SPECIFICATION
TCM3901

Bluetooth 4.1 Class2 Module

RF&BB

TCM3901_SPECIFICATION_V0.1.3

Rev. 0.1.3

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Telechips

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Revision History

Date	Revision	Description
2017-01-19	0.1.0	Initial release Bluetooth V4.1 Class 2 Module
2017-01-24	0.1.1	10. Reference Peripheral circuit update
		11. Antenna design guide release
2017-04-12	0.1.2	3. Pin description update
		4. Electrical Specification update
		6.Internal Pattern Antenna Specification
		7. Startup Timing update (BT_REG_ON)
		10. Reference Peripheral circuit update
		11.3. In case of using the internal antenna Delete 11.4. Reserved External Antenna use Delete
		12. SMT Temperature Sequence (Pb-free) updata
2017-05-30	0.1.3	Add features list

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1 Introduction

The TCM3901 is the optimal solution for voice and data applications that require a Bluetooth SIG standard Host Controller Interface(HCI) via UART and PCM/I2S audio interface support.
In addition, the serial enhanced coexistence interface is available for WLAN devices.

This module has adopted BCM20713 industrial WLBGA chipset.
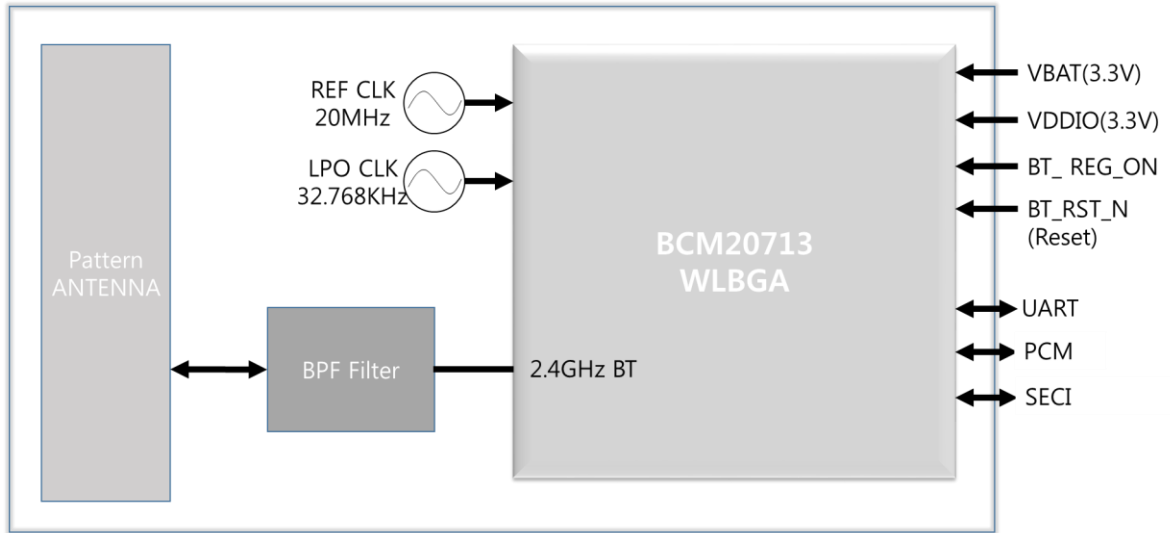
Figure 1.1 TCM3901 Block Diagram

2 Features

- Bluetooth 4.1 + EDR compliant
- Bluetooth Low Energy
- Programmable output power control meets Class1, Class2.
- High speed UART port(Up to 4Mbps)
- PCM/I2S digital audio interface
- Enhanced Coexistence Interface with 3-wire(SECI_OUT, SECI_IN, BT_STATUS)
- Supports Broadcom SmartAudio, wide-band speech, SBC codec and pccket loss concealment.
- Use supply voltage up to 5.5V
- Ultra-low power consumption
- Built-in PCB pattern antenna
- Built-in 32.768KHz LPO clock oscillator
- Operating temperature range(-40℃ ~+85℃)
- Competitive size (12mm x 10mm x 1.9T : LGA 32-pin)
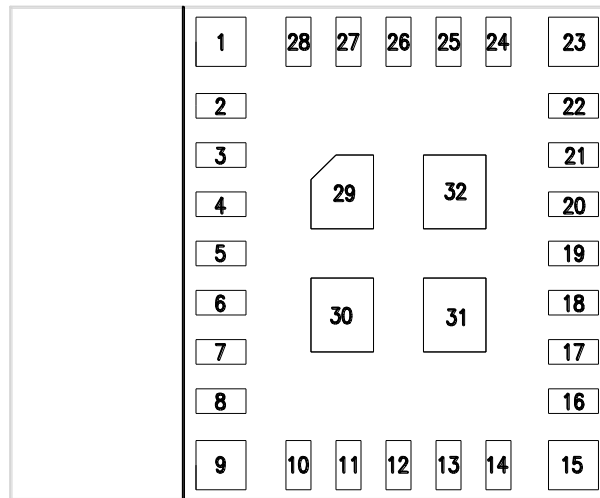
3 Pin description

