

CC85XXDK-HEADSET User's Guide

SWRU281

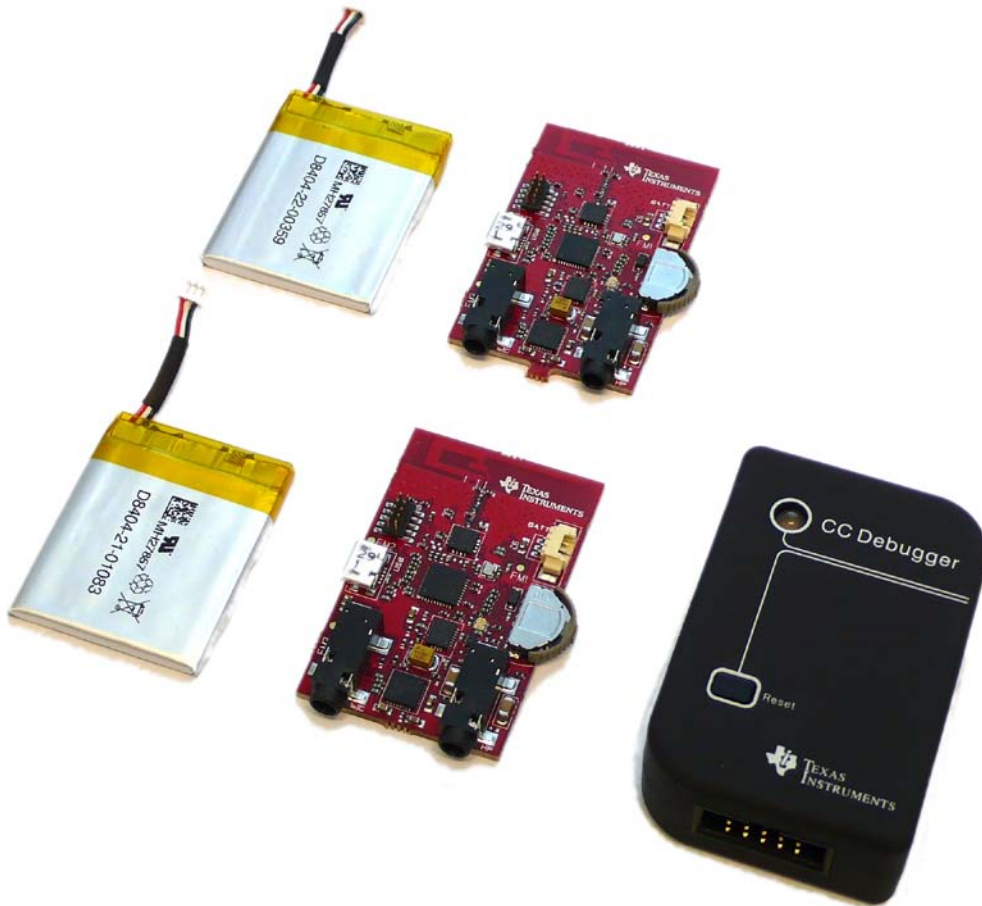


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1 Introduction

Thank you for purchasing the PurePath Wireless Headset Kit (CC85XXDK-HEADSET).

The CC85xx devices are Texas Instrument's wireless audio SoCs for the 2.4 GHz unlicensed ISM band. Upon the release of the PurePath Wireless Headset Kit only the CC8520 and CC8530 is released to the market, the subsequent devices in the CC85xx family will be released in the future. For the CC85xx family roadmap, please see the PurePath Wireless Audio page [1].

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. The CC8520 product folder on the web [6] has more information, with datasheets, user guides and application notes.

The PurePath Wireless Headset Kit includes all the necessary hardware to evaluate, demonstrate, prototype and develop analog input and output applications, as well as USB applications with the CC85xx. The main parts in the kit are the two CC85xx Headset boards. The hardware included in the kit has the potential to demonstrate complete headset¹ functionality. However, firmware to support bi-directional audio is not yet ready upon the release of this kit. Please see the product folder for all the supported features.

2 About This Manual

This manual describes PurePath Wireless Headset Kit in detail, and points the user to other useful information sources.

Chapter 4 briefly describes the contents of the kit. Chapter 5 gives a quick introduction to how to get started with the kit. Chapter 6 describes the hardware in the kit. Appendix A and B includes schematics of the hardware and the component placement for the kit.

The CC85XXDK-HEADSET Quick Start Guide [2] has a short tutorial on how to use the kit with its out-of-the-box settings. This document is delivered within the kit box.

For more details about the CC85xx devices, see the CC85xx Family User's Guide [5].

Please visit the CC85XXDK-HEADSET web page [10] and CC8520 product page [6] for additional information. The complete production material i.e., schematics, BOM, gerber files etc. can also be found in CC85XXDK-HEADSET-RD web page [11].

Further information and support can be found on the TI LPRF Online Community [12]. Also see chapter 7 for a list of additional relevant documents and links.

¹ Texas Instruments differentiates between the applications "headset" and "headphone", the first being bidirectional with both headphones and microphone, and the latter being unidirectional with audio streaming in only one direction (no microphone).

3 Abbreviations

DAC	Digital-to-Analog Converter
HID	Human Interface Device
I2C	Inter-Integrated Circuit
ISM	Industrial, Scientific and Medical
LDO	Low-Dropout Regulator
LED	Light Emitting Diode
LNA	Low-Noise Amplifier
PA	Power Amplifier
PCB	Printed Circuit Board
SNR	Signal-to-Noise Ratio
SoC	System-on-Chip
THD+N	Total Harmonic Distortion + Noise
USB	Universal Serial Bus

4 PurePath Wireless Headset Kit Overview

The main purpose of the PurePath Wireless Headset Kit is letting the user evaluate complete headphone and headset functionality with the CC85xx devices. The CC85xx Headset board is a low cost and low power reference design for a state-of-the-art wireless headphone/headset. The kit can also be used to demonstrate simple cable replacement applications. Finally it has a USB micro connector for evaluation of USB applications, however firmware with USB support is not yet available upon the release of this kit.

The development kit can be used through all stages of development of applications with CC85xx:

- Evaluate CC85xx RF performance and range testing with the onboard inverted-F PCB antenna
- Test wireless sound quality. The onboard codec is the TLV320AIC3204 [3]
- Interface to analog input and output (3.5 mm mini-jack)
- Interface to USB audio and USB HID on the protocol master
- Support for programming interface with the PurePath Wireless Configurator PC software [4]

Figure 1 shows the main components of the PurePath Wireless Headset Kit.

