Application Report
SWRA440–November 2013

2.4-GHz Bi-directional Audio Streaming with Karaoke for DVDs and Set Top Boxes (STB) using CC853x

Vikas Thawani and Sanjay Dixit *Low-Power Wireless*

ABSTRACT

This application note describes the power of the CC853x, which is a 2.4-GHz RF SoC for wireless audio streaming. A standard CC853x wireless headset development kit is used to make a wireless demo for audio transmission and reception in a standard IR (infrared) Remote-DVD/STB-TV system. Two audio channels are transmitted from Remote to DVD, and stereo audio channels are transmitted from DVD to Remote. The built-in Audio protocol of CC853x makes multiple audio channels to co-exist simultaneously. The target applications for the demo are DVD and STBs without doing any software modification to the existing IR-based system.

Contents

1 CC85xx 1
2 Existing Remote-STB/DVD-TV system: 2
3 Modified System to Establish Bi-Directional Audio Link 2
4 Conclusion 6
5 References 6
6 Schematics 7

List of Figures

1 Typical CC85xx and TLV320AIC3204 Application Schematic 2
2 Audio Conversion Signal Chain 3
3 CC85xx Headset EVM (Master or Slave) 3
4 Demo Architecture 4
5 IR Commands from Remote 4
6 Karaoke MIC Audio into Right Channel 5
7 Processing of Received RC5 Remote Commands 5
8 Add the Received Karaoke Sound to TV Audio Input 6
9 STB/DVD Stereo Audio Added to MIC Input for Transmission to Remote 6
10 Remote-Side Schematics 7
11 STB-Side Schematics 8

List of Tables

1 CC85xx

The CC85xx are TI's wireless audio devices that use 2.4-Ghz unlicensed industrial, scientific, and medical (ISM) band. This CC85xx family offers state-of-the-art co-existence and robustness, excellent link budget and low-power operation while streaming high-quality audio wirelessly. This family has built-in audio protocol providing excellent robustness and co-existence through multiple techniques such as adaptive-frequency hopping and forward-error correction. CC85xx devices operate autonomously and can be used with or without external MCU. The control interface for CC85xx is SPI and the Audio interface is I2S and USB (CC85x1 only). Different members of the CC85xx family differ in the number of audio channels that can be streamed simultaneously and in USB audio support.

2 Existing Remote-STB/DVD-TV system:

The bidirectional wireless Audio demo described in the application note uses the existing IR system. The system consists of IR remote, DVD or STB and an LCD TV. DVD or STB has an IR receiver that decodes IR commands transmitted by remote and controls the DVD operation. This IR system has the following limitations:

- Range of control
- Line of sight is required for control

3 Modified System to Establish Bi-Directional Audio Link

A typical application schematic of the CC85xx Headset reference design kit is shown in Figure 1.

