



REALTEK

RTL8763B Series

RTL8763BM, RTL8763BF, RTL8763BFR, RTL8763BS, RTL8763BA

BLUETOOTH 5 DUAL MODE SOC

PRELIMINARY DATASHEET

(CONFIDENTIAL: Development Partners Only)

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**REALTEK**

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USING THIS DOCUMENT

This document is intended for the software engineer’s reference and provides detailed programming information.

Though every effort has been made to ensure that this document is current and accurate, more information may have become available subsequent to the production of this guide.

ELECTROSTATIC DISCHARGE (ESD) WARNING

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- Use a conductive wrist strap attached to a good earth ground
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- If working on a prototyping board, use a soldering iron or station that is marked as ESD-safe
- Always disconnect the microcontroller from the prototyping board when it is being worked on

REVISION HISTORY

Revision	Release Date	Summary
0.92	2017/11/14	Preliminary Release.

Table of Contents

1. GENERAL DESCRIPTION	1
2. FEATURES	2
3. SYSTEM APPLICATIONS	4
4. BLOCK DIAGRAM	5
5. POWER TREE	6
5.1. POWER ON SEQUENCE-BATTERY MODE	7
5.2. POWER ON SEQUENCE-ADAPTER MODE	8
6. CLOCK TREE	8
6.1. OVERVIEW	8
6.2. RESET	9
7. PIN ASSIGNMENTS	11
7.1. PACKAGE IDENTIFICATION	11
7.2. PIN OUT (TOP VIEW) RTL8763BM QFN40	12
7.3. PIN OUT (TOP VIEW) RTL8763BF/BFR QFN40	13
7.4. PIN OUT (TOP VIEW) RTL8763BS QFN48	14
7.5. PIN OUT (TOP VIEW) RTL8763BA QFN68	15
8. PIN DESCRIPTIONS	16
8.1. RF INTERFACE	16
8.2. CRYSTAL OSCILLATOR	16
8.3. GENERAL PURPOSE I/OS	16
8.4. AUDIO CODEC	18
8.5. POWER MANAGEMENT	19
8.6. SPI FLASH MEMORY INTERFACE	20
8.7. SYSTEM	20
9. RF RADIO	21
9.1. RF RADIO	21
9.1.1. Transceiver	21
9.1.2. Transmitter	21
9.1.3. Receiver	21
9.1.4. RF IQM and TPM	22
9.2. CRYSTAL OSCILLATOR	23
9.3. CRYSTAL OSCILLATOR 32.768KHZ	24
9.4. DSP	25
9.5. AUDIO CODEC: DAC	26
9.5.1. Single-Ended Output	26
9.5.2. Cap-Less Output	28
9.5.3. Differential Output	29
9.6. AUDIO CODEC: ADC	30
9.7. AUDIO DIGITAL MICROPHONE	31
9.8. PCM I2S	33
9.9. UART INTERFACE	34
9.10. I2C INTERFACE	36
9.11. SPI INTERFACE	37
9.12. NFC	37
9.13. USB INTERFACE	38

9.14.	S/PDIF INTERFACE	38
9.15.	AUXILIARY ADC INTERFACE.....	39
9.16.	BT Wi-Fi Co-EXISTENCE (PTA).....	40
9.17.	PWM INTERFACE.....	41
9.18.	MEMORY MANAGEMENT	43
9.19.	SERIAL FLASH MEMORY INTERFACE	44
9.20.	POWER MANAGEMENT UNIT - SWITCH MODE REGULATOR.....	45
9.21.	BATTERY CHARGER.....	47
9.21.1.	PMU Protection Scheme.....	50
9.22.	REFERENCE CIRCUITS	54
9.22.1.	RTL8763BM Reference Circuits.....	54
9.22.2.	RTL8763BF/BFR Reference Circuits	55
9.22.3.	RTL8763BS Reference Circuits	56
9.22.4.	RTL8763BA Reference Circuits.....	57
10.	ELECTRICAL CHARACTERISTICS.....	58
10.1.	ABSOLUTE MAXIMUM RATINGS	58
10.2.	RECOMMENDED OPERATING CONDITIONS	58
10.3.	POWER MANAGEMENT UNIT; SWITCH MODE REGULATOR FOR AUDIO CORE AND AUDIO DRIVE STAGE.....	59
10.4.	POWER MANAGEMENT UNIT; SWITCH MODE REGULATOR FOR DIGITAL CORE, RF, AND SYNTHESIZER.....	59
10.5.	POWER MANAGEMENT UNIT; LOW DROP LINEAR REGULATOR.....	59
10.6.	POWER MANAGEMENT UNIT; BATTERY CHARGER	60
10.7.	AUDIO CODEC DAC (IF NOT SPECIALLY MARKED, THE TEST IS WITH $A_{VCC} = 2.8V$).....	61
10.8.	AUDIO CODEC ADC (IF NOT SPECIALLY MARKED, THE TEST IS WITH $A_{VCC} = 2.8V$).....	62
11.	RF CHARACTERISTICS	64
11.1.	TRANSMITTER BT CLASSIC BASIC DATA RATE (BDR).....	64
11.2.	TRANSMITTER BT CLASSIC ENHANCED DATA RATE (EDR).....	64
11.3.	TRANSMITTER BT CLASSIC BLUETOOTH LOW ENERGY (BLE IQM)	65
11.4.	RECEIVER BT CLASSIC BASIC DATA RATE (BDR)	66
11.5.	RECEIVER BT CLASSIC ENHANCED DATA RATE (EDR)	67
11.6.	RECEIVER BT CLASSIC BLUETOOTH LOW ENERGY (BLE) IQM.....	68
11.7.	RECEIVER BT CLASSIC BLUETOOTH LOW ENERGY (BLE) 2M IQM	69
11.8.	RECEIVER BT CLASSIC BLUETOOTH LOW ENERGY (BLE) LONG RANGE 500K IQM.....	69
11.9.	RECEIVER BT CLASSIC BLUETOOTH LOW ENERGY (BLE) LONG RANGE 125K IQM.....	69
11.10.	ANALOG ADC INPUT	70
11.11.	ESD PROTECTION	70
11.12.	POWER CONSUMPTION	71
12.	MECHANICAL DIMENSIONS.....	73
12.1.	PACKAGE DIMENSIONS QFN40	73
12.2.	QFN40 LAYOUT LAND PATTERN STENCIL OPEN	74
12.3.	SUGGESTED STENCIL OPEN FOR SMT SOLDERING ON EP PAD (EXPOSED PAD UNDER THE CHIP).....	74
12.4.	PACKAGE DIMENSION QFN48 6X6MM2.....	75
12.5.	QFN48 LAYOUT LAND PATTERN STENCIL OPEN	75
12.6.	SUGGESTED STENCIL OPEN FOR SMT SOLDERING ON EP PAD (EXPOSED PAD UNDER THE CHIP).....	76
12.7.	PACKAGE DIMENSION QFN68 8X8MM2.....	77
12.8.	QFN68 LAYOUT LAND PATTERN STENCIL OPEN	78
12.9.	SUGGESTED STENCIL OPEN FOR SMT SOLDERING ON EP PAD (EXPOSED PAD UNDER THE CHIP).....	78
12.10.	PCB DESIGN LAYOUT TRACE ROUTING FOR 2-LAYER PCB	79
12.11.	REFLOW PROFILE	79
12.12.	TAPE AND REEL INFORMATION	80
12.12.1.	Tape Information	80
12.12.2.	Reel Information.....	80
12.12.3.	IC Tray Information (QFN40).....	81

12.12.4.	IC Tray Information (QFN48)	81
12.12.5.	IC Tray Information (QFN68)	82
12.12.6.	Storage Conditions	82
13.	ORDERING INFORMATION	83

List of Tables

TABLE 1.	POWER-ON SEQUENCE-BATTERY MODE	8
TABLE 2.	POWER-ON SEQUENCE-BATTERY MODE	8
TABLE 3.	RF INTERFACE	16
TABLE 4.	CRYSTAL OSCILLATOR	16
TABLE 5.	GENERAL PURPOSE I/OS	16
TABLE 6.	AUDIO CODEC	18
TABLE 7.	POWER MANAGEMENT	19
TABLE 8.	SPI FLASH MEMORY INTERFACE	20
TABLE 9.	SYSTEM	20
TABLE 10.	CRYSTAL OSCILLATOR	23
TABLE 11.	CRYSTAL OSCILLATOR	24
TABLE 12.	AUDIO DIGITAL MICROPHONE TIMING	32
TABLE 13.	UART TIMING CHARACTERISTICS	35
TABLE 14.	UART DATA ERROR RATE ESTIMATION BASED ON VARIOUS BAUD RATES	36
TABLE 15.	I2C TIMING CHARACTERISTICS	37
TABLE 16.	INDUCTOR SELECTION	46
TABLE 17.	CHARGER MODE DEFINITION	47
TABLE 18.	LED	51
TABLE 19.	PIN MUX AVAILABLE LIST	52
TABLE 20.	ABSOLUTE MAXIMUM RATINGS	58
TABLE 21.	RECOMMENDED OPERATING CONDITIONS	58
TABLE 22.	POWER MANAGEMENT UNIT; SWITCH MODE REGULATOR FOR AUDIO CORE AND AUDIO DRIVE STAGE	59
TABLE 23.	POWER MANAGEMENT UNIT; SWITCH MODE REGULATOR FOR DIGITAL CORE, RF, AND SYNTHESIZER	59
TABLE 24.	POWER MANAGEMENT UNIT; LOW DROP LINEAR REGULATOR	59
TABLE 25.	POWER MANAGEMENT UNIT; BATTERY CHARGER	60
TABLE 26.	AUDIO CODEC DAC (IF NOT SPECIALLY MARKED, THE TEST IS WITH AVDD= 2.8V)	61
TABLE 27.	AUDIO CODEC ADC (IF NOT SPECIALLY MARKED, THE TEST IS WITH VCC= 2.8V)	62
TABLE 28.	TRANSMITTER BT CLASSIC BASIC DATA RATE (BDR)	64
TABLE 29.	HARMONIC	64
TABLE 30.	TRANSMITTER BT CLASSIC ENHANCED DATA RATE (EDR)	64
TABLE 31.	TRANSMITTER BT CLASSIC BLUETOOTH LOW ENERGY (BLE) IQM	65
TABLE 32.	RECEIVER BT CLASSIC BASIC DATA RATE (BDR)	66
TABLE 33.	RECEIVER BT CLASSIC ENHANCED DATA RATE (EDR)	67
TABLE 34.	RECEIVER BT CLASSIC BLUETOOTH LOW ENERGY (BLE) IQM	68
TABLE 35.	RECEIVER BT CLASSIC BLUETOOTH LOW ENERGY (BLE) 2M IQM	69
TABLE 36.	RECEIVER BT CLASSIC BLUETOOTH LOW ENERGY (BLE) LONG RANGE 500K IQM	69
TABLE 37.	RECEIVER BT CLASSIC BLUETOOTH LOW ENERGY (BLE) LONG RANGE 125K IQM	69
TABLE 38.	ANALOG ADC INPUT	70
TABLE 39.	ESD PROTECTION	70
TABLE 40.	VBAT=3.7V, RTL8763BFR ONE HEADSET TEST WITHOUT SPEAKER LOADING; RF TX= +2dBm	71
TABLE 41.	VBAT=3.7V, RWS HEADSET TEST WITHOUT SPEAKER LOADING; RF TX= +6dBm, TEST WITH HANDSET APPLE I-PHONE7 PLAYING THE MASTER ROLE, MASTER SIDE	71
TABLE 42.	VBAT=3.7V, RWS HEADSET TEST WITHOUT SPEAKER LOADING; RF TX= +6dBm, TEST WITH HANDSET ANDROID PHONE/ANDROID7.0 PLAYING THE MASTER ROLE, SLAVE SIDE	71
TABLE 43.	ORDERING INFORMATION	83

List of Figures

FIGURE 1.	BLOCK DIAGRAM	5
FIGURE 2.	POWER TREE-1	6
FIGURE 3.	POWER TREE-2	7
FIGURE 4.	POWER-ON SEQUENCE-BATTERY MODE	7
FIGURE 5.	POWER-ON SEQUENCE-ADAPTER MODE	8
FIGURE 6.	CLOCK TREE.....	9
FIGURE 7.	RESET	10
FIGURE 8.	PACKAGE IDENTIFICATION	11
FIGURE 9.	PIN OUT (TOP VIEW) RTL8763BM QFN40	12
FIGURE 10.	PIN OUT (TOP VIEW) RTL8763BF/BFR QFN40	13
FIGURE 11.	PIN OUT (TOP VIEW) RTL8763BS QFN48	14
FIGURE 12.	PIN OUT (TOP VIEW) RTL8763BA QFN68	15
FIGURE 13.	RF RADIO	21
FIGURE 14.	REFERENCE CIRCUIT.....	22
FIGURE 15.	40MHZ CRYSTAL SPECIFICATION SUGGESTION	23
FIGURE 16.	32MHZ CRYSTAL SPECIFICATION SUGGESTION	24
FIGURE 17.	DSP INTERFACES IN RTL86XX IC PLATFORM	25
FIGURE 18.	CODEC AND DAC BLOCK DIAGRAM.....	26
FIGURE 19.	RTL8763B MONO	27
FIGURE 20.	RTL8763B STEREO.....	27
FIGURE 21.	RTL8763B MONO	28
FIGURE 22.	RTL8763B STEREO.....	28
FIGURE 23.	RTL8763B MONO	29
FIGURE 24.	RTL8763B STEREO.....	29
FIGURE 25.	CODEC AND ADC BLOCK DIAGRAM.....	30
FIGURE 26.	RTL8763B DUAL MICROPHONE REFERENCE	30
FIGURE 27.	RTL8763B ONE MICROPHONE AND ONE AUX-IN REFERENCE	31
FIGURE 28.	AUDIO DIGITAL MICROPHONE	31
FIGURE 29.	AUDIO DIGITAL MICROPHONE TIMING DIAGRAM.....	32
FIGURE 30.	I2S CONNECTION; RTL8763B IN MASTER MODE.....	33
FIGURE 31.	I2S CONNECTION; RTL8763B IN SLAVE MODE.....	33
FIGURE 32.	TIMING DIAGRAM-3.....	34
FIGURE 33.	UART INTERFACE	35
FIGURE 34.	UART INTERFACE TIMING DIAGRAM	35
FIGURE 35.	I2C INTERFACE TIMING DIAGRAM	37
FIGURE 36.	NEAR FIELD COMMUNICATION	38
FIGURE 37.	USB INTERFACE	38
FIGURE 38.	BLUETOOTH SPEAKER APPLICATION	39
FIGURE 39.	BLUETOOTH AUDIO RECEIVER APPLICATION	39
FIGURE 40.	AUXILIARY ADC INTERFACE APPLICATION	40
FIGURE 41.	BT Wi-Fi Co-EXISTENCE (PTA)	40
FIGURE 42.	PWM INTERFACE	41
FIGURE 43.	COMPLEMENTARY OUTPUT MODE ENABLED BUT NOT SET IN THE DEAD ZONE	42
FIGURE 44.	MAXIMUM SETTING OF DEAD ZONE	43
FIGURE 45.	DEAD ZONE IS LONGER THAN PWM HIGH LEVEL TIMER	43
FIGURE 46.	DEAD ZONE IS LONGER THAN PWM LOW LEVEL TIMER	43
FIGURE 47.	MEMORY MANAGEMENT	44
FIGURE 48.	SERIAL FLASH MEMORY; 1 AND 2-BIT MODE	44
FIGURE 49.	SERIAL FLASH MEMORY; 4-BIT MODE.....	45
FIGURE 50.	POWER MANAGEMENT UNIT - SWITCH MODE REGULATOR.....	45
FIGURE 51.	INDUCTOR SELECTION	46
FIGURE 52.	BATTERY VOLTAGE VS. CHARGER CURRENT CURVE	48
FIGURE 53.	AMBIENT DETECTION FOR BATTERY CHARGE PROTECTION	49
FIGURE 54.	PMU PROTECTION SCHEME.....	50
FIGURE 55.	LED.....	51

FIGURE 56. I/O MUX	52
FIGURE 57. RTL8763BM REFERENCE CIRCUITS.....	54
FIGURE 58. RTL8763BF/BFR REFERENCE CIRCUITS	55
FIGURE 59. RTL8763BS REFERENCE CIRCUITS.....	56
FIGURE 60. RTL8763BS REFERENCE CIRCUITS.....	57

1. General Description

The RTL8763B series are single-chip Bluetooth ROM audio solutions for mono (RTL8763BM) and stereo (RTL8763BF/BFR, RTL8763BS, RTL8763BA) applications. The RTL8763B is composed of an ARM core and an ultra-low power DSP core with high efficiency computing power, high performance audio codec, power management unit, ADC, ultra-low current RF transceiver, and smart I/O distribution controller.

The parameter configuration tools, the EVB kits, and the MP kits, including controller hardware and software, provide a simple and flexible procedure for customers to quickly design and proceed to mass production with Realtek's new generation of audio solutions. These complete total solutions provide a fast and highly reliable development path with a very competitive R-BOM.

2. Features

General Features

- Bluetooth 5 specification compliant
- Supports HFP 1.7, HSP 1.2, A2DP 1.3, AVRCP 1.6, SPP 1.2 and PBAP 1.0
- Single-end RF radio output with high performance 10dBm of transmitter power and -94dBm 2M EDR receiver sensitivity
- Supports Bluetooth classic (BDR/EDR)
- Supports Bluetooth Low Energy (BLE)
 - ◆ Generic access service
 - ◆ Device information service
 - ◆ Proprietary services for data communication
 - ◆ Apple Notification Center Service (ANCS)
- Real Wireless Stereo (RWS)
- Supports USB type-C audio
- Supports iAP2
- Realtek's latest RCV (Real Clear Voice) technology for narrowband and wideband voice connection, including wind noise reduction
- Supports high resolution audio codec up to 24bits, 192kHz audio data format
- Supports dual analog and digital MIC, AUX-IN, I2S digital audio, analog output
- Supports high speed UART, I2C, SPI and USB2.0 compatible interface
- Supports high resolution 12-bits multi-channel ADC
- Supports PWM I/O and smart LED controller
- Supports USB BC1.2 battery charging
- Smart I/O distribution scheme with MUX
- Built-in 8Mbits FLASH memory (RTL8763BF/RTL8763BFR)
- Integrated dual switch mode power regulator, linear regulators, and battery charger; charging current up to 400mA
- Built-in battery voltage monitoring and thermal protection scheme with external thermal resistor
- SBC, AAC decoder support
- Package: 5x5mm² QFN40 (RTL8763BM, RTL8763BF, RTL8763BFR), 6x6mm² QFN48 (RTL8763BS) and 8x8mm² QFN68 (RTL8763BA) with 0.4mm pitch
- Supports OTA and USB firmware upgrade
- GSM 217Hz interference block out design
- Low BOM cost
- Green (RoHS compliant and no antimony or halogenated flame retardants)
- Supports PTA (Packet Traffic Arbiter) when co-existing with Wi-Fi

Baseband Features

- 40MHz main clock
- Supports serial flash for FW storage and parameter upgrade
- Adaptive Frequency Hopping (AFH)
- Multi-link support
- Supports Serial Copy Management System (SCMS-T) content protection

RAM and ROM Size

- ROM size 768KB
- MCU RAM size 16KB x 8 Data RAM + 8KB X 2 cache RAM
- DSP RAM 8KB x 22

RF

- Supports TX +10dBm (typ.) maximum output power for Bluetooth classic
- Supports TX +10dBm (typ.) maximum output power for Bluetooth BLE
- Supports TX +4dBm (typ.) maximum output power for Bluetooth BLE low power TPM mode
- Receive sensitivity: -94dBm (2Mbps EDR)
- Receive sensitivity: -97dBm (BLE)
- Receiver sensitivity: -106.5dBm (125K BLE long range)
- Single-end TX/RX RF port without matching component required (when TX power is below +4dBm and using PIFA type PCB antenna)
- Crystal oscillator with built-in integrated capacitor for clock offset digital tuning (0~20pF), could save 2-compensation CL cap following Realtek design guidelines

MCU

- 32-bit ARM Cortex-M4F Processor
- 1.23 DMIPS/MHz performance (Dhrystone)
- Supports hardware Floating Point Unit (FPU)
- Supports Memory Protect Unit (MPU)
- Supports SWD debug interface
- Executed external SPI flash
- 4-way association cache controller

DSP Audio Processing

- Enhanced Tensilica Hi-Fi-mini compatible 24-bit DSP core providing maxima 160-MIPS computation power
- 2 single-cycle MACs: 24 x 24-bit multiplier and 56-bit accumulator
- Supports G.711 A-Law, μ -Law, continuous-variable-slope-delta (CVSD) and mSBC voice codecs

- Supports 8/16 kHz 1/2-mic noise suppression and echo cancellation
- Packet Loss Concealment (PLC) for voice processing
- SBC, and AAC-LC audio codecs supported for BT audio streaming

Audio Codec

- Dual operation voltage range 2.8V and 1.8V
- Supports cap-less, single-ended, and differential mode at the DAC path
- Supports 16ohm and 32ohm speaker loading
- Stereo 24-bit digital-to-analog (DAC) with 102dBA SNR
- Stereo 24-bit analog-to-digital (ADC) with 97dBA SNR
- 5-band configurable EQ at both DAC/ADC paths
- Sampling rates of 8, 16, 32, 44.1, 48, 88.2, and 96kHz are supported.
- Built-in MIC bias generator

Digital Audio Interface

- Supports two PDM digital MIC inputs
- Supports 24-bit, 192kHz on I2S digital audio
- Sampling frequency 8/16/32/44.1/48/88.2/96/176.4/192kHz

Radio

- Compliant with Bluetooth Core Specification including BR/EDR/LE-1M/LE-2M/LE-Coded (LongRange)
- Fully integrated balun and synthesizer minimizes external components.
- RF circuit design minimizes power-consumption while keeping excellent performance

PMU

- Highly integrated PMU design for the system application
- Dual switching mode regulator for digital core, radio and audio codec respectively
- Built-in LDO for the I/O and FLASH memory
- Built-in Li-Ion battery charger with up to 400mA charger current capability
- Supports ambient thermal detection to detect the battery temperature
- Built-in OVP, OCP, UVP protection to protect the system.

Operating Condition

- Operating voltage: 2.8V to 4.35V (VBAT)
- Temperature range: -40°C to +85°C

Package

- 5mmx5mm, QFN40 package (RTL8763BM)
- 5mmx5mm, QFN40 package (RTL8763BF/BFR)
- 6mmx6mm, QFN48 package (RTL8763BS)
- 8mmx8mm, QFN68 package (RTL8763BA)

3. System Applications

- Mono headset
- Stereo headset
- Real Wireless Stereo (RWS) headset
- Mono speaker
- Stereo speaker

4. Block Diagram

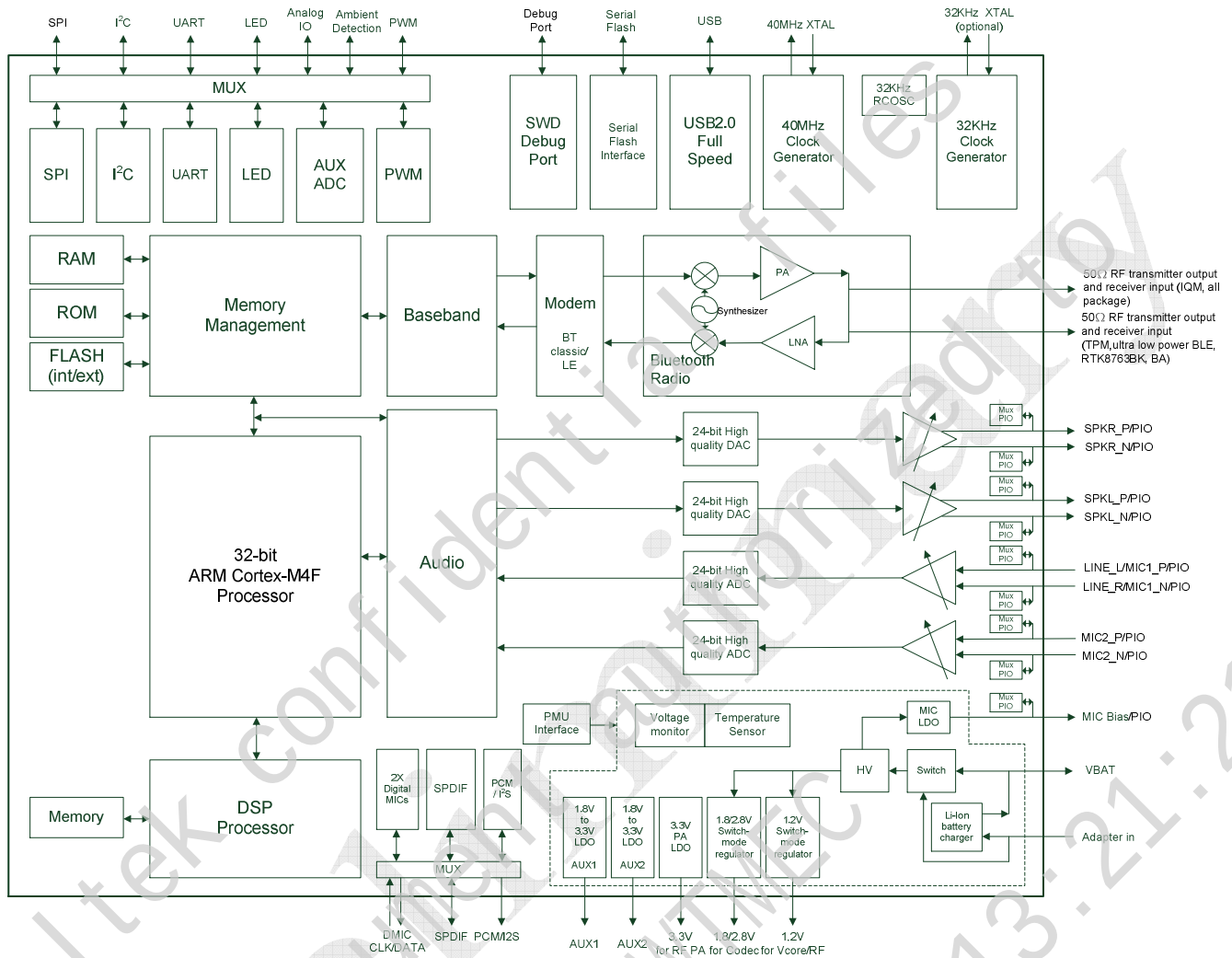


Figure 1. Block Diagram

5. Power Tree

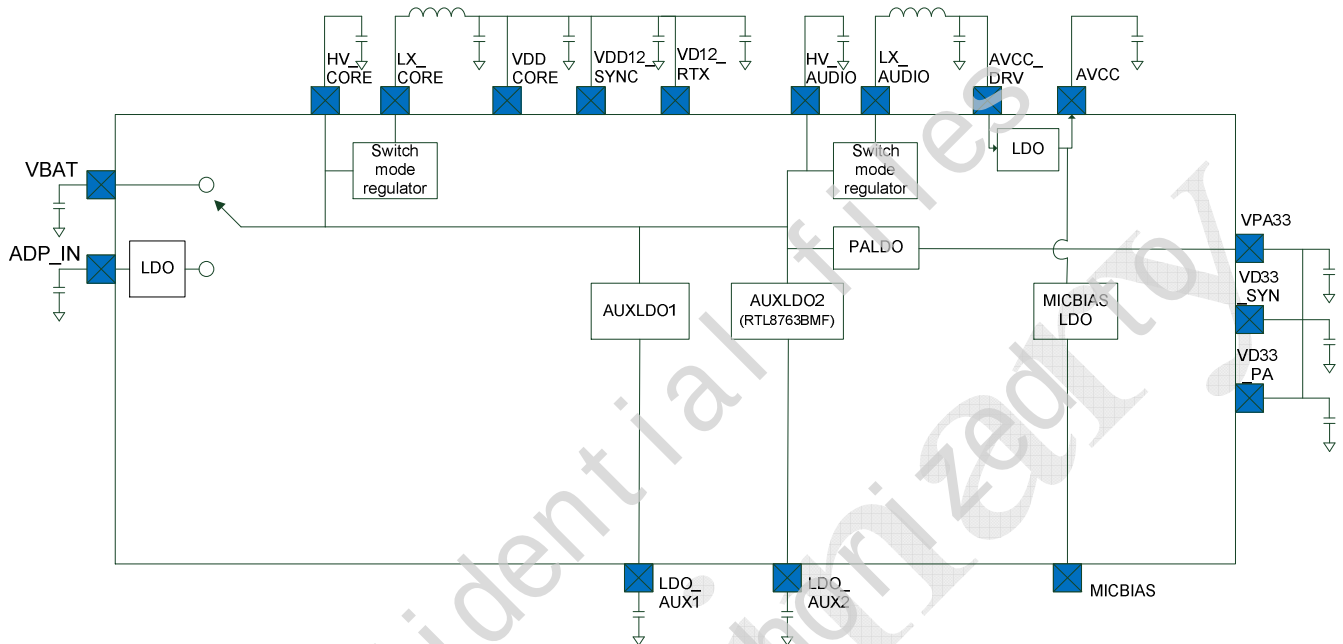


Figure 2. Power Tree-1

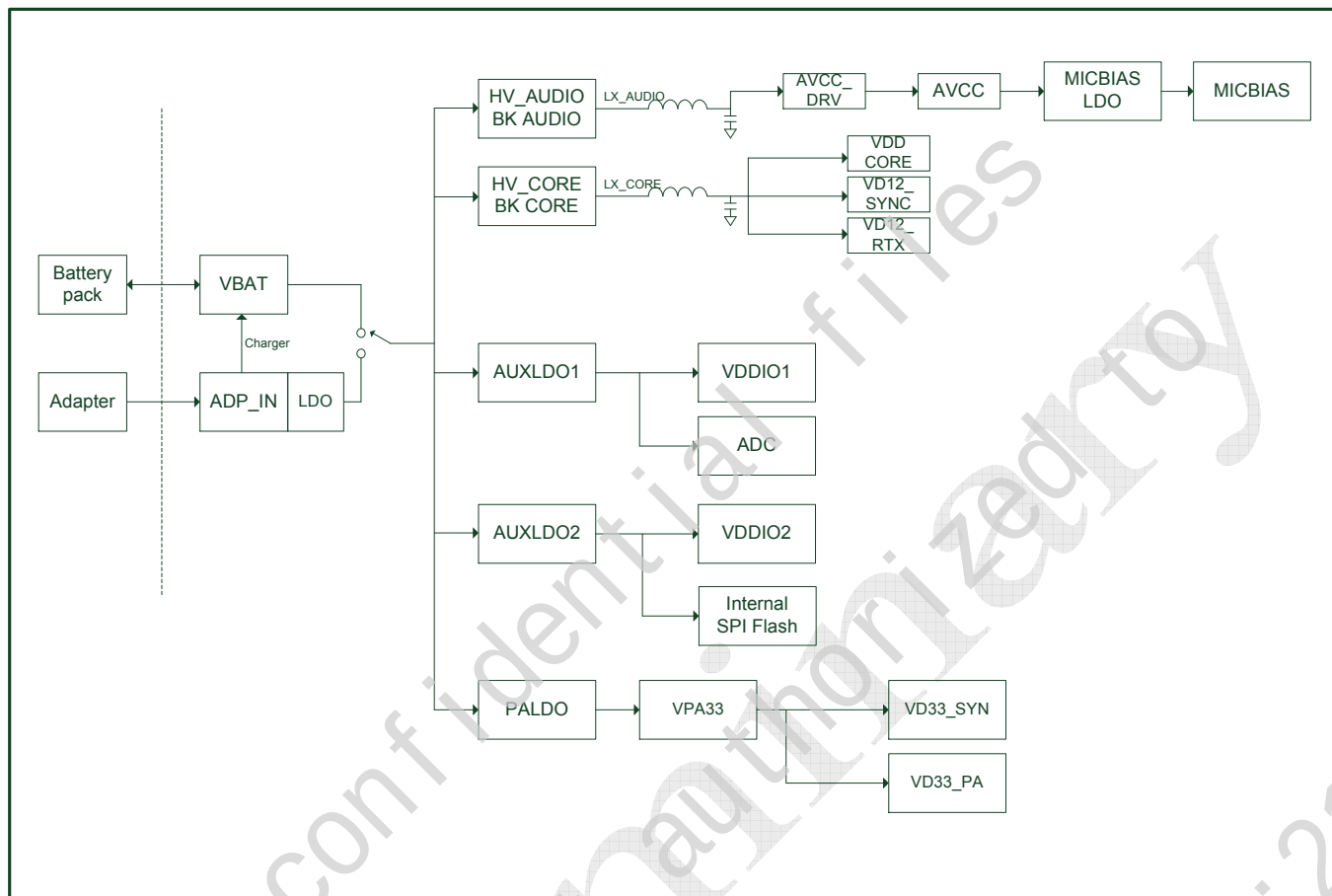


Figure 3. Power Tree-2

5.1. Power On Sequence-Battery Mode

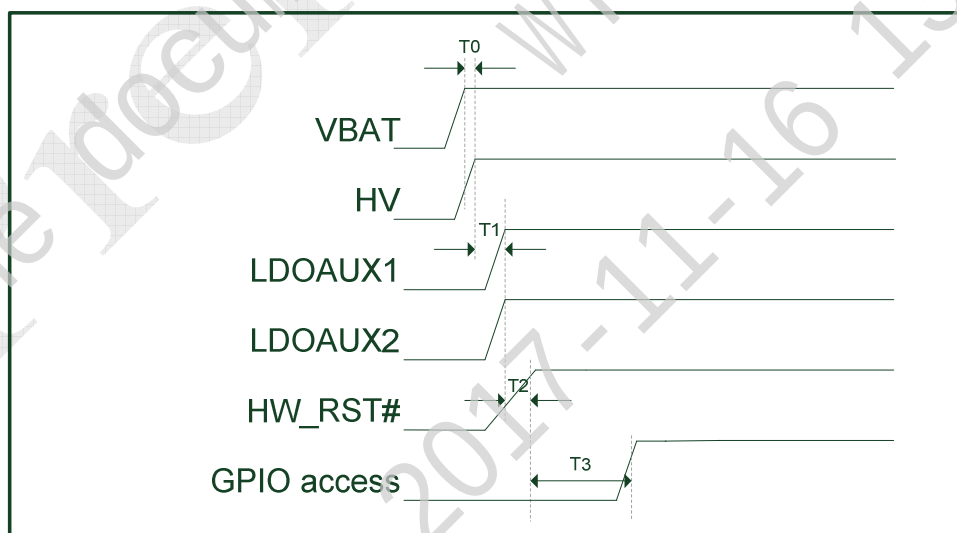


Figure 4. Power-On Sequence-Battery Mode

Table 1. Power-On Sequence-Battery Mode

Parameter	Min.	Typ.	Max.	Unit
T0	-	58.5	-	mS
T1	-	6.7	-	mS
T2	-	10	-	mS
T3	-	TBD	-	-

5.2. Power On Sequence-Adapter Mode


Figure 5. Power-On Sequence-Adapter Mode
Table 2. Power-On Sequence-Battery Mode

Parameter	Min.	Typ.	Max.	Unit
T0	100	-	-	mS

6. Clock Tree

6.1. Overview

The RTL8763B is composed of two clock oscillator circuits, 40MHz and 32.768kHz. 40MHz is for the system main clock in active mode, while 32.768kHz is for a low power clock when in sleep mode.