- 2 pcs CC85xx Headset boards
- 2 pcs 1.72Wh (3.7V, 465mAh) Li-ion batteries
- 1 pcs CC Debugger [7], used to program the CC8531 onboard the CC85xx Headset boards, or in an end customer application

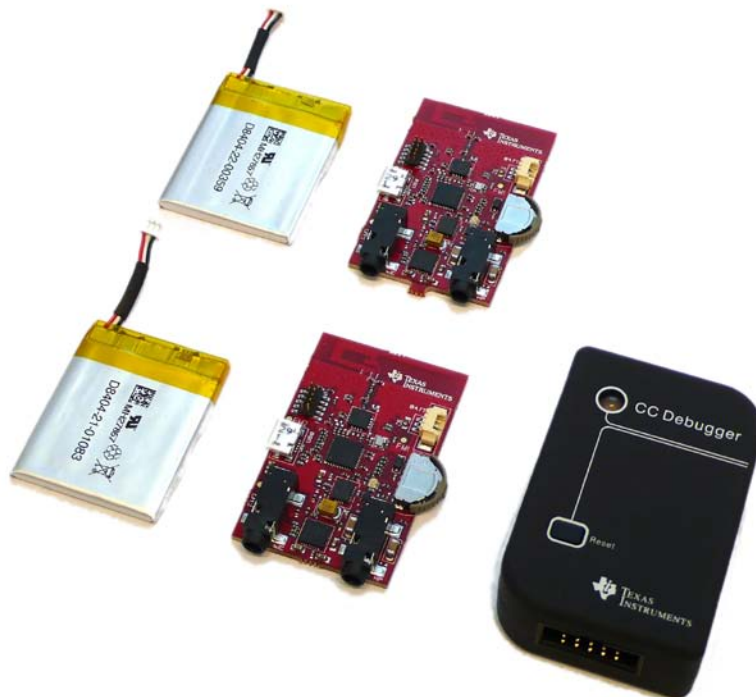


Figure 1. The main components included in the PurePath Wireless Headset Kit.

Also included in the kit is:

- 1 USB micro cable for charging the Li-ion battery and for powering the CC85xx Headset boards.
- 1 audio cable (3.5mm jack to 3.5mm jack) to be used at the analog input.
- Documentation

5 Getting Started With the PurePath Wireless Headset Kit

The CC85xx Headset boards are pre-programmed in production. This pre-programmed firmware can be found in the example project “CC85XXDK-HEADSET Preloaded Demo” in the PurePath Wireless Configurator [4]. The boards are labeled with MASTER and SLAVE stickers, and instructions on how to pair them and start the audio streaming can be found in the CC85XXDK-HEADSET Quick Start Guide [2]. Please note that when purchasing CC85xx devices they come un-programmed from production.

Figure 2 shows the main components of the CC85xx Headset board.

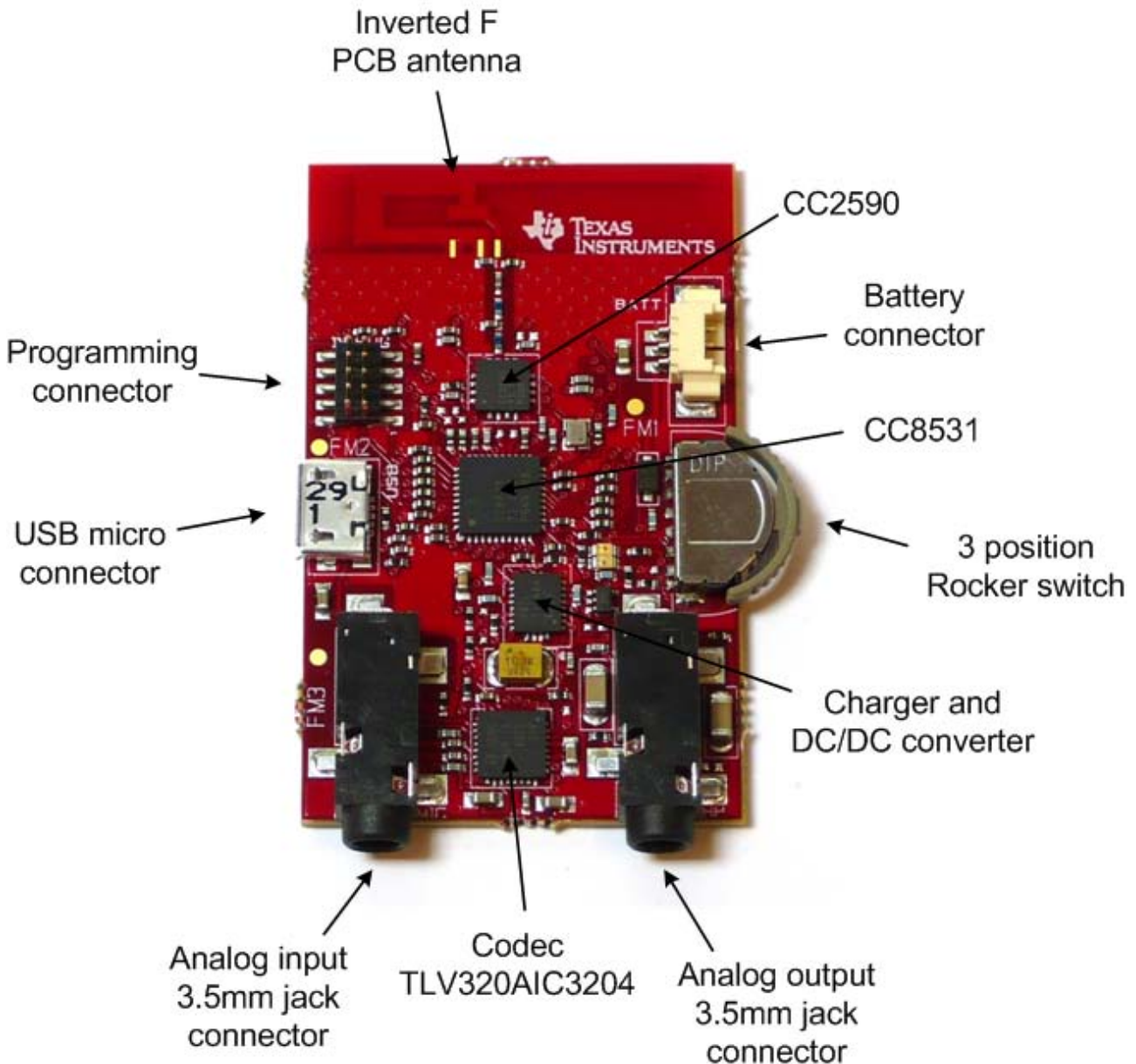


Figure 2. Photo of the CC85xx Headset board

The pre-programmed firmware on the two CC85xx Headset boards demonstrates a stereo input base station (labeled MASTER) streaming audio to a stereo headphone (labeled SLAVE). The main features of this pre-programmed application are:

