



Bluetooth Module Datasheet

Model: TS8670

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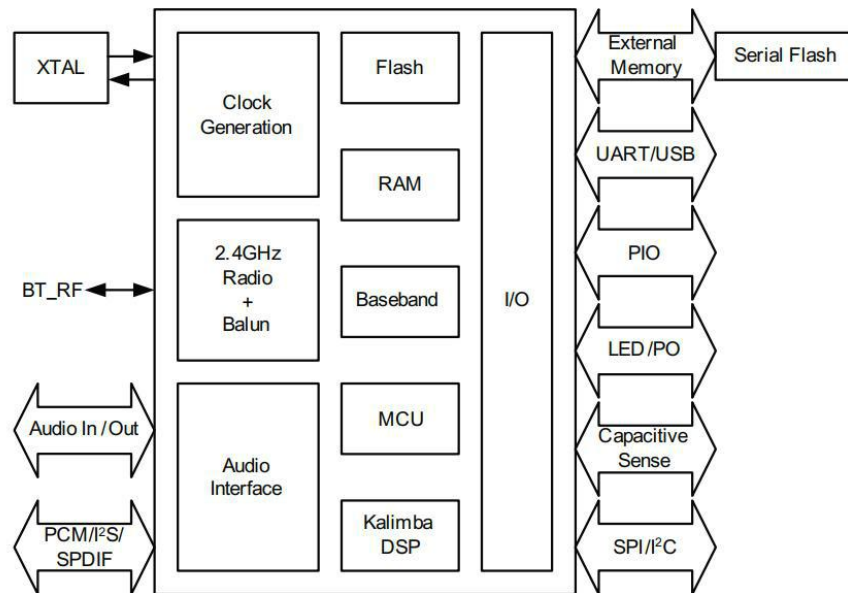
1. INTRODUCTION

The TS8670 Bluetooth® module is a perfect consumer audio solution for wireless applications, such as wireless soundbars, wireless stereo speakers and headphones. It can be connected with any Bluetooth® devices in an operating range. It is slim and light so the designers can have better flexibilities for the product shapes.

The TS8670 Bluetooth® module complies with Bluetooth® specification version 4.0. It supports HSP, HFP, A2DP, AVRCP, PBAP, MAP, SPP... profiles. It integrates an ultra-low-power DSP and application processor with embedded flash memory, a high-performance stereo codec, a power management subsystem, LED and LCD drivers and capacitive touch sensor inputs in a SOC IC. The dual-core architecture with flash memory enables manufacturers to easily differentiate their products with new features without extending development cycles. It integrates RF Baseband controller, antenna, ... etc. and provides UART interface, programmable I/O, stereo speaker output, microphone input, ... etc.

The detail information of TS8670 Bluetooth® module is presented in this document below.

1.1 Block Diagram



1.2 Features

Bluetooth Profiles

- Bluetooth v5.0 specification support
- Qualcomm® Bluetooth® Low Energy secure connection
- A2DP v1.3.1
- AVRCP v1.6
- HFP v1.7
- HSP v1.2
- MAP v1.1
- PBAP v1.1.1
- DID v1.1
- QTIL's proximity pairing and QTIL's proximity connection

Music Enhancements

- aptX, aptX Low Latency, SBC, and AAC audio codecs
- Qualcomm TrueWireless™ Stereo (TWS), which allows two devices to be configured as a stereo pair
- Configurable Signal Detection to trigger events
- 1 bank of up to 10-stage Speaker Parametric EQ
- 6 banks of up to 5-stage User Parametric EQ for music enhancement
- Qualcomm® meloD™ Expansion audio processing: 3D stereo widening
- Compressor to compress or expand the dynamic range of the audio
- Post Mastering to improve DAC fidelity
- Dual I²S outputs with crossover

Additional Functionality

- Support for multi-language programmable audio prompts
- Multipoint support for A2DP connection to 2 A2DP sources for music playback
- Talk-time extension, which automatically reduces processor functions to extend use when a low battery condition is detected
- Slim module with 15mm x 22mm x 2.0mm

