

Rayson

MICROCHIP

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BTM978 datasheet

Revision History

Revision No.	Date	Description
Rev00	2015-6-9	Initial version
Rev01	2016-4-11	Update the module picture

Rayson Bluetooth® Module

MICROCHIP

Bluetooth® 4.0 Dual mode Module

BTM-978

Product Description

The BTM978 is a fully Certified Bluetooth Version 4.0 (BR/EDR/LE) IC for designers who want to easily add dual mode Bluetooth Wireless capability to their products .Delivering local connectivity for the internet of Things (IOT), the IC bridges your product to Smart Phones and Tablets for convenient data transfer. Control and access to cloud applications. It supports GAP SDA SPR and GATT profiles. Data is transferred over the Bluetooth link by sending/receiving data via transparent UART mode, making it easy to integrate with any processor or Microcontroller with a UART interface. Configuration is made easy using a Windows based GUI or directly via UART by MCU.

Features

Outline

- Main Chip: ISSC IS1678SM
- Bluetooth 4.0 EDR compliant
- Bluetooth Classic (BR/EDR) and Low Energy(LE)
- Transparent UART mode for seamless serial data over UART interface
- Easy to configure with Windows GUI or direct by MCU
- Firmware can be field upgradable via UART
- Receive Sensitivity: -90 dBm (Classic)
- Operating voltage: 3.2V to 4.3V
- Perfect for Portable Battery Operated Devices
- Internal Battery Regulator Circuitry
- Worldwide regulatory certifications
- 1 LED and 16 steps Brightness
- Size: 22 x 12x 2.4 mm
- RoHS compliant



Applications

- Mobile Point of Sales(mPOS)
- LED lighting(16 step)
- Wearables
- Digital Sports
- Fitness Devices
- Health Care/Medical
- Automotive Accessories
- Home Automation
- Remote control Toys

General Electrical Specification

Recommended operate condition

Symbol	Parameters	Min	Typical	Max	Unit
VCC_RF	RF supply voltage	1.8			V
AVDD_SAR	SAR ADC supply voltage	1.8	1.9	2.1	V
VDD_XO	supply voltage	1.8	1.9	2.1	V
VDD_IO	I/O supply voltage	2.8	3.3	3.63	V
SW_BTN		1.7		4.3	V
LED				3.6	V
LDO1.8_IN	Supply voltage	1.9	3.3	3.63	V
BAT_IN	Input voltage for battery	3.2		4.3	V
TOperation	Ambient Operation temperature	-20	+25	+70	°C

1) HTOL life test condition: +125 °C, BAT_IN=4.2V, LDO33_3.3V, LDO_O=1.9V

1.8V LDO

Parameters	Min	Typical	Max	Unit
Input Voltage	2.0		3.6	V
Output Current ($V_{IN}=3.0V$ /load regulation with 80mV drop)		100		mA
Quiescent Current($V_{IN}<3.0V$)		13		uA
Programmable output voltage(Condition: LDO_IN=3.0V)				
Range(3-bit selectable)	1.5		2.2	V
Default when power on		1.8		V
Output steps		100		mV/step

Note:

- 1) With 1uF capacitors at LDO18_O as the condition of verification.
- 2) When $V_{IN}=2.4V$, the LDO could supply 100mA loading, when $V_{IN}<2.4V$, the output voltage drop out depends on the loading.

3.3V LDO

Parameters	Min	Typical	Max	Unit
Input Voltage	3.2		4.3	V
Output Current ($V_{IN}=3.6V$ /load regulation with 100mV drop)		100		mA
Quiescent Current($V_{IN}=3.6V$)		150		uA
Programmable output voltage(Condition: BAT_IN=4.3V)				
Range(3-bit selectable)	2.5		3.3	V
Default when power on		3.3		V
steps		100		mV/step

Note: With 10uF capacitors at LDO33_O as the condition of IP verification.

PMU LDO

Parameters	Min	Typical	Max	Unit
Input Voltage	3.2		4.3	V
Output Current ($V_{IN}=3.6V$ /load regulation with 0.3mV drop)		100		mA
Quiescent Current($V_{in}=3.6V$)		120		uA
Adjustable output voltage(Condition: $V_{in}=3.3V$)				
Range(2-bit selectable)	1.8		2.1	V
Default when power on		1.9		V
steps		100		mV/step

Note: With 1uF capacitors at PMULDO_O as the condition of IP verification.

