

# **LTE Cat-M1**

## **Multi Band Module**

### **WSCLxADAH2Z**

#### **Data Report**

**WSCL2ADAH2Z413**

**WSCL3ADAH2Z413**

**TAIYO YUDEN**

## ● Contents

1. Introduction .....	- 4 -
2. Overall Description.....	- 5 -
2.1. Function Overview .....	- 5 -
2.2. Circuit Block Diagram.....	- 6 -
3. Description of the Application Interfaces .....	- 7 -
3.1. pin .....	- 7 -
3.1.1. Default Pin Allocation for Hosted Applications .....	- 12 -
3.2. Power Supply Interface .....	- 13 -
3.2.1. Overview .....	- 13 -
3.2.2. USIM Power Supply VSIM .....	- 13 -
3.3. Signal Control Interface.....	- 14 -
3.3.1. Overview .....	- 14 -
3.3.2. SC_SWP Pin.....	- 14 -
3.3.3. PMU_SHUTDOWN Pin.....	- 15 -
3.3.4. PMU_WAKEUP Pin .....	- 15 -
3.3.5. SPIM1_CLK pin.....	- 15 -
3.4. UART Interface.....	- 16 -
3.4.1. UART0 Interface .....	- 17 -
3.4.2. UART1, UART2 Interface.....	- 17 -
3.5. USIM Card Interface.....	- 18 -
3.6. RF Antenna Interface .....	- 19 -
3.6.1. RF Connector location .....	- 19 -
4. RF Specifications .....	- 20 -
4.1. Operating Frequencies.....	- 20 -
4.2. Test Standards .....	- 20 -
4.3. RF Specifications .....	- 20 -
5. Electrical Specifications .....	- 21 -
5.1. Absolute Maximum Ratings.....	- 21 -
5.2. Operating Conditions.....	- 21 -
5.3. Power Supply .....	- 22 -
5.3.1. Input Power Supply .....	- 22 -
5.3.2. Power State.....	- 22 -
5.3.3. Power Consumption.....	- 23 -
6. Function and Features .....	- 24 -
6.1. Power on/off .....	- 24 -
6.1.1. Power on.....	- 24 -
6.1.2. Power off.....	- 24 -
.....	- 24 -
6.2. Host-Module Mutual Wakeup Interface .....	- 25 -
7. Mechanical Specifications.....	- 26 -
7.1. Dimensions of the module.....	- 26 -
7.2. Label .....	- 27 -

7.3. Packing System ..... - 28 -

8. Handling Precautions ..... - 29 -

8.1. Thermal Management ..... - 29 -

8.2. Desire and Conditions ..... - 29 -

8.2.1. Environment conditions for use and storage ..... - 29 -

8.2.2. Conditions for handling of products ..... - 29 -

9. Certifications ..... - 31 -

9.1. Certifications ..... - 31 -

10. Safety Information ..... - 32 -

10.1. Interference ..... - 32 -

10.2. Medical Device ..... - 32 -

10.3. Area with Inflammables and Explosives ..... - 32 -

10.4. Airline Security ..... - 33 -

10.5. Safety of Children ..... - 33 -

10.6. Environment Protection ..... - 33 -

10.7. RoHS Approval ..... - 33 -

10.8. Laws and Regulations Observance ..... - 33 -

10.9. Care and Maintenance ..... - 33 -

10.10. Emergency Call ..... - 33 -

11. Appendix Acronyms and Abbreviations ..... - 34 -

# 1. Introduction

TAIYO YUDEN offers a turnkey solution of Cat-M1 multi band LGA module supporting the following key features:

## Module highlights

- Based on Altair Semiconductor ALT1250 chipset
- LTE Cat-M1
- Supporting standard multi band design
  - 1 x Band1 (2GHz)
  - 1 x Band19 (800MHz)
  - 1 x Band26 (800MHz)
- Small size (module size 15.0mm x 14.0 mm x 1.9 mm)
- Power supply: 2.3-4.35V (VBAT / VBAT\_FEM)
- Supports ultra-low DRX, eDRX, PSM and standby power consumption

## LTE features highlights

- LTE Cat-M1 support based on 3GPP release13
- SW upgradable to Cat-M1 based Release14

## Features

- LwM2M, TCP/IP, UDP/IP, SMS, Power saving

## Interface support

- UART

This document describes the hardware application interfaces and air interfaces that are provided when the module is used.

