Bluetooth Module

HSBT3031-08

User Manual

HANSONG (NANJING) TECHNOLOGY CO. , LTD.

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Customer.

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Revision control

Revision	Date/Author	Check by	Approve by	Remarks
V1.0	Bruce/25.11.2021			Initial
V2.0	Bruce/15.02.2022			Optimize FCC ISED Statement

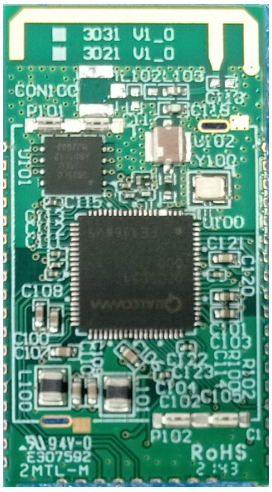
Contents

1 Overview

HSBT3031-08 Bluetooth module is an intelligent wireless audio data dual-mode transmission product independently developed by the company, which is high-end and efficient stereo wireless transmission scheme, the module adopts QCC30xx series chips to provide the module with high quality sound quality and compatibility better performance.

The HSBT3031-08 Bluetooth module adopts the drive free mode. Customers only need to connect the module to the application product, and it can be fast realize the wireless transmission of music and enjoy the fun of wireless music.

2 Features



HSBT3031-08-EA:Ext antenna
HSBT3031-08-IA:PCB antenna

- Main Chipset : QCC-3031-0-80PQFN-TR-00-0
- Fully qualified single-chip dual-mode Bluetooth v5.1 system
- High-performance programmable Bluetooth® stereo audio SoC with Qualcomm® aptX™ audio
- Tri-core processor architecture with low power for extended battery life
- 120 MHz Qualcomm® Kalimba™ audio DSP
- 32 MHz Developer Processor for applications
- Firmware Processor for system
- Flexible QSPI flash programmable platform
- Advanced audio algorithms
- High-performance 24‑bit stereo audio interface
- Digital and analog microphone interfaces
- Flexible PIO controller and LED pins with PWM support
- 1-mic Qualcomm® cVc™ speaker noise reduction and echo cancellation technology
- aptX, aptX HD, aptX Low Latency, SBC, and AAC audio codecs support
- Serial interfaces: UART, Bit Serializer (I^2C/SPI), USB 2.0
- Integrated PMU: Dual SMPS for system/digital circuits, Integrated Li-ion battery charger
- Size :34.1mm x 18.7mm x 3.0mm

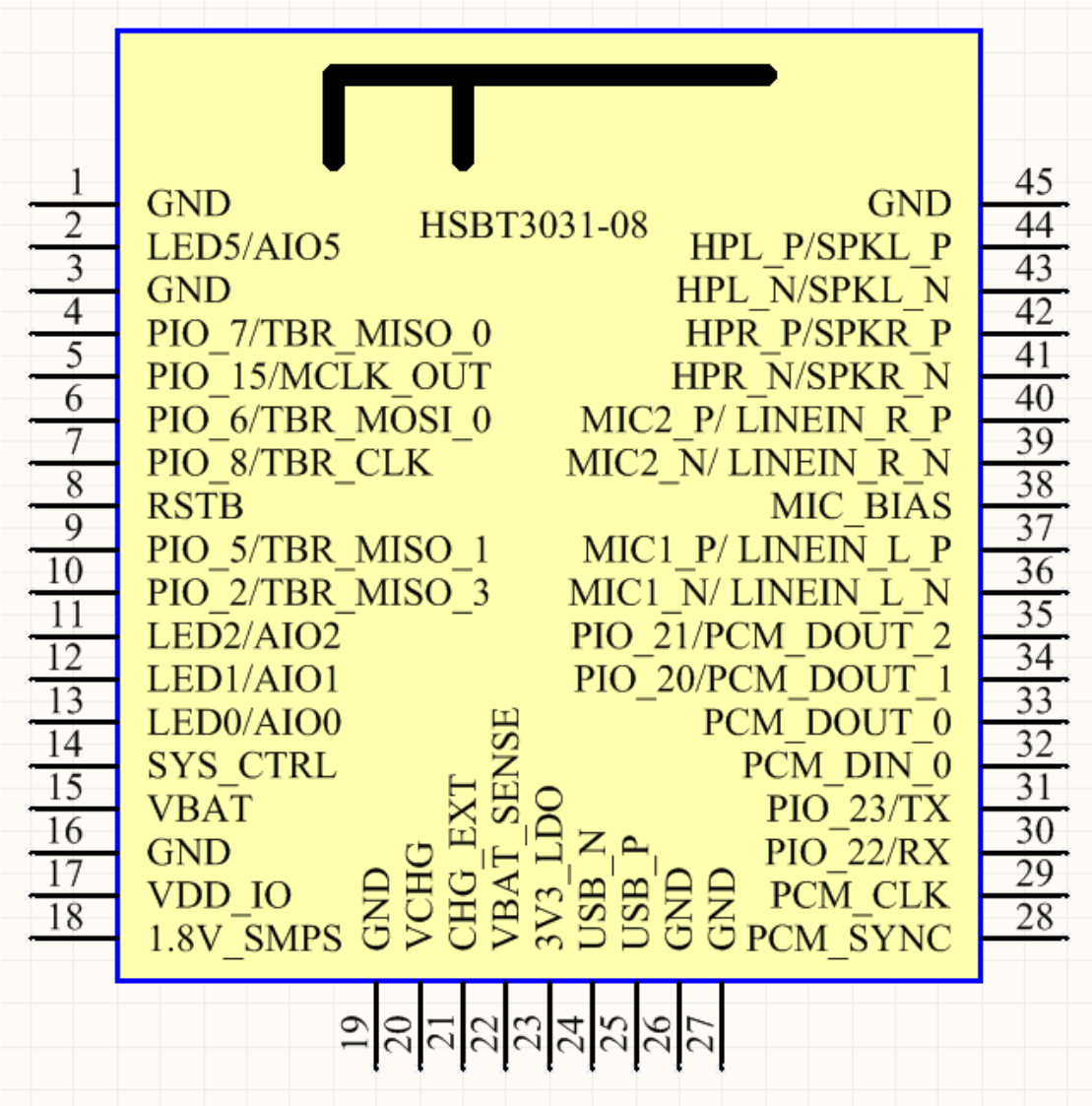
3 Applications

- Stereo Wireless Headsets.
- Wired stereo headsets and headphones.
- Portable stereo speakers.
- Home Audio System.

