</th>
<th>Resonant Impedance (Ω)</th>
<th>Static Capacitance (pF)</th>
<th>Dimensions (mm)</th>
<th>Metal Disc Material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Metal Disc (μA)</td>
<td>Ceramic Disc (μA)</td>
</tr>
<tr>
<td>KBS-27DA-5G</td>
<td>4.6 ± 0.5</td>
<td>200</td>
<td>16,000 ± 30%</td>
<td>27.0 ± 0.1</td>
<td>20.2 ± 0.3</td>
</tr>
<tr>
<td>KBS-35DA-3G</td>
<td>2.9 ± 0.5</td>
<td>200</td>
<td>25,000 ± 30%</td>
<td>35.0 ± 0.1</td>
<td>25.0 ± 0.5</td>
</tr>
<tr>
<td>KBS-35DA-3GS</td>
<td>3.2 ± 0.5</td>
<td>200</td>
<td>25,000 ± 30%</td>
<td>34.55 ± 0.1</td>
<td>25.0 ± 0.5</td>
</tr>
<tr>
<td>KBS-35DA-3GS-6</td>
<td>3.2 ± 0.3</td>
<td>200</td>
<td>25,000 ± 30%</td>
<td>34.55 ± 0.1</td>
<td>25.0 ± 0.5</td>
</tr>
<tr>
<td>KBS-41DA-2G</td>
<td>2.2 ± 0.3</td>
<td>200</td>
<td>20,000 ± 30%</td>
<td>41.47 ± 0.1</td>
<td>25.0 ± 0.5</td>
</tr>
</tbody>
</table>

(F type)

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Resonant Frequency (kHz)</th>
<th>Resonant Impedance (Ω)</th>
<th>Static Capacitance (pF)</th>
<th>Dimensions (mm)</th>
<th>Metal Disc Material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Metal Disc (μA)</td>
<td>Ceramic Disc (μA)</td>
</tr>
<tr>
<td>KBS-35DA-3FCS</td>
<td>3.2 ± 0.5</td>
<td>200</td>
<td>25,000 ± 30%</td>
<td>34.55 ± 0.1</td>
<td>25.0 ± 0.5</td>
</tr>
</tbody>
</table>

Application Circuits for Self-Drive Oscillation Buzzer

NOTE:
Wherever possible, the piezo devices should be capacitive coupled to avoid permanent DC bias and possible long term damage.
Piezoelectric Acoustic Generators

Housed Buzzers

Features:
1) High sound pressure with low power consumption
2) Compact, lightweight
3) No-contact design makes element highly reliable and eliminates noise problem
4) Easily mountable
5) A wide variety of tones can be generated depending on casing design

How To Order:
KBS - 27 DB - 3 A
1 Model
2 Diameter: eg. 27mm
3 Housed Buzzer
4 Resonant Frequency: eg. 3kHz
5 Lead Types
   A = Lead Wire
   P = Pins

Applications:
1) Telephone ringers
2) Confirmation tones in various office automation equipment
3) Used in a variety of consumer products such as microwave ovens and refrigerators
4) Clocks, toys games
5) Automobiles

Specifications (Casing Type Piezoelectric Buzzers)

<table>
<thead>
<tr>
<th>Model No</th>
<th>Sound Pressure Level</th>
<th>Static Capacitance</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBS-13DB-4P-2</td>
<td>73dB Min. 4.096 kHz</td>
<td>10nF ± 30%</td>
</tr>
<tr>
<td>KBS-20DB-2P-0 or KBS-20DB-2P-8 (U.S.)</td>
<td>75dB Min. 2.048 kHz</td>
<td>22nF ± 30%</td>
</tr>
<tr>
<td>KBS-20DB-3P-0</td>
<td>65dB Min. 3.000 kHz</td>
<td>17nF ± 30%</td>
</tr>
<tr>
<td>KBS-20DB-4P-0</td>
<td>77dB Min. 4.096 kHz</td>
<td>14nF ± 30%</td>
</tr>
<tr>
<td>KBS-20DB-6P-2</td>
<td>75dB Min. 6.000 kHz</td>
<td>12nF ± 30%</td>
</tr>
<tr>
<td>KBS-15DB-4A</td>
<td>72dB Min. 4.096 kHz</td>
<td>9.5nF ± 30%</td>
</tr>
<tr>
<td>KBS-20DB-4A-22</td>
<td>70dB Min. 4.000 kHz</td>
<td>17nF ± 30%</td>
</tr>
<tr>
<td>KBS-20DB-5A</td>
<td>75dB Min. 5.000 kHz</td>
<td>10nF ± 30%</td>
</tr>
<tr>
<td>KBS-27DB-2A-5</td>
<td>70dB Min. 2.500 kHz</td>
<td>46nF ± 30%</td>
</tr>
<tr>
<td>KBS-27DB-3A</td>
<td>75dB Min. 3.000 kHz</td>
<td>20nF ± 30%</td>
</tr>
</tbody>
</table>

