STAND-ALONE/PARALLEL INTERFACE PRODUCTS

Circuit Examples for ISD1100, ISD1200 and ISD1400 Products

This chapter provides various applications for the ISD1100, ISD1200, and ISD1400 series of products. Most of these applications can use the ISD1200 or ISD1400 series interchangeably. In some cases the ISD1100 series may also be used. See Application Brief 3 for a discussion of the differences between the ISD1200 and the other two device series.

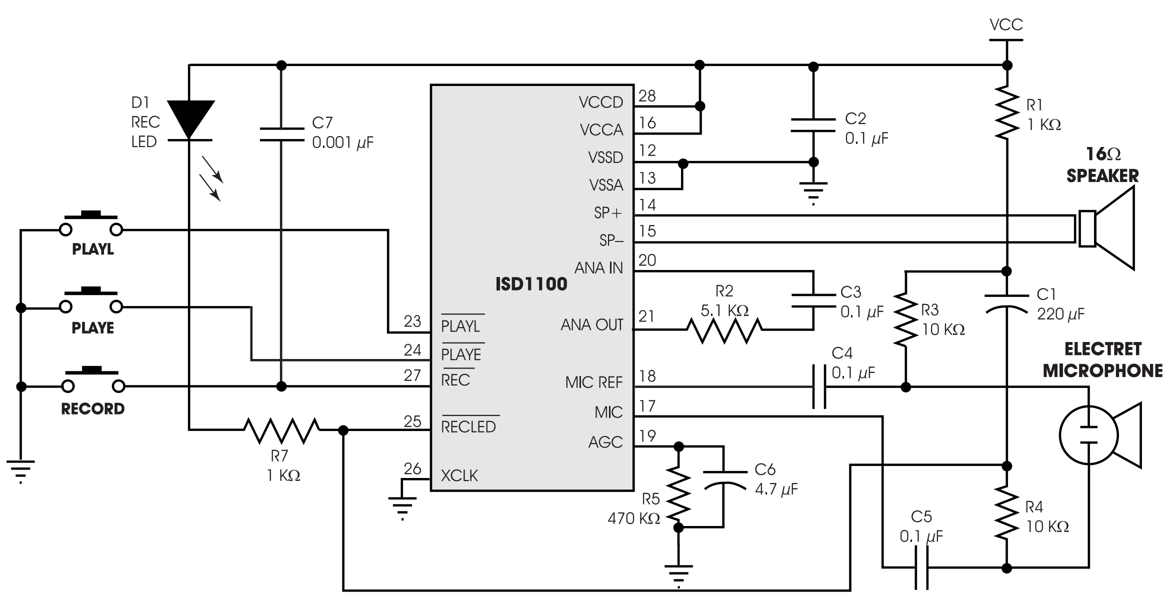
MINIMUM PARTS COUNT ISD1100 APPLICATION

An ISD1100 series device may be used to make a very low power record and playback system with automatic power down. An added difficulty arises for the designer, however, due to the continuous current drain of the electret microphone bias circuit.

Figure 1 shows a schematic diagram that neatly solves this problem by using the $\overline{\text{RECLED}}$ output of the ISD1100 to provide the ground for the microphone bias circuit only during the time recording is active. Since $\overline{\text{RECLED}}$ only goes LOW during record, it shuts off current to the microphone bias circuit when recording is complete. C1 supplies filtering for the microphone bias circuit.

Another feature of this circuit is the differential use of the electret microphone. The microphone is connected directly between MIC and MIC REF on the ISD1100. Since R3 and R4 are equal resistors, power supply noise will be a common mode signal and will be rejected by the ISD1100's microphone pre-amplifier.

Figure 1: Simple Application for ISD1100 Series Device



The $\overline{REC}$, $\overline{PLAYL}$, $\overline{PLAYE}$ and address inputs have on-chip pull-up or pull-down resistors. (For a complete discussion of the ISD1100's on-chip pull-up or pull-down resistors, see Application Brief 3). Simple push buttons or slide switches may be used with an ISD1100 series product. The device will draw approximately 50 μA while each push button is pressed.