3.1 Pin Assignment

Figure 3.1 Pin Diagram (Top view)

Table 3.1 Pin Description

No.	Name	Type	Description
1	GND	GND	Ground connection
2	VDDIO_3V3	P	I/O voltage supply input
3	Reserved(LPO)	I	Reserved external LPO (32.768KHz)[1]
4	GND	GND	Ground connection
5	GND	GND	Ground connection
6	GND	GND	Ground connection
7	GND	GND	Ground connection
8	GND	GND	Ground connection
9	ANT	I/O	Internal Antenna port
10	Reserved(RF)	I/O	RF In / Out port[2]
11	GND	GND	Ground connection
12	VBAT_3V3	P	Main power voltage source input
13	BT_RST_N	I	Active-low reset input. Requires an external 10Kohm pull-up resistor
14	BT_REG_ON	I	Internal Regulator – High : ON / Low : OFF
15	GND	GND	Ground connection
16	UART_TX	O	UART transmit data
17	UART_RX	I	UART receive data
18	UART_RTS	O	UART request to send output
19	UART_CTS	I	UART clear to send input
20	SECI_OUT	O	SECI output
21	SECI_IN	I	SECI input
22	GPIO_0	I/O	Rerserved GPIO
23	GND	GND	Ground connection
24	BT_STATUS	O	BT status
25	PCM_OUT	O	PCM data out
26	PCM_IN	I	PCM data in
27	PCM_CLK	I/O	PCM clock
28	PCM_SYNC	I/O	PCM sync signal
29	GND	GND	Ground connection
30	GND	GND	Ground connection
31	GND	GND	Ground connection
32	GND	GND	Ground connection

1) Pin.3 Reserved(External LPO) : This pin is not used because there is an internal LPO.
2) Pin.10 Reserved(RF) : This pin is not used because there is an internal matching.
3) All digital I/O has internal pull-up or pull-down values which are around 60Kohm

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4 Electrical Specification

4.1 Absolute Maximum Rating

Table 4.1 Absolute maximum rating

Symbol	Description	Min.	Max.	Unit
VBAT	Input Supply Voltage	-0.3	5.5	V
VDDIO	I/O Voltage for Digital/Bluetooth/SDIO	-0.3	3.6	V

4.2 Recommended Operating Rating

Table 4.2 Recommended operating rating

Symbol	Min	Typ.	Max.	Unit
Operating Temperature	-40	25	85	℃
VBAT	2.5	3.3	5.5	V
VDDIO	1.8	3.3	3.6	V

4.3 Current Consumption

Table 4.3 Current Consumption

Test Mode	DUT Status	VBAT : 3.3V	VDDIO : 3.3V
BDR(1Mbps)Note.1	Class 2 @ 2dBm Tx power (DH5 / 3-DH5)	45	0.1
	Rx @ -70dBm Rx power(DH5/3-DH5)	34	0.1
BDR(2 or 3Mbps)Note.2	Class 2 @ 2dBm Tx power (DH5 / 3-DH5)	45	0.1
	Rx @ -70dBm Rx power(DH5/3-DH5)	42	0.1
Sleep	UART transport active Internal LPO clock available	0.05	0.03

(Unit : mA)

Note.1
- Transmit(BDR): Current level during transmit of basic rate packet, GFSK output power=2dBm
- Receive(BDR): Current level during receive of a basic rate packet

Note.2
- Transmit(EDR): Current level during transmit of 2 or 3Mbps rate packet
- Receive(EDR): Current level during receive of 2 or 3Mbps rate packet

5 RF Specification

Nomal Condition : 25deg.C, VBAT=3.3V, VDDIO=3.3V

Table 0.1 RF Specification

Transmitter	*Min*	*Typ*	*Max*	Unit
BDR				
Output Power(Class 2)	0	2	4	dBm
Frequency range	2401	-	2480	MHz
20dB bandwidth	-	-	1	MHz
Adjacent Channel Power				
[M-N]=2	-	-	-20	dBm
[M-N]>=3	-	-	-40	dBm
Modulation Characteristics				
Delta f1avg	140	-	175	KHz
Delta f2max (at 99.9%)	99.9	-	-	%
Delta f2avg / Delta f1avg	0.8	-	-	%
Initial Carrier Frequency Tolerance	-75	-	75	KHz
Carrier Frequency Drift				
1slot	-25	-	25	KHz
3slot / 5slot	-40	-	40	KHz
Maximum drift rate	-20	-	20	KHz/50uS
EDR				
EDR Relative Power for DQPSK / 8DPSK	-4	-	1	dBm
EDR Carrier Frequency Stability and Modulation Accuracy				
wi	-75	-	75	KHz
wi+wo	-75	-	75	KHz
wo	-10	-	10	KHz
RMS DEVM(DQPSK)	-	-	20	%
Peak DEVM(DQPSK)	-	-	35	%
99% DEVM(DQPSK)	99	-	-	%
RMS DEVM(8DPSK)	-	-	13	%
Peak DEVM(8DPSK)	-	-	25	%
99% DEVM(8DPSK)	99	-	-	%
Receiver	**Min**	**Typ**	**Max**	**Unit**
BDR				
Sensitivity(BER=<0.1%) for GFSK	-70	-	-	dBm
Maximum input Level(BER=<0.1%)	-20	-	-	dBm
EDR				
Sensitivity(BER=<0.007%) for DQPSK	-77	-		dBm
Sensitivity(BER=<0.007%) for 8DPSK	-77	-		dBm