4 Specifications

Model	HSBT3031-08-08
Bluetooth specifications	Fully qualified single-chip dual-mode Bluetooth v5.1system
Modulation mode	GFSK, π / 4 DQPSK, 8DPSK
Supply voltage	3.3-5.0V
Support Bluetooth protocol	A2DP V1.3.1, AVRCP v1.6, HFP V1.7, HSP v1.2 SPP v1.2，DID v1.3，HOGP v1.0，PXP v1.0.1 FMP v1.0，BAS v1.0
Working current	≤ 20mA
Standby current	< 500uA
Temperature range	- 40 ° C to + 85 ° C
Wireless transmission range	more than 10m
Transmission power	support class 1 / class 2 / class 3 with maximum adjustable 10dbm
Sensitivity	- 80 DBM < 0.1% BER
Frequency range	2.402GHz-2.480GHz
External interface	PIO, SPI, AIO, UART, USB, I2S, MIC, Lin, SPK (L / R)
Support system	Android, IOS and windows
Audio decoding output	aptX, aptX HD, aptX Low Latency, SBC, and AAC
Audio SNR	≥75dB
Distortion	≤ 0.1%
FCC ID	XCO-QCC3031
ISED	7756A-QCC3031
Module size	34.1mm x 18.7mm x 3.0mm

5 Pin view


HSBT3031-08
1 GND
2 LED5/AIO5
3 GND
4 PIO_7/TBR_MISO_0
5 PIO_15/MCLK_OUT
6 PIO_6/TBR_MOSI_0
7 PIO_8/TBR_CLK
8 RSTB
9 PIO_5/TBR_MISO_1
10 PIO_2/TBR_MISO_3
11 LED2/AIO2
12 LED1/AIO1
13 LED0/AIO0
14 SYS_CTRL
15 VBAT
16 GND
17 VDD_IO
18 1.8V_SMPS
19 GND
20 VCHG
21 CHG_EXT
22 VBAT_SENSE
23 3V3_LDO
24 USB_N
25 USB_P
26 GND
27 GND
45 GND
44 HPL_P/SPKL_P
43 HPL_N/SPKL_N
42 HPR_P/SPKR_P
41 HPR_N/SPKR_N
40 MIC2_P/ LINEIN_R_P
39 MIC2_N/ LINEIN_R_N
38 MIC_BIAS
37 MIC1_P/ LINEIN_L_P
36 MIC1_N/ LINEIN_L_N
35 PIO_21/PCM_DOUT_2
34 PIO_20/PCM_DOUT_1
33 PCM_DOUT_0
32 PCM_DIN_0
31 PIO_23/TX
30 PIO_22/RX
29 PCM_CLK
28 PCM_SYNC

6 Pin Assignment

Pin No.	Pin Name	Pin Type	Description
1	GND	GND	Common Ground
2	LED5/AIO5	Analog or digital input/ open drain output.	General-purpose analog/digital input or open drain LED output.
3	GND	GND	Common Ground
4	TBR_MISO_0	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 7. Alternative function: ■ TBR_MISO[0]
5	MCLK_OUT	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 15. Alternative function: ■ MCLK_OUT
6	TBR_MOSI_0	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 6. Alternative function: ■ TBR_MOSI[0]
7	TBR_CLK	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 8. Alternative function: ■ TBR_CLK
8	RSTB	Digital: Bidirectional with programmable strength internal pullup/pull-down	Automatically defaults to RESET# mode when the device is unpowered, or in off modes. Reconfigurable as a PIO after boot. Alternative function: ■ Programmable I/O line 1
9	TBR_MISO_1	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 5. Alternative function: ■ TBR_MISO[1]
10	TBR_MISO_3	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 2. Alternative function: ■ TBR_MISO[3]
11	LED2/AIO2	Analog or digital input/ open drain output.	General-purpose analog/digital input or open drain LED output.
12	LED1/AIO1	Analog or digital	General-purpose analog/digital

		input/ open drain output.	input or open drain LED output.
13	LED0/AIO0	Analog or digital input/ open drain output.	General-purpose analog/digital input or open drain LED output.
14	SYS_CTRL	Digital input	Typically connected to an ON/OFF push button. Boots device in response to a button press when power is still present from battery and/or charger but software has placed the device in the OFF or DORMANT state. Additionally useable as a digital input in normal operation. No pull. Additional function: ■ PIO[0] input only
15	VBAT	Supply	Battery voltage input.
16	GND	GND	Common Ground
17	VDD_IO	Supply	1.8 V/3.3 V PIO supply.
18	1V8_SMPS	Power out	1V8_SMPS out.
19	GND	GND	Common Ground
20	VCHG	Supply	Supply to SMPS power switch from charger input.
21	CHG_EXT	Analog	External charger transistor current control. Connect to base of external charger transistor as per application schematic.
22	VBAT_SENSE	Analog	Battery voltage sense input.
23	3V3_LDO	Power out	Bypass regulator decoupling.
24	USB_N	Digital	USB Full Speed device D- I/O.
25	USB_P	Digital	USB Full Speed device D+ I/O.
26	GND	GND	Common Ground
27	GND	GND	Common Ground
28	PCM_SYNC	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 17. Alternative function: ■ PCM_SYNC
29	PCM_CLK	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 16. Alternative function: ■ PCM_CLK
30	PIO_22	Digital: Bidirectional	Programmable I/O line 22.

		with programmable strength internal pullup/pull-down	Alternative function: ■ UART_RX
31	PIO_23	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 23. Alternative function: ■ UART_TX
32	PCM_DIN_0	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 19. Alternative function: ■ PCM_DIN[0]
33	PCM_DOUT_0	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 18. Alternative function: ■ PCM_DOUT[0]
34	PCM_DOUT_1	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 20. Alternative function: ■ PCM_DOUT[1]
35	PCM_DOUT_2	Digital: Bidirectional with programmable strength internal pullup/pull-down	Programmable I/O line 21. Alternative function: ■ PCM_DOUT[2]
36	MIC1_N/ LINEIN_L_N	Analog	Microphone differential 1 input, negative. Alternative function: ■ Differential audio line input left, negative
37	MIC1_P/ LINEIN_L_P	Analog	Microphone differential 1 input, positive. Alternative function: ■ Differential audio line input left, positive
38	MIC_BIAS	Analog	Mic bias output.
39	MIC2_N/ LINEIN_R_N	Analog	Microphone differential 2 input, negative. Alternative function: ■ Differential audio line input right, negative
40	MIC2_P/ LINEIN_R_P	Analog	Microphone differential 2 input, positive. Alternative function: ■ Differential audio line input right,

			positive
41	HPR_N/SPKR_N	Analog	Headphone/speaker differential right output, negative. Alternative function: ■ Differential right line output, negative
42	HPR_P/SPKR_P	Analog	Headphone/speaker differential right output, positive. Alternative function: ■ Differential right line output, positive
43	HPL_N/SPKL_N	Analog	Headphone/speaker differential left output, negative. Alternative function: ■ Differential left line output, negative
44	HPL_P/SPKL_P	Analog	Headphone/speaker differential left output, positive. Alternative function: ■ Differential left line output, positive
45	GND	GND	Common Ground

7 Interfaces

7.1 USB Interface

HSBT3031-08 has a USB device interface: An upstream port, for connection to a host Phone/PC or battery charging adaptor.

7.1.1 USB device port

The device port is a USB2.0 Full Speed (12 Mb/s) port. Typically HSBT3031-08 enumerates as a compound device with a hub with the enabled audio source / sink / HID / mass storage device appearing behind this hub.

The DP 1.5 k pull-up is integrated in HSBT3031-08. No series resistors are required on the USB data lines.

HSBT3031-08 contains integrated ESD protection on the data lines to IEC 61000-4-2 (device level). In normal applications, no external ESD protection is required.

Extra ESD protection is not required on VCHG (VBUS) because HSBT3031-08 meets the USB

certification requirements of a minimum of 1uF, and a maximum of 10 μF being present on VCHG (VBUS).
The VCHG input of HSBT3031-08 is tolerant of a constant 6.5 V and transients up to 7.0 V. If extra overvoltage protection is required, external clamping protection devices can be used.