RECORD

Press and hold the $\overline{REC}$ push-button. The $\overline{REC}$ LED will illuminate to indicate recording is in progress. If overflow is reached, or the button is released, the LED will go out and the ISD1100 will automatically power-down. Since the $\overline{RECLED}$ output is now at V_{CC}, no current will be drawn by the microphone bias circuit.

PLAYBACK WITH A SINGLE PRESS OF A BUTTON

Press and release the $\overline{PLAYE}$ push-button. The message contained in the device will playback until it reaches a set EOM bit or OVF. Playback will then cease and the device will power down.

PLAYBACK USING A SLIDE SWITCH OR CONTINUOUS PRESS OF A BUTTON

Press and hold the push button or close the slide switch to begin and continue playback. If overflow is reached, the push button is released or the slide switch is opened, the device will end playback and automatically power down.

NOTE *If the push button is held down or the slide switch remains closed, the on-chip pull-up resistor will continue to draw approximately 50 μA of current.*

MINIMUM PARTS COUNT ISD1200/1400 APPLICATION

A minimum ISD1100/ISD1200 application is similar to the above ISD1100 application. The differences are caused by the lack of on-chip pull-up and pull-down resistors on the ISD1200/ISD1400 series devices. All inputs to the ISD1200/ISD1400 must be strapped to V_{CC} or V_{SS} or pulled up (or down) with external resistors. A representative circuit is shown in Figure 2. The operation of these devices is identical to that described in the above ISD1100 application.

AUTOMATIC POWER-UP LOOPING

There is one circuit function the ISD1000A device can do that the ISD1100, ISD1200, and ISD1400 cannot, which is power-up in looping playback. The ISD1100, ISD1200, and ISD1400 series all power-up with the input pins "locked out" and remain in that state until an internal power up delay time is satisfied. These new products include a playback looping Operational Mode. Unfortunately, the on-chip built-in power up delay ends the ability to automatically power up with the looping function enabled.

The circuit in Figure 3 shows an alternative way to accomplish this function. C1 rapidly pulls the $\overline{PLAYE}$ pin to V_{CC} when voltage is applied to the circuit. After the power up delay time is satisfied, the voltage decay caused by R1 allows the $\overline{PLAYE}$ to drop below its "ON" threshold and the device begins playback. Since the device is in Operational Mode (A6 and A7 are HIGH), and A3 is HIGH, playback loops on the first message contained in its memory. Playback looping will continue until power is removed from the device.

The designer should assume power up delay time of at least 25 ms before the $\overline{PLAYE}$ pin voltage level falls below minimum V_{IH} to ensure the circuit will correctly be put into looping mode.

