

# Simplify Smartphone Designs with Audio Jack Detection and Configuration Switches

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The audio jack is a common feature found in most smartphones today. With growing phone complexity and the need to maintain small form factors, the use of this audio jack is evolving. Phones and other mobile devices are being designed to use a growing variety of audio plug configurations and recognize what type is being inserted into the jack. Currently, discrete components (comparators, resistors, capacitors, & FETs) are used to detect the plug, the Send/End key, and 3 pole (audio headphones) vs. 4 pole (headset with microphone) accessories. Unfortunately, these discrete designs have inherent issues with current leakage, detection errors, and pop and click. To eliminate these issues and to enhance the user experience, Fairchild has created a new device type: audio jack detection and configuration switches.

Audio jack detection and configuration switches such as the FSA8008 integrate the functions of the discrete components and resolve:

1. Pop and click caused by the microphone bias
2. Current leakage from comparator voltage references and microphone bias leakage
3. 4 pole stuck Send/End key error detection

## Eliminate Pop and Click Caused by Microphone Bias

Typically, the microphone is connected to either the 3rd or 4th contact internal to the audio jack. In many phones, the MIC bias is not gated so if the audio plug is inserted or removed while the MIC bias is present, then pop and

click can be heard. Audio jack detection and configuration switches integrate all of the components to fully resolve this issue. These switches integrate plug detection, switch for isolation, and debounce circuitry (Figure 1). When no audio plug is connected, the internal switch is open and the MIC bias is isolated from the audio jack. After a plug is inserted, the device detects and debounces the mechanical connection and the switch can be closed. When the plug is removed, the detection switch identifies the removal and opens the switch before the plug's right speaker pole contacts the audio jack's ground. This combination of circuitry fully resolves the pop and click issues by fully isolating the MIC bias during plug insertion and removal.

## Reduce System Current

In the current design, comparators are used to sense between a 3 vs. 4 pole jack and the Send/End key. The voltage references are typically set by a resistor voltage divider. This resistor divider is connected directly to the supply and creates a continuous leakage path of  $\sim 28\mu\text{A}$ , whether a plug is connected or not. By integrating the voltage reference into the detection switch, the leakage path is greatly reduced. In devices such as the FSA8008, the total worst case power ( $25\mu\text{A}$ ) is less than the resistor leakage alone. Further power savings can be obtained by understanding the current system usage model. In MP3 mode, the microphone is not required but the Send/End key is used for play and pause. Typically, the MIC bias is connected to the microphone and a comparator is used to determine a key press (above 200mV, no press; below 200mV, key press). In the current design, this leakage path through the MIC pull-up resistor,  $R_{\text{MIC}}$ , to the microphone accounts for  $>500\mu\text{A}$ . Detection switches reduce this leakage

90% by isolating the MIC bias and sensing for a Send/End key only 10% of the time. This allows for power savings, while still providing the Send/End key function.

### Resolve Detection Errors

In the current solution, the same comparator is used to sense between a 3 vs. 4 pole jack and a Send/End key push. This can result in detection errors. If a 4 pole headset is plugged in, and the user holds down the Send/End key, the phone will recognize the headset as a 3 pole jack. Even worse, the phone will never resolve this error, resulting in a poor user experience. Detection switches resolve this error. If a 3 pole jack is determined, the switch will continuously double check for error detection. If an error is found, the detection switch will update the baseband and the phone will recover.

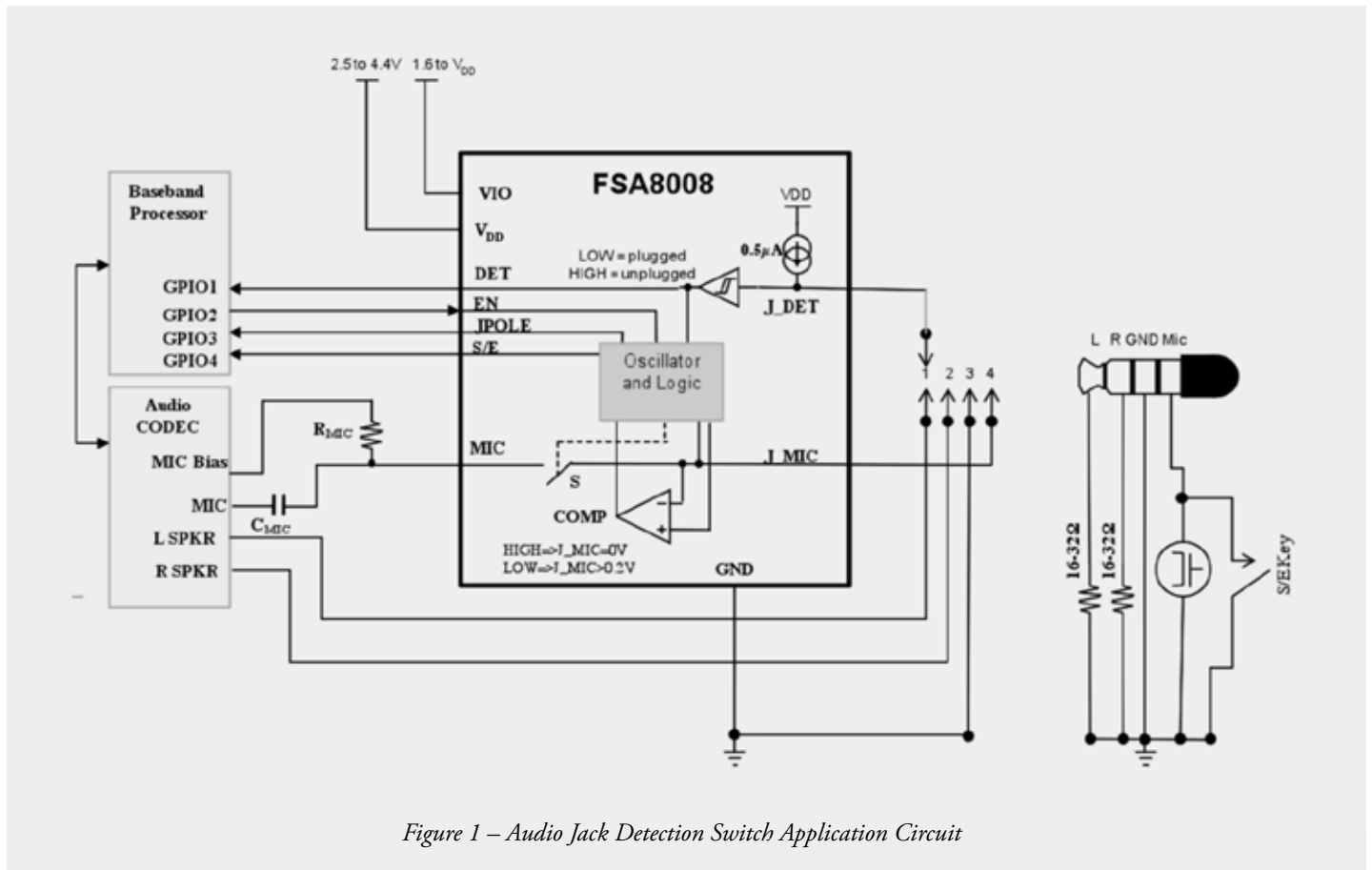


Figure 1 – Audio Jack Detection Switch Application Circuit