7.1.2 USB charger detection

HSBT3031-08 supports charger detection to the USB BCv1.2 standard.
It provides Data Contact Detection (DCD) using an internal current source, and provides:
- Detection of standard downstream ports (SDP)
- Charging downstream ports (CDP)
- Dedicated downstream ports (DCP)

The voltage on the USB data lines can be read by the 10-bit auxiliary ADC. This allows detection of proprietary chargers that voltage bias USB the data lines.
For USB C type connectors, the LED pins can be used to detect the voltage on the CC line pins to detect the charge current capabilities of the upstream device.

7.2 PIO

HSBT3031-08 has the following digital I/O pads:
- 17 PIO pads:
  Including 1 x Reset (active low) pad: PIO[1]
- 4 x pads intended for LED operation: LED[5, 2:0]
- 1 x Output on standard pad: XTAL_CLKOUT
- 1 x Power-on signaling: SYS_CTRL, usable as an input after boot.

7.2.1 PIO pad allocation

The following HSBT3031-08 functions have specific pad allocations:
- LED pads
- Transaction bridge
- Audio I^2S/PCM

NOTE Digital microphones, SPDIF, UART, Bit Serializer (I^2C/SPI), and LED PWM controllers can use any PIO.

7.2.2 Standard I/O

The standard digital I/O pins (PIO) on HSBT3031-08 are split into separate pad domains. Each VDD_PADS domain can be separately powered, from 1.7 V to 3.6 V. When PIOs in a supply domain are used for a high-speed interface, decoupling the respective VDD_PADS pin with a

100 nF decoupling capacitor may be beneficial. The VDD_PADS of a particular pin should be powered before voltages are applied to any PIO powered by that domain, otherwise back powering can occur through the electrostatic discharge (ESD) protection in the pad.
PIO can be programmed to have a pull-up or pull down with two strengths (weak and strong).
PIO can also be programmed with a sticky function where they are strongly pulled to their current input state. PIO have a reset pull state, after reset the pulls can be re-configured by software.
PIO also have a programmable drive strength capability of 2, 4, 8, or 12 mA.
All PIO are readable by all subsystems, but for write access are assigned by software to particular subsystem control. PIO inputs are via Schmitt triggers.

7.3 Transaction bridge

The transaction bridge is an external bridge into the internal transaction bus between HSBT3031-08 subsystems. It is the primary debug interface and can also be used for production programming.
A USB to transaction bridge interface (TRBI200) is available. For details, contact a QTIL sales representative.
The transaction bridge is multiplexed on PIO[8:2], see Table 7.3-1.

NOTE A direct USB2.0 connection from a host computer to the HSBT3031-08 can be used for most debugging and programming activities. For more details, see ADK documentation.
TRBI200 can use USB3.0 for maximum data rate.

NOTE USB3.0 signals can generate noise in the Bluetooth ISM band. For applications where sensitive RF measurements take place, QTIL recommends connecting TRBI200 using USB2.0.
The transaction bridge is a multilane interface, and only requires three wires for its minimum configuration (suitable for production programming).

NOTE The TRBI200 USB transaction bridge interface requires power for input/output buffers to be supplied externally. This voltage must match the power supply domain used for the TRB pads (VDD_PADS_1).

NOTE Minimum configuration is sufficient for production programming and code download, but not for extensive debug and code tracing. The configuration in use is automatically detected.

Table 7.3-1 Transaction bridge PIO multiplex

TRB	PIO	Required for minimum configuration	Intermediate configuration	Full bus width
TBR_CLK	PIO[8]	Yes	Yes	Yes
TBR_MISO[0]	PIO[7]	Yes	Yes	Yes
TBR_MOSI[0]	PIO[6]	Yes	Yes	Yes
TBR_MISO[1]	PIO[5]	No	Yes	Yes
TBR_MOSI[1]	PIO[4]	No	Yes	Yes
TBR_MISO[2]	PIO[3]	No	No	Yes
TBR_MISO[3]	PIO[2]	No	No	Yes

NOTE PIO[7] should not be held low during boot.

Transaction bridge debug access is lockable. When locked, this interface only becomes active after the correct unlock key sequence is provided.

7.4 RESET# reset

The HSBT3031-08 digital reset pin (RESET#) is an active low reset signal. PIO[1] defaults to RESET# upon boot.

The pin is active low and on-chip glitch filtering avoids the need to filter out any spurious noise that may cause unintended resets. The RESET# pin has a fixed strong pull-up to VDD_PADS_1, and therefore can be left unconnected. The input is asynchronous, and is pulse extended within HSBT3031-08 to ensure a full reset.

HSBT3031-08 contains internal Reset Protection functionality to automatically keep the power rails enabled and enable the system to restart after unintended reset (such as a severe ESD event). Assertion of RESET# beyond the Reset Protection timeout (typically greater than ~1.8 s) causes the device to power down if VCHG is not present and SYS_CTRL is low. HSBT3031-08 then requires a SYS_CTRL assertion or VCHG attach to restart.

NOTE HSBT3031-08 is always powered if VCHG is present. It does not power down if RESET# is asserted while VCHG remains present.
QTIL recommends that HSBT3031-08 is powered down via software-controlled methods rather than external assertion of RESET#.
Holding RESET# low continuously is not the lowest HSBT3031-08 power state, because pull downs are enabled on VCHG and VDD_BYP in this state.
RESET# is guaranteed to work if held low for 120us.
After boot, PIO[1] is configurable as a digital PIO.

7.5 SYS_CTRL

SYS_CTRL is an input pin that acts as a power on signal for the internal regulators. It can also be used as an input (appears to software as virtual PIO[0]) or as a multifunction button.

From the OFF state, SYS_CTRL must be asserted for >20 ms to start power up.

SYS_CTRL is VBAT tolerant (4.8 V max), and typically connected via a button to VBAT.

SYS_CTRL has no internal pull resistor, and requires an external pull-down if left undriven.
SYS_CTRL can be logically disconnected from the power on signal for internal regulators by software. Therefore, for example, once booted, software takes control of the internal regulators and the state of SYS_CTRL is ignored by the regulators.

7.6 LED Drivers

7.6.1 LED pads

HSBT3031-08 contains LED pads that are configurable in four different operating modes:

1. LED Driver: This mode is designed for driving LEDs. The pad operates as an open-drain pad, tolerable of voltages up to 7.0 V. Therefore the cathode of the LED should be connected to the HSBT3031-08 LED pad.

Each pad is rated to sink up to 50 mA of current.

2. Digital / Button input: This mode is designed for slow input signals, typically buttons. It is not designed for fast switching digital inputs like SPI. For these types of inputs, use the standard PIOs.

In this mode, an internal weak pull-down can be enabled. Typically this is used for active high button signals to

ensure that the input returns to 0 when the button is released. The pads are 7.0 V tolerant and the logic 1 threshold is typically 1 V.

In digital input mode, the logic inputs can be read by the software as virtual PIO[71, 68:66].

3. Analog input: In this mode, the LED pad is used as an analog input port. The pad voltage is routable to a 10‑bit auxiliary ADC.

4. Disabled: This is the default state for LED pads, where the pad is 7.0 V tolerant and a high impedance with no pull-down.

NOTE LED[1] pin will be driven to ground level for up to 6 ms within 50 ms of the chip powering up from off state or after chip reset being released.
Other LED pins might be driven to ground level for up to 300us within 50 ms of the chip powering up from off state.