This document helps you to understand the interface specifications, electrical features and related product information of the module.

## 2. Overall Description

### 2.1. Function Overview

**Table1 Features**

Feature	Description
Physical Features	Dimensions:15.0mm × 14.0mm × 1.9mm
Weight	0.92g
Operating Band	Band1, 19, 26
Operating Temperature <sup>[1]</sup>	-30 to +70°C
Storage Temperature	-40 to +80°C
Power Voltage	VBAT: 2.3V to 4.2V <sup>[2]</sup> VBAT_FEM: 2.85V to 4.5V <sup>[2]</sup>
Application Interface	Serial communication interface UART0 (for AT) UART1 (for debug <sup>[3]</sup> ) UART2 (for CLI (FW update etc.) <sup>[3]</sup> )
	Control signal SC_SWP, PMU_SHUTDOWN, PMU_WAKEUP, AUX_ADC4 (BOOST_EN)
	USIM Card Interface
SMS	Supports formats of PDU (AT command) SMS over SGs
Data Services	Half-Duplex DL: 300kbps (OFDMA) / UL: 375kbps (SC-FDMA) <sup>[4]</sup>
Operating System	Real Time OS

<sup>[1]</sup>: 3GPP release 13 compliant

<sup>[2]</sup>: Power voltage of our evaluation board is as follows; VBAT: 3.0 V

VBAT\_FEM: 3.3 V

<sup>[3]</sup>: UART1 and UART2 is used for debug and FW update. So, please prepare test pads for external connection.

<sup>[4]</sup>: the maximum value in theory

## 2.2. Circuit Block Diagram

Figure1 shows the circuit block diagram of the module. The application block diagram and major functional units of the module contain the following parts:

- Radio Frequency (RF) transceiver + Base Band (BB) unit
- Multi-chip package (MCP) include Power Management Unit (PMU)
- RF Front End Module (FEM)

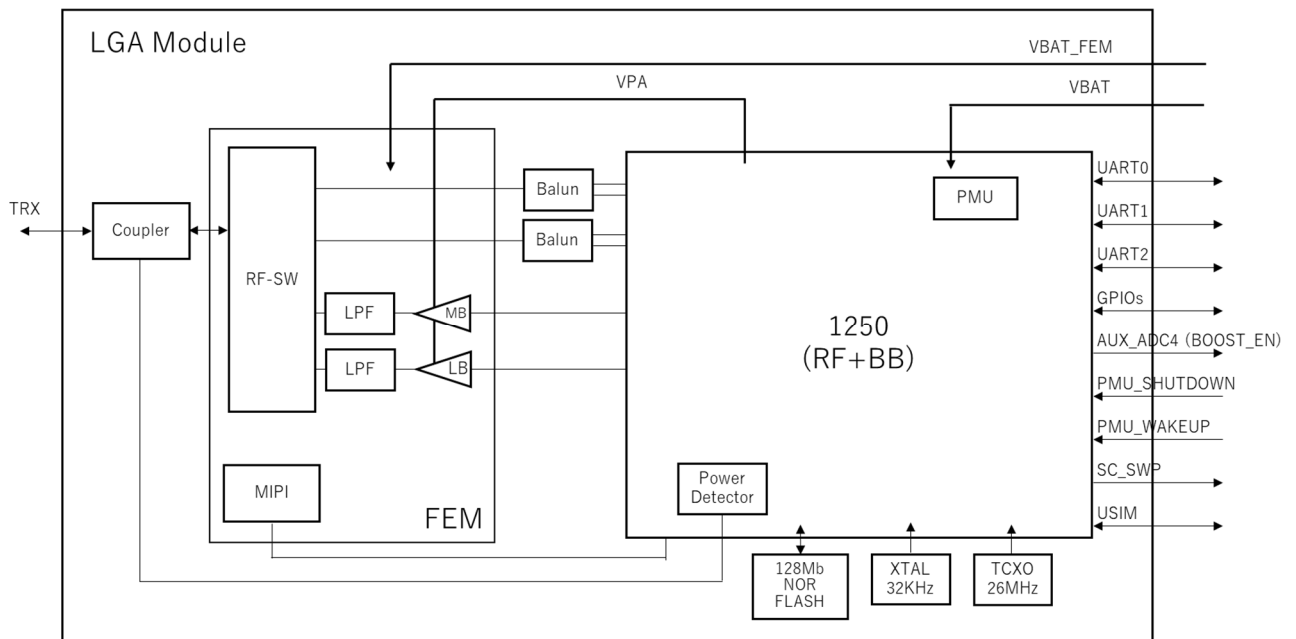


Figure1 circuit block diagram of the module

### 3. Description of the Application Interfaces

#### 3.1. pin

The module uses pins as its external interfaces.