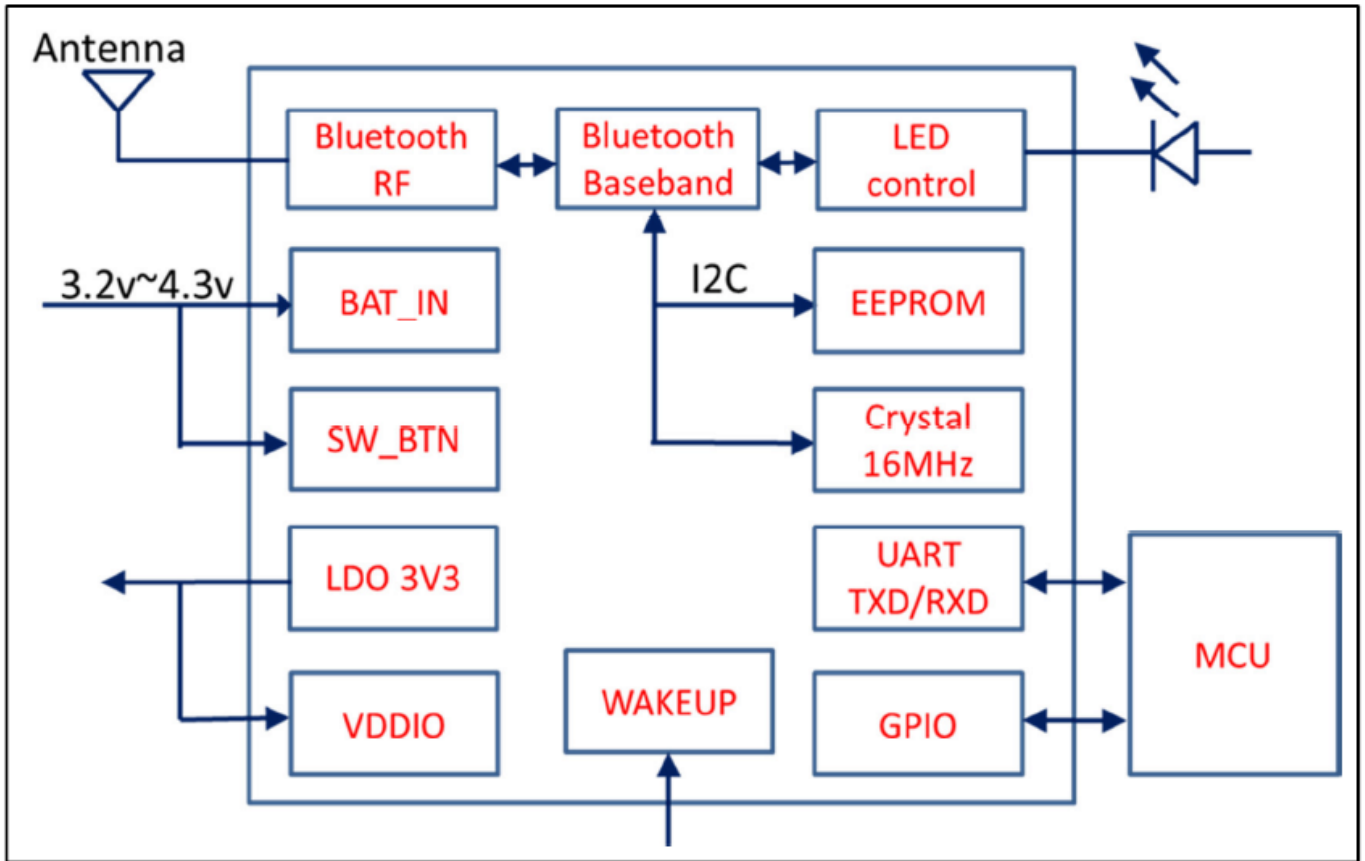
SAR-ADC and Battery Voltage Detector

Parameters	Min	Typical	Max	Unit
AVDD_SAR power supply		1.8		V
SAR_BAT(BAT_IN)	1.1		4.5	V
Resolution		10		bit
Operating Current(including bandgap)			1	mA
Shutdown Current			1	uA