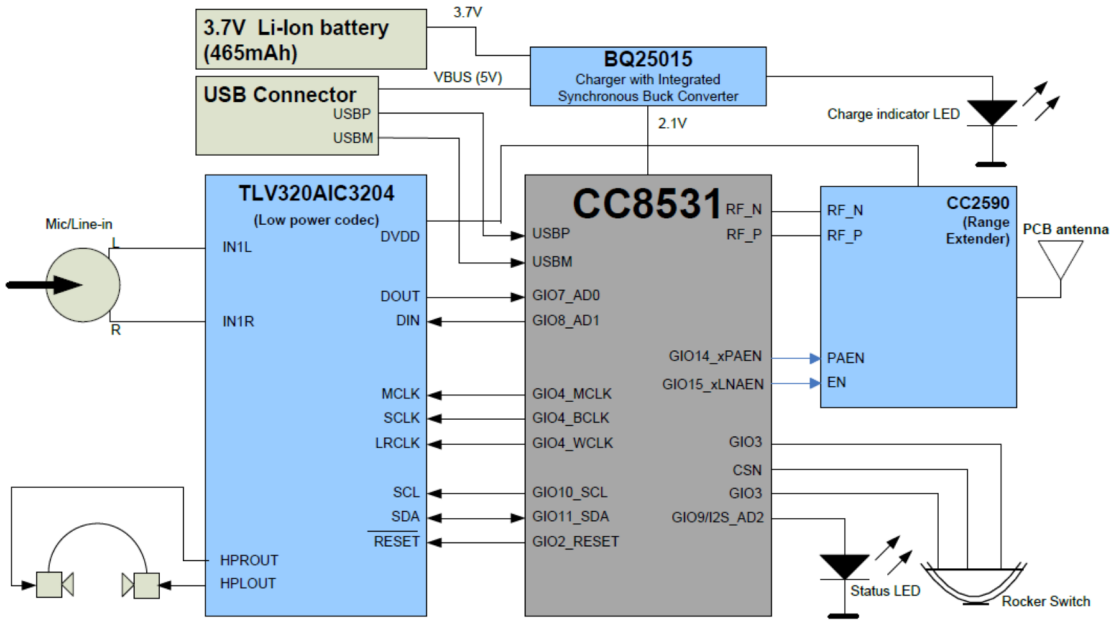

Figure 1. Typical CC85xx and TLV320AIC3204 Application Schematic

The TLV320AIC3204 is a low-power stereo codec that forms the data converter of the system. MIC input goes to ADC and is converted to I2S digital audio, whereas the I2S digital audio received is converted to analog audio by DAC and routed to the headphone output. I2S audio is interfaced with CC8531 that forms the link between I2S and RF. CC2590 has additional PA and LNA that are used to extend the RF range. Figure 2 illustrates this architecture.

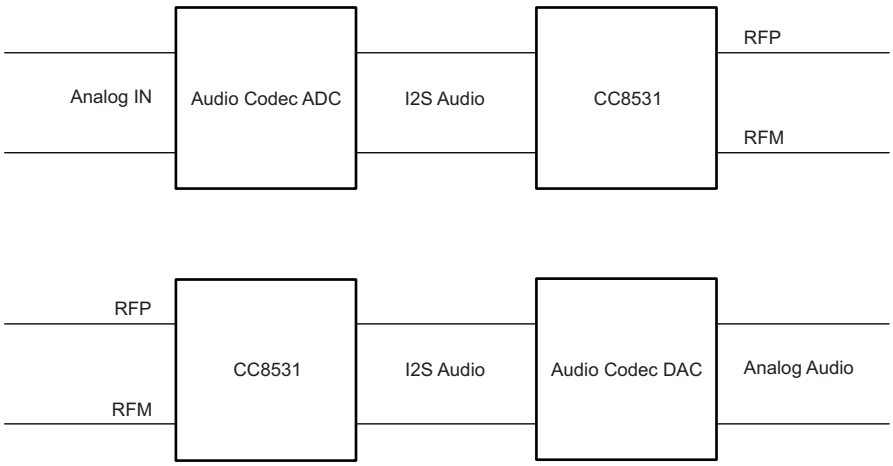

Figure 2. Audio Conversion Signal Chain

The CC85xx headset development kit consists of two similar EVMs, configured as master and slave. Figure 3 illustrates the CC85xx headset EVM (master or slave).