Figure2 shows an LGA map diagram of this module. Table2 shows definitions of pins on the LGA map.

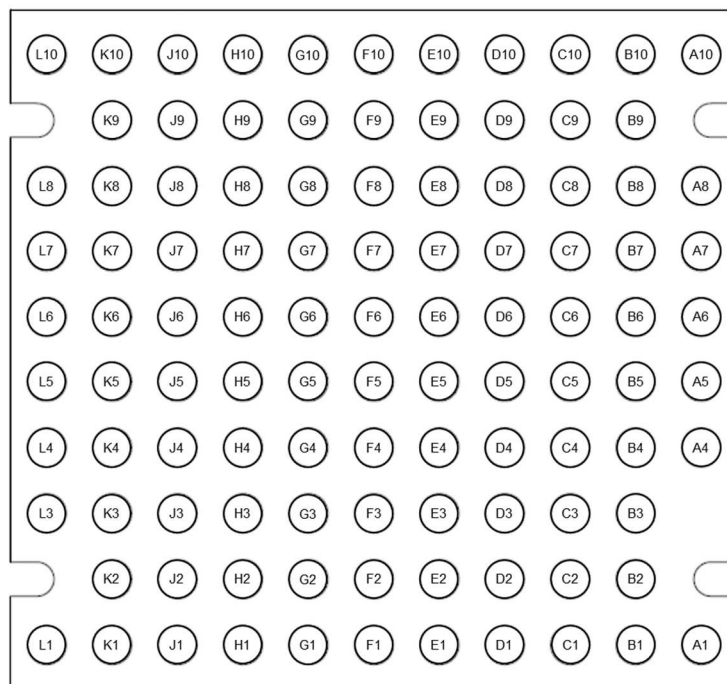


Figure2 LGA map diagram (TOP\_THRU\_VIEW)

**Table2 Definitions of pins**

No.	Pin Name	Direction	Type	Reset Value	Recommendation for Unused pin	Description
A1	GND	-	-	-	-	Ground
A4	GND	-	-	-	-	Ground
A5	RF_AUX_OUT1	-	A	-	Open	Reserved
A6	GND	-	-	-	-	Ground
A7	RF_RXTX	IO	A	-	-	RF TXRX Main LTE antenna
A8	GND	-	-	-	-	Ground
A10	GND	-	-	-	-	Ground
B1	VBAT_FEM	I	P	-	-	Module input power supply
B2	VBAT_FEM	I	P	-	-	Module input power supply
B3	VBAT_FEM	I	P	-	-	Module input power supply
B4	GND	-	-	-	-	Ground
B5	GND	-	-	-	-	Ground
B6	GND	-	-	-	-	Ground
B7	GND	-	-	-	-	Ground
B8	GND	-	-	-	-	Ground
B9	UART2_RX	I	D	PU	Open	UART2 receiving data
B10	UART2_RTS	O	D	PU	Open	UART2 request to send
C1	GND	-	-	-	-	Ground
C2	GND	-	-	-	-	Ground
C3	GND	-	-	-	-	Ground
C4	GND	-	-	-	-	Ground
C5	GND	-	-	-	-	Ground
C6	VDD_RF	O	P	-	Open	VDD_RF out
C7	GND	-	-	-	-	Ground
C8	UART0_RX	I	D	PU	Open	UART0 receiving data
C9	UART2_TX	O	D	PU	-	UART2 transmitting data
C10	UART2_CTS	I	D	PD	Open	UART2 clear to send
D1	EJ_TRST	IO	D	PD	Pull down (10kΩ)	Reserved
D2	I2C0_SCL	IO	D	PU	Open	Reserved
D3	I2C0_SDA	IO	D	PU	Open	Reserved
D4	PMU_EXT_ALARM	O	A	-	Open	Module's power mode 'High' is active state, 'Low' is inactive state
D5	FE_DEBUG	-	-	-	-	Ground
D6	GND	-	-	-	-	Ground



