VT-RT6MB

Bluetooth® Low Energy Module

■ INTRODUCTION

VT-RT6MB is an ultra-low-power SoC module for Bluetooth® 5.0 low energy applications that combines the excellent performance of a leading RF transceiver with a low-power ARM® Cortex-M4F and rich powerful supporting features and peripherals. The VT-RT6MB supports BLE related applications Bluetooth® and mesh networking specification suited for large-scale device networks to support building automation, sensor networks, asset tracking and other solutions where multiple devices need to communicate reliably and securely.

■ FEATURES

- Bluetooth® Core Spec v5.0 compliant
- Supports 2Mbps LE, LE advertising extension and LE long range
- Supports Bluetooth Mesh Network Specification
- Supports AES128/192/256 encryption/decryption
- Supports OTA (Over-the-Air) for firmware upgrade
- Battery Supply Voltage 1.8V to 3.6V
- Operational Temperature -30˚C to +85˚C
- Current Consumptions
  - Power Down Mode 450nA (Typ.)
  - Deep LPS (with 160K SRAM retention) Mode 2.5uA (Typ.)
  - TX Mode (+0dBm) 8.4mA (Typ.)
  - TX Mode (+4dBm) 10.4mA (Typ.)
  - TX Mode (+8dBm) 12.7mA (Typ.)
  - RX Mode 6.8mA (Typ.)
- Radio Bluetooth® Qualification (End Product, QDID: TBD)
- Meets Radio Certification FCC, RED, KCC and MIC Japan
- Dimension 12mm(W) x 18.82mm(L) x 2.3mm(H)
- Pb Free, RoHS Compliant

■ REVERSION HISTORY

Version Code	Date	Descriptions
0.1 BETA	9-MAY-22	Preliminary release
0.2BETA	8-AUG-22	Modify module Description

