APPLICATION BRIEF 6A — USING EXTERNAL SPEAKER AMPLIFIERS WITH THE ISD SINGLE CHIP VOICE RECORD/PLAYBACK DEVICES

MAKING IT SOUND LOUDER

Many applications for ISD devices use very small speakers, often less than two inches in diameter. The basic sampling system used by all ISD single-chip voice record/playback devices in itself supports a wide frequency response, only limited in low frequency by the value of the coupling capacitors in the microphone and ANA IN to ANA OUT circuits. Small speakers usually do not reproduce low frequencies well. The result is that a "full bandwidth" recording often does not sound very loud when played through such a speaker. Another way to look at this is that the low frequency components consume much of the output power of the ISD speaker driver. This power is not usable by a small speaker.

One method of recording "louder" signals that reproduce well through a small speaker is to limit the ISD device's low-end frequency response. This may easily be done by decreasing the size of the coupling capacitors used in the microphone circuit. The ISD1400 data sheet shows 0.1 μF capacitors connected to MIC and MIC REF. This value results in signals above 160 Hz being recorded without attenuation. A better choice for a small speaker system is to change these capacitors to 0.01 μF. This results in a low end pole of approximately 1500 HZ, sharply rolling off frequency response below this value.

The resulting recording will be made without the low frequencies that distort a small speaker. The relative "loudness" of the playback will be increased.

The circuit designer should try several values of capacitance to determine what is best for a specific application.

REALLY MAKING IT LOUDER

The on-chip speaker drivers present in all current ISD single chip voice record/playback devices have adequate power output for most applications. Some applications, however, need more speaker power than these chips provide. Fortunately, a number of manufacturers make single chip or single module speaker amplifiers that range from a few hundred milliwatts to 50 watts or more into an 8 Ω load.

Most of these speaker amplifier devices are supported by manufacturer's applications information that shows a single ended connection to the audio source. In the case of the ISD products, however, there are advantages to a balanced feed to the amplifier circuit. The potential pop resulting from a Power-Down cycle, for instance, may be avoided by driving the speaker amplifier from both SP+ and SP–. Fortunately, many of the available speaker driver products have an operational amplifier front end that includes a differential input.

The following two circuits demonstrate the general method that may be used to increase the speaker drive from ISD products.

NOTE *ISD customers are strongly encouraged to obtain the appropriate data sheet from the listed manufacturer to determine exact device specifications and the suitability of these devices in their specific application.*

USING THE NATIONAL SEMICONDUCTOR CORPORATION LM386 LOW VOLTAGE AUDIO POWER AMPLIFIER

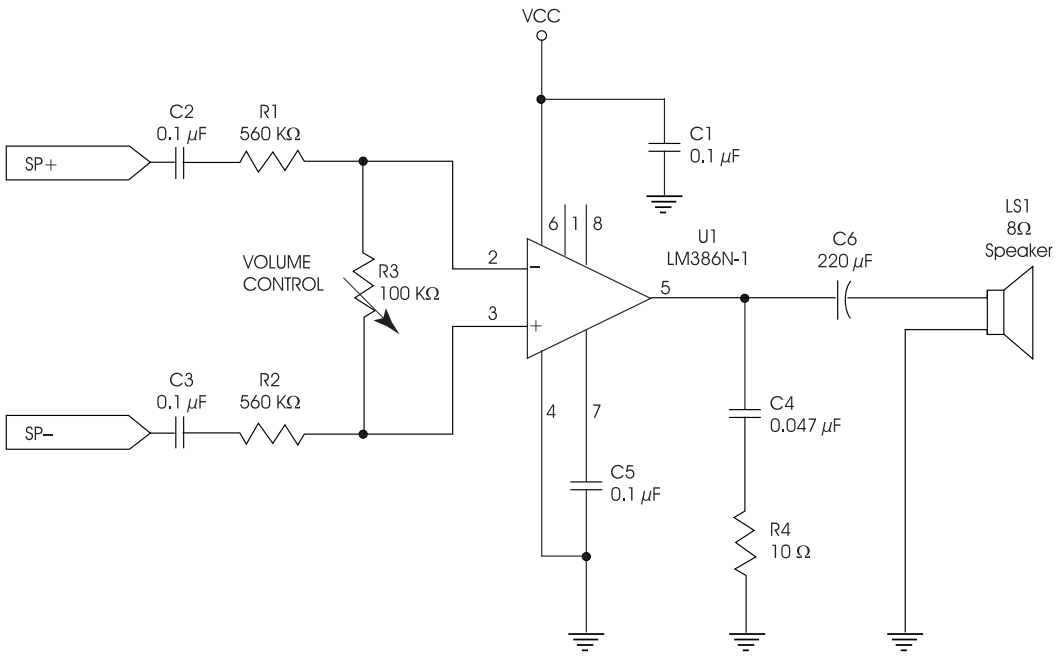
The NSC LM386 amplifier was designed for use in low voltage consumer applications. According to the NSC data sheet, it will operate over a voltage range of 4 to 12 volts or 5 to 18 volts. The voltage gain is adjustable from 20 to 200. At 6 volts the typical power output is 325 mW, at 9 volts it is 700 mW. (These numbers are at 10 percent THD.)

In the circuit in Figure 8, the output level of the ISD device must be attenuated by resistors R1 and R2 before it can be applied to the inputs of the LM386. This is because the ISD device output leads are designed to drive a speaker directly to 12.5 mW. The voltage swing drives the LM386 into distortion if not reduced. At 5 volts, the value required is approximately 1 MΩ; at 9 volts the resistors can be at 560 KΩ. This is because the input pins of the LM386 have about a 50 KΩ to ground impedance, forming a voltage divider. Using 560 KΩ resistors and putting the 100 KΩ potentiometer R3 across the input pins creates a volume control.

The LM386 data sheet includes various applications circuits, all single ended. To eliminate the "pop" that can occur with the ISD speaker outputs being used single ended, the LM386 is used differentially. This lets the common mode rejection of the LM386 reduce the "pop" considerably. Because the differential connection is DC isolated, the LM386 can be run at any voltage in its allowable range while the ISD device remains at 5 volts. This give the designer some options as far as required power output for the particular application.

In the example circuit in Figure 8, pins 1 and 8 are left open for minimum gain of 20 in the LM386N-1. Then a volume control is provided in the potentiometer (R3) across pins 2 and 3.

Figure 8: LM386 Speaker Driver



USING THE MOTOROLA MC34119 LOW-POWER AUDIO AMPLIFIER

The MC34119 low power audio amplifier integrated circuit, shown in Figure 9, was intended primarily for telephone applications. According to the Motorola data sheet, it operates over a voltage range from 2 to 16 volts and can supply up to 250 mW into a 32 Ω speaker. It can drive speaker loads down to 8 Ω. The MC34119 does not automatically power down. If the CD pin (pin 1) is taken to V_{CC}, however, the device will power down to typically less than 1/2 mA.

The circuit used with the MC34119 is similar to that used with the NSC device. The FC1 and VIN inputs are driven differentially from the ISD Speaker outputs. Speaker volume is set by adjusting the value of R3 which is a feedback resistor used to set gain in the MC34119. Care should be taken so that the Motorola amplifier's package power dissipation specification is not exceeded. The designer may wish to derive a control signal to drive the CD pin to lower circuit power consumption when not in use.

Figure 9: MC34119 Speaker Driver