Figure 2: Simple Application for ISD1200/ISD1400 Series Device

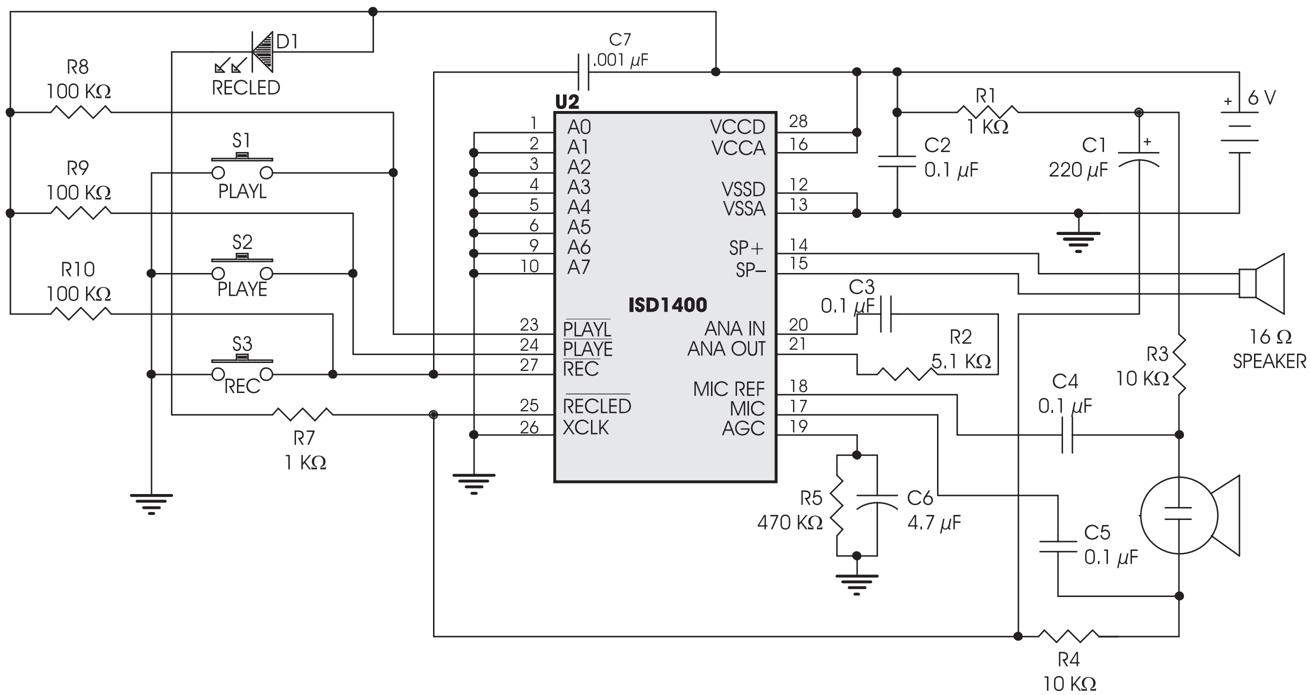
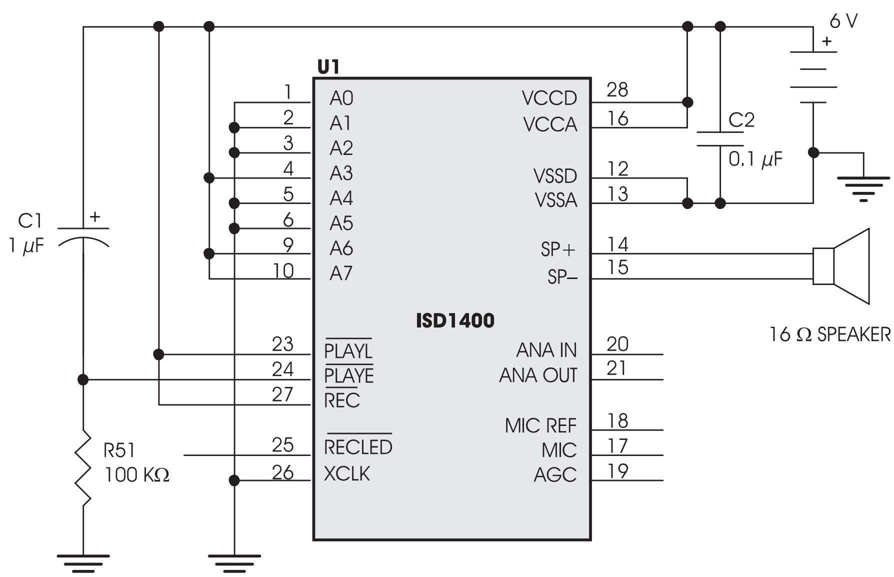


Figure 3: Automatic Power-up Looping



LOOPING AT ANY ADDRESS

The ISD1100, ISD1200, and ISD1400 products are recommended for new designs in the 10- to 20-second storage duration because of their simpler interface and automatic power-down capability. These devices include an Operational Mode (A3) that allows automatic looping at a message that starts at the beginning of memory or address "0." Some customers, however, want to loop on a message that begins at an address location other than "0." This allows them to store several messages in one device and select one of them for automatic looping.

Figure 2 under the section "Circuit Examples for ISD1000A and ISD2500 Products" shows a circuit that performs this function using the ISD1000A device. A slightly different circuit is required for the ISD1100, ISD1200, and ISD1400 series device. The diagram and explanation that follow demonstrate how this may be achieved.