- Uncompressed audio (PCM16)
- 44.1 kHz sample rate

- Maximum latency (2048 samples i.e. 46.44 ms with the 44.1 kHz sample rate)
- Optimized codec register settings in order to lower the power consumption
- Volume control on the slave using the UP and DOWN positions on the slave rocker switch
- Power ON/OFF on both master and slave by pressing the rocker switch IN for 1.6 sec.
- Pairing button on both master and slave by a fast press on the rocker switch IN

To change this functionality the CC85xx must be re-programmed. Figure 3 shows how to connect the CC debugger to the CC85xx Headset board, which is used to program the CC85xx. The CC85xx Headset board must be powered either with the battery or the USB cable, in order for the CC Debugger to recognize the CC85xx. Further it's important to place the programming connector so that the red wire (pin 1) is oriented towards the USB connector as shown in the Figure 3. For more details about the programming connector see section 6.6. If the board is powered and the CC Debugger is connected correctly, pressing the reset button on the CC Debugger should make the LED on the CC Debugger turn green. If so, the CC debugger is ready to download firmware images from the PurePath Wireless Configurator.

The PurePath Wireless Configurator is used to configure the functionality of the CC85xx, and it can be downloaded from the PurePath Wireless Configurator product page [4]. A screen shot of the PurePath Wireless Configurator is shown in Figure 4.

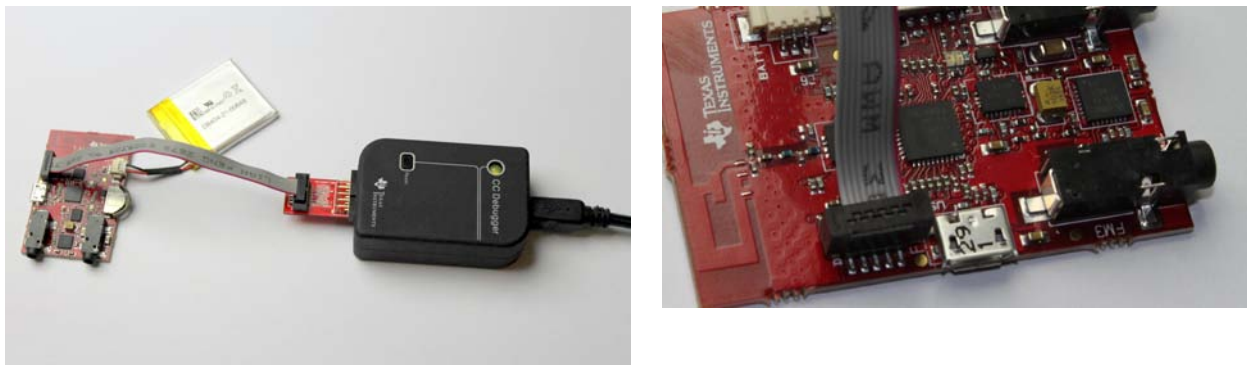


Figure 3. CC debugger connected to the CC85xx Headset board

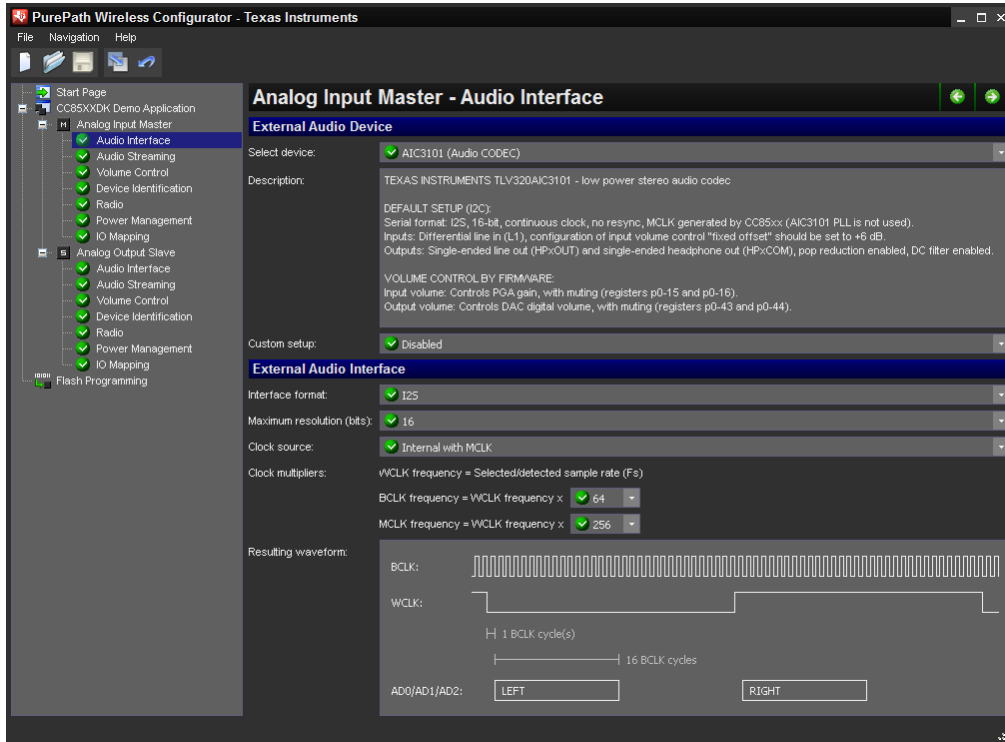


Figure 4 Screen shot of the PurePath Wireless Configurator.

6 Hardware Overview

This section describes each block of the CC85xx Headset board. A simplified block diagram of the CC85xx Headset board is shown in Figure 5.