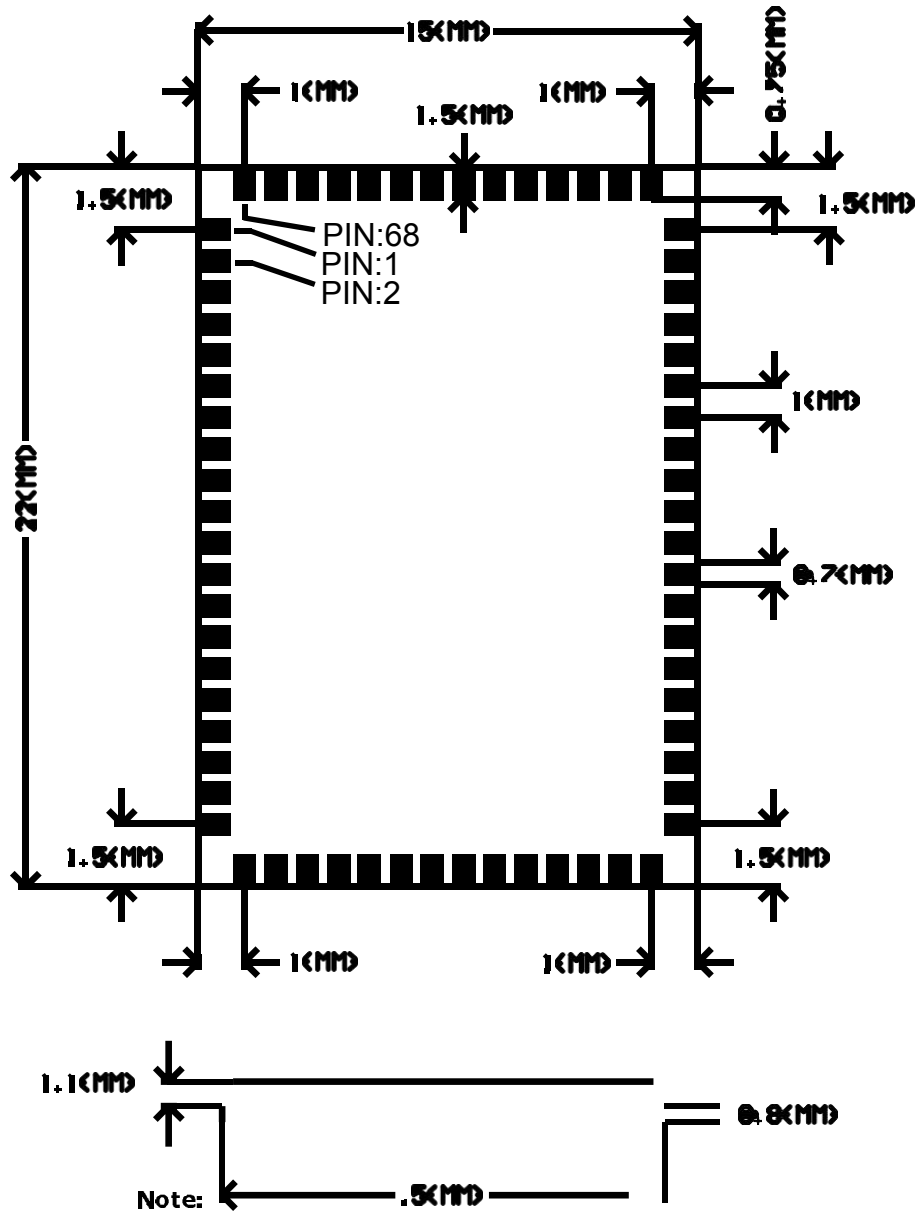
1.3 Application

- Stereo Headsets
- Wired Stereo headsets and headphones
- Portable Bluetooth Stereo speakers