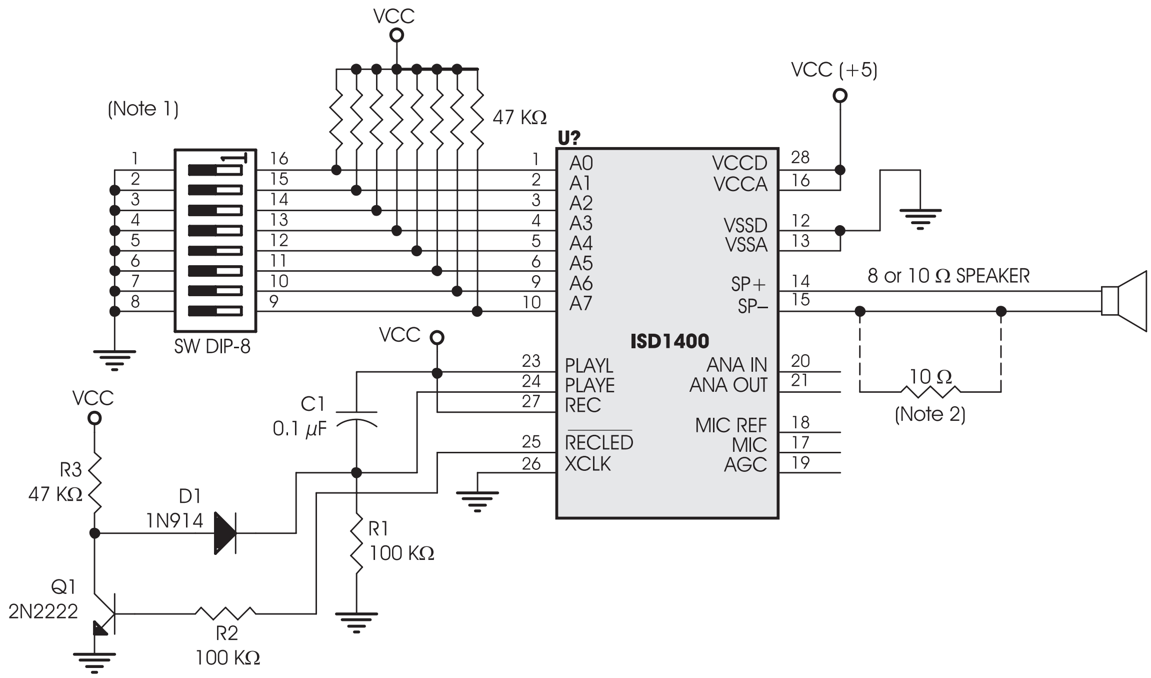
Figure 4 shows how the $\overline{\text{RECLED}}$ signal may be used to make the ISD1100, ISD1200, and ISD1400 device to loop on a message at an address other than "0." The R1-C1 combination causes the loop to automatically start at the address set by the dip switches when power is first applied to the circuit. If this is not desired, C1 should be replaced with a push button. A momentary closure of the push button will start the circuit to loop on the addressed message.

An unfortunate side effect of this circuit is a slight pop or "click" that occurs at the beginning of each loop. The circuit designer should evaluate their system requirements to determine whether or not this is a problem in their application.

FIXED MESSAGE AND RE-RECORDABLE MESSAGE SEGMENT EXAMPLE

Many applications require a fixed factory programmed message plus some capability for the end user to also program one or more messages. By manipulating the address and $\overline{\text{REC}}$ lines of the ISD1100, ISD1200, and ISD1400 series products, this capability may be easily achieved with few external parts. The following applications discussion and schematic show how this may be accomplished. While the ISD1400 is specifically mentioned, the ISD1100 and ISD1200 series may also be used in exactly the same way as long as the address and pull-up/pull-down resistor differences are understood.

Figure 4: Looping at Any Address[3]



1. *Only address 0 through 159 (decimal) are valid.*
2. *Add the 10 Ω resistor if an 8 Ω speaker is used.*

The applications schematic in Figure 5 shows a method for dividing the ISD1400 device into two messages.

- One of the messages is permanently recorded into the device by the manufacturer.
- The second message may be recorded (and erased and recorded again) in the field by the end user.

