

AN12648

带 NXH3670 的 K32L2B 耳机

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应用笔记

1 引言

本文档提供低功耗蓝牙音频系统中 K32L2B 耳机端的必要信息。

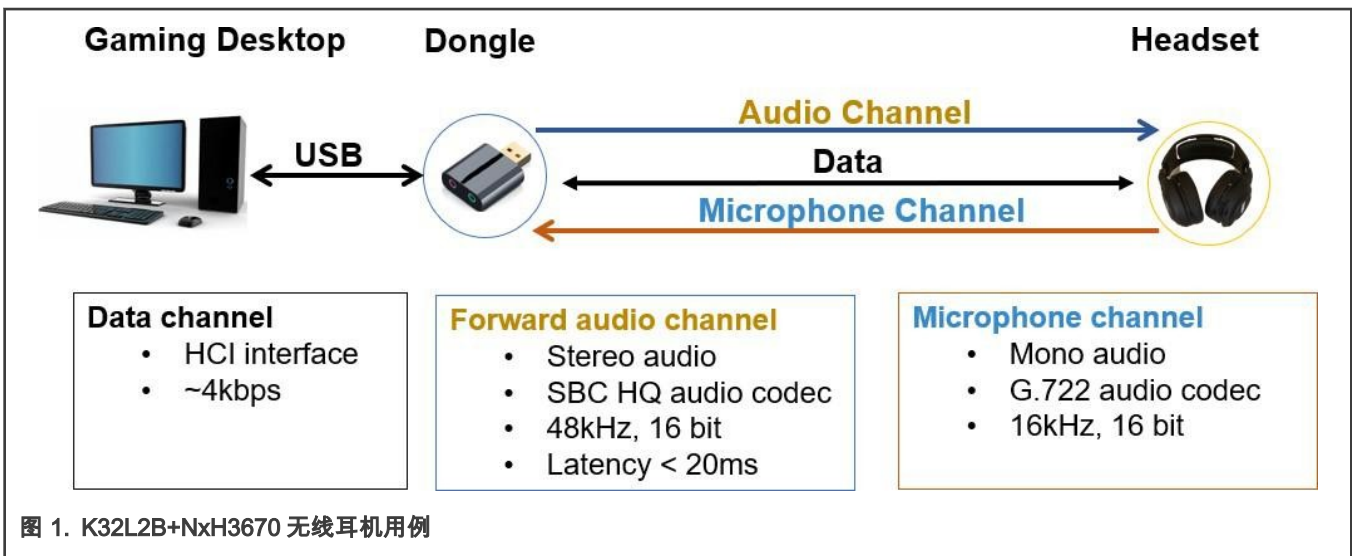
本系统包含 K32L2B_Dongle 和 K32L2B_Headset。

- K32L2B_Dongle：此 Dongle 有一个连接到 PC 的 USB 接口。它负责创建一个与耳机之间的无线音频连接。
- K32L2B_Headset：此耳机有一个扬声器、麦克风与一些用户界面接口（UI），如按钮、滑块、旋转开关和 LED。