Bluetooth LE(Low Energy)	Min	Typ	Max	Unit
Output Power	-	-	10	dBm
Modulation Characteristics				
Delta f1avg	225	-	275	KHz
Delta f2max (at 99.9%)	99	-	-	%
Delta f2avg / Delta f1avg	0.8	-	-	%
Carrier Frequency Offset and Drift				
Frequency Offset	-	-	150	KHz
Frequency Drift	-	-	50	KHz
Drift Rate	-	-	20	KHz
Receiver Sensitivity(PER<30.8%)	-70	-	-	dBm
Maximum Input Signal Level(PER<30.8%)	-10	-	-	dBm
PER Report Integrity (-30dBm Input)	50	-	65.4	%

6 Internal Pattern Antenna Specification

6.1 Antenna Gain

Table 6.1 Antenna Gain

Frequency	Efficiency	Average Gain	Max Gain	Max Position
2400MHz	41.8 %	-3.8 dBi	1.2 dBi	Theta105/Pie60
2425MHz	43.1 %	-3.7 dBi	1.5 dBi	Theta105/Pie60
2445MHz	35.7 %	-4.5 dBi	0.6 dBi	Theta105/Pie60
2465MHz	31.0 %	-5.1 dBi	-0.1 dBi	Theta105/Pie60
2485MHz	27.4 %	-5.6 dBi	-0.7 dBi	Theta105/Pie240

6.2 Antenna 3D Radiation Pattern

2400MHz Pattern	2425MHz Pattern
2445MHz Pattern	2465MHz Pattern
2485MHz Pattern	
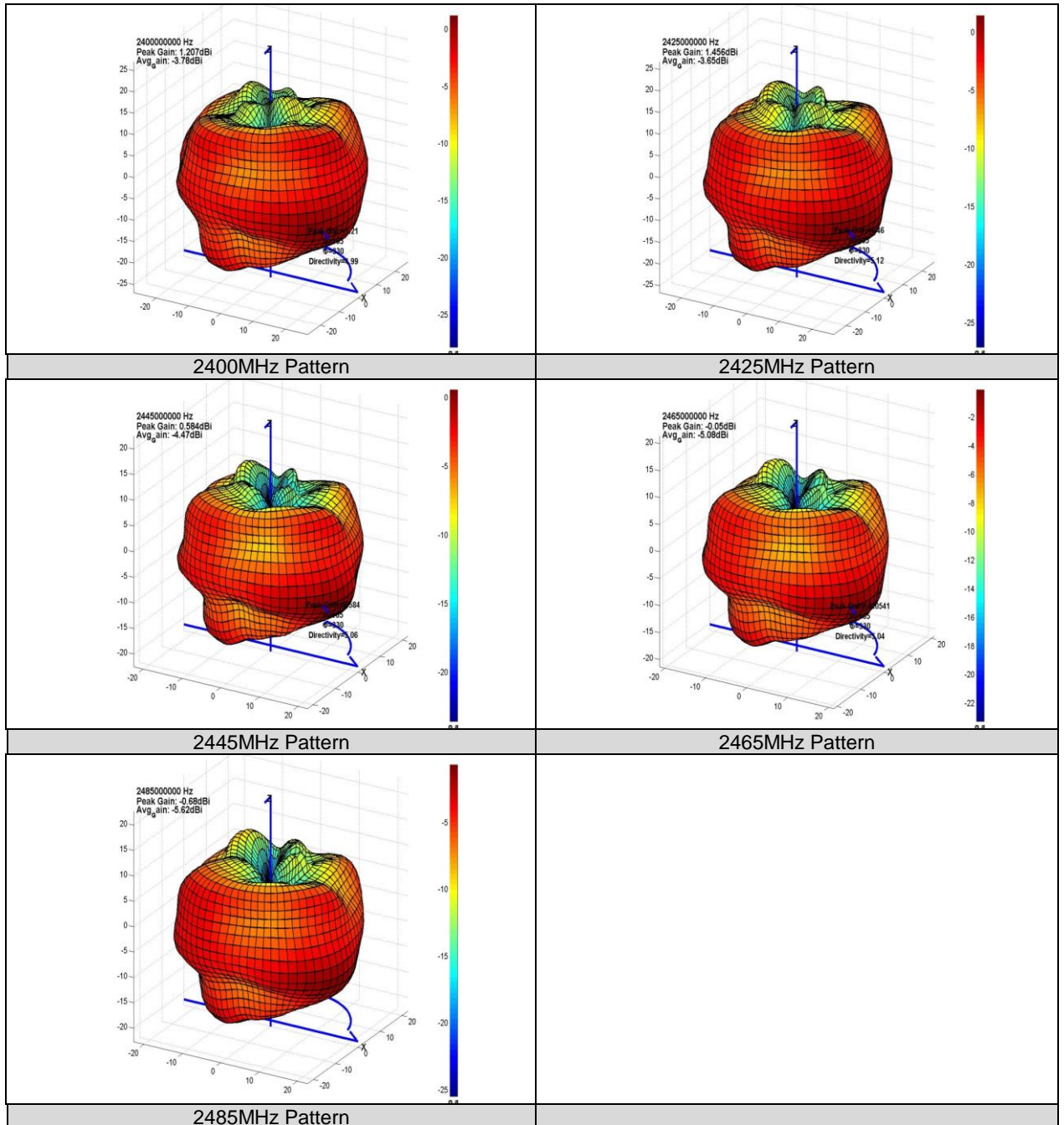
Figure 6.1 3D Radiation Pattern

