Bluetooth Module
HSBT5181
Product Specification

HANSONG (NANJING) TECHNOLOGY CO. , LTD.

APROVED	MANAGER	CHECKED	FILLED

Customer.

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Revision control

Revision	Date	Check by	Author	Remarks
V1.0	2023.7.21		Echo.Lu	Initial

Contents

1 Overview

HSBT5181 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 QCC5181 series chips to provide the module with high quality sound quality and compatibility better performance.

The HSBT5181 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

- Main Chipset : QCC5181
- Qualified to Bluetooth v5.4 specification
- Dual 240 MHz Qualcomm® Kalimba™ audio DSPs
- 32/80 MHz Developer Processor for applications
- Firmware Processor for system
- Flexible QSPI flash programmable platform

- High-performance 24‑bit stereo audio interface

- Digital and analog microphone interfaces
- Flexible LED controller and LED pins with PWM support
- Serial interfaces: UART, Bit Serializer (I²C/SPI), USB 2.0
- Advanced audio algorithms
- Active Noise Cancellation: Hybrid, Feedforward, and Feedback modes, using Digitalor Analog Mics, enabled using license keys available from Qualcomm®
- Qualcomm® aptX™ and aptX HD Audio
- aptX Adaptive, enabled using license key
- Qualcomm® cVc™ Noise Cancellation Technology, enabled using license key
- Integrated PMU: Dual SMPS for system/digital circuits,Integrated Li-ion battery charger
- 99-ball 4.930 mm x 3.936 mm x 0.57 mm, 0.4 mm pitch WLCSP
- Integrated dual switch-mode regulators, linear regulators, and battery charger
- Green (RoHS compliant and no antinomy or halogenated flame retardants)
- Size 34.1mm x 18.7mm x 3.0mm

3 Applications

- Stereo Wireless Headsets.

- Wired stereo headsets and headphones.
- Portable stereo speakers.
- Analog and USB Mulitmedia Dongle.
- Home Audio System.
- Qualcomm TrueWireless™ stereo earbuds

4 Specifications

Model	HSBT5181
Bluetooth specifications	Qualified to Bluetooth v5.4 specification
Modulation mode	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
Charger operating temperature range	- 10 ° C to + 85 ° C
Wireless transmission range	more than 10m
Transmission power	support class 1
Sensitivity	Typ -96 DBM at 0.1% BER
Frequency range	2.402GHz-2.480GHz
External interface	PIO, SPI, AIO, UART, USB, I2S, MIC,I2C, PCM, SPK (L / R)
Support system	Android, IOS and windows
Audio decoding output	APTX(QCC5181)
Audio SNR	≥88dB
Distortion	≤ 0.1%
Module size	36mm x 18.5mm x3.8mm

HANSONG（NANJING) TECHNOLOGY CO.,LTD

7 Pin Assignment

Terminal	Pin Name	Pin Type	Description
1.	GND	GND	Common Ground
2.	CAP 0	NC	NC
3.	CAP 1	NC	NC
4.	CAP 2	NC	NC
5.	CAP 3	NC	NC
6.	CAP 4	NC	NC
7.	CAP 5	NC	NC
8.	GND	GND	Common Ground
9.	PIO_21	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 21. Alternative function: ■ PCM_DOUT[2]
10.	PIO_15	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 15. Alternative function: ■ MCLK_OUT
11.	PIO19/PCM_IN	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 19. Alternative function: ■ PCM_DIN[0]
12.	PIO16/PCM_CLK	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 16. Alternative function: ■ PCM_CLK
13.	PIO17/PCM_SYNC	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 17. Alternative function: ■ PCM_SYNC
14.	PIO18/PCM_OUT	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 18. Alternative function: ■ PCM_DOUT[0]
15.	GND	GND	Common Ground
16.	PIO1/RST#	Digital: Bidirectional with programmable strength internal pull-up/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
17.	PIO5/SPI_CS	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 5. Alternative function: ■ TBR_MISO[1]
18.	PIO7/SPI_MISO	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 7. Alternative function: ■ TBR_MISO[0]
19.	PIO8/SPI_CLK	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 8. Alternative function: ■ TBR_CLK
20.	PIO6/SPI_MOSI	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 6. Alternative function: ■ TBR_MOSI[0]
21.	GND	GND	Common Ground
22.	PIO3/RXD	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 3. Alternative function: ■ TBR_MISO[2]
23.	PIO2/TXD	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 2. Alternative function: ■ TBR_MISO[3]
24.	PIO4/RTS	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 4. Alternative function: ■ TBR_MOSI[1]
25.	PIO20/CTS	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 20. Alternative function: ■ PCM_DOUT[1]
26.	GND	GND	Common Ground
27.	LED0/AIO0	Analog or digital input/ open drain output.	General-purpose analog/digital input or open drain LED output.
28.	LED1/AIO1	Analog or digital input/ open drain output.	General-purpose analog/digital input or open drain LED output.
29.	LED2/AIO2	Analog or digital input/ open drain output.	General-purpose analog/digital input or open drain LED output.
30.	LED3/AIO3	Analog or digital input/ open drain output.	General-purpose analog/digital input or open drain LED output.
31.	NC	NC	NC
32.	NC	NC	NC
33.	NC	NC	NC
34.	GND	GND	Common Ground
35.	MIC4_N	Analog	Microphone differential 4 input, negative. Alternative function: ■ Differential audio line input 4,