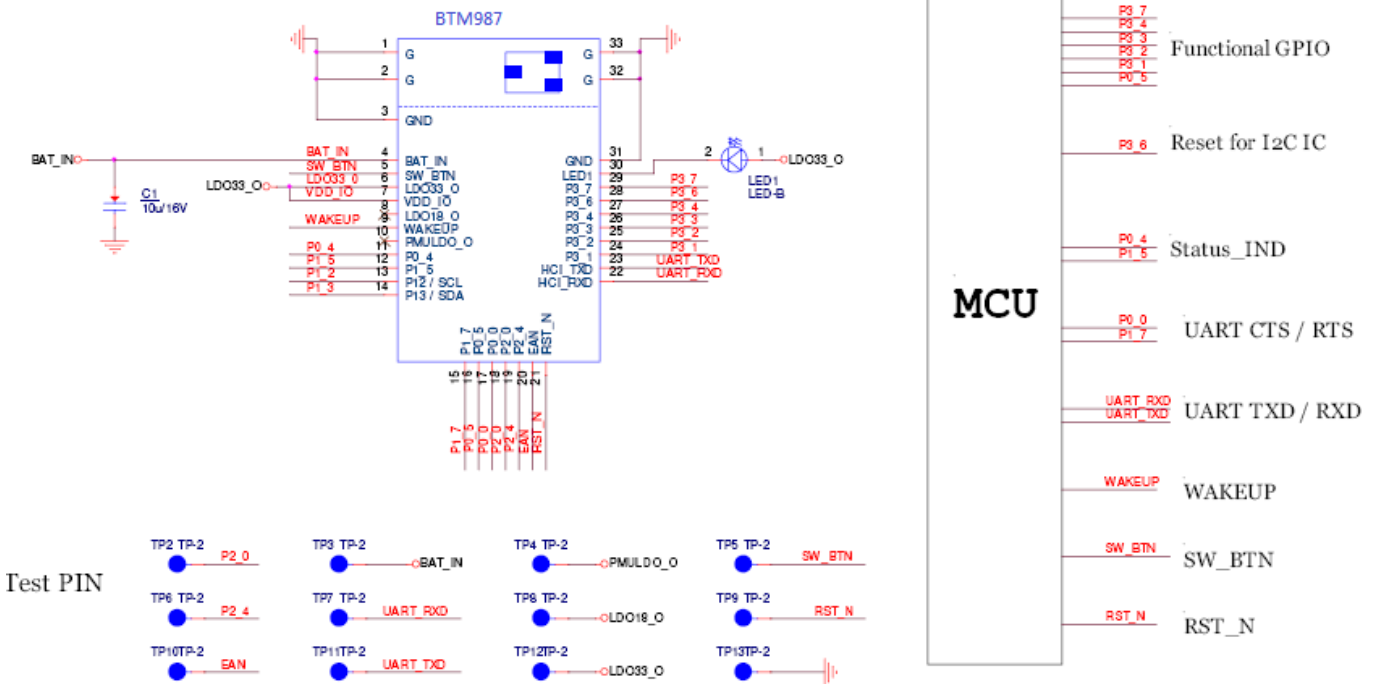
Intensity controllable LED driver

Parameters	Min	Typical	Max	Unit
Open-drain Voltage			3.6	V
Current Step		0.3		mA
Progrannable Current Range	0		5	mA
Intensity control		16		step
Power Down Open-drain Current			1	uA
Shutdown Current			1	uA

Block Diagram



REFERENCE CIRCUIT



RF Specification:

Transmitter section for BDR

Temperature = 25°C	Min	Typ	Max	Bluetooth Specification	Unit
Maximum RF transmit power	-6	2	-	-6 to +4	dBm
RF power variation over temperature range with compensation disabled	±2		-	-	dB
RF power control range		18	-	≥ 16	dB
RF power range control resolution	-	±0.5			dB
20dB bandwidth for module carrier		925		1000	kHz
Adjacent channel transmit power $F = F_0 \pm 2\text{MHz}$	-	-42	-40	≤ -20	dBm
Adjacent channel transmit power $F = F_0 \pm 3\text{MHz}$	-	-49	-48	≤ -40	dBm
Adjacent channel transmit power $F = F_0 \pm > 3\text{MHz}$	-	-57	-53	≤ -40	dBm
$\Delta f_{1\text{avg}}$ Maximum Modulation	150	165	175	$140 < f_{1\text{avg}} < 175$	kHz
$\Delta f_{2\text{max}}$ Minimum Modulation	120		140	≥ 115	kHz
$\Delta f_{2\text{avg}}/\Delta f_{1\text{avg}}$	0.92	0.94	-	≥ 0.80	-
Initial carrier frequency tolerance	-75	15	75	±75	kHz
Drift Rate	3.3	5	70	≤ 20	kHz/50μ
Drift (single slot packet)	-	12	25	≤ 40	kHz
2nd Harmonic Content	-	-42	-	≤ -30	dBm
3rd Harmonic Content	-	-45	-	≤ -30	dBm

Receiver section for BDR

Temperature = 25°C	Frequency (GHz)	Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity at 0.1% BER for all packet types	2.402	-	-90		≤ -70	dBm
	2.441	-	-90			
	2.480	-	-90			
Maximum received signal at 0.1% BER			0	0-	≥ -20	dBm
C/I co-channel		-	6	11	≤ 11	dB
Adjacent channel selectivity C/I $F = F_0 + 1\text{MHz}$		-	-6	0	≤ 0	dB
Adjacent channel selectivity C/I $F = F_0 - 1\text{MHz}$		-	-6.5	0	≤ 0	dB
Adjacent channel selectivity C/I $F = F_0 + 2\text{MHz}$		-	-36	-30	≤ -30	dB
Adjacent channel selectivity C/I $F = F_0 - 2\text{MHz}$		-	-28	-20	≤ -20	dB
Adjacent channel selectivity C/I $F = F_0 + 3\text{MHz}$		-	-31	-40	≤ -40	dB
Adjacent channel selectivity C/I $F = F_0 - 5\text{MHz}$		-	-48	-40	≤ -40	dB
Adjacent channel selectivity C/I $F = F_{\text{Image}}$		-	-28	-9	≤ -9	dB
Maximum level of intermodulation interferers			-37	-	≥ -39	dBm
Spurious output level		-	NA	-		dBm/Hz

