

VT-RT6M

Bluetooth® Low Energy Mesh Module

Version 0.6BETA Preliminary Release

■ INTRODUCTION

VT-RT6M 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-RT6M supports Bluetooth® 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 Bluetooth Mesh Networking 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 11.05mm(W) x 17.0mm(L) x 2.1mm(H)
- Pb Free, RoHS Compliant

■ REVERSION HISTORY

Version Code	Date	Descriptions
0.52 BETA	7-MAY-19	Preliminary release
0.53 BETA	6-JUN-19	Change module part no.; Update operational temperature range;
0.60 BETA	4-SEP-19	Add module block diagram; Add AT Command mode pin definitions; Add module interface descriptions; Add module electrical characteristics; Add PCB layout guide;
1.0	21-Dec-20	Add RF certifications

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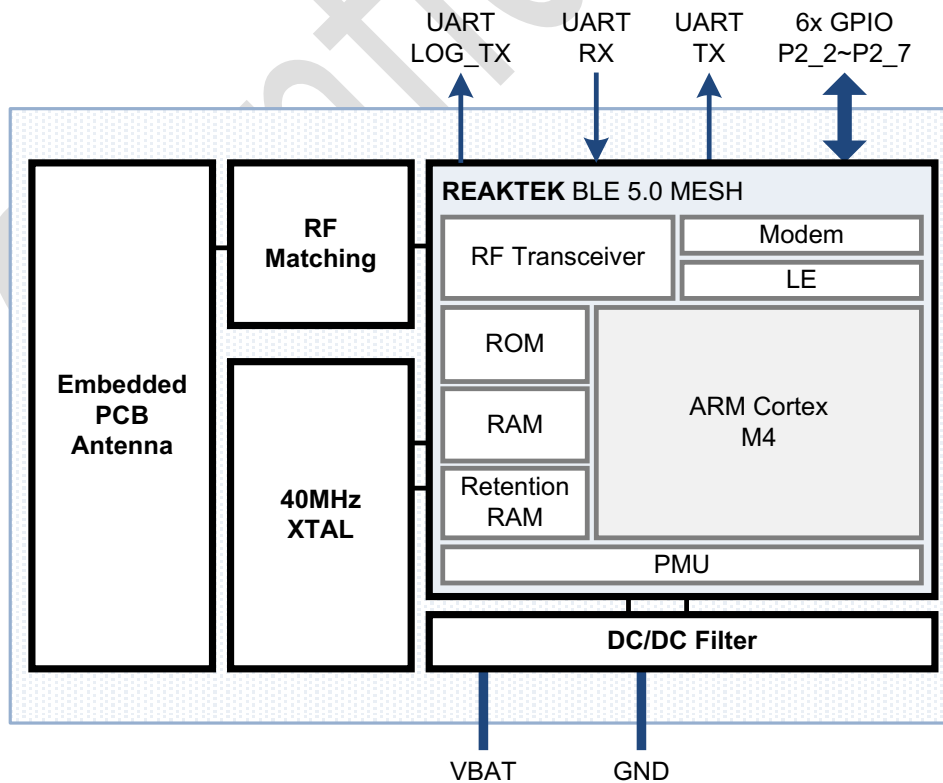
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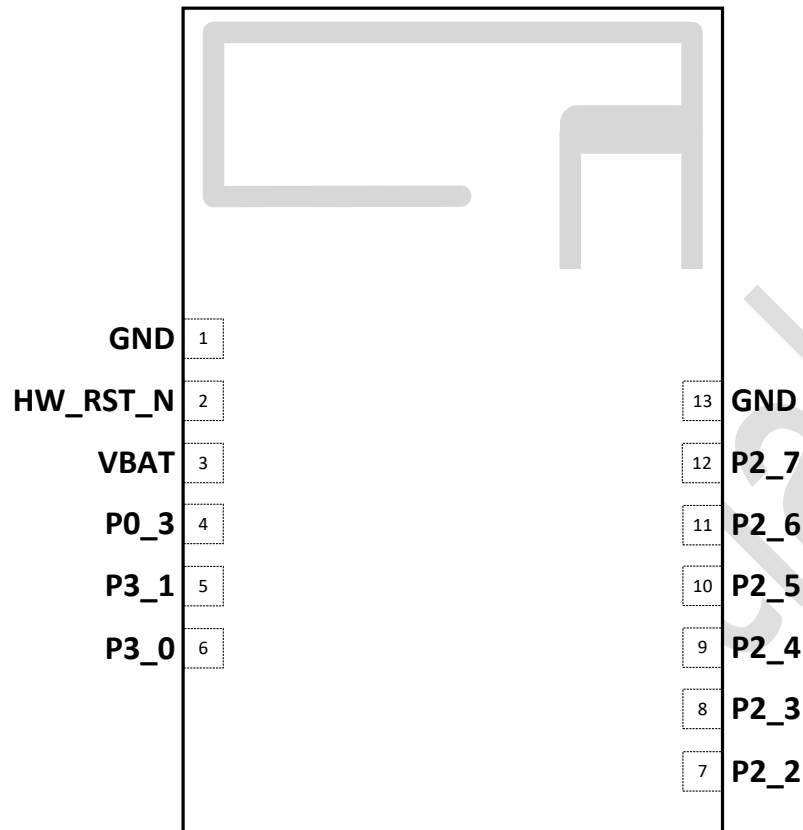
MODULE SPECIFICATIONS