No.	Pin Name	Direction	Type	Reset Value	Recommendation for Unused pin	Description
D7	GND	-	-	-	-	Ground
D8	UART0_TX	O	D	PU	-	UART0 transmitting data
D9	UART0_CTS	I	D	PU	Open	UART0 clear to send
D10	VDD_XO	O	P	-	Open	VDD_XO out
E1	EJ_TDO	IO	D	PU	Open	Reserved
E2	EJ_TDI	IO	D	PD	Open	Reserved
E3	SC_SWP	O	D	PD	Open	Host wakeup
E4	PMU_POWER_BUTTTON	I	A	-	PU*	Reserved Internal pull up
E5	DCDC_1v3	O	P	-	Open	DCDC_1v3 out
E6	GND	-	-	-	-	Ground
E7	GND	-	-	-	-	Ground
E8	UART0_RTS	O	D	PU	Open	UART0 request to send
E9	GND	-	-	-	-	Ground
E10	RESERVED0_USB_DN	-	-	-	Open	Reserved
F1	EJ_TCK	IO	D	PD	Open	Reserved
F2	EJ_TMS	IO	D	PD	Open	Reserved
F3	VDD_DIG	O	P	-	Open	VDD_DIG out
F4	DEBUG_SEL	IO	D	PD	Open	Reserved
F5	TEST	-	-	-	-	Ground
F6	GND	-	-	-	-	Ground
F7	GND	-	-	-	-	Ground
F8	AUX_ADC4 (BOOST_EN)	O	D	PD	Open	1.8V = enable the external DC-DC for VBAT_FEM power
F9	RESERVED2_USB_3V	-	-	-	Open	Reserved
F10	RESERVED0_USB_DP	-	-	-	Open	Reserved
G1	GND	-	-	-	-	Ground
G2	PMU_SHUTDOWN	I	A	-	PU*	Shutdown active low. HW reset. Internal pull up
G3	PMU_ATB	I	-	-	Open	Reserved
G4	PMU_WAKEUP	I	A	-	PD (10KΩ)	Device wakeup, active high
G5	DEBUG_RSTN	IO	D	PU	Open	Reserved
G6	UART1_RTS	O	D	PU	Open	UART1 request to send
G7	GND	-	-	-	-	Ground
G8	SF_nHOLD/IO3	IO	D	-	Open	Reserved
G9	SPIM0_EN1	IO	D	PU	Open	Reserved

No.	Pin Name	Direction	Type	Reset Value	Recommendation for Unused pin	Description
G10	VFLASH	O	P	-	Open	VFLASH out
H1	VBAT	I	P	-	-	Module input power supply
H2	VDD_EXTRA	O	P	-	Open	VDD_EXTRA out
H3	PMU_AT_OUT	O	A	-	Open	Reserved
H4	PMU_VCAP	O	A	-	Open	Reserved
H5	VDD_GPM	O	P	-	Open	VDD_GPM out
H6	SPIM1_CLK	IO	D	PD	Open	Module's reset indicator "High" is resetting.
H7	SPIM1_MISO	IO	D	PD	Open	Reserved
H8	GND	-	-	-	-	Ground
H9	UART1_TX	O	D	PU	Open	UART1 transmitting data
H10	GND	-	-	-	-	Ground
J1	VBAT	I	P	-	-	Module input power supply
J2	SIM_DETECT	I	D	PD	Open	SIM detection If use eSIM, it is NC.
J3	PMU_AT_IN	I	A	-	-	Ground
J4	PMU_VBACKUP	I	-	-	Connect to VBAT	Reserved
J5	CLKOUT	O	D	PU	Open	Reserved
J6	SPIM1_EN	IO	D	PU	Open	Reserved
J7	SPIM1_MOSI	IO	D	PD	Open	Reserved
J8	GND	-	-	-	-	Ground
J9	GND	-	-	-	-	Ground
J10	UART1_RX	I	D	PU	Open	UART1 receiving data
K1	GND	-	-	-	-	Ground
K2	SIMIO	IO	D	PD	-	SIM data
K3	SIMRST	O	D	PD	-	SIM reset
K4	PMU_VRTC	O	P	-	Open	Used for PMU_SHUTDOWN and PMU_POWER_BUTTON pull source
K5	VDDIO_GPM	O	P	-	Open	VDDIO_GPM out
K6	GND	-	-	-	-	Ground
K7	GND	-	-	-	-	Ground
K8	GND	-	-	-	-	Ground
K9	GND	-	-	-	-	Ground
K10	UART1_CTS	I	D	PU	Open	UART1 clear to send
L1	GND	-	-	-	-	Ground
L3	SIMCLK	O	D	PD	-	SIM clock