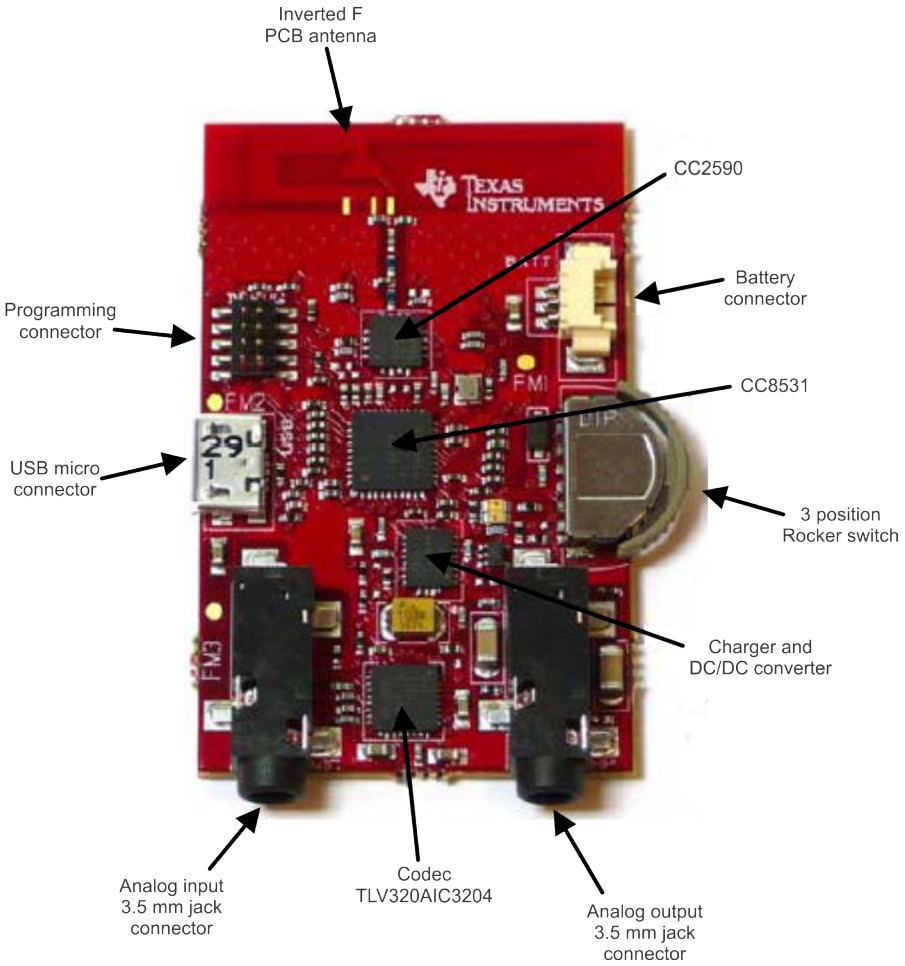

Figure 3. CC85xx Headset EVM (Master or Slave)

The demo architecture is illustrated in Figure 4.

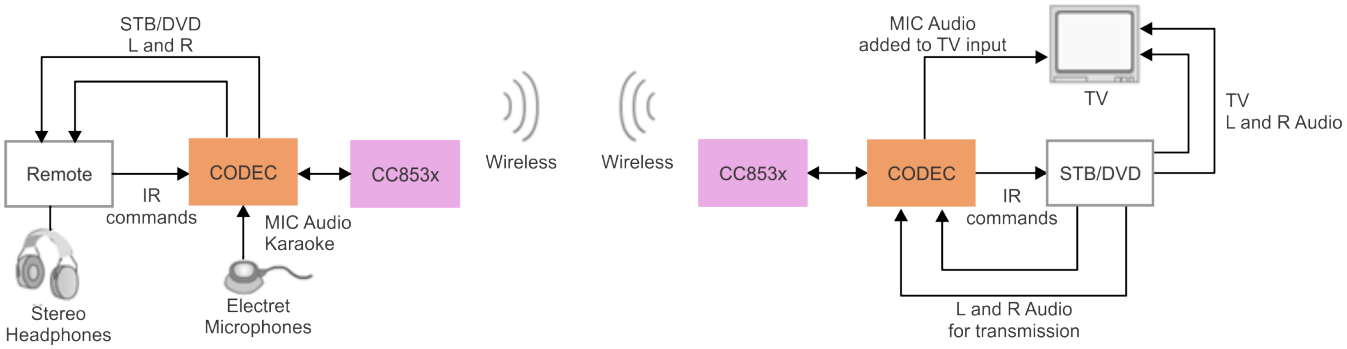

Figure 4. Demo Architecture

The default configuration is half duplex and is factory programmed. The following steps were performed to configure the demo:

1. The EVM was reprogrammed to full duplex mode with both master and slave transmitting and receiving at the same time.
2. IR commands from Remote are captured by IR receiver TSOP312xx (Figure 5), stepped down in voltage level and fed to the MICL pin of audio codec on Headset EVM located at the remote side.