本文档主要描述了低功耗蓝牙音频系统中 K32L2B 耳机的硬件设计和软件架构。它为用户提供了蓝牙音频系统中 K32L2B 耳机的系统视图。

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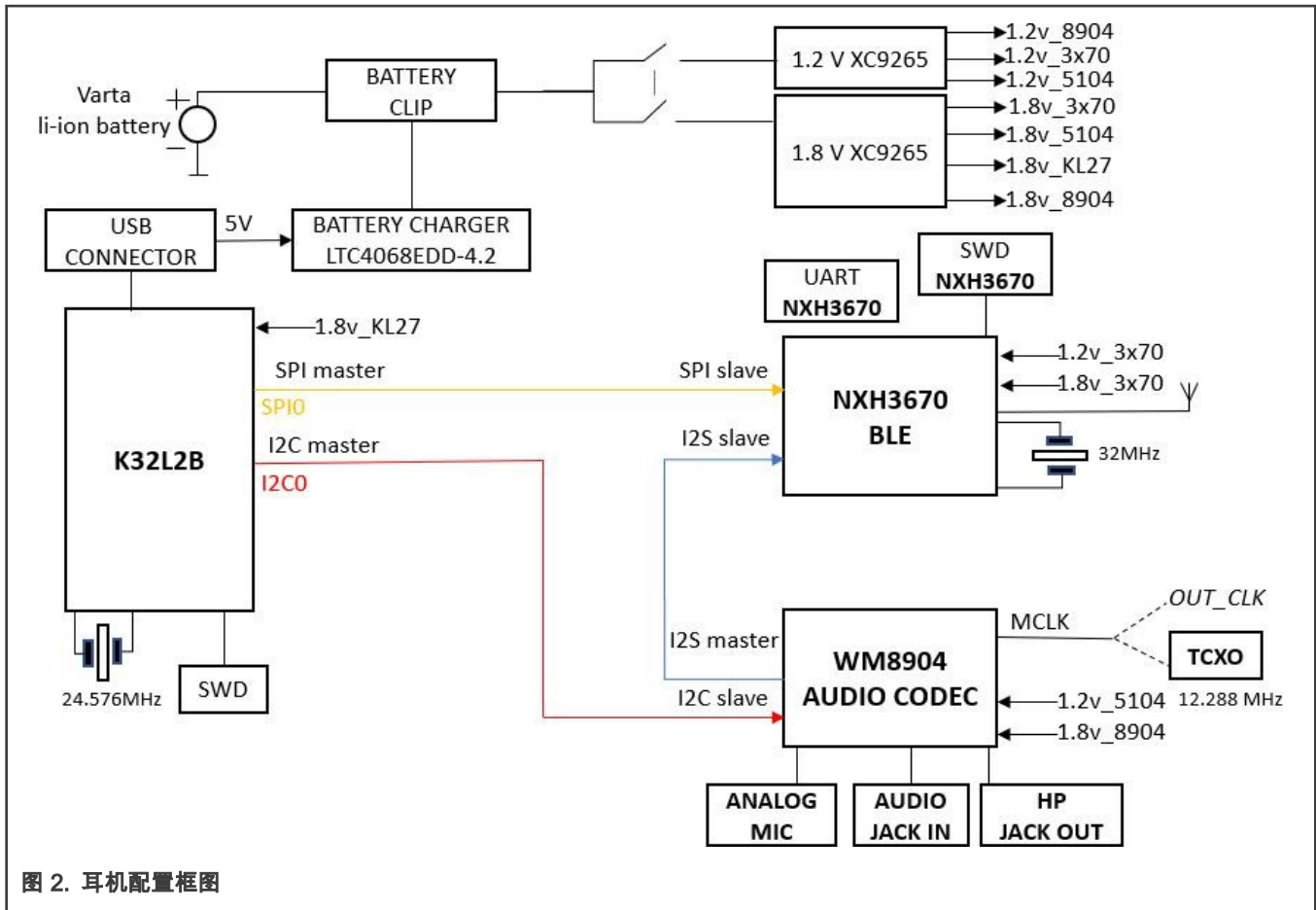


2 板子概况

2.1 框图

图 2 显示了 K32L2B_Headset 的框图。





如 图 2 所示，

- 主机控制器(K32L2B)用于运行 Headset 和 OTA_Headset 程序。
- CODEC(WM8904)用于对数字音频流进行编码或解码，在软件中，我们使用 I2C 接口配置 CODEC。