This design divides divide the device into a 4-second permanent message and a 16-second re-recordable message. The same techniques could be used to divide the memory into other combinations of permanent and recordable messages.

The permanent message (less than 4 seconds) is recorded at the OEM location at address "0" in the ISD1400. Recording of this message is explained below. Once recorded, there is no way to record over the analog memory at address "0" so the message cannot be erased.

RECORDING THE PERMANENT MESSAGE

The permanent message may be recorded into a packaged device before installing it into a circuit board. Once installed, the permanent message cannot be recorded over as long as JP1 is left intact.

The product may also be built using ISD1400 die. In this case, the permanent message is programmed by recording into the device before JP1 is installed. Simply press S2 and feed the audio to be recorded into the connection marked "Record In." Next install JP1 and the message is permanent.

NORMAL OPERATION

The normal operation of the device is simple. With S3 open, press S1 to playback the permanent message. With S3 closed, press S1 to playback the re-recordable message. Press S2 to record a message starting at the 4-second boundary.

CIRCUIT EXPLANATION

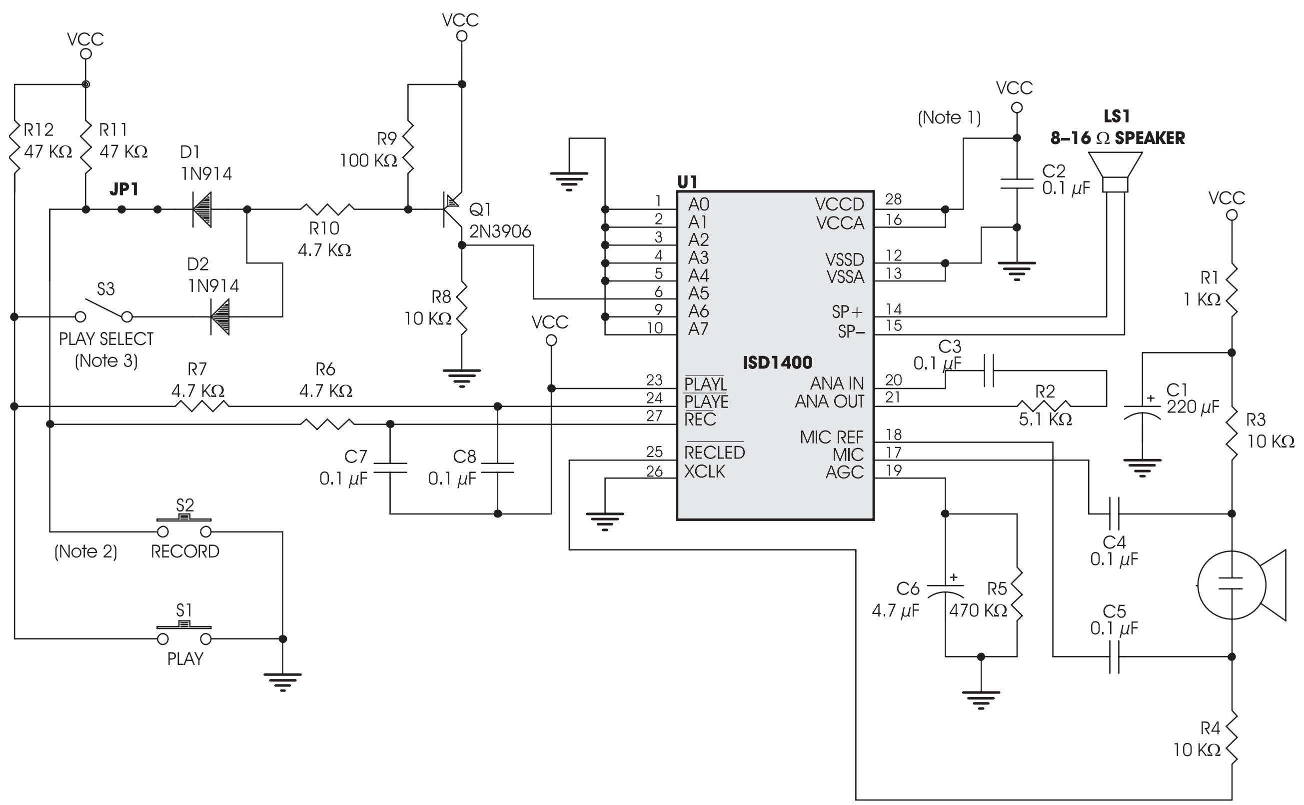
The PNP inverter transistor Q1 drives the address line A5 of the ISD1400. When S2 is pressed, D1 provides a base current path turning on Q1. Collector current through R8 brings A5 to a "1" level. The $\overline{REC}$ pin's LOW transition is delayed by the RC time constant set up by R6–C7 to satisfy the address set up time of the ISD1400. Record starts at address 0010 0000 of the device which equates to recording starting at the 4-second point in the memory.