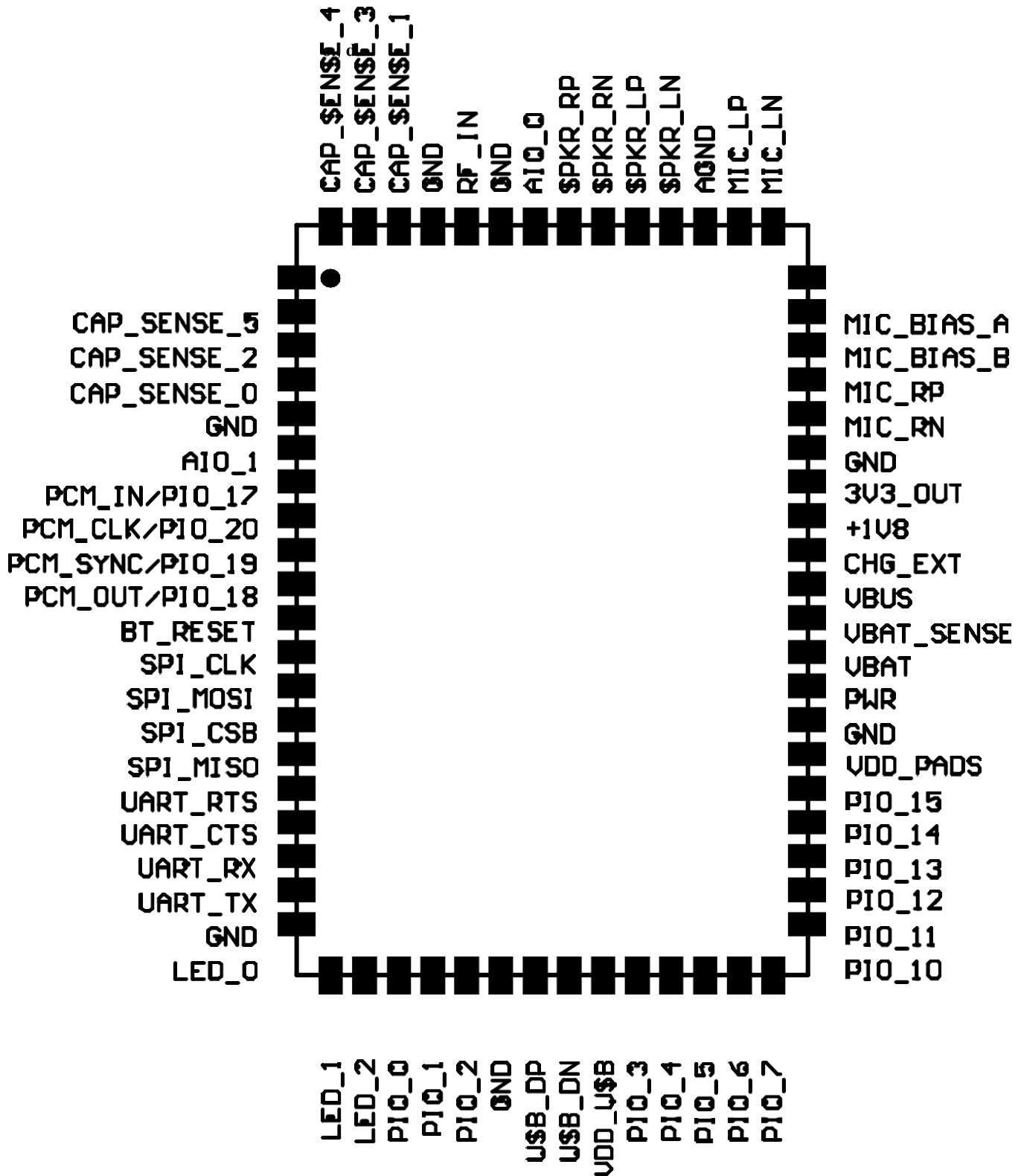
2. GENERAL SPECIFICATION

Model Name	TS8670
Product Description	Bluetooth 5.0 Class2 Module
Bluetooth Standard	Bluetooth 5.0
Chipset	CSR8670 BGA
Dimension	15mm x 22mm x 2.0mm
Operating Conditions	
Voltage	2.8~4.2V
Temperature	-10~+70°C
Storage Temperature	-40~+85°C
Electrical Specifications	
Frequency Range	2402~2480MHz
Maximum RF Transmit Power	9dBm
$\pi/4$ DQPSK Receive Sensitivity	-91dBm
8DPSK Receive Sensitivity	-81dBm