注意

NXH3670(I2S 从机)与 CODEC(I2S 主机)通过 I2S 直接通信。

- NXH3670 通过 SPI 接口与 K32L2B 通信

2.2 耳机端软件架构

耳机端的软件设计如下。

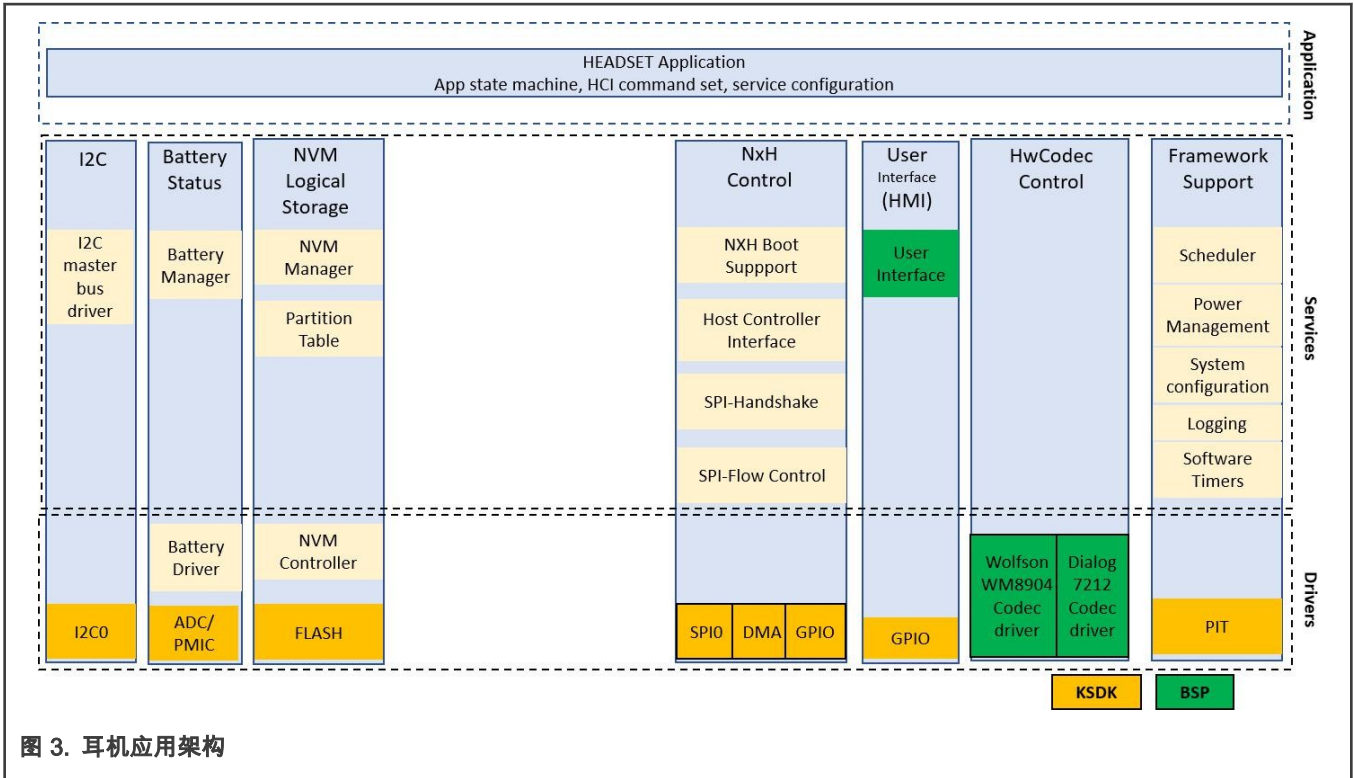


图 3. 耳机应用架构

如 图 3 所示，耳机应用程序包含 NVM 服务、CODEC 服务、NXH 服务和用户接口服务。本文件只列出以下功能：

1. Nvm 服务：读取分区表。
2. NxH 控制：使用 SPI 接口引导、启动和传输数据。
3. 用户接口：用于控制音量、启动和暂停的按钮。
4. CODEC 服务：通过 I2C 接口配置 CODEC。

在硬件设计中，NXH3670 和 CODEC 通过 I2S 连接，因此音频数据可以直接通过 I2S 从 NXH3670 传输到 CODEC（用户需要通过 I2C 接口配置 CODEC）。