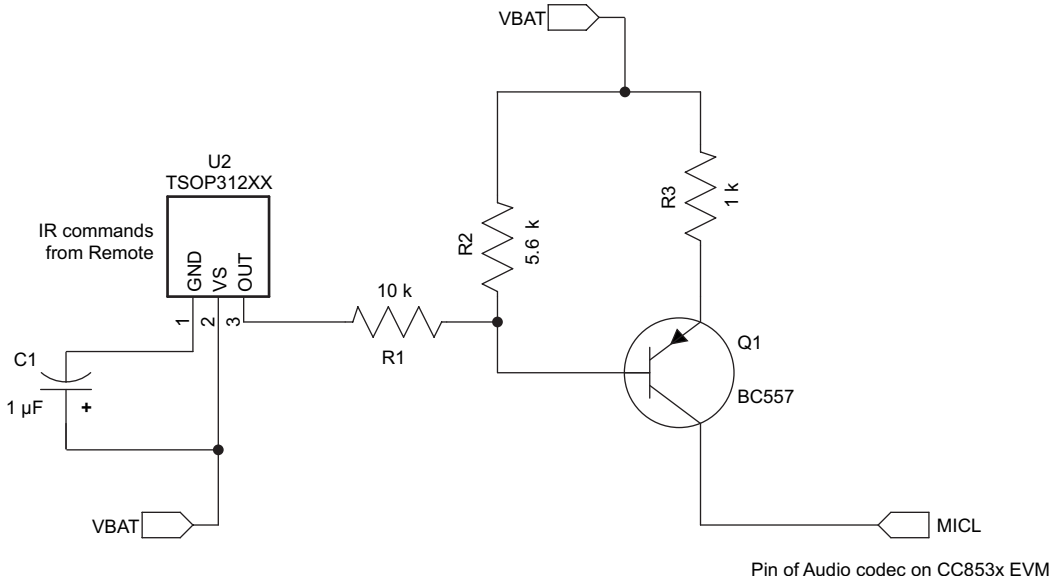

Figure 5. IR Commands from Remote

3. Karaoke MIC voice data is captured by the Electret Microphone, stepped up in voltage level by 2 stage amplifier, and fed to MICR input of Headset EVM located at the remote side.

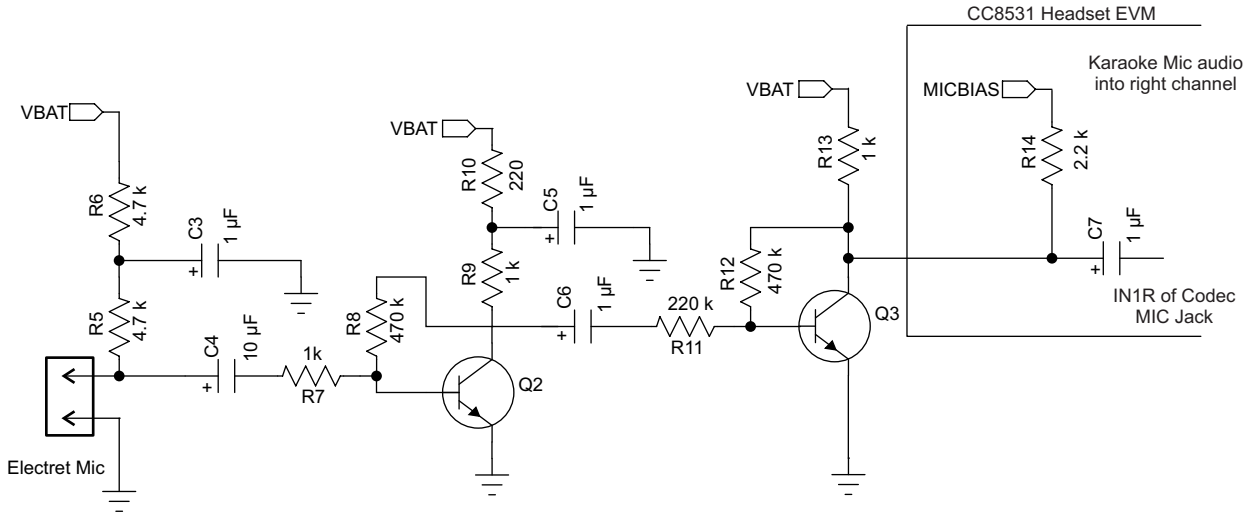

Figure 6. Karaoke MIC Audio into Right Channel

4. A wireless audio link is established between the remote-side EVM and the STB/DVD-side EVM. This enables the STB/DVD EVM to receive IR commands in RF format, and CC8531 converts the received signal in digital I2S format. Audio codec on the EVM converts the digital audio to analog. This signal is converted to 5-V logic level RC5 signal. A 36-kHz square wave is used to modulate RC5 and drive an IR LED. This IR LED, when kept in front of STB/DVD, will respond to IR commands without opening the STB/DVD.