7 Startup Timing

The TCM3901 startup and firmware boot is held off while the RESET pin is asserted.

The TCM3901 has an integrated power-on reset circuit which completely resets all circuits to a known power on state. This action can also be driven by RST_N signal, which can be used to externally control the device, forcing it into a power-on reset state.

Note:
- VBAT should be up before or at the same time as VDDIO, BT_REG_ON.
- RST_N signal input is an active-low signal. This signal must be driven high or low (not left floating).
- The TCM3901 requires an external pull-up resistor on the RST_N input.
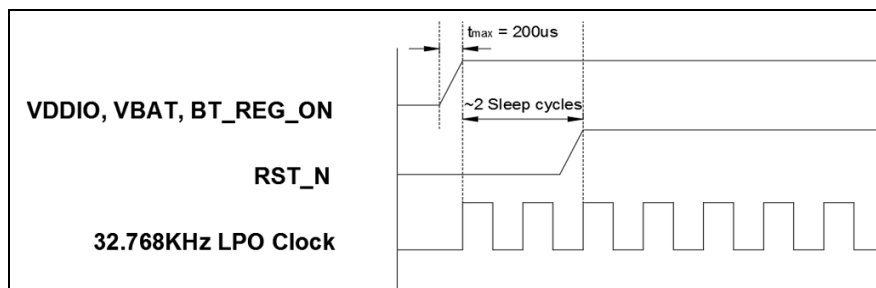
Figure 7.1 Startup Timing from RST_N

8 Interface Description

8.1 UART

The UART physical interface is a standard, 4-wire(RX, TX, RTS, CTS) with adjustable baud rates from 9600 bps to 4.0 Mbps. The interface features an automatic baud rate detection capability that returns a baud rate selection. Alternatively, the baud rate can be selected via a vendor-specific UART HCI commend. The interface supports Bluetooth UART HCI specifications. The default baud rate is 115.2Kbaud.
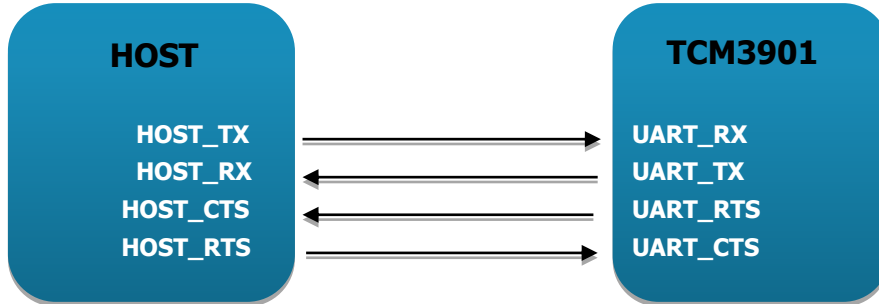

Figure 8.1 UART Interface Connection

8.2 PCM/I2S

The TCM3901 PCM interface can connect to linear PCM codec devices in master or slave mode. In master mode, the device generates the PCM_BCLK and PCM_SYNC signals. In slave mode, these signals are provided by another master on the PCM interfaces as inputs to the device.

The PCM interface supports the industry standard formats for I2S, left-justified or right-justified.

