Product Overview

Four Considerations for Designing Cost-Effective and Reliable Emergency Call (eCall)

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Introduction

Emergency Call (eCall) systems provide a communication channel between motorists and emergency services in case of an accident. By automatically alerting authorities, this can help reduce response times and as a result, save lives. Located in the Telematics Control Unit (TCU), systems typically have one or two microphones to enable direct communication and the speech from the emergency operator is played back on dedicated loudspeakers inside the car. This has been mandated in the EU since 2018 and other parts of the world have followed suit. These are some key things to consider when designing an eCall system and how our new TAC5(3/4)1x-Q1 family of automotive audio Codecs satisfy these requirements.

Figure 1. Example of an Emergency Call System

Simplicity, Size, and Cost

The TCU where eCall sits in needs to be a set size (approximately 170mm × approximately 127mm) to fit in certain areas of a car (such as under the roof). However, there are more features being added to the telematics module such as antennas for mobile and V2X, making space for other devices a premium. In addition, cost is key, many automakers need a design to meet the standards at the most optimized cost possible, as saving a few cents on every board yields millions of dollars saved over the lifespan of a production run of a vehicle.

TAC5(3/4)1x-Q1 Codecs meet this requirement by integrating a large portion of the audio record signal path and microphone power. This includes:

- Audio Codec
- Boost Converter and LDO for High-Voltage MICBIAS (5V-10V, Programmable)
- SAR ADC for Comprehensive Input Fault Diagnostics
- High-CMRR Pre-Amplifier (TAC5412-Q1 Only)

The TAC5(3/4)1x-Q1 Codecs are expected to save up to >40% in board space savings by turning what was traditionally six ICs per board to two (See Figure 2), helping also save approximately $0.50 in BOM cost.

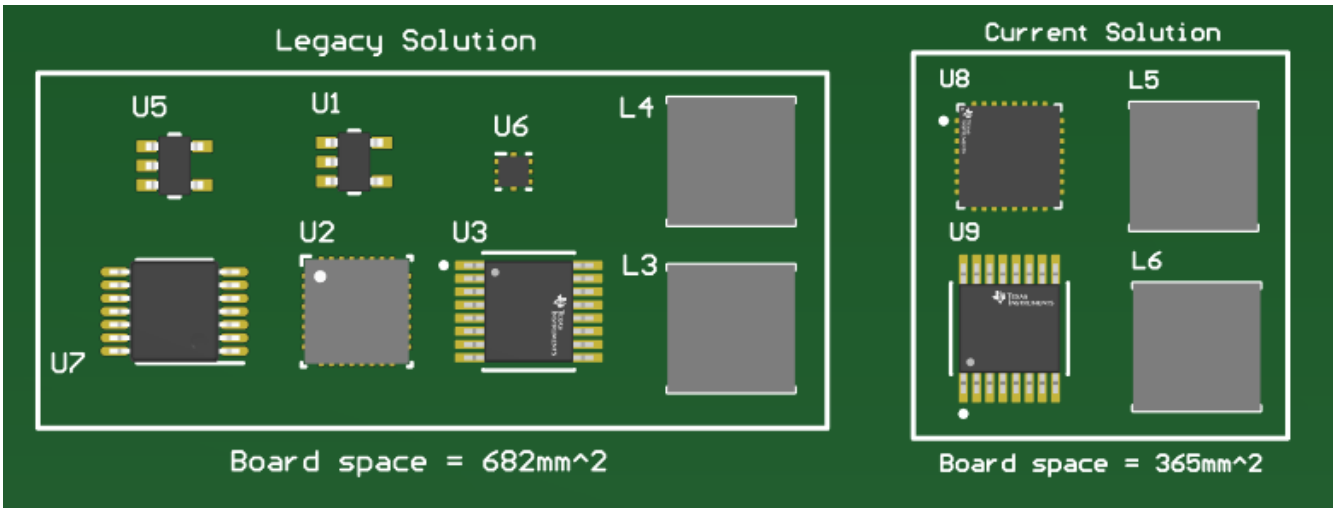

Figure 2. Example of the Board Space Savings the TAC5(3/4)1x-Q1 Codecs Can Offer Compared to TI's TLV320AIC310x-Q1 Codecs