A low power clock from an external 32.768kHz crystal (only RTL8763BA) and its circuitry is optional for consideration of minimum power consumption in deep sleep mode. The low power clock could also be derived from the internal RCOSC block for cost efficiency and PCB design area optimization.

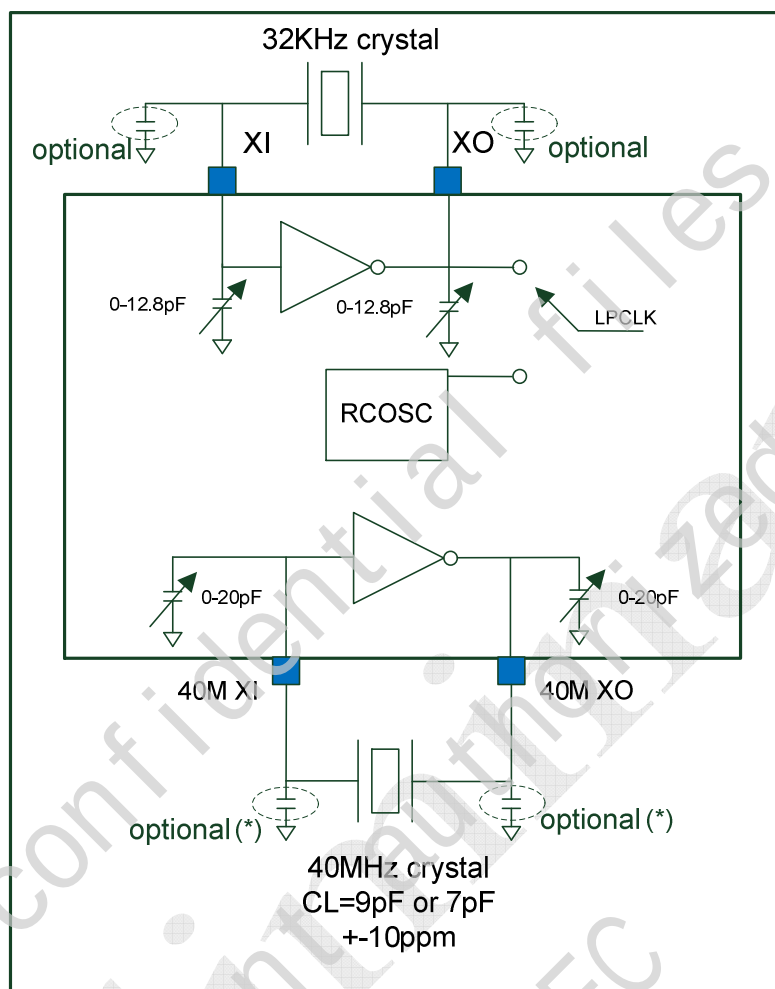


Figure 6. Clock Tree

6.2. Reset

The RTL8763B integrates multiple-reset protections to guarantee the system is working under the defined power range, and to avoid system hang up or FLASH memory corruption issues. The external reset IC is optional if the reset threshold defined by the customer is higher than 1.8V. If the customer would like to add an external reset IC, it is required to choose an OPEN drain type as the I/O power domain is different from the HV port.

HW_RST# pin is active low to trigger reset behavior, and the drive low should be longer than 8ms (>8ms) to avoid unconditional rest noise from the PCB board.

This high reliability design can stabilize the whole system and save the BOM of an external reset.

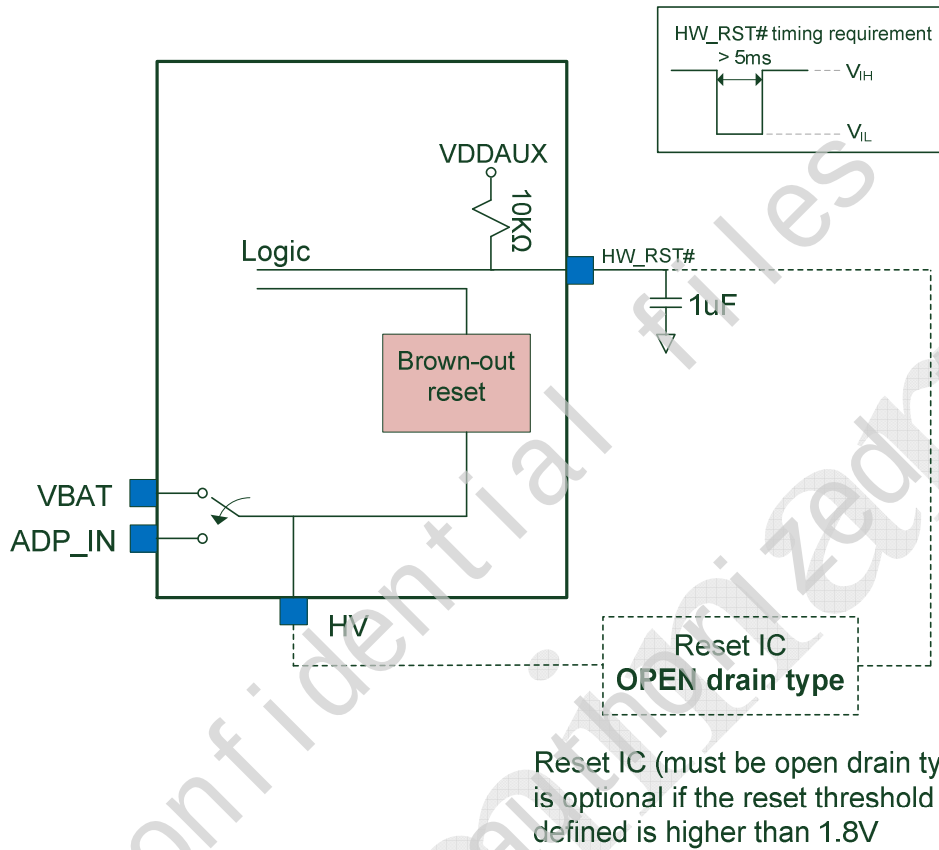


Figure 7. Reset

7. Pin Assignments

7.1. Package Identification

Green package is indicated by the 'G' in GXXXV (Figure 9). The version is shown in the location marked 'V'.



Figure 8. Package Identification

7.2. PIN OUT (TOP View) RTL8763BM QFN40

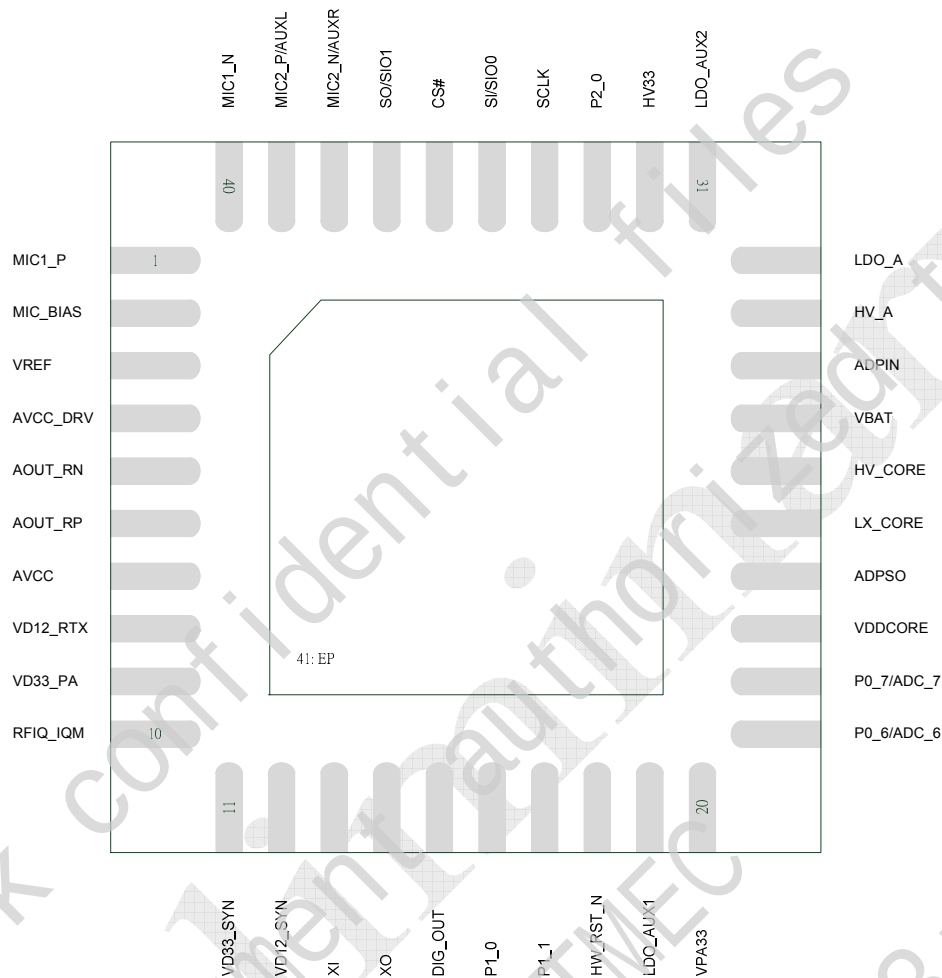


Figure 9. PIN OUT (TOP View) RTL8763BM QFN40

7.3. PIN OUT (TOP View) RTL8763BF/BFR QFN40

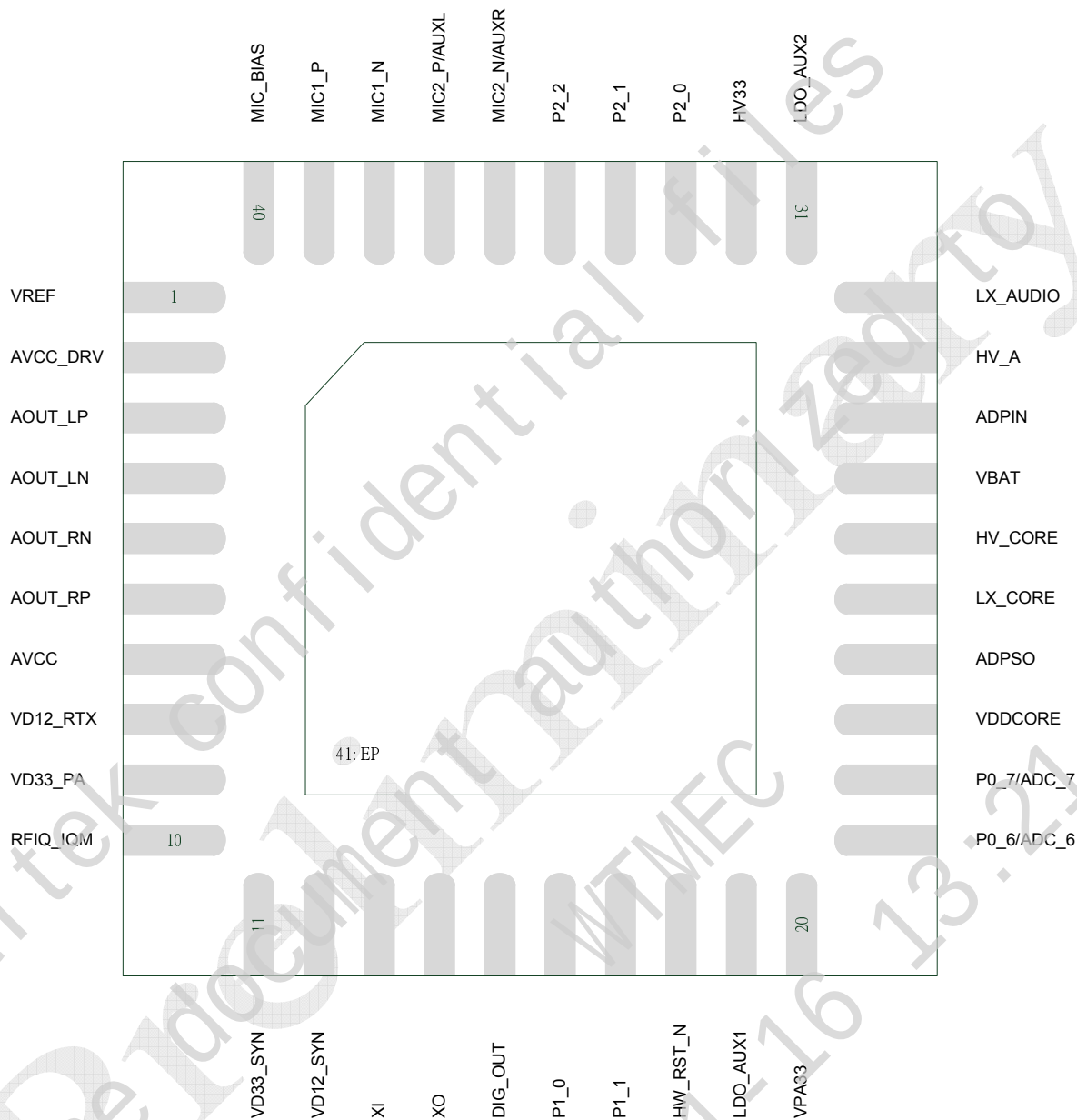


Figure 10. PIN OUT (TOP View) RTL8763BF/BFR QFN40

7.4. PIN OUT (TOP View) RTL8763BS QFN48

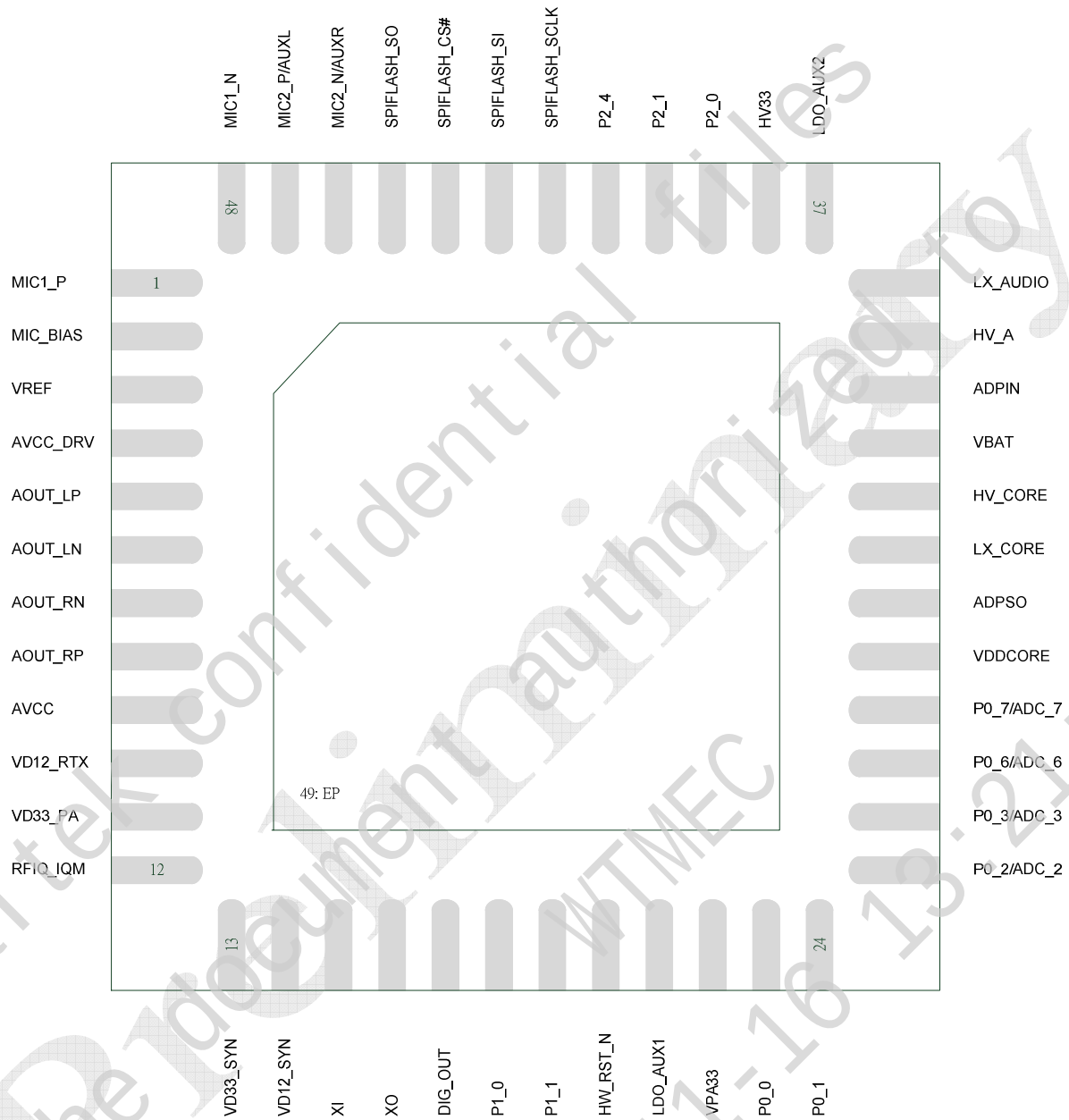


Figure 11. PIN OUT (TOP View) RTL8763BS QFN48

7.5. PIN OUT (TOP View) RTL8763BA QFN68

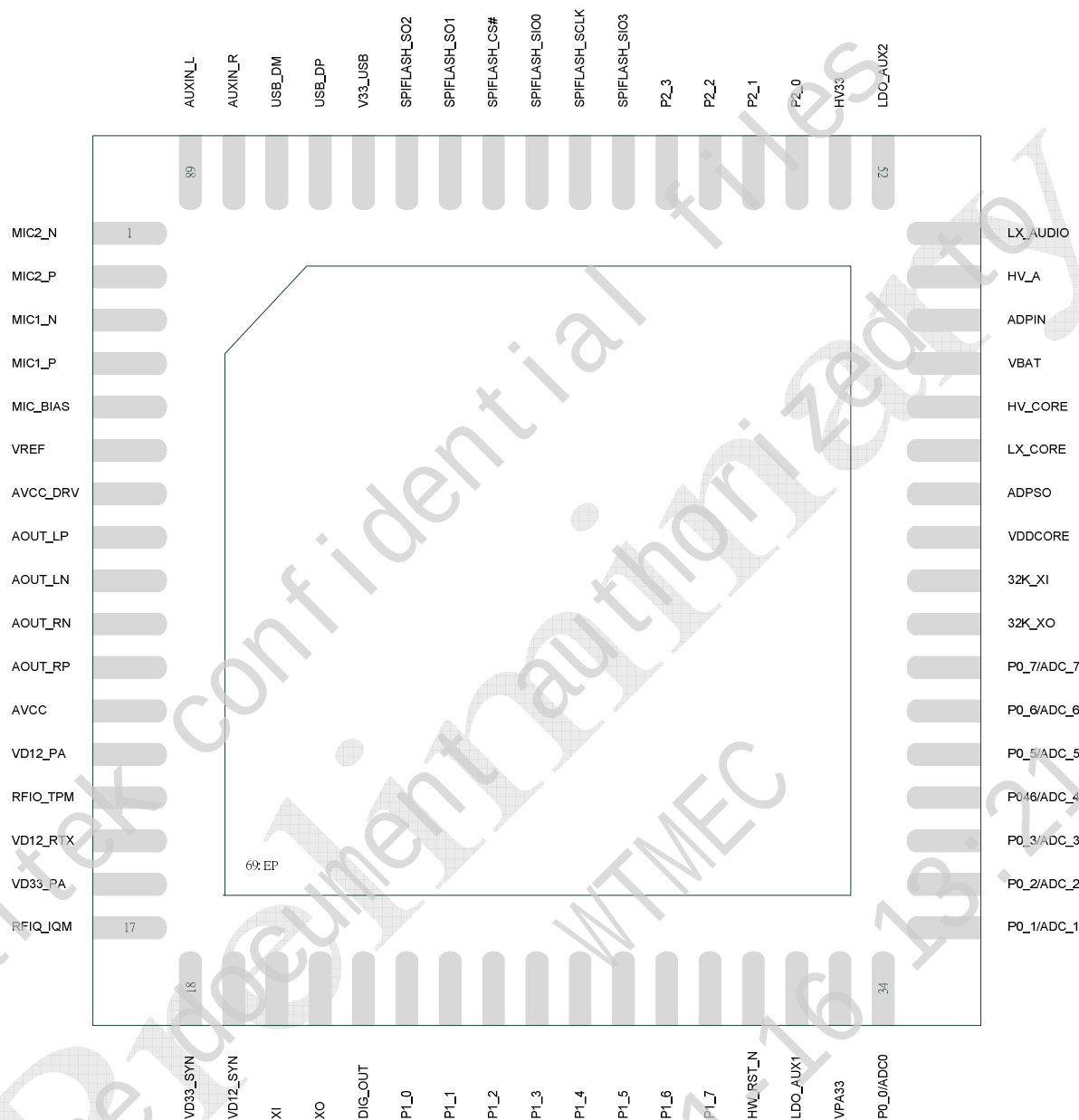


Figure 12. PIN OUT (TOP View) RTL8763BA QFN68

8. Pin Descriptions

8.1. RF Interface

Table 3. RF Interface

Pin Name	Pad Type	RTL 8763BM	RTL 8763BF/BFR	RTL 8763BS	RTL 8763BA	Description
RFIO_IQM	RF	10	10	12	17	Bluetooth radio 50Ω transmitter output and receiver input (dual mode)
RFIO_TPM	RF	-	-	-	14	Bluetooth radio 50Ω transmitter output and receiver input (BLE)

8.2. Crystal Oscillator

Table 4. Crystal Oscillator

Pin Name	Pad Type	RTL 8763BM	RTL 8763BF/BFR	RTL 8763BS	RTL 8763BA	Description
XI	A	13	13	15	20	Crystal input
XO	A	14	14	16	21	Crystal output

A: Analog

8.3. General Purpose I/Os

Table 5. General Purpose I/Os

Pin Name	Pad Type	RTL 8763BM	RTL 8763BF/BFR	RTL 8763BS	RTL 8763BA	Description
P0_0/ADC_0	I/O I/O A	-	-	23	34	Programmable GPIO. Can be programmed as ADC input pin Pull high/low input configurable
P0_1/ADC_1	I/O I/O A	-	-	24	35	Programmable GPIO. Can be programmed as ADC input pin Pull high/low input configurable
P0_2/ADC_2	I/O I/O A	-	-	25	36	Programmable GPIO. Can be programmed as ADC input pin Pull high/low input configurable
P0_3/ADC_3	I/O I/O A	-	-	26	37	Programmable GPIO. Can be programmed as ADC input pin Pull high/low input configurable
P0_4/ADC_4	I/O I/O A	-	-	-	38	Programmable GPIO. Can be programmed as ADC input pin Pull high/low input configurable

Pin Name	Pad Type	RTL 8763BM	RTL 8763BF/BFR	RTL 8763BS	RTL 8763BA	Description
P0_5/ADC_5	I/O I/O A	-	-	-	39	Programmable GPIO. Can be programmed as ADC input pin Pull high/low input configurable
P0_6/ADC_6	I/O I/O A	21	21	27	40	Programmable GPIO. Can be programmed as ADC input pin Pull high/low input configurable
P0_7/ADC_7	I/O I/O A	22	22	28	41	Programmable GPIO. Can be programmed as ADC input pin Pull high/low input configurable
P1_0	I/O	16	16	18	23	Programmable GPI and MFB for power on
P1_1	I/O	17	17	19	24	Programmable GPIO Pull high/low input configurable
P1_2	I/O	-	-	-	25	Programmable GPIO Pull high/low input configurable
P1_3	I/O	-	-	-	26	Programmable GPIO Pull high/low input configurable
P1_4	I/O	-	-	-	27	Programmable GPIO Pull high/low input configurable
P1_5	I/O	-	-	-	28	Programmable GPIO Pull high/low input configurable
P1_6	I/O	-	-	-	29	Programmable GPIO Pull high/low input configurable
P1_7	I/O	-	-	-	30	Programmable GPIO Pull high/low input configurable
P2_0	I/O	33	33	39	54	Programmable GPIO Pull high/low input configurable
P2_1	I/O	-	34	40	55	Programmable GPIO Pull high/low input configurable
P2_2	I/O	-	35	-	56	Programmable GPIO Pull high/low input configurable
P2_3	I/O	-	-	-	57	Programmable GPIO Pull high/low input configurable
P2_4	I/O	-	-	41	-	Programmable GPIO Pull high/low input configurable

I/O: Bidirectional digital pad

I/O PU: Bidirectional digital pad with pull high resistor inside when input mode

I/O PD: Bidirectional digital pad with pull low resistor inside when input mode

I/O A: Bidirectional digital pad and programmable ADC

8.4. Audio Codec

Table 6. Audio Codec

Pin Name	Pad Type	RTL 8763BM	RTL 8763BF/BFR	RTL 8763BS	RTL 8763BA	Description
MIC1_N	AH	40	38	48	3	MIC1 input negative pad. Used as main MIC in dual MIC application. Programmable digital I/O, refer to MUX table
MIC1_P	AH	1	39	1	4	MIC1 input positive pad. Used as main MIC in dual MIC application. Programmable digital I/O, refer to MUX table
MIC2_N	AH	-	36 ^(*)	46 ^(*)	1	MIC2 input negative pad. Used as 2nd MIC in dual MIC application. Programmable digital I/O, refer to MUX table (*) AUX input right channel pad. Programmable digital I/O, refer to MUX table
MIC2_P	AH	-	37 ^(**)	47 ^(**)	2	MIC2 input positive pad. Used as 2nd MIC in dual MIC application. Programmable digital I/O, refer to MUX table (**) AUX input left channel pad. Programmable digital I/O, refer to MUX table
SPKR_N	AH	5	5	7	10	Right channel speaker output negative Programmable digital I/O, refer to MUX table
SPKR_P	AH	6	6	8	11	Right channel speaker output positive Programmable digital I/O, refer to MUX table
SPKL_N	AH	-	4	6	9	Left channel speaker output negative Programmable digital I/O, refer to MUX table
SPKL_P	AH	-	3	5	8	Left channel speaker output positive Programmable digital I/O, refer to MUX table
MICBIAS	PO	2	40	2	5	Microphone bias output
VREF	PO	3	41	3	6	Codec bandgap reference output, add a 1μF cap as close as possible.
AUXIN_R	AH	-	-	-	67	AUX input right channel pad. Programmable digital I/O, refer to MUX table
AUXIN_L	AH	-	-	-	68	AUX input left channel pad. Programmable digital I/O, refer to MUX table

AH: Analog and digital hybrid programmable

PO: Power output

8.5. Power Management

Table 7. Power Management

Pin Name	Pad Type	RTL 8763BM	RTL 8763BF/BFR	RTL 8763BS	RTL 8763BA	Description
VBAT	PIO	27	27	33	48	Battery input when battery only Battery charge output when in charger mode with adapter in
ADP_IN	PI	28	28	34	49	Adapter input for battery charge
HV_CORE	PO	26	26	32	47	Switch output for switch mode regulator, add a 4.7μF cap as close as possible
LX_CORE	PO	25	25	31	46	Switch mode regulator output, connect to a 2.2μH inductor as close as possible
VDDCORE	PI	23	23	29	44	Switch mode regulator sense input and digital core power input
HV_AUDIO	PO	-	29	35	50	Switch output for switch mode regulator, add a 4.7μF cap as close as possible
LX_AUDIO	PO	-	30	36	51	Switch mode regulator output, connect to a 2.2μH inductor as close as possible
HV_A	PO	29	-	-	-	Switch output for LDO, add a 1μF cap as close as possible
LDO_A	PO	30	-	-	-	LDO mode regulator output, add a 1μF as close as possible.
AVCC	PO	7	7	9	12	Switch mode regulator sense input and power input for codec digital circuitry, 1.8V or 2.8V
AVCC_DRV	PI	4	4	4	7	Power input for codec drive stage, 1.8V or 2.8V
VD33_PA	PI	9	13	11	16	3.3V power input for RF PA
VD33_SYN	PI	11	15	13	18	3.3V power input for RF synthesizer
VPA33	PO	20	20	22	33	3.3V linear regulator output
VD12_SYN	PI	12	12	14	19	1.2V power input for RF synthesizer
VD12_RTX	PI	8	8	10	15	1.2V power input for RF circuitry
LDO_AUX1	PO	19	19	21	32	Programmable linear regulator output for I/O
LDO_AUX2	PO	31	31	37	52	Programmable linear regulator output for I/O
V33_USB	PO	-	-	-	64	Power output, add 1μF cap
ADPSO	PO	24	24	30	45	Power output, add 1μF cap
DIG_OUT	PO	15	15	17	22	Power output, add 1μF cap
HV33	PO	32	32	38	53	Power output, add 1μF cap
GND_EP	GND	EP	EP	EP	EP	Exposed pad with ground connections

PO: Power Output

PI: Power Input

PIO: Power Input and Output

8.6. SPI FLASH Memory Interface

Table 8. SPI FLASH Memory Interface

Pin Name	Pad Type	RTL 8763BM	RTL 8763BF/BFR	RTL 8763BS	RTL 8763BA	Description
SPIFLASH_SCLK	O	34	-	42	59	Serial flash clock output
SPIFLASH_CS#	I/O	36	-	44	61	Serial flash chip select, low active
SPIFLASH_SI/SIO0	I/O	35	-	43	60	Serial flash data output for 1-bit mode, connect to SI pin of external FLASH memory Serial flash data output for 4-bit mode, connect to SIO0 pin of external FLASH memory
SPIFLASH_SO/SIO1	I/O	37	-	45	62	Serial flash data input for 1-bit mode, connect to SO pin of external FLASH memory Serial flash data output for 4-bit mode, connect to SIO1 pin of external FLASH memory
SPIFLASH_WP#/SIO2	I/O	-	-	-	63	Serial flash data output for 4-bit mode, connect to SIO2 pin of external FLASH memory
SPIFLASH_HOLD#/SIO3	I/O	-	-	-	58	Serial flash data output for 4-bit mode, connect to SIO3 pin of external FLASH memory

O: Digital output

I: Digital input

8.7. System

Table 9. System

Pin Name	Pad Type	RTL 8763BM	RTL 8763BF/BFR	RTL 8763BS	RTL 8763BA	Description
HW_RST#	I_PU	18	18	20	31	System reset input with internal pull high, low active with at least 5ms low to trigger system reset
USB_DP	AI/O	-	-	-	65	USB signal positive
USB_DN	AI/O	-	-	-	66	USB signal negative

I_PU: Input with internal pull high inside

9. RF Radio

9.1. RF Radio

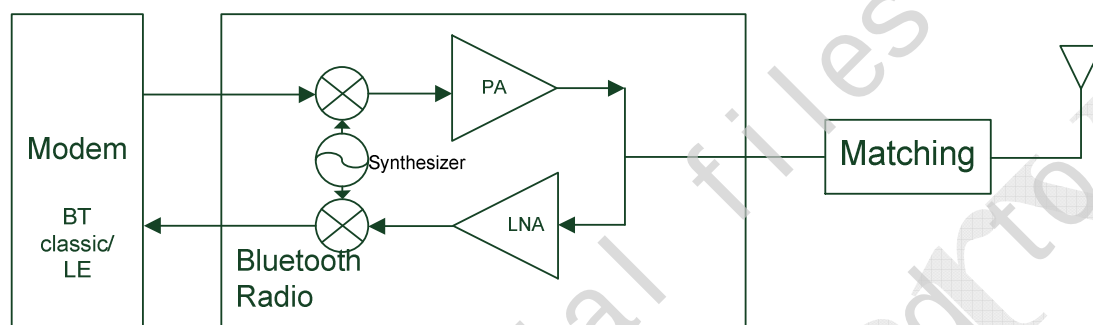


Figure 13. RF Radio

9.1.1. Transceiver

Fully integrated radio transceiver compliant with Bluetooth SIG test specification. Designed for low power consumption and excellent transmit and receive performance in the ISM band.

