

# TI Designs TI WiLink8™ Wi-Fi®/Bluetooth®/Bluetooth Smart Audio Multiroom Cape Reference Design



## TI Designs

TI Designs provide the foundation that you need including methodology, testing and design files to quickly evaluate and customize the system. TI Designs help you accelerate your time to market.

## Design Resources

<a href="#">TIDC-WL1837MOD-AUDIO-MULTIROOM-CAPE</a>	Design Folder
<a href="#">WL1837MOD</a>	Product Folder
<a href="#">PCM1808</a>	Product Folder
<a href="#">PCM5101AQPWRQ1</a>	Product Folder
<a href="#">TXS0108EPWR</a>	Product Folder
<a href="#">TL1963A-33DCQT</a>	Product Folder
<a href="#">TPS73618DBVT</a>	Product Folder



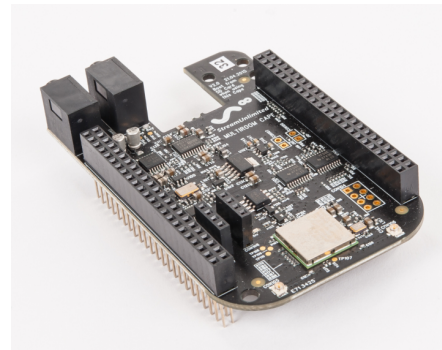
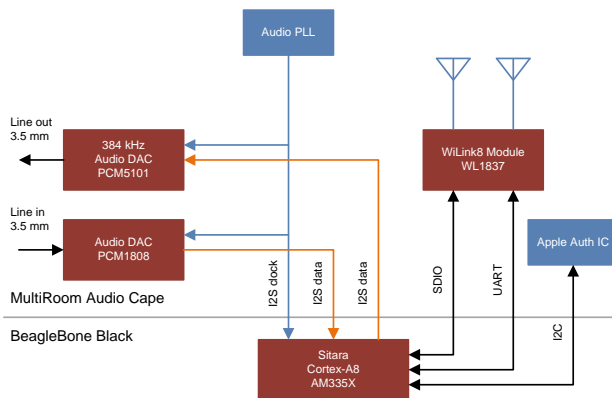
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## Design Features

- Ultraprecise Audio Multiroom Synchronization (<20 usecs) Between Multiple Speakers/Capes
- SDK Supports Rich Set of Online Music Services, UPnP, Airplay Audio Receiver, and GStreamer
- Wi-Fi® Dual Band Support on 2.4-GHz Band (Featuring 2 x 2 MIMO) and Antenna Diversity on 5-GHz Band
- Wi-Fi/Bluetooth (A2DP)/Bluetooth™ Smart Co-ex and Multirole AP/Station Support
- Stereo ADC and DAC Support

## Featured Applications

- Wireless Speakers
- Multiroom Speakers
- Home Theater
- Soundbar



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## 1 System Description

TI WiLink8™ WL1837MOD ( <http://www.ti.com/product/wl1837mod> ) Audio cape is a Wireless Multiroom Audio reference design used with BeagleBone Black ( <http://www.ti.com/tool/beaglebk> featuring TI Sitara™ AM335x) TI WiLink 8 WLAN capability to capture and register precise arrival time of the connected AP's beacons is used to achieve ultraprecise synchronization between multiple connected audio devices. TI WL1837MOD offers integrated Wi-Fi/*Bluetooth*/*Bluetooth* Smart solution featuring 2.4-GHz MIMO and antenna diversity on 5-GHz band. The device offers an audio solution featuring Multiroom, Airplay receiver, full audio stack streaming, support for online music services, and more. This TI Design enables customers to design their own audio boards with TI WL1837MOD combo-connectivity and to evaluate Audio Multiroom Software.