When S1 is pressed with S3 closed, playback starts in a similar fashion at the 4-second point with the control signal coupled to Q1 through D2. R7–C8 provides the address set up delay.

When S1 is pressed with S3 open, playback then begins as address 0000 0000 of the ISD1400. This is the beginning of the device's memory.

On the analog side of the circuit, C4 and C5 have been changed from the ISD suggested value of 0.1 μF to 0.01 μF to roll off the low frequency response of the ISD1200 microphone amplifier. By reducing the lows, during playback more high frequency energy will be transferred to the speaker, making the sound seem louder and easier to hear.

Figure 5: Fixed and Re-recordable Message Segment Circuit Example



1. V_{CC} = 4.5 to 6.5 volts.
2. Pressing S2 begins recording at 4-second boundary. Pressing S1 starts Playback at 0 or 4 seconds according to switch S3 setting.
3. S3 open, Playback begins at 0, S3 closed, Playback begins at 4 seconds.

SIMPLE MULTIPLE MESSAGE APPLICATION WITH $\overline{EOM}$ DELETE AND ADDRESS RESET

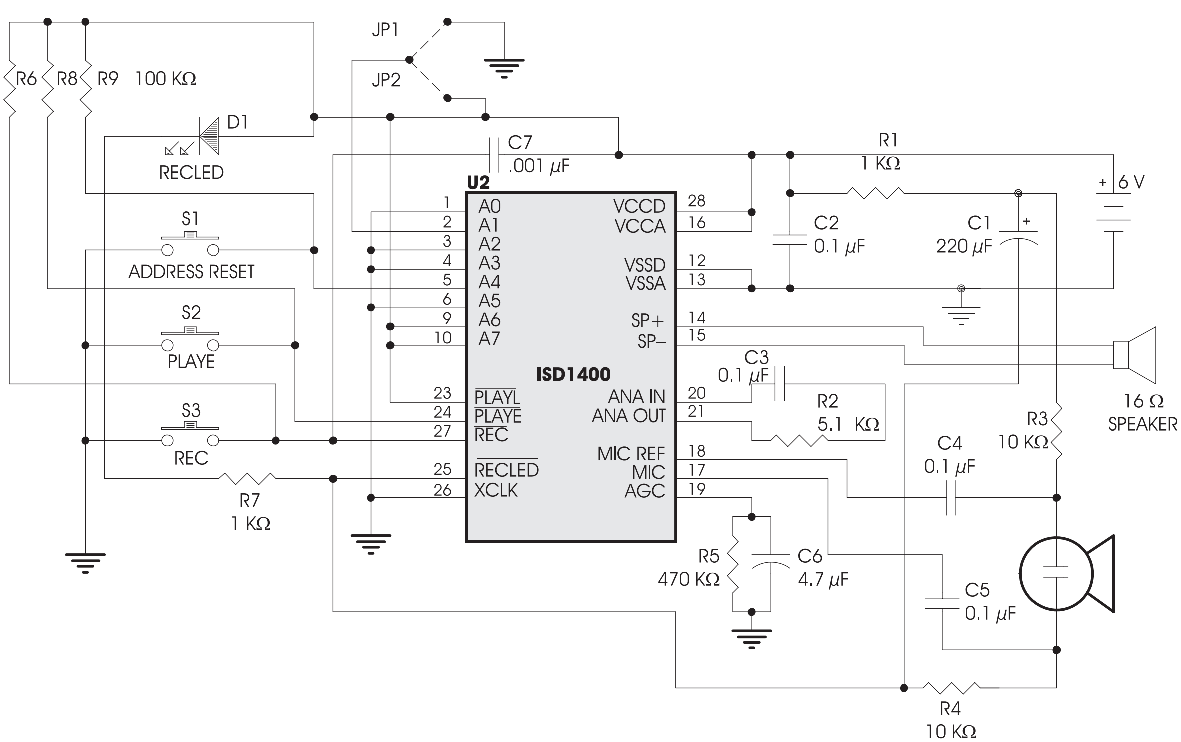
The ISD1100, ISD1200, and ISD1400 series include the A1 EOM Delete and A4 Consecutive Addressing Operational Modes found in the original ISD1000A device series. These modes allow the designer to produce a low cost product that can store multiple random length messages and play them back individually or all at once. When the Delete EOM Operational Mode is activated, playback starts at the beginning of memory and continues through all the messages just recorded without stopping. When Delete EOM is not activated, the messages are played back individually. The circuit diagram in Figure 6 and circuit explanation demonstrate these two applications.