			negative
36.	MIC4_P	Analog	Microphone differential 4 input, positive. Alternative function: ■ Differential audio line input 4, positive
37.	NC	NC	NC
38.	MIC3_N	Analog	Microphone differential 3 input, negative. Alternative function: ■ Differential audio line input 3, negative
39	MIC3_P	Analog	Microphone differential 3 input, positive. Alternative function: ■ Differential audio line input 3, positive
40	NC	NC	NC
41	NC	NC	NC
42	GND	GND	Common Ground
43	NC	NC	NC
44	NC	NC	NC
45	NC	NC	NC
46	NC	NC	NC
47	NC	NC	NC
48	PIO39/QSPI2_IO3	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 39. Alternative function: ■ QSPI2_IO[3]
49	PIO36/QSPI2_IO2	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 36. Alternative function: ■ QSPI2_IO[2]
50	PIO37/QSPI2_IO1	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 37. Alternative function: ■ QSPI2_IO[1]
51	PIO34/QSPI2_IO0	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 34. Alternative function: ■ QSPI2_IO[0]
52	GND	GND	Common Ground
53	PIO35/QSPI2_CLK	Digital: Bidirectional with programmable strength internal pull-up/pull-down	Programmable I/O line 35. Alternative function: ■ QSPI2_CLK
54	PIO38/QSPI2_CS	Digital: Bidirectional with programmable strength	Programmable I/O line 38. Alternative function:

		internal pull-up/pull-down	■ QSPI2_CS
55	GND	GND	Common Ground
56	USB_P	Digital	USB Full Speed device D- I/O. IEC-61000-4-2 (device level) ESD Protection
57	USB_N	Digital	USB Full Speed device D- I/O. IEC-61000-4-2 (device level) ESD Protection
58	GND	GND	Common Ground
59	VDDIO	Supply	Supply to VDD_PADS
60	SMPS_VBAT	Supply	Supply to SMPS power switch from battery.
61	VCHG_SEN	Analog	Charger input sense pin after external mode sense-resistor. High impedance. **NOTE**: If using internal charger or no charger, connect VCHG_SENSE direct to SMPS_VCHG.
62	VBAT_SEN	Analog	Battery voltage sense input.
63	CHG_EXT	Analog	External charger transistor current control. Connect to base of external charger transistor as per application schematic.
64	USB_VBUS	Supply	Supply to SMPS power switch from charger input.
65	VBAT	Supply	Supply to SMPS power switch from battery.
66	SYS_CTRL	Digital input	Typically connected to an ON/OFF push button. If power is present from the battery and/or charger, and software has placed the device in the OFF or DORMANT state, a button press boots the device. Also usable as a digital input in normal operation. No pull. Additional function: ■ PIO[0] input only
67	GND	GND	Common Ground
68	MIC2_N	Analog	Microphone differential 2 input, negative. Alternative function: ■ Differential audio line input right,

			negative
69	MIC2_P	Analog	Microphone differential 2 input, positive. Alternative function: ■ Differential audio line input right, positive
70	BIAS_B	NC	NC
71	MIC1_N	Analog	Microphone differential 1 input, negative. Alternative function: ■ Differential audio line input left, negative
72	MIC1_P	Analog	Microphone differential 1 input, positive. Alternative function: ■ Differential audio line input left, positive
73	BIAS_A	Analog	Mic bias output.
74	SPKR_P	Analog	Headphone/speaker differential right output, positive. Alternative function: ■ Differential right line output, positive
75	SPKR_N	Analog	Headphone/speaker differential right output, negative. Alternative function: ■Differential right line output, negative
76	SPKL_N	Analog	Headphone/speaker differential left output, negative. Alternative function: ■ Differential left line output, negative
77	SPKL_P	Analog	Headphone/speaker differential left output, positive. Alternative function: ■ Differential left line output, positive
78	GND	GND	Common Ground

