APPLICATION BRIEF 5 — ADDRESS BIT M6 (PIN 7), ISD2500 PUSH-BUTTON MODE

In the ISD2500 series of devices there is an additional Operational Mode, not available in other ISD series devices. This is the Push-Button Mode that is provided for a very simple, minimum part count, application. When this mode is selected the functionality of three pins change to alternate uses. Pin 23, $\overline{CE}$, becomes Start/Pause and is activated by a LOW going pulse. Pin 24, PD, becomes Stop/Reset and is activated by a HIGH going pulse. Pin 25, $\overline{EOM}$, becomes RUN, with an active HIGH indication. (See the ISD2500 series data sheets for illustrations of how to use this mode with a microcontroller.)

Table 5: Push-Button Mode Control Pins for ISD2500

Pin Number	Pin Name	Changes for Push-Button Mode
Pin 23	$\overline{CE}$	Becomes $\overline{START}$ or $\overline{PAUSE}$ (–edge activated)
Pin 24	PD	Becomes STOP + RESET (+level activated)
Pin 25	$\overline{EOM}$	Becomes RUN to drive LED
Pin 22	$\overline{OVF}$	Remains the same

Start/Pause is used to start the device in either the Record or Playback Mode, depending upon the state of pin 27. Applying a LOW pulse here will begin the operation that will continue until it reaches the end of the chip, an EOM marker (in the Playback Mode), the Stop/Reset pin is pulsed HIGH, or the Start/Pause pin is pulsed again.

In the Record Mode, beginning at address 0, a series of messages can be recorded by pressing the Start/Pause button multiple times. Each *odd* numbered press of the button starts the next message. Each *even* press of the button stops the current message being recorded. The next message is then recorded at the beginning of the next address row when the button is pressed again. If no further messages are desired, or the end of the chip has been reached, pressing the Stop/Reset button will stop any recording in progress, record an EOM marker, and reset the address counter to 0.

In the Playback Mode, each time Start/Pause is pressed, the next message will be played. It will stop when it reaches the EOM marker and wait for the next command.

In the Push-Button Mode pin 25, $\overline{EOM}$, becomes RUN. This is an active HIGH signal that is true whenever a Record or Play operation is in progress. It is designed to drive a low-power LED as an indicator. It will indicate whether the last push of the Start/Pause button started an operation or paused one.

One important feature of the Push-Button Mode is that the ISD2500 device automatically enters the Power-Down Mode at the end of each operation *without* losing the message start pointer value. This means that the next operation will begin at the desired location. It is not reset by automatic power-down as it is on the ISD1000A devices when put into power-down with the PD pin.

Several descriptions of Push-Button Mode operations follow to help the user understand how to use these functions. These operations are illustrated in the State Diagram Flow Chart diagram found in Figure 7 that follows these descriptions, and shows each possible state of the ISD2500 device and what state it can transition to next.

POWER-UP CONDITION

The numbers in square brackets [] in Figure 7 indicate the current position of the operation in the State Diagram.

Number [1] indicates the power-up condition. Pushing the Stop button at this point does nothing.

RECORD

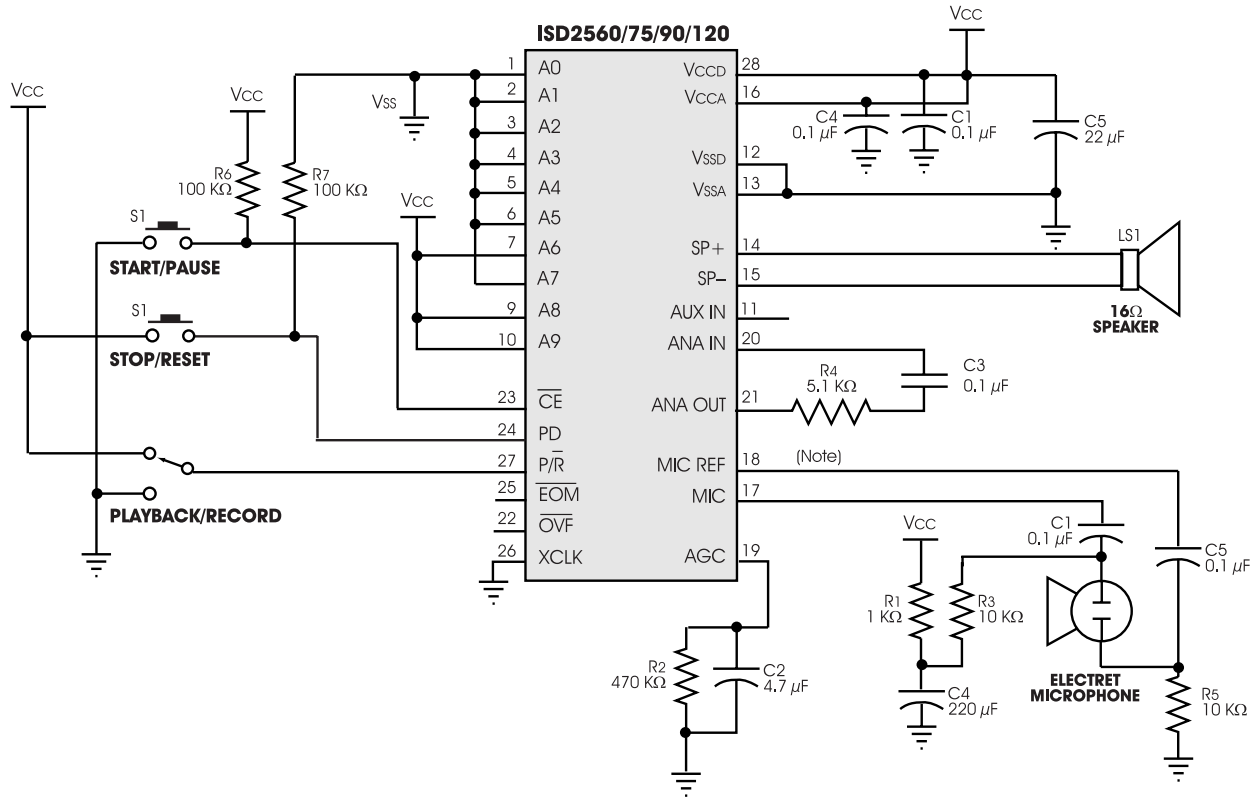
Setting the P/$\overline{R}$ to a 0 and then pressing the Start/Pause button starts the chip recording from address 000. [2] This recording will stop for three reasons: [5] The recording can reach the end of the chip and overflow. [3] It can be paused by hitting the Start/Pause button again. [4] One could hit the Stop button.