No.	Pin Name	Direction	Type	Reset Value	Recommendation for Unused pin	Description
L4	VSIM	O	P	-	-	VSIM out The external capacitor is max 1uF.
L5	SF_nWP/IO2	IO	D	-	Open	Reserved
L6	SF_SO/IO1	IO	D	-	Open	Reserved
L7	SF_CLK	O	D	-	Open	Reserved
L8	SF_SI/IO0	IO	D	-	Open	Reserved
L10	GND	-	-	-	-	Ground

#### NOTE

- **I**: Input only functionality. **O**: Output only functionality.  
**IO**: Both input and output functionality.
- **A**: Analog pin. **D**: Digital pin. **PD**: Pull Down. **PU**: Pull Up. **P**: Power
- **Reserved**: Unused pin. Do not connect to external equipment.
- The internal resistance of digital pin is 13kΩ to 45kΩ.

### 3.1.1. Default Pin Allocation for Hosted Applications

Figure3 shows the recommended connections for external devices.

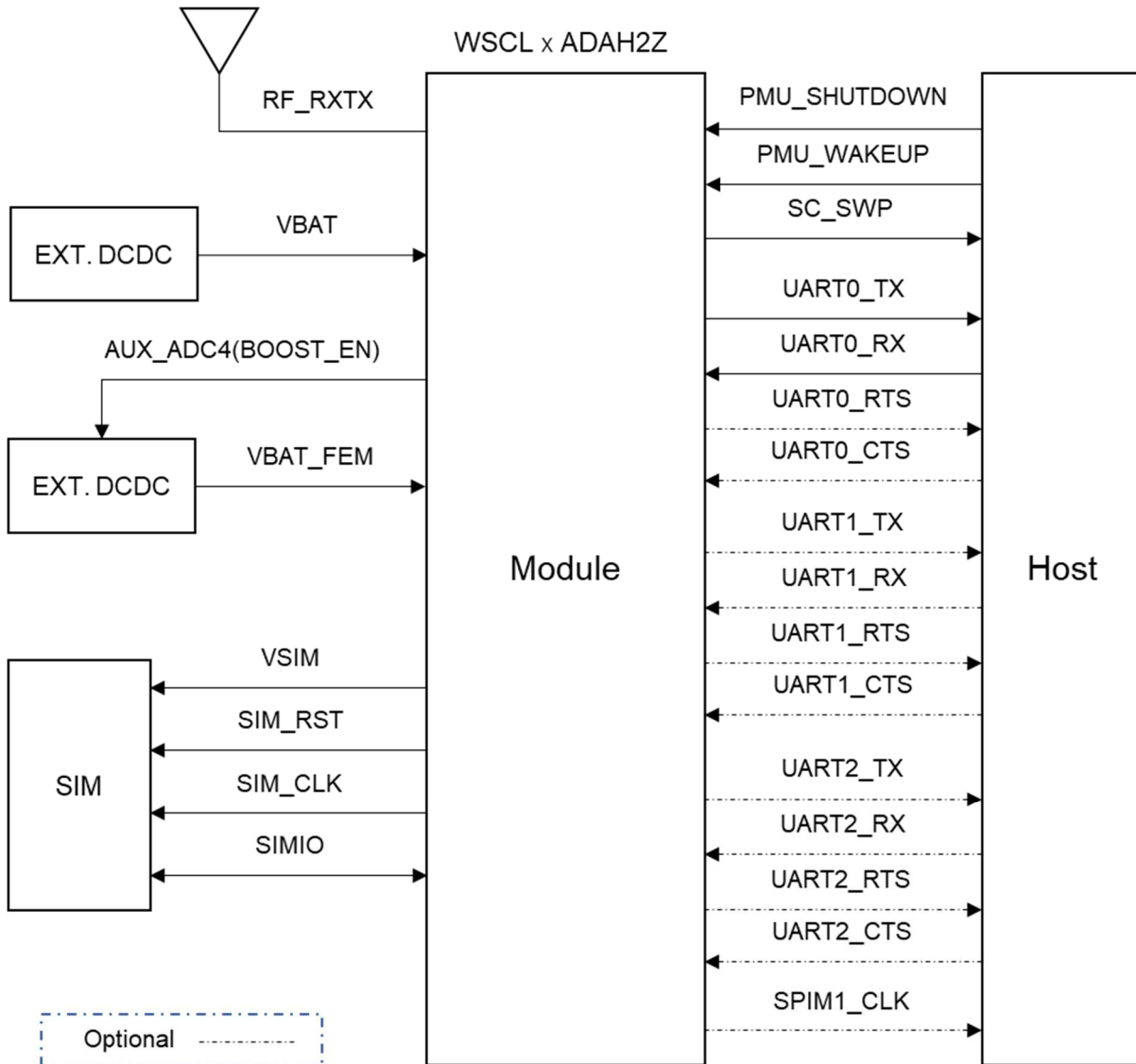


Figure3 Recommended Connections for External Devices

## 3.2. Power Supply Interface

### 3.2.1. Overview

The ALT1250 includes an integrated PMU. The PMU is designed to work directly from both rechargeable and primary batteries. The PMU supplies current to all ALT1250 blocks, the IOs, the External Flash, the TCXO and the UICC.

In addition, the PMU includes a low power RTC.

The power supply part of the module contains:

- RTC (Real Time Clock)
- APC (Advance Power Controller)
- Different regulators (LDOs and DC-DC)

**Table3 lists the definitions of the pins on the power supply interface**

Pin No.	Signal Name	I/O	Description	voltage (V)
B1	VBAT_FEM	I	Module input power supply	2.3-4.35
B2	VBAT_FEM	I		
B3	VBAT_FEM	I		
H1	VBAT	I	Module input power supply	2.3-4.35
J1	VBAT	I		
C6	VDD_RF	O	VDD_RF out	1.9
D10	VDD_XO	O	VDD_XO out	1.9
E5	DCDC_1v3	O	DCDC_1v3 out	1.3
F3	VDD_DIG	O	VDD_DIG	0.9
