SIMPLE CIRCUITS

By Jeff Alder, CET

Review of a Solid State Audio Recording Chip

Greetings all! In this installment of Simple Circuits, I have chosen to review a solid state audio recording chip. Note, I did not call it a digital recording chip, because, technically, according to the manufacturer, they do not digitize the signals as they are recorded.

The part is manufactured by a company called Winbond and I have used it in several applications over the years. The part number is ISD1110. This chip will store 10 seconds of audio in non-volatile E2PROM memory. In truth, I actually used the ISD1416. The only real differences between the chips are the length of record/playback time (16 seconds for the ISD1416), and the sample rates for the incoming audio. The pin outs for the two devices are identical.

I am not reviewing the ISD1416 because I am under the impression that it may be an end of life part as I could not find a current data sheet on the Winbond website

The devices themselves are extremely easy to connect into a working circuit, using just a few passive devices to produce a full blown audio recorder.

Internally, the chip has several higher level circuits including input amplifiers, an AGC (Automatic Gain Control) circuit, an anti-aliasing filter, a smoothing filter (on the output) an internal audio output amplifier and of course the E2PROM memory. The device also allows for external addressing of the memory via an 8 bit address bus, but I have never used the unit in this configuration and it is not required to create the digital recorder. Simply leave the address bits floating if external addressing is not required.

Because the ISD1110 has both analog and digital circuitry, it is important that noise from the digital portions of the chip be isolated from the analog sections. Without good isolation, noisy recordings may result. The manufacturer helps to accomplish this isolation

by providing separate pins for both analog and digital power supply connections as well as analog and digital grounds.

Connect the analog and digital power supply pins together as close to the power supply as possible and make sure to decouple the "power supplies" as close to the chip as possible. For the ground connections, the manufacturer recommends tying the pins together as close to the device as possible.

The AGC circuit provides gain control to the input pre-amplifier circuit. This allows for signals from loud sounds to whispers to be recorded with minimal distortion. The application notes recommend values for external passive devices to create appropriate attack and release times for the AGC circuit.

A microphone is connected to the chip using an external coupling capacitor, which works in conjunction with an internal 10K resistance, to determine
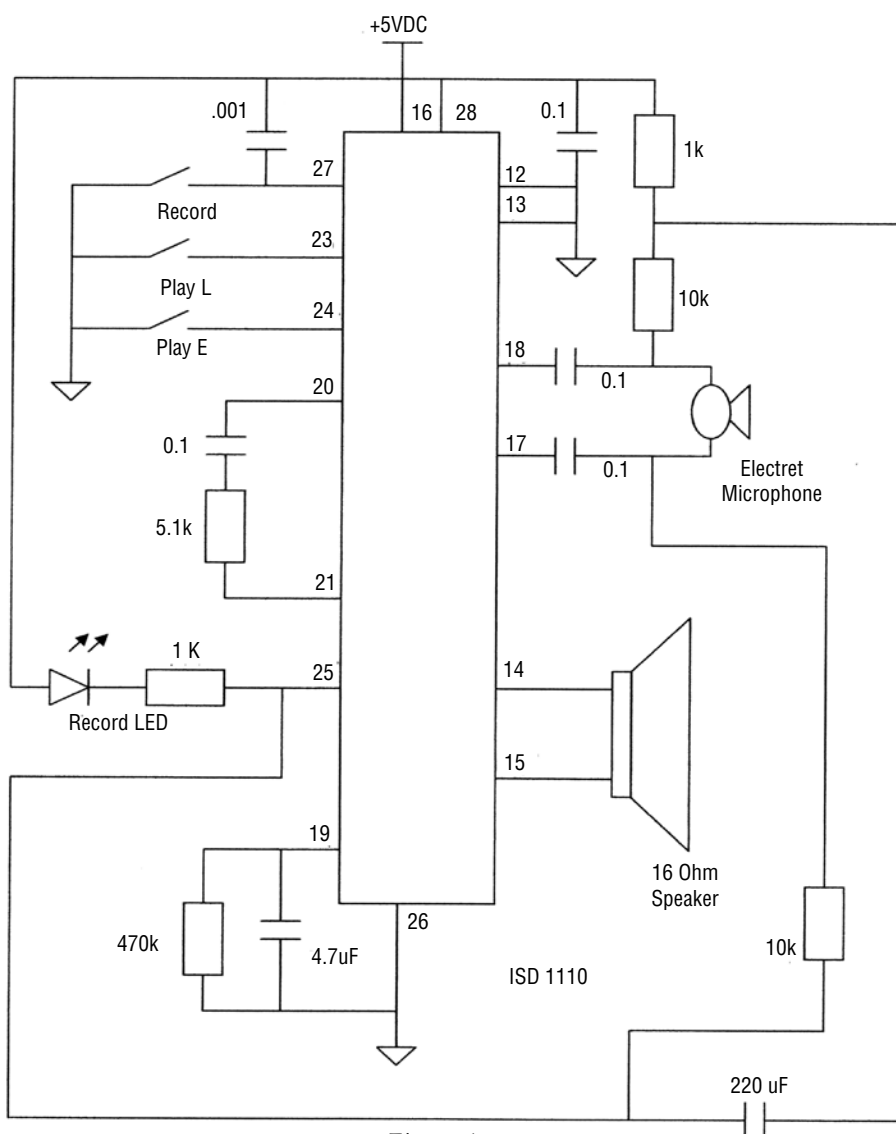
Figure 1

the low frequency cutoff for the input. Application notes are available for cutoff calculations, but a 0.1 uF will suffice nicely for most typical applications.