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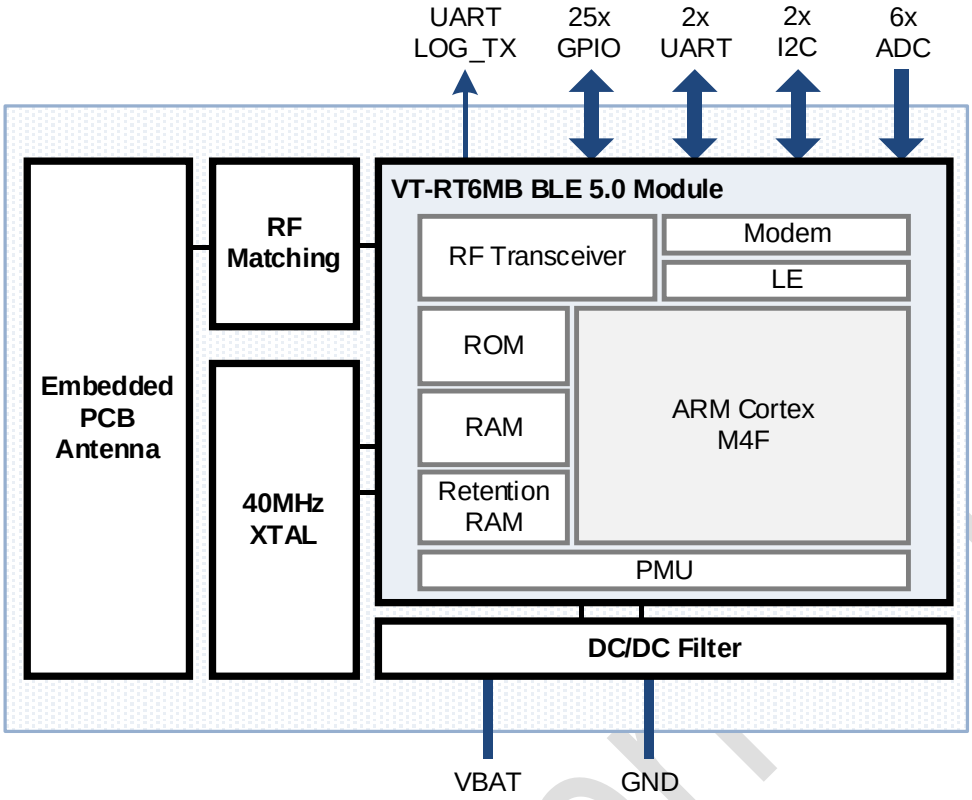
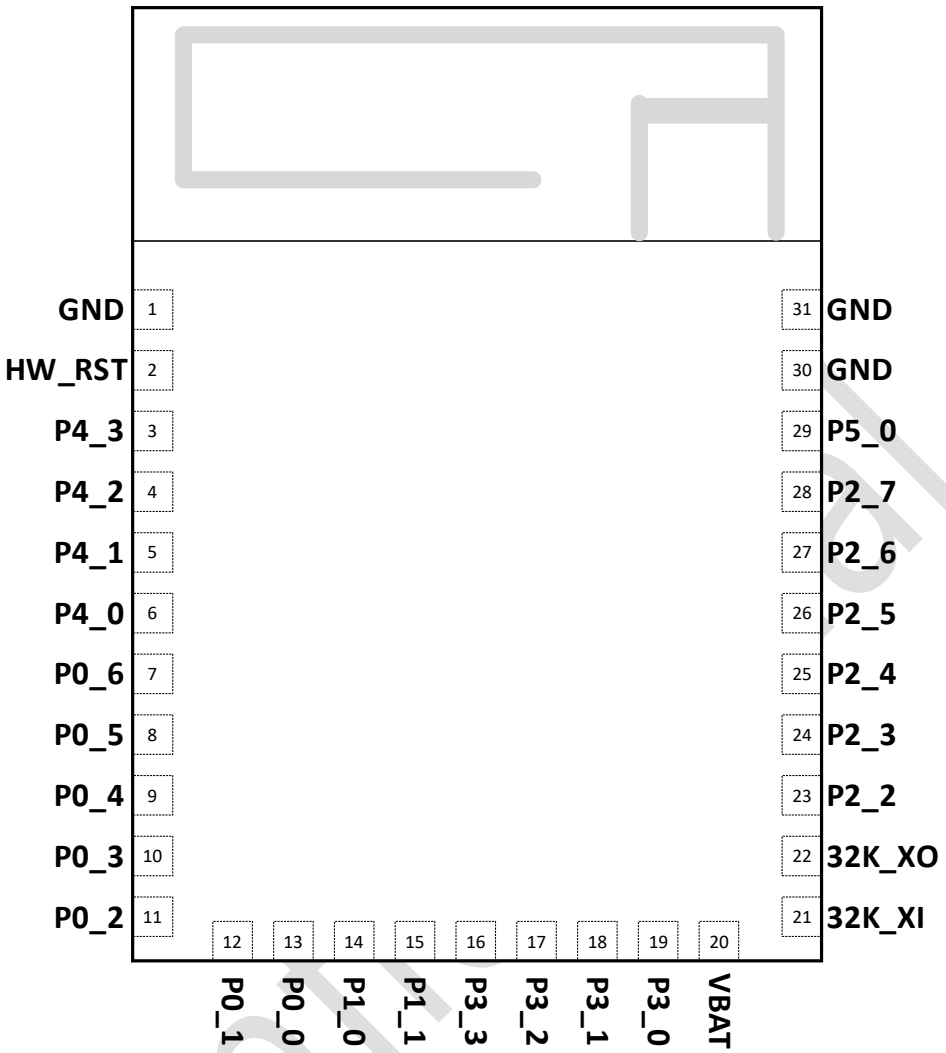
■ MODULE SPECIFICATIONS

Specification Name		Descriptions
Module Dimension		12mm(W) x 18.82mm(L) x 2.3mm(H)
BLE Core Compliant		BLE V5.0
Operation Distance		Up to 80Meters (*LE 1M, module to module testing results)
Power Supply		1.8V – 3.6V
Power Consumption	Power Down Mode	450nA
	Deep LPS	2.5uA
	TX mode (+0dBm)	8.4mA
	TX mode (+4dBm)	10.4mA
	TX mode (+8dBm)	12.7mA
	RX mode	6.8mA
Antenna Type		embedded PCB antenna
GPIO Numbers:		Up to 25x
PWM Numbers:		Up to 6x
12bit ADC Numbers:		Up to 6x (P2_2 to P2_7)
Support interfaces		UART/4-wire SPI master and slave/I2C/I2S

■ BLOCK DIAGRAM



■ PIN ASSIGNMENTS (TOP VIEW)



■ PIN DEFINITIONS

➢ SoC Mode Condition:

Note: *INOUT* (digital bidirectional), *ANA*(analog pin), *DIG*(digital pin).