8 Interfaces

8.1 USB Interface

QCC5181 WLCSP has a USB interface, device port and charger detection.

8.1.1 USB interface

QCC5181 WLCSP has a USB device interface: An upstream port, for connection to a host Phone/PC or battery charging adaptor.

For details on software support for USB features, see ADK documentation.

8.1.2 USB device port

The device port is a USB2.0 Full Speed (12 Mb/s) port. Typically QCC5181 WLCSP enumerates as a compound device with a hub. The enabled audio source / sink / HID / mass storage device appears behind that hub.

The DP 1.5 k pull-up is integrated in QCC5181 WLCSP. No series resistors are required on the USB data lines.

QCC5181 WLCSP 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 QCC5181 WLCSP 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 QCC5181 WLCSP is tolerant of a constant 6.5 V and transients up to 7.0 V. Use an external clamping protection device if extra overvoltage protection is required.

8.1.3 USB charger detection

QCC5181 WLCSP supports charger detection to the USB BC 1.2specification.

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 10-bit auxiliary ADC reads the voltage on the USB data lines. This enables

detection of proprietary chargers that bias the voltage on the USB data lines.

For USB Type-C® connectors, use the LED pins to detect the voltage on the

USB Configuration Channel (CC) line pins (CC1 and CC2) to detect the charge

current capabilities of the upstream device.

8.2 PIO

QCC5181 WLCSP has the following digital input/output (I/O) pads:

■ 21 PIO pads:

□ Including 1 x Reset (active low) pad: PIO[1]

■ 6 x pads for the Applications subsystem QSPI interface

■ 6 x pads intended for LED operation: LED[5:0]

■ 1 x power-on signaling: SYS_CTRL, available for use as an input after boot.

8.2.1 PIO pad allocation

The following QCC5181 WLCSP functions have specific pad allocations:

■ QSPI (Applications subsystem)

■ QSPI interface for optional support of external Audio buffer RAM

- LED pads

- Transaction bridge

- Audio I²S/PCM

NOTE: Any PIO is usable for:

- Digital microphones

- SPDIF

- UART

- Bit Serializer (I²C/SPI)

- LED PWM controllers

8.3 Standard I/O

The standard digital I/O pins (PIO) on QCC5181 WLCSP are split into separate pad domains. Each VDD_PADS domain can be separately powered, from 1.7 V to 3.6 V.

NOTE: 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 are programmed to have a pull-up or pull down with two strengths (weak and strong). Program PIO with a sticky function where they are strongly pulled to their current input state. PIO have a reset pull state. After reset, pulls are reconfigurable using software.

PIO also have a programmable drive strength capability of 2, 4, 8, or 12 mA. All subsystems can read all PIO. Use software to assign PIO write access to particular subsystem control. To make PIO inputs available use Schmitt triggers.

8.4 Pad multiplexing

A QCC5181 WLCSP pad function is chosen at runtime from multiple potential functions, using multiplexing.

In the input direction, signals driven into the chip, all PIOs are distributed to each subsystem and visible on the PIO status bus. The subsystem selects I/Os of interest for a particular application.

In the output direction, the System Manager has overall control of PIO allocation and control. When a PIO is allocated to a particular subsystem, the output is connected from the subsystem to the pad. There are no registers between the subsystem and the pad.

The LED pins and some other peripheral I/O states are read as virtual PIOs, see Table 8-1.

Function	PIO
SYS_CTRL	PIO[0]
LED[5:0]	PIO[79:74]

Table 8-1

8.5 RESET# reset pin

The QCC5181 WLCSP digital reset pin (RESET#) is an active low reset signal. PIO[1] defaults to RESET# on boot.

When the pin is active low, on-chip glitch filtering avoids unintended resets by filtering out spurious noise. The RESET# pin has a fixed strong pull-up to VDD_PADS_1, and can be left unconnected. The input is asynchronous, and is pulse extended within QCC5181 WLCSP to ensure a full reset.