Specification Name	Descriptions	
Module Dimension	11.05mm(W) x 17mm(L) x 2.1mm(H)	
BLE Core Compliant	BLE V5.0	
Operation Distance	Up to 80Meters (*LE 1M, apple to apple 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 8x (including P3_0 and P3_1)	
PWM Numbers:	Up to 6x (P2_2 to P2_7)	
12bit ADC Numbers:	Up to 6x (P2_2 to P2_7)	
Support interfaces	UART/4-wire SPI master/4-wire SPI slave	

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_N	IN	DIG	Hardware reset pin; low active;
3	VBAT	-	PWR	Power Supply, 1.8V to 3.6V;
4	P0_3	OUT	DIG	LOG_UART_TX (default)
5	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;
6	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;

7	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;
8	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;
9	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;
10	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;
11	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;
12	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;
13	GND	-	GND	GND

➤ **UART AT Command Mode Condition:**

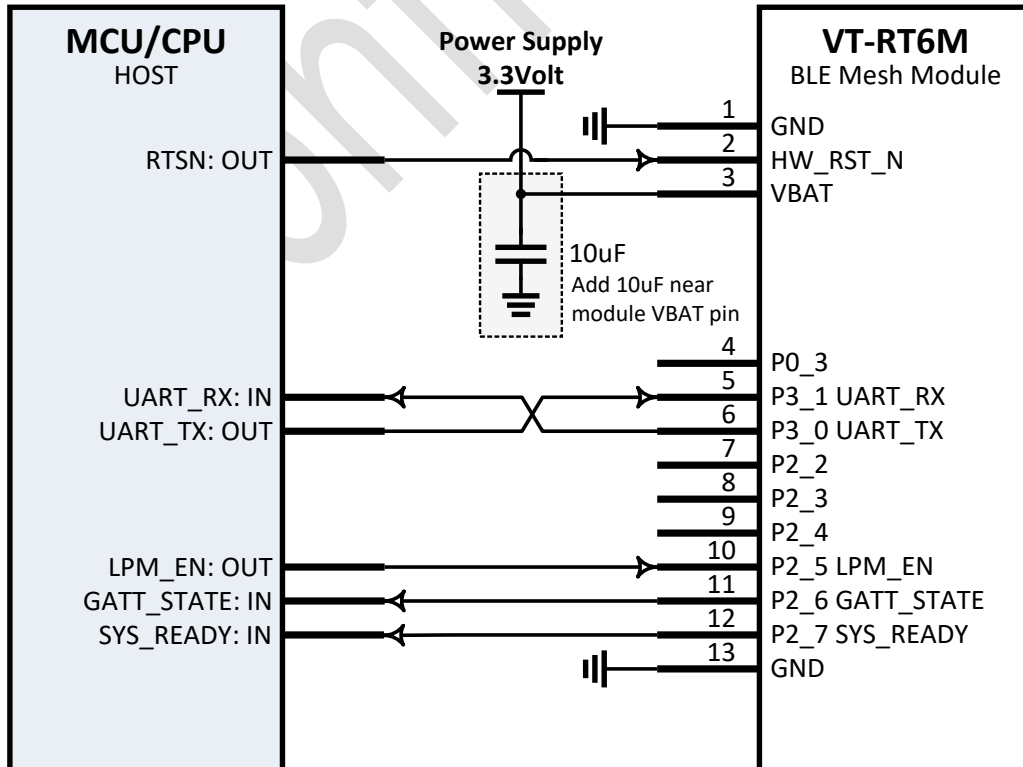
Note: ANA(analog pin), DIG(digital pin).