### 1.1 TI WL1837MOD

The certified WiLink 8 module from TI offers high throughput and extended range along with Wi-Fi and *Bluetooth* coexistence in a power-optimized design. The WL18x7MOD is a Wi-Fi, dual-band, 2.4- and 5-GHz module solution with two antennas supporting industrial temperature grade. The device is FCC, IC, ETSI/CE, and TELEC certified for AP (with DFS support) and client. TI offers drivers for high-level operating systems, such as Linux® and Android™. Additional drivers, such as WinCE and RTOS, which includes QNX, Nucleus, ThreadX, and FreeRTOS, are supported through third parties. The TI [WL1837MOD](#) offers a unique feature of time synchronization using AP beacons that are used to achieve ultraprecise Audio Multiroom/Speaker synchronization.

### 1.2 TI PCM1808

The PCM1808 device is a high-performance, low-cost, single-chip, stereo analog-to-digital converter with single-ended analog voltage input. The PCM1808 device uses a delta-sigma modulator with 64-times oversampling and includes a digital decimation filter and high-pass filter that removes the dc component of the input signal. For various applications, the PCM1808 device supports master and slave mode and two data formats in serial audio interface.

### 1.3 TI PCM5101AQPWRQ1

The PCM510xA devices are a family of monolithic CMOS-integrated circuits that include a stereo digital-to-analog converter and additional support circuitry in a small TSSOP package. The PCM510xA devices use the latest generation of TI's advanced segment-DAC architecture to achieve excellent dynamic performance and improved tolerance to clock jitter.

### 1.4 TXS0108EPWR

The TXS0108EPWR is an 8-bit non-inverting translator that uses two separate configurable power-supply rails. The A port is designed to track VCCA. VCCA accepts any supply voltage from 1.2 V to 3.6 V. The B port is designed to track VCCB. VCCB accepts any supply voltage from 1.65 V to 5.5 V. This allows for low-voltage bidirectional translation between any of the 1.2-V, 1.5-V, 1.8-V, 2.5-V, 3.3-V, and 5-V voltage nodes.

### 1.5 TL1963A-33DCQT

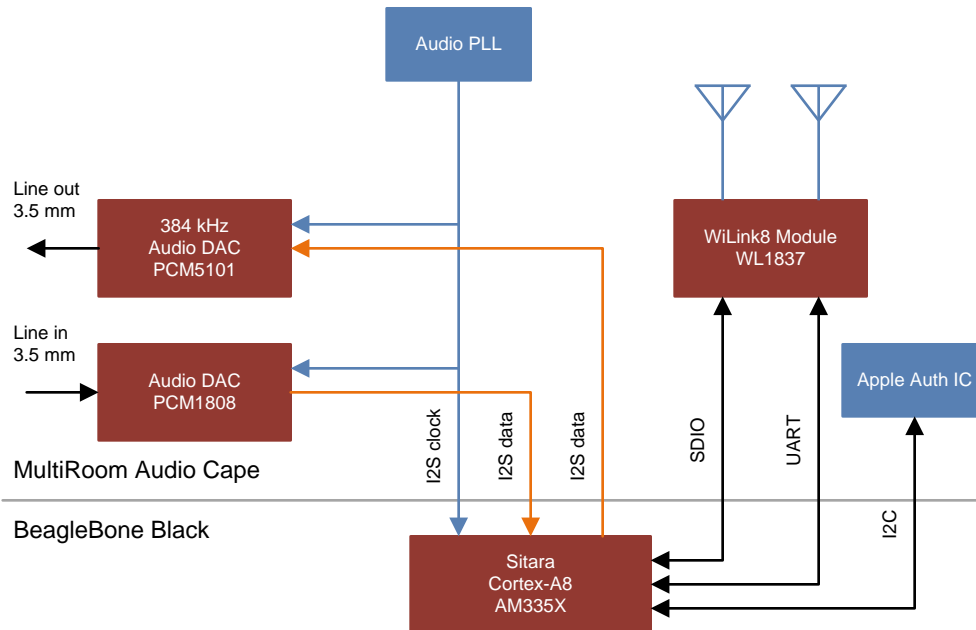
The TL1963A-xx devices are low-dropout (LDO) regulators optimized for fast transient response. The device can supply 1.5 A of output current with a dropout voltage of 340 mV. Operating quiescent current is 1 mA, dropping to less than 1  $\mu$ A in shutdown. Quiescent current is well controlled; it does not rise in dropout as with many other regulators. In addition to fast transient response, the TL1963A-xx regulators have very low output noise, which makes them ideal for sensitive RF supply applications.