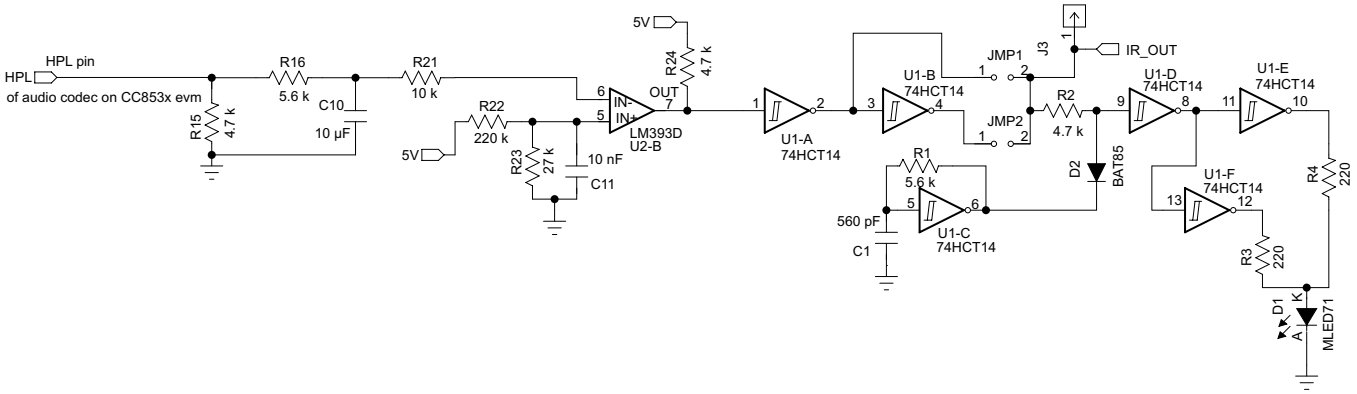

Figure 7. Processing of Received RC5 Remote Commands

5. The right RF channel received on the STB/DVD side is Karaoke voice that is converted back to digital I2S. The digital I2S audio is converted back to analog output received at right Headphone channel, and is fed into TV audio along with STB/DVD audio. Hence, a karaoke effect is in place.

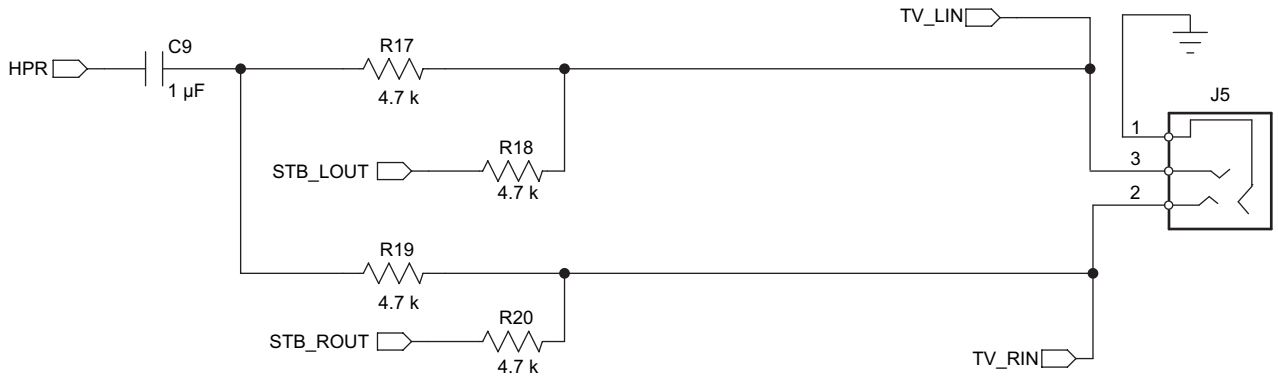

Figure 8. Add the Received Karaoke Sound to TV Audio Input

6. The STB/DVD stereo audio output is also fed to Microphone MICL and MICR inputs of DVD/STB-side EVM. Remote side EVM receives the audio wirelessly. CC853x converts RF audio to digital I2S audio. Audio codec on board changes digital audio to analog output that is routed to headphones connected at the Headphone jack of the remote-side EVM. Thus, the person viewing a movie can listen to audio on headphones and mute the TV output, a case helpful for viewing late night television.