9.1.2. Transmitter

The Transmit mixer translates the baseband input signal to form the RF signal. It is designed to provide good stability and modulation characteristics.

The power amplifier integrated in the chip can provide up to 10 dBm in the ISM band.

9.1.3. Receiver

This is a Low Noise Amplifier. It amplifies a low energy RF signal to the desired level without significantly increasing the noise power. When input power is high, the designed limits non-linearity.

The Receive mixer is a device whose input is an RF signal, and the output is an IF signal. The IF signal is then passed along the IF path to the demodulator.

The Synthesizer is a control loop to compare the crystal and VCO during their phases. If the VCO frequency shifts, then the phase difference produces an error signal for the control loop.

9.1.4. RF IQM and TPM

9.1.4.1 RF IQM

The RTL8763B supports Bluetooth classic and Bluetooth BLE for all packages (known as the RF_IQM path). TX radiation power is up to +10 dBm.

9.1.4.2 RF TPM

As well as RF_IQM, the RTL8763BA supports RF_TPM, which is an extra low current consumption RF path for Bluetooth BLE. TX radiation power is up to +4 dBm.

In order to combine RF_IQM and RF_TPM into one antenna port, an SPDT circuit is required; refer to the RTL8763B hardware instructions or the RTL8763B reference circuit.

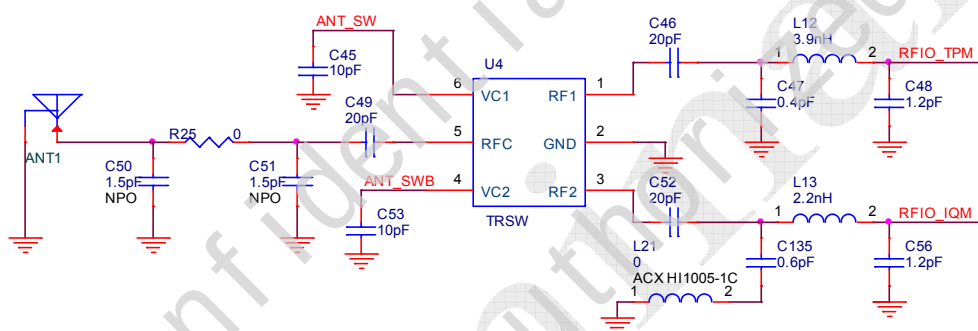


Figure 14. Reference Circuit

9.2. Crystal Oscillator

The RTL8763B series has a built-in 40MHz crystal oscillation circuit to provide a stable, controllable system clock. With the built-in capacitor, the clock offset can be fine-tuned in the mass production process. The maximum internal cap is 20pF typically, and we suggest following the Realtek crystal design specification and QVL.

The external capacitors, C1 and C2, can be replaced by an internal cap, reducing the BOM cost, minimizing PCB dimensions, and providing flexibility for clock fine-tuning. The clock offset calibration procedure is supported with Realtek's MP GU hardware; contact Realtek's FAE for details.

Table 10. Crystal Oscillator

Parameter	Min.	Typ.	Max.
Frequency (MHz)	-	40	-
Frequency tolerance (ppm)	-	-	±10
Frequency stability (ppm) over operating temperature	-	-	±10
Load capacitance (pF)	7	9	-
Drive Level (μW)	-	-	300
Equivalent Series Resistance (Ohm)	-	-	50Ω@7pF 40Ω@9pF
Insulation Resistance (MOhm)	500	-	-

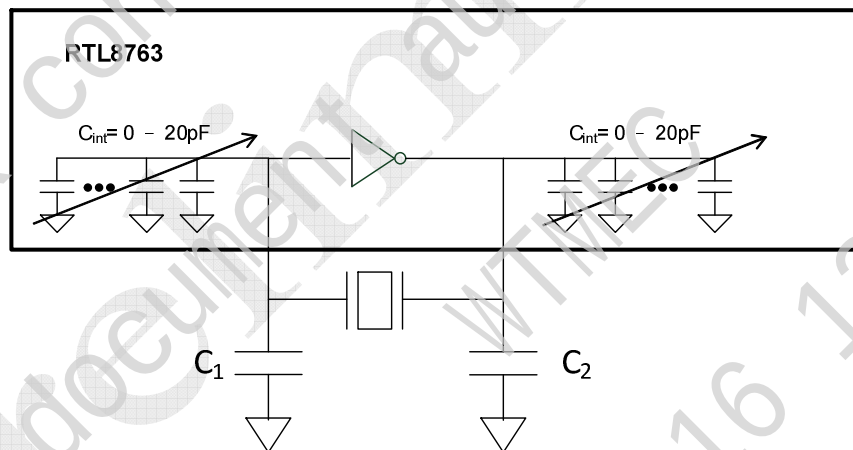


Figure 15. 40MHz Crystal Specification Suggestion

Example:

For a crystal with specification CL=9pF

$CL = [(C1 \times C2) / (C1 + C2)] + (C_{int} / 2) + C_{parasitic}$, the parasitic capacitor $C_{parasitic}$ can be observed on the PCB trace and IC SMT soldering pad....etc.

Rule of thumb says 'C1 + Cint' is typically 12~15pF, hence the external capacitor C1 and C2 can be replaced by the internal capacitor Cint, which can be 20pF at the maximum setting to cover the needs of external capacitors.

9.3. Crystal Oscillator 32.768kHz

The RTL8763BA has a built-in 32768Hz crystal oscillation circuit to provide a stable, controllable low power clock. With the internal built-in capacitor, the clock offset can be fine-tuned. The maximum internal cap is 12.8pF typically, and we suggest following the Realtek crystal design specifications and QVL.

If the CL specification of the crystal is 7pF, the external capacitor, C1 and C2, can be replaced by an internal cap, reducing the BOM cost, minimizing PCB dimensions, and providing flexibility for clock fine-tuning

Table 11. Crystal Oscillator

Parameter	Min.	Typ.	Max.
Frequency (kHz)	-	32.768	-
Frequency tolerance (ppm)	-	-	±20
Load capacitance (pF)	-	7	-
Drive Level (μW)	-	-	0.5
Equivalent Series Resistance (KOhm)	-	-	90
Insulation Resistance (MOhm)	500	-	-

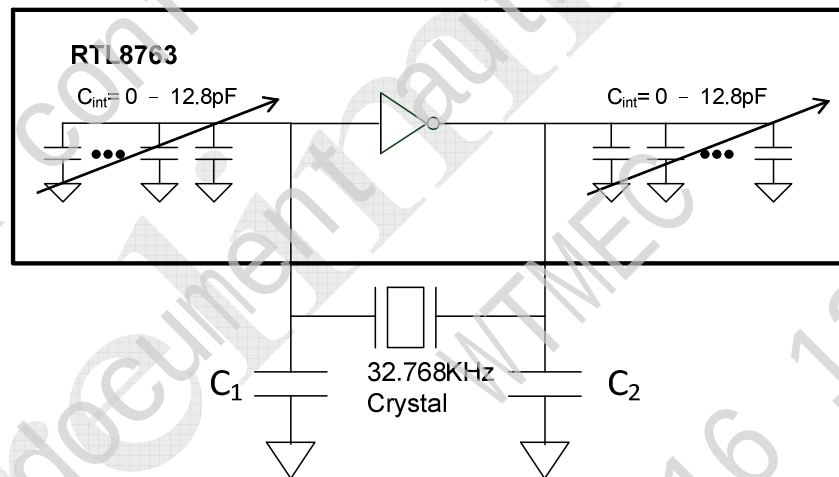


Figure 16. 32MHz Crystal Specification Suggestion

Example:

For a crystal with specification $C_L=7\text{pF}$

$C_L = [(C_A \times C_B) / (C_A + C_B)] + C_{\text{parasitic}}$, the parasitic capacitor $C_{\text{parasitic}}$ can be observed on the PCB trace and IC SMT soldering pad....etc.

$$C_A = C1 + C_{\text{int}}$$

$$C_B = C2 + C_{\text{int}}$$

9.4. DSP

The RTL86xx IC platform incorporates a Tensilica Hi-Fi DSP core to enable high-performance signal processing functions for Bluetooth audio/voice data streaming. With customized powerful instructions designed in the DSP, Figure 17 illustrates the DSP architecture and interfaces with other hardware functional blocks.

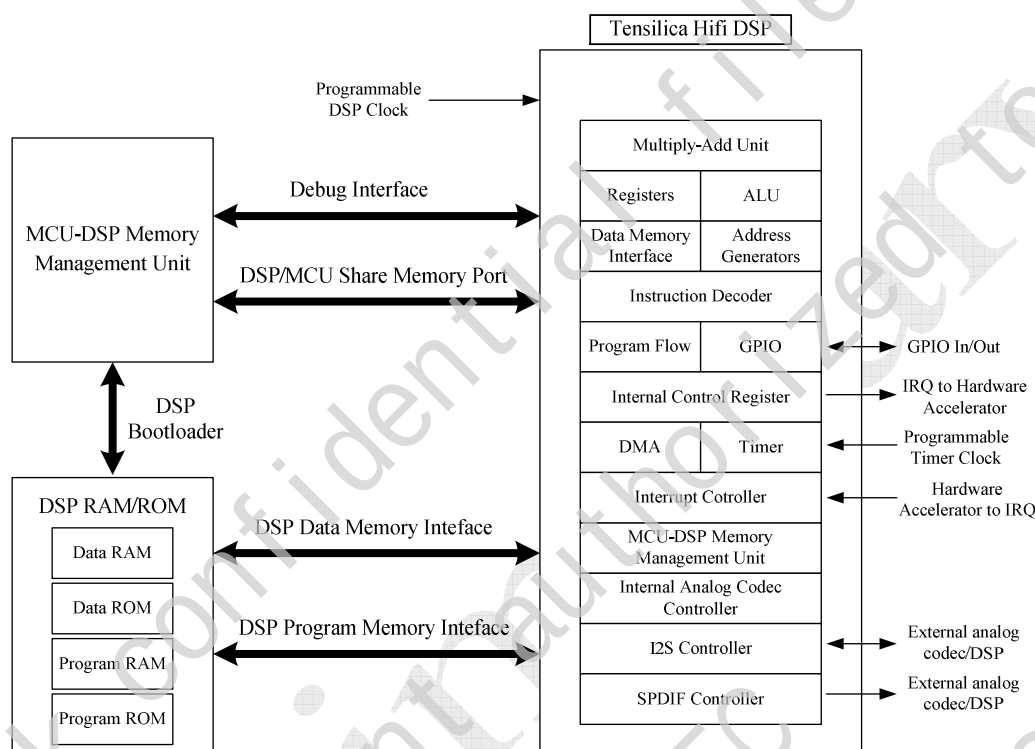


Figure 17. DSP Interfaces in RTL86xx IC Platform

Key features of this DSP core include:

- 160 MHz clock, providing up to 160 MIPS computation power.
- Dual-issue VLIW architecture
- 32-bit ALU fixed-point DSP core
- Single-cycle flexible multiply-and-add (MAC) supporting capability:
 - Dual 24x24-bit MAC units with 56-bit accumulator
 - Single 32x16-bit MAC unit with 56-bit accumulator
- Variable-length (8/16/32/64-bit) data memory fetch
- Zero overhead looping
- Zero overhead circular buffering indexing
- Single cycle barrel shifter supporting up to 56-bit operation.
- Multi-cycle 32-bit divide
- Low overhead interrupt

9.5. Audio CODEC: DAC

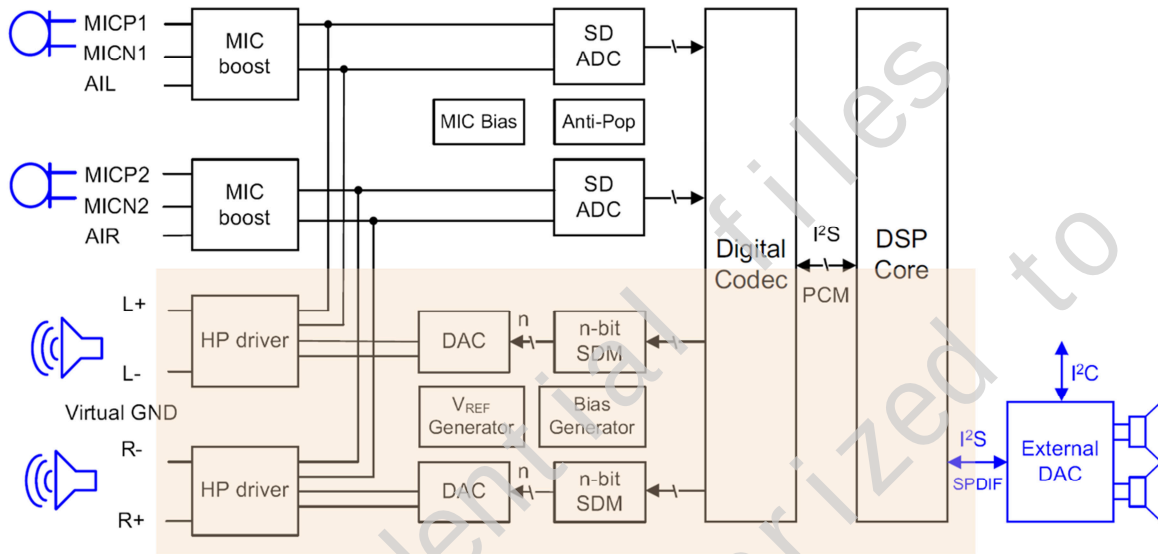


Figure 18. Codec and DAC Block Diagram

The RTL8763B supports three types of analog audio output format

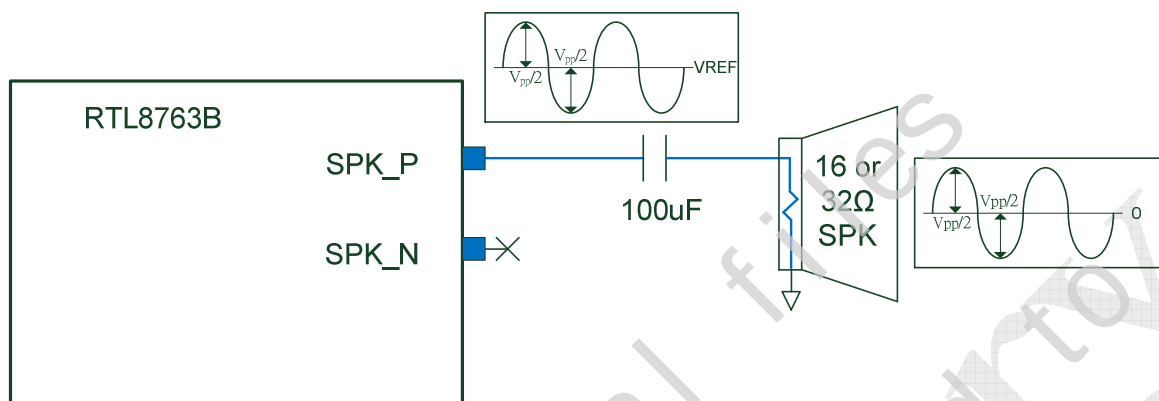
- Single-ended output
- Cap-less output
- Differential output

9.5.1. Single-Ended Output

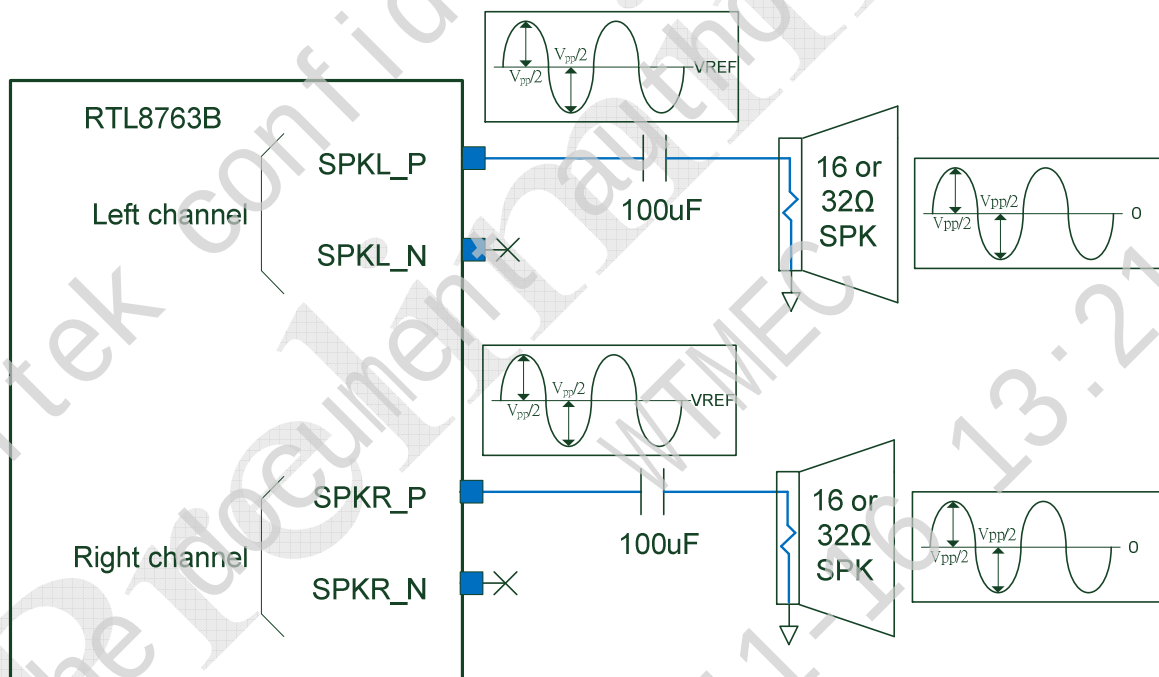
In single-ended output mode, only SPK_P drives the audio signal and bias on VREF DC level. An external 100 μ F capacitor is needed to do DC decoupling. The DC voltage must be eliminated as:

- DC voltage will create a large DC current on the speaker unit, which is designed for 16 or 32ohm, and result in power consumption issues.
- The large DC current will result in heat issues on the speaker unit and possible burn out.

The 100 μ F cap can be adjusted according to end product requirements.

RTL8763B MONO

Figure 19. RTL8763B MONO
RTL8763B STEREO

Crosstalk isolation between Right channel and Left channel should be below -80dB


Figure 20. RTL8763B STEREO

9.5.2. Cap-Less Output

In cap-less mode, SPK_P drives the audio signal and bias on the VREF DC level. SPK_N drives a bias VREF DC signal. Both SPK_P and SPK_N are connected to the speaker unit 'PLUS' and 'MINUS' nodes respectively. The DC signal can be cancelled without the need for a DC decoupling capacitor. The low frequency response is not degraded because there is no decoupling DC on the PCB path; hence the low frequency response is not changed.

The advantage: save one or two big capacitors in the BOM, save PCB design area and good audio low frequency response. The main application is for audio products, mono headset, and stereo headset.

RTL8763B MONO

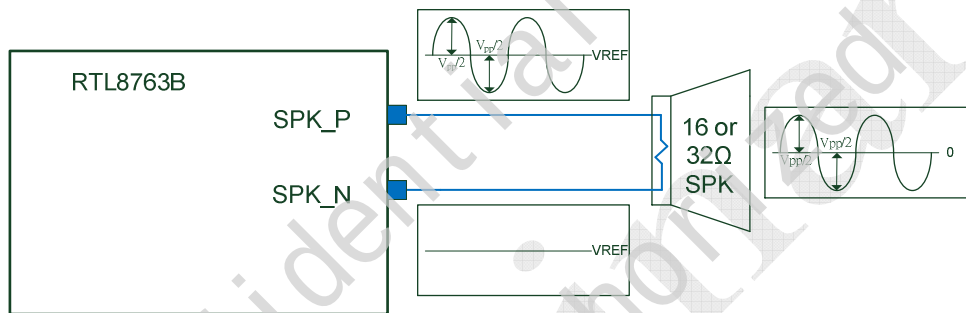


Figure 21. RTL8763B MONO

RTL8763B STEREO

Crosstalk isolation between Right channel and Left channel is lessened; approximately -50dB ~ -60dB only.

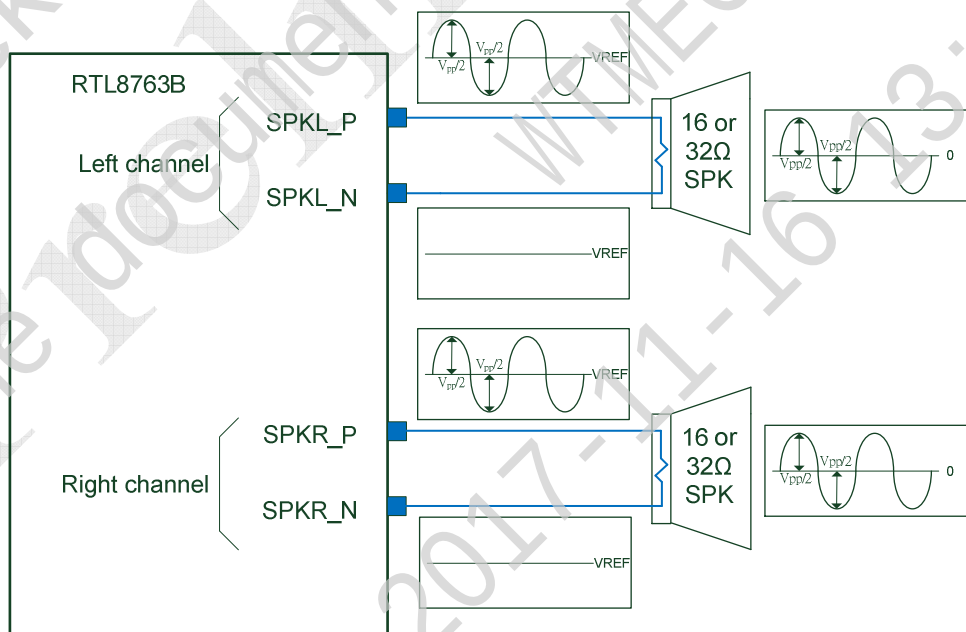


Figure 22. RTL8763B STEREO

9.5.3. Differential Output

In differential mode, both SPK_P and SPK_N drive the audio signal and bias on VREF DC level. SPK_P and SPK_N are in one differential pair and drive a signal with 180° difference (reverse). The anti-interference performance is best when the signals are routed on the PCB. Both SPK_P and SPK_N are connected to speaker unit 'PLUS' and 'MINUS' node respectively. The DC signal can be cancelled without the need for a DC decoupling capacitor, and the signal swing (peak to peak V_{pp}) on the speaker unit will be doubled.

The low frequency response is not degraded as there is no decoupling capacitor on the path, hence the low frequency response is not changed. The advantage: save one or two big capacitors in the BOM, save PCB design area, good audio low frequency response, good anti-interference performance, and good crosstalk isolation between Right and Left channels. The solution is especially good for headband headset, and neckband headset.

RTL8763B MONO

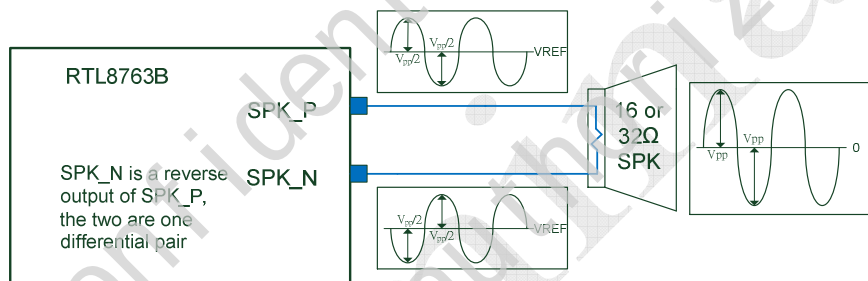


Figure 23. RTL8763B MONO

RTL8763B STEREO

Crosstalk isolation between Right channel and Left channel should be below -80dB

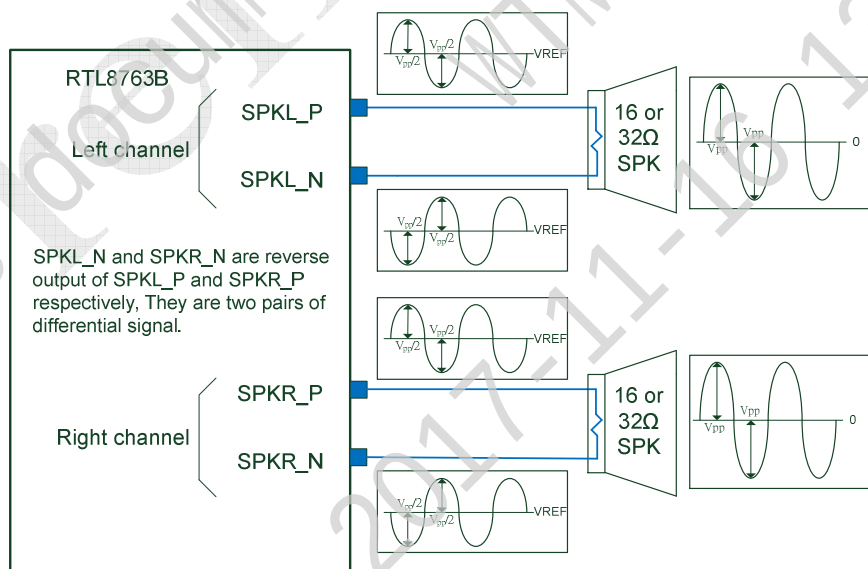


Figure 24. RTL8763B STEREO

9.6. Audio CODEC: ADC

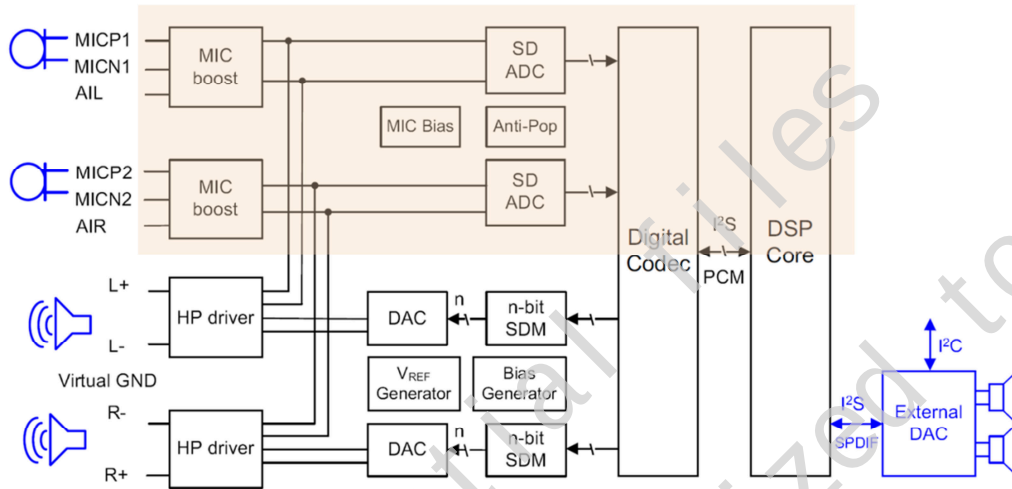


Figure 25. Codec and ADC Block Diagram

The RTL8763B supports dual analog microphones, MIC2 and MIC1. MIC1 is treated as main microphone always, and MIC2 as the 2nd auxiliary in dual microphone applications. If MIC2 is not used, it can be configured as analog line input (AUX IN).