QCC5181 WLCSP 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. QCC5181 WLCSP then requires a SYS_CTRL assertion or VCHG attach to restart.

NOTE: QCC5181 WLCSP is always powered if VCHG is present. It does not power down if RESET# is asserted while VCHG remains present.

QTIL recommends that QCC5181 WLCSP is powered down using software-control rather than external assertion of RESET#.

Holding RESET# low continuously is not the lowest QCC5181 WLCSP power state, because pull downs are enabled on VCHG and VDD_BYP in this state.

RESET# is guaranteed to work if held low for 120 μs.

After boot, PIO[1] is configurable as a digital PIO.

8.6 SYS_CTRL pin

SYS_CTRL is an input pin that acts as a power-on signal for the internal regulators. Use it as an input (virtual PIO[0]-available using software) 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 using a button to VBAT. SYS_CTRL has no internal pull resistor, and requires an external pull-down if left undriven.

Use software to logically disconnect SYS_CTRL from the power on signal for internal regulators. For example, when booted, software takes control of the internal regulators and the state of SYS_CTRL is ignored by the regulators.

8.7 LED

QCC5181 WLCSP has LED pads and controllers.

8.7.1 LED pads

Table 8‑2 lists QCC5181 WLCSP LED pad operating modes.

Table 8-2 QCC5181 WLCSP LED pad operating modes

Mode name	Description
LED Driver	This mode drives LEDs. The pad operates as an open-drain pad, which tolerates voltages up to 7.0 V. The cathode of the LED can connect to the QCC5151 WLCSP LED pad. Each pad is rated to sink current of up to 50 mA.
Digital / Button Input	This mode is for slow input signals, typically buttons. It is not for fast switching digital inputs like SPI. For these types of inputs, use the standard PIOs.
	In this mode, an internal weak pull-down is enabled. Typically this mode is 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 are read by the software as virtual PIO[79:74].
Analog Input	In this mode, the LED pad is an analog input port. The pad voltage routes to a 10-bit auxiliary ADC.
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.

Table 8-2

NOTE: LED pins might be driven to ground level for up to 300μs within 50 ms of the chip powering up from off stage.

8.7.2 LED controllers

QCC5181 WLCSP 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.

Table 8-3 lists the LED controller pattern for QCC5181 WLCSP. Each PWM block can make use of the PIOs and LED pads (virtual PIOs).

Table 8-3 LED controller pattern

LED_PWM number	PIO						
LED_PWM[0]	-	PIO[6]	-	PIO[18]	-	PIO[42]	PIO[74]
LED_PWM[1]	PIO[1]	PIO[7]	-	PIO[19]	-	PIO[43]	PIO[75]
LED_PWM[2]	PIO[2]	PIO[8]	-	PIO[20]	-	PIO[44]	PIO[76]
LED_PWM[3]	PIO[3]	-	PIO[15]	PIO[21]	-	PIO[45]	PIO[77]
LED_PWM[4]	PIO[4]	-	PIO[16]	-	PIO[40]	-	PIO[78]
LED_PWM[5]	PIO[5]	-	PIO[17]	-	PIO[41]	-	PIO[79]

Table 8-3

NOTE: The configuration of the PWM controller is the same whether it drives a

PIO or LED pad.

If an OEM assigns other functions, not all PIOs may be available for use with

the PWM generator.

Table 8-4 shows how each LED_PWM maps to a specific virtual PIO and

LED_PAD on QCC5181 WLCSP.

Table 8-4 LED_PWM to PIO to LED_PAD mapping

LED_PWM number	=	PIO number	=	LED_PAD number
LED_PWM[0]	=	PIO[74]	=	LED_PAD[0]
LED_PWM[1]	=	PIO[75]	=	LED_PAD[1]
LED_PWM[2]	=	PIO[76]	=	LED_PAD[2]
LED_PWM[3]	=	PIO[77]	=	LED_PAD[3]
LED_PWM[4]	=	PIO[78]	=	LED_PAD[4]
LED_PWM[5]	=	PIO[79]	=	LED_PAD[5]

Table 8-4

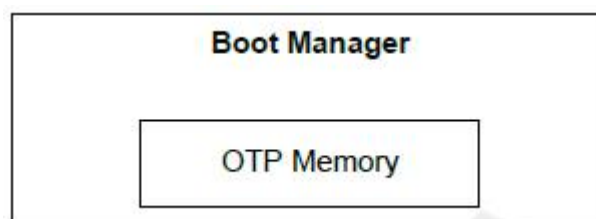# 9 Boot Manager

Figure 9-1 shows the Boot Manager.