#	Pin Name	I/O	Ana/Dig	Function
1	GND	-	GND	GND
2	HW_RST	IN	DIG	Hardware reset pin; low active;
3	P4_3	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
4	P4_2	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
5	P4_1	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;

6	P4_0	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
7	P0_6	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
8	P0_5	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
9	P0_4	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
10	P0_3	OUT	DIG	LOG_UART_TX (default)
11	P0_2	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
12	P0_1	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
13	P0_0	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
14	P1_0	INOUT	DIG	SWDIO (default) General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
15	P1_1	INOUT	DIG	SWDCLK (default) General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
16	P3_3	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
17	P3_2	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
18	P3_1	INOUT	DIG	HCI_UART_RX (default) General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
19	P3_0	INOUT	DIG	HCI_UART_TX (default) General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
20	VBAT	-	PWR	Power Supply, 1.8V to 3.6V;
21	32K_XI	INOUT	ANA/DIG	32k crystal input or external 32k clock input (optional) Pin share as GPIO when external 32k is not used.
22	32K_XO	INOUT	ANA/DIG	32k crystal output (optional) Pin share as GPIO when external 32k is not used.

23	P2_2	INOUT	ANA/DIG	AUXADC input 2 (default) General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
24	P2_3	INOUT	ANA/DIG	AUXADC input 3 (default) General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
25	P2_4	INOUT	ANA/DIG	AUXADC input 4 (default) General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
26	P2_5	INOUT	ANA/DIG	AUXADC input 5 (default) General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
27	P2_6	INOUT	ANA/DIG	AUXADC input 6 (default) General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
28	P2_7	INOUT	ANA/DIG	AUXADC input 7 (default) General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
29	P5_0	INOUT	DIG	General purpose IO, 8mA driving capability; With wakeup function, internal strong/weak pull-up and pull-down;
30	GND	-	GND	GND
31	GND	-	GND	GND

■ ELECTRICAL CHARACTERISTICS

● Temperature Limit Ratings

Parameter	Description	Note	Min.	Typ.	Max.	Unit
T_{STORE}	Storage temperature		-55		125	°C
T_{AOP}	Operational Temperature		-30		85	°C

● Power Supply DC Characteristics

Parameter	Description	Note	Min.	Typ.	Max.	Unit
V_{BAT}	Supply Voltage		1.8	3	3.6	V

● ESD Characteristics

Parameter	Description	Note	Min.	Typ.	Max.	Unit
ESD_{HBM}	ESD, human body mode	All pins, test method: JESD22			3500	V
ESD_{MM}	ESD, machine mode	All pins, test method: JESD22			200	V
ESD_{CDM}	ESD, charged device mode	All pins, test method: JESD22			500	V

● 12bit-AUX ADC Characteristics

Parameter	Description	Note	Min.	Typ.	Max.	Unit
ADC_{BIT}	Resolution	Bypass mode		12		BITS
		Divided mode (1/3.3)		12		BITS
F_{CLK_ADC}	Clock Source	From digital			400	kHz
ADC_{DNL}	DNL	Single-ended mode (Bypass mode)		±1.5		LSB
		Differential mode (Bypass mode)		±3.0		LSB
ADC_{INL}	INL	Single-ended mode (Bypass mode)		±1.0		LSB
		Differential mode (Bypass mode)		±2.0		LSB
ADC_{VIN_RANGE}	Input Voltage Range	External channel (Divided Mode)	0		VBAT	V
		External channel (Bypass Mode)	0		1	-
		Internal channel (VBAT)	1.8		3.63	V
ADC_{R_IN}	Input Impedance	Bypass mode		10M		Ohm
		Resistor divider mode (1/4)		500k		Ohm
ADC_{C_Sample}	Input Impedance	Bypass mode		1.9		pF
		Resistor divider mode (1/4)		1.9		pF

● Radio Characteristics

General Radio Characteristics

Parameter	Description	Note	Min.	Typ.	Max.	Unit
F_{RANGE}	Frequency range		2402		2480	MHz

