ChipCorder®
TECHNOLOGY BY ISD

APPLICATION INFORMATION FOR ALL ISD ChipCorder PRODUCTS

Microphone and Speaker Selection

The ISD1000A series data sheet recommends a minimum speaker impedance of 16 Ω. An 8 Ω impedance speaker may be used that will result in a higher volume level and increased distortion. In addition, I_{CC} current will be higher. An 8 to 20 Ω resistor, in series with the speaker, controls volume and reduces I_{CC} playback current. Additionally, the speaker enclosure is important for best audio performance. Experiment with the sound cavity, grille, and foam baffle behind the speaker to optimize the system's performance.

Volume and audio improvements of 50 to 100 percent can be realized with improvements to the speaker enclosure that can include a sound baffle of foam or glass wool.

It is recommended that the ISD devices be evaluated initially using high quality speakers and low background noise to confirm the high voice quality possible. Then if trade-offs need to be made later on speaker size or quality, an informed quality versus cost decision can be made.

The selection of a good quality microphone and speaker enhances the audio performance of your application.

Two sources for 16-Ω speakers are:

MCM Electronics
Dayton, OH
(800) 543-4330

QUAM
Chicago, IL
(312) 488-5800

With the proper connections, some telephone handsets can also be used. Good quality audio techniques should be used so input signal noise and background noise will be minimized during recording.

Table 1: Speaker Sources

Mfg.	Device #	Shape	Weight	Freq. Resp.	Max. Watts
Quam	4A1Z16	3" sq.	0.25 lbs.	200–11K	3
Quam	35A05Z16	3 x 5 oval	0.50 lbs.	150–7K	2
Pioneer	ALLEC80-092F	4.5" round	1.50 lbs.	68–15K	30

MICROPHONE OPTIONS FOR THE ISD1000A, ISD1100, ISD1200, ISD1400, ISD1500, AND ISD2500 SERIES

Most schematics for the ISD single-chip voice record and playback devices show the use of a conventional electret or "capacitor" microphone. These microphones have several advantages over other common types. They have excellent frequency response and high output. They are available in many different sizes, from "grain-of-rice" to a standard 1/4-inch diameter. They are also rugged and inexpensive.

The ISD "standard" microphone application requires seven components to operate; see Figure 1. These components perform several functions.

- Microphone bias is supplied by a network composed of R2, R3, and R4, with C3 acting as a filter capacitor.
- C4 is a DC blocking capacitor between the microphone and the MIC pin on the ISD device.
- C5 acts as a coupling capacitor bringing microphone ground noise into the MIC REF pin.
- The MIC REF input provides a noise canceling (common mode rejection) input to reduce recorded noise.
- Since R3 and R4 are equal, the power supply noise will be equal and canceled by the common mode rejection of the microphone preamplifier.

These parts must be used with any microphone that requires DC bias. Another example would be a carbon microphone. These were used until recently in telephones or two way radios. However, there are other microphones that do not require a bias supply.

There are several types of microphones that are "self-generating." These microphones cause a current to flow (or a potential to be developed) directly from sound wave pressure. Two of these are dynamic and crystal microphones.

- A dynamic microphone uses a coil of wire and a magnet. One end of the magnet is tied to a diaphragm to generate a current proportional to sound pressure.
- A crystal microphone has a diaphragm connected to a crystalline structure. Sound pressure causes stress in the crystal. Through the piezoelectric effect the crystal generates a voltage.

Such self-generating microphones may be connected directly to an ISD device's microphone inputs.

The two microphone inputs to the ISD device are MIC and MIC REF. These two pins are differential inputs to the on-chip microphone preamplifier. A non-biased microphone, as discussed, may be connected directly across these two pins. No coupling capacitors are needed. This benefits the designer in several ways. Most obvious is the elimination of the components associated with the microphone bias. The secondary considerations may be as important.

Figure 2 shows how a non-biased microphone is connected to an ISD single-chip voice record/playback device. Only the components directly associated with the microphone are shown.

When an electret microphone is used, its signal must be referenced to the external circuit ground. This is because of the bias requirement. This creates two potential external sources of noise. Noise can come from the V_{CC} supply and from currents flowing in the circuit board ground.

The MIC REF pin is a common mode noise canceling input in the electret application. This method of noise reduction usually works well. It depends on good PC board layout rules and adequate bypassing of the V_{CCD} and V_{CCA} pins. When a non-biased microphone is used, however, these two noise sources are eliminated. A designer may find the circuit will perform adequately with no bypass capacitors at all.

Several readily available microphones will drive ISD1000A, ISD1100, ISD1200, ISD1400 ISD1500, and ISD2500 series devices. The following notes have been determined experimentally from a sample of microphone elements.