Figure 9-1 Boot Manager

The Boot Manager:
■ Performs all low-level housekeeping functions

■ Manages chip boot

■ Manages the lowest level stages of Deep Sleep and Dormant state entry/exit

10   OTP memory

QCC5181 WLCSP contains one-time programmable memory areas, used to hold a customer programmable security key.

System Manager

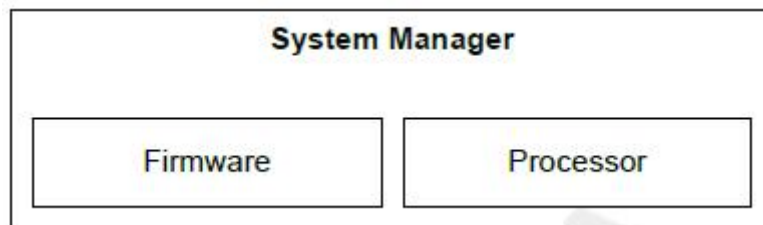Figure 10-1 shows the System Manager.

Figure 10-1 System Manager

The System Manager:

■ Executes from ROM

■ Controls the allocation of the resources in the system

■ Coordinates firmware operation using message-passing and interaction with the other subsystems

Chip-level sleep modes are coordinated by the System Manager. Each subsystem indicates to the System Manager that they are asleep. The System Manager can individually disable clocks and/or power to subsystems in turn to minimize device power.

10.1 System timer

The System Manager maintains a 1 MHz system timer, which is distributed to the subsystems in the hardware using the transaction bus. The system time has 20 ppm, 250 ppm, and 20% modes to optimize current in low-power states.

11   Charging system

11.1 Li-ion charger overview and configurations

The QCC5181 WLCSP integrated Li-ion charger is designed to support single Li-ion cells with a wide range of cell capacities and variable VFLOAT voltages. It has two circuit configurations with different charge current capabilities:

■ Internal configuration: Supports charge rates of 2 mA to 200 mA with no additional external components

required.

■ External configuration: Supports fast charge rates of 200 mA to 1800 mA with the addition of one PNP pass

device and external resistor. Lower trickle and pre-charge charge currents are still available in external configuration.

Operating configuration is set in firmware using
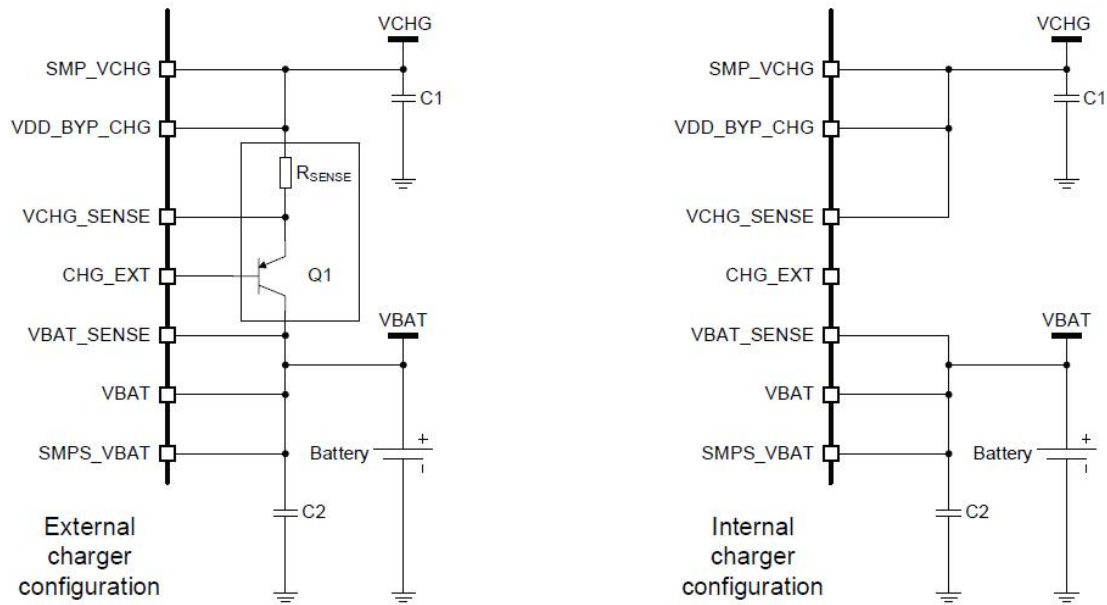
CHARGER_ENABLE_HIGH_CURRENT_EXTERNAL_MODE.