Transmitter Section for EDR

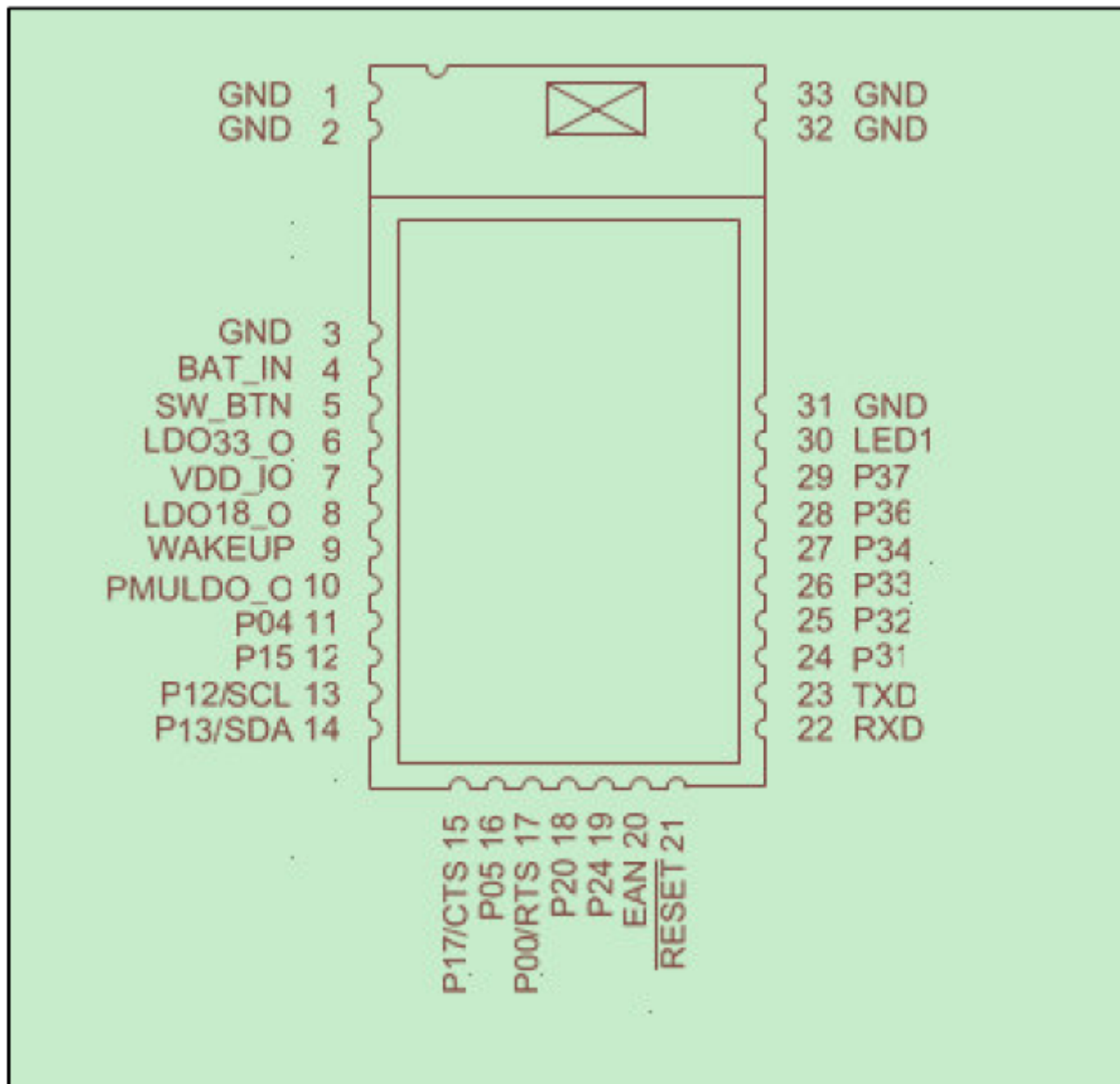
Temperature = 25°C		Min	Typ	Max	Bluetooth specification	Unit
Relative transmit power			-1		-20 to 10	dB
π/4 DQPSK max carrier frequency stability	$ \omega_o $ freq. error		5		≤10 for all blocks	KHz
	$ \omega_i $ initial freq. error		10		≤75 for all blocks	KHz
	$ \omega_o+\omega_i $ block freq. error		10		≤75 for all blocks	KHz
8DPSK max carrier frequency stability	$ \omega_o $ freq. error		5		≤10 for all blocks	KHz
	$ \omega_i $ initial freq. error		10		≤75 for all blocks	KHz
	$ \omega_o+\omega_i $ block freq. error		10		≤75 for all blocks	KHz
π/4 DQPSK modulation accuracy @ Tx= 2dBm	RMS DEVM		7		≤20	%
	99% DEVM		Pass		≤30	%
	Peak DEVM			25	≤35	%
8DQPSK modulation accuracy @ Tx= 2dBm	RMS DEVM		7		≤13	%
	99% DEVM		Pass		≤20	%
	Peak DEVM			20	≤25	%
In-band spurious emissions Note: $F_0=2441\text{MHz}$	$F > F_0+3\text{MHz}$		<-54		≤-40	dBm
	$F = F_0-3\text{MHz}$		-46		≤-40	dBm
	$F = F_0-2\text{MHz}$		-28		≤-20	dBm
	$F = F_0-1\text{MHz}$		-30		≤-26	dBm
	$F = F_0+1\text{MHz}$		-30		≤-26	dBm

	$F = F_0 + 2\text{MHz}$		-28		≤ -20	dBm
	$F = F_0 + 3\text{MHz}$		-46		≤ -40	dBm
EDR differential phase encoding			100		≥ 99	%