RX Performance

Condition: VBAT=3V, ambient temperature=25°C

Parameter	Description	Note	Min.	Typ.	Max.	Unit
P_{RX_MIN}	Sensitivity (LE 1M)	PER ≤ 30.8%	-97			dBm
P_{RX_MAX}	Maximum received power	PER ≤ 30.8%		-1		dBm
CI_{RX_1M}	C/I co-channel		21			dB
	C/I + 1MHz offset		15			dB
	C/I - 1MHz offset		15			dB
	C/I + 2MHz offset		-17			dB
	C/I - 2MHz offset		-15			dB
	C/I + 3MHz offset		-27			dB
	C/I image		-9			dB
	C/I image + 1MHz offset		-15			dB
	C/I image - 1MHz offset		-15			dB
P_{RX_OOB}	Blocker Power Wanted signal level= -67dBm	30MHz ~ 2000MHz	-30			dBm
		2003MHz ~ 2399MHz	-30			dBm
		2484MHz ~ 2997MHz	-30			dBm
		3000MHz ~ 12.75GHz	-30			dBm
PER_{MAX}	Max PER report integrity	Wanted signal= -30dBm		50%		-
P_{RX_IMD}	Max Intermodulation level	Wanted signal f(0) = -64dBm Worst intermodulation level @2f1-f2=f0, |f1-f2|=n MHz, n=3,4,5…	-50			dBm

TX Performance

Condition: VBAT=3V, ambient temperature=25°C

Parameter	Description	Note	Min.	Typ.	Max.	Unit
P_{TX_MAX}	Maximum output power				8	dBm
P_{TX_ADJ}	Adjacent channel power ratio (LE 1M)	+2MHz			-20	dBm
		-2MHz			-20	dBm
		≥ +3MHz			-30	dBm
		≤ -3MHz			-30	dBm
F_{MOD}	Modulation Characteristics (LE 1M)	Δf1avg		250		kHz
		Δf2max	185			kHz
		Δf2max pass rate		100%		-
		Δf2avg / Δf1avg		0.88		-
F_{CAR_OFFSET}	Carrier frequency offset and drift (LE 1M)	Average Fn		12.5		kHz
		Drift rate		10		kHz/50μs
		Average drift		10		kHz/50μs
		Maximum drift		10		kHz/50μs
P_{TX_HD2}	2nd harmonic power			-50		dBm
P_{TX_HD3}	3rd harmonic power			-50		dBm