3. PHYSICAL CHARACTERISTIC



Tolerance without mark default +/-0.05mm
 尺寸未标注公差处公差为+/-0.05mm



3.1 Pin Description

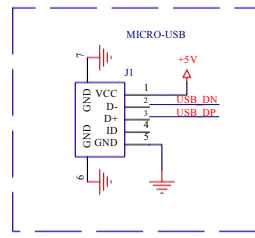
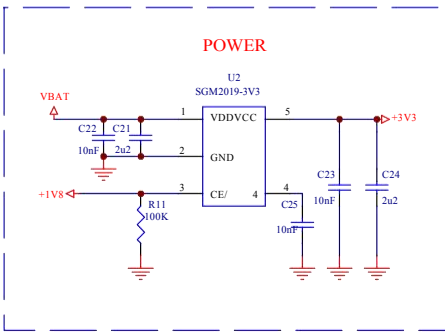
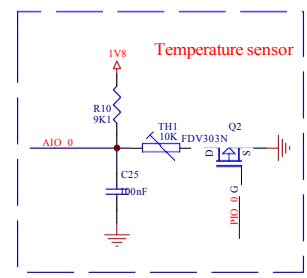
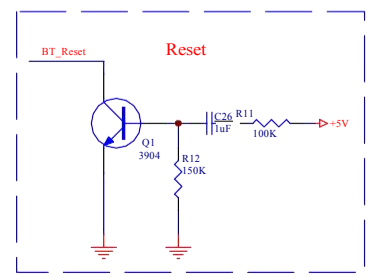
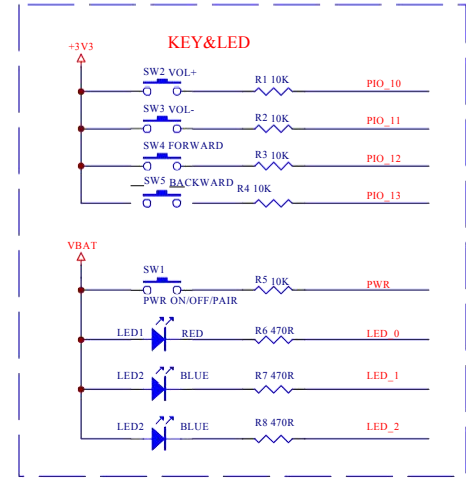
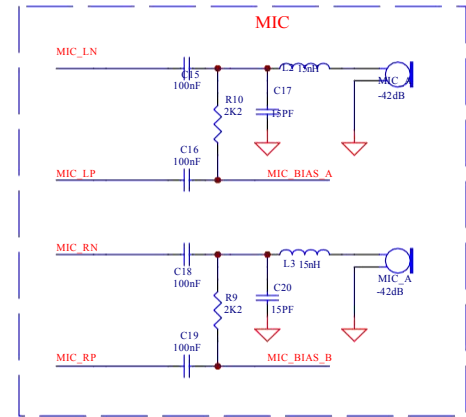
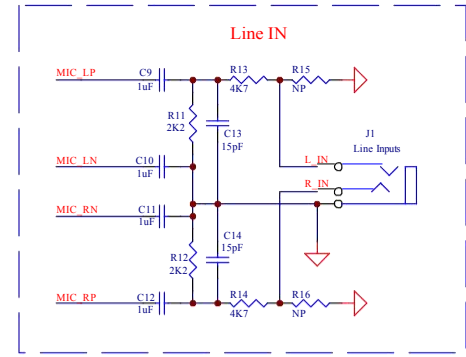
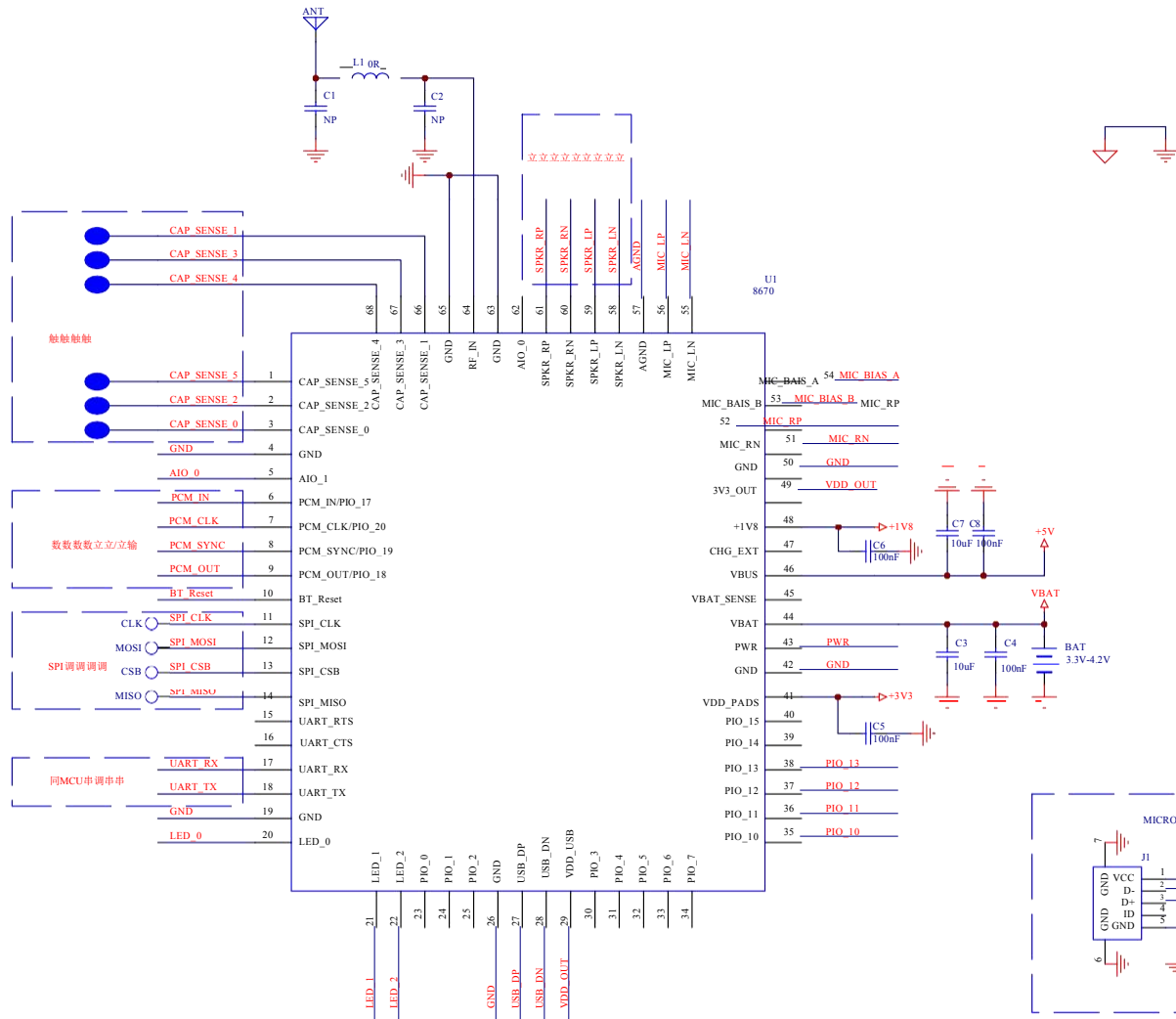
Pin#	Pin Name	Pad Type	Description
1	CAP_SENSE_5	Analogue input	Capacitive touch sensor input
2	CAP_SENSE_2	Analogue input	Capacitive touch sensor input
3	CAP_SENSE_0	Analogue input	Capacitive touch sensor input
4	GND	Ground	Digital Ground
5	AIO_1	Bi-directional	Analogue programmable input / output line
6	PCM_IN/PIO_17	Bi-directional with weak pull_down	Synchronous data input.Alternative function PIO[17]
7	PCM_CLK/PIO_20	Bi-directional with weak pull_down	Synchronous data clock.Alternative function PIO[20]
8	PCM_SYNC/PIO_19	Bi-directional with weak pull_down	Synchronous data sync.Alternative function PIO[19]
9	PCM_OUT/PIO_18	Bi-directional with weak pull_down	Synchronous data output.Alternative function PIO[18]
10	BT_RESET	Input with strong pull-up	Reset if low.Input debounced so must be low for >5ms to cause a reset
11	SPI_CLK	Input with weak pull-down	SPI Clock
12	SPI_MOSI	Input with weak pull-down	SPI data input
13	SPI_CSB	Input with strong pull-up	Chip select for SPI,active low
14	SPI_MISO	Output with weak pull-down	SPI data output
15	UART_RTS	Bi-directional with weak pull_up	UART request to send,active low.Alternative function PIO[16]
16	SPI_CTS	Bi-directional with weak pull_down	UART clear to send,active low
17	UART_RX	Bi-directional with strong pull_up	UART data input
18	UART_TX	Bi-directional with weak pull_up	UART data output
19	GND	Ground	Digital Ground
20	LED_0	Open drain	LED driver Alternative function PO[29]
21	LED_1	Open drain	LED driver Alternative function PO[30]