#	Pin Name	I/O	Ana/Dig	Function
1	GND	-	GND	GND
2	HW_RST_N	IN	DIG	Hardware reset pin; low active;
3	VBAT	-	PWR	Power Supply, 1.8V to 3.6V;
4	P0_3	OUT	DIG	LOG_UART_TX (default) for debugging purposed; Keep floating for general usage;
5	P3_1	IN	DIG	UART_RX; With weakly pull-high;
6	P3_0	OUT	DIG	UART_TX;

7	P2_2	IN	ANA	NC, keep floating for general usage; With weakly pull-low;
8	P2_3	IN	ANA	NC, keep floating for general usage; With weakly pull-low;
9	P2_4	IN	ANA	NC, keep floating for general usage; With weakly pull-low;
10	P2_5	IN	DIG	LPM_EN; Enable low power mode, high active; With weakly pull-low;
11	P2_6	OUT	DIG	GATT_STATE; Indication pin for GATT connection state; Output high when connected; Output low when disconnected;
12	P2_7	OUT	DIG	SYS_READY; indication pin for BLE stack ready; Output high when BLE stack ready; Output low when BLE stack not ready;
13	GND	-	GND	GND

■ **APPLICATION EXAMPLE**

UART AT Command Mode:



■ INTERFACE DESCRIPTIONS

● UART

VT-RT6M provides multiple UART baud-rate. The common baud-rate is shown in below table. **The UART clock error between two devices should be less than +/- 2.5%.**

VT-RT6M UART Features:

- Supports 7/8 data format.
- 1/2 bit stop bit.
- Configurable parity bit: odd/even.
- Programmable baud rate (maximum baud rate=4Mbps).
- Support hardware flow control.
- RX line idle state detect.
- DMA supported.

Baud-rate (bps)	Error (%)	Baud-rate (bps)	Error (%)
1200	-0.23	460800	0.17
9600	< 0.01	500000	< 0.01
14400	< 0.01	921600	0.18
19200	< 0.01	1000000	< 0.01
28800	< 0.01	1382400	0.17
38400	< 0.01	1444400	-0.31
57600	< 0.01	1500000	< 0.01
76800	0.01	1843200	-0.35
115200	< 0.01	2000000	0.02
128000	0.02	2764800	0.14
153600	-0.1	3000000	0.06
230400	0.03	4000000	0.03

Table: UART Baud Rate

■ 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		V _{BAT}	V
		External channel (Bypass Mode)	0		1	-
		Internal channel (V _{BAT})	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
C _{IRX_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}	2 nd harmonic power			-50		dBm
P _{TX_HD3}	3 rd harmonic power			-50		dBm