● Digital I/O Pin DC Characteristics

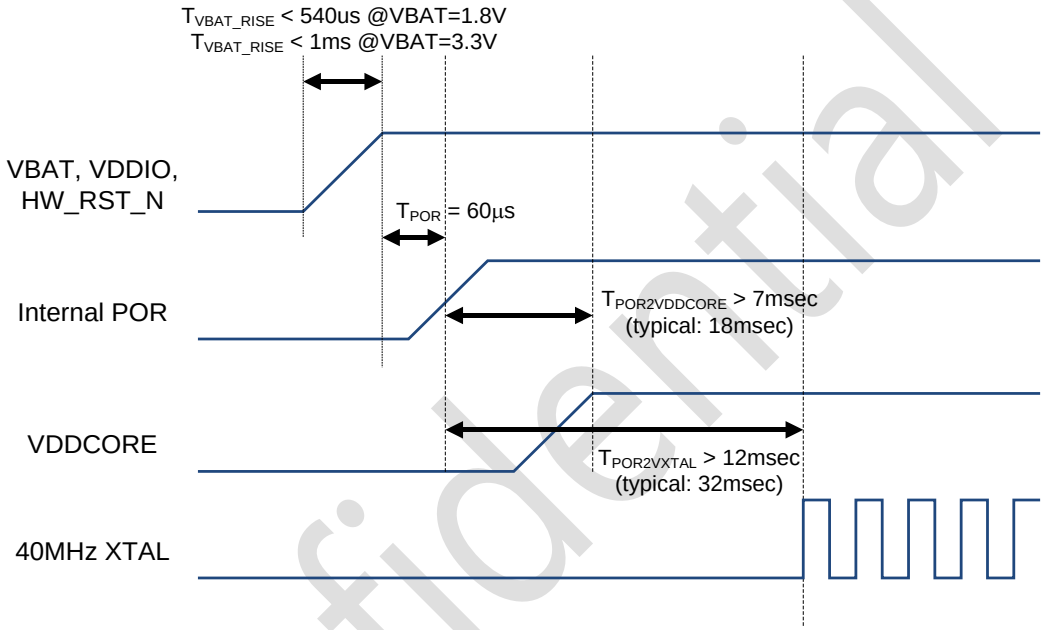
Condition: ambient temperature=25°C

Parameter	Description	Note	Min.	Typ.	Max.	Unit
V_{IH33}	Input high voltage	VDDIO=3.3V	2	3.3	3.6	V
V_{IL33}	Input low voltage			0	0.9	V
V_{OH33}	Output high voltage		2.97		3.3	V
V_{OL33}	Output low voltage		0		0.33	V
V_{IH28}	Input high voltage	VDDIO=2.8V	1.8	2.8	3.1	V
V_{IL28}	Input low voltage			0	0.8	V
V_{OH28}	Output high voltage		2.5			V
V_{OL28}	Output low voltage		0		0.28	V
R_{pull}	Strong Pull	VDDIO=3.3V		10		kOhm
		VDDIO=1.8V		20		kOhm
	Weak Pull	VDDIO=3.3V		100		kOhm
		VDDIO=1.8V		200		kOhm
	Strong Pull (P2_2~P2_7)	VDDIO=3.3V		5		kOhm
		VDDIO=1.8V		2.5		kOhm

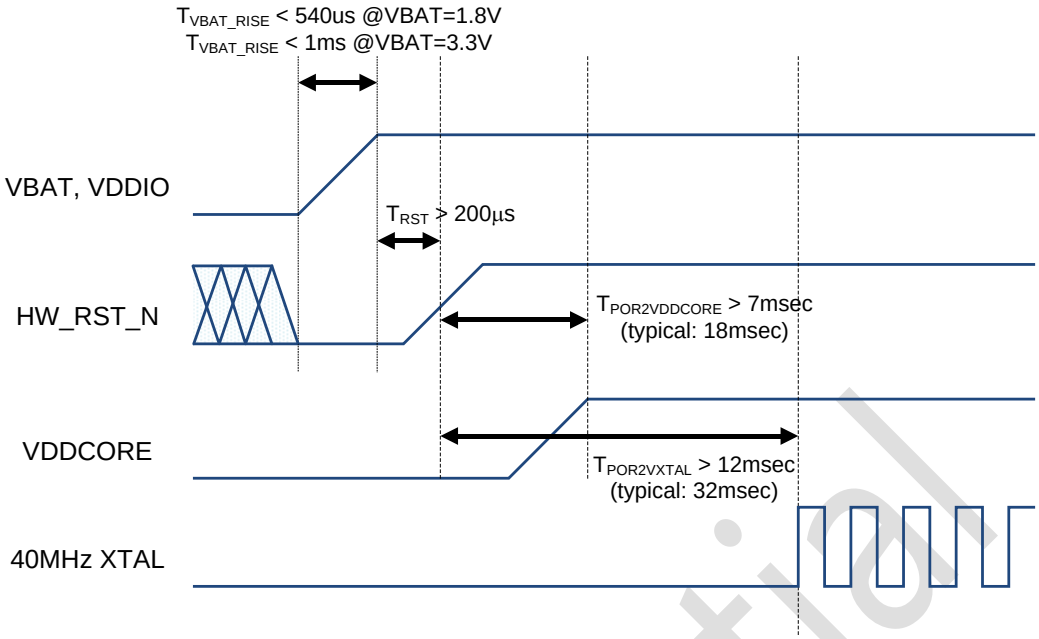
R_{pull}	Weak Pull (P2_2~P2_7)	VDDIO=3.3V		50		kOhm
		VDDIO=1.8V		25		kOhm
I_{IH}	Input high current	PAD configured as input mode			0.1	μA
I_{IL}	Input low current				0.1	μA