	1-MIC Application	2-MIC Application	Note
Main MIC	MIC1	MIC1	-
2 nd MIC	-	MIC2	-
Audio line in (AUX IN)	MIC2	-	-

Microphone Application with Biasing

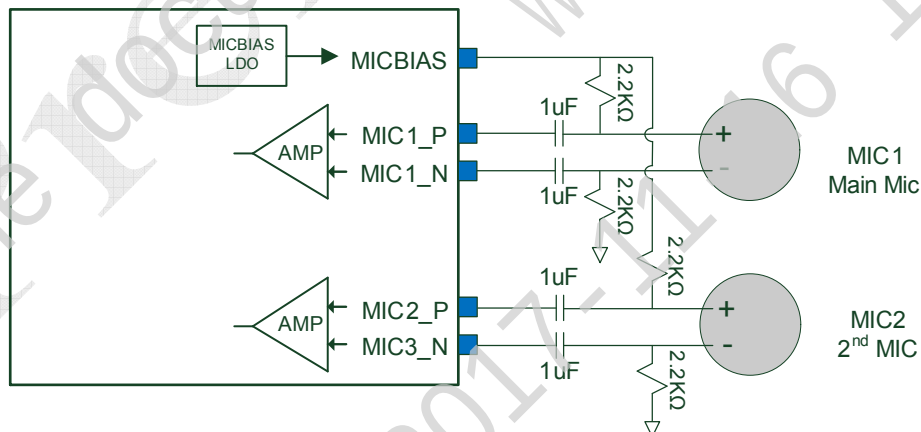


Figure 26. RTL8763B Dual Microphone Reference

Note: UI configuration to enable MIC1 and MIC2 function; DSP configuration to set the AMP gain.

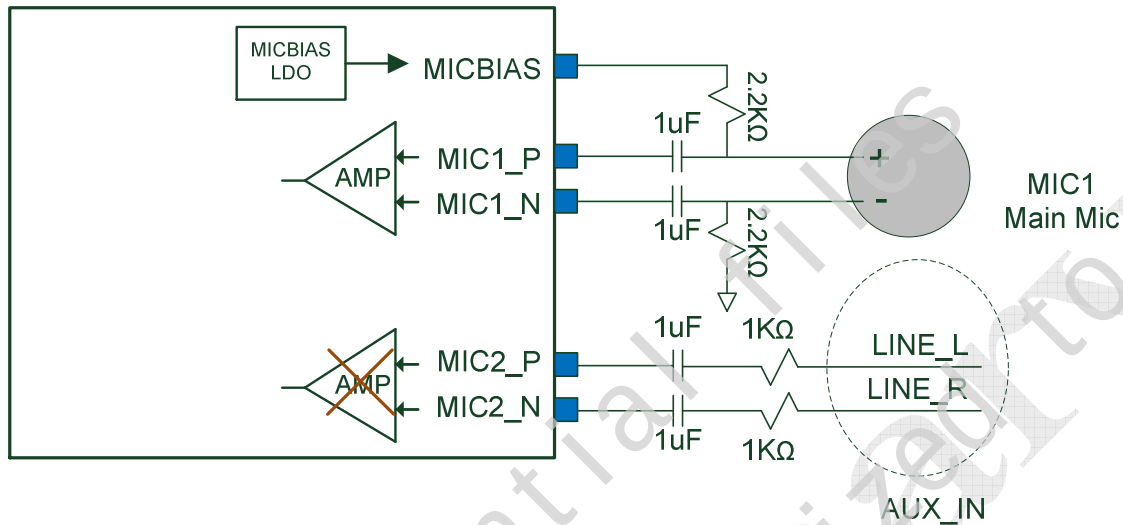
RTL8763B One Microphone and One AUX-IN


Figure 27. RTL8763B One Microphone and One AUX-IN Reference

Note: UI configuration to enable MIC1 and AUX_IN function; DSP configuration to set the AMP gain.

9.7. Audio Digital Microphone

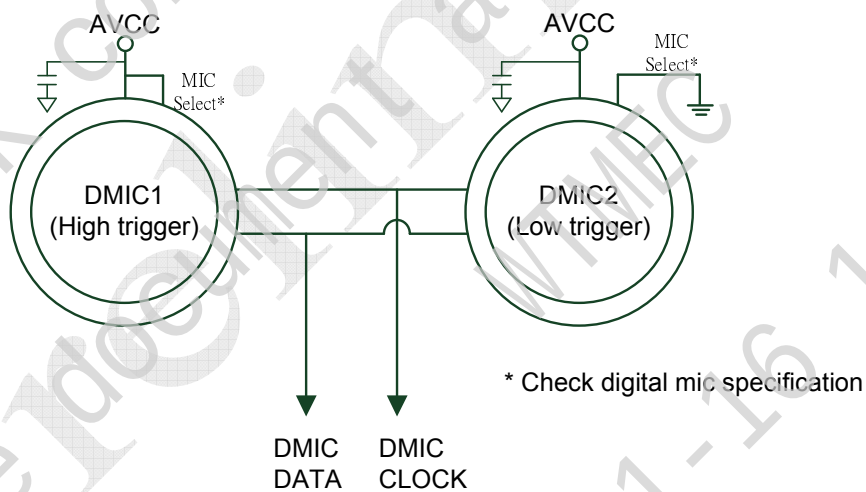
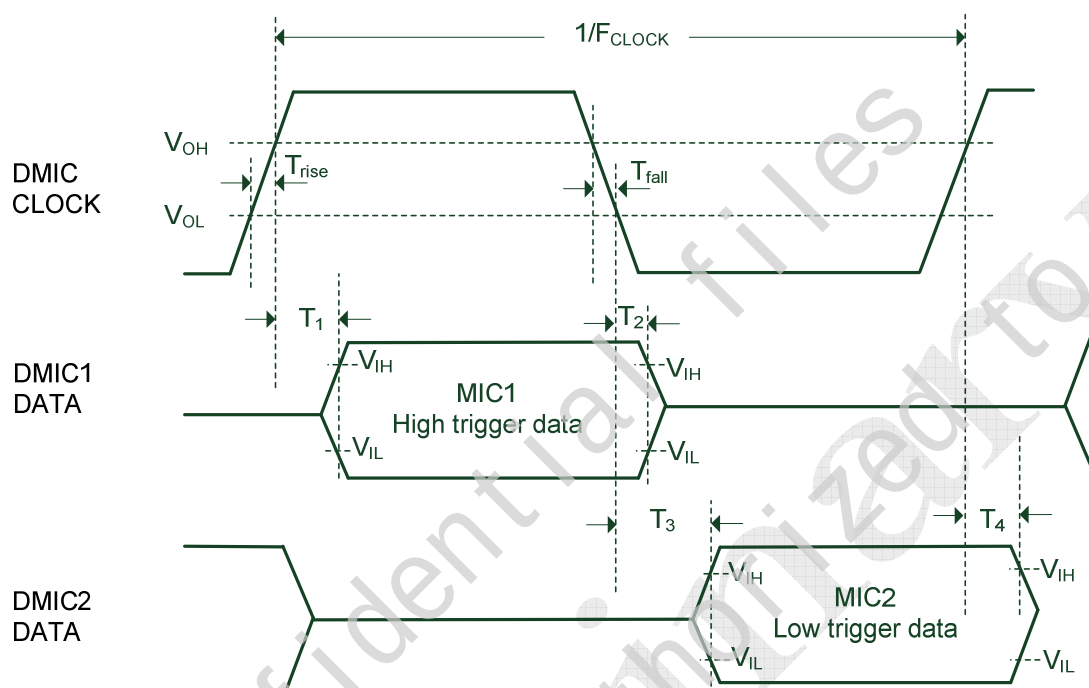


Figure 28. Audio Digital Microphone

Audio Digital Microphone Timing Diagram

Figure 29. Audio Digital Microphone Timing Diagram
Table 12. Audio Digital Microphone Timing

	Min.	Typ.	Max.	Note
F_{CLOCK}	312.5kHz	2.5MHz	5MHz	Supports five clock rates, 312.5K, 625K, 1.25M, 2.5M, 5M
Clock Duty	40%		60%	-
T_{rise}	5		20	-
T_{fall}	5		20	-
T1 (ns)	8	15	100	-
T2 (ns)	8	15	100	-
T3 (ns)	8	15	100	-
T4 (ns)	8	15	100	-

9.8. PCM I2S

The RTL8763B supports two PCM/I2S digital audio output interfaces. The sampling rate can be from 8kHz to 192kHz to support middle quality and high quality I2S DAC. A MCLK for external DSP chip as main clock is also available from the RTL8763 PLL, and can be enabled from the I/O MUX table in the UI tool. The MCLK can be programmed as $128 \times \text{BCLK}$ or $256 \times \text{BCLK}$ depending on the DSP specification, and with the I2C controller interface it provides a complete I2S control interface.

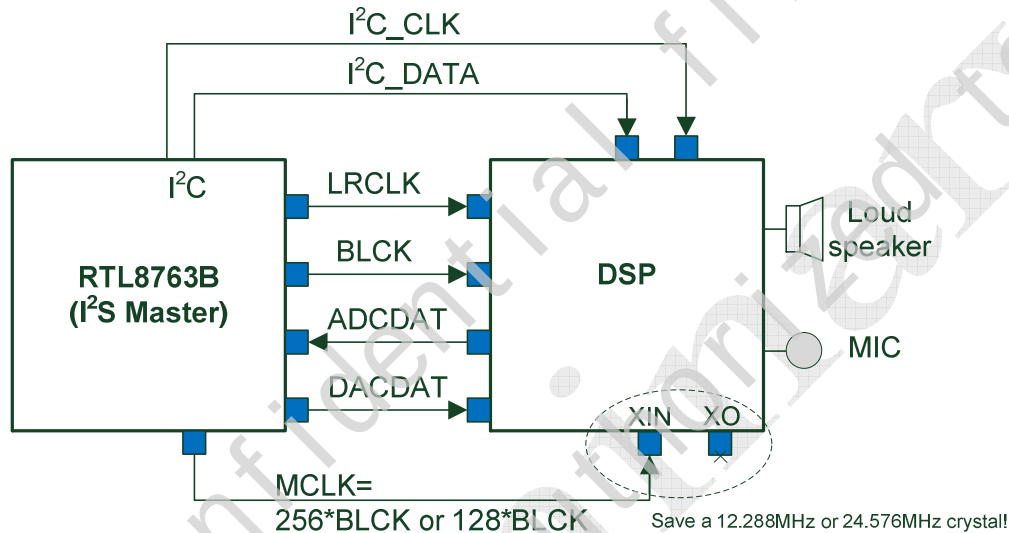


Figure 30. I2S Connection; RTL8763B in Master Mode

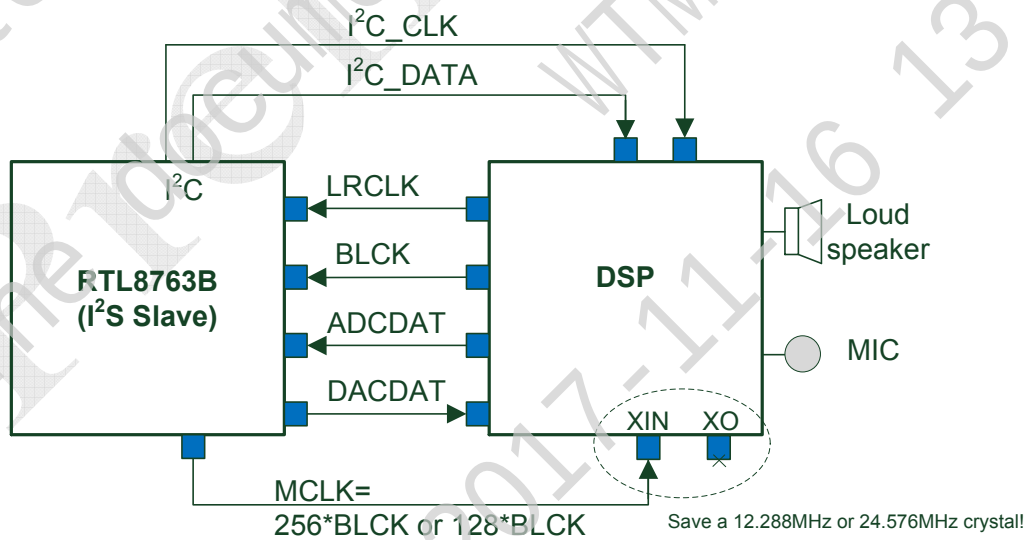


Figure 31. I2S Connection; RTL8763B in Slave Mode

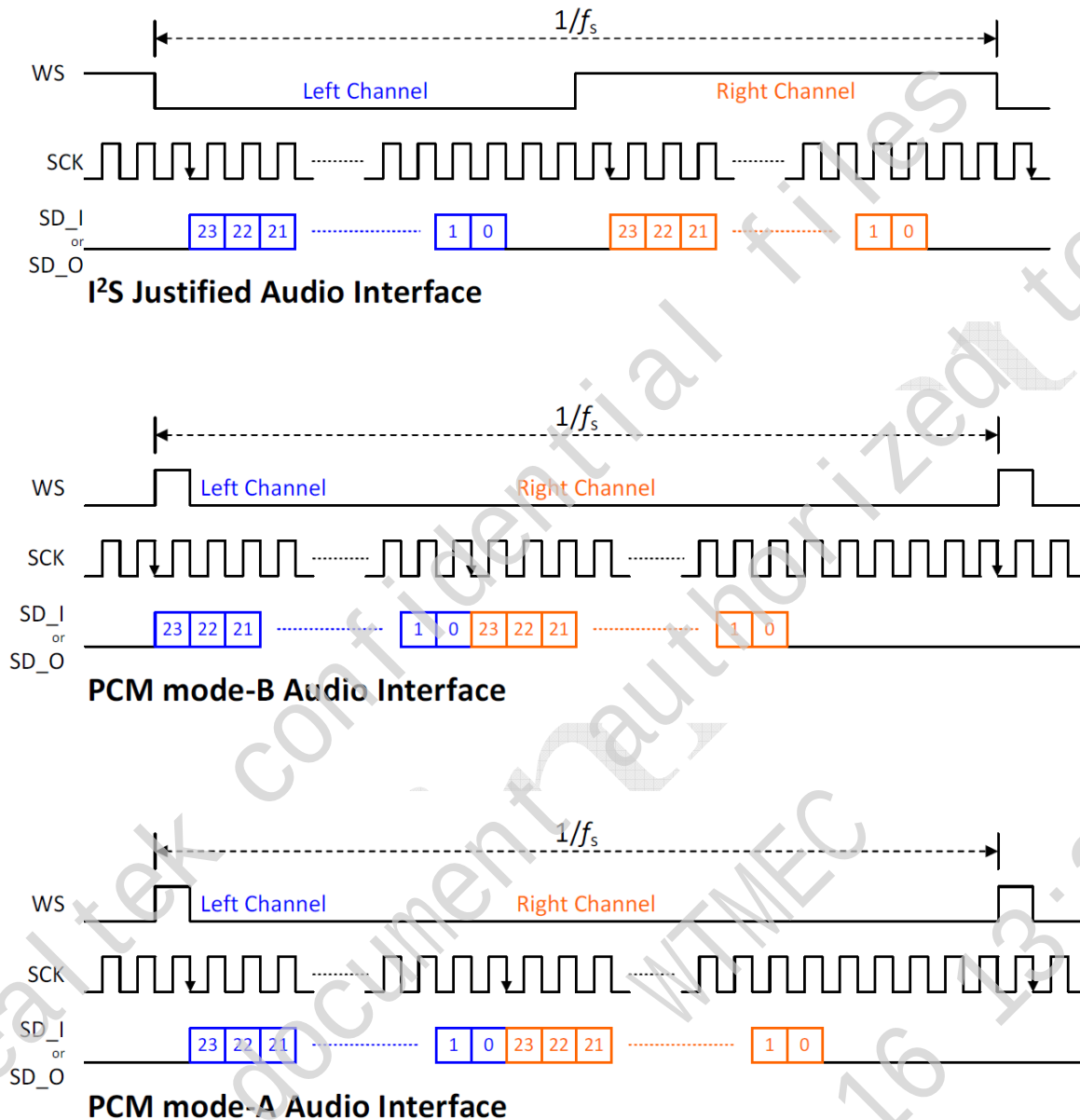
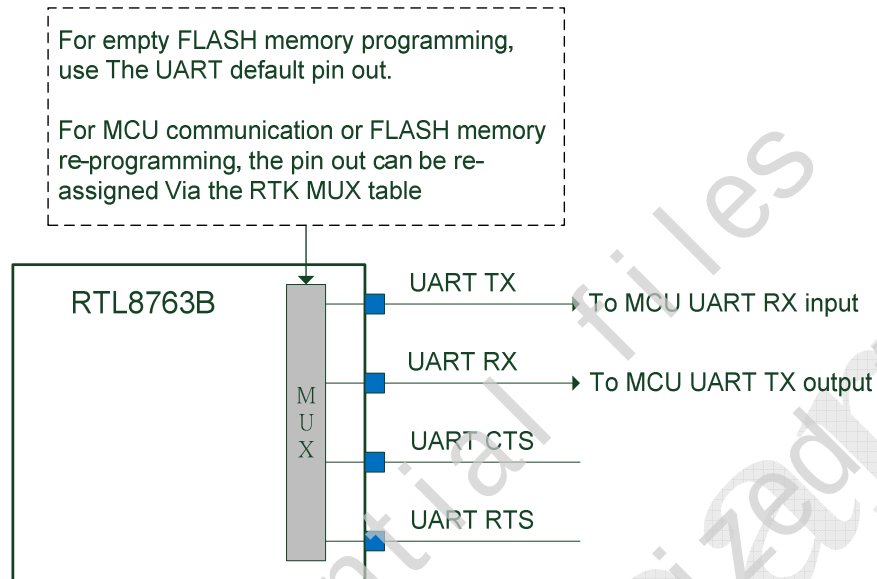
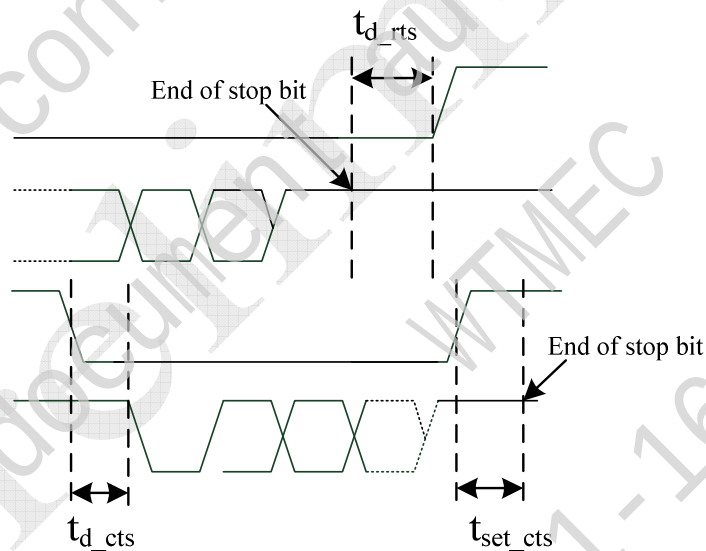


Figure 32. Timing Diagram-3

Note: 'SCK' may to be inverted at any time if required.

9.9. UART Interface

The RTL8763B supports a UART interface for FLASH memory parameter programming, and UART commands for MCU application. For the UART command application, refer to the 'Realtek UART command set' document.


Figure 33. UART Interface

Figure 34. UART Interface Timing Diagram
Table 13. UART Timing Characteristics

Parameter	Symbol	Min	Typical	Max
Timing between RX Stop bit and RTS go high when RX FIFO is full (symbol time)	t_{d_rts}	-	-	0.5
Timing between CTS go low and device send first bit (ns)	t_{d_cts}	-	-	25

Parameter	Symbol	Min	Typical	Max
Timing between CTS go high and TX send stop bit (ns)	$t_{\text{set_cts}}$	75	-	-

Table 14. UART Data Error Rate Estimation Based On Various Baud Rates

UART Classification	Baud rate	Error
-	1200	0.08%
-	9600	0.08%
-	14400	0.08%
-	19200	0.4%
-	28800	0.28%
-	38400	0.15%
-	57600	0.02%
-	76800	0.01%
Default Rate	115200	0.08%
-	128000	0
-	153600	0.22%
-	230400	0.08%
-	460800	0.11%
-	500000	0
-	921600	0.11%
-	1000000	0
-	1843200	0.14%
-	2000000	0
-	3000000	0.3%
Maximum Rate	4000000	0

9.10. I2C Interface

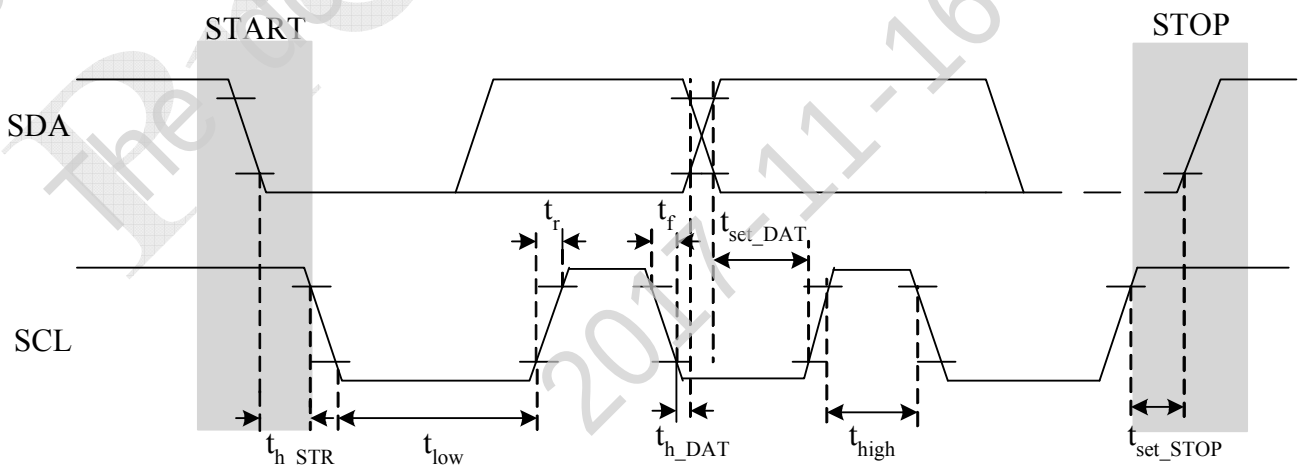


Figure 35. I2C Interface Timing Diagram
Table 15. I2C Timing Characteristics

Parameter	Symbol	Min	Typical	Max
SCL clock frequency (kHz)	-	-	-	400
High period of SCL (ns)	t_{high}	600	-	-
Low period of SCL (ns)	t_{low}	1300	-	-
Hold time of START (ns)	t_{h_STR}	600	-	-
Hold time of DATA (ns)	t_{h_DAT}	0	-	-
Setup time of STOP (ns)	t_{set_STOP}	600	-	-
Setup time of DATA (ns)	t_{set_DAT}	100	-	-
Rise time of SCL and SDA (ns) (with 4.7k ohm resistor pulled high)	t_r	See note	-	-
Fall time of SCA and SDA (ns)	t_f	See note	-	-

Note: Depends on the external bus pull up resistor.

9.11. SPI Interface

The RTL8763B supports industrial SPI (Serial Peripheral Interface), in both master and slave mode.

The SPI function can be enabled using the I/O MUX settings in the UI tool. Refer to the MUX function table in the I/O MUX section (page 52).

9.12. NFC

NFC (Near Field Communication) is a technology to simplify the establishment of a Bluetooth link between a Bluetooth host and a Bluetooth device. This is often used in smartphone applications with a smartphone APP.

The RTL8763B supports the NFC feature to power on the whole system and connect with smart phone automatically by touching the two devices together.

The NFC application circuit in the RTL8763B reference circuit is very simple and cost effective with minimum BOM required. In mass production flow, an MP tool also supports an easy way to synchronize the BD ADDR in the NFC tag with the memory in the RTL8763B.

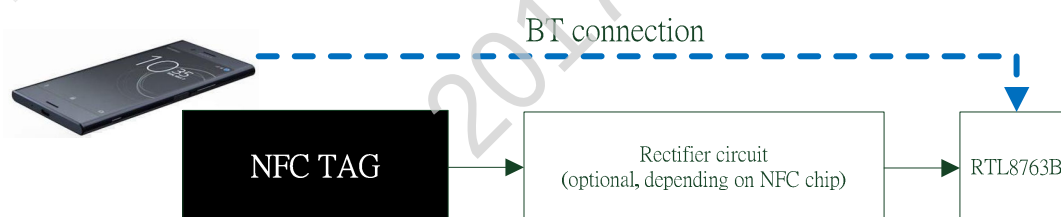


Figure 36. Near Field Communication

9.13. USB Interface

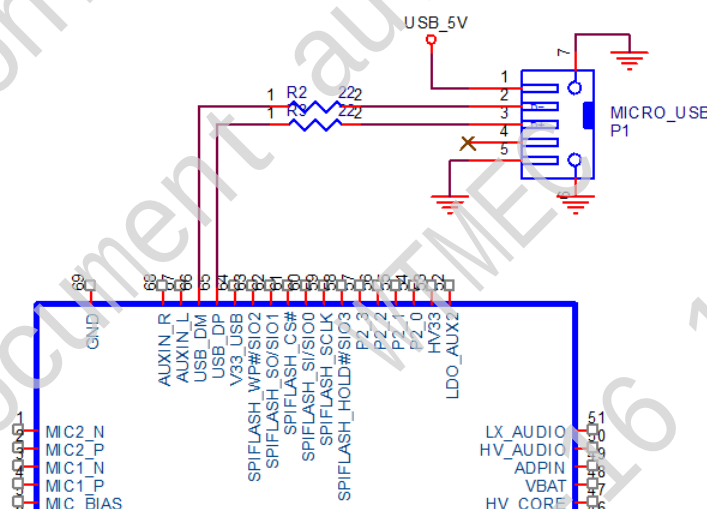
The RTL8763BA supports a USB2.0 full speed interface and the USB BC1.2 USB charger specification.

The USB ports on personal computers, laptop PCs, and USB adapters are convenient for portable devices to draw current for the audio device to charge the battery. When a device attaches to the USB ports, the USB2.0 specification requires that after connecting a device must draw current less than:

- 2.5mA average if the USB bus is suspended
- 100mA if the bus is not suspended and not configured
- 500mA if the bus is not suspended and configured for 500mA
- Support USB charger with a DCP, such as wall adapter or car power adapter

The RTL8763BA follows the USB2.0 and USB BC1.2 specification to draw the charging current from the USB ports and adjust the current under different USB port states accordingly.

The USB port also supports a FLASH memory parameter update process; refer to MP tool guidelines.


Figure 37. USB Interface

9.14. S/PDIF Interface

The RTL8763B supports S/PDIF (SONY/PHILIPS Digital Interface) output; the purpose is to transfer digital audio data among digital devices with minimum loss.

Bluetooth Speaker Application

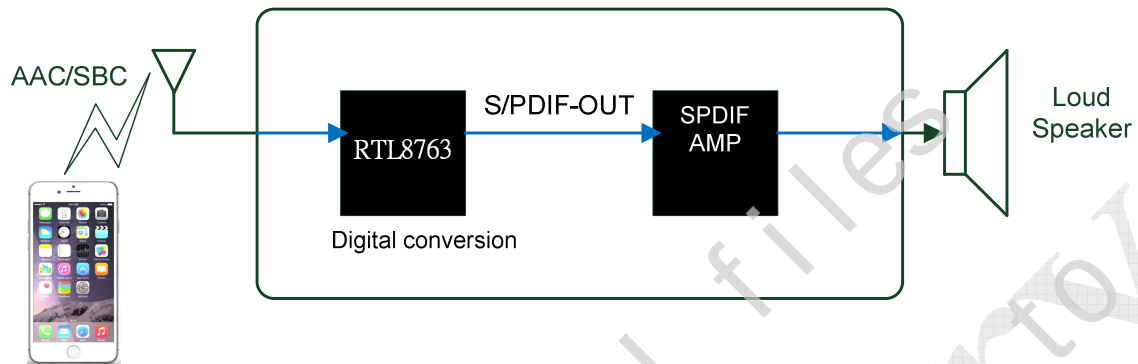


Figure 38. Bluetooth Speaker Application

Bluetooth Audio Receiver Application

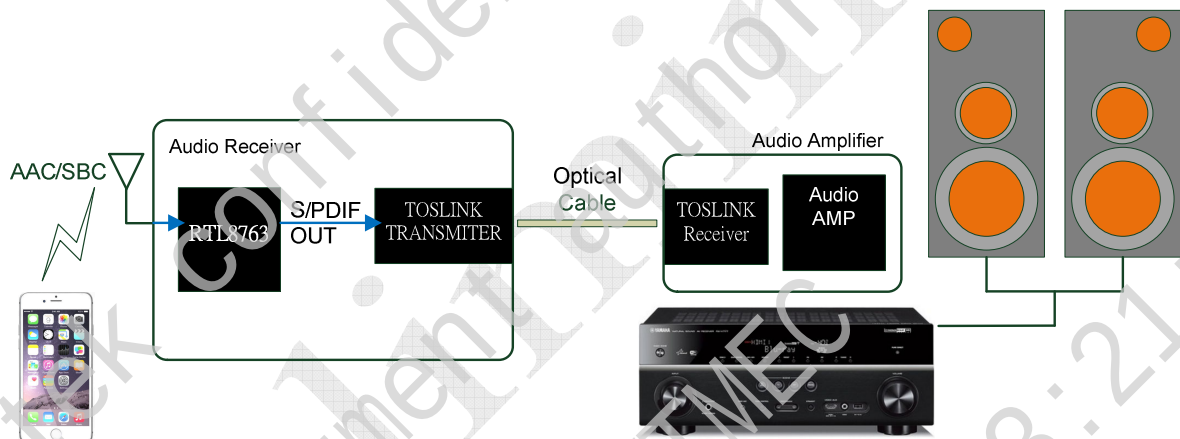


Figure 39. Bluetooth Audio Receiver Application

9.15. Auxiliary ADC Interface

The RTL8763B supports high quality ADC input, designed-in 12-bit, and can be multiplexed with the digital GPIO function. The allowable input swing is from 0V to min (VDDIO, 3V) in normal mode.

The allowable input swing is from 0V to 1 in bypass mode.

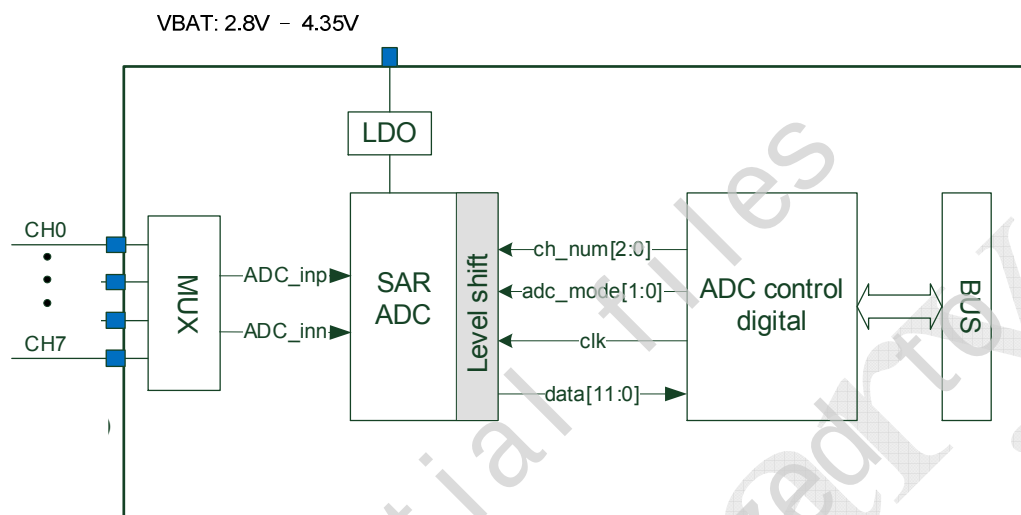


Figure 40. Auxiliary ADC Interface Application

9.16. BT Wi-Fi Co-Existence (PTA)

The RTL8763B supports a BT/Wi-Fi co-existence scheme, PTA (Packet Traffic Arbiter)

PTA is a handshake algorithm between Wi-Fi and Bluetooth in a Wi-Fi and Bluetooth co-existence system.