CIRCUIT OPERATION – DELETE EOM ACTIVATED

The circuit is constructed as shown with JP2 installed. This straps A1 to a HIGH. Additionally, A6 and A7 are held HIGH to put the ISD1400 in Operational Mode. Also, R9 holds A4 HIGH unless the S1 push-button switch (Address Reset) is pressed.

Messages are recorded into the ISD1400 individually by pressing and holding the REC push- button for the length of the recording. The $\overline{REC}$ LED will illuminate during the recording. Additional messages may be recorded until the $\overline{REC}$ LED turns off. This indicates the device memory is full. The PLAYE push-button should not be pressed during this sequence. When the recording sequence is complete, a single momentary press of the PLAYE push-button will playback all the messages stored during the preceding Record sequence. A record sequence is ended by a playback operation, even if the memory is not full.

Figure 6: Multiple Message, EOM Delete, and Address Reset Application



NOTE: *Install JP2 for Delete EOM, install JP1 for normal operation.*

To start this playback sequence over, momentarily press the ADDRESS RESET push-button while the device is not playing back. This resets the internal address counter. The next press of PLAYE will start playback from the beginning of memory.

CIRCUIT OPERATION - DELETE EOM NOT ACTIVATED

The circuit is built exactly as the same with JP1 in and JP2 removed. The Delete EOM Operational mode is now disabled.

The recording sequence is performed as before. When the record sequence is complete, a single momentary press of the PLAYE push button will play the first message stored. A second press of the PLAYE push-button will play the second message stored. Messages will continue to playback in sequence, one message for each press of the PLAYE push-button.

As before, a momentary press of the ADDRESS RESET push-button will reset the ISD1400's internal address counter to enable the playback of the first message in the sequence.

USING THE SPEAKER OUTPUTS AS A PLAYBACK "RUN" INDICATOR IN THE ISD1100/1200/1400 SERIES DEVICES

Many applications require a signal to indicate when playback is occurring. An automatic announcement for a radio system, for instance, needs a signal to key the transmitter during the time the message is running. The ISD1100, ISD1200, and ISD1400 series of single-chip voice record/playback devices with their automatic power-down feature can provide this function using the speaker outputs.