Receiver Section for EDR

Temperature = 25°C	Frequency (GHz)	Modulation	Min	Typ	Max	Bluetooth specification	Unit
Sensitivity at 0.01% BER	2.402	$\pi/4$ DQPSK		-90		≤ -70	dBm
	2.441	$\pi/4$ DQPSK		-90			
	2.480	$\pi/4$ DQPSK		-90			
	2.402	8DPSK		-82		≤ -70	dBm
	2.441	8DPSK		-82			
	2.480	8DPSK		-82			
Maximum received signal at 0.1% BER		$\pi/4$ DQPSK		-10		≥ -20	dBm
		8DPSK		-10		≥ -20	
C/I co-channel at 0.1% BER		$\pi/4$ DQPSK		4		≤ 13	dB
		8DPSK		5		≤ 21	dB
Adjacent channel selectivity C/I Note: $F_0 = 2441\text{MHz}$	$F = F_0 + 1\text{MHz}$	$\pi/4$ DQPSK		-14		≤ 0	dB
		8DPSK		-8		≤ 5	dB
	$F = F_0 - 1\text{MHz}$	$\pi/4$ DQPSK		-13		≤ 0	dB
		8DPSK		-8		≤ 5	dB
	$F = F_0 + 2\text{MHz}$	$\pi/4$ DQPSK		-38		≤ -30	dB
		8DPSK		-34		≤ -25	dB
	$F = F_0 - 2\text{MHz}$	$\pi/4$ DQPSK		-21		≤ -7	dB
		8DPSK		-21		≤ 0	dB
	$F = F_0 - 3\text{MHz}$	$\pi/4$ DQPSK		-27		≤ -20	dB
		8DPSK		-20		≤ -13	dB
	$F = F_0 + 5\text{MHz}$	$\pi/4$ DQPSK		-52		≤ -40	dB
		8DPSK		-45		≤ -33	dB
	$F = F_{\text{image}}$	$\pi/4$ DQPSK		-21		≤ -7	dB
		8DPSK		-21		≤ 0	dB