OSCILLATION FREQUENCY VS. SOUND PRESSURE

- INPUT SIGNAL: 10VP-P Square Wave
- DISTANCE: 30cm
- INPUT SIGNAL: 10VP-P Sine Wave
- DISTANCE: 30cm
- INPUT SIGNAL: 10VP-P Square Wave
- DISTANCE: 30cm
- INPUT SIGNAL: 10VP-P Sine Wave
- DISTANCE: 30cm
Piezoelectric Acoustic Generators

Housed Buzzers

Dimensions

KBS-13DB-4P-2

KBS-20DB-2P-0

KBS-20DB-3P-0 / KBS-20DB-4P-0 / KBS-20DB-6P-0

KBS-15DB-4A

KBS-20DB-4A-22

KBS-20DB-5A

KBS-27DB-2A-5

KBS-27DB-3A
Piezoelectric Acoustic Generators

Tweeter Type -KBS-XX-XA/ZA

Features:
1) Compact, thin, highly efficient
2) Lower power consumption
3) Lightweight
4) Generate no magnetic flux
5) High reliability

Applications:
1) Tweeter
2) Car audio speakers

How To Order:

KBS - 21 XA - 4 A __

1 Model
2 Diameter (mm) eg. 21
3 Element Shape
   XA = Unimorph
   ZA = Bimorph
4 Resonant Frequency: eg. 4
5 2-Terminal Electrode Type
6 Disc Material
   Blank = Brass

Dimensions

<table>
<thead>
<tr>
<th>XA Type (KBS-21XA Series)</th>
<th>ZA Type (KBS-21ZA Series)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal Disc</td>
<td>Electrode</td>
</tr>
<tr>
<td>Piezoelectric Disc</td>
<td>Piezoelectric Disc</td>
</tr>
<tr>
<td>Electrode</td>
<td>Electrode</td>
</tr>
</tbody>
</table>

Characteristics

<table>
<thead>
<tr>
<th>KBS-21XA-4A</th>
<th>KBS-21ZA-4A-51</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="#" alt="Graph" /></td>
<td><img src="#" alt="Graph" /></td>
</tr>
</tbody>
</table>

Features:
1) Compact, thin, highly efficient
2) Lower power consumption
3) Lightweight
4) Generate no magnetic flux
5) High reliability

Applications:
1) Tweeter
2) Car audio speakers

How To Order:

KBS - 21 XA - 4 A __

1 Model
2 Diameter (mm) eg. 21
3 Element Shape
   XA = Unimorph
   ZA = Bimorph
4 Resonant Frequency: eg. 4
5 2-Terminal Electrode Type
6 Disc Material
   Blank = Brass

Dimensions

<table>
<thead>
<tr>
<th>XA Type (KBS-21XA Series)</th>
<th>ZA Type (KBS-21ZA Series)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Metal Disc</td>
<td>Electrode</td>
</tr>
<tr>
<td>Piezoelectric Disc</td>
<td>Piezoelectric Disc</td>
</tr>
<tr>
<td>Electrode</td>
<td>Electrode</td>
</tr>
</tbody>
</table>