● Digital I/O Pin DC Characteristics

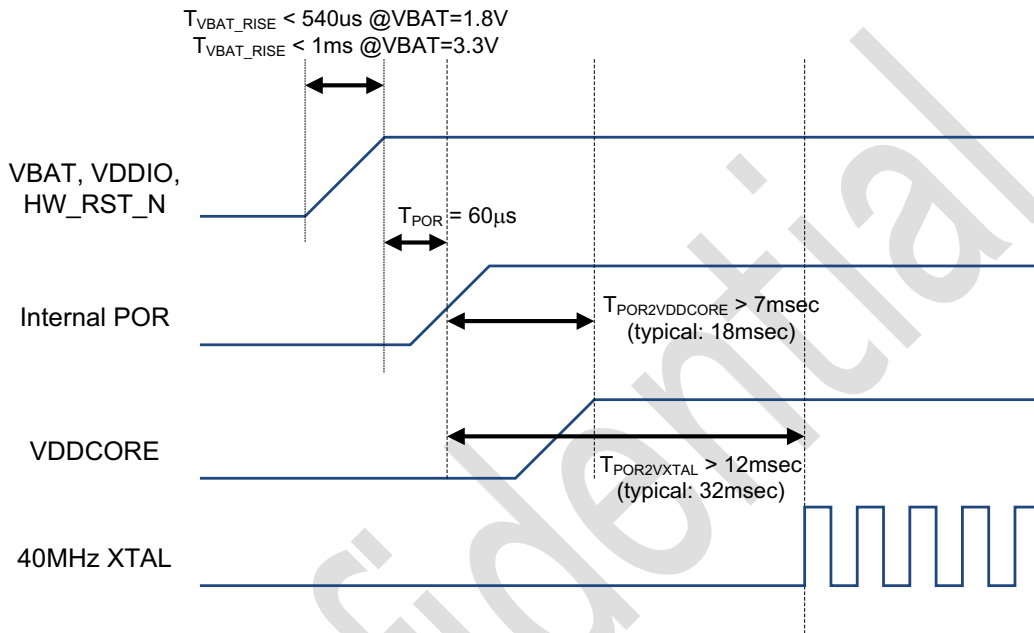
Condition: ambient temperature=25°C

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

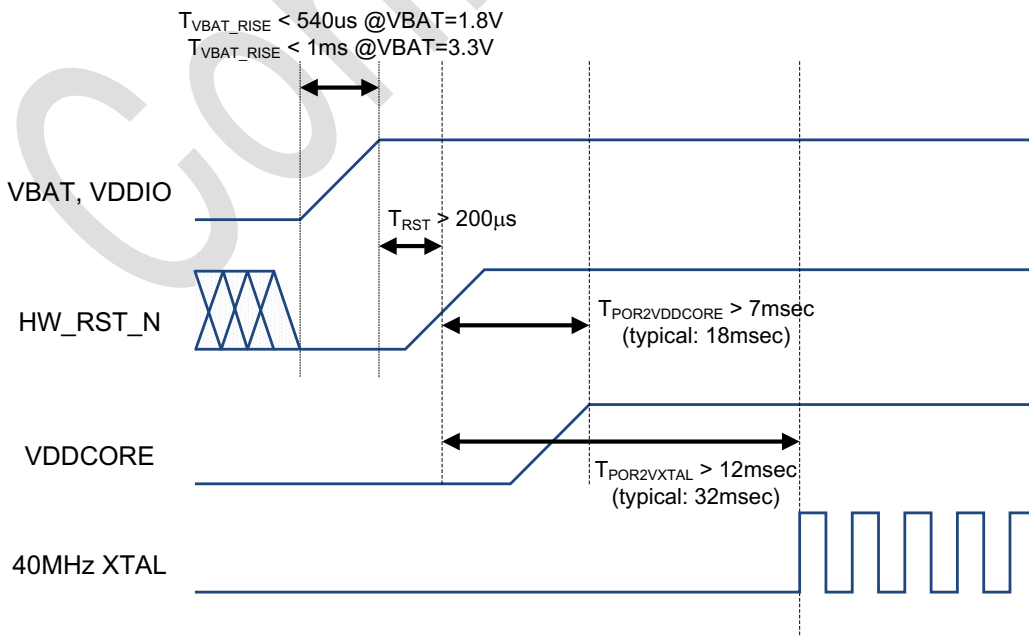
R_{pull}	Weak Pull (P2_2~P2_7)	VDDIO=3.3V	50	kOhm
		VDDIO=1.8V	25	kOhm
I_{IH}	Input high current	PAD configured as input mode	0.1	μA
I_{IL}	Input low current		0.1	μA