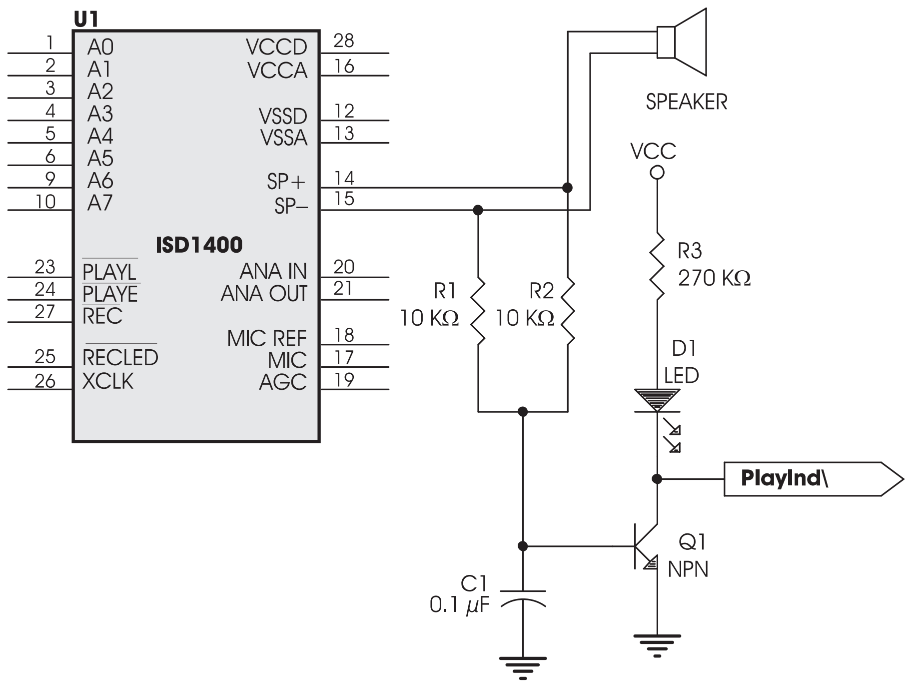
The speaker output pins of these ISD products power up to an average value of approximately 1.4 volts DC above the V_{SS} supply (which is usually at ground) during message playback. When the message stops at an End of Message location or the end of the analog memory space, the device automatically powers down, and the speaker output voltage falls to zero. This speaker bias voltage may be used to control an external circuit to provide a signal we may call PlayInd or PlayIndicator.

The circuit shown in Figure 7 exhibits one way this $\overline{\text{PlayInd}}$ signal may be derived. In this example R1 and R2 provide base current for Q1. Since the AC speaker voltage on SP+ is 180 degrees out of phase with the speaker voltage on SP–, the net result of the current flow into the base of Q1 will be as if a steady 1.4 volt signal were applied at each speaker pin. In Figure 7, each resistor will supply approximately 70 μA of base current or 140 μA total. If Q1 has a beta of 100 minimum, it can support at least 14 mA of collector current, enough to illuminate the LED as shown. Of course, a resistor may be substituted for the LED if a simple "1" and "0" switch is required. In this case, the signal at the collector of Q1 is the inversion of PlayInd or $\overline{\text{PlayInd}}$.

DETERMINING AN OVERFLOW CONDITION IN THE ISD1100, ISD1200, ISD1400 PRODUCT SERIES

The ISD1100, ISD1200, and ISD1400 product series do not have an overflow pin or other obvious indication of overflow status. In fact, it is not possible during playback to differentiate a normal EOM signal (present at the $\overline{\text{RECLED}}$ pin) from an EOM that results from the message stopping at the end of the device memory (overflow). It is possible in the A4 Operational Mode (A4, A6 and A7 HIGH), however, to determine if the device is at overflow by attempting a PLAY Edge operation and looking at the speaker pins.

Figure 7: Playback Run Indicator for ISD1100, ISD1200, and ISD1400 Series



NOTE: *Only speaker circuit shown to simplify diagram. Other components required for the circuit to record and playback.*

The previous heading described a method of deriving a PlayInd signal from an ISD1100, ISD1200, and ISD1400 series device. Using this circuit as an indicator, pulse the PLAYE pin and look at the PlayInd output. If the device is not in overflow, it will play the stored message and the PlayInd signal will be LOW for the duration of the message. If the device is in overflow, the PlayInd will pulse LOW for approximately 16 ms and go back HIGH.

It is also possible to determine an overflow condition from the PlayInd output when in Message Cueing Operational Mode (A0, A4, A6 and A7 HIGH, see the section “Operational Modes”). If the device “fast-forwards” through a message, the LOW-going PlayInd signal will be over 30 ms. If the device is in overflow, the PlayInd signal will be approximately 16 ms long.