PTA is used to control the priority of the Wi-Fi and Bluetooth traffic by accessing a 3-wire MAILBOX block to avoid packet collisions in the same shared 2.4GHz ISM frequency band.

The PTA and mailbox signals can be defined via the PIN MUX table in the UI tool.

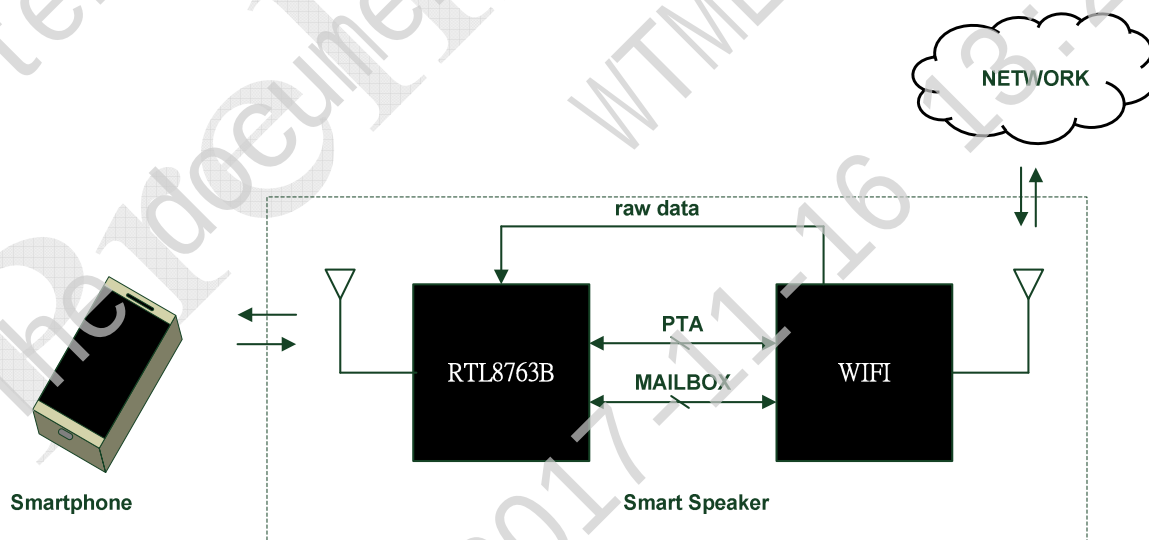


Figure 41. BT Wi-Fi Co-Existence (PTA)

PTA and MAILBOX connection

3-wire MAILBOX	I2C_SCL
	I2C_INIT
	I2C_SDA
PTA	BT_CK
	BT_ACT
	BT_WLAN_ACT
	BT_STE

9.17. PWM Interface

The RTL8763B supports up to six PWM signals. (* when applied for different user scenario, some more timers will be occupied, e.g. RWS, push button, AUX-IN detection and buzzer...etc.)

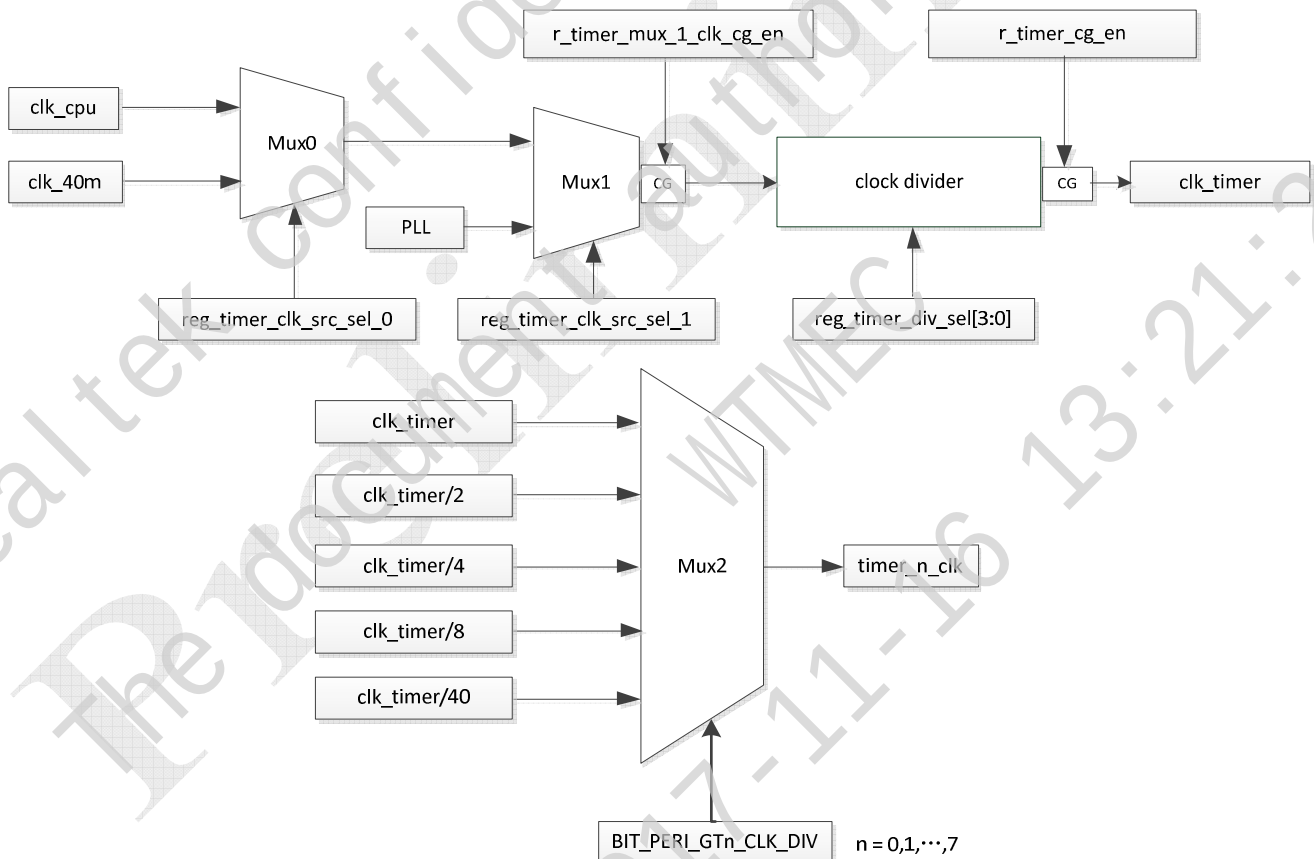


Figure 42. PWM Interface

PWM Output Setting

The PWM module is controlled by register [ControlReg] [3].

When [ControlReg] [3] = 1, PWM is enabled and the PWM waveform is derived by controlling [LoadCount] and [LoadCount2] registers and deciding the level high and level low time interval:

PWM level high timer = (TimerNLoadCount2 + 1) * timer_N_clk clock period

PWM level low timer = (TimerNLoadCount + 1) * timer_N_clk clock period

After the PWM timer is enabled, the register [LoadCount]和[LoadCount2] is loaded periodically. PWM outputs low level during the time interval before LoadCount is decreased to zero; PWM outputs high level during the time interval before LoadCount2 is decreased to zero.

When [ControlReg] [3] = 0, PWM is disabled, the timer toggle still outputs; the output high and low timer is the same, e.g. (LoadCount + 1) * timer_N_clk clock period.

PWM Complementary Output Setting

Only Timer2 and timer3 support PWM complementary output mode.

Taking timer2 as an example, by setting register [PWM_CR2][12] and [PWM_CR3][12] to enable PWM complementary output and dead zone setting.

When complementary output mode is enabled but not set in the dead zone, PWM_2P will be the same as PWM2, while PWM2_N will be the reverse of PWM2.

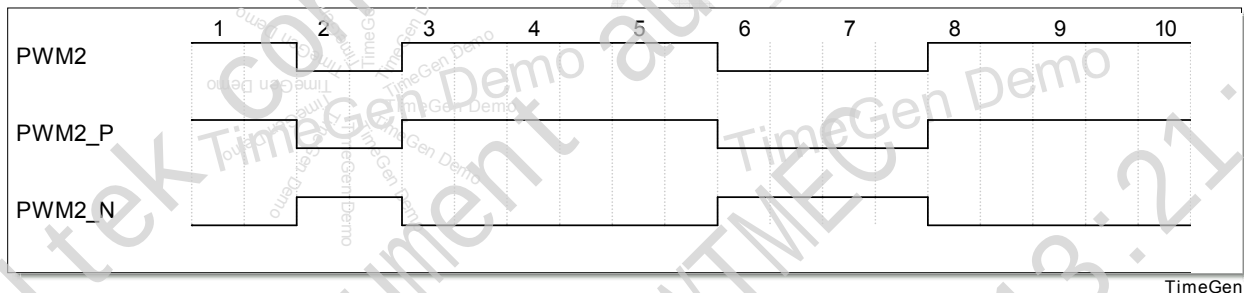


Figure 43. Complementary Output Mode Enabled But Not Set in the Dead Zone

The maximum setting of the dead zone is 256/32000 or 256/32768 according to the source of the low power clock (internal or external 32K clock source).

When the dead zone is set, the level high output of PWM2_P and PWM2_N contain a time delay

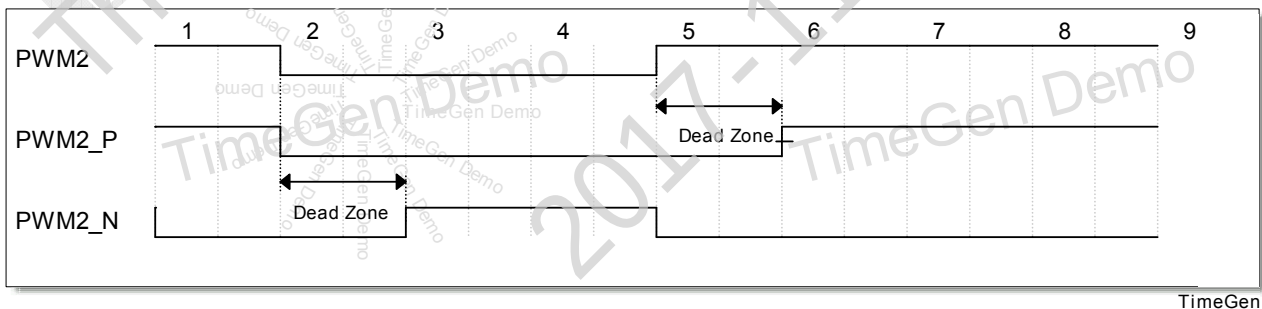
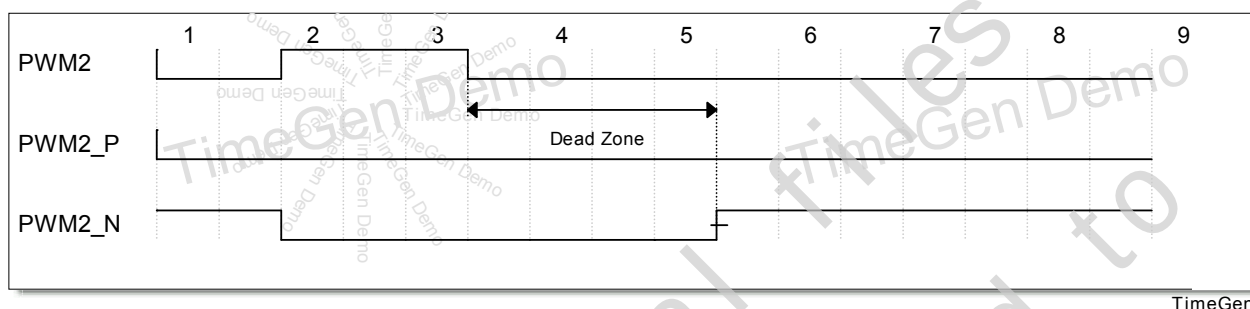
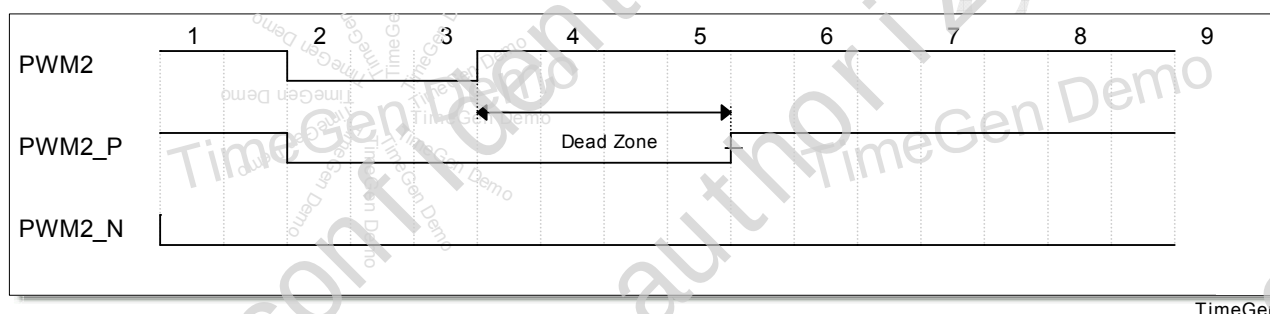


Figure 44. Maximum Setting of Dead Zone

When the dead zone is longer than the PWM high level timer, PWM_P will always be low.


Figure 45. Dead Zone Is Longer Than PWM High Level Timer

When the dead zone is longer than the PWM low level timer, PWM_N will always be low.


Figure 46. Dead Zone Is Longer Than PWM Low Level Timer

9.18. Memory Management

The memory management unit manages the data buffer between the MCU and DSP.

- System RAM: 128KB MCU RAM and 16KB cache RAM
- DSP RAM: 176KB DSP RAM
- ROM: 768KB ROM
- Serial FLASH support: The RTL8763B supports internal or external serial FLASH interface for IC to storage UI, DSP parameter, voice prompt and ROM code fix setting

The external flash control interface supports 1-bit or 4-bit mode depending on the silicon package.

- RTL8763BF/BFR and RTL8763BO: Internal FLASH memory, 4-bit mode
- RTL8763BA: 4-bit mode flash memory control interface
- RTL8763BM and RTL8763BS: 1-bit mode flash memory control interface

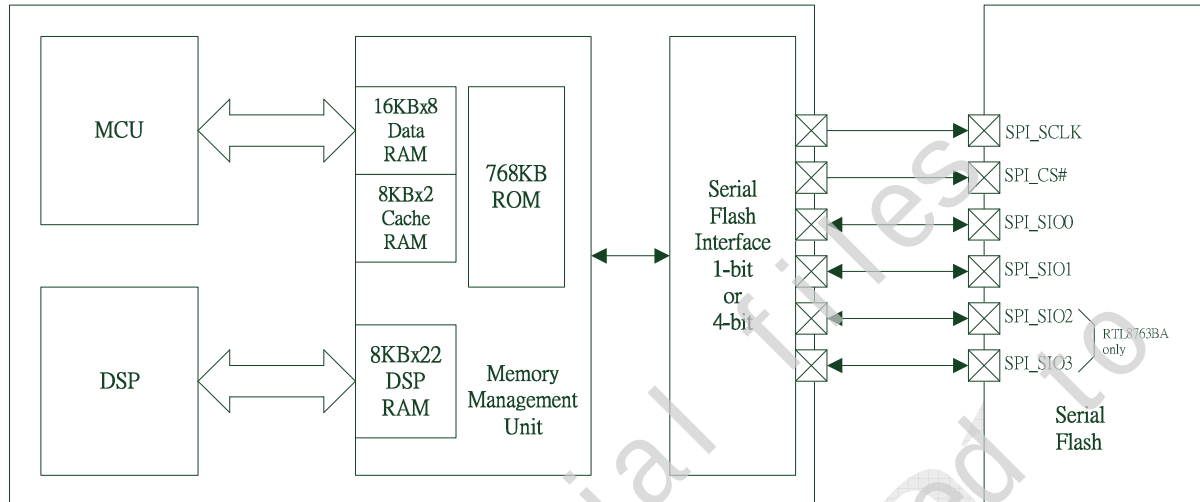


Figure 47. Memory Management

9.19. Serial FLASH Memory Interface

The RTL8763BF/BFR supports 8M-bits on chip serial FLASH memory. We encourage using this solution for sensitive PCB area designs.

The RTL8763BM, RTL8763BS, RTL8763BA do not support internal FLASH memory, but support a serial interface to connect to external serial FLASH memory for parameter and data storage purposes; for example, voice prompt, UI parameters....etc.

The RTL8763BM and RTL8763BS supports 1-bit and 2-bit mode. The RTL8763BA support 1-bit, 2-bit, and 4-bit modes.

The figures below show the connectivity of the serial FLASH memory.

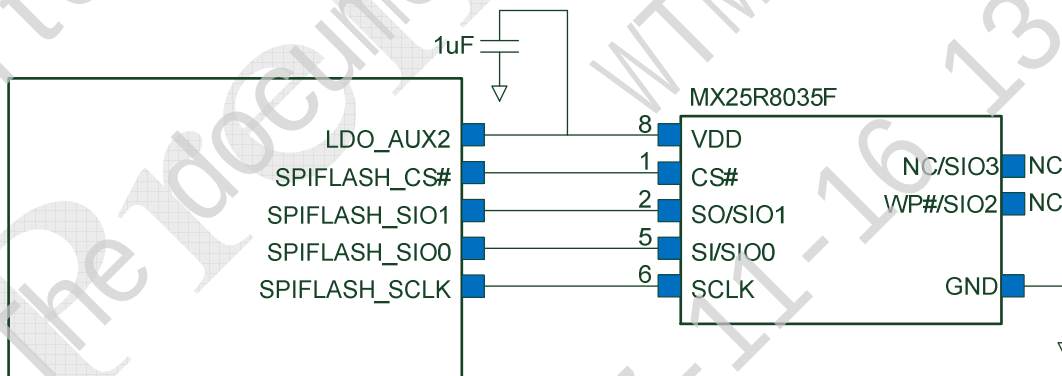


Figure 48. Serial FLASH Memory; 1 and 2-bit Mode

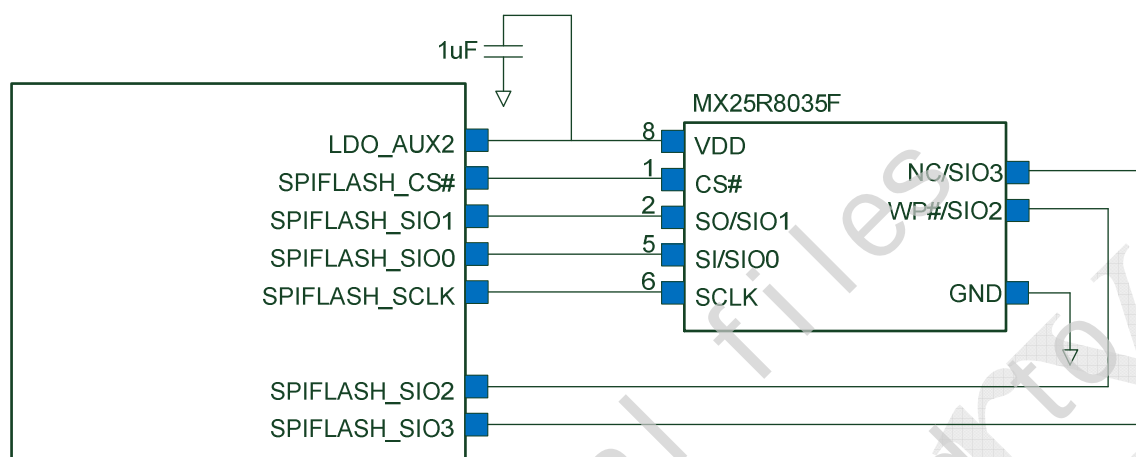


Figure 49. Serial FLASH Memory; 4-bit Mode

9.20. Power Management Unit - Switch Mode Regulator

The RTL8763B series (except for the RTL8763BM) support dual switch mode regulator with planned external components, the inductor can be as small as 2.2 μ H with capacitor 2.2 μ F, which is ideal to design into small PCB applications, for example, wearable devices, earbud headsets, RWS headsets...etc.

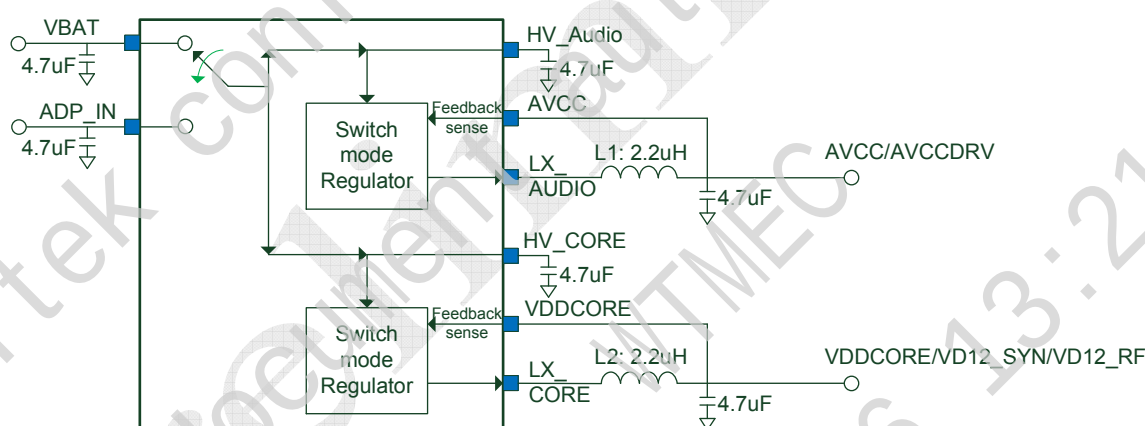


Figure 50. Power Management Unit - Switch Mode Regulator

The 2.2 μ H inductor is recommended to be a wire-wound inductor. This has a small DCR (around 0.5 Ω) for good switching efficiency and good saturation current to guarantee the inductance is enough under normal operation.

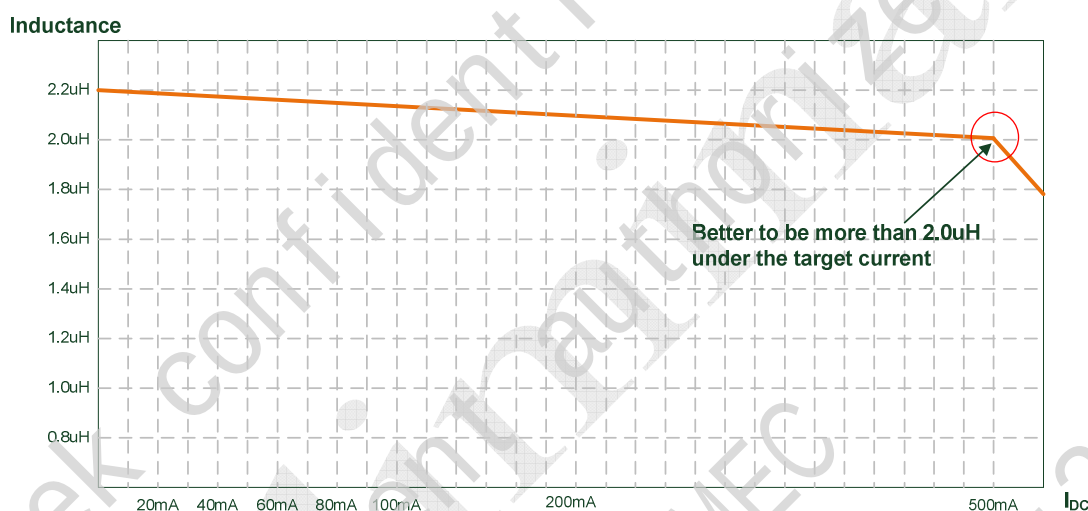
For both L1 and L2, the suggested specification is:

- IDC > 500mA
- DCR < 0.6 Ω
- Wire-wound type

IDC is defined as saturation current, which is further defined as a current that will cause the inductance to be 20% degraded. This is quite different from the Irms or rated current, generally defined in inductor specifications as a current that causes an increase in inductor temperature of 20°C, e.g. 20°C → 40°C. The Irms number or rated current defined in the inductor datasheet may not be the logical buck inductor selection; so always ask the inductor vendor to provide the IDC current vs. inductance curve. The following figures show two examples

Table 16. Inductor Selection

MANUFACTURER	PART	VALUE (μH)	DCR ($\text{m}\Omega$)	I_{SAT} (mA)	Dimension (mm^3)
ZENITHTEK	ZADK-252012SB-2R2M	2.2	93	1800	2.5 x 2 x 1.2
ZENITHTEK	ZWP-0603-2R2K	2.2	560	600	1.2 x 1.8 x 1
TAIYO	NRH3010T2R2MNV	2.2	83	1300	3 x 3 x 1


Figure 51. Inductor Selection

- The capacitor 4.7 μF specification should be X5R or above in order to ensure the ripple of the buck output power is small for good RF and audio characteristics
- The specification of the capacitor 4.7 μF at VBAT and ADP_IN should be X5R or above
- The routing trace of LX_AUDIO and LX_CORE on PCB should be short, and as wide as possible. The 2.2 μH inductor and 4.7 μF capacitor should be close to the chip

Power Management Unit - Low Drop Linear Regulator

The RTL8763B supports the low drop linear regulators listed below:

LDO AUX1

Output with one capacitor 1 μF ; suggested to be X5R or above.

LDO AUX1 LQ

Shares the same pin of LDO AUX1 as pin out.

LDO AUX2

Output with one capacitor 1 μ F; suggested to be X5R or above.

MICBIAS LDO

No need to add output capacitor. The output is adjustable according to the MEMs MIC specification.

LDO VPA33

Output with one capacitor 1 μ F; suggested to be X5R or above.

The switch mode regulator can be programmed as a low drop linear regulator to eliminate the 2.2 μ H inductor if current consumption is not a concern.

9.21. Battery Charger

The RTL8763B supports an integrated charger for Li-Ion battery application.

The supported charger current can be programmed in the UI tool; maximum is 400mA with thermal protection.

Table 17. Charger Mode Definition

Charger Mode	Battery Voltage	Charger Current	Note
Trickle charger mode	BAT < 3V	0.1C	-
Constant Current Mode (CC Mode)	3.0V $\leq$ BAT $\leq$ 4.2V or 4.35V	Customer defined; 400mA max.	Charger current is defined by customer with the UI tool. Customers should pay attention to the charger current setting with regard to their battery pack.
Constant Voltage Mode (CV Mode)	BAT = 4.2V or 4.35V	Controlled by MCU, the charger current slowly degrades from CC mode and stops at 0.1C	The CV mode voltage can be defined with the UI tool. Customers should set the CV mode voltage according to the Li-Ion battery specification. Do not set over specification.
Re-Charge Mode	BAT $\leq$ 4.0V	-	-

Trickle Charger Mode

If the battery voltage is below 3V, the charger will charge the battery with a low current of 0.1C. If the battery voltage does not rise up to 3.0V before time out, the charger will be in error and stop.

Constant Current Mode

If the battery voltage is over 3.0V, the charger will be in constant current mode until battery voltage reaches 4.2V.

The constant current is defined in the UI tool by customer product definition.

Constant Voltage Mode

If the battery voltage reaches 4.2V or 4.35V, the charger will go into constant voltage mode and the charge current will start to drop until reaching 0.1C. Note that the stop current can be defined in the UI tool by customer.

Re-Charge Mode

If the battery charge process is completed, the charger will stop charging the battery. If the adapter is not removed and battery voltage drops over a period of time, the charger will re-start the charging process with a 0.25C charge current.

*** Realtek verified the battery charger on Realtek EVB and branded Li-Ion batteries. Realtek confirm that the charger design is suitable based on this environment. The result may be changed due to different PCB layout, schematics design, rBOM, and battery package; customers should verify the battery charger function themselves in each design to assure the charger design correct for the application.*

Charge Curve

The figure below is a battery voltage vs. charger current curve across different charger modes.

The Li-Ion battery charger in the RTL8763B series is very flexible for customers using various Li-Ion batteries. It supports both 4.2V and 4.35V Li-Ion battery packs. The charge to full voltage can be programmed in the UI tool by the customer.

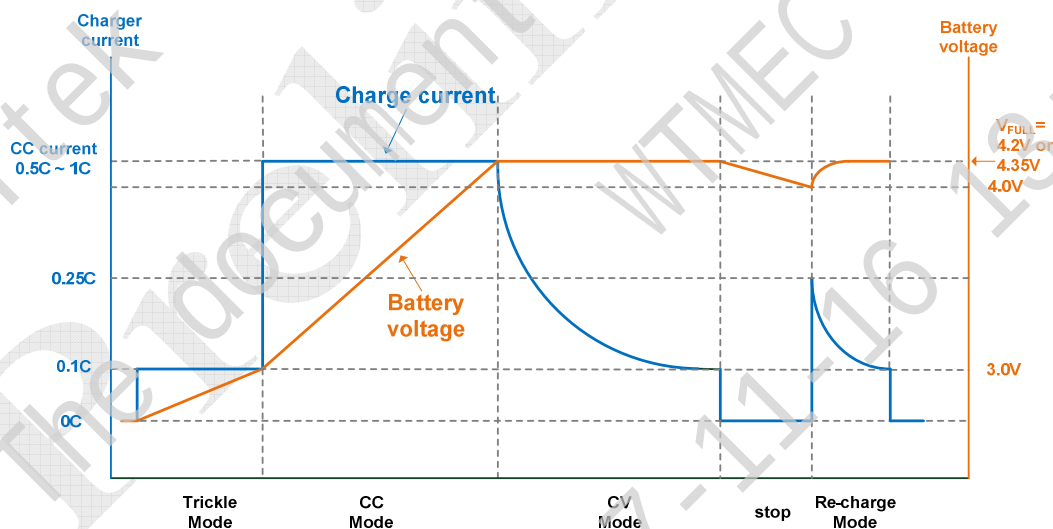


Figure 52. Battery Voltage vs. Charger Current Curve

Battery Charger Protection Scheme

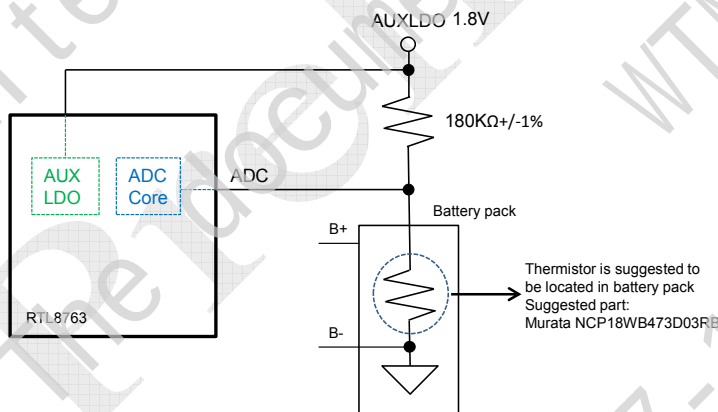
The RTL8763B monitors the safety of the charger process and integrates several protection schemes. If the battery is damaged or ageing after a long time of operation, the RTL8763 will implement the following protection:

- If the battery voltage does not rise to the target voltage in a defined time period, the battery will be judged as a dead battery and the charger will time out and then disable itself.
- Chip thermal detection will be implemented if the chip temperature rises up continuously and over the defined threshold. In such cases the charger current will be decreased or stopped.
- Watchdog protection; the system will be reset if the system hangs.
- Ambient detection design will monitor the battery temperature with an external thermistor close or attached to the battery pack.