The host can adjust the PCM interface configuration using vendor-specific HCI commands or it can be setup in the configuration file.
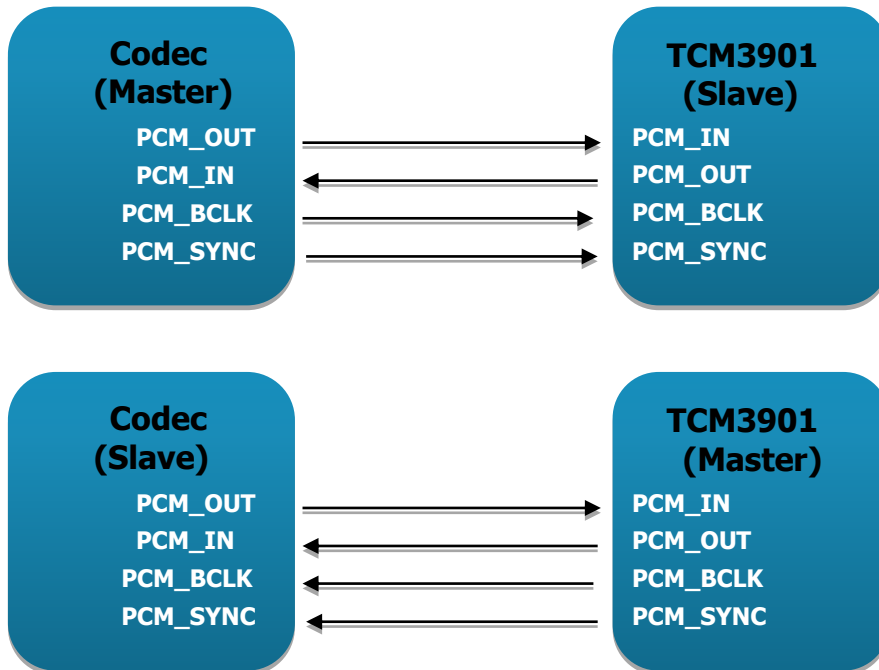

Figure 8.2 PCM Interface Connection

8.3 SECI

The TCM3901 provides extensions and collaborative coexistence to the standard Bluetooth AFH for direct communication with WLAN devices. Collaborative coexistence enables WLAN and Bluetooth to operate simultaneously in a single device. The device supports industry-standard coexistence signaling, including 802.15.2, and supports WLAN solutions.

- Enhanced coexistence data can be exchanged over SECI_IN and SECI_OUT
- It supports generic UART communication between WLAN and Bluetooth devices.
- Up to 48-bits of coexistence data can bel exchanged
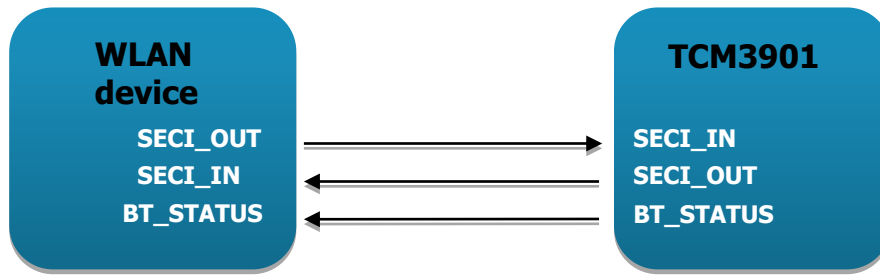
Figure 8.3 SECI Interface Connection
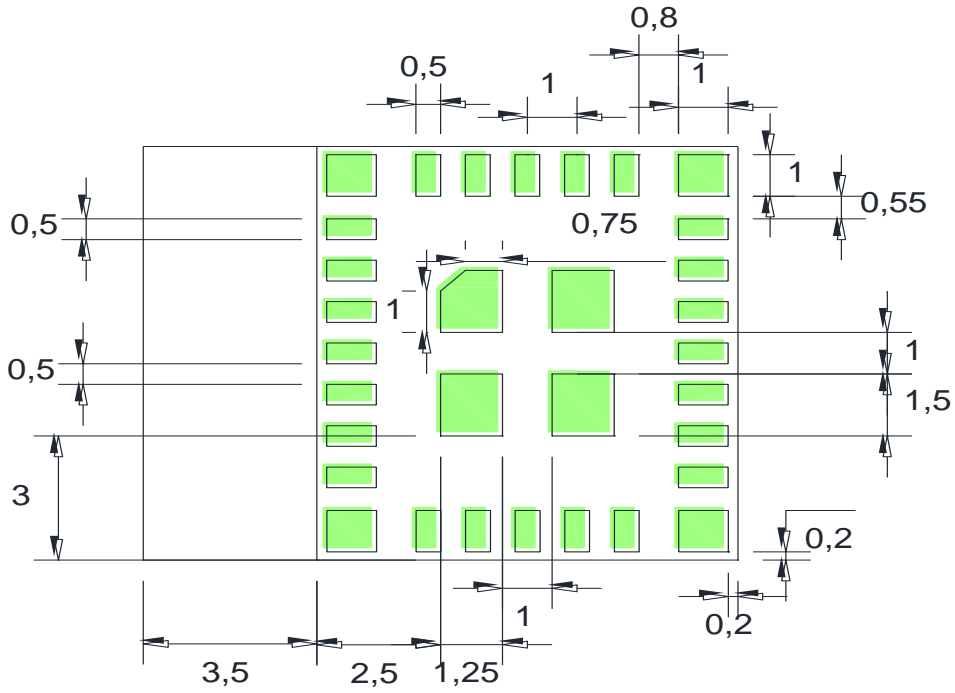
9 Mechanical Information