● Boot Sequence

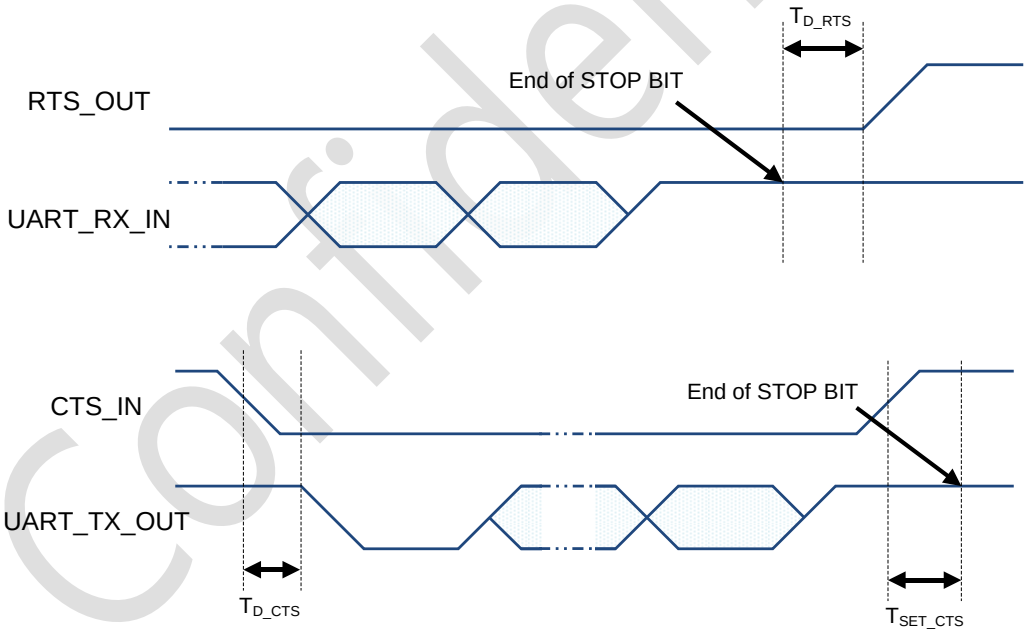
Boot up by internal power on reset circuit, power on timing is shown in below figure.



Boot up by HW_RST_N pin, power on timing is shown in below figure.