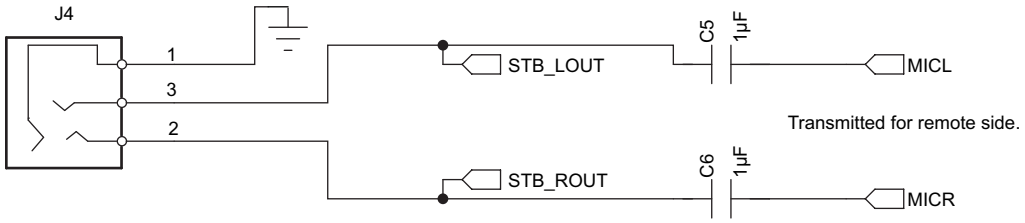

Figure 9. STB/DVD Stereo Audio Added to MIC Input for Transmission to Remote

The previous steps help to setup a four channel wireless audio link between Remote and STB. Two channels, MIC and IR commands, are streamed from remote to STB/DVD, and two stereo audio channels are streamed from STB/DVD side to Remote headphones. Throughout the demo, no software changes were made either on the remote side or on the DVD/STB side.

4 Conclusion

The remote EVM can be hooked to any standard IR Remote. The STB EVM can be placed in front of any STB/DVD and has the capability to communicate with the IR receiver inside. This demo can further be extended if a voice decoding engine is made on the STB side, and STB can be controlled by voice commands from Remote. CC8531 can support wireless streaming of up to 4 audio channels simultaneously. There are no audio dropouts, as shown in the above demo, and multiple channels can co-exist. This fact makes CC85xx an excellent choice for applications like wireless headphones, wireless loudspeakers and wireless 2.1 audio systems.

5 References

Use the following references for additional information:

1. CC85xx datasheet (SWRS091)
2. CC85xx Headset Quick Start Guide (SWRU282)
3. CC85xxDK Headset User's Guide (SWRU281)
4. CC85xx Design Documents (SWRR079)

6 Schematics

Figure 10 and Figure 11 illustrate the Remote-side and STB-side schematics for audio streaming using CC853x.