(Unit : mm)

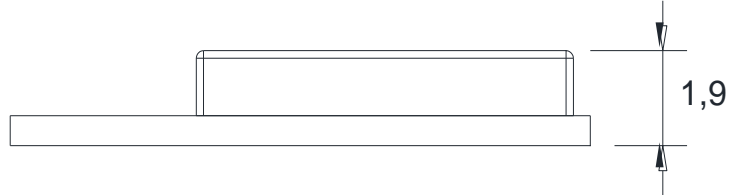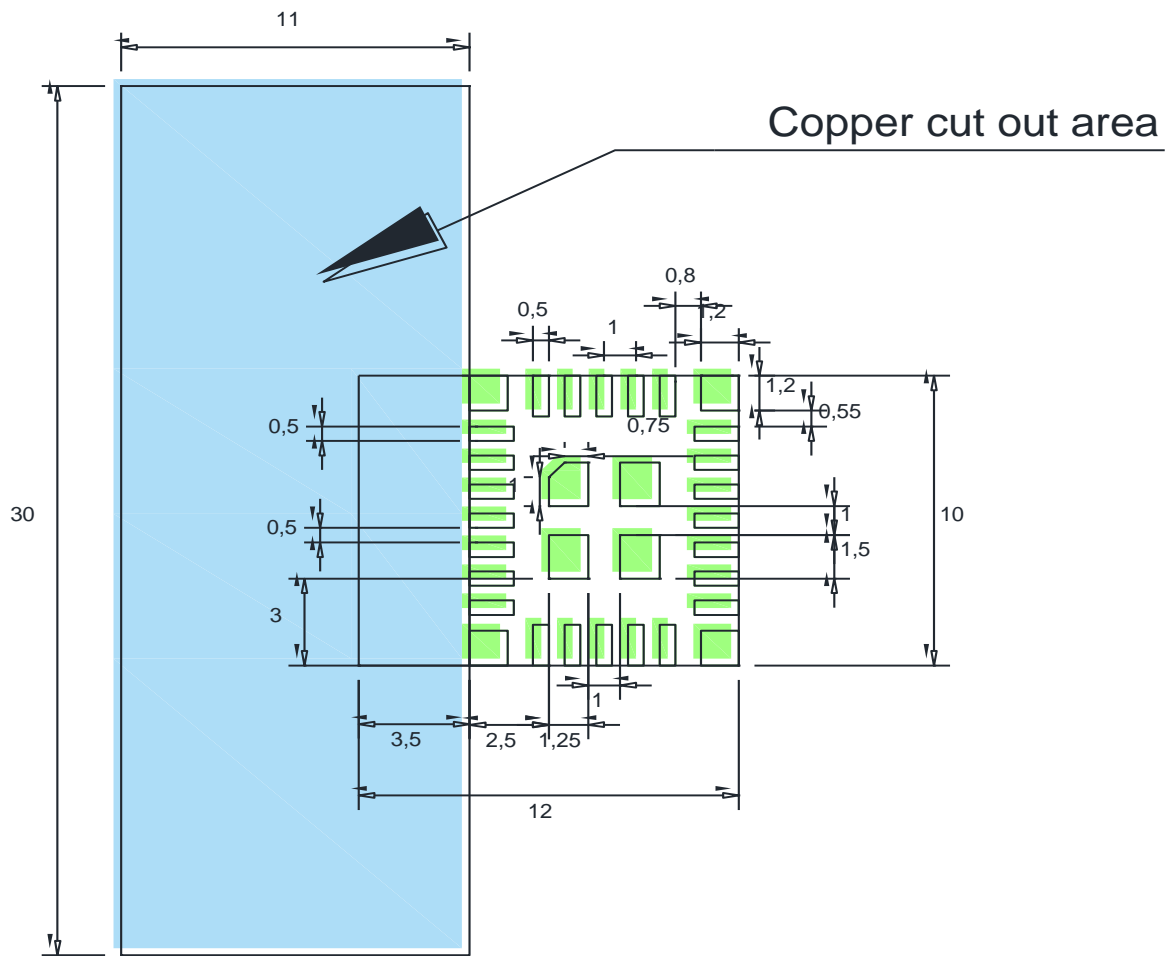**Figure 9.1 32-pin LGA package Mechanical Information (TOP VIEW)**