22	LED_2	Open drain	LED driver Alternative function PO[31]
23	PIO_0	Bi-directional with weak pull_down	Programmable input/output line
24	PIO_1	Bi-directional with weak pull_down	Programmable input/output line
25	PIO_2	Bi-directional with weak pull_down	Programmable input/output line
26	GND	Ground	Digital Ground
27	USB_DP	Bi-directional	USB data plus with selectable internal 1.5kohm pull-up resistor
28	USB_DN	Bi-directional	USB data minus
29	VDD_USB	NC	Positive supply for USB ports
30	PIO_3	Bi-directional with weak pull_down	Programmable input/output line
31	PIO_4	Bi-directional with weak pull_down	Programmable input/output line
32	PIO_5	Bi-directional with weak pull_down	Programmable input/output line
33	PIO_6	Bi-directional with weak pull_down	Programmable input/output line
34	PIO_7	Bi-directional with weak pull_down	Programmable input/output line
35	PIO_10	Bi-directional with weak pull_down	Programmable input/output line
36	PIO_11	Bi-directional with weak pull_down	Programmable input/output line
37	PIO_12	Bi-directional with weak pull_down	Programmable input/output line
38	PIO_13	Bi-directional with weak pull_down	Programmable input/output line
39	PIO_14	Bi-directional with weak pull_down	Programmable input/output line
40	PIO_15	Bi-directional with weak pull_down	Programmable input/output line
41	VDD_PADS	Analogue in	positive supply input for digital input/output ports PIOx
42	GND	Ground	Digital Ground
43	PWR	Input enable	Regulator enable input. Can also be sensed as an input. Regulator enable and multifunction button. A high input (tolerant to VBAT) enables the on-chip regulators, which can then be latched on internally and the button used as a multifunction input.
44	VBAT	Power supply	Battery positive terminal

45	VBAT_SENSE	NC	Battery charger sense input
46	VBUS	Power supply	Alternative supply via bypass regulator for 1.8V and 1.35V switchmode power supply regulator inputs. Must be connected to the same potential as VOUT_3V3.
47	CHG_EXT	NC	External battery charger control
48	+1V8	Open drain output	LED driver
49	3V3_OUT	Analogue out	3.3V bypass linear regulator output
50	GND	Ground	Digital Ground
51	MIC_RN	Analogue in	Microphone input negative,right
52	MIC_RP	Analogue in	Microphone input positive,right
53	MIC_BIAS_B	Analogue out	Microphone bias B
54	MIC_BIAS_A	Analogue out	Microphone bias A
55	MIC_LN	Analogue in	Microphone input negative,left
56	MIC_LP	Analogue in	Microphone input positive,left
57	AGND	Ground	Analogue Ground
58	SPKR_LN	Analogue out	Speaker output negative,left
59	SPKR_LP	Analogue out	Speaker output positive,left
60	SPKR_RN	Analogue out	Speaker output negative,right
61	SPKR_RP	Analogue out	Speaker output positive,right
62	AIO_0	Bi-directional	Analogue programmable input / output line
63	GND	Ground	Analogue Ground
64	RF_IN	RF	Bluetooth 50ohm transmitter output/receiver input
65	GND	Ground	Analogue Ground
66	CAP_SENSE_1	Analogue input	Capacitive touch sensor input
67	CAP_SENSE_3	Analogue input	Capacitive touch sensor input
68	CAP_SENSE_4	Analogue input	Capacitive touch sensor input

4. REFERENCE SCHEMATIC

Next page for detail.



5. PHYSICAL INTERFACE

5.1 Programmable I/O ports

- The module provide 11 lines of programmable bidirectional I/O, Can configurate to different function by firmware.

5.2 Analogue I/O ports

- The module has an analogue port AIO_0, typically connections to thermistor for battery pack temperature measurements during charger control.