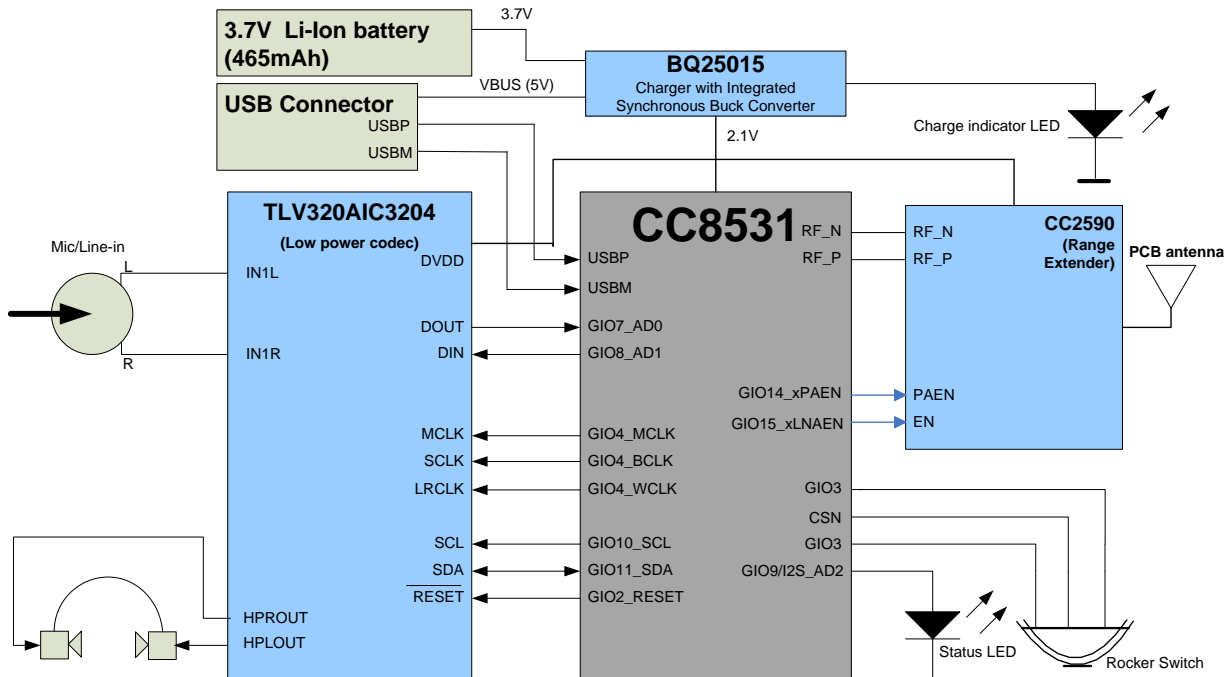


Figure 5. Block diagram of the CC85xx Headset board.

6.1 TLV320AIC3204 Codec

The codec on the CC85xx Headset board is the TLV320AIC3204 [3] from Texas Instruments Inc. The TLV320AIC3204 is a stereo codec that supports six single-ended or 3 fully differential inputs. On the CC85xx Headset board two input pins are used in single ended configuration (IN1L and IN1R). The other inputs on the TLV320AIC3204 are unconnected. The TLV320AIC3204 has four output pins. On the CC85xx Headset board two of these are used in single-ended configuration for the headphone left and right. The other two outputs are unconnected.

The codec settings can be changed by changing the I²C configuration of the codec in the PurePath Wireless Configurator. For more details on how to configure the codec, see the PurePath Wireless Configurator help system. This is opened by selecting *Help->Configurator Help* in the PurePath Wireless Configurator. For more details about the I²C interface available on the CC85xx see the CC85xx Family User's Guide [5].

Audio tests have been conducted to verify codec performance. The codec has been run with local LDO enabled, running at 1.77V. THD+N and SNR tests were conducted with a Rhode & Schwartz UPA audio analyzer. The firmware used to measure the performance is the pre-programmed firmware i.e., from the analog input of the Master to the analog output of the Slave. The volume on the slave must be maximized to reproduce these measurements. The measured SNR performance a-weighted at 1 kHz input is approximately 93 dB. The THD+N is measured to be approximately - 83 dB at an input voltage of 250 mVrms.

6.2 Power supply and charging of Li-ion battery

The CC85xx Headset board can be powered from the following sources

- Li-ion battery included in the kit
- USB interface, micro-USB type

Onboard the CC85xx Headset board is a single-chip charger and DC/DC converter i.e. BQ25015 [8]. The output voltage from its switch mode regulator is 2.15V which powers the other components on the board (CC8531, CC2590 and TLV320AIC3204). The current consumption will vary with different RF environments (more retransmission of data) as well as the volume of the audio. However, the slave consumes in average approximately 22mA when using moderate audio volume. This is measured at the battery (i.e. 81mW) with the firmware pre-programmed in production. The master consumes approximately 31 mA measured at the battery. In powerdown the CC85xx headset board consumes less than 0,1 mA measured at the battery

The BQ25015 is also used to charge the Li-ion battery. Charging occurs when both the battery and the USB cable are connected. The CC85xx headset board can stream audio while the battery is being charged. The power led D3 (see Appendix B) is lit when

- the USB cable is connected while the battery is not.
- the battery is charging (the LED is turned off when charging is complete).

The charge current in the BQ25015 is set to 100 mA. The charging time for the battery is approximately 5.5h (CC85xx in power down while charging).

6.3 CC2590 Range Extender

As can be seen from Figure 2, the CC85xx Headset board has the CC2590 [9] mounted on the board. This is a 2.4 GHz range extender which works seamlessly together with all the CC85xx family members. The CC2590 provides a PA for increased output power (up to +11 dBm) and an LNA for improved receiver sensitivity (typically 4 dB with the CC85xx). The CC2590 is not mandatory in a design with the CC85xx but can be utilized where increased range is needed.

6.4 Buttons and LEDs

On the CC85xx Headset board there is a rocker switch and 2 LEDs to be used for “human interaction”. This switch actually has 5 positions i.e. IN, UP, DOWN, HALFWAY UP and HALFWAY DOWN, but the positions HALFWAY UP and HALFWAY DOWN are not in use. This can also be seen from the schematic (Appendix A). Table 1 shows the button positions and the signals they assert, as well as out-of-the-box functionality tied to these signals.

Table 1: Human interaction signal mapping

Button position	CC85xx pin	Out-of-the-box functionality
IN	CSN	Pairing button and power toggling
UP	GIO1	Slave: volume up, Master: no function
DOWN	GIO3	Slave: volume down, Master: no function
HALFWAY UP	NC	-
HALFWAY DOWN	NC	-

LED (D2) is connected to the CC85xx pin GIO12, and the intended usage of this diode is as a network status LED. For details on how to configure the network LED please see the PurePath Wireless Configurator [4]. The other LED (D3) is connected to the charger IC BQ25015 (for more details see section 6.2).

6.5 RF Performance

The CC85xx Headset board does not have the output connected to a SMA connector, it is only connected to an inverted F antenna. However, the output power measured into a 50 Ohm load as shown in Figure 6, is approximately 9 dBm. Please note that the supply voltage of the board is approximately 2.15V. Note that to achieve maximum output power the supply voltage of the board must be raised from 2.15V to 3.3V. This can be done by changing the ratio between the BQ25015 feedback resistors according to eq 8 in the BQ25015 datasheet [14]. The audio link is sustained for input signals above -87dBm. Hence, a total link budget of 96 dB can be archived with the CC85xx Headset board.