● **Boot Sequence**

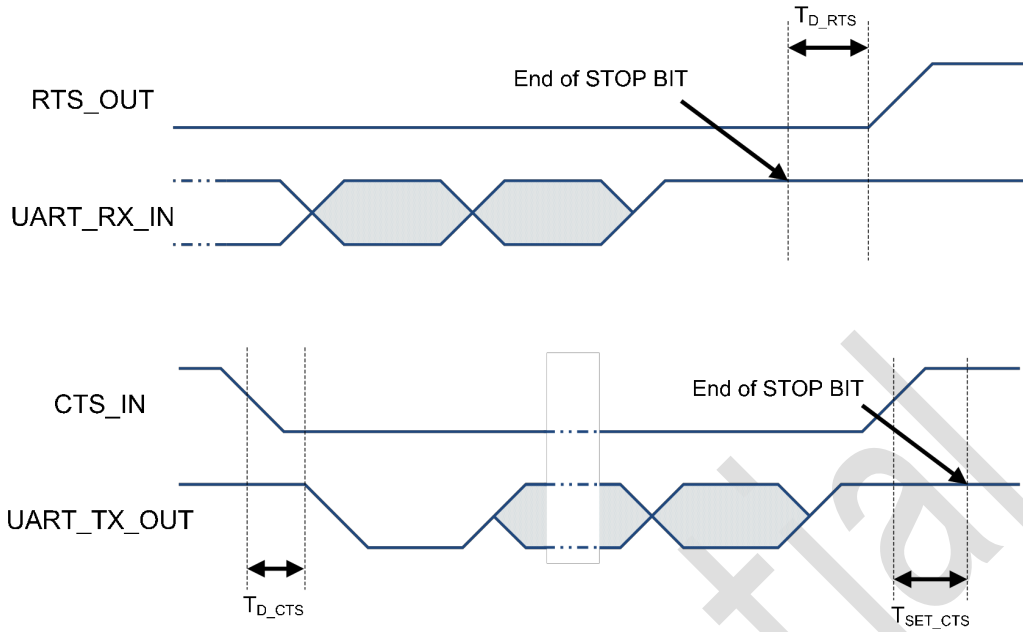
Boot up by internal power on reset circuit, power on timing is shown in below figure.