BTM-978 Pin Functions

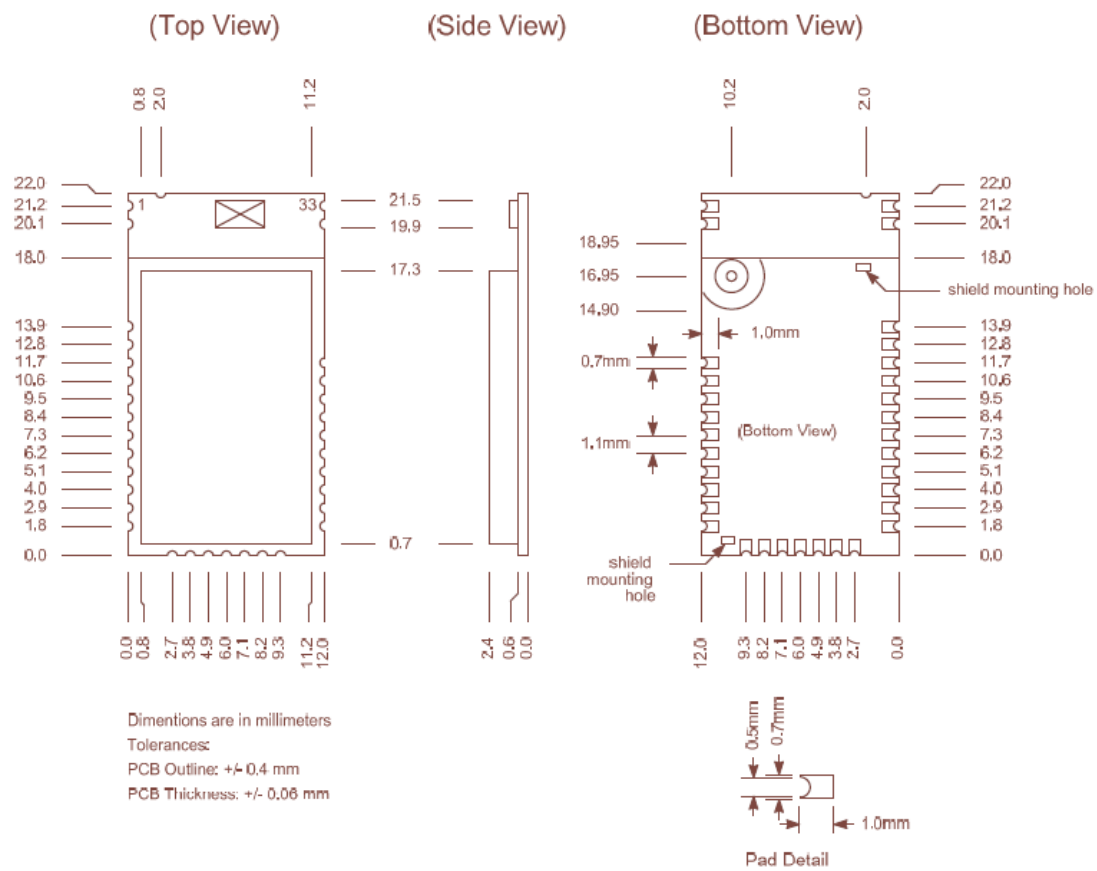


No.	Pin Name	Pin Type	Supply Domain	Pin Description
1	GND	Power		Ground
2	GND	Power		Ground
3	GND	Power		Ground
4	BAT_IN	Power		Battery input, Main positive supply input Connect to 10uF capacitor
5	SW_BTN	DI		software button H:Power on/L: Power off
6	LDO33_O	Power		Internal 3.3V LDO regulator output. Connect to 10uF capacitor
7	VDD_IO	Power		I/O positive supply input. Ensure VDD_IO and MCU I/O voltages are compatible
8	LDO18_O	Power		Internal 1.8V LDO regulator output .Connect 10uF

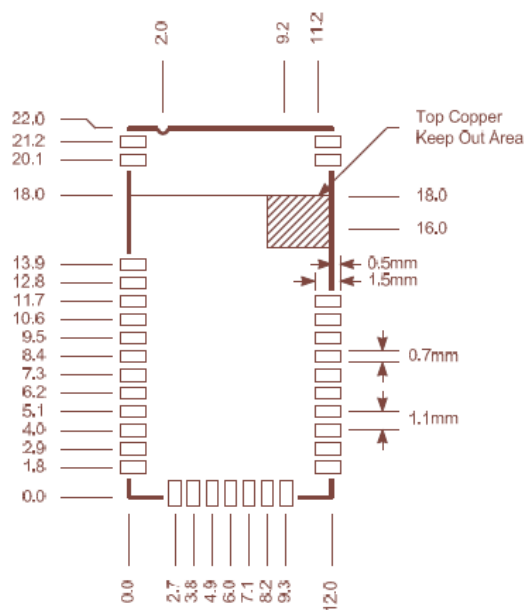
				capacitor
9	WAKEUP	DI		Wakeup from shutdown mode (active low) (internal pull-up)
10	PMULDO_O	Power		Power management unit output. Connect to 1uF capacitor.
11	P0_4	DO	VDD_IO	UART_TX_IND: H:BTM978 indicate UART data will be transmitted out after certain timing.(Setting by UI@ “MCU setting”, default wait 5ms)*1 L:Otherwise. STATUS_IND_2: BTM978 State indication, refer to P1_5
12	P1_5	DO	VDD_IO	STATUS_IND: Bluetooth link status indication.
13	P1_2/SCL	DO	VDD_IO	I2C SCL.(Do Not Connect)
14	P1_3/SDA	DIO	VDD_IO	I2C SDA(Do Not Connect)
15	P1_7/CTS	DIO	VDD_IO	Configurable Control or Indication pin or UART CTS (lutput)
16	P0_5	DIO	VDD_IO	Configurable Control or Indication pin
17	P0_0/RTS	DIO-	VDD_IO	Configurable Control or Indication pin or UART RTS(output)
18	P2_0	DI	VDD_IO	System configuration(internal pull-up)
19	P2_4	DI	VDD_IO	System configuration(internal pull-up)
20	EAN	DI	VDD_IO	System configuration(internal pull-down)
21	RST_N	DI	VDD_IO	Module reset(active low)(internal pull-up) Apply a pulse of at least 63ns
22	RXD	DI	VDD_IO	UART data input
23	TXD	DO	VDD_IO	UART data output
24	P3_1	DIO	VDD_IO	Configurable Control or Indication pin (when configured as input: internal pull-up)
25	P3_2	DIO	VDD_IO	Configurable Control or Indication pin (when configured as input: internal pull-up)
26	P3_3	DIO	VDD_IO	Configurable Control or Indication pin (when configured as input: internal pull-up)
27	P3_4	DIO	VDD_IO	Configurable Control or Indication pin (when configured as input: internal pull-up)
28	P3_6	DIO	VDD_IO	Configurable Control or Indication pin (when configured as input: internal pull-up)
29	P3_7	DIO	VDD_IO	Configurable Control or Indication pin (when configured as input: internal pull-up)
30	LED1	DO		Status LED
31	GND	Power		Ground
32	GND	Power		Ground