Finally, the design is pre-scanned for ETSI and FCC compliance, and the CC85xx Headset board is suitable to fulfill these specifications.

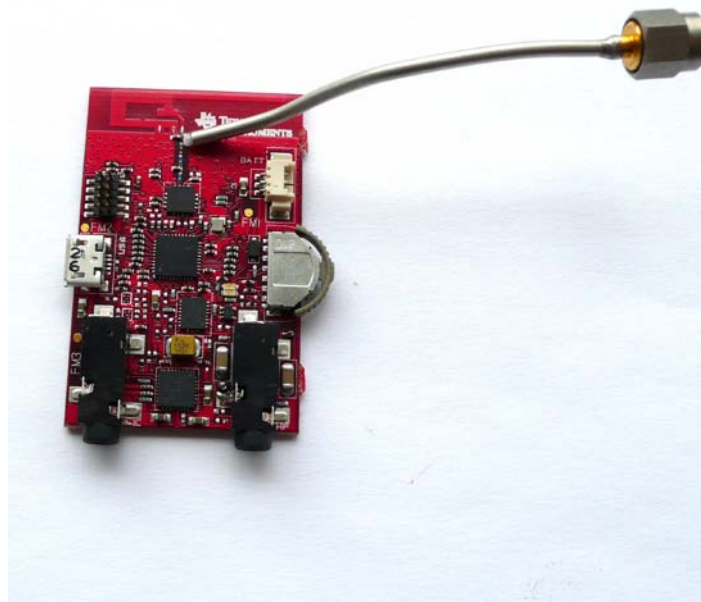


Figure 6. Photo of the CC85xx headset board connected to a 50ohm micro coax cable.

6.6 Programming Connector

The Programming connector (see Figure 2) labeled DEBUG is used to program the CC85xx using the CC Debugger. The pin-out of the programming interface is listed in Table 2. Figure 3 shows how to connect the CC Debugger to the CC85xx Headset board. For more details about the CC debugger, see the CC debugger product page [7].

The connector can also be used to connect an external MCU for controlling the CC85xx with the external host interface. The pins needed for this are GND, CSn, SCLK, MISO, MOSI and RSTN. For more details about the external host interface, see the CC85xx Family User's Guide [5]. Note that the CC85xx Headset board needs to be powered by the battery or the USB while programming.

Table 2: Program interface pin mapping

CC debugger pin	CC debugger Pin name	CC85xx pin
1	GND	GND
2	Vdd from target	IOVDD
3	DC (Debug Clock)	NC
4	DD (Debug Data)	NC
5	CSn (SPI Chip Select)	CSN
6	SCLK (SPI Clock)	SCLK
7	RESETh	RSTN
8	MOSI (SPI Data Out)	MOSI
9	3.3V Vdd (from debugger)	NC
10	MISO (SPI Data In)	MISO

6.7 Test signals available on P7

Table 3 shows the signals available on the test pads on the back of the board.

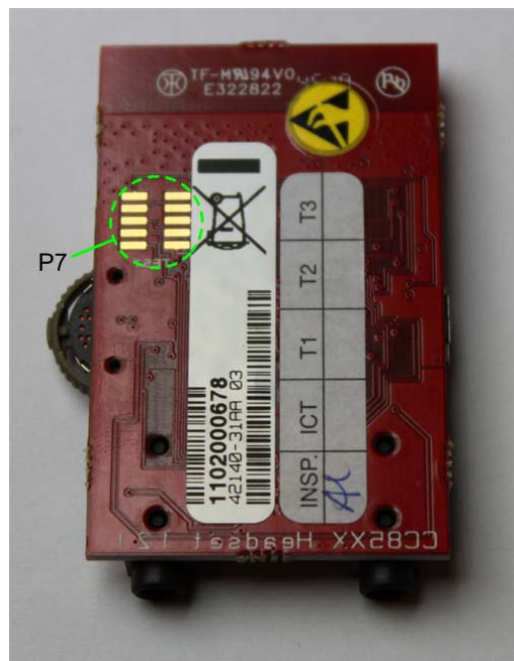


Figure 7. Test pad 1

Table 3: Test signals (P7)

Test pad number	Signal
1	GND
2	MCLK
3	WCLK
4	BCLK
5	DOUT
6	DIN
7	CODEC_RESET
8	I2C_SCL
9	NC
10	I2C_SDA