7.6.2 LED controllers

HSBT3031-08 has six PWM-based LED controllers controlled by the Applications subsystem. Use them for driving either the LED pads (through virtual PIOs) or other available PIOs.
An application may configure the LED flash rate and ramp time using a dedicated API.
Once configured, the LED flash and ramp rate are fully hardware controlled within the LED/PWM module. It is possible to synchronize any number of the LED drivers together. Use the flash/ramp rate configuration to generate color change sequences on RGB LEDs.
LED outputs are able to operate in Deep Sleep state, but not in Dormant state.

7.7 Audio interfaces

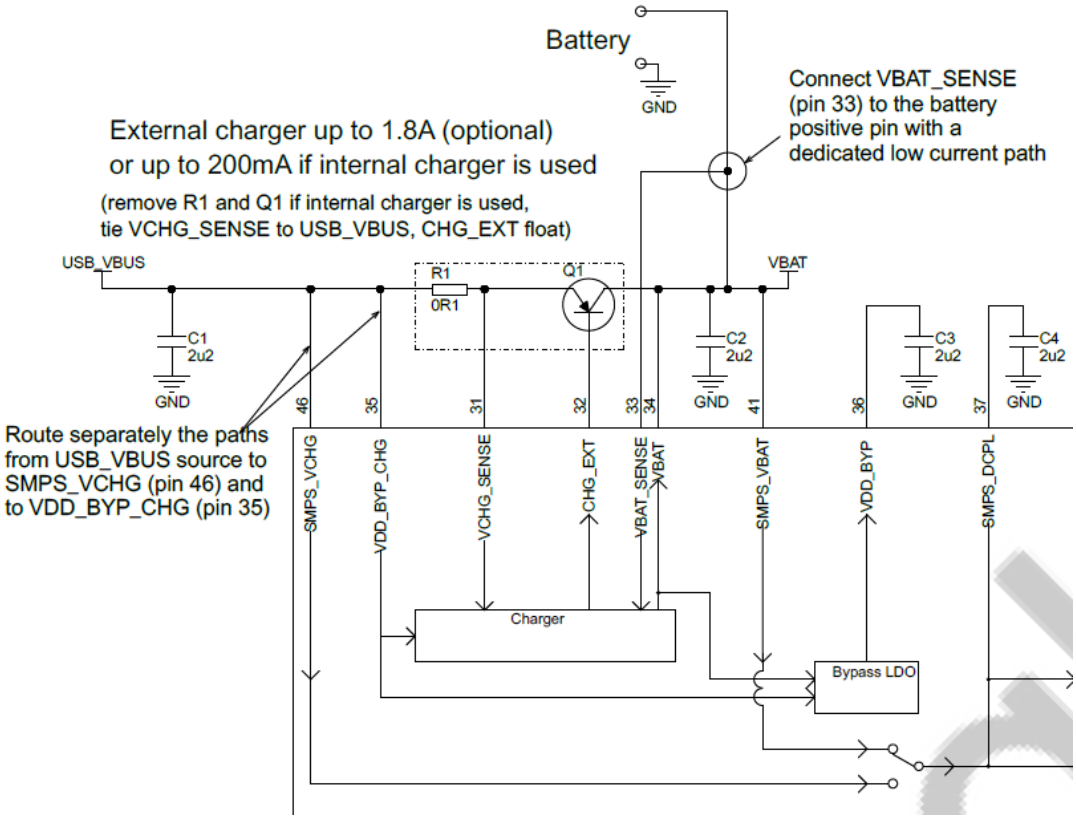
- 24-bit I²S interface with 1 input and 3 output channels
- Programmable audio master clock (MCLK).
- Sony/Philips digital interface (SPDIF): 2, configurable as input or output
- Stereo analog Class-AB headphone outputs:
  - ☐ Class-AB signal-to-noise ratio (SNR): ⩾75dB.
  - ☐ Class-AB total harmonic distortion plus noise (THD +N): ⩽0.1%.
- Dual analog inputs configurable as single ended line inputs or, unbalanced or balanced analog microphone inputs:
  - ☐ SNR single-ended: ⩾75dB.
  - ☐ THD+N single-ended: ⩾75dB.
- 1 microphone bias (single bias shared by the two channels).
  - ☐ Crosstalk attenuation between two inputs using recommended application circuit: ⩾ 75dB.
- Digital microphone inputs with capability to interface up to 6 digital microphones.
- Both analog-to-digital converter (ADC)s and digital-toanalog converter (DAC)s support sample rates of 8, 16, 32, 44.1, 48, 96 kHz. DACs also support 192 kHz.

8 Battery Charger

The HSBT3031-08 Li-ion charger is designed to support small to large batteries (several Amp hours). It is connectable in one of two modes:

■ Internal configuration: Supporting charge rates of 2 mA to 200 mA with no external components required.

■ External configuration: Supporting charge rates of 200 mA to 1800 mA with the addition of one PNP pass device and external resistor.



The charger system has five main operating states. The current charger status can be read by application software.

Figure 8-1 shows the five states in the charge cycle.

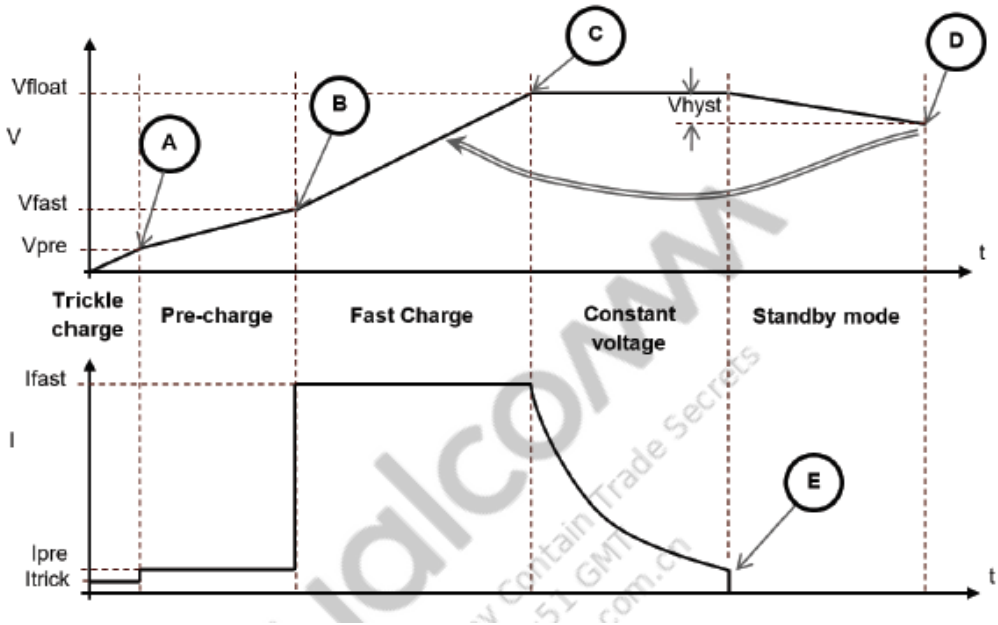


Figure 8-1 Charge cycle states

Trickle charge

This mode is entered when VBAT is sensed in the range 0 to Vpre. This is encountered only with a deeply discharged battery (below Vpre threshold, point (A)), or when the cell's battery protection circuit has opened, temporarily disconnecting the cell. It is used to pass a small charging current to safely charge a cell, and also cause a cell battery protection circuit to reset. The hysteresis on Trickle charge into Pre-Charge is typically 100 mV.