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

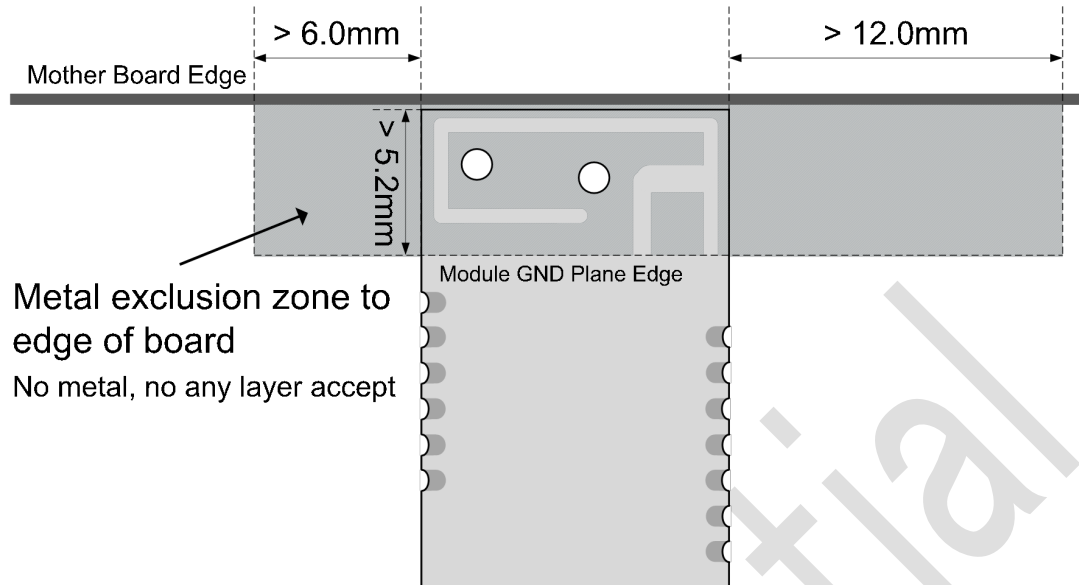


● **UART Characteristics**



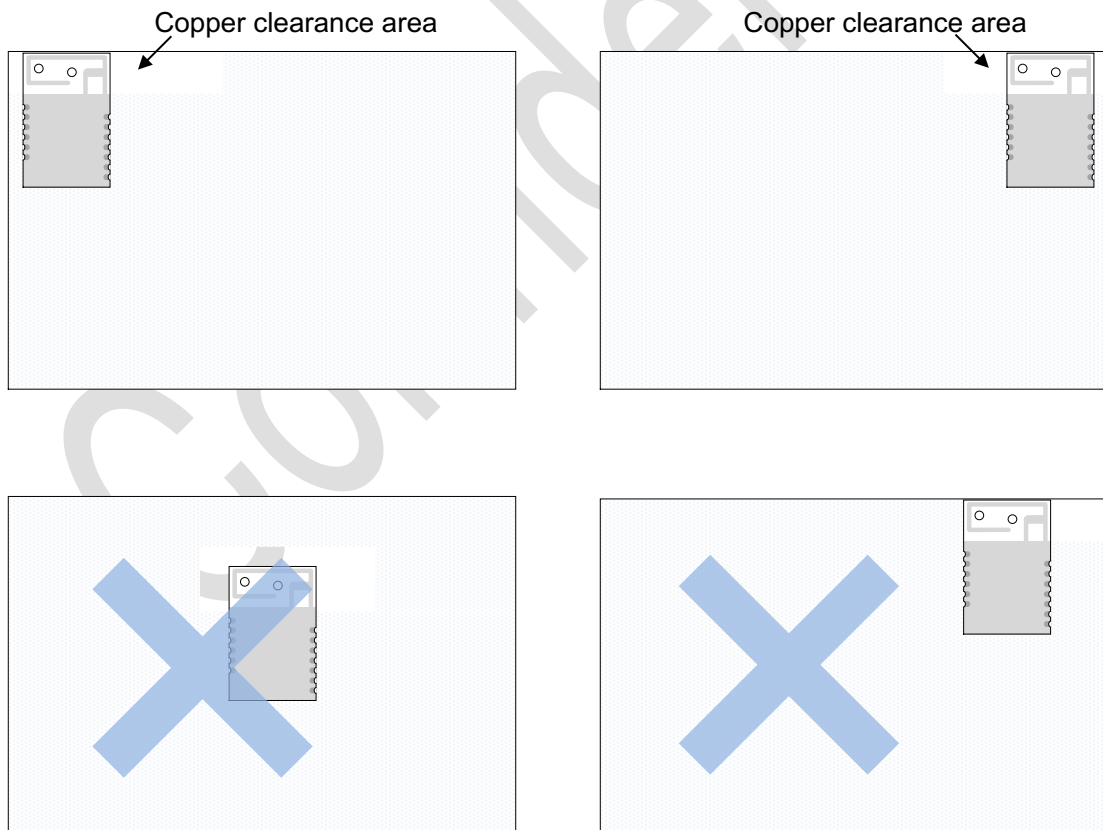
Parameter	Description	Note	Min.	Typ.	Max.	Unit
T_{D_RTS}	Timing between UART_RX_IN stop bit and RTS rising edge when RX FIFO is full				0.5	ns
T_{D_CTS}	Timing between CTS falling edge and UART_TX_OUT first bit				25	ns
T_{SET_CTS}	Timing between CTS rising edge and UART_TX_OUT stop bit		75			ns