**** Realtek verified the battery charger on Realtek EVB and branded Li-Ion batteries. Realtek confirm that the charger design is suitable based on this environment. The result may be changed due to different PCB layout, schematics design, rBOM, and battery package; customers should verify the battery charger function themselves in each design to assure the charger design correct for the application.**

Ambient Detection for Battery Charge Protection

The RTL8763B supports an excellent, high precision ambient detection algorithm design with the reference circuit below and with a specified external thermistor located in the battery pack. With this specified thermistor (QVL: Murata, part number: NCP18WB473D03RB or NCP18WB473F10RB), a detection temperature of 0~5°C and 40~45°C can be achieved within +/-2°C difference. When in charger mode, if the reading temperature of the battery pack is out of (0~45°C) range, the charger will stop until the temperature is back to this range again. The stop and re-start temperature can be programmed with the UI tool.



Continued from the preceding page.

Part Number	NCP18WB473D03RB	NCP18WB473D03RB	NCP18WB473D03RB	NCP18WB473D03RB
Resistance	33kΩ	47kΩ	47kΩ	47kΩ
B-Constant	4485K	4050K	4030K	4030K
Temp. (°C)	Resistance (kΩ)	Resistance (kΩ)	Resistance (kΩ)	Resistance (kΩ)
-40	1610.154	1690.586	1743.085	1743.085
-35	1130.850	1215.318	1241.814	1241.814
-30	802.609	882.908	896.201	896.201
-25	575.985	647.911	654.460	654.460
-20	416.464	480.069	483.172	483.172
-15	304.219	359.009	360.367	360.367
-10	224.193	270.868	271.363	271.363
-5	166.623	206.113	206.604	206.604
0	124.850	158.126	158.051	158.051
5	94.287	122.267	122.145	122.145
10	71.747	95.256	95.145	95.145
15	54.996	74.754	74.676	74.676
20	42.455	59.075	59.038	59.038
25	33.000	47.000	47.000	47.000
30	25.822	37.636	37.667	37.667
35	20.335	30.326	30.381	30.381
40	16.115	24.583	24.654	24.654
45	12.849	20.043	20.124	20.124
50	10.306	16.433	16.518	16.518
55	8.317	13.545	13.631	13.631
60	6.748	11.223	11.306	11.306
65	5.504	9.345	9.424	9.424
70	4.513	7.818	7.892	7.892

Figure 53. Ambient Detection for Battery Charge Protection

9.21.1. PMU Protection Scheme

OVP

OVP (Over Voltage Protection) is used to protect the battery charger. The RTL8763B continuously monitors the battery voltage. If an over voltage condition occurs, the charger will stop immediately. The OVP threshold is configurable in the UI tool.

OCP

OCP (Over Current Protection) is used to protect the PMU in case of an over current condition occurs. It limits the regulator output to protect the PMU from burning out.

UVP

UVP (Under Voltage Protection) is used to protect the system from operating under a low voltage condition. The RTL8763B supports both SW UVP and HW UVP. If the battery voltage is below the lower band of the operating threshold, the system will be in hibernation mode first, and the PMU will force a stop of the output, or force a reset if the voltage continues to drop below the brown out or black out threshold.

- SW UVP: Configurable in the UI tool. If the battery voltage is below the pre-defined threshold, FW will turn off the system and hibernate
- HW UVP: The RTL8763B supports hardware UVP to protect the system from operating under an un-defined voltage. There are two thresholds, brown out and black out. The UVP hardware protection scheme will be triggered when a low voltage condition occurs. The UVP states will be resolved only when the voltage has recovered from the $V_{LOW} + V_{threshold}$

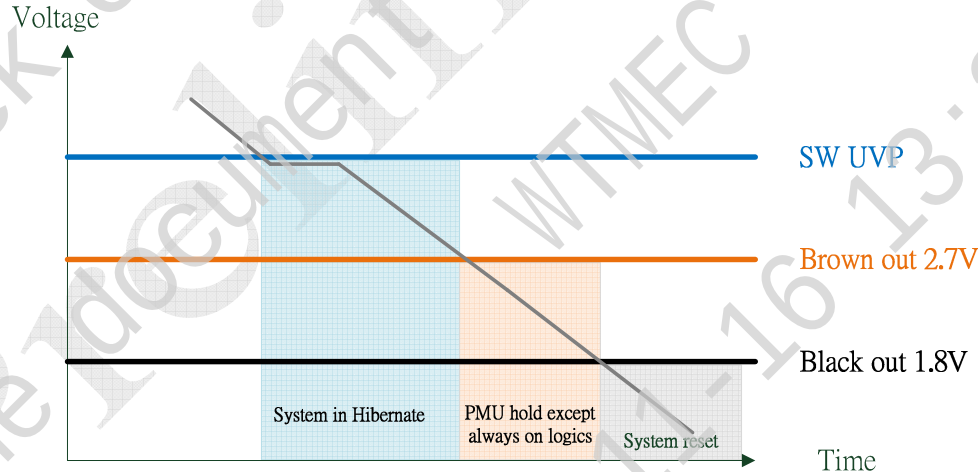


Figure 54. PMU Protection Scheme

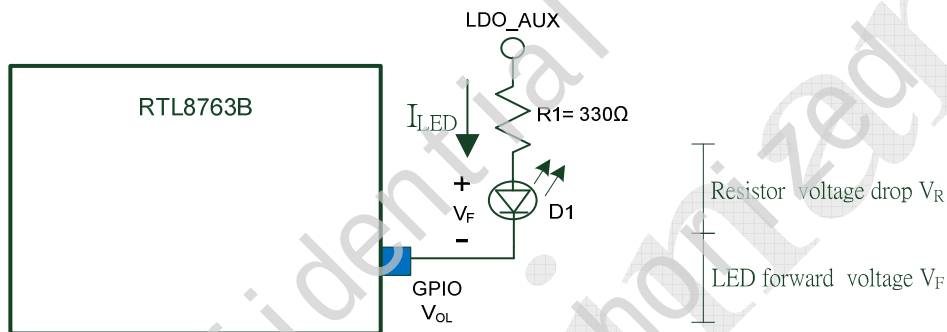
LED

The RTL8763B supports dynamic GPIO assignment to drive the LED for status indication. It offers flexibility to assign the GPIO at the best pin out location to ease PCB trace routing constrictions.

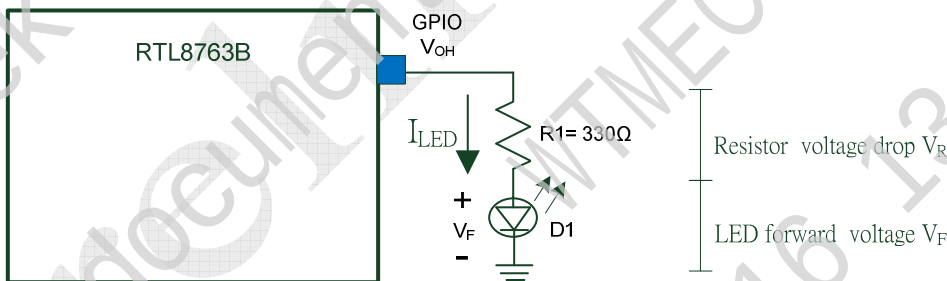
The method of LED indication can be selected in the UI tool and programmed into FLASH memory in the mass production process. The LED can still be active in deep sleep mode without the need for MCU control.

Table 18. LED

Parameter	Min.	Typ.	Max.	Unit
Driving Capacity	-	-	12	mA
GPIO VOH	1.8	-	3.6	V
GPIO VOL	-	0.2	-	-



$$I_{LED} = \frac{LDO_AUX - V_{OL} - V_F}{R1}$$



$$I_{LED} = \frac{V_{OH} - V_F}{R1}$$

Figure 55. LED

Where V_F is defined in the LED specification, V_{OL} is defined as the GPIO drive low level, typically 0.2V. V_{OH} depends on the LDO_AUX output level. If LDO_AUX=1.8V, then V_{OH} =1.8V. If LDO_AUX=3.3V, then V_{OH} =3.3V.

$R1=330\Omega$ for LED drive with 4mA with LDO_AUX=3.3V.

R1 can be adjusted according to the LED brightness needed.

I/O Mux

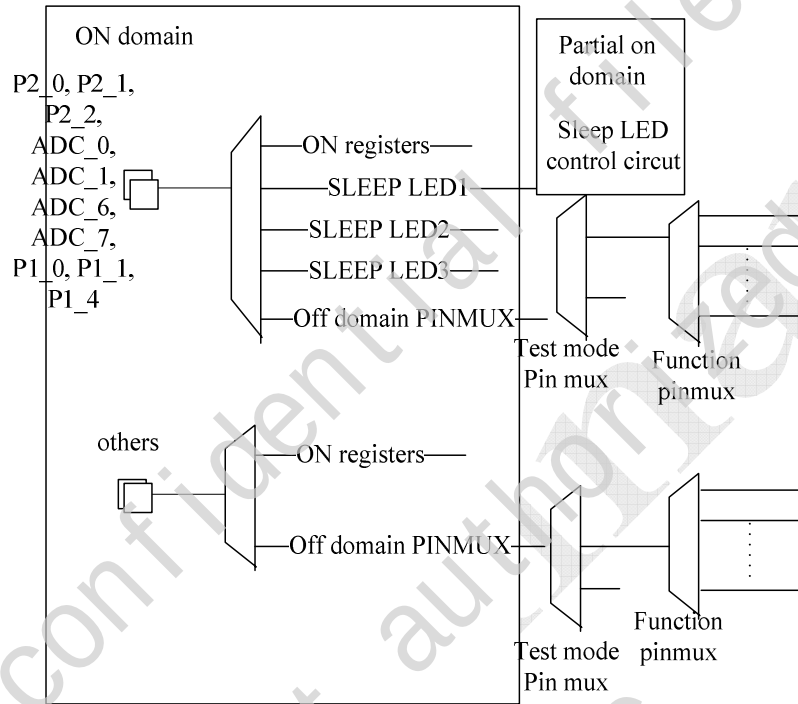


Figure 56. I/O Mux

The table below shows a PIN MUX available list. Each function in the table can be directed to the selected GPIO in the UI tool. These parameters can be set and programmed into the IC.

Table 19. PIN MUX Available List

0	IDEL	25	qdec_phase_a_z	50	SPI0_CLK (master only)	75	KEY_COL_17	100	SDI (CODEC - slave)	125	ADCDAT (SPORT0)
1	HCI_UART_TX	26	qdec_phase_b_z	51	SPI0_MO (master only)	76	KEY_COL_18	101	SDO (CODEC - slave)	126	DACDAT (SPORT0)
2	HCI_UART_RX	27	LOG0_UART_TX	52	SPI0_MI (master only)	77	KEY_COL_19	102	LRC_I (PCM)	127	MCLK
8	I2C1_DATA	33	IRDA_TX	58	KEY_COL_0	83	KEY_ROW_5	108	BT_COEX_I_2	-	-
9	PWM0_P	34	IRDA_RX	59	KEY_COL_1	84	KEY_ROW_6	109	BT_COEX_I_3	-	-

10	PWM0_N	35	DATA_UART_TX	60	KEY_COL_2	85	KEY_ROW_7	110	BT_COEX_O_0	-	-
11	PWM1_P	36	DATA_UART_RX	61	KEY_COL_3	86	KEY_ROW_8	111	BT_COEX_O_1	-	-
12	PWM1_N	37	DATA_UART_CTS	62	KEY_COL_4	87	KEY_ROW_9	112	BT_COEX_O_2	-	-
13	PWM0	38	DATA_UART_RTS	63	KEY_COL_5	88	KEY_ROW_10	113	BT_COEX_O_3	-	-
14	PWM1	39	SPI1_SS_N_0 (master only)	64	KEY_COL_6	89	KEY_ROW_11	114	PTA_I2C_CLK (slave only)	-	-
15	PWM2	40	SPI1_SS_N_1 (master only)	65	KEY_COL_7	90	DWGPIIO	115	PTA_I2C_DAT (slave only)	-	-
16	PWM3	41	SPI1_SS_N_2 (master only)	66	KEY_COL_8	91	LRC (SPORT1)	116	PTA_I2C_INT_OUT	-	-
17	PWM4	42	SPI1_CLK (master only)	67	KEY_COL_9	92	BCLK (SPORT1)	117	DSP_GPIO_OUT	-	-
18	PWM5	43	SPI1_MO (master only)	68	KEY_COL_10	93	ADCDAT (SPORT1)	118	DSP_JTCK	-	-
19	PWM6	44	SPI1_MI (master only)	69	KEY_COL_11	94	DACDAT (SPORT1)	119	DSP_JTDI	-	-
20	PWM7	45	SPI0_SS_N_0 (slave)	70	KEY_COL_12	95	SPDIF_TX	120	DSP_JTDO	-	-
21	qdec_phase_a_x	46	SPI0_CLK (slave)	71	KEY_COL_13	96	DMIC1_CLK	121	DSP_JTMS	-	-
22	qdec_phase_b_x	47	SPI0_SO (slave)	72	KEY_COL_14	97	DMIC1_DAT	122	DSP_JTRST	-	-
23	qdec_phase_a_y	48	SPI0_SI (slave)	73	KEY_COL_15	98	LRC_I (CODEC - slave)	123	LRC (SPORT0)	-	-
24	qdec_phase_b_y	49	SPI0_SS_N_0 (master only)	74	KEY_COL_16	99	BCLK_I (CODEC - slave)	124	BCLK (SPORT0)	-	-

9.22. Reference Circuits

9.22.1. RTL8763BM Reference Circuits

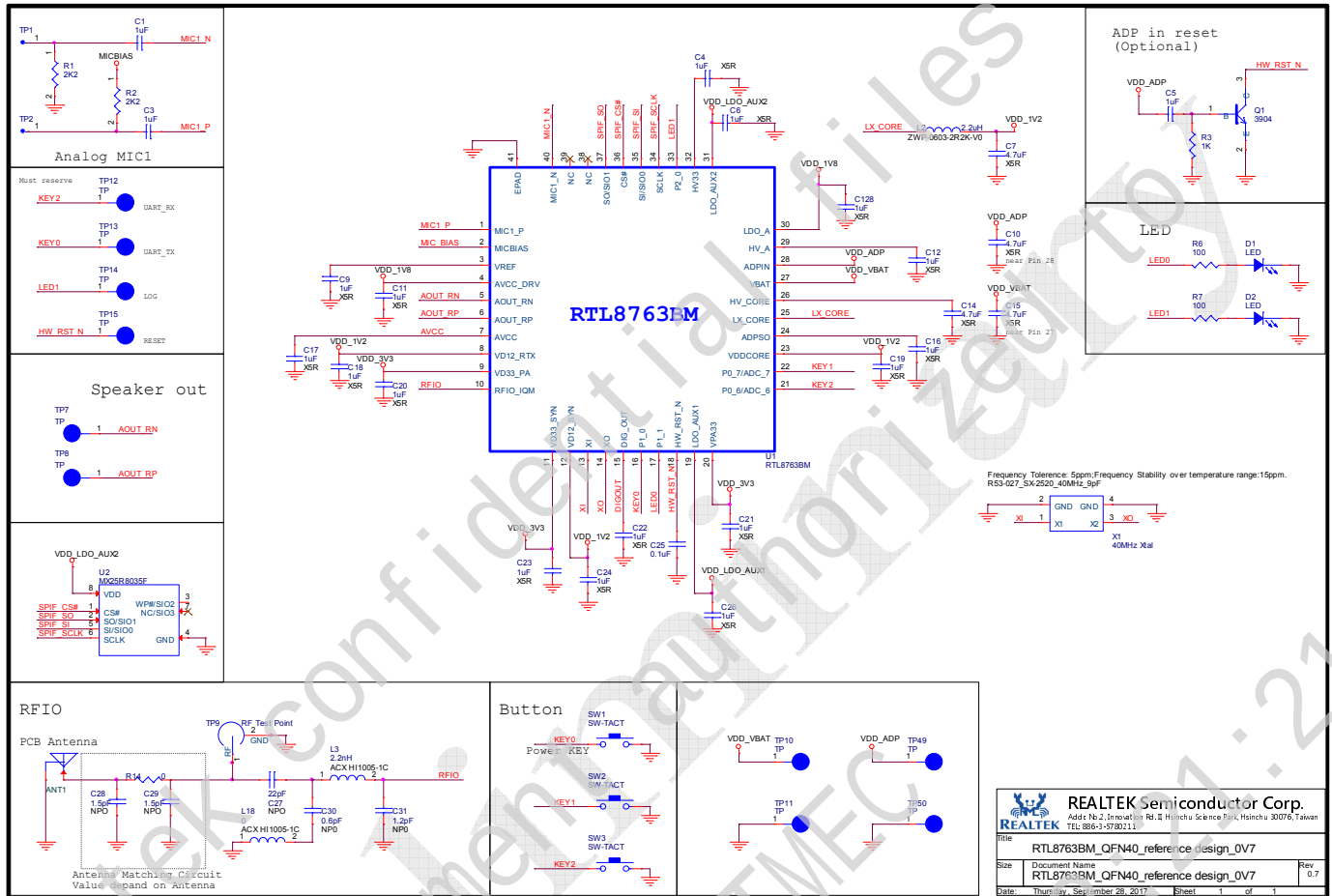


Figure 57. RTL8763BM Reference Circuits

9.22.2. RTL8763BF/BFR Reference Circuits

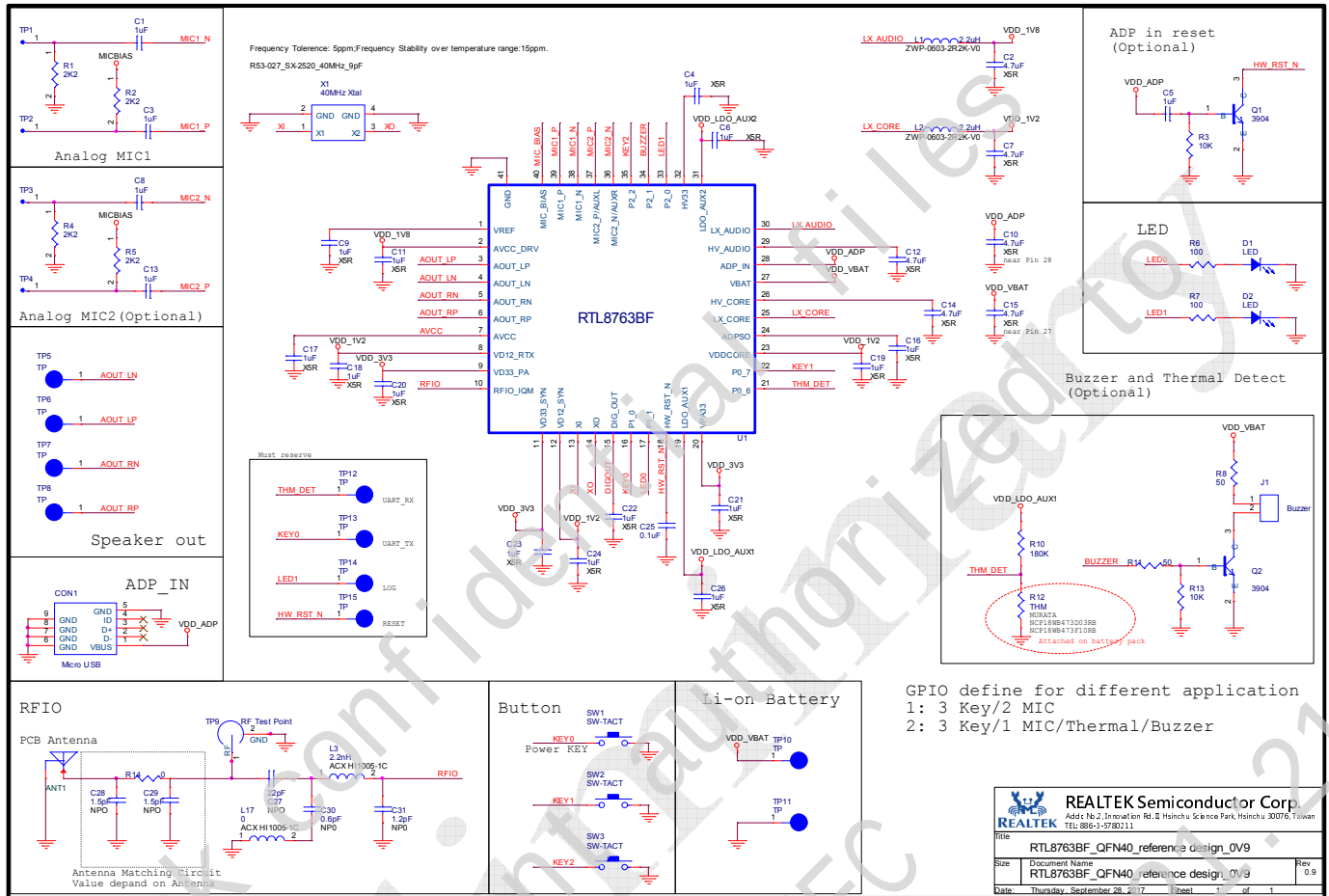


Figure 53. RTL8763BF/BFR Reference Circuits

Reference design schematic for the RTL8763BK-QFN56 module. The schematic shows the internal components of the module, including the RTL8763BS IC, and external components for various functions. Key sections include:

- Analog MIC1 and MIC2 (Optional):** Microphone input sections with resistors (R1, R2, R4, R5) and capacitors (C1, C2, C8, C14).
- Speaker out:** Audio output section with pins TP8 through TP14 and a speaker (SPK).
- NFC:** Near Field Communication section with an antenna matching circuit (ANT1, C30, C31, C32, C33) and a pin for NFC_DET.
- RFIO:** Radio Frequency I/O section with an antenna matching circuit (ANT1, C30, C31, C32, C33) and a pin for RFIO_IOM.
- Power and Control:** Various power pins (VDD_1V8, VDD_1V2, VDD_3V3, VDD_LDO_AUX1, VDD_LDO_AUX2, VDD_LDO_AUX3, VDD_VBAT) and control pins (KEY1, KEY2, KEY3, KEY4, KEY5, KEY6, KEY7, KEY8, KEY9, KEY10, KEY11, KEY12, KEY13, KEY14, KEY15, KEY16, KEY17, KEY18, KEY19, KEY20, KEY21, KEY22, KEY23, KEY24, KEY25, KEY26, KEY27, KEY28, KEY29, KEY30, KEY31, KEY32, KEY33, KEY34, KEY35, KEY36, KEY37, KEY38, KEY39, KEY40, KEY41, KEY42, KEY43, KEY44, KEY45, KEY46, KEY47, KEY48, KEY49, KEY50, KEY51, KEY52, KEY53, KEY54, KEY55, KEY56, KEY57, KEY58, KEY59, KEY60, KEY61, KEY62, KEY63, KEY64, KEY65, KEY66, KEY67, KEY68, KEY69, KEY70, KEY71, KEY72, KEY73, KEY74, KEY75, KEY76, KEY77, KEY78, KEY79, KEY80, KEY81, KEY82, KEY83, KEY84, KEY85, KEY86, KEY87, KEY88, KEY89, KEY90, KEY91, KEY92, KEY93, KEY94, KEY95, KEY96, KEY97, KEY98, KEY99, KEY100).

The schematic also includes a pin list on the right side, showing the connection of the module pins to the external components. The title block at the bottom right identifies the document as 'RTL8763BK_QFN56_reference design_0V7' and provides contact information for Realtek Semiconductor Corp.

Figure 59. RTL8763BS Reference Circuits

9.22.4. RTL8763BA Reference Circuits

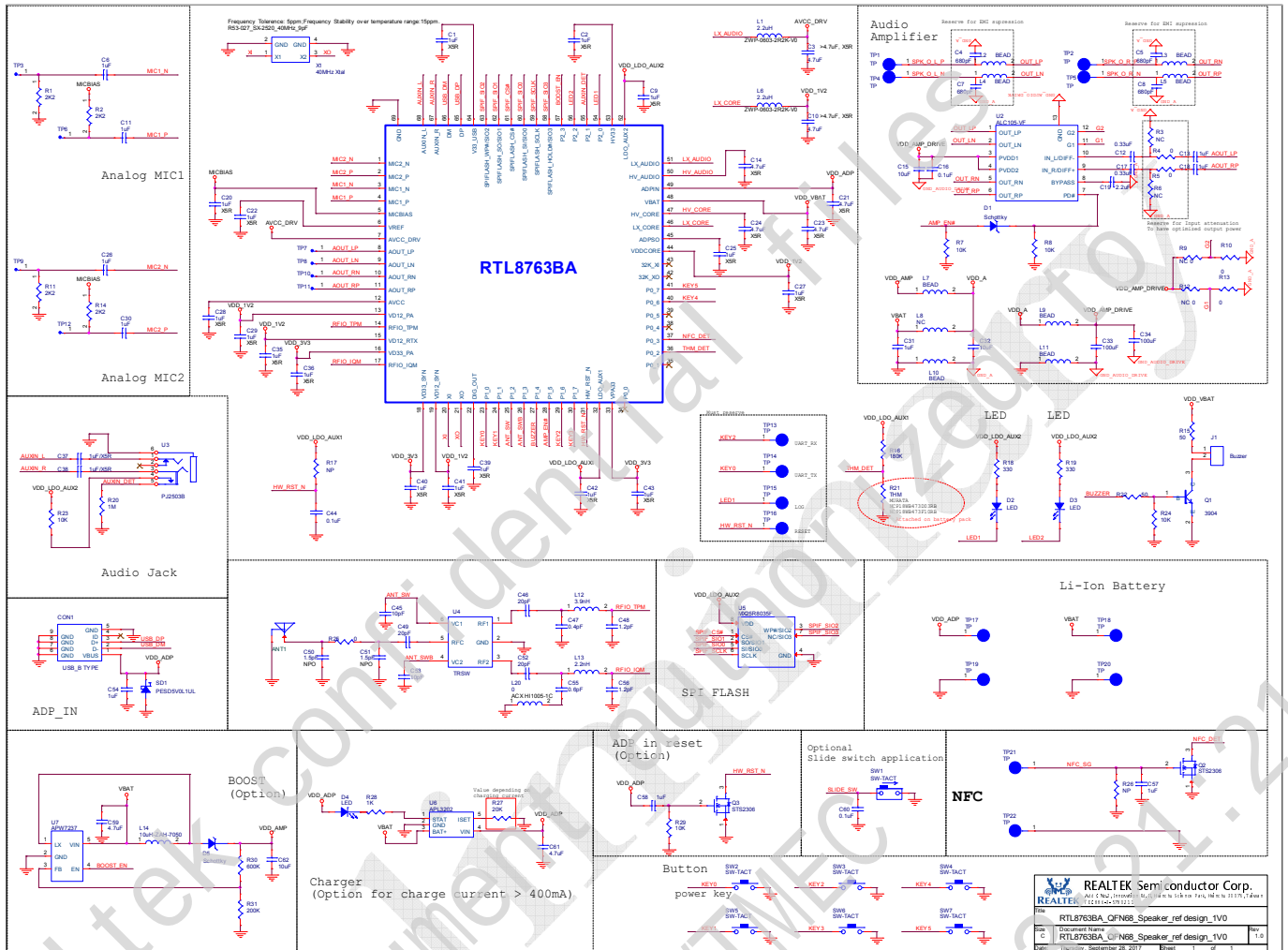


Figure 60. RTL8763BS Reference Circuits

10. Electrical Characteristics

10.1. Absolute Maximum Ratings

Table 20. Absolute Maximum Ratings

Item		Min.	Typical	Max.	Unit
Storage Temperature		-40	-	+105	°C
Power Management Unit		Min.	Typical	Max.	Unit
VDD_CORE	VDDCORE	-	-	1.32	V
Synthesizer control	VD12_SYNC	-	-	1.32	V
RF transceiver control	VD12_RTX	-	-	1.32	V
Codec	AVCC @ 1.8V mode	-	-	2.1	V
	AVCC @ 2.8V mode	-	-	2.9	V
Headphone driver	AVCC_DRV @ 1.8V mode	-	-	2.1	V
	AVCC_DRV @ 2.8V mode	-	-	2.9	V
VDDIO	VDD_AUX1	-	-	3.6	V
ADC Power	VDD_AUX2	-	-	3.6	V
BAT IN	VBAT	-	-	4.5	V
ADAPTER IN	ADP_IN (DC)	-	-	7	V

10.2. Recommended Operating Conditions

Table 21. Recommended Operating Conditions

Item		Min.	Typical	Max.	Unit
Operating Temperature		-40	25	+85	°C
Power Management Unit		Min.	Typical	Max.	Unit
VDD_CORE	VDDCORE	1.14	1.1	1.26	V
Synthesizer control	VD12_SYNC	1.14	1.2	1.26	V
RF transceiver control	VD12_RTX	1.14	1.2	1.26	V
Codec	AVCC @ 1.8V mode	1.7	1.8	1.98	V
	AVCC @ 2.8V mode	2.6	2.7	2.8	V
Headphone driver	AVCC_DRV @ 1.8V mode	1.85	1.9	2.1	V
	AVCC_DRV @ 2.8V mode	2.7	2.8	2.9	V
VDDIO	VDD_AUX1	2.8	-	3.6	V
ADC Power	VDD_AUX2	2.8	-	3.6	V
BAT IN	VBAT	2.8	-	4.35	V
ADAPTER IN	ADP_IN (DC)	4.5	-	6.5	V

10.3. Power Management Unit; Switch Mode Regulator for Audio Core and Audio Drive Stage

Table 22. Power Management Unit; Switch Mode Regulator for Audio Core and Audio Drive Stage

Item	Min.	Typ.	Max.	Unit
Input voltage	2.8	-	5	V
Output voltage	1.8	-	2.8	V
Inductor inductance	-	2.2	-	μH
Inductor specification, saturation current	-	500	-	mA
Inductor specification, DCR	-	0.1	0.6	Ω
Input capacitor	-	4.7	-	μF
Output capacitor	-	4.7	-	μF

(*1) +/-20%@500mA

10.4. Power Management Unit; Switch Mode Regulator for Digital Core, RF, and Synthesizer

Table 23. Power Management Unit; Switch Mode Regulator for Digital Core, RF, and Synthesizer

Item	Min.	Typ.	Max.	Unit
Input voltage	2.8	-	5	V
Output voltage	-	1.2	-	V
Inductor inductance	-	2.2	-	μH
Inductor specification, saturation current	-	500	-	mA
Inductor specification, DCR	-	0.1	0.6	Ω
Input capacitor	-	4.7	-	μF
Output capacitor	-	4.7	-	μF

10.5. Power Management Unit; Low Drop Linear Regulator

Table 24. Power Management Unit; Low Drop Linear Regulator
LDO AUX1

Item	Min.	Typ.	Max.	Unit
Input voltage	2.8	-	5	V
Output voltage	2.8	-	3.6	V
Output current	-	150(*1)	-	mA
Quiescent current	-	30	-	μA

LDO AUX1 L_Q

Item	Min.	Typ.	Max.	Unit
Input voltage	2.8	-	5	V
Output voltage	2.8	-	3.6	V
Output current	-	3(*2)	-	mA

LDO AUX2

Item	Min.	Typ.	Max.	Unit
Input voltage	2.8	-	5	V
Output voltage	2.8	-	3.6	V
Output current	-	150(*3)	-	mA
Quiescent current	-	30	-	μA

PALDO

Item	Min.	Typ.	Max.	Unit
Input voltage	2.8	-	5	V
Output voltage	2.8	3.3	-	V
Output current	-	150(*4)	-	mA
Quiescent current	-	30	-	μA

(*1) (*3) For external loading use, the maximum is 100mA.