If the recording had stopped because of overflow [5], pressing the Start/Pause button again will not do anything. Hitting the Stop button will reset the address counter to 000. [1] The chip is ready for any new operation. Or, switching P/$\overline{R}$ to a 1 and hitting Start/Pause will start the chip playing from the beginning of the chip. [6]

If the recording stopped because the Stop button was pressed, an EOM is set and then the address counter is reset. The chip returns to step [1], ready for the next operation.

If the recording had stopped because of Start/Pause being pressed, it finishes recording and writes an EOM, [3], then three choices are available. Pressing the Start/Pause button again, the chip resumes recording from the beginning of the next row. [2] Pressing Stop resets the address counter and returns the chip to step [1] to await the next operation. Or, switching P/$\overline{R}$ to a 1 and pressing Start/Pause will start the chip playing from the beginning of the chip. [6]

Figure 6: Application Example—Push-Button Mode



RECORD-TO-PLAY

From either state [3] or [5], switching P/$\overline{R}$ to a 1 and hitting Start/Pause will reset the address counter and start the chip playing from the beginning. [6] If, during the recording, P/$\overline{R}$ had been switched to a 1 and Start/Pause had been pressed, the pause will be from the Record Mode, setting an EOM bit. The next Start/Pause will then play from address 0.

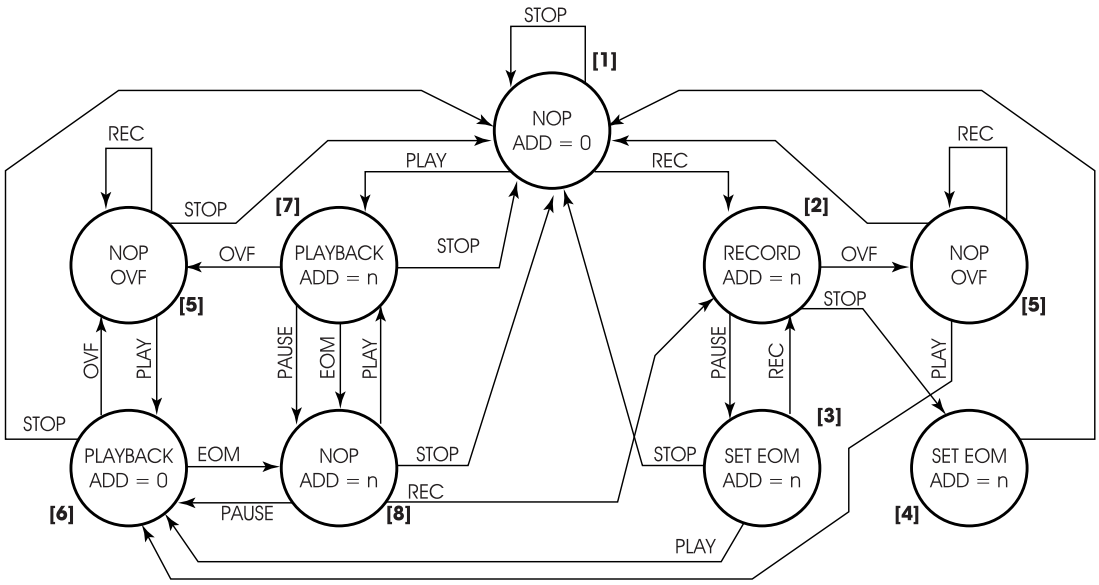
PLAYBACK

From position [1], if P/$\overline{R}$ had been a 1, and Start/Pause had been pushed, the chip would have begun playing from the beginning of the chip, address 000. [7] Playback would continue until one of four conditions was reached. (1) The message can reach the end of the chip and overflow. [5] (2) It can be paused by pressing the Start/Pause button again. [8] (3) One could press the Stop button. [1] (4) The message could reach an EOM bit. [8] If, while playing the message, P/$\overline{R}$ had been switched to a 0 and Start/Pause had been pressed, the chip will pause from the Play Mode. Then, if the Start/Pause is pressed with P/$\overline{R}$ = 0, a Record will start from the present position. If P/$\overline{R}$ = 1, a normal play will resume.

(1) If the chip reached overflow [5], pressing Start/Pause again will reset the address counter and the chip will begin to play from the beginning again. [6] (State [6] is very similar to state [7] except that the address counter has been reset. EOM and "Pause" send it to state [8] as they do from state [7]. Stop goes back to state [1] and $\overline{OVF}$ goes back to state [5].)

If, instead of pressing Start/Pause again from [5], one presses "Stop," the address counter would reset and the chip would return to state [1]. It would not play, and would await the next operation. Switching P/$\overline{R}$ to a 0 and pressing Start/Pause at the overflow will not do anything. The chip will remain in state [5].

Figure 7: ISD2500 Series Push-Button Mode State Diagram Flow Chart



(2) If the message had stopped because the Start/Pause button had been pressed [8], it does not reset the address counter. Three choices are available from state [8]: First, pressing Start/Pause again will make the chip resume [7] from the beginning of the row. Second, pressing Stop will reset the address counter and return the chip to state [1] awaiting the next operation. The third choice is to change from Play to Record [2] as explained in the following section.