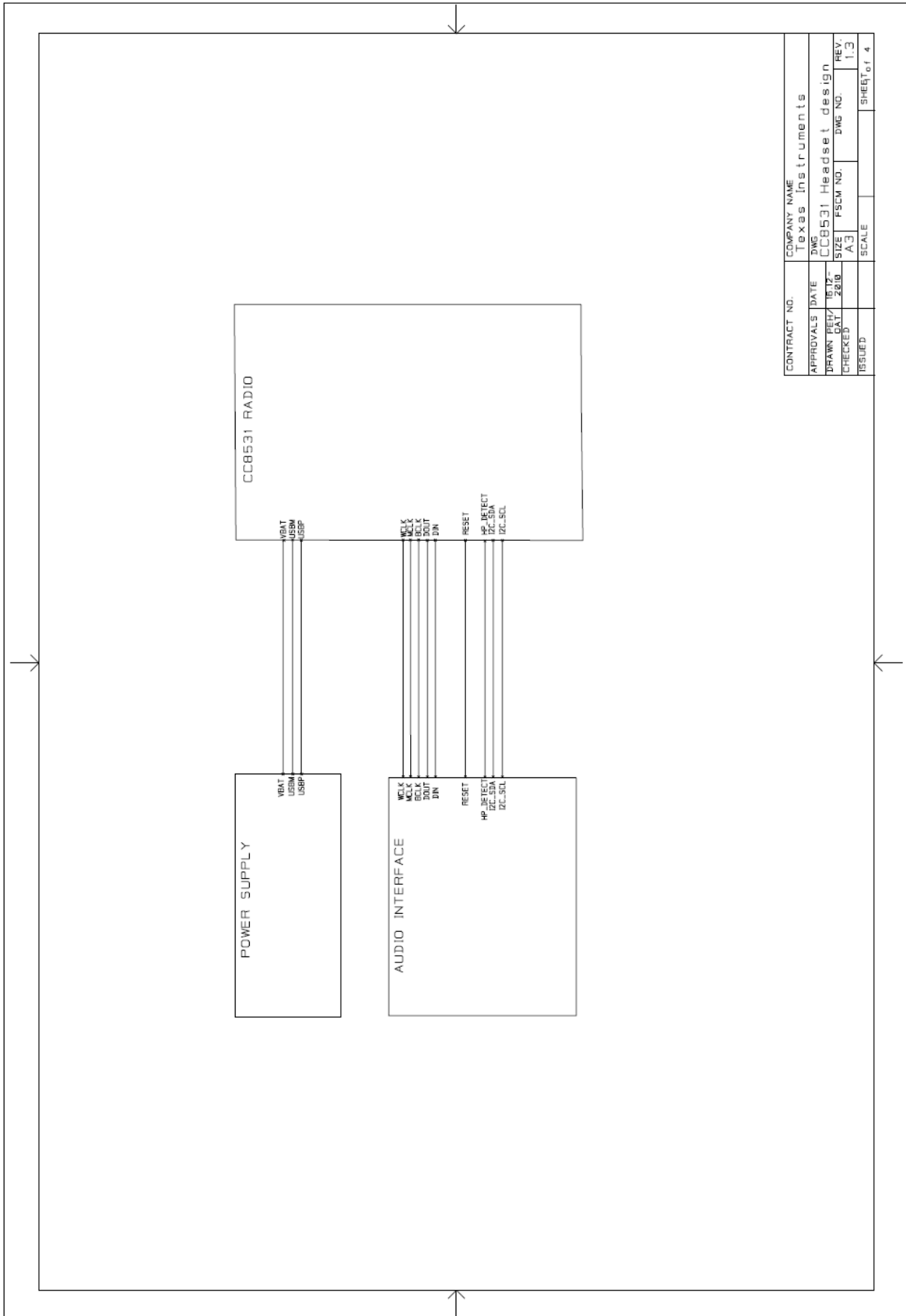
7 References

- [1] Purepath Wireless Audio product page
<http://www.ti.com/ww/en/analog/cc8520/index.shtml>
- [2] CC85XXDK-HEADSET Quick Start Guide
<http://www.ti.com/lit/pdf/swru282>
- [3] TLV320AIC3204 Product folder:
<http://focus.ti.com/docs/prod/folders/print/tlv320aic3204.html>
- [4] PurePath Wireless Configurator product page
<http://focus.ti.com/docs/toolsw/folders/print/purepath-wl-cfg.html>
- [5] CC85xx Family User's Guide
<http://focus.ti.com/general/docs/lit/getliterature.tsp?baseLiteratureNumber=swru250>
- [6] CC8520 Product folder
<http://focus.ti.com/docs/prod/folders/print/cc8520.html>
- [7] CC Debugger product page
<http://focus.ti.com/docs/toolsw/folders/print/cc-debugger.html>
- [8] BQ25015 Product folder:
<http://focus.ti.com/docs/prod/folders/print/bq25015.html>
- [9] CC2590 Product page
<http://focus.ti.com/docs/prod/folders/print/cc2590.html>
- [10] CC85XXDK-HEADSET product page
<http://focus.ti.com/docs/toolsw/folders/print/cc85xxdk-headset.html>
- [11] CC85XXDK-HEADSET reference design page
<http://focus.ti.com/docs/toolsw/folders/print/cc85xxem-rd.html>
- [12] Texas Instruments Low Power RF forum
<http://www.ti.com/lprf-forum>
- [13] Texas Instruments Support
<http://support.ti.com>
- [14] BQ25015 Datasheet
<http://focus.ti.com/lit/ds/symlink/bq25015.pdf>