Characteristics

<table>
<thead>
<tr>
<th>KBS-21XA-4A</th>
<th>KBS-21ZA-4A-51</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="#" alt="Graph" /></td>
<td><img src="#" alt="Graph" /></td>
</tr>
</tbody>
</table>
# Piezoelectric Acoustic Generators

## Tweeter Type

### Specifications

#### (XA type)

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Resonant Frequency (kHz)</th>
<th>Resonant Impedance (Ω)</th>
<th>Static Capacitance (pF)</th>
<th>Metal Disc (μA)</th>
<th>Ceramic Disc (μB)</th>
<th>Electrode (μC)</th>
<th>Total Thickness (T)</th>
<th>Metal Disc Thickness (t)</th>
<th>Metal Disc Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBS-21XA-4A</td>
<td>3.6 ± 0.6</td>
<td>150</td>
<td>90,000 ± 30%</td>
<td>21.0 ± 0.1</td>
<td>20.2 ± 0.3</td>
<td>(19.0)</td>
<td>0.28 ± 0.1</td>
<td>0.15 ± 0.03</td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-27XA-2A</td>
<td>1.8 ± 0.5</td>
<td>150</td>
<td>123,000 MIN.</td>
<td>27.0 ± 0.1</td>
<td>25.0 ± 0.5</td>
<td>(23.5)</td>
<td>0.28 ± 0.1</td>
<td>0.15 ± 0.03</td>
<td>Brass</td>
</tr>
</tbody>
</table>

#### (ZA type)

<table>
<thead>
<tr>
<th>Model No.</th>
<th>Resonant Frequency (kHz)</th>
<th>Resonant Impedance (Ω)</th>
<th>Static Capacitance (pF)</th>
<th>Metal Disc (μA)</th>
<th>Ceramic Disc</th>
<th>Electrode</th>
<th>Total Thickness (T)</th>
<th>Metal Disc Thickness (t)</th>
<th>Metal Disc Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBS-18ZA-7A</td>
<td>6.8 ± 1.0</td>
<td>100</td>
<td>125,000 ± 30%</td>
<td>18.0 ± 0.1</td>
<td>16.8 ± 0.3</td>
<td>(16.0)</td>
<td>0.32 ± 0.1</td>
<td>0.10 ± 0.03</td>
<td>Brass</td>
</tr>
<tr>
<td>KBS-21ZA-4A-51</td>
<td>3.9 ± 1.0</td>
<td>100</td>
<td>150,000 MIN.</td>
<td>21.0 ± 0.1</td>
<td>20.2 ± 0.3</td>
<td>(19.0)</td>
<td>0.33 ± 0.1</td>
<td>0.10 ± 0.03</td>
<td>Brass</td>
</tr>
</tbody>
</table>
Piezoelectric Acoustic Generators

Piezo Ringers

**Features:**
1) Specifically designed for tone-ringer in telephones
2) Generates high sound pressure
3) Wide variety available

**Specifications**

<table>
<thead>
<tr>
<th>Model Number</th>
<th>Sound Pressure Level</th>
<th>Static Capacitance</th>
</tr>
</thead>
<tbody>
<tr>
<td>KBS-30DB-1A-20</td>
<td>70dB Min. 1.0~1.5KHz 20Vp-p SQ 30cm</td>
<td>★ 48nF ± 30%</td>
</tr>
<tr>
<td>KBT-33SB-2T-2</td>
<td>70dB Min. 1.0~1.5KHz 20Vp-p SQ 30cm</td>
<td>★ 48nF ± 30%</td>
</tr>
<tr>
<td>KBT-34SB-1T/1A-0</td>
<td>75dB Min. 1.0~1.5KHz 20Vp-p SQ 30cm</td>
<td>★ 68nF ± 30%</td>
</tr>
<tr>
<td>KBT-44SB-1A</td>
<td>75dB Min. 1.0KHz 10Vp-p SQ 30cm</td>
<td>★ 68nF ± 30%</td>
</tr>
<tr>
<td>KBS-50DL-05C</td>
<td>———————————</td>
<td>★ 120nF Min.</td>
</tr>
</tbody>
</table>