Figure 9.1 Side View

Copper cut out area

※   Antenna part should be placed outside the PCB

Figure 9.2 PCB Footprint recommendation
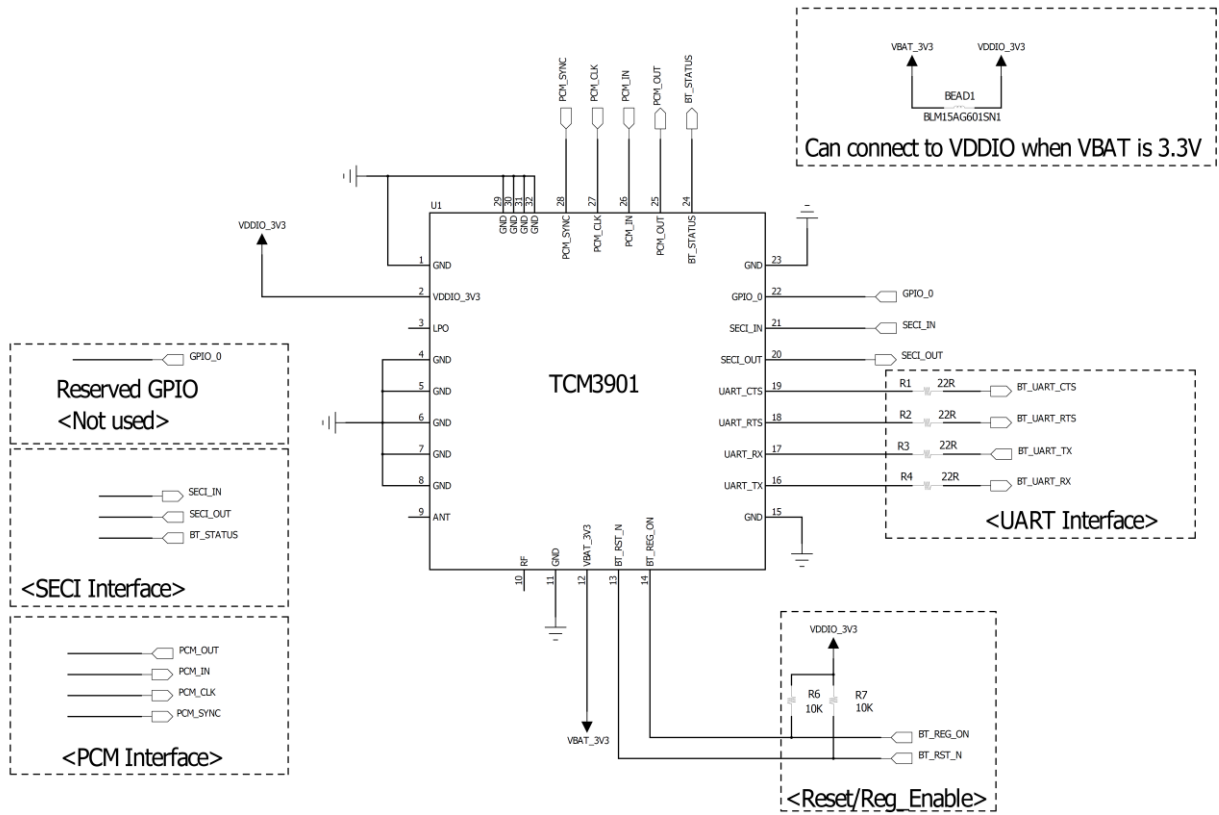
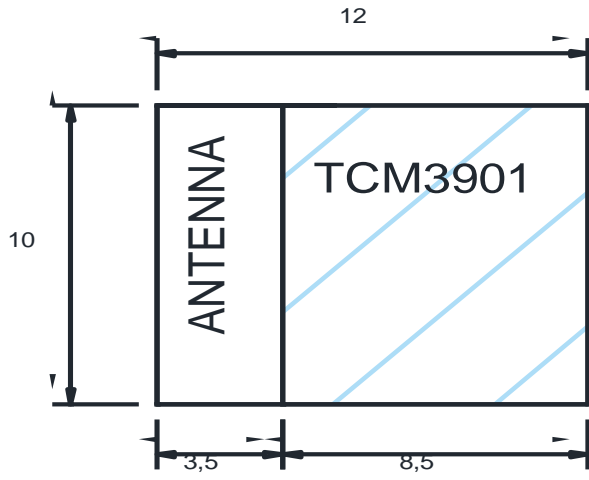## 10 Reference Peripheral Circuit