G10	VFLASH	O	VFLASH out	1.8
H2	VDD_EXTRA	O	VDD_EXTRA out	1.8
H5	VDD_GPM	O	VDD_GPM out	1.1
K5	VDDIO_GPM	O	VDDIO_GPM out	1.8
L4	VSIM	O	VSIM out	1.8

### 3.2.2. USIM Power Supply VSIM

Through the VSIM power supply interface, 1.8 V power from module can be supplied to USIM card. Special attention should be taken on PCB design at the host side.

### 3.3. Signal Control Interface

#### 3.3.1. Overview

The external host interface IO in the module includes the following:

- Host Wakeup (SC\_SWP pin)
- Module Reset (PMU\_SHUTDOWN pin)
- Module Wakeup (PMU\_WAKEUP pin)
- External DCDC Control for FEM (AUX\_ADC4 (BOOST\_EN) pin)
- Module reset status indicator (SPIM1\_CLK pin)

The interface signal voltage is 1.7V to 1.9V.(TYP:1.8V)

**Table4 Pins on the signal control interface**

Pin No.	PIN Name	I/O	Description
E3	SC_SWP	O	host wakeup
G2	PMU_SHUTDOWN	I	Shutdown, HW reset, active low
G4	PMU_WAKEUP	I	Module wakeup, active high
F8	AUX_ADC4 (BOOST_EN)	O	1.8V=enable the external DC-DC for VBAT_FEM power
H6	SPIM1_CLK	O	Module reset state indication

#### 3.3.2. SC\_SWP Pin

**Table5 Two States of SC\_SWP Pin**

Item	Pin state	Description
1	High	Interrupt to wakeup HOST. 1.8V Module wants to send data to host.
2	Low	No interrupt.

### 3.3.3. PMU\_SHUTDOWN Pin

This pin requires an external PU resistor (min 600kΩ). Pull source is PMU\_VRTC.

This pin has the highest priority compared to other functionalities.

Therefore, it will forcibly hard reset.

Connect this pin to external host with open drain terminal.

To set this pin low level, external host has to output low to this pin.

To set this pin high level, external host does not have to output high. Terminal of host on this pin must be Hi-Z.