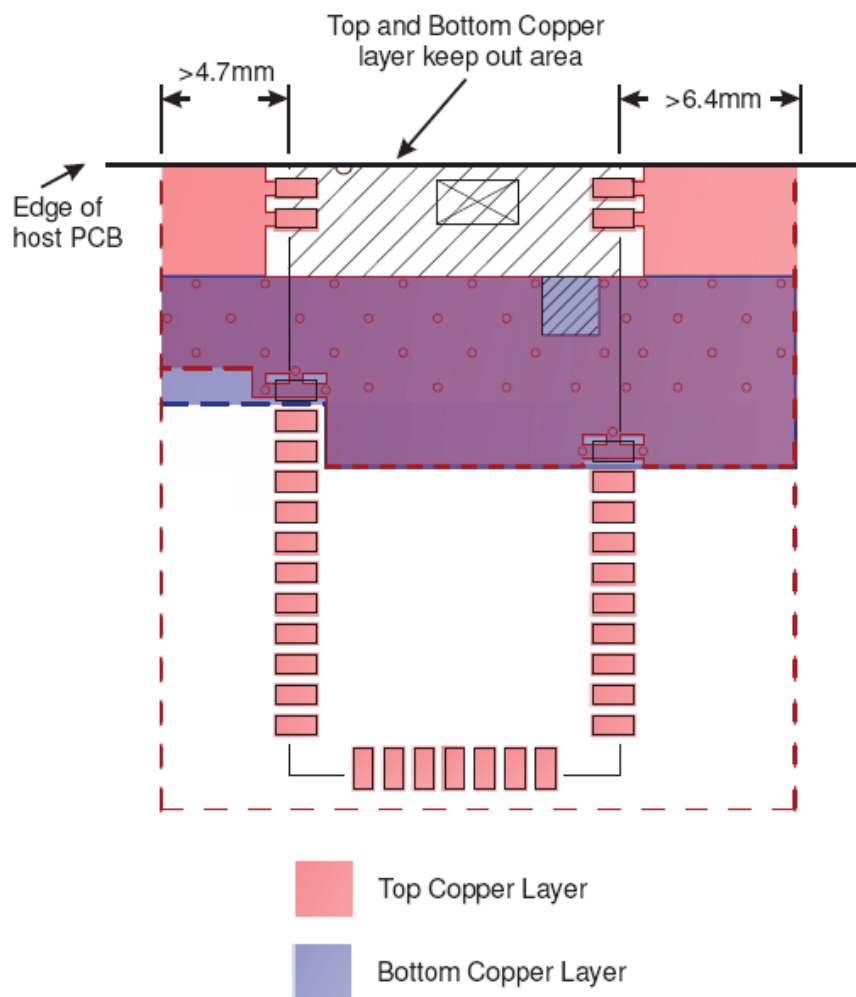
33	GND	Power		Ground
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Dimension



(Top View)





Reflow Profile

Reflow profile requirements		
Parameter Specification	Referenc	Specification
Average temperature gradient in		1~2.5°C/s to 175°C
Soak time	T _{soak}	120~180 seconds
Time above 217°C (T ₁)	t ₁	45~90 seconds
Peak temperature in reflow	T ₂	250°C (-0/+5°C)
Time at peak temperature	t ₂	6 seconds
Temperature gradient in cooling		6°C/second max.