**Example of circuit diagram**

KBS-30DB-1A-20

Input Signal: 20Vp-p Sine Wave
Distance: 30cm

KBT-33SB-2T-2

Input Signal: 20Vp-p Sine Wave
Distance: 30cm
Piezoelectric Acoustic Generators

Piezo Ringers

KBT-34SB-1A-0

KBT-34SB-1T-0

KBT-44SB-1A

KBS-50DL-05C
Piezoelectric Acoustic Generators

Magnetic Receivers - PCRT Series

**Features:**
1) Compact and light weight
2) High sound quality and high S.P.L.
3) Hearing aid compatible (HAC)
4) Anti-shock, anti-vibration design

**Applications:**
1) Telecommunications
2) Cordless and cellular telephones (HAC)

**How To Order:**

<table>
<thead>
<tr>
<th>PCRT</th>
<th>21</th>
<th>A</th>
<th>S</th>
<th>X</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Model
2. Diameter in mm (20 or 21)
3. Impedance (A:150Ω, B:32Ω)
5. Shape
   - X = ø21 round shape
   - S = ø20 round shape
   - E = ø21 with flanges

**Electrical Characteristics**

<table>
<thead>
<tr>
<th>P/N</th>
<th>S.P.L.</th>
<th>Input Impedance</th>
<th>Magnetic Flux Density</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Axial Direction</td>
</tr>
<tr>
<td>PCRT20ALS</td>
<td>100±3dB</td>
<td>150Ω±20%</td>
<td></td>
</tr>
<tr>
<td>PCRT21ASX</td>
<td>93±3dB</td>
<td>150Ω±15%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.1V RMS, 1kHz)</td>
<td>(1kHz)</td>
<td></td>
</tr>
<tr>
<td>PCRT21BSX</td>
<td>100±3dB</td>
<td>32Ω±15%</td>
<td></td>
</tr>
</tbody>
</table>

**Dimensions**

<table>
<thead>
<tr>
<th>PCTR20</th>
<th>PCTR21</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Type</td>
<td>E Type</td>
</tr>
</tbody>
</table>

---

**Notes:**
- P/N PCRT21PCTR20
Piezoelectric Acoustic Generators

Magnetic Receivers - PCRT Series

PCRT21 Recommended Earpiece

Rubber Ring (T: 0.5mm)
Note: Holding pressure should be 3.5kgf max.
Tol: ±0.3mm unless shown otherwise.

Unit: mm

S.P.L. Test Circuit

S.S.G./AMP: B & K 2010
Piezoelectric Acoustic Generators

Ceramic Receivers

Features:
1) Excellent acoustic characteristics
2) High durability (shock, thermal)
3) Small and thin shape
4) Low current consumption
5) Low cost

Applications:
1) Multiple function telephone
2) Push button telephone
3) Cordless phone
4) Portable phone
5) Mobile phone

How To Order:
KBT - 33 - RB - 2CN - 0

1) Model
2) Diameter
3) Ceramic Receiver
4) Type: CN
5) Spec Number (if modified specification is used)

Specifications

<table>
<thead>
<tr>
<th>Model</th>
<th>KBT-33RB-2S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound</td>
<td>107 ± 3dB</td>
</tr>
<tr>
<td>Pressure</td>
<td>1Vrms, IEC318</td>
</tr>
<tr>
<td>Capacitance</td>
<td>60nF ± 25% (120Hz)</td>
</tr>
<tr>
<td>Impedence</td>
<td>2.8 KΩ ± 25% (1KHz)</td>
</tr>
<tr>
<td>Wire</td>
<td>(AWG #32) UL1571</td>
</tr>
</tbody>
</table>

Earpiece (Recommended)
In order to obtain optimum ceramic receiver characteristics, the earpiece construction should be as shown below.

KBT-33RB-2CN-0

Impedance Curve

Measurement of S.P.L.

Dimensions
KBT-33RB-2CN-0
Mouser Electronics

Authorized Distributor

Click to View Pricing, Inventory, Delivery & Lifecycle Information:

AVX:

KBS-27DA-5C-105  KBT-33SB-2T-2  KBT-44SB-1A