图 4 显示音频传输过程。

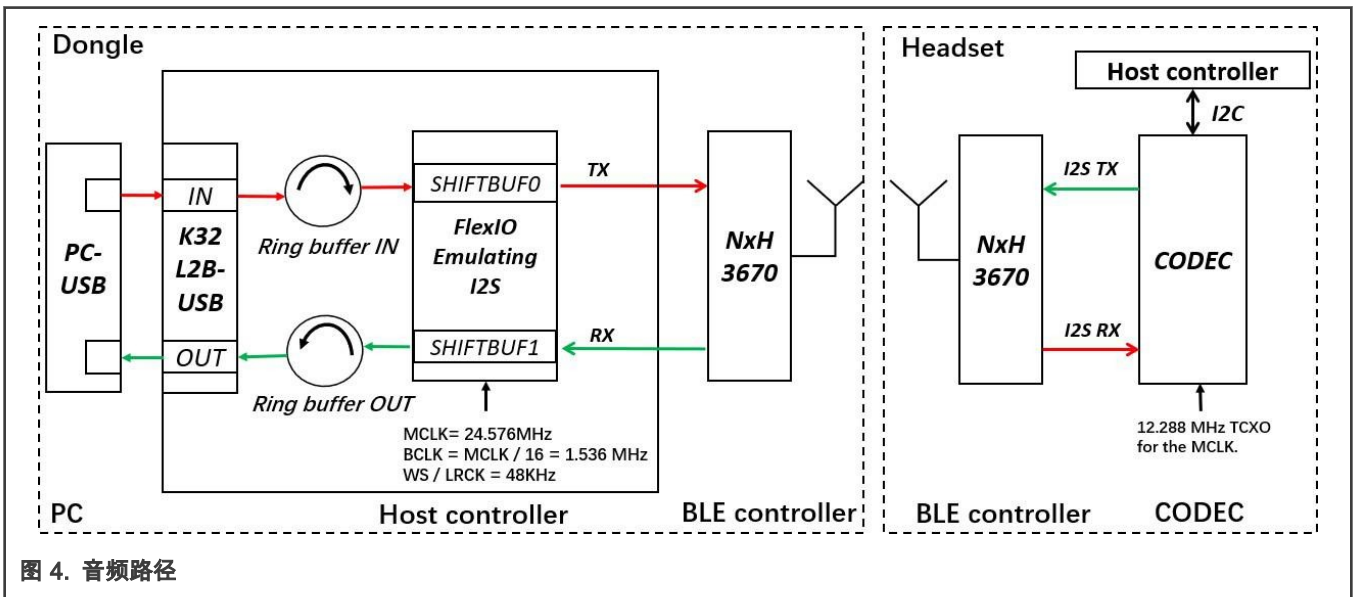


图 4. 音频路径

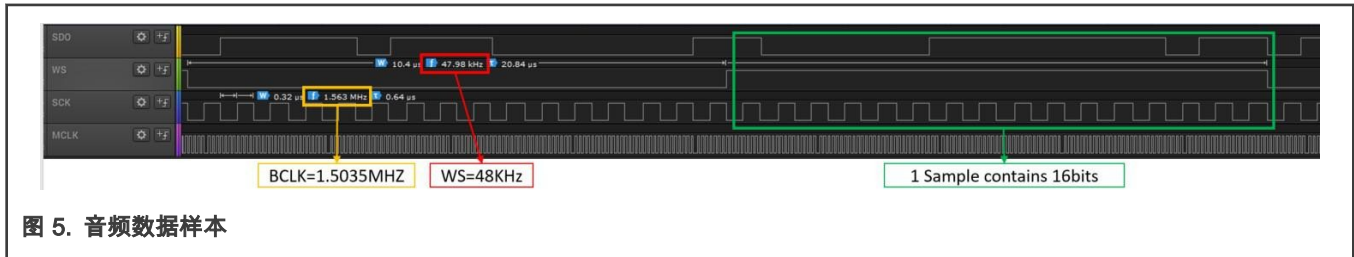


播放（前向通道）：音频路径从 PC 到耳机。



录音（后向通道）：音频路径从耳机到 PC。

前向通道支持的音频格式为 48K/16bit,后向通道支持的音频格式为 16 K/16 bit。



本文档只介绍了耳机部分的音频传输过程。有关 Dongle 部分的更多信息，请参阅《带有 NxH3670 的 K32L2B USB 适配器 (Dongle)》(文档 AN12647)。