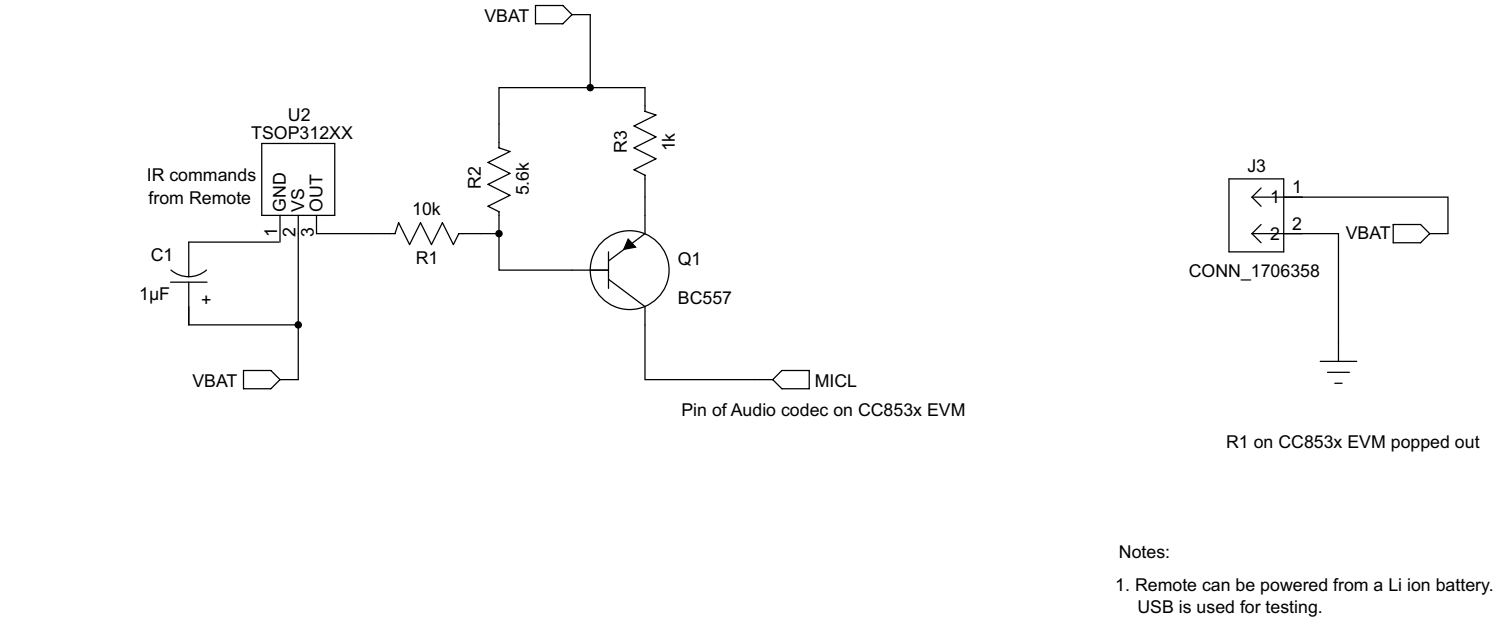

Figure 10. Remote-Side Schematics

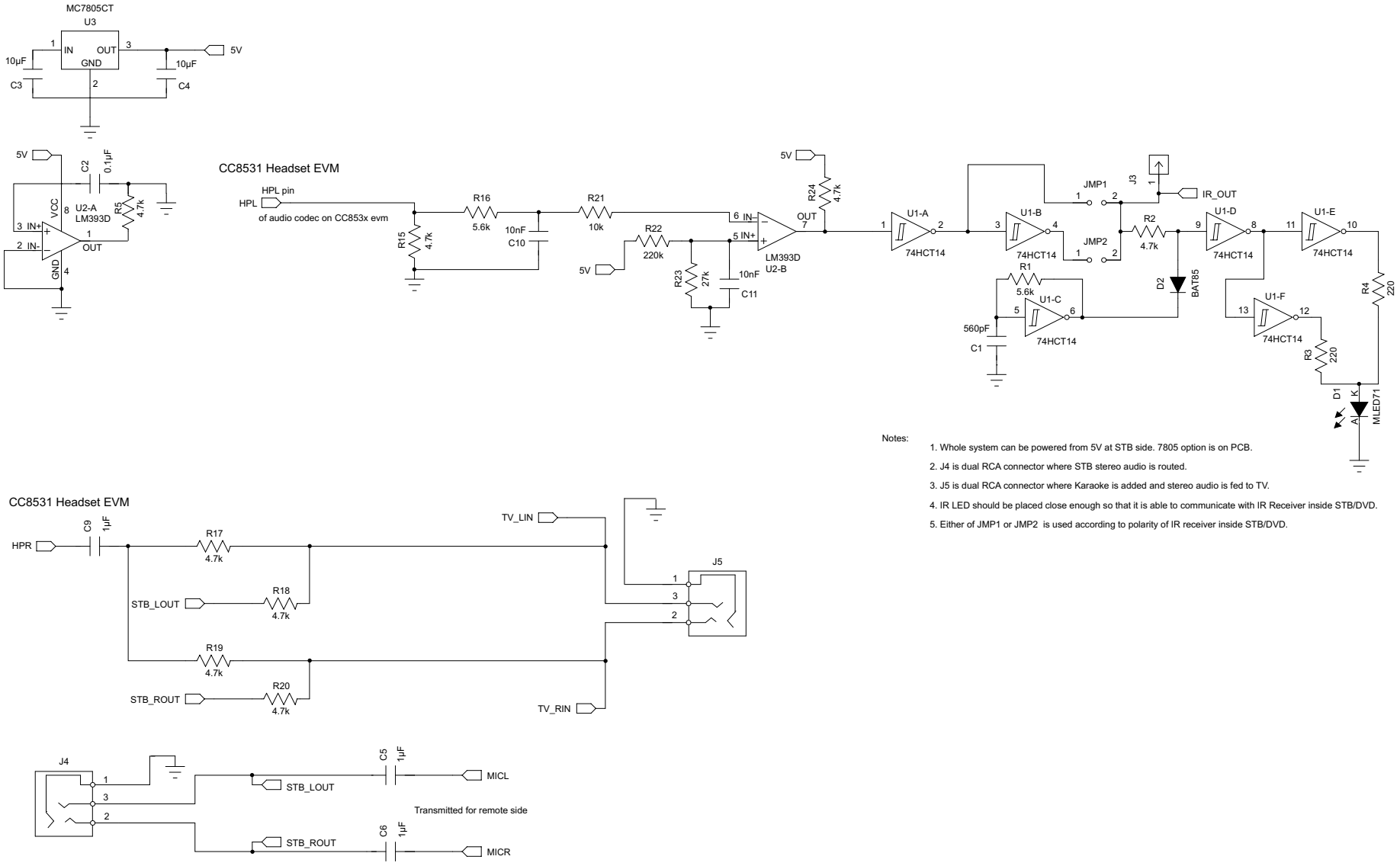

Figure 11. STB-Side Schematics

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