During Trickle charge, HSBT3031-08 controls charge current internally. The external pass transistor is not used.

Parameters in Trickle charge

Parameter	Description	Min	Typ	Max
Vpre threshold (A)	Voltage at which the charger transitions out of Trickle charge into Pre-charge.	2.0 V	2.1 V	2.2 V
Itrick	Trickle charge current.	1 mA	-	50 mA

Pre-charge

This mode is entered when VBAT is sensed in the range Vpre to Vfast. In this range, it is not recommended to charge the cell at maximum rate, but a faster charge rate than that of Trickle charge is allowable. Typically this is ~10 % to 20 % of the Fast charge rate. The Vfast threshold, point (B) is programmable.

The hysteresis on the Vfast transition from Pre-Charge to Fast charge is typically 200 mV.

During Pre-Charge, HSBT3031-08 controls the charge current internally and the external pass transistor is not used.

Parameters in Pre-charge

Parameter	Description	Min	Typ	Max
Vfast threshold (B)	Voltage at which the charger transitions out of Pre-charge into Fast charge.	0 = 2.8 V 1 = 2.9 V 2 = 3.0 V 3 = 2.4 V	0 = 2.9 V 1 = 3.0 V 2 = 3.1 V 3 = 2.5 V	0 = 3.0 V 1 = 3.1 V 2 = 3.2 V 3 = 2.6 V
Ipre	Pre-charge current.	2 mA	-	200 mA

Fast charge

Fast charge has two parts:

■ Constant current: Entered when VBAT is sensed in the range Vfast to Vfloat point (C). This is the maximum charge rate, and should be set according to the battery manufacturers Data Sheet.

■ Constant voltage: When Vfloat is reached the cell voltage is maintained at Vfloat, and the current slowly reduces until the termination point (E) is reached where charging ceases, and the charger transitions to Standby mode.

Vfloat can be configured from 3.65 V to 4.40 V in 50 mV increments. This allows use of cells with different Vfloat values, or cell life extension by reducing Vfloat. Vfloat can also be altered depending on temperature change, for cell life protection.

The current termination point (E) can be adversely influenced by dynamic changes in VBAT load current, or to a lesser extent changes in VCHG voltage.

Parameters in Fast charge

Parameter	Description	Min	Typ	Max
Ifast	Ifast Fast charge current (Internal mode).	2 mA	-	200 mA
Ifast	Ifast Fast charge current (External mode).	-	-	1.8 A
Termination point (E)	Transition from fast charge (constant voltage) to Standby. Expressed as % of Ifast.	-	0 = 10 1 = 20 2 = 30 3 = 40	-

Standby mode

Once the charge current has fallen and the charger is terminated, the system enters Standby mode. In Standby mode, the charger does not charge. It continues to monitor the battery voltage. If the voltage falls back below Vfloat

by more than a configurable threshold Vhyst, point (D), then the charger re-enters Fast charge mode. Vhyst is expressed as a percentage of Vfloat.

In this way, the charger system maintains the cell near full charge while prolonging cell life.

Parameters in Standby mode

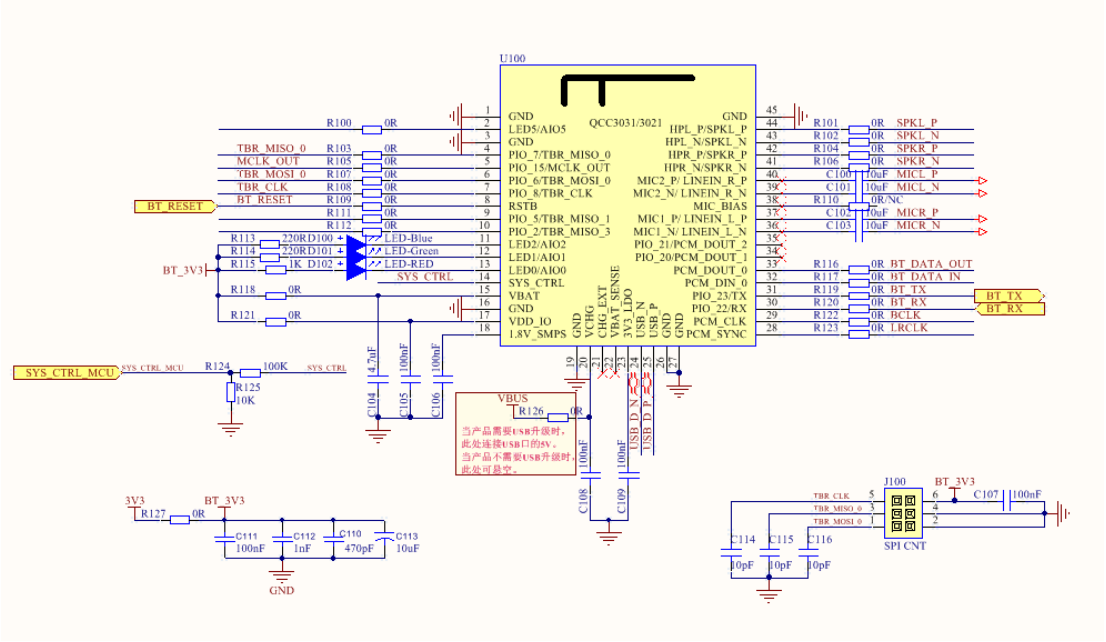
Parameter	Description	Min	Typ	Max
Vhyst threshold (D)	Percentage of Vfloat at which the charger moves from Standby back to Fast charge.	0 = 1.8 1 = 3.0 2 = 4.2 3 = 5.4	0 = 2.4 1 = 3.6 2 = 4.8 3 = 6.0	0 = 3.0 1 = 4.2 2 = 5.4 3 = 6.5

9 Power supply

The system have three power supply mode:

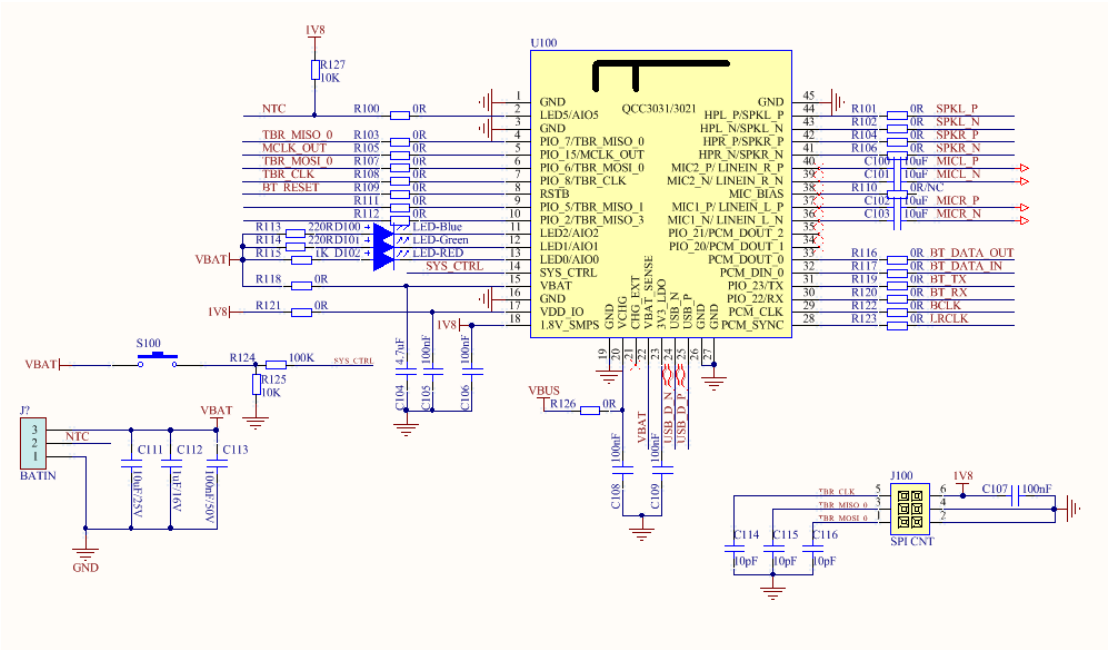
Mode1: Single 3.3V only supply (3.3V I/O)