**Table6 Two States of PMU\_SHUTDOWN Pin**

Item	Pin state	Description
1	High	Active 1.8V
2	Low	Shutdown

### 3.3.4. PMU\_WAKEUP Pin

**Table7 Two States of PMU\_WAKEUP Pin**

Item	Pin state	Description
1	High	Wakeup the module or keep active. Module won't enter hibernation if this signal kept high. 1.8V
2	Low	Change the state of module Active to hibernation.

### 3.3.5. SPIM1\_CLK pin

A signal to indicate that the module is resetting.

**Table8 Two States of SPIM1\_CLK Pin**

Item	Pin state	Description
1	High	Resetting. 1.8V
2	Low	Not in Resetting

### 3.4. UART Interface

The module includes a 4-wire UART interface (UART0 - 2).

The UART is an asynchronous serial interface. The interface is a fully compliant and standard RS-232.

Offers similar functionality to industry-standard 16C550 UART devices.

UART0 is used for AT command or PPP.

\* AT command response timeout: max 120s

UART1 is used for debug.

UART2 is used for CLI and firmware version up.

Support baud rates of up to 3Mbps (\*). The baud rate can only be changed via AT command. (Refer to Software Application Guide)

The maximum baud rate error is 1.56%.

\* Flow control is recommended when the baud rate setting is over 1Mbps.

Default setting is following:

Baud rete: 115200, Data: 8bit, Parity: none, Stop: 1bit, Flow control: none (See Data Format)

[Data Format]

(1) Start bit	(2) Data	(3) Parity	(4) Stop bit
---------------------	-------------	---------------	--------------------

(1) Start bit: start frame transmission (1bit)

(2) Data: length of transmission data in one frame (8bit)

(3) Parity: error detecting code (none)

(4) Stop bit: end frame transmission (1bit)



### 3.4.1. UART0 Interface

UART0 is used for AT commands and PPP. And connect with the host.

The interface signal voltage is 1.7V to 1.9V.(TYP:1.8V)

**Table9 List of UART0 pins**

No.	Pin Name	I/O	Description
C8	UART0_RX	I	UART0 receiving data.
D8	UART0_TX	O	UART0 transmitting data.
D9	UART0_CTS	I	UART0 clear to send.
E8	UART0_RTS	O	UART0 ready to send.

### 3.4.2. UART1, UART2 Interface

UART1, UART2 are manufacturer maintenance ports and are used for debugging and firmware updates.

Special tools are required for data logging and firmware updates.

Please contact your local sales team for tools.

**Table10 List of UART1 pins**

No.	Pin Name	I/O	Description
J10	UART1_RX	I	UART1 receiving data.
H9	UART1_TX	O	UART1 transmitting data.
K10	UART1_CTS	I	UART1 clear to send.
G6	UART1_RTS	O	UART1 ready to send.

**Table11 List of UART2 pins**

No.	Pin Name	I/O	Description
B9	UART2_RX	I	UART2 receiving data.
C9	UART2_TX	O	UART2 transmitting data.
C10	UART2_CTS	I	UART2 clear to send.
B10	UART2_RTS	O	UART2 ready to send.

### 3.5. USIM Card Interface

The USIM interface can be used either for USIM socket, and for eSIM.

The module supports Class C (1.8V).

For 3.0V USIM cards support, an external voltage translator will be required.

To achieve ultra-low power consumption, SIM power will be off during hibernation mode.

The USIM input/output lines are following USIM specifications.

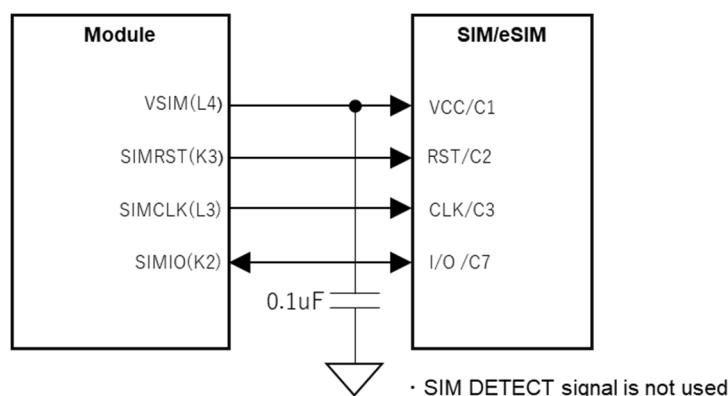
As the module is not equipped with an USIM card adapter, you need to place an USIM/eSIM card adapter on the user interface board.