- Crystal, ceramic, and dynamic microphone elements (as well as crystal earphones) will work when connected directly to the MIC and MIC REF inputs of ISD devices.
- In general, the crystal and dynamic microphones have more output level and the ceramic elements less.
- The best quality was achieved using the dynamic microphone.
- A piezo speaker element (sometimes called a sounder) will work adequately for some applications. It must be mechanically mounted to some sort of sounding board (such as a piece of cardboard). The cardboard becomes a sounding board and couples the sound pressure into the element. Note that piezo sounders come in active and passive styles. The active piezo elements are actually noise makers and cannot be used as microphones.

Catalog suppliers such as Mouser (1-800-346-6873) carry microphone elements of several types that will work adequately. The Mouser catalog shows electret, crystal, ceramic, and dynamic microphones plus crystal earphones.

One source for piezo speaker elements is Radio Shack (part number is 273-091).

ELECTRET MICROPHONE SPECIFICATIONS

Specifications for the electret microphone are:

- 1 KΩ impedence
- Omni-directional
- 64 dB sensitivity
- 50 Hz to 8 KHz frequency
- Less than 1 mA current drain
- Greater than 40 dB S/N ratio
- Operates 2 to 10 VDC

These microphone specifications are not critical; however, microphones with these characteristics have been found to operate satisfactory.

Three sources for electret microphones are:

Mouser Electronics
(800) 346-6873
#25LM049 (PC mount)
#25LM045 (Coax leads)

Radio Shack
(800) 433-2024
#270-090 (PC mount)
#270-092 (Coax leads)
#273-091 (Piezo)

DIGI-KEY
(800) 344-4539
#P9931-ND (PC mount)

PREFERRED ELECTRET MICROPHONE CIRCUIT

Figure 1 shows a differential circuit for the standard ISD device microphone input. In this circuit, an electret microphone is used to differentially drive the microphone preamplifier. The microphone is connected directly between MIC and MIC REF. Since R3 and R4 are equal resistors, power supply noise will be a common mode signal. Common mode rejection inherent in the microphone preamplifier will attenuate any noise.

Figure 1: Differential Electret Microphone Circuit

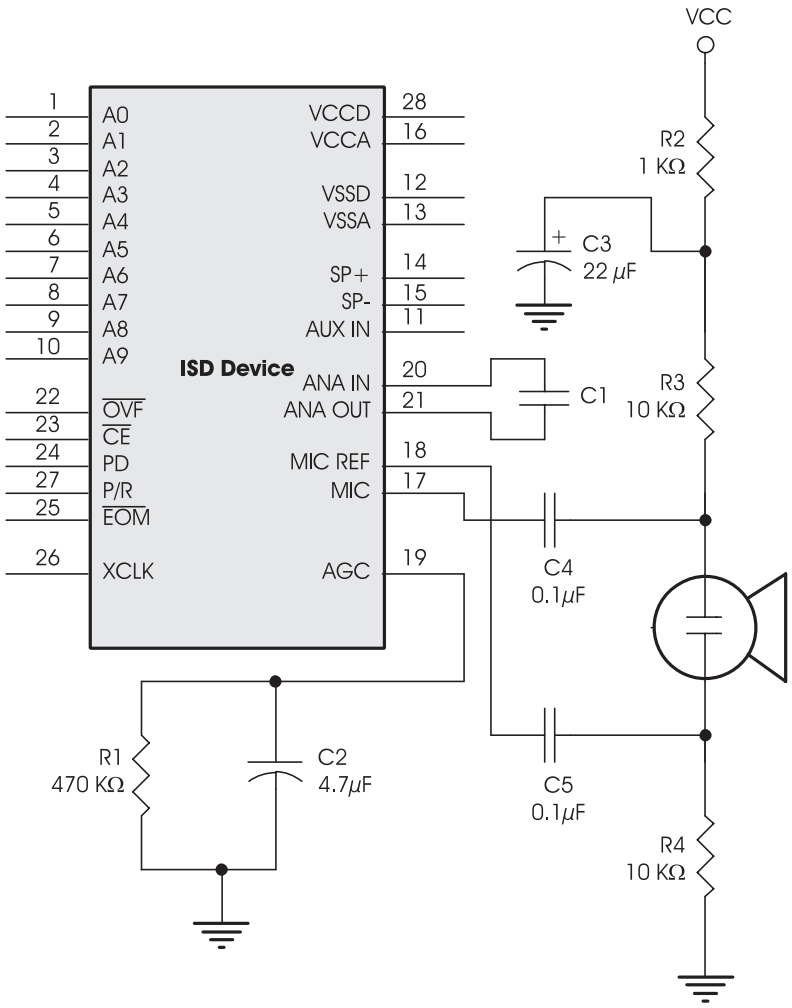

Figure 2: Self-Biasing Microphone