3 K32L2B 耳机组件

3.1 K32L2B

3.1.1 主机控制器

该设备是基于增强型 Cortex-M0+(CM0+)内核的高度集成的，市场领先的超低功耗 32 位微控制器。带有 NXH3670 的 K32L2B 耳机拥有以下特点。

- 内核时钟高达 48 MHz，总线时钟高达 24 MHz
- 内存选项最大为 256 KB Flash 和 32KBRAM
- 工作电压范围为 1.71–3.6 V，具有全功能的 Flash 编程/擦除/读取操作
- 两个支持 16 位数据长度的 SPI 模块
- 两个 I2C 模块
- 一个 FlexIO 模块

3.1.2 时钟

本电路板上使用的两个晶振：

- 与 NxH3670 连接的 32MHz 晶振。
- 12.288 MHz 晶振用作 CODEC 的 MCLK，用户可以通过 J10 选择其时钟源，如 图 6 所示。

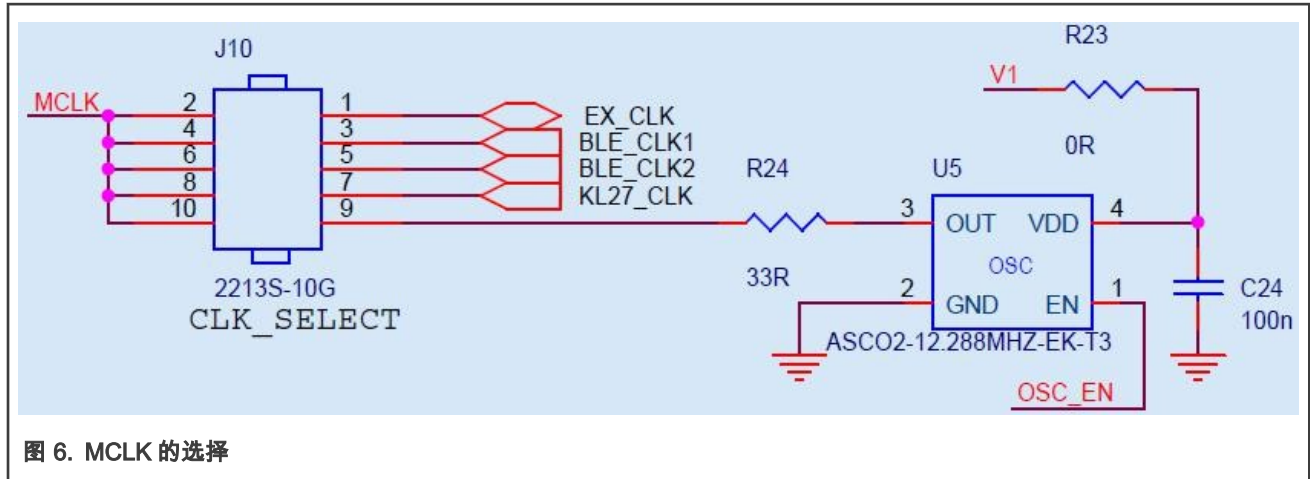


图 6. MCLK 的选择

3.1.3 串行调试接口 (SWD)

- FRDM-K32L2B3 板上提供串行调试接口。
- 用户还可以使用 CMSIS-DAP 或 JLINK 固件在 FRDM-K32L2B 板上下载或调试项目。