5.3 LED driver

- The module provide 3 synchronized PWM LED driver for RGB leds. Can controlled by firmware. The driver are open-drain outputs, and the LEDs must pull up to positive supply. Refer to the section 4.1

5.4 Audio interfaces

Audio interface as following features:

Stereo or dual mono analogue audio output through
SPK_LP, SPK_LN, SPK_RP, SPK_RN.

- Stereo and mono analogue input through MIC_LN, MIC_LP, MIC_RN, MIC_RP.

The module is designed for different output, if a single-ended audio output is required, use an external differential to single-ended converter.

5.5 Microphone input

The module contains an independent low-noise microphone bias generator. The microphone bias generator is recommended for biasing electret condenser microphone. section 4.1 is a basing circuit for microphone with a sensitivity between -40~-60db.

5.6 Digital microphone inputs

The TS8670 interfaces to 6 digital MEMS microphones. Figure x shows that 4 of the inputs have dedicated codec channels and 2 are multiplexed with the high-quality ADC channels.

5.7 Line input

If the pre-amplifier audio input gain is set at a low gain level it acts as an audio line level amplifier. In this line input mode the input impedance varies from 6kohm to 30kohm, depending on the volume setting.

5.8 PCM interface

The audio PCM interface on the TS8670 supports:

- On-chip routing to Kalimba DSP
- Continuous transmission and reception of PCM encoded audio data over Bluetooth.
- PCM interface master, generating PCM_SYNC and PCM_CLK.
- PCM interface slave, accepting externally generated PCM_SYNC and PCM_CLK.

The PCM configuration options are enabled by setting the PS Key PSKEY_PCM_CONFIG32.

5.9 Digital audio interface(I2S)

The digital audio interface supports the industry standard formats for I2S, left-justified or right-justified. The interface shares the same pins as the PCM interface, which means each audio bus is mutually exclusive in its usage. Table as below lists these alternative functions

PCM Interface	I ² S Interface
PCM_OUT	SD_OUT
PCM_IN	SD_IN
PCM_SYNC	WS
PCM_CLK	SCK

5.10 Reset

- The module is reset from several sources:
 - Reset# pin
 - Power on reset
 - Software configured watch-dog

The Reset pin is an active low reset and is internally filtered using the internal low frequency clock oscillator. Recommended the low period > 10ms.
RAM data not available after cold reset.

5.11 RF interface

The module integrates a balun filter. A 50ohms load is needed.

5.12 Battery charger

5.12.1 battery charger hardware operating modes

The battery charger hardware is controlled by VM, it has 5 modes:

- Disabled
- Trickle charger
- Fast charger
- Standby: fully charged or float charge
- Error: charging input voltage, VCHG is too low.

5.12.2 External charge mode

The external mode is for charging higher capacity batteries using an external bass device. The current is controlled by sinking a varying current into the CHG_EXT pin, and the current is determined by measuring the voltage drop across a resistor. The max current up to 700mA.

5.13 Serial interfaces

5.13.1 UART

This is a standard UART interface for communicating with other serial devices. The UART interface provides a simple mechanism for communicating with other serial devices using the RS232 protocol.

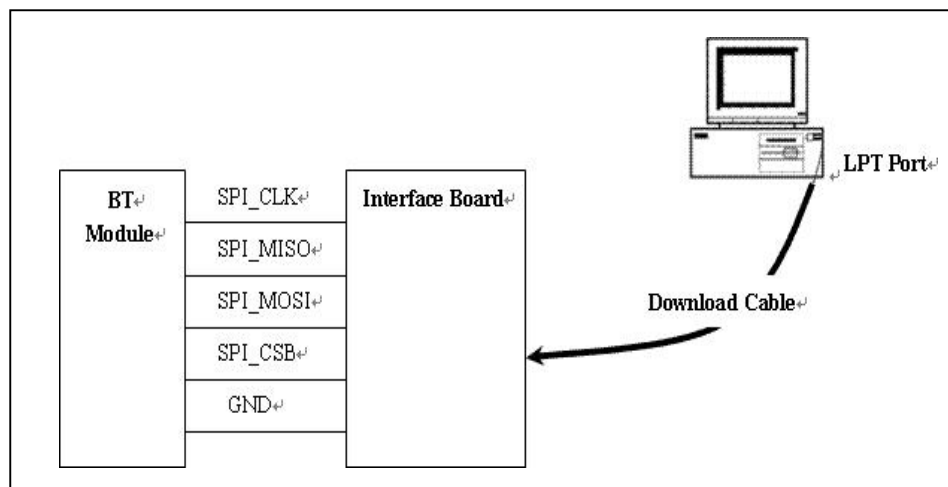
When the module is connected to another digital device, UART_RX and UART_TX transfer data between the two devices. The remaining two signals, UART_CTS and UART_RTS, can be used to implement RS232 hardware flow control where both are active low indicators.