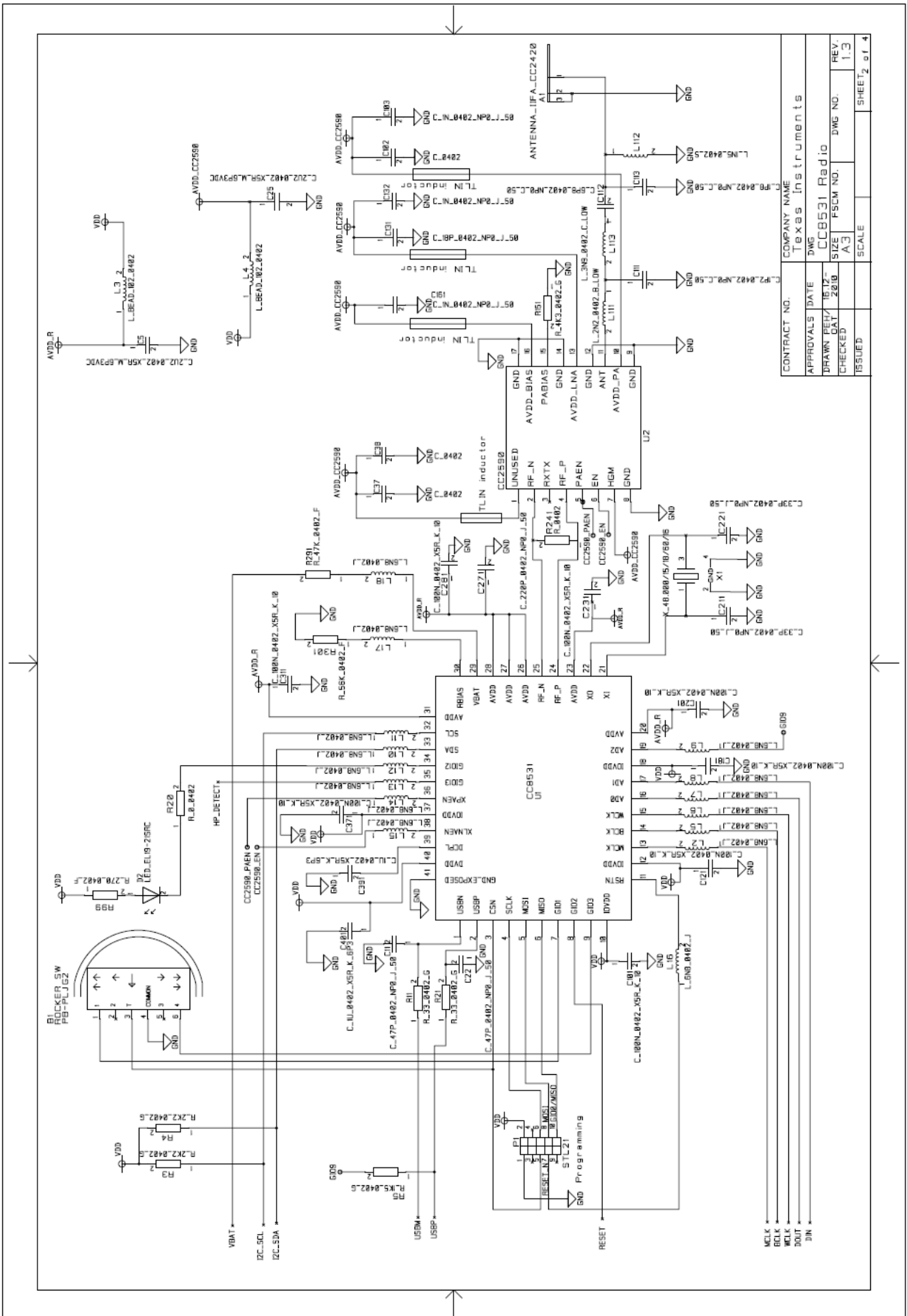
8 Document History

Revision	Date	Description/Changes
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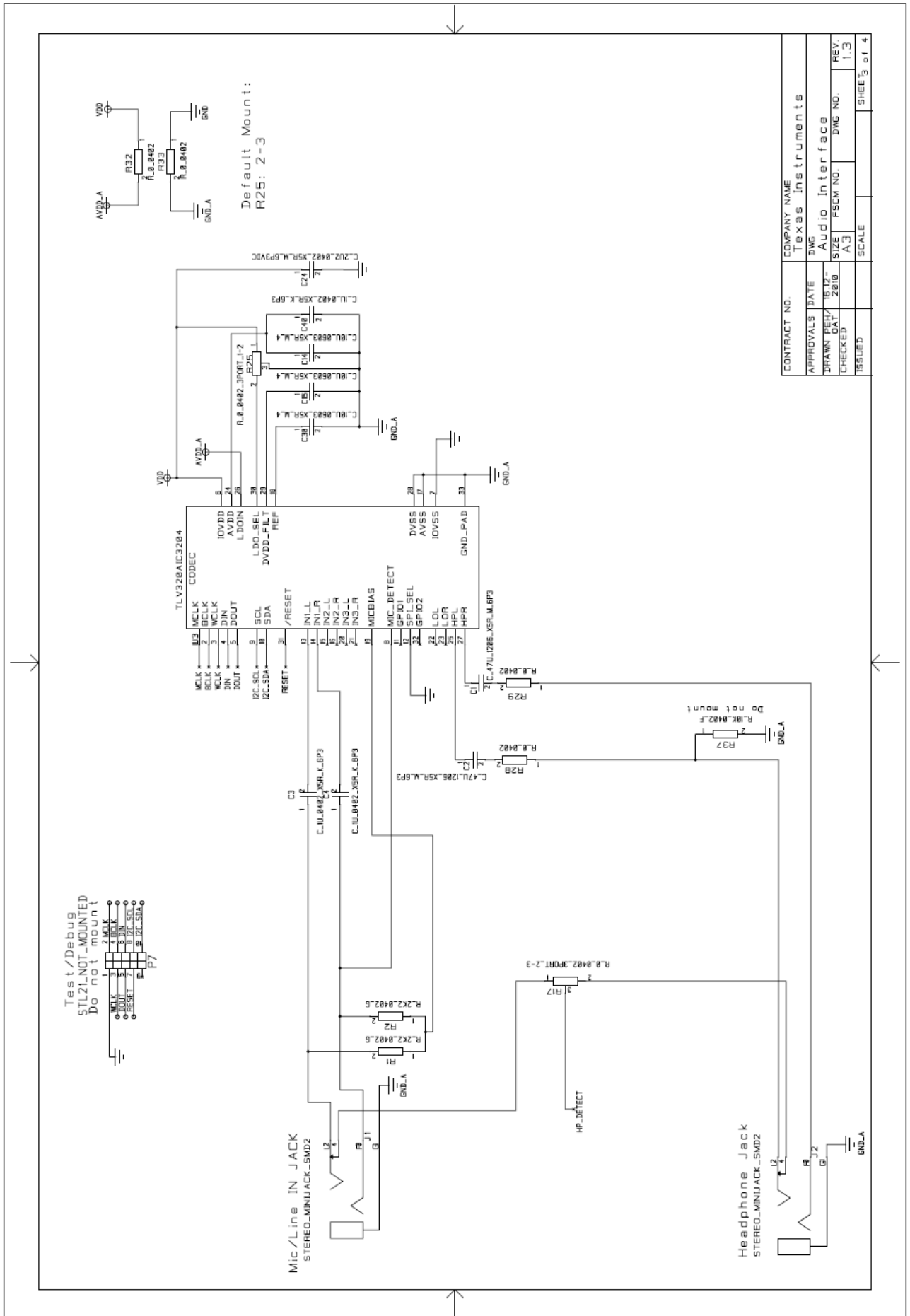
Appendix A: CC85xx Headset Schematic



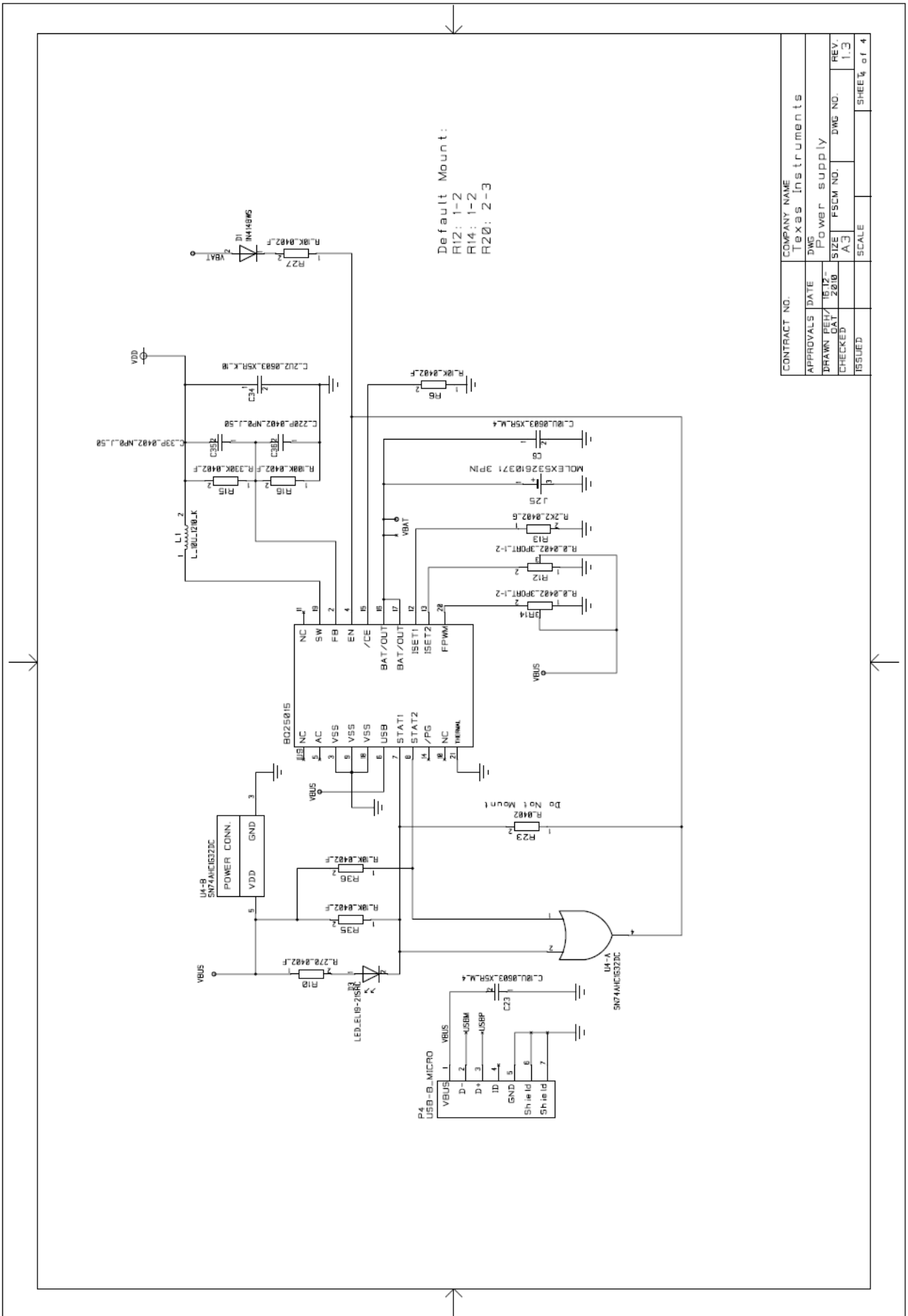
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APPROVALS DATE	DWG NO.	CC8531 Headset design
DRAWN BY/DATE	SIZE	FSCM NO.
CHECKED	A3	DWG NO.
ISSUED	SCALE	REV. 1.3
		SHEET of 4