Reliability

Designed for when an emergency happens, eCall systems must be reliable; occupants of the damaged vehicle are relying solely on eCall to be able to communicate to emergency services. However, there are many potential faults that can affect the system during a crash, which is why diagnostics to identify and handle faults are so important. For instance, take the microphone and Codec. Long harnesses and wires connect between the two to help make communication clear. However, the disadvantage of this is that in a crash, these harnesses are more likely to break off, preventing communication from happening.

TAC5(3/4)1x-Q1 Codecs integrate a SAR ADC to provide the SoC diagnostics of the microphone input connection. Such diagnostics include:

- Inputs shorted to ground
- Inputs shorted to MICBIAS
- Input open circuit
- Input pins shorted together
- Input overvoltage detection
- Inputs shorted to VBAT
- MICBIAS Overvoltage
- MICBIAS Overcurrent
- MICBIAS Load Current
- Overtemperature
- Supply Back Pumping
- Output Overcurrent
- Virtual Ground

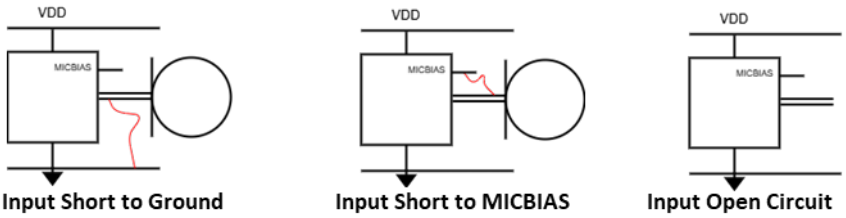

Figure 3. Examples of Some of the Input Fault Diagnostics Supported by the TAC5(3/4)1x-Q1 Codecs

See TAx5xxx-Q1 Fault Diagnostic Features to learn more about each fault diagnostic and how to program it.

Efficiency and Power Consumption

Telematics systems have a backup battery in case the main one disconnects during a crash. To help save costs, automakers prefer to use a cheaper lithium-ion battery. This means to help preserve the life of a battery, automakers want all components on the board to draw as minimal power as possible.

All our TAC5(3/4)1x-Q1 Codecs has two shutdown (pulling IOVDD = 0V, drawing <1uA on AVDD) and sleep modes (using I2C, drawing ~5uA from AVDD) which enables the TCU controller to switch off the record and playback paths until an accident is detected to preserve battery life. Upon a crash detection scenario, the device can be brought online using I2C writes. Both record and playback chains are optimized to help verify longer battery run time.

Temperature

5G modems typically run very hot due to the multiple antennas needed to achieve faster speeds. The addition of these modems in the TCU, combined with the limited space means that the TCU itself can get extremely hot. This makes it a requirement that all ICs inside need to withstand an ambient temperature up to at least 105°C.

TAC5(3/4)1x-Q1 Codecs are AEC-Q100 Grade 1 qualified, meaning they are able to handle this by having an ambient temperature range up to 125°C, exceeding these requirements. In addition, these Codecs also have diagnostics to track for overtemperature faults and thermal foldback features that limits device performance so that the device is still functional if the ambient temperature is too hot.

See *Dynamic Voltage and Temperature Tracking Based Limiter in TAX5XXX-Q1* to learn more about each fault diagnostic and how to program it.

Additional Resources

- Order the TAC5412-Q1 evaluation module (TAC5412Q15B5EVM-K)
- Start designs with TI's eCall reference design for the TAC5312-Q1
- Check out TI's full range of end-to-end audio designs, including amplifiers, processors, converters and switches

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