For improving the noise, recommend adding one 10Uf capacitor on the power supply pin



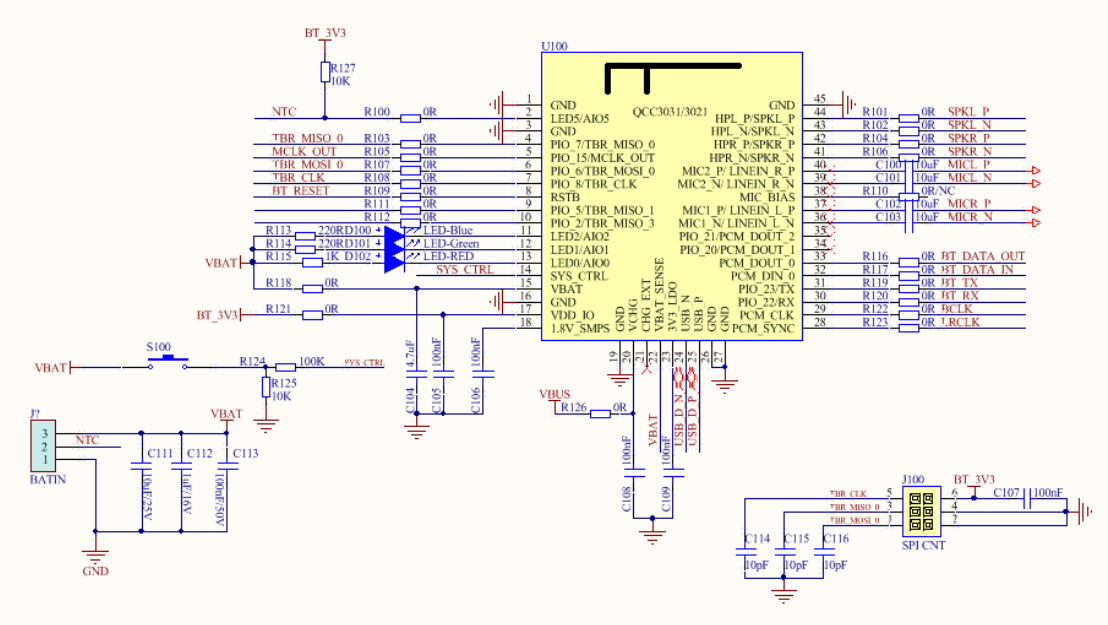
Mode2. VBAT only supply (1.8V I/O).

For improving the noise, recommend adding one 10Uf capacitor on the power supply pin



Mode3. VBAT and 3.3V both supply (3.3V I/O).

For improving the noise, recommend adding one 10Uf capacitor on the power supply pin



10 General Specifications

10.1 Absolute Maximum Ratings:

Ratings	Min.	Max.	Unit
Storage Temperature	-40	+85	℃
Supply Voltage (VCHG)	-0.4	7.0	V
Supply Voltage (VBAT)	-0.4	4.8	V
Supply Voltage (VDD_PADS_1 3_4)	-0.4	3.8	V
RSTB	-0.4	3.8	V
AIO/LED[5, 2:0] (Disabled / Digital Input / Open Drain Output Modes)	-0.4	7.0	V
AIO/LED[5, 2:0] (AIO Mode)	-0.4	2.1	V
SYS_CTRL	-0.4	4.8	V

10.2 Recommended Operating Condition:

Ratings	Min	Typ	Max	Unit
Operating Temperature range	-40	20	+85	℃
Supply Voltage (VCHG)	4.0	5.0	6.5	V
Supply Voltage (VBAT)	2.8	3.7	4.6	V
Supply Voltage (VDD_PADS_1 3_4)	1.7	1.8	3.6	V
RSTB	0	-	3.3	V
AIO/LED[5, 2:0] (Disabled / Digital Input / Open Drain Output Modes)	0	-	6.5	V
AIO/LED[5, 2:0] (AIO Mode)	0	-	1.95	V
SYS_CTRL	0	-	4.6	V

10.3 Battery Charger

NOTE **Unless specified otherwise, all specifications are applicable over the charger operating temperature range stated in Recommended operating conditions.**

Trickle charge mode	Min	Type	Max	Unit
VPRE threshold (rising)	2.0	2.1	2.2	V
VPRE threshold (falling)	1.9	2.0	2.1	V
Trickle charge current: VCHG: 4.25 V to 6.5 V VBAT: 0 V to 2.2 V	1	-	50	mA

Pre-charge mode		Min	Type	Max	Unit
VFAST threshold (rising) Configured by application software	0	2.8	2.9	3.0	V
	1	2.9	3.0	3.1	V
	2	3.0	3.1	3.2	V
	3	2.4	2.5	2.6	V
VFAST threshold (falling) hysteresis		0.15	0.2	0.25	V

Fast charge modes	Min	Type	Max	Unit
Internal fast charge accuracy: VCHG: 5 V VBAT: 3.4 V Temperature: 25° C	197 (1.5%)	200	203 (+1.5%)	mA
Internal fast charge accuracy: VCHG: 4.75 V to 6.5 V VBAT: 2 V to 4.2 V VCHG-VBAT ⩾ 0.55 V	194 (-3%)	200	206 (+3%)	mA
Internal fast charge accuracy (Low VCHG voltage) VCHG: 4.4 V to 6.5 V VBAT: 2 V to 4.2 V VCHG-VBAT ⩾ 0.15 V	100 (-50%)	200	206 (+3%)	mA

Fast charge modes		Min	Type	Max	Unit
Battery Voltage VCHG: 5 V Temperature: 25° C		4.18 (-0.5%)	4.2	4.22 (+0.5%)	V
Battery Voltage VCHG : VFLOAT+50 mV to 6.5 V		4.16 (-1%)	4.2	4.24 (+1%)	V
Termination current Termination accuracy as a percentage of fast charge.	0	7	10	13	%
	1	17	20	23	%
	2	27	30	33	%
	3	37	40	43	%

Standby mode		Min	Type	Max	Unit
VFAST threshold (rising) Configured by application software	0	1.8% (75 mV at 4.2 V)	2.4% (100 mV at 4.2 V)	3.0% (125 mV at 4.2 V)	%
	1	3.0% (125 mV at 4.2V)	3.6% (150 mV at 4.2 V)	4.2% (175 mV at 4.2 V)	%
	2	4.2% (175 mV at 4.2 V)	4.8% (200 mV at 4.2 V)	5.4% (225 mV at 4.2 V)	%
	3	5.4% (225 mV at 4.2 V)	6.0% (250 mV at 4.2 V)	6.5% (275 mV at 4.2 V)	%