CONTRACT NO.	COMPANY NAME
APPROVALS DATE	Texas Instruments
DRAWN BY: 1817	DWG
CHECKED: 2210	CC8531 Radio
ISSUED	SIZE: A3
	FSCM NO.
	DWG NO.
	REV: 1.3
	SHEET 2 of 4



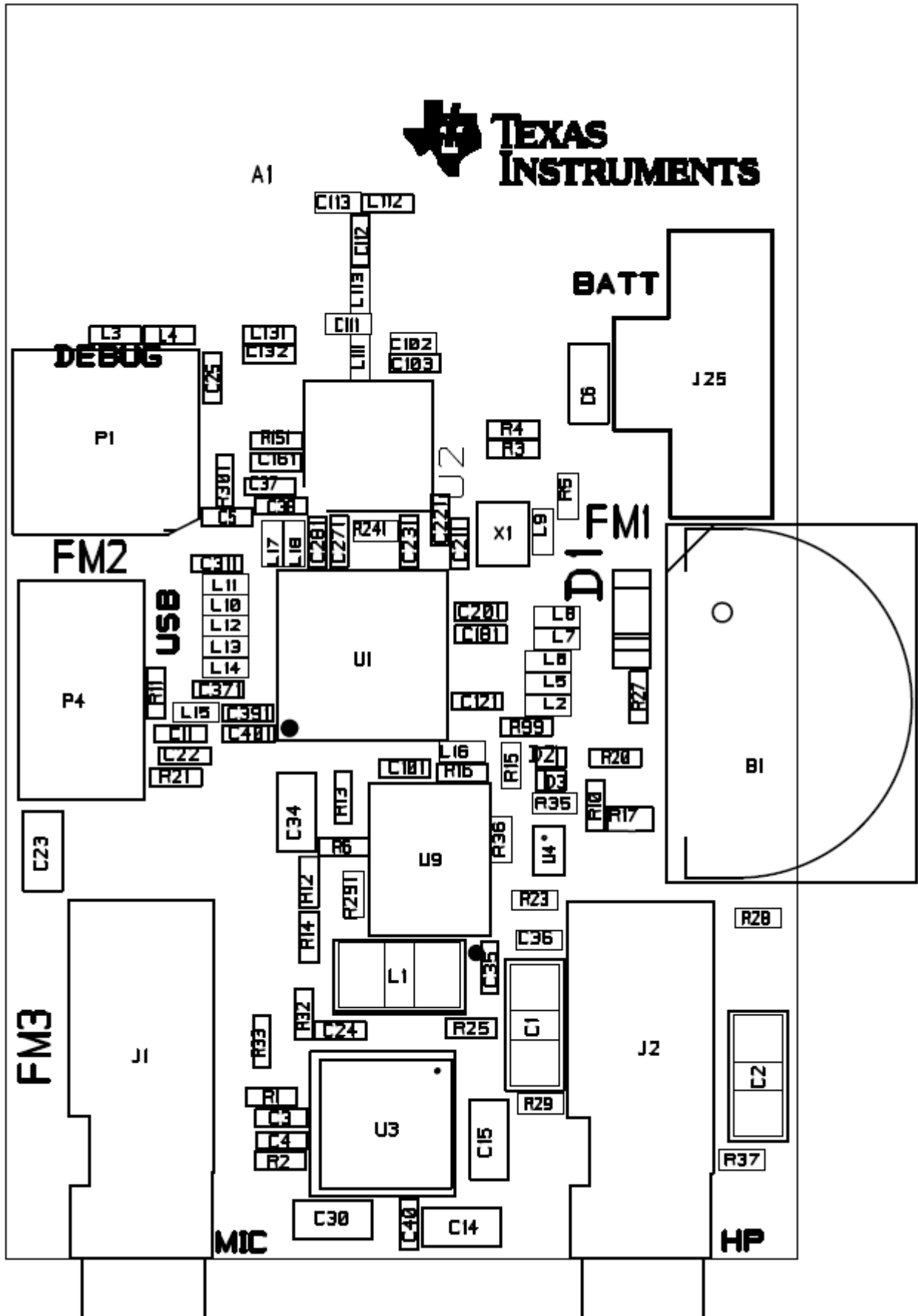
CONTRACT NO.	COMPANY NAME
APPROVALS DATE	Texas Instruments
DRAWN BY/ DATE	DWG Audio Interface
CHECKED/ DATE	SIZE A3 FSCM NO. DWG NO. REV. 1.3
ISSUED	SCALE SHEETS 4



Default Mount:
 R12: 1-2
 R14: 1-2
 R20: 2-3

CONTRACT NO.	COMPANY NAME
DWG	Texas Instruments
APPROVALS DATE	Power supply
DRAWN BY/DATE	SIZE
CHECKED/DATE	FSCM NO.
ISSUED	SCALE
	REV. NO.
	REV. 1.3
	SHEET 4 of 4

Appendix B: CC85xx Headset Components Placement



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