Figure 11-1 Internal and external Li-ion charger configurations

11.2 Charger connections

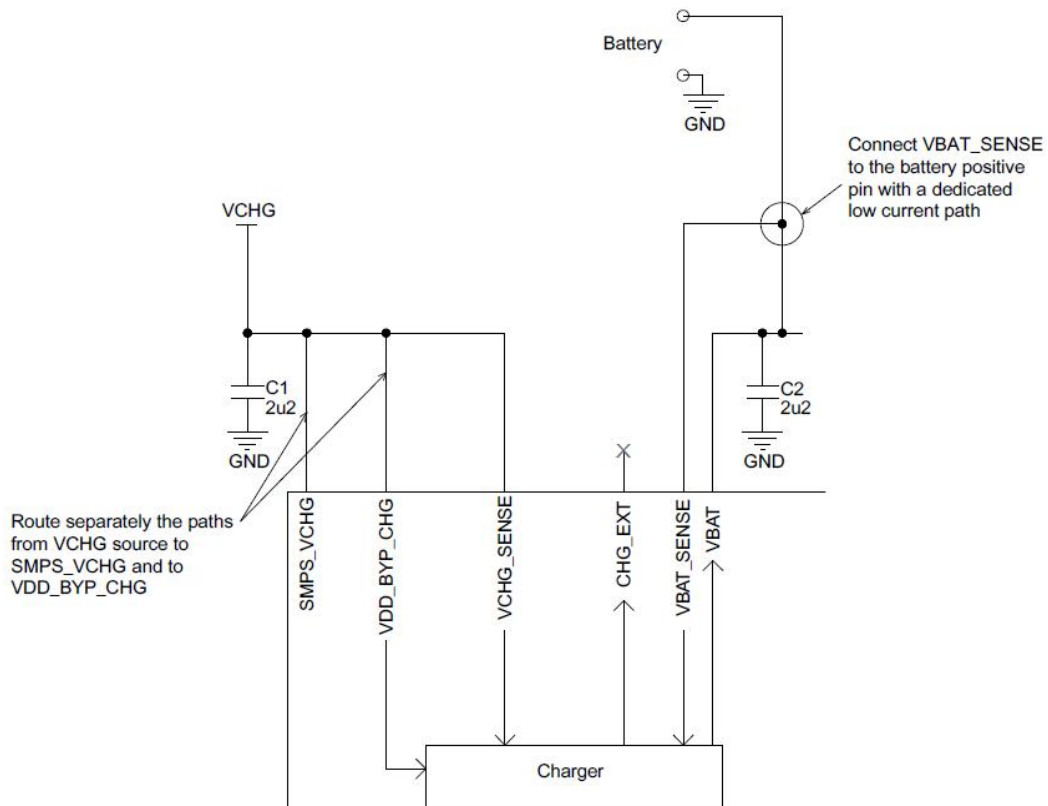### Internal configuration connections

Figure 11-2 Schematic of internal charger configuration

Figure 11-2 shows that in internal configuration, connect the VCHG_SENSE pin to VCHG and leave CHG_EXT unconnected. The charge current passes through QCC5181 WLCSP internally in all charging phases.

Charge current enters through the VCHG pin, which should be locally decoupled with a 2.2 μF ceramic capacitor.

The charger output current exits via the VBAT pin to the battery.

The VBAT_SENSE pin is used to sense the voltage on the battery and must be routed as a Kelvin connection (separately) to the battery connector to avoid IR drop in the battery PCB traces from affecting the charge process, which can lead to early termination.

IC Information

This device complies with Industry Canada license-exempt RSS standard(s). 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.

Cet appareil est conforme avec Industrie Canada exempts de licence standard RSS (s). L'opération est soumise aux deux conditions suivantes:

(1) cet appareil ne peut causer d'interférences, et

(2) cet appareil doit accepter toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.

The end product must be labeled to display the Industry Canada certification number of the module.