Charger headroom error mode	Mln	Typ	Max	Unit
Headroom error threshold (falling)	30	65	100	mV
Headroom error threshold (rising)	95	140	170	mV

Charger Vbat overvoltage mode	Mln	Typ	Max	Unit
Overvoltage (rising)	4.65	4.7	4.75	V
Headroom error hysteresis	-	100	-	mV
Headroom error threshold (falling)	4.55	4.6	4.65	V

Charger with external transistor mode	Mln	Typ	Max	Unit
External fast charge current, IFAST	0.2	-	1.8	A
External pass device hfe	45	120	700	-
Charger with external transistor mode accuracy[a]	max			-
	The accuracy is the sum of the following: ■ ±3.5% of current corresponding to 100 mV drop across the external sense resistor[b] ■ ± accuracy of the external sense resistor and PCB trace resistance between VDD_BYP_CHG and the external sense resistor ■ – % charge current reduction due to base current of the external pass transistor given by 1/(hfe + 1) ■ + % charge current increase			

	related to the current drawn by the Bypass LDO[c]	

a To achieve specified accuracy, follow layout recommendations in QCC3031 QFN Hardware Design Guide (80-CG380-1).

b Resistor value should be chosen such that the maximum fast charge current corresponds to 100 mV of voltage drop.

C Varies linearly with the total current (internal + external) drawn by the Bypass LDO; worst case inaccuracy is +3% corresponding to 50 mA Bypass LDO output.

10.4 10-bit auxiliary ADC

		Min	Typ	Max	Unit
Resolution		-	-	10	Bits
VDD_AUX_ADC[a]		1.746	1.8	1.854	V
Functional input voltage range[b]		0	-	VDD_AUX_ADC	V
Accuracy (Guaranteed monotonic)[c]	INL	-3	-	3	LSB
	DNL	-1	-	2	LSB
Offset		-1	-	1	LSB
Gain error		-1	-	1	%
Hardware conversion time[d]		-	10	-	us
LED pad leakage		-1	-	1	uA
External pad capacitance for < 0.5 LSB error		0	100	-	nF

a Internal voltage reference.

b LSB size = VDD_AUX_ADC/1023.

c Accuracy guaranteed for input signal range: [4LSBs; Full scale - 4LSBs].

d Software may introduce additional delay.

10.5 Digital terminals

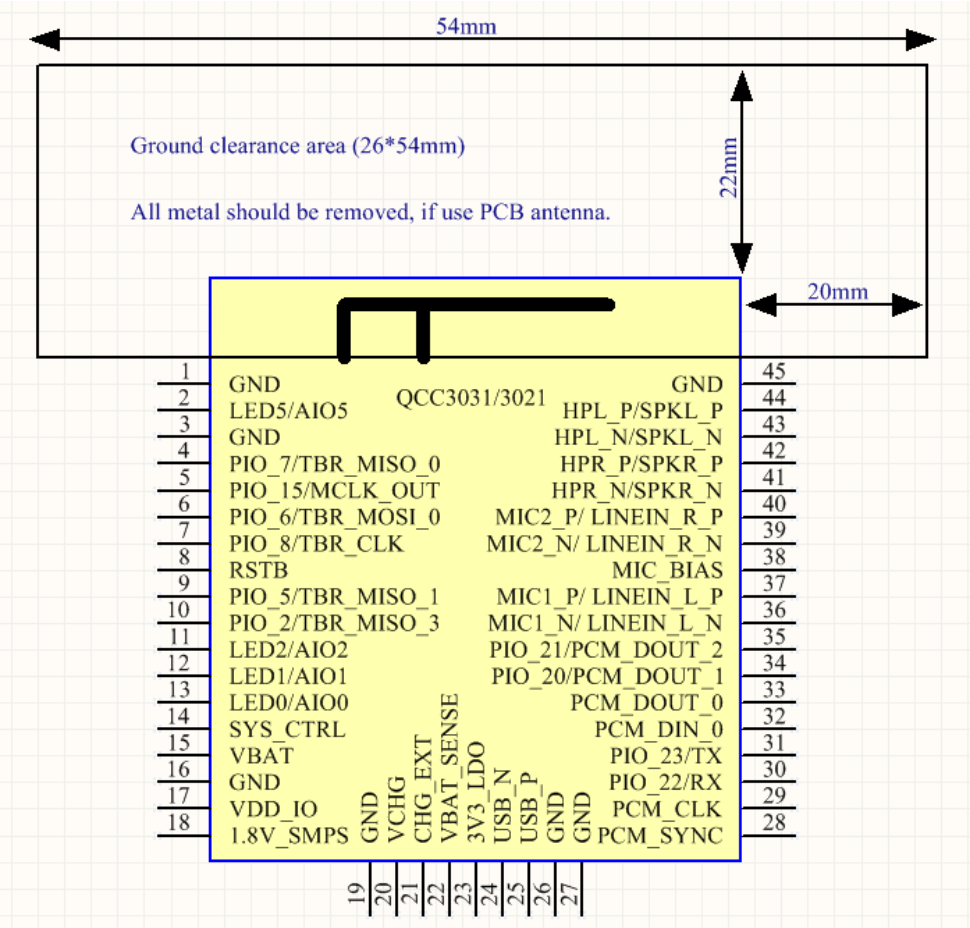
	Min	Typ	Max	Unit
VDD_PADS supply	1.7	1.8	3.6	V
VIL input logic level low	-	-	0.22 x VDD_PADS	V
VIH input logic level high	0.7 x VDD_PADS	-	-	V
Drive current (configurable)	2, 4, 8, 12	4	-	mA
VOL output logic level low, at max rated drive	-	-	0.22 x VDD_PADS	V
VOH output logic level high, at max rated drive	0.75 x VDD_PADS	-	-	V

Strong pull (up & down)	**15**	**65**	**150**	**kΩ**
Weak pull (up & down)	**500**	**2200**	**5000**	**kΩ**

10.6 LED Driver Pads

LED Driver Pads		Min	Typ	Max	Unit
Open drain current	**High impedance state**	**-**	**-**	**5**	**uA**
	Current sink state	**-**	**-**	**50**	**mA**
LED pad resistance	**V < 0.5 V**	**-**	**-**	**12**	**Ω**
VIL input logic level low		**-**	**-**	**0.4**	**V**
VIH input logic level high		**1.0**	**-**	**-**	**V**

11 Layout Notes



A. If there is battery, metal, LCD, loudspeaker, etc. beside the module antenna, it is required to be at least 15mm away from the antenna