3.1.4 引脚连接

表 1 列出了 K32L2B 和其他组件之间的连接信息。

表 1. 连接信息

功能	Jumper (K32L2B 耳机)	名称	Jumper (NXH3670)	名称
I2S (K32L2B 没有 I2S 外设)	—	CODEC_SDI	J12_1/9 (I2S_CONFIG)	BLE_SDO
	—	CODEC_SDO	J12_3/11 (I2S_CONFIG)	BLE_SDI
	—	CODEC_WS	J12_5/13 (I2S_CONFIG)	BLE_WS
	—	CODEC_SCK	J12_7/15 (I2S_CONFIG)	BLE_SCK
I2C0	J4-4 (PIN PTB1)	K32L2B_SDA	J11_2 (PERIPHERAL_I2C)	PH_SDA
	J4-2 (PIN PTB0)	K32L2B_SCL	J11_4 (PERIPHERAL_I2C)	PH_SCL
NXH 握手	J1_2 (PIN PTA1)	BLE_SPIS_INTN	J16_9 (BLE_SPI)	SWM4 (- INTN)
	J1_8 (PIN PTA12)	BLE_SPIS_SRQ	J16_13 (BLE_SPI)	SRQ
SPI0	J1-11 (PIN PTC7)	BLE_SPIS_MISO	J16_1 (BLE_SPI)	SW0
	J1-9 (PIN PTC6)	BLE_SPIS_MOSI	J16_3 (BLE_SPI)	SW1
	J1-15 (PIN PTC5)	BLE_SPIS_SCLK	J16_5 (BLE_SPI)	SW2
	J1-7 (PIN PTC4)	BLE_SPIS_SSN	J16_7 (BLE_SPI)	SW3
NXH 复位	J1_4 (PIN PTA2)	BLE_RESETN	J20_5 (BLE_SWD)	POR_RESETN