Note: The serial port interface(UART)can be used for system debugging.Don't support to use command set for profile function application by UART,such as HFP/A2DP/AVRCP and so on.These profiles function application can be contolled only by PIO,such as pairing/connect/answer/play/pause/next/previous function application and so on.

5.13.2 SPI

The synchronous serial port interface (SPI) can be used for system debugging. It can also be used for in-system programming for the flash memory within the module. SPI interface uses the SPI_MOSI, SPI_MISO, SPI_CSB and SPI_CLK pins. Testing points for the SPI interface are reserved on board in case that the firmware shall be updated during manufacture.

The module operates as a slave and thus SPI_MISO is an output of the module. SPI_MISO is not in high-impedance state when SPI_CSB is pulled high. Instead, the module outputs 0 if the processor is running and 1 if it is stopped. Thus the module should NOT be connected in a multi-slave arrangement by simple parallel connection of slave SPI_MISO lines.



6. ELECTRICAL CHARACTERISTIC

6.1 Absolute maximum ratings

Rating	Min	Max	Unit
Storage temperature	-40	105	°C
Supply Voltage			
VBAT	2.8	4.25	V
VBUS	-0.4	5.75	V
VBAT_SENSE	-0.4	4.20	V
PWR	-0.4	4.40	V

6.2 Recommended operating conditions

Rating	Min	Typ	Max	Unit
Operating temperature range	-40		85	°C
Supply Voltage				
VBAT	2.8	3.30	4.25	V
VBUS	4.75	5.00	5.75	V
VBAT_SENSE	0	3.70	4.30	V
PWR	0	3.30	4.25	V

6.3 PIO Recommended operating conditions

Input Voltage	Min	Typ	Max	Unit
PIOx	1.70	1.80	3.6	V
AIOx	1.30	1.35	1.40	V
LED[0:2]	1.10	3.30	4.25	V
Output	Min	Typ	Max	Unit
PIOx	1.70	1.80		V
LED[0:2]	0	0		V

Output current with 3.3v supply	Min	Typ	Max	Unit
PIOx(Total output)			5.0	mA

Current with 3.3V Input and Tristate	Min	Typ	Max	Unit
Strong pull up	-150	-40	-10	uA
Strong pull down	10	40	150	uA
Weak pull up	-5	-1.0	-0.33	uA
Weak pull down	0.33	1.0	5.0	uA

6.4 Battery charger

Fast Charge mode	Min	Typ	Max	Unit
Charge current during constant charge mode	194	200	206	mA
Standby mode	100	-	150	mA

6.5 External charge mode

	Min	Typ	Max	Unit
Fast Charge current during constant charge mode	200	-	500	mA
Control current into CHG_EXT	0	-	20	mA

6.6 RF characteristics

Receiver		Average	Bluetooth Spec	Transmitter		Average	Bluetooth Spec	Unit
Sensitivity at 0.1 Ber	2402MHz	-86	<=-70	Output Power	2402MHz	3.7	-6~+4	dBm
	2441MHz	-85			2441MHz	3.5		dBm
	2480MHz	-87			2480MHz	3.5		dBm

6.7 Power consumption

Operating Condition		Average Current	Unit
Slave	SCO connection with pocket type HV3	9.2	mA
	eSCO connection with pocket type 2EV3	7.3	mA
	eSCO connection with pocket type 3EV3	6.7	mA
	Stereo with high quality SBC decode	10.2	mA
	Stereo with high quality Aptx decode	14.9	mA
Master	SCO connection with pocket type HV3	10.2	mA
	eSCO connection with pocket type EV3	6.8	mA
	eSCO connection with pocket type 2EV3	6.2	mA
	Stereo with high quality SBC decode	15.2	mA