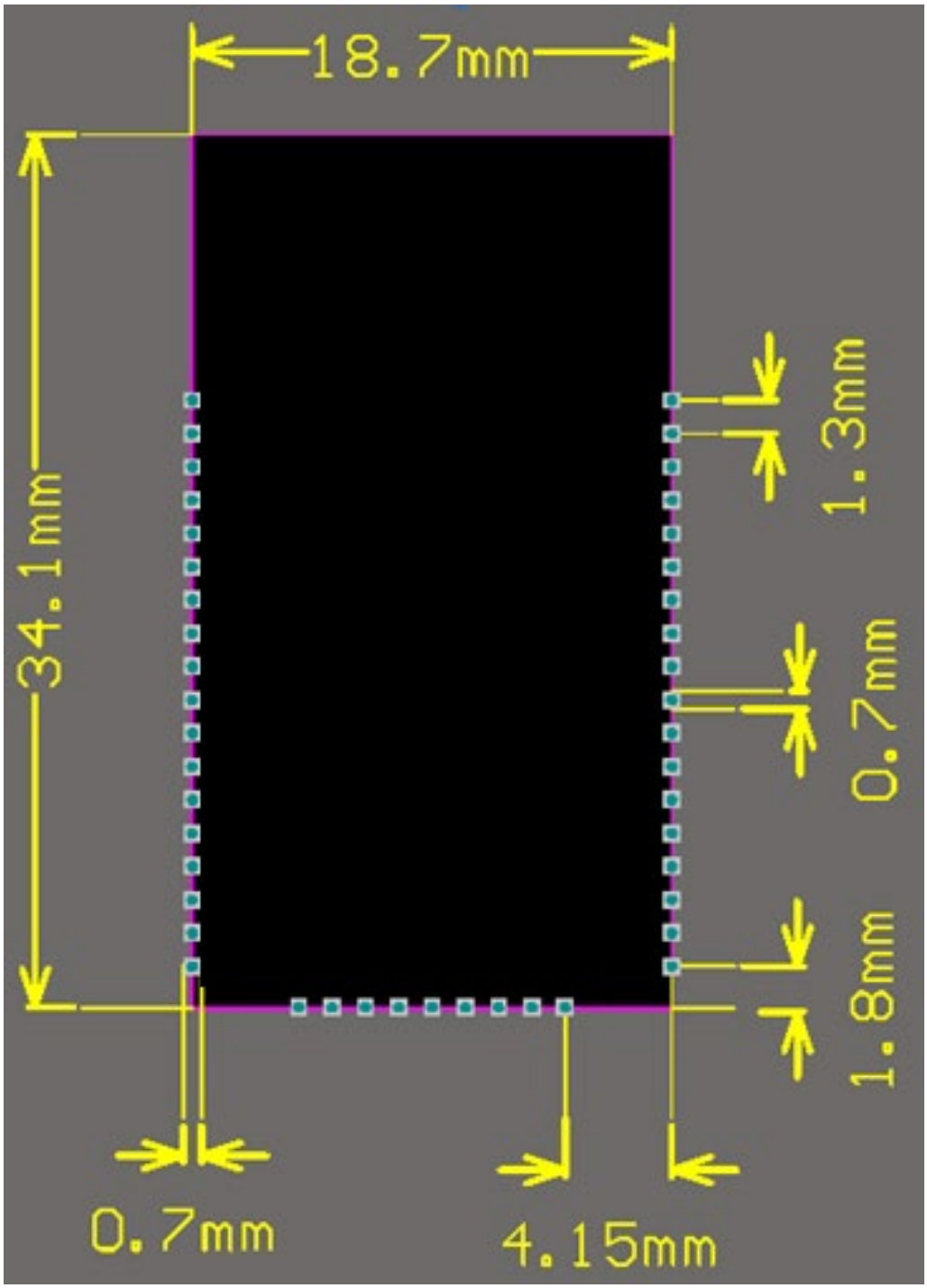
B. It is recommended to use star routing for the power supply line during layout, and ensure that the power supply linearity of Bluetooth module is good, and the ground of BT is also available

It must be separated from the ground of operational amplifier, power amplifier, MCU, etc., and there shall be no other interference ground under BT

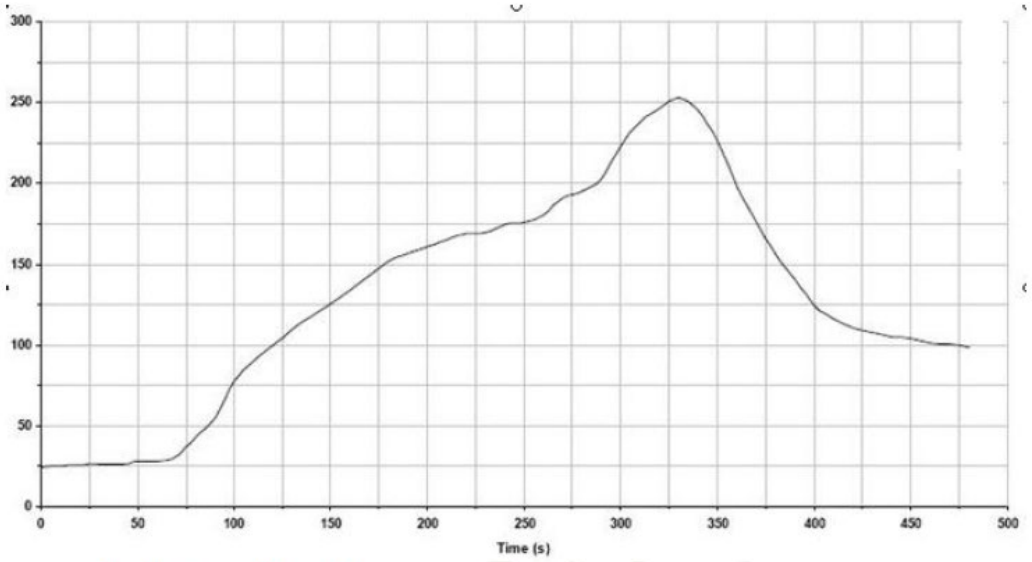
C. Do not walk around the antenna control line, power line, audio line, MIC and other interference lines

D. If there is a row base near the module antenna and the shell has metal iron mesh which has an impact on the signal, it is recommended to select a professional high-rise heater beneficial antenna.

12 Module Dimension



13 Reflow temperature



Key features of the profile:

-Initial Ramp=1-2.5℃/sec to 175℃ equilibrium

-Equilibrium time=60 to 80 seconds

-Ramp to Maximum temperature (250℃)=3℃/sec Max

-Time above liquidus temperature(217℃): 45 - 90 seconds

-Device absolute maximum reflow temperature: 250℃

14 FCC ISED Statement

FCC

Important Notice to OEM integrators
1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).
3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations
4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s). The Grantee will provide guidance to the host manufacturer for Part 15 Subpart B requirements if needed.

notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to Hansong (Nanjing) Technology Co,LTD. that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

When the module is installed in the host device, the FCC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: “Contains FCC ID: XCO-QCC3031”. The FCC ID can be used only when all FCC compliance requirements are met.

(1) The antenna must be installed such that 20 cm is maintained between the antenna and users,
(2) The transmitter module may not be co-located with any other transmitter or antenna.
In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is

no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.
To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed below.

Antenna Type	Antenna Gain (dBi)
Onboard PCB Antenna	1.97
External PCB Antenna	4.15
External Rod Antenna	2.0

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Any changes or modifications not expressly approved by Hansong (Nanjing) Technology Co,LTD. for compliance could void the user's authority to operate this equipment.
This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

This module has been tested and found to comply with FCC Part 15C requirements

for Modular Approval.
The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

ISED

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:
(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body

Déclaration d'exposition aux radiations:
Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna. As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

In the event that these conditions cannot be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed below.

Antenna Type	Antenna Gain (dBi)
Onboard PCB Antenna	1.97
External PCB Antenna	4.15
External Rod Antenna	2.0

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains IC: 7756A-QCC3031”.

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20 cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 7756A-QCC3031".
The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user’s manual of the end product which integrates this module.
The end user manual shall include all required regulatory information/warning as show in this manual.

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.
Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.