### 1.6 TPS73618DBVT

The TPS736xx family of low-dropout (LDO) linear voltage regulators uses a new topology: an NMOS pass element in a voltage-follower configuration. This topology is stable using output capacitors with low ESR, and even allows operation without a capacitor. It also provides high reverse blockage (low reverse current) and ground pin current that is nearly constant over all values of output current.

## 2 Block Diagram and System Design Theory

Figure 1 shows the WL1837MOD audio multiroom cape block diagram.



**Figure 1. WL1837MOD Audio Multiroom Cape Block Diagram**

This wireless multiroom audio reference design combines the latest dual-Band TI WiLink 8 module [WL1837MOD](#) with all software building blocks required for a high-end streaming audio platform from StreamUnlimited.

Analog audio IN and OUT are provided, which supports sound reproduction at up to 384-kHz sampling frequency. Using technology that is co-developed by TI and StreamUnlimited Engineering, the audio is synchronized at few microseconds precision between multiple devices. The mainline Linux based SDK of StreamUnlimited combines this highly-accurate synchronization with a rich set of online music services, a customizable user interface offering both local control and display and control through IOS® and Android devices.

The cape is used with BeagleBone Black, as shown in [Figure 1](#). The Host Processor AM335x is connected to WL1837MOD through SDIO bus (for WLAN IP) and UART (BT IP). For MFi Licensees, there is also a provision to connect MFi sub-pcb. There are 2-U.FL antenna ports where external antennas must be connected, and an onboard audio PLL provides a I2 S clock.

## 3 Test Setup and Data

### 3.1 Regulatory Certification

For TI WL1837MOD certifications, see [http://processors.wiki.ti.com/index.php/WL18xxMOD\\_Certificates](http://processors.wiki.ti.com/index.php/WL18xxMOD_Certificates).

### 3.2 WL1837MOD Time Synchronization

For TI WL1837MOD time synchronization, see <http://www.ti.com/lit/an/swaa162/swaa162.pdf>.

### 3.3 Multiroom Ultralow Synchronization Testing on Oscilloscope

StreamUnlimited provides software that plots audio analog data or digital I2-S data on an oscilloscope. For more details, see <http://www.streamunlimited.com/products/wifiaudiocape.html>.

## 4 Getting Started

### 4.1 Schematics

To download the schematics, see the design files at <http://www.ti.com/tool/TIDC-WL1837MOD-AUDIO-MULTIROOM-CAPE>.

### 4.2 Bill of Materials

To download the Bill of Materials, see the design files at <http://www.ti.com/tool/TIDC-WL1837MOD-AUDIO-MULTIROOM-CAPE>.

### 4.3 Gerber Files

To download the Gerber files, see the design files at <http://www.ti.com/tool/TIDC-WL1837MOD-AUDIO-MULTIROOM-CAPE>.

### 4.4 Assembly Drawings

To download the Assembly Drawings, see the design files at <http://www.ti.com/tool/TIDC-WL1837MOD-AUDIO-MULTIROOM-CAPE>.

## 5 Software Files

TI partner StreamUnlimited provides software for BeagleBone Black and WL1837MOD Audio Multiroom cape, for more details see <http://www.streamunlimited.com/products/wifiaudiocape.html>.

## **6 About the Author**

This project was made possible with the collaboration of TI WiLink engineers SAURABH NARANG, EITAN BAR, and StreamUnlimited.

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