A Mic Ref input is also made available to allow for noise cancelling functionality when the device is connected differentially to a microphone.

The output from the pre-amplifier is brought out to a pin which can then be coupled via a series capacitor to the analog input pin. This then transfers the input signal to the chip for recording. The capacitor works in conjunction with an internal 3K resistor to create a network, which allows the user to provide additional cutoff at the low frequency end for the application. Once again, the application notes suggest that a 0.1 uF will do nicely for this function, at the bottom of the voice pass band. The analog input pin will also accept audio frequencies directly, through a coupling capacitor, when a microphone is not used as the audio source.

The user is able to clock the sampling of the input audio externally, but this is unnecessary for most applications unless very strict recording times are required. Be sure to use the manufacturers recommended external clock frequencies as the anti aliasing and smoothing filters are fixed and straying from these values might result in unsatisfactory performance.

There are two output pins for direct drive to an external speaker. The external speaker should have a minimum impedance of 16 Ohms, and will be driven with approximately 12 mW. No external coupling capacitor is required if the speaker is driven with both outputs. Single ended drive is also available, but this lessens the output power transfer to the speaker and an AC coupling capacitor then becomes necessary.

Control of the device is simple and uses momentary NO switches to accomplish record and playback functions. The record switch always takes priority over playback and will interrupt a playback function if depressed. Recording takes place as long as the switch is depressed, or until the unit runs out of record memory. The record switch circuit has an internal debounce of 50 msec to prevent false re-triggering of the record session.

Playback can happen two different ways:

1) There is an input pin for an edge triggered playback, which will allow for a momentary closure to play an entire message.
2) There is also a level sensitive input pin which allows the user to depress the switch and allow playback to happen until the switch is released.

If all the memory is not used during a record session, the device records an internal EOM (End of Message) marker, once the record switch has been released. The playback will then terminate at the end of the actual message, once reaching the EOM.

The ISD1110 also provides a Record LED output to indicate that recording is taking place. This output also pulses low during playback, once an EOM marker is reached. I found this feature useful when I needed to let a PIC microcontroller know that a playback had been completed, for one of my applications.

The device itself runs on 5 VDC and typically draws 15 mA, during playback and record sessions. Other than that, the device automatically enters a low power standby mode and draws current in the low uA's. THD (Total Harmonic Distortion) is rated at 1% (typical) at 1000Hz.

The device can be re-recorded 100,000 times and will the device will retain the audio message for 100 years without power.

Let's go back now to the concept of "analog" recording into a digital memory device. Under normal operation, an E2PROM would store a "1" or a "0" into a bit location within the memory hardware. Winbond has developed an ingenious means of pulsing small packets of charge, through the oxide, into the floating gate and into the storage cell. By doing this, they can actually store 1 of up to 256 different voltage levels into each single cell of E2PROM memory! Because there is no compression etc. of the audio, excellent reproduction of

SIMPLE CIRCUITS . . .

Continued from 23

the recorded signal is produced and memory usage is nicely minimized.

This particular device is not available in an extended temperature range, but Winbond does manufacture several devices which are available from -40C to +85C.

I have used these devices in several applications which included a repeating, low power FM transmitter, which broadcast the details of homes for sale, to passing motorists, during off hours, when Real Estate agents were unavailable. Potential buyers simply parked in front of a house they were interested in and tuned their car radios to the appropriate "off station" frequency. Information was available immediately and repeated every minute, 24/7.

I also created a microcontroller based alarm reporting unit which could monitor remote Oil and Gas installations for power failure etc. When an alarm condition occurred, it would call out over a voice radio system and speak the alarm condition and location.

Have fun trying this device out on your bench. As always, read the application notes carefully for aspects which I have not had a chance to explore with this review.

The Canadian Sales Representative for Winbond products is Norcan Technologies Inc. Norcan Technologies Inc., 1837 Maple Grove Road, Stittsville Ontario, Canada K2S 1B9, Office: 613-831-5425

The parts are also available from Digi-Key for under $10.00 USD and further information can be viewed on the Winbond website at www.isd.com, under the Voice and Sound IC's ChipCorder section.

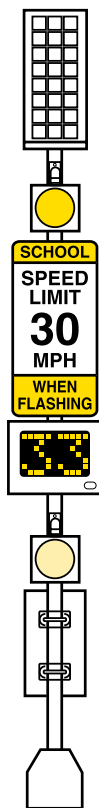Until next time, take care out there!

Jeff