■ PCB LAYOUT GUIDE

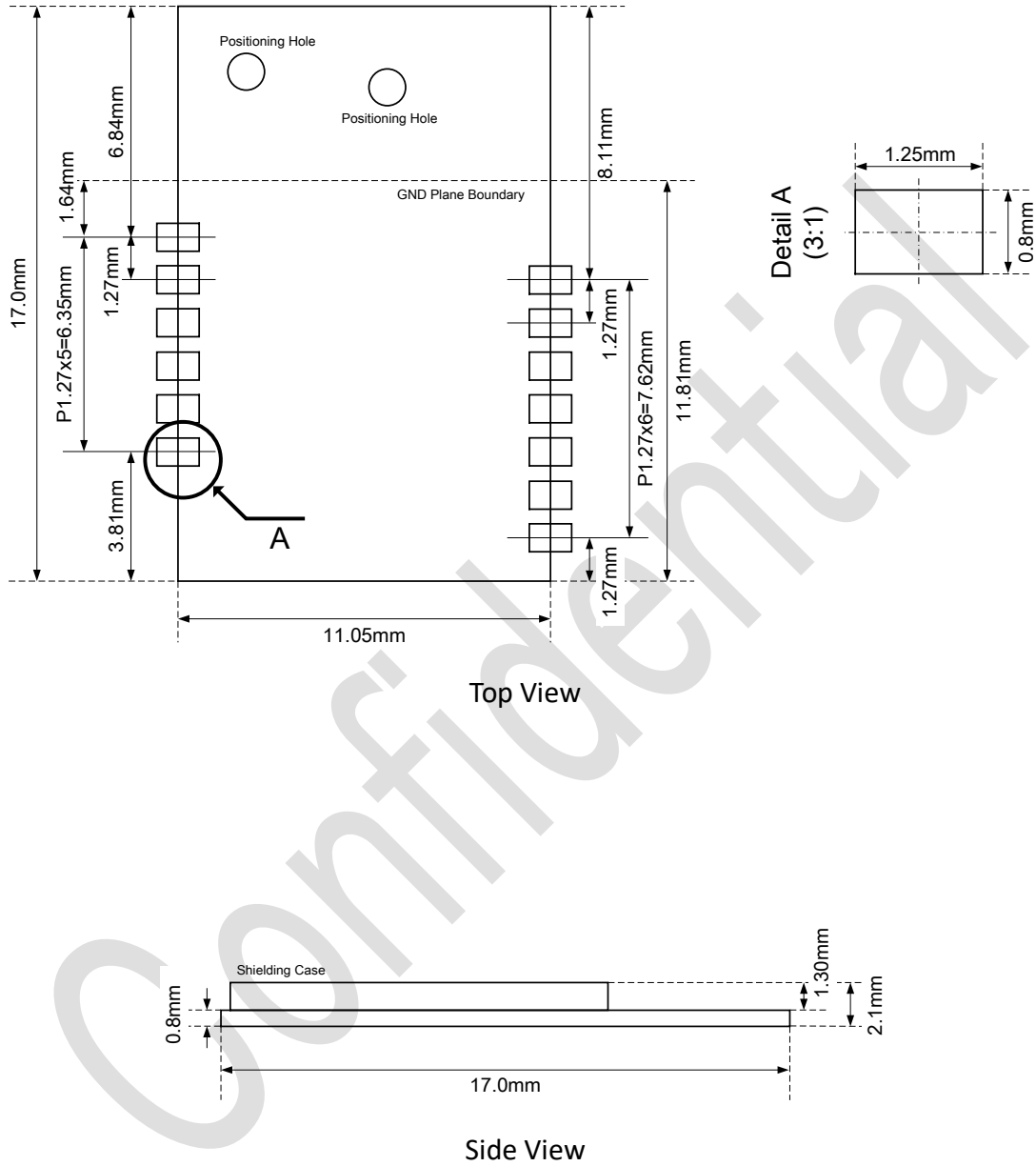


Metal exclusion zone to edge of board
 No metal, no any layer accept

Module Placement Example:



■ MODULE DIMENTIONS



BQB Certificate



FCC certificate



CE Certificate



Japan Telecom



Antenna Test Report