(*2) For external loading use, the maximum is 3mA

(*4) Not for external use

10.6. Power Management Unit; Battery Charger

Table 25. Power Management Unit; Battery Charger

Item	Min.	Typ.	Max.	Unit
ADP_IN input voltage	4.5	5	6.5	V
Charge current, ADP_IN ≥ 5V	-	-	400	mA
Charge current, 4.5V < ADP_IN < 5V	-	-	200	mA
Trickle charge current	5	-	-	mA(*1)
VBAT in Trickle charge mode	0.5	-	3.0	V
VBAT in constant current mode	3.0	-	4.35(*1)	V, max programmable
VBAT in constant voltage mode	-	4.2	4.35(*2)	V, max programmable
Battery charge full, stop current	2mA	0.1C	-	C(*3)
Re-charge threshold	-	4.0	-	V(*4)

(*1) Adjustable by UI, the max is defined by Li-Ion battery

(*2) Adjustable by UI, the max is defined by Li-Ion battery

(*3) 1C= Li-Ion battery full capacity

(*4) UI configurable

10.7. Audio Codec DAC (If not specially marked, the test is with $AV_{CC} = 2.8V$)

Table 26. Audio Codec DAC (If not specially marked, the test is with $AV_{DD} = 2.8V$)

	Conditions		Min	Typ.	Max	Unit
Over-sampling rate (f)	-		-	128	-	fs
Operating Temperature	-		-40	25	85	°C
Resolution	-		-	24	-	Bits
Output Sample Rate, F _{sample}	8,16,32,44.1,48,88.2,96kHz		8	-	96	kHz
Signal to Noise Ratio (SNR @cap-less mode)	f _{in} =1kHz B/W=20~20kHz A-weighted THD+N < 0.02% 0dBFS signal Load=100KΩ	AV _{CC} =1.80V	-	98	-	dBA
		AV _{CC} =2.80V	-	102	-	
Signal to Noise Ratio (SNR @single-end mode)	f _{in} =1kHz B/W=20~20kHz A-weighted THD+N < 0.02% 0dBFS signal Load=100KΩ	AV _{CC} =1.80V	-	98	-	dBA
		AV _{CC} =2.80V	-	102	-	
Dynamic range	24-bit mode	AV _{CC} =1.80V	-	97	-	dB
		AV _{CC} =2.80V	-	101	-	
	16-bit mode	AV _{CC} =1.80V	-	96	-	dB
		AV _{CC} =2.80V	-	96	-	
Digital Gain			-65.625	-	0	dB
Digital Gain Resolution			-	0.375	-	dB
Analog Gain @headphone stage			-9		0	dB
Analog Gain Step			-	3	-	dB
Maximum Output Power	16Ω load	AV _{CC} =1.80V	-	16	-	mW
		AV _{CC} =2.80V	-	40	-	
	32Ω load	AV _{CC} =1.80V	-	8	-	
		AV _{CC} =2.80V	-	20	-	
Allowed Load	Resistive		-	16	O.C.	Ω
	Capacitive		1500	-	-	pF
THD+N @single-end mode, 2.8V or 1.8V, 0dBFS input	100KΩ load		-	0.02	-	%
	16Ω load		-	0.04	-	
Signal to Noise Ratio (SNR @ earphone load)	16Ω load, 0dBFS input relative to digital silence		-	96	-	dB

	Conditions	Min	Typ.	Max	Unit
Crosstalk between channels	L vs. R, measured at -10dBFS@1kHz input, single-ended output, 2.8V@16ohm	-	-95	-	dB
	L vs. R, measured at -10dBFS@1kHz input, differential output, 2.8V@16ohm	-	-98	-	dB
	L vs. R, measured at -10dBFS@1kHz input, cap-less output, 2.8V@16ohm	-	-54	-	dB
Analog supply voltage (AV _{CC})	(1) For earphone, AV _{CC} = 1.80V (2) For earphone/speakers, AV _{CC} = 2.80V	1.80	2.8	3.0	V

10.8. Audio Codec ADC (If not specially marked, the test is with AV_{CC}= 2.8V)

Table 27. Audio Codec ADC (If not specially marked, the test is with V_{CC}= 2.8V)

	Conditions	Min	Typ.	Max	Unit
Operating Temperature	-	-40	25	85	°C
Resolution	-		24		Bits
Input sample rate, F _{sample}	8, 16, 32, 44.1, 48, 88.2, 96kHz Note: Better to have 88.2, 96kHz	8		96	kHz
Signal to Noise Ratio (SNR @Line-in mode)	f _{in} =1kHz B/W=20~20kHz A-weighted THD+N < 0.1% 800mV _{RMS} input (AV _{CC} =2.8V)	-	97	-	dBA
Signal to Noise Ratio (SNR @Line-in mode)	f _{in} =1kHz B/W=20~20kHz A-weighted THD+N < 0.1% 800mV _{RMS} input (AV _{CC} =1.8V)	-	96	-	dBA
Signal to Noise Ratio (SNR @MIC mode)	f _{in} =1kHz B/W=20~20kHz A-weighted THD+N < 0.5% 8mVRMS input 40dB gain (AV _{CC} =2.8V)	-	70	-	dBA

	Conditions	Min	Typ.	Max	Unit
Dynamic range	$AV_{CC}=1.80V$	-	95	-	dB
	$AV_{CC}=2.80V$	-	95	-	
Digital Gain	-	-17.625		30	dB
Digital Gain Resolution	-	-	0.375		dB
MIC Boost Gain	0/20/30/40dB	0	20	40	dB
MIC Input full-scale at maximum gain (differential)	Gain=40dB	-	$5.65 \cdot AV_{DD}$	-	mV_{RMS}
MIC Input full-scale at minimum gain (differential)	Gain=0dB	-	$0.8 \cdot AV_{DD}$	-	V_{PP}
3dB bandwidth	-	-	20	-	kHz
Microphone mode input impedance	Input impedance	-	6	10	$K\Omega$
	Input capacitance	-	20	-	pF
THD+N (microphone input) @30mV _{RMS} input, 20dB gain	-	-	0.03	-	%
THD+N (line input) @-3dBFS	$AV_{CC} = 1.8$ or $2.8V$	-	0.02	-	%
ADC channels	-	-	2	-	ch
Line-input full-scale	$AV_{CC} = 2.8V$	-	2.2	-	V_{PP}
Line-input full-scale	$AV_{CC} = 1.8V$	-	1.4	-	V_{PP}
Line-input input impedance	Input impedance	-	10	-	$K\Omega$
	Input capacitance	-	20	-	pF
Crosstalk between channels	Line-in	-	-98	-	dB
	MIC-IN	-	-98	-	dB
Analog supply voltage (AV_{CC})	(1) For BT earphone, $AV_{CC}=1.80V$ (2) For BT earphone/ speakers, $AV_{CC}=2.80V$	1.80	2.8	3.0	V
MIC bias	$AV_{CC}=2.80V$	$AV_{DD} \cdot 0.75$	-	$AV_{DD} \cdot 0.9$	V
	$AV_{CC}=1.8V$	1.5V	-	-	

11. RF Characteristics

11.1. Transmitter BT Classic Basic Data Rate (BDR)

Table 28. Transmitter BT Classic Basic Data Rate (BDR)

Parameter		Min.	Typ.	Max.	Bluetooth Specification
Transmitter frequency (MHz)		2402	-	2480	2402 ~ 2480, 79CH
Transmitter Power (dBm)		-	10	-	-
Transmitter power control step (dB)		-	4	-	2dB ≤ step size ≤ 8 dB
20dB bandwidth (kHz)		-	900	-	1000kHz
Initial carrier frequency offset ^(*)		-	±10kHz	-	±75kHz
Frequency drift (kHz)	DH1	-	±10kHz	-	±25kHz
	DH3	-	±10kHz	-	±40kHz
	DH5	-	±10kHz	-	±40kHz
Frequency deviation $\Delta f_{1\text{avg}}$ (kHz)		-	160	-	140~175kHz
Frequency deviation $\Delta f_{2\text{max}}$ (kHz)		115	-	-	≥ 115kHz
$f_{1\text{avg}}/f_{2\text{avg}}$		-	0.88	-	≥ 0.8
Adjacent channel TX power (dBm)	N+2	-	-	-20	≤ -20dBm
	N-2	-	-	-20	≤ -20dBm
	N+3	-	-	-40	≤ -40dBm
	N-3	-	-	-40	≤ -40dBm

(*) Initial carrier offset should be calibrated in MP process in customer side.

Table 29. Harmonic

Parameter	2402MHz	2440MHz	2480MHz	Unit
2 nd harmonic typical ^(*)	-	-50	-	dBm
3 rd harmonic typical ^(*)	-	-50	-	dBm

(*) A π -type matching or a Low Pass Filter (LPF) or a Band Pass Filter (BPF) is needed to suppress the 2nd and 3rd harmonic energy, follow REALTEK design guide.

11.2. Transmitter BT Classic Enhanced Data Rate (EDR)

Table 30. Transmitter BT Classic Enhanced Data Rate (EDR)

Parameter		Min.	Typ.	Max.	Bluetooth Specification
Transmitter frequency (MHz)		2402	-	2480	2402 ~ 2480, 79CH
Relative TX power (dB)		-	-1	-	-4 ~ +1
EDR carrier frequency stability (kHz)		-	10	-	-75≤ ω_i ≤75 -75≤($\omega_i+\omega_o$)≤75
2M EDR modulation accuracy EDR TX=7.5 dBm	RMS DEVM	-	-	0.2	≤ 0.2
	Peak DEVM	-	-	0.35	≤ 0.35
	99% DEVM	-	100%	-	99%DEVM ≤ 0.3
3M EDR modulation accuracy	RMS DEVM	-	-	0.13	≤ 0.13
	Peak DEVM	-	-	0.25	≤ 0.25

Parameter		Min.	Typ.	Max.	Bluetooth Specification
EDR TX=7.5 dBm	99% DEVM	-	100%	-	$\geq 99\%$
EDR differential phase encoding		-	100%	-	$\geq 99\%$
2M EDR in-band spurious emission (dBm)	$ M-N = 1$	-	-	-26	$P_{TX-26dB}(f) \leq P_{TXref} - 26dB$ for $ M-N = 1$ (M: Tx Channel, N: Adjacent Channel)
	$ M-N = 2$	-	-	-20	$P_{TX}(f) \leq -20dBm$ for $ M-N = 2$ (M: Tx Channel, N: Adjacent Channel)
	$ M-N = 3$	-	-	-40	$P_{TX}(f) \leq -40dBm$ for $ M-N \geq 3$ (M: Tx Channel, N: Adjacent Channel)
3M EDR in-band spurious emission (dBm)	$ M-N = 1$	-	-	-26	$P_{TX-26dB}(f) \leq P_{TXref} - 26dB$ for $ M-N = 1$ (M: Tx Channel, N: Adjacent Channel)
	$ M-N = 2$	-	-	-20	$P_{TX}(f) \leq -20dBm$ for $ M-N = 2$ (M: Tx Channel, N: Adjacent Channel)
	$ M-N = 3$	-	-	-40	$P_{TX}(f) \leq -40dBm$ for $ M-N \geq 3$ (M: Tx Channel, N: Adjacent Channel)

11.3. Transmitter BT Classic Bluetooth Low Energy (BLE IQM)

Table 31. Transmitter BT Classic Bluetooth Low Energy (BLE IQM)

Parameter		Min.	Typ.	Max.	Bluetooth Specification
Transmitter frequency (MHz)		2402	-	2480	2402 ~ 2480, 40CH
Transmitter Power (dBm)		-	10	-	-
In-band emission (dBm)	$ M-N = 2$	-	-	-20	$P_{TX} \leq -20$ dBm for $(f_{TX} \pm 2$ MHz)
	$ M-N \geq 3$	-	-	-30	$P_{TX} \leq -30$ dBm for $(f_{TX} \pm [3 + n]$ MHz)]; where $n=0, 1, 2, \dots$
Carrier frequency offset (kHz) and drift(kHz)	$F_n^{(*)1}$	-	± 10	-	$f_{TX} - 150kHz \leq f_n \leq f_{TX} + 150$ kHz
	$ f_0 - f_n , n=2, 3, 4, \dots, k$	-	± 15	-	$ f_0 - f_n \leq 50$ kHz where $n=2, 3, 4, \dots, k$
	$ f_1 - f_0 $ and $ f_n - f_{n-5} $	-	± 15	-	$ f_1 - f_0 \leq 20$ kHz and $ f_n - f_{n-5} \leq 20$ kHz
Modulation characteristics Δf_{avg} (kHz)		-	250	-	225~275kHz
Frequency deviation 99.9% of $\Delta f_{max} \geq 185kHz$		-	100%	-	$\geq 99.9\%$
$f1_{avg}/f2_{avg}$		-	0.88	-	≥ 0.8

(*1) Initial carrier offset should be calibrated in the MP process at the customer side.

11.4. Receiver BT Classic Basic Data Rate (BDR)

Table 32. Receiver BT Classic Basic Data Rate (BDR)

Parameter		Min.	Typ.	Max.	Bluetooth Specification
Sensitivity, DH1 (dBm)		-94.5	-	-	$\leq -70\text{dBm}$, $\text{BER} \leq 0.1\%$
Sensitivity, DH3/DH5 (dBm)		-94.5	-	-	$\leq -70\text{dBm}$, $\text{BER} \leq 0.1\%$
C/I carrier over Interference (dB)	Co-channel	-	10	-	$C/I_{\text{co-channel}} (\text{dB}) \leq 11\text{dB}$
	Adjacent 1MHz	-	-13	-	$C/I_{1\text{MHz}} \leq 0\text{dB}$
	Adjacent 2MHz	-	-43	-	$C/I_{2\text{MHz}} \leq -30\text{dB}$
	Adjacent $\geq 3\text{MHz}$	-	-45	-	$C/I_{\geq 3\text{MHz}} \leq -40\text{dB}$
	Image interference	-	-22	-	$C/I_{\text{Image}} \leq -9\text{dB}$
	Adjacent (1MHz) interference to in-band mirror frequency	-	-29	-	$C/I_{\text{Image} \pm 1\text{MHz}} \leq -20\text{dB}$
Blocking (dBm)	30MHz ~ 2000MHz	-10	-	-	-10
	2000MHz ~ 2400MHz	-27	-	-	-27
	2500MHz ~ 3000MHz	-27	-	-	-27
	3000MHz ~ 12.75GHz	-10	-	-	-10
Inter-modulation (*1) (*2)	BER @ f1 = 2407MHz & f2 = 2412MHz (%)	0			≤ 0.1
	Max Intermodulation Level @ f1 = 2407MHz & f2 = 2412MHz (dBm)	-30.0			≥ -39
	BER @ f1 = 2397MHz & f2 = 2392MHz (%)	0			≤ 0.1
	Max Intermodulation Level @ f1 = 2397MHz & f2 = 2392MHz (dBm)	-30.0			≥ -39
	BER @ f1 = 2446MHz & f2 = 2451MHz (%)	0			≤ 0.1
	Max Intermodulation Level @ f1 = 2446MHz & f2 = 2451MHz (dBm)	-30			≥ -39
	BER @ f1 = 2436MHz & f2 = 2431MHz (%)	0			≤ 0.1
	Max Intermodulation Level @ f1 = 2436MHz & f2 = 2431MHz (dBm)	-30			≥ -39
	BER @ f1 = 2485MHz & f2 = 2490MHz (%)	0			≤ 0.1
	Max Intermodulation Level @ f1 = 2485MHz & f2 = 2490MHz (dBm)	-30			≥ -39
	BER @ f1 = 2475MHz & f2 = 2470MHz (%)	0			≤ 0.1
	Max Intermodulation Level @ f1 = 2475MHz & f2 = 2470MHz (dBm)	-30			≥ -39
Maximum input (dBm)		0			$\text{BER} \leq 0.1\% @ -20\text{dBm}$

11.5. Receiver BT Classic Enhanced Data Rate (EDR)

Table 33. Receiver BT Classic Enhanced Data Rate (EDR)

Parameter		Min.	Typ.	Max.	Bluetooth Specification
Sensitivity, 2-DH5 (dBm)		-94	-	-	$\leq -70\text{dBm}$, $\text{BER} \leq 0.01\%$
Sensitivity, 3-DH5 (dBm)		-87.5	-	-	$\leq -70\text{dBm}$, $\text{BER} \leq 0.01\%$
EDR BER Floor performance		-	0	-	$\text{BER} \leq 0.001\%$
EDR-2M C/I carrier over Interference (dB)	Co-channel	-	10	-	$C/I_{\text{co-channel}} (\text{dB}) \leq 13\text{dB}$
	Adjacent 1MHz	-	-12	-	$C/I_{1\text{MHz}} \leq 0\text{dB}$
	Adjacent 2MHz	-	-42	-	$C/I_{2\text{MHz}} \leq -30\text{dB}$
	Adjacent $\geq 3\text{MHz}$	-	-47	-	$C/I_{3\text{MHz}} \leq -40\text{dB}$
	Image interference	-	-28	-	$C/I_{\text{Image}} \leq -7\text{dB}$
	Adjacent (1MHz) interference to in-band mirror frequency	-	-32	-	$C/I_{\text{Image} \pm 1\text{MHz}} \leq -20\text{dB}$
EDR-3M C/I carrier over Interference (dB)	Co-channel	-	17	-	$C/I_{\text{co-channel}} (\text{dB}) \leq 21\text{dB}$
	Adjacent 1MHz	-	-5	-	$C/I_{1\text{MHz}} \leq 5\text{dB}$
	Adjacent 2MHz	-	-36	-	$C/I_{2\text{MHz}} \leq -25\text{dB}$
	Adjacent $\geq 3\text{MHz}$	-	-44	-	$C/I_{3\text{MHz}} \leq -33\text{dB}$
	Image interference	-	-23	-	$C/I_{\text{Image}} \leq 0\text{dB}$
	Adjacent (1MHz) interference to in-band mirror frequency	-	-27	-	$C/I_{\text{Image} \pm 1\text{MHz}} \leq -13\text{dB}$
Maximum input (dBm)			0		$\text{BER} \leq 0.1\% @ -20\text{dBm}$

11.6. Receiver BT Classic Bluetooth Low Energy (BLE) IQM

Table 34. Receiver BT Classic Bluetooth Low Energy (BLE) IQM

Parameter		Min.	Typ.	Max.	Bluetooth Specification
Sensitivity LE 1M		-97	-	-	$\leq -70\text{dBm}$, PER $\leq 30.8\%$
C/I carrier over Interference (dB)	Co-channel	-	6	-	$C/I_{\text{co-channel}} (\text{dB}) \leq 21\text{dB}$
	Adjacent 1MHz	-	-3	-	$C/I_{1\text{MHz}} \leq 15\text{dB}$
	Adjacent 2MHz	-	-40	-	$C/I_{2\text{MHz}} \leq -17\text{dB}$
	Adjacent $\geq 3\text{MHz}$	-	-50	-	$C/I_{3\text{MHz}} \leq -27\text{dB}$
	Image interference	-	-29	-	$C/I_{\text{image}} \leq -9\text{dB}$
	Adjacent (1MHz) interference to in-band mirror frequency	-	-30	-	$C/I_{\text{image} \pm 1\text{MHz}} \leq -15\text{dB}$
Blocking (dBm)	30MHz ~ 2000MHz	-30	-	-	-30
	2000MHz ~ 2400MHz	-35	-	-	-35
	2500MHz ~ 3000MHz	-35	-	-	-35
	3000MHz ~ 12.75GHz	-30	-	-	-30
Inter-modulation (*1) (*2)	PER @ f1 = 2407MHz & f2 = 2412MHz (%)	0			PER $\leq 30.8\%$
	Max Intermodulation Level @ f1 = 2407MHz & f2 = 2412MHz (dBm)	-30			≥ -50
	PER @ f1 = 2397MHz & f2 = 2392MHz (%)	0			PER $\leq 30.8\%$
	Max Intermodulation Level @ f1 = 2397MHz & f2 = 2392MHz (dBm)	-30			≥ -50
	PER @ f1 = 2445MHz & f2 = 2450MHz (%)	0			PER $\leq 30.8\%$
	Max Intermodulation Level @ f1 = 2445MHz & f2 = 2450MHz (dBm)	-30			≥ -50
	PER @ f1 = 2435MHz & f2 = 2430MHz (%)	0			PER $\leq 30.8\%$
	Max Intermodulation Level @ f1 = 2437MHz & f2 = 2434MHz (dBm)	-30			≥ -50
	PER @ f1 = 2485MHz & f2 = 2490MHz (%)	0			PER $\leq 30.8\%$
	Max Intermodulation Level @ f1 = 2485MHz & f2 = 2490MHz (dBm)	-30			≥ -50
	PER @ f1 = 2475MHz & f2 = 2470MHz (%)	0			PER $\leq 30.8\%$
	Max Intermodulation Level @ f1 = 2475MHz & f2 = 2470MHz (dBm)	-30			≥ -50
Maximum input (dBm)		0			PER $\leq 30.8\%$ @ -10dBm

(*1) $f_{\text{channel}} = 2f_1 - f_2$, $|f_2 - f_1| = n * 1 \text{ MHz}$, $n=3, 4 \text{ or } 5$

(*2) The value of n (for which the TC is performed) shall be declared by the manufacturer in the IXIT table (See PICS Proforma for Bluetooth low energy RF PHY).

11.7. Receiver BT Classic Bluetooth Low Energy (BLE) 2M IQM

Table 35. Receiver BT Classic Bluetooth Low Energy (BLE) 2M IQM

Parameter		Min.	Typ.	Max.	Bluetooth Specification
Sensitivity LE 2M		-94	-	-	$\leq -70\text{dBm}$, PER $\leq 30.8\%$
C/I carrier over Interference (dB)	Co-channel	-	6	-	$C/I_{\text{co-channel}} (\text{dB}) \leq 21\text{dB}$
	Adjacent 2MHz	-	-5	-	$C/I_{2\text{MHz}} \leq 15\text{dB}$
	Adjacent 4MHz	-	-47	-	$C/I_{4\text{MHz}} \leq -17\text{dB}$
	Adjacent $\geq 6\text{MHz}$	-	-51	-	$C/I_{6\text{MHz}} \leq -27\text{dB}$
	Image interference	-	-30	-	$C/I_{\text{Image}} \leq -9\text{dB}$
	Adjacent (2MHz) interference to in-band mirror frequency	-	-27	-	$C/I_{\text{Image} \pm 2\text{MHz}} \leq -15\text{dB}$

11.8. Receiver BT Classic Bluetooth Low Energy (BLE) Long Range 500K IQM

Table 36. Receiver BT Classic Bluetooth Low Energy (BLE) Long Range 500K IQM

Parameter		Min.	Typ.	Max.	Bluetooth Specification
Sensitivity LE Long Range -500K		-100.5	-	-	$\leq -75\text{dBm}$, PER $\leq 30.8\%$
C/I carrier over Interference (dB)	Co-channel	-	1.9	-	$C/I_{\text{co-channel}} (\text{dB}) \leq 17\text{dB}$
	Adjacent 1MHz	-	-8	-	$C/I_{1\text{MHz}} \leq 11\text{dB}$
	Adjacent 2MHz	-	-43	-	$C/I_{2\text{MHz}} \leq -21\text{dB}$
	Adjacent $\geq 3\text{MHz}$	-	-54	-	$C/I_{3\text{MHz}} \leq -31\text{dB}$
	Image interference	-	-33	-	$C/I_{\text{Image}} \leq -13\text{dB}$
	Adjacent (1MHz) interference to in-band mirror frequency	-	-33	-	$C/I_{\text{Image} \pm 1\text{MHz}} \leq -19\text{dB}$

11.9. Receiver BT Classic Bluetooth Low Energy (BLE) Long Range 125K IQM

Table 37. Receiver BT Classic Bluetooth Low Energy (BLE) Long Range 125K IQM

Parameter		Min.	Typ.	Max.	Bluetooth Specification
Sensitivity LE Long Range -125K		-106.5	-	-	$\leq -82\text{dBm}$, PER $\leq 30.8\%$
C/I carrier over Interference (dB)	Co-channel	-	1.9	-	$C/I_{\text{co-channel}} (\text{dB}) \leq 12\text{dB}$
	Adjacent 1MHz	-	-16	-	$C/I_{1\text{MHz}} \leq 6\text{dB}$
	Adjacent 2MHz	-	-50	-	$C/I_{2\text{MHz}} \leq -26\text{dB}$
	Adjacent $\geq 3\text{MHz}$	-	-60	-	$C/I_{3\text{MHz}} \leq -36\text{dB}$
	Image interference	-	-34	-	$C/I_{\text{Image}} \leq -18\text{dB}$
	Adjacent (1MHz) interference to in-band mirror frequency	-	-38	-	$C/I_{\text{Image} \pm 1\text{MHz}} \leq -24\text{dB}$

11.10. Analog ADC Input

Table 38. Analog ADC Input

Parameter	Condition	Min	Typical	Max	Unit
Input impedance	Bypass mode ^(*1)	-	3M	-	Ω
	Normal mode ^(*2)	-	100K	-	Ω
Input voltage range	Bypass mode	0	-	1	V
	Normal mode	0	-	3	V
Number of ADC ch.	P0_0 - P0_7 ^(*3)	-	-	8	ch
Offset	With FT	-	TBD	-	mV
Gain error	With FT	-	TBD	-	%
Internal ref. voltage	-	-	0.5	-	-
Resolution	-	-	12	-	bit
ENOB	-	-	10.3	-	bit

Test condition: VDDIO=3.3V

(*1) Normal mode: with internal resistor divider

(*2) Bypass mode: without internal resistor divider

(*3) The ADC input counts is varied depending on part number

11.11. ESD Protection

The table below shows the maximum ESD capability of RTL8763B.

The ESD protection scheme should be applied during manufacture procedure to avoid unconditional ESD damage.

Table 39. ESD Protection

Parameter	Condition	Min.	Typ.	Max.
Human Body Mode	All pins, test method: JESD22	-	±2KV (all pins)	-
Machine Mode	All pins, test method: JESD22	-	±200V (all pins except XI, XO is rated at 150V)	-
Charged Device Model	All pins, test method: JESD22	-	±400V (all pins)	-
Latch up	All pins, test method: JESD22	-	±200mA (all pins)	-

11.12. Power Consumption

VBAT=3.7V, One Headset Test Without Speaker Loading; RF TX= +2dBm, Test With Handset APPLE i-Phone7

Table 40. VBAT=3.7V, RTL8763BFR One Headset Test Without Speaker Loading; RF TX= +2dBm

Test Condition	Min.	Typ.	Max.	Unit
Power off	-	TBD	-	μA
DLPS mode	-	TBD	-	μA
Standby mode	-	TBD	-	μA
Page mode	-	TBD	-	μA
Page + Inquiry mode	-	TBD	-	μA
A2DP AAC	-	TBD	-	mA
A2DP SBC High quality, bit pool=53	-	TBD	-	mA
A2DP SBC Mid quality, bit pool=35	-	TBD	-	mA
eSCO	-	TBD	-	mA

VBAT=3.7V, RTL8763BFR RWS Headset Test Without Speaker Loading; RF TX= +6dBm, Test With Handset APPLE i-Phone7 Playing the Master Role, Master Side

Table 41. VBAT=3.7V, RWS Headset Test Without Speaker Loading; RF TX= +6dBm, Test With Handset APPLE i-Phone7 Playing the Master Role, Master Side

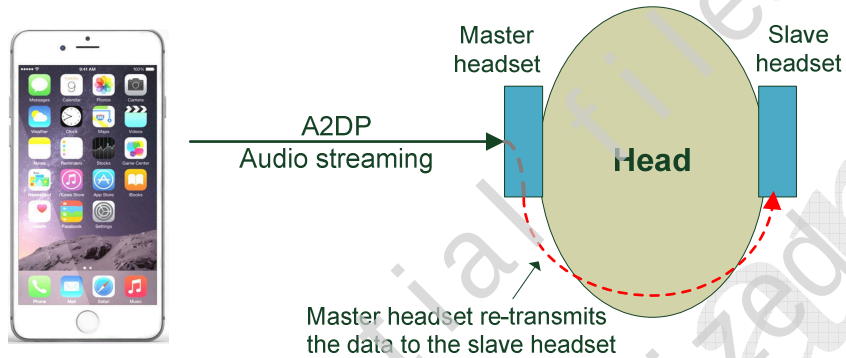
Test Condition	Min.	Typ.	Max.	Unit
Power off	-	TBD	-	μA
DLPS mode	-	TBD	-	μA
Standby mode	-	TBD	-	μA
Page mode	-	TBD	-	μA
Page + Inquiry mode	-	TBD	-	μA
A2DP AAC	Master headset	TBD	-	mA
	Slave headset	TBD	-	mA
eSCO	Master headset	TBD	-	mA
	Slave headset	TBD	-	mA

VBAT=3.7V, RWS Headset Test Without Speaker Loading; RF TX= +6dBm, Test With Handset APPLE i-Phone7 Playing the Master Role, Slave Side

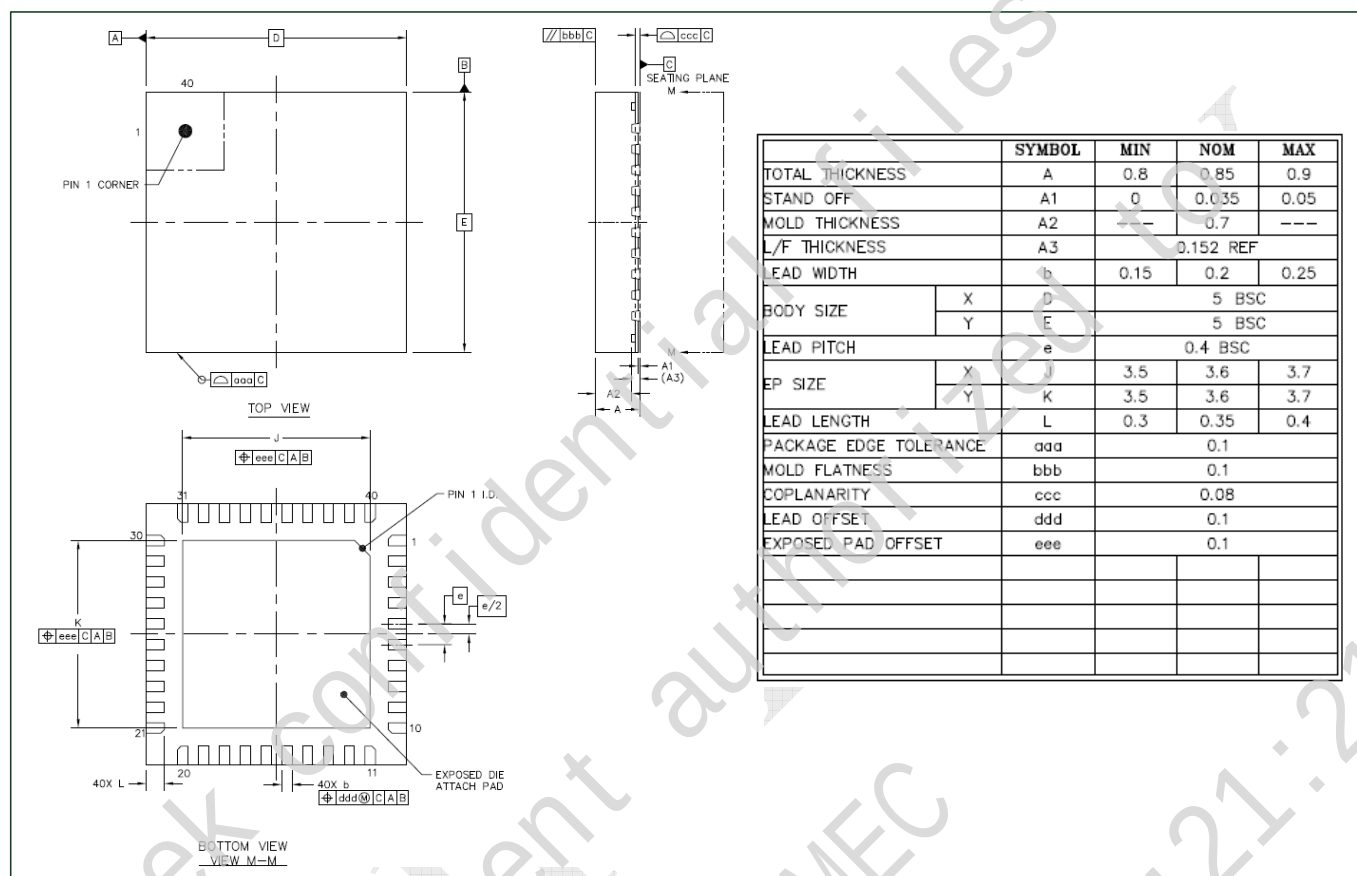
Table 42. VBAT=3.7V, RWS Headset Test Without Speaker Loading; RF TX= +6dBm, Test With Handset Android Phone/Android7.0 Playing the Master Role, Slave Side