(3) If the message had stopped because the Stop button had been pressed, the address counter was reset and the chip returned to state [1], ready for the next operation.

(4) Stopping for the EOM also places the chip in state [8], similar to pressing the Start/Pause while playing. The address counter is not reset. Instead, it is incremented to the beginning of the next row. This is slightly different from the pause that puts the counter at the beginning of the current row. Unless the pause occurred during the very last scan, in which case it will go to the beginning of the next row]

PLAY-TO-RECORD

Switching P/$\overline{R}$ to a 0 from state [8] and hitting Start/Pause will make the chip begin recording. This is without resetting the address counter from where it stopped playing. [2] This puts a new message on the chip, following the ones, or portions thereof, that were already played back. Note that it might be significant if state [8] was entered from the EOM or "Pause" as to where the recording will begin.

SOME SIMPLE ONE LINERS

- Pressing Stop from any state resets the entire chip, returning it to state [1].
- Pressing Start/Pause when playing or recording will pause the operation, pressing it again will resume that same operation.
- Pause in Record Mode will plant EOM bits *each* time. (Unless M1, delete EOM is set HIGH also.)
- Setting M1 true in the Push-Button Mode will mean that the pause EOM bits will be erased upon resuming Record. Only the last one at the end of the Record operation will remain. (Going from [3] to [1] or [6] leaves the EOM in place.)
- EOM bits in playback will pause the chip [8]. Each time you press Start/Pause plays the next message.
- The EOM is not erased when going from [8] to [2] with M1 true.
- In the Push-Button Record Mode the $\overline{CE}$ (Start/Pause) button does not need to be held down for the duration of the recording.
- Switching P/$\overline{R}$ to the opposite state during an operation, then pressing Start/Pause does not change the normal Pause operation.
- When the Start/Pause is pressed to resume an operation it initiates the current state of P/$\overline{R}$ independently of the state of P/$\overline{R}$ when the part was paused.

STATE DIAGRAM FLOW CHART DEFINITIONS

The lines represent a push-button action, an end of message or an overflow:

$\overline{REC}$ = P/$\overline{R}$ = 0 from NOP operation with Start/Pause = Negative Pulse

PAUSE (from $\overline{REC}$) = P/$\overline{R}$ = x from $\overline{REC}$ with Start/Pause = Negative Pulse

PLAY = P/$\overline{R}$ = 1 from NOP operation with Start/Pause = Negative Pulse

PAUSE (from PLAY) = P/$\overline{R}$ = x from PLAY with Start/Pause = Negative Pulse

STOP = P/$\overline{R}$ = x, $\overline{CE}$ = x, PD = Positive Pulse

The circles represent an operation:

NOP = No Operation

PLAYBACK = Playback starting at ADD = Previous operation or 0

RECORD = Record starting at ADD = Previous operation or 0

$\overline{OVF}$ = Overflow

(add = n) = current operation will start at the ending address location of the previous operation.