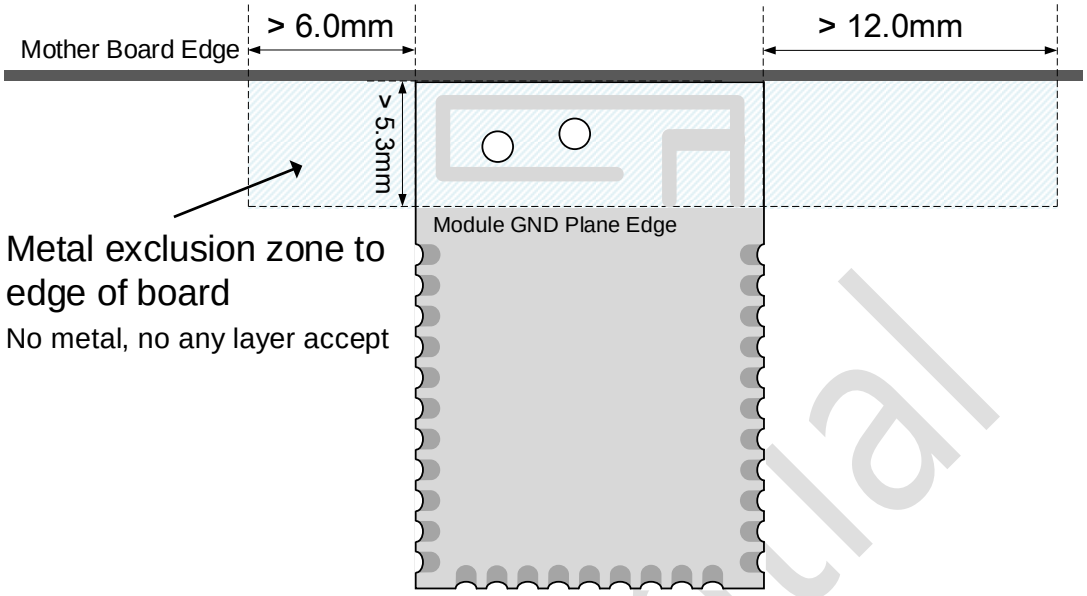
● UART Characteristics



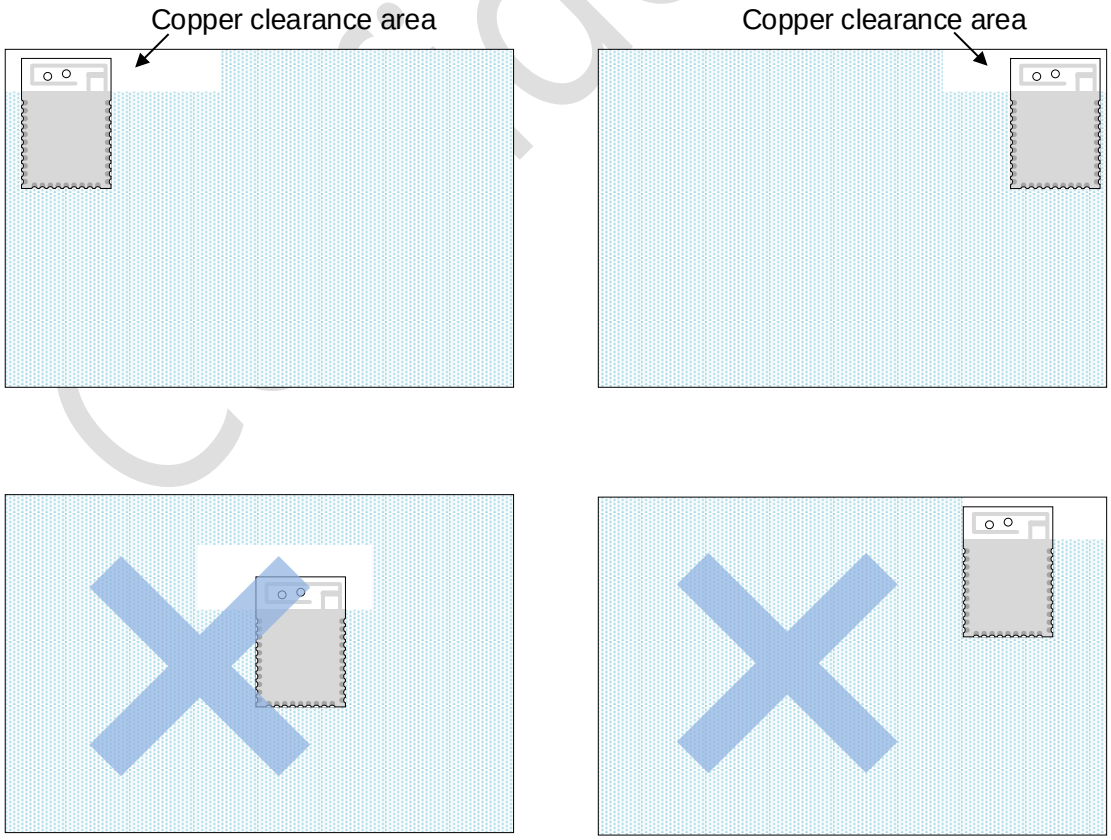
Parameter	Description	Note	Min.	Typ.	Max.	Unit
T_{D_RTS}	Timing between UART_RX_IN stop bit and RTS rising edge when RX FIFO is full				0.5	ns
T_{D_CTS}	Timing between CTS falling edge and UART_TX_OUT first bit				25	ns