Test Condition	Min.	Typ.	Max.	Unit
Power off	-	TBD	-	μA
DLPS mode	-	22	-	μA
Standby mode	-	145	-	μA
Page mode	-	175	-	μA
Page + Inquiry mode	-	310	-	μA
A2DP SBC	Master headset	11	-	mA

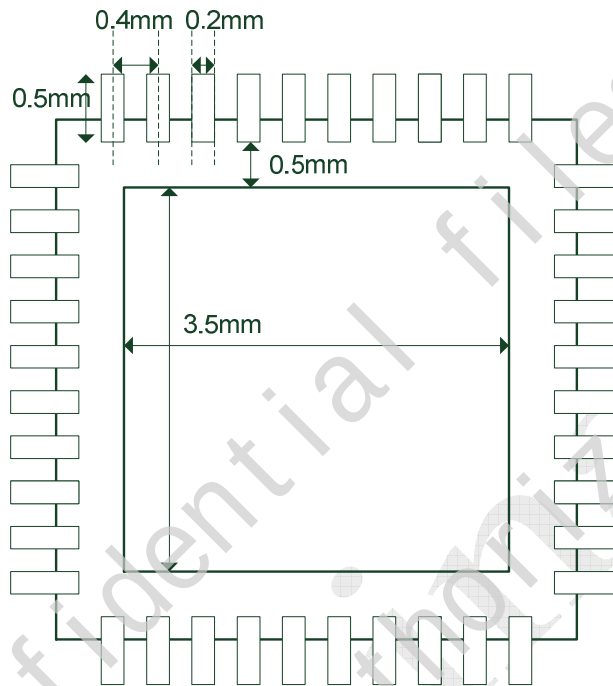
High quality (bit pool=53)	Slave headset		6.8		mA
eSCO	Master headset		9.3		mA
	Slave headset		8.3		mA



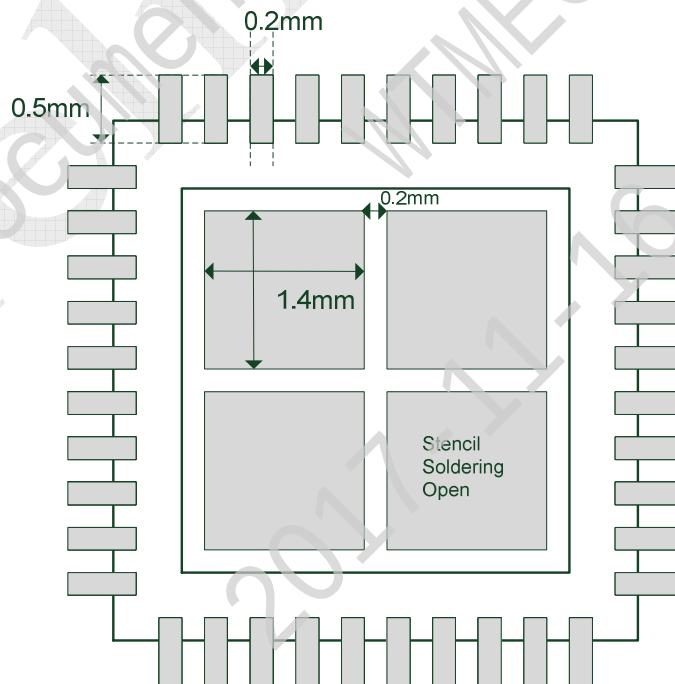
12.1. Package Dimensions QFN40



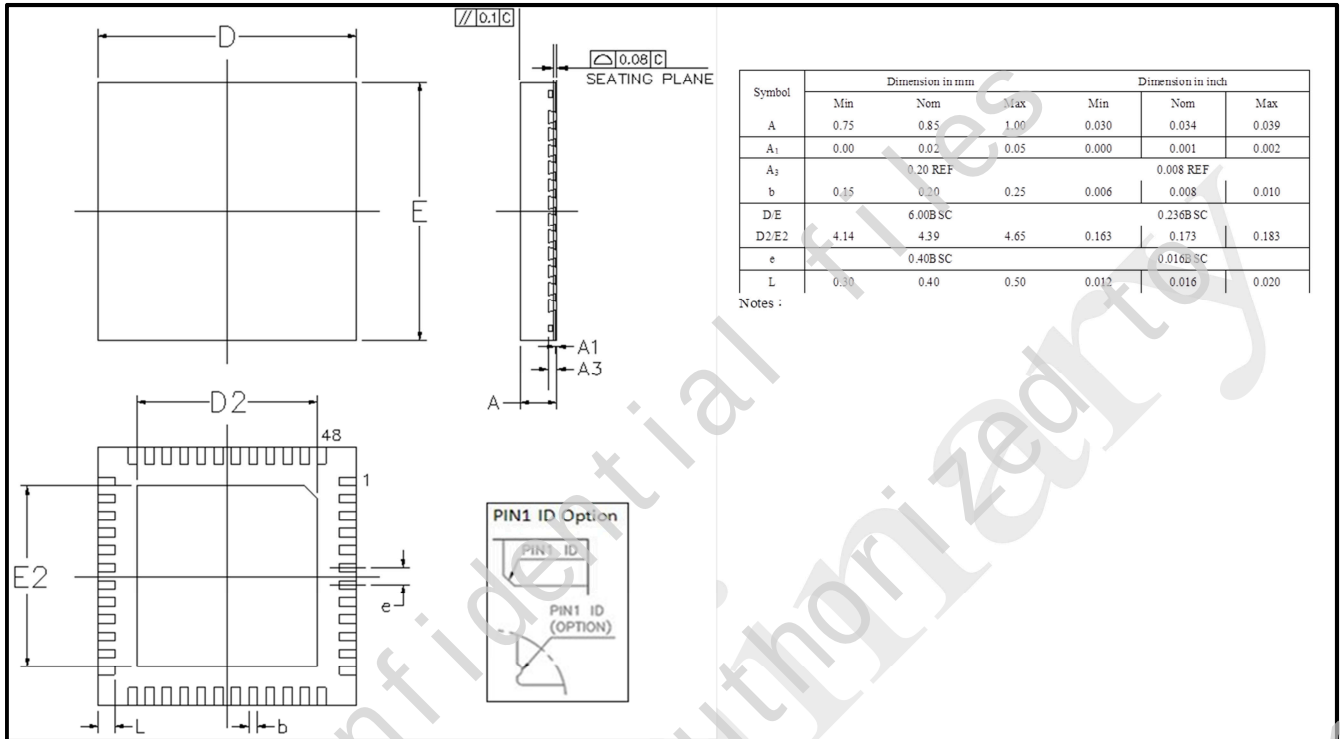
12.2. QFN40 Layout Land Pattern Stencil Open



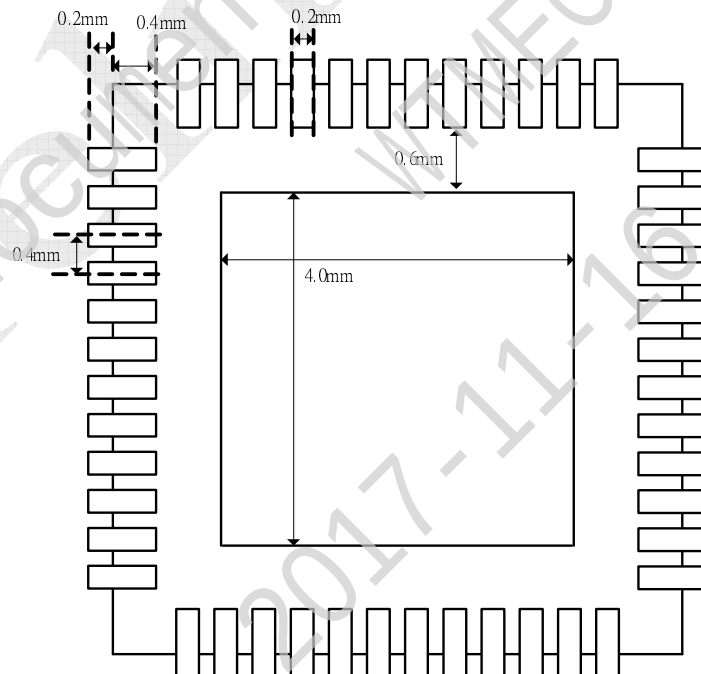
12.3. Suggested Stencil Open for SMT Soldering on EP Pad (Exposed Pad Under the Chip)



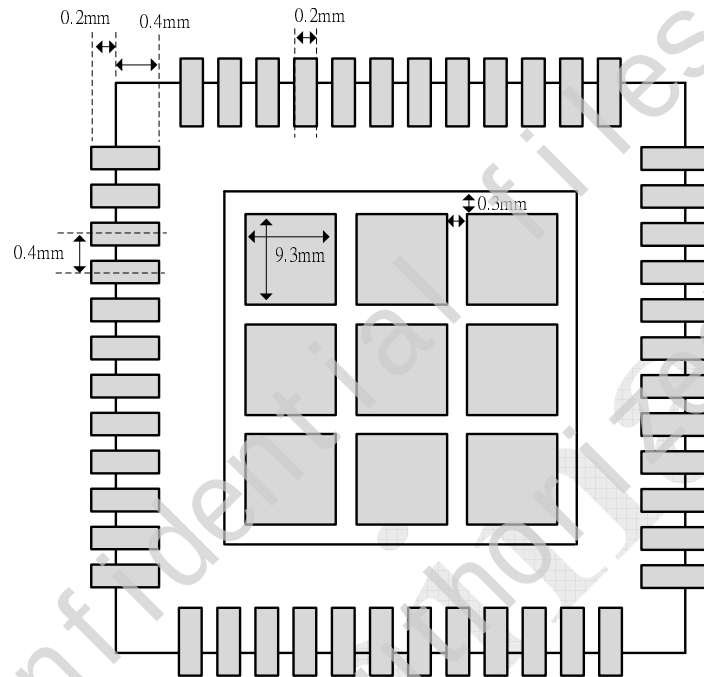
12.4. Package Dimension QFN48 6x6mm²



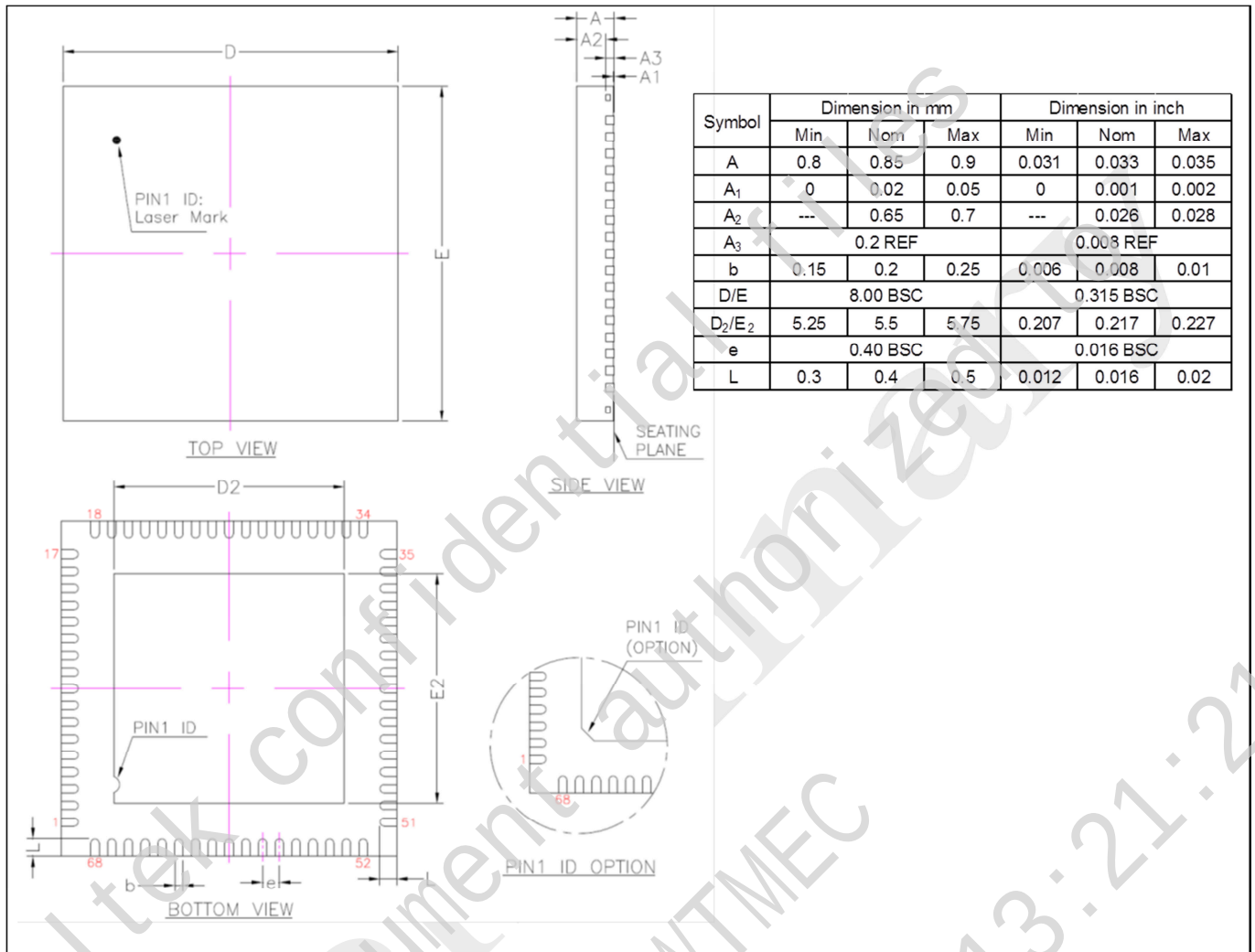
12.5. QFN48 Layout Land Pattern Stencil Open



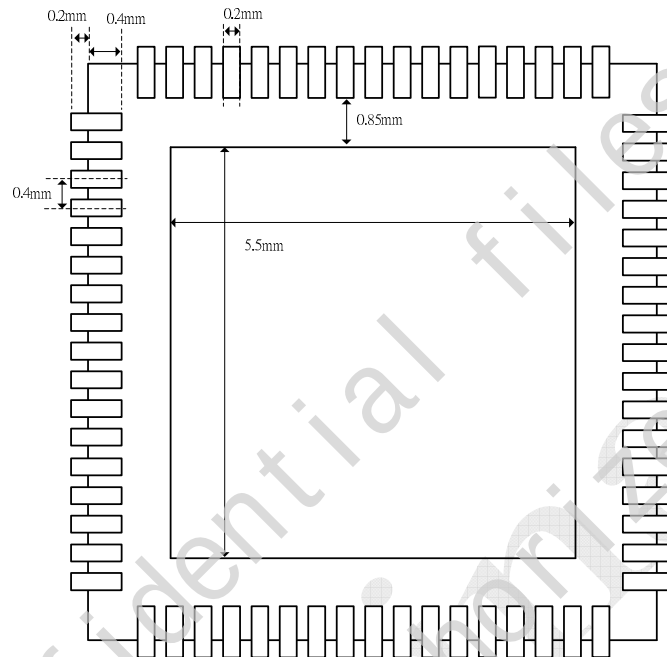
12.6. *Suggested Stencil Open for SMT Soldering on EP Pad (Exposed Pad Under the Chip)*



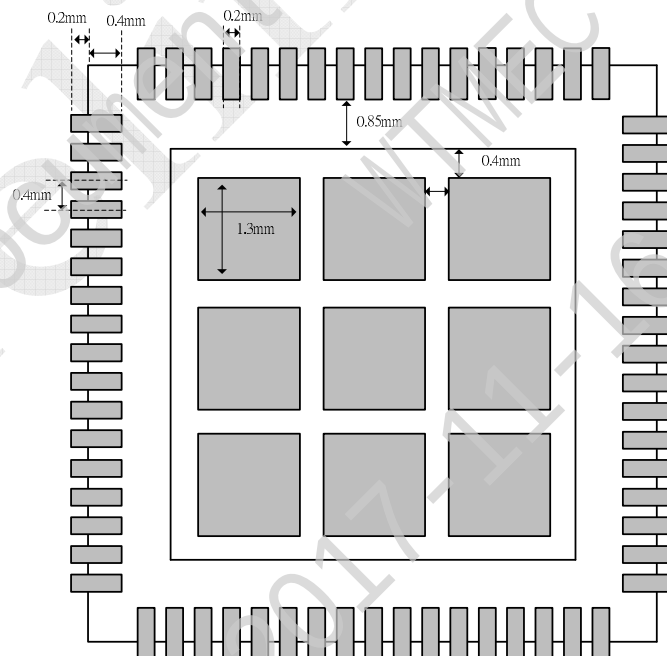
12.7. Package Dimension QFN68 8x8mm²



12.8. QFN68 Layout Land Pattern Stencil Open



12.9. Suggested Stencil Open for SMT Soldering on EP Pad (Exposed Pad Under the Chip)



12.10. PCB Design Layout Trace Routing for 2-Layer PCB

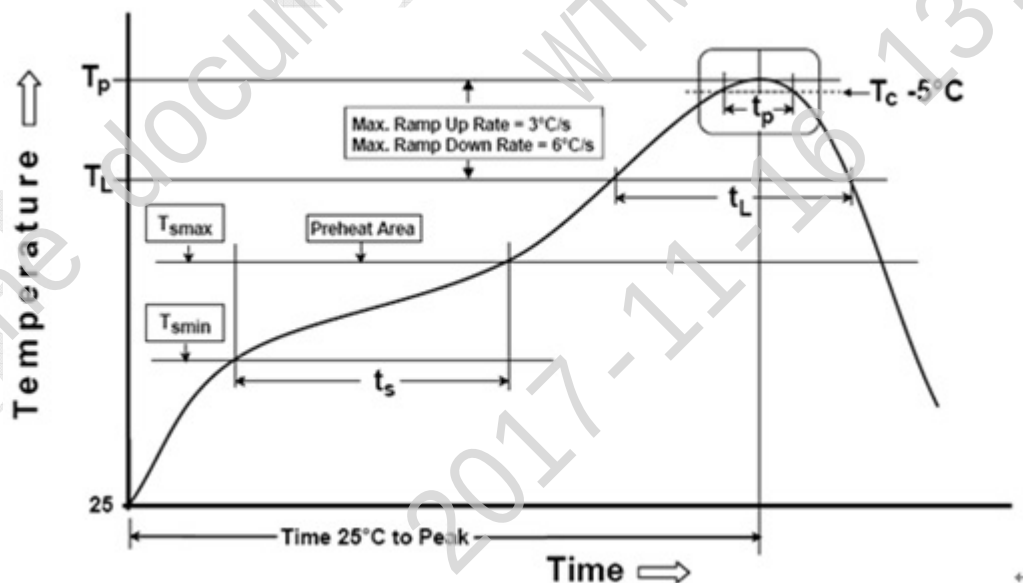
For cost consideration, 2-layer PCB is often used, however, cost and performance tradeoff is always an issue. For a robust design in a 2-layer PCB, a layout route pattern is suggested in the 'RTL8763 layout guide'. A 2-layer PCB is simple with the RTL8763BM/BF/BFR audio solution

Advantages of the RTL8763Bx series:

- Simple and optimized reference BOM list
- Availability of small component pattern

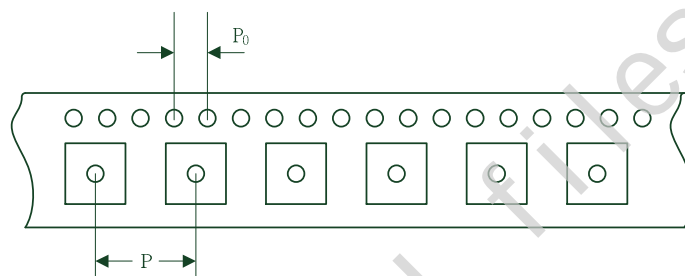
12.11. Reflow Profile

Stage	Note	Pb-free assembly
Average ramp-up rate	T_L to T_p	3 °C/ second max.
Preheat	Temperature min (T_{smin})	150°C
	Temperature max (T_{smax})	200°C
	Time (t_{smin} to t_{smax})	60 – 120 seconds
Time maintained above	Temperature(T_L)	217°C
	Time (t_L)	60 – 150 seconds
Peak package body temperature (T_p)	See following table.	
	T_p must not exceed the specified classification temp in following table.	
Time(t_p) within 5°C of the specified classification temperature (T_c)	30 seconds	
Ramp-down rate (T_p to T_L)	6 °C / seconds max.	
Time 25°C to peak temperature	8 minutes max.	



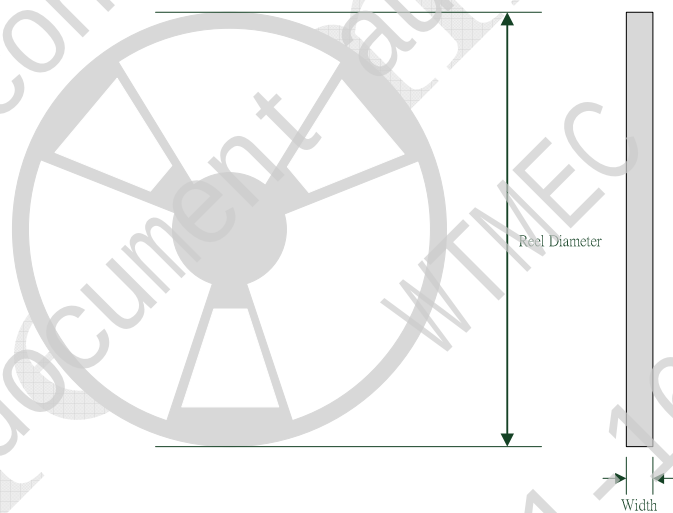
12.12. Tape and Reel Information

12.12.1. Tape Information



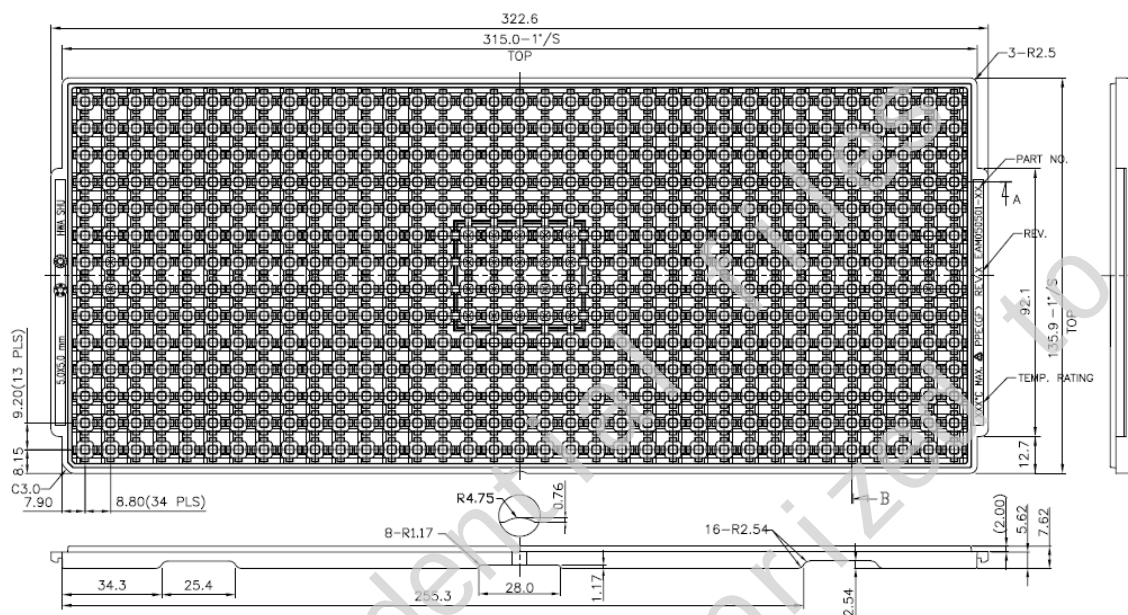
Package Code	Number of Pins	Body Size (mm ²)	Package Pitch: P (mm)	Hole Pitch: P0 (mm)
QFN40	40	5X5	8	4
QFN48	48	6X6	12	4
QFN68	68	8X8	12	4

12.12.2. Reel Information

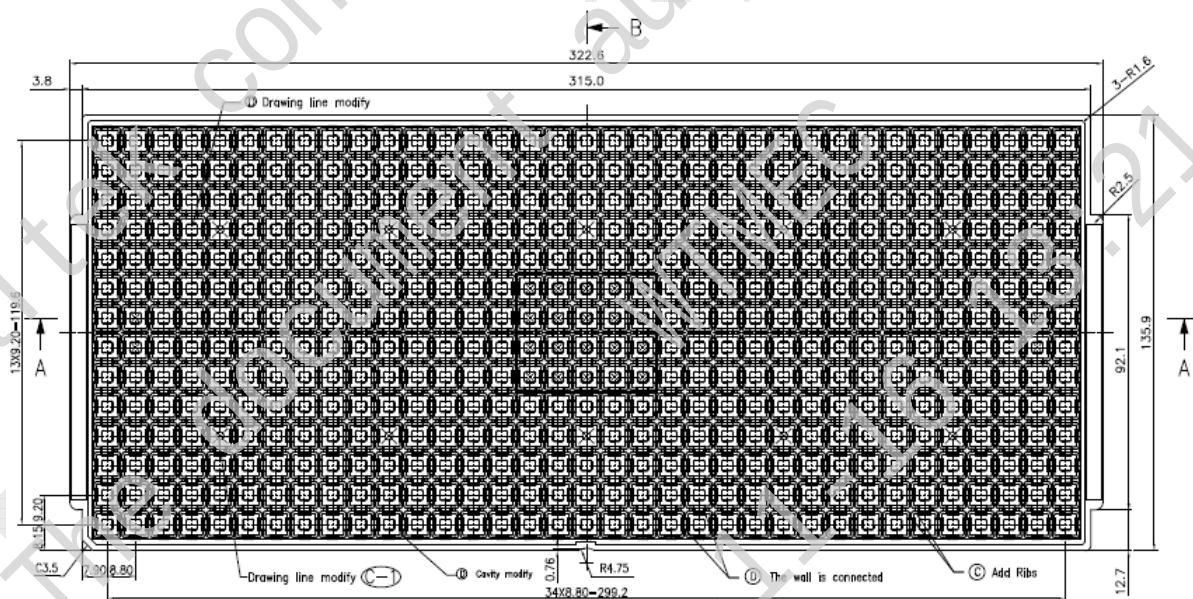


Package Code	Number of Pins	Reel Diameter	Reel Width
QFN40	40	330mm	12mm
QFN48	48	330mm	12mm
QFN68	68	330mm	12mm

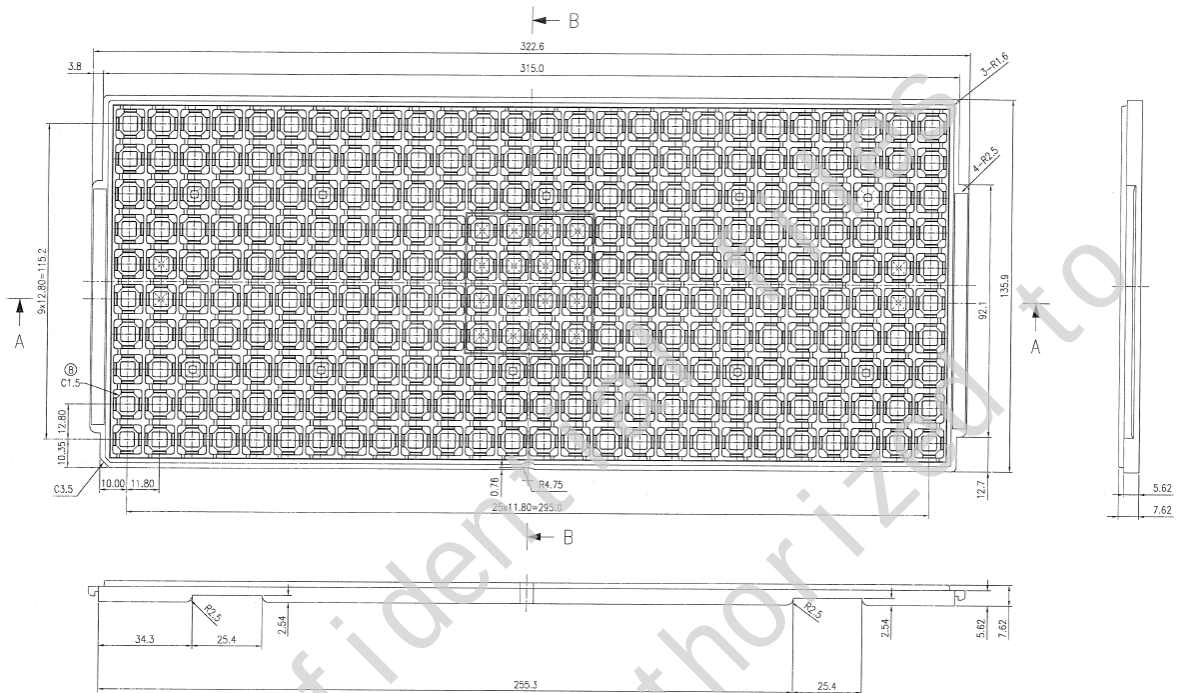
12.12.3. IC Tray Information (QFN40)



12.12.4. IC Tray Information (QFN48)



12.12.5. IC Tray Information (QFN68)



12.12.6. Storage Conditions

	MIN.	TYP.	MAX.
Storage Temperature	-	-	30°C
Storage Humidity	-	-	60%

13. Ordering Information

Table 43. Ordering Information

Part Number	Package	Status
RTL8763BM	QFN-40, 5mm x 5mm Outline; 'Green' Package	MP
RTL8763BF	QFN-40, 5mm x 5mm Outline; 'Green' Package	MP
RTL8763BFR	QFN-40, 5mm x 5mm Outline; 'Green' Package	MP
RTL8763BS	QFN-48, 6mm x 6mm Outline; 'Green' Package	MP
RTL8763BA	QFN-68, 8mm x 8mm Outline; 'Green' Package	MP

Note: See page 11 for package identification information.

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