Contains transmitter module IC: 7756A-HSBT5181

Le dispositif d'accueil doivent être étiquetés pour afficher le numéro de certification d'Industrie Canada du module.

Contient module émetteur IC: 7756A-HSBT5181

Information for OEM Integrator

This device is intended only for OEM integrators under the following conditions:

1) The antenna must be installed such that 5mm is maintained between the antenna and users, and

2) The transmitter module may not be co-located with any other transmitter or antenna.

End product labelling

The label for end product must include "Contains IC: 7756A-HSBT5181".

"CAUTION: Exposure to Radio Frequency Radiation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance of 5mm between the radiator and your body. This transmitter module is authorized only for use in device where the antenna may be installed such that 5mm may be maintained between the antenna and users."

The Host Marketing Name (HMN) must be indicated at any location on the exterior of the host product or product packaging or product literature, which shall be available with the host product or online.

This radio transmitter [IC: 7756A-HSBT5181] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Frequency Range	Manufacturer	Peak gain	Impedance	Antenna type
2400-2483.5MHz	Hansong(Nanjing) Technology Ltd.	1.14dBi	50 Ω	PCB Antenna

FCC MODULAR APPROVAL INFORMATION EXAMPLES for 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.

(2) This device must accept any interference received, including interference that may cause undesired operation.

CAUTION: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: 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 or more 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.

FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 5mm between the radiator & your body.

OEM INTEGRATION INSTRUCTIONS:

This device is intended only for OEM integrators under the following conditions:

The module must be installed in the host equipment such that 5mm is maintained between the antenna and users, and the transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the internal on-board antenna that has been originally tested and certified with this module. External antennas are not supported. As long as these 3 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 (for example, digital device emissions, PC peripheral requirements, etc.). The end-product may need Verification testing, Declaration of Conformity testing, a Permissive Class II Change or new Certification. Please involve a FCC certification specialist in order to determine what will be exactly applicable for the end-product.

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module 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. In such cases, please involve a FCC certification specialist in order to determine if a Permissive Class II Change or new Certification is required.

Upgrade Firmware:

The software provided for firmware upgrade will not be capable to affect any RF parameters as certified for the FCC for this module, in order to prevent compliance issues.

End product labeling:

This transmitter module is authorized only for use in device where the antenna may be installed such that 5mm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains FCC ID: XCO-HSBT5181".

Information that must be placed in the end user manual:

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.

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"CAUTION : Exposure to Radio Frequency Radiation.
Antenna shall be mounted in such a manner to minimize the potential for human contact during normal operation. The antenna should not be contacted during operation to avoid the possibility of exceeding the FCC radio frequency exposure limit.

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Requirement per KDB996369 D03

2.2 List of applicable FCC rules

List the FCC rules that are applicable to the modular transmitter. These are the rules that specifically establish the bands of operation, the power, spurious emissions, and operating fundamental frequencies. DO NOT list compliance to unintentional-radiator rules (Part 15 Subpart B) since that is not a condition of a module grant that is extended to a host manufacturer. See also Section 2.10 below concerning the need to notify host manufacturers that further testing is required.3
Explanation: This module meets the requirements of FCC part 15C(15.247).

2.3 Summarize the specific operational use conditions

Describe use conditions that are applicable to the modular transmitter, including for example any limits on antennas, etc. For example, if point-to-point antennas are used that require reduction in power or compensation for cable loss, then this information must be in the instructions. If the use condition limitations extend to professional users, then instructions must state that this information also extends to the host manufacturer's instruction manual. In addition, certain information may also be needed, such as peak gain per frequency band and minimum gain, specifically for master devices in 5 GHz DFS bands.
Explanation: The EUT has a PCB Antenna, and the antenna use a permanently attached antenna which is not replaceable.

2.4 Limited module procedures

If a modular transmitter is approved as a "limited module," then the module manufacturer is responsible for approving the host environment that the limited module is used with. The manufacturer of a limited module must describe, both in the filing and in the installation instructions, the alternative means that the limited module manufacturer uses to verify that the host meets the necessary requirements to satisfy the module limiting conditions.
A limited module manufacturer has the flexibility to define its alternative method to address the conditions that limit the initial approval, such as: shielding, minimum signaling amplitude, buffered modulation/data inputs, or power supply regulation. The alternative method could include that the limited module manufacturer reviews detailed test data or host designs prior to giving the host manufacturer approval.
This limited module procedure is also applicable for RF exposure evaluation when it is necessary to
demonstrate compliance in a specific host. The module manufacturer must state how control of the product into which the modular transmitter will be installed will be maintained such that full compliance of the product is always ensured. For additional hosts other than the specific host originally granted with a limited module, a Class II permissive change is required on the module grant to register the additional host as a specific host also approved with the module.
Explanation: The module is not a limited module.