3.1.5 原理图

1. 第一部分：音频传输

- I²C

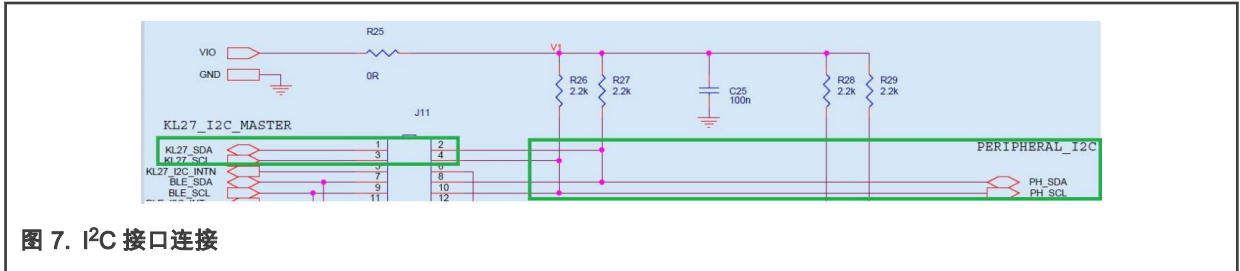


图 7. I²C 接口连接

音频数据将通过 I2S 直接从 NXH3670 传输到 CODEC。软件方面，需要通过 I²C 接口配置 CODEC 而不是 I²S 接口。

- I²S

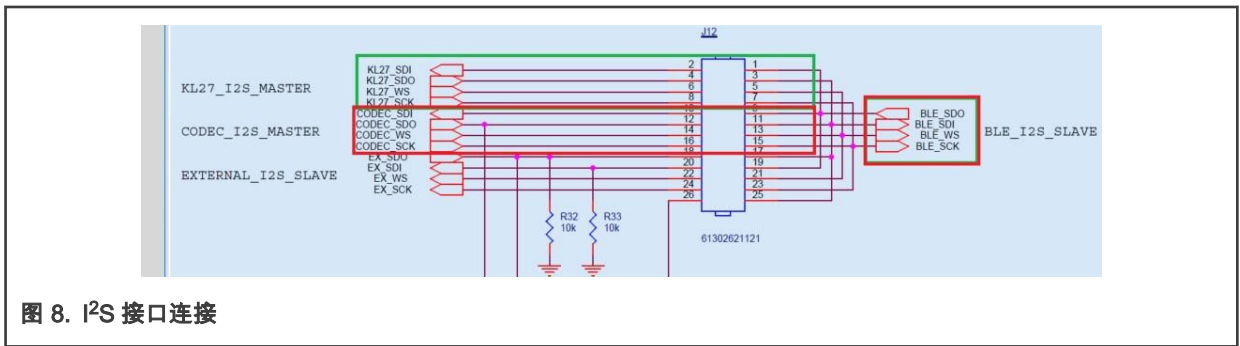


图 8. I²S 接口连接

NXH3670 通过 I²S 接口与 CODEC 连接

2. 第二部分：NXH3670

- NXH 握手引脚

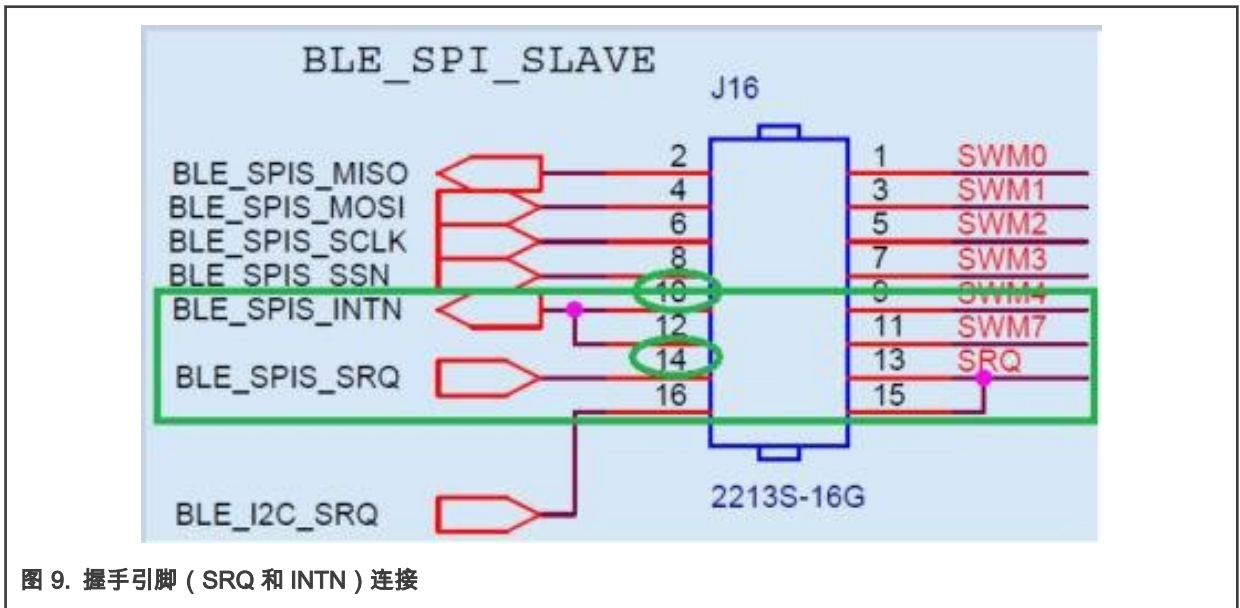


图 9. 握手引脚 (SRQ 和 INTN) 连接

- SPI

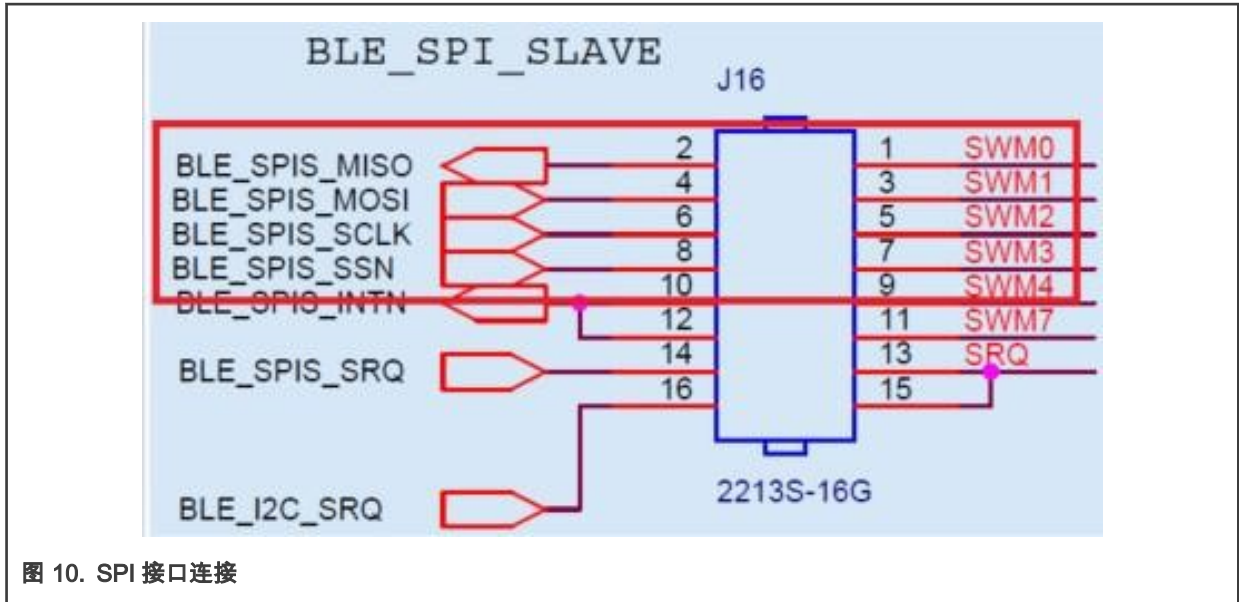


图 10. SPI 接口连接

• POR

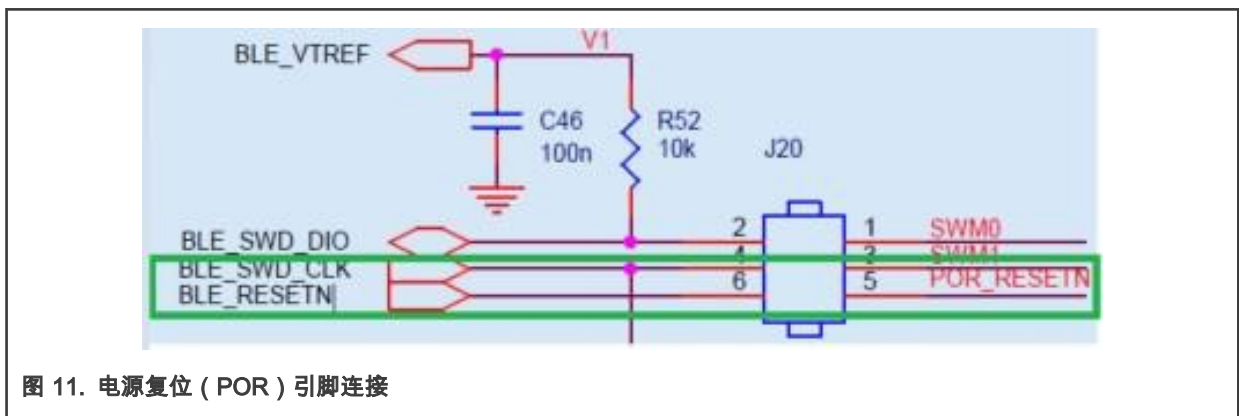


图 11. 电源复位 (POR) 引脚连接

3.1.6 引脚配置

• SPI

- 接口：SPI0
- 引脚：CS (PTC4)、SCK (PTC5)、MISO (PTC7)、MOSI (PTC6)
- 极性：SPI 时钟高电平有效 (空闲时为低)
- 相位：SPSCK 的第一个时钟边沿为采样点
- 波特率：将 SPI 的波特率值配置为 8000000

• I²C

- 接口：I2C0
- 引脚：SCL (PTB0)，SDA (PTB1)
- 配置 I2C 的地址值为 0x1A

• NxH3670 相关引脚

- INIT (PTA1)：配置为数字输入
- SRQ (PTA12)：配置为数字输出

— POR (PTA2) : 配置为数字输出

3.2 NXH3670

有关 NXH3670 的更多信息，请参阅《带有 NxH3670 的 K32L2B USB 适配器 (Dongle) 》 (文档 [AN12647](#)) 。

4 结论

本文档描述了低功耗蓝牙音频系统中 K32L2B_Headset 的硬件设计和软件架构。本文可以为用户构建自己的方案提供参考。

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