T_{SET_CTS}	Timing between CTS rising edge and UART_TX_OUT stop bit		75			ns

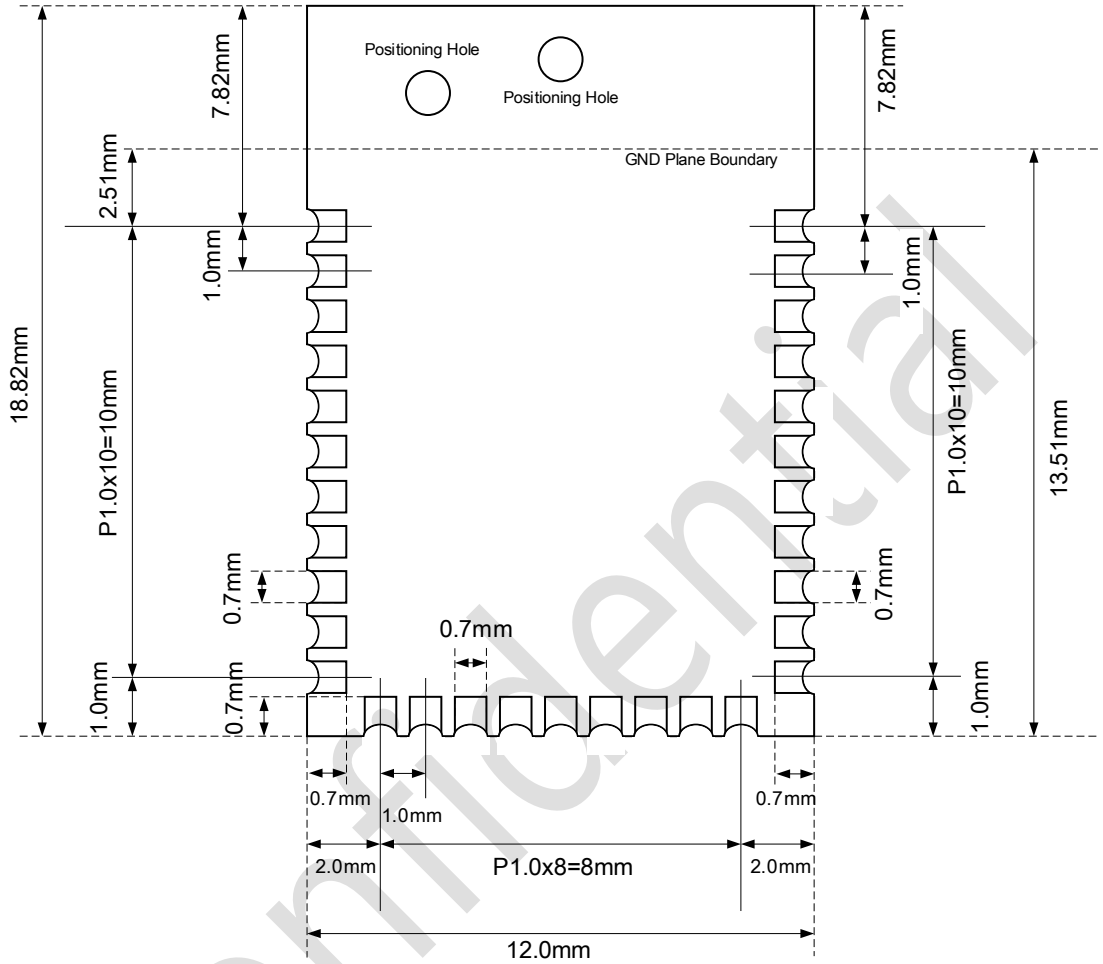
■ PCB LAYOUT GUIDE



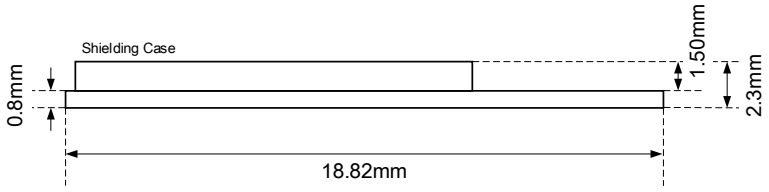
Module Placement Example:



■ MODULE DIMENSIONS



Top View



Side View

Federal Communication Commission Interference Statement:

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.

RF Exposure warning

This equipment must be installed and operated in accordance with provided instructions and the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 20 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter. End-users and installers must be provide with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance.

AUTION:

Any changes or modifications not expressly approved by the grantee of this device could void the user's authority to operate the equipment.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20cm 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: 2AXKL-BTRT6MB".

Information for the OEMs and Integrators

The following statement must be included with all versions of this document supplied to an OEM or integrator, but should not be distributed to the end user.

1) This device is intended for OEM integrators only.

2) Please see the full Grant of Equipment document for other restrictions.

NCC 警語：

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本模組於取得認證後將依規定於模組本體標示審驗合格標籤，並要求最終產品平台廠商 (OEM Integrator) 於最終產品平台 (End Product) 上標示 “本產品內含射頻模組，其 NCC 型式認證號碼為: CCXXxxYYyyyZzW “