2.5 Trace antenna designs

For a modular transmitter with trace antenna designs, see the guidance in Question 11 of KDB Publication 996369 D02 FAQ – Modules for Micro-Strip Antennas and traces. The integration information shall include for the TCB review the integration instructions for the following aspects:

layout of trace design, parts list (BOM), antenna, connectors, and isolation requirements.
a) Information that includes permitted variances (e.g., trace boundary limits, thickness, length, width, shape(s),
  dielectric constant, and impedance as applicable for each type of antenna);
b) Each design shall be considered a different type (e.g., antenna length in multiple(s) of frequency,
the wavelength, and antenna shape (traces in phase) can affect antenna gain and must be considered);
c) The parameters shall be provided in a manner permitting host manufacturers to design the printed circuit (PC) board layout;
d) Appropriate parts by manufacturer and specifications;
e) Test procedures for design verification; and
f) Production test procedures for ensuring compliance.

The module grantee shall provide a 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 the module grantee 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 grantee, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

Explanation: Yes, The module with trace antenna designs, and This manual has been shown the layout
of trace design, antenna, connectors, and isolation requirements.

2.6 RF exposure considerations

It is essential for module grantees to clearly and explicitly state the RF exposure conditions that permit a host product manufacturer to use the module. Two types of instructions are required for RF exposure information: (1) to the host product manufacturer, to define the application conditions (mobile, portable – xx cm from a person's body); and (2) additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

Explanation: This module complies with FCC RF radiation exposure limits set forth for an uncontrolled environment, This equipment should be installed and operated with a minimum distance of 5mm between the radiator and your body." This module is designed to comply with the FCC statement, FCC ID is: XCO-HSBT5181.

2.7 Antennas

A list of antennas included in the application for certification must be provided in the instructions. For modular transmitters approved as limited modules, all applicable professional installer instructions must be included as part of the information to the host product manufacturer. The antenna list shall also identify the antenna types (monopole, PIFA, dipole, etc. (note that for example an "omni-directional antenna" is not considered to be a specific "antenna type")).

For situations where the host product manufacturer is responsible for an external connector, for example with an RF pin and antenna trace design, the integration instructions shall inform the installer that unique antenna connector must be used on the Part 15 authorized transmitters used in the host product. The module manufacturers shall provide a list of acceptable unique connectors.

Explanation: The EUT has a Chip Antenna, and the antenna use a permanently attached antenna

which is unique.

2.8 Label and compliance information

Grantees are responsible for the continued compliance of their modules to the FCC rules. This includes advising host product manufacturers that they need to provide a physical or e-label stating "Contains FCC ID" with their finished product. See Guidelines for Labeling and User Information for RF Devices – KDB Publication 784748.

Explanation: The host system using this module, should have label in a visible area indicated the

following texts: "Contains FCC ID: XCO-HSBT5181, Contains IC: 7756A-HSBT5181

2.9 Information on test modes and additional testing requirements5

Additional guidance for testing host products is given in KDB Publication 996369 D04 Module Integration Guide. Test modes should take into consideration different operational conditions for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

The grantee should provide information on how to configure test modes for host product evaluation for different operational conditions for a stand-alone modular transmitter in a host, versus with multiple, simultaneously transmitting modules or other transmitters in a host.

Grantees can increase the utility of their modular transmitters by providing special means, modes, or

instructions that simulates or characterizes a connection by enabling a transmitter. This can greatly simplify a host manufacturer's determination that a module as installed in a host complies with FCC requirements.

Explanation: Top band can increase the utility of our modular transmitters by providing instructions

that simulates or characterizes a connection by enabling a transmitter.

2.10 Additional testing, Part 15 Subpart B disclaimer

The grantee should include a statement that 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.

Explanation: The module without unintentional-radiator digital circuity, so the module does not

require an evaluation by FCC Part 15 Subpart B. The host shoule be evaluated by the FCC Subpart B.