Figure 0.1 Reference Peripheral Circuit

11 Antenna Design Guide

11.1 Antenna Field in Module

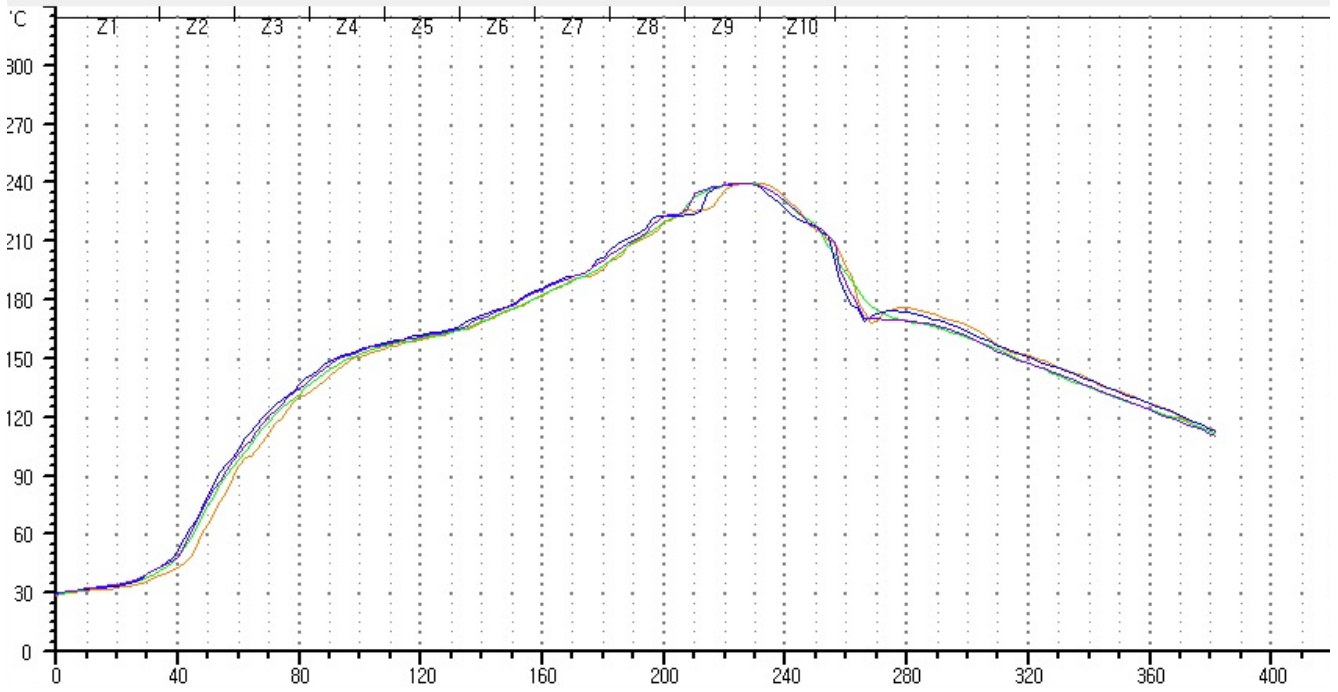## 12 SMT Temperature Sequence (Pb-free)

Figure 12.1 SMT Temperature Sequence

Certifications

Certified under FCC Part 15
Certified in Canada by IC to RSS-247
Manufacturer Model : TCM3901
FCC ID: 2ALS3-3901
IC: 22661-3901
Product Marketing Name (PMN): Bluetooth module

FCC Statement

This device complies with Part 15 of the FCC rules. Operation is subject to the following 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.

FCC Caution

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

Important Note

OEM Responsibilities to comply with FCC and Industry Canada Regulations
The TCM3901 Module has been certified for integration into products only by OEM integrators under the following conditions:

　　　1.　The antenna(s) must be installed such that a minimum separation distance of 20cm is maintained between the radiator (antenna) and all persons at all times.
　　　2.　The transmitter module must not be co-located or operating in conjunction with any other antenna or transmitter.

As long as the two conditions above are met, further transmitter testing 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.).

IMPORTANT NOTE: In the event that these conditions cannot be met (for certain configurations or co-location with another transmitter), then the FCC and Industry Canada authorizations are no longer considered valid and the FCC ID and IC Certification Number 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 and Industry Canada authorization.

Label of the end product

The final end product must be labeled in a visible area with the following " Contains FCC ID: 2ALS3-3901" and " Contains IC: 22661-3901". If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of 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.

Canada Statement

　"This device complies with Industry Canada's license-exempt RSSs.
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."

« Le présent appareil est conforme aux CNR d'Industrie Canada applicables
aux appareils radio exempts de licence. L'exploitation est autorisée aux
deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage,
et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi,
même si le brouillage est susceptible d'en compromettre le fonctionnement. »

Exposure to Radio Frequency Energy

　"To comply with FCC and Industry Canada RF radiation exposure limits for general population, the antenna(s) used for this transmitter must be installed such that a minimum separation distance of 20cm is maintained between the radiator (antenna) and all persons at all times and must not be co-located or operating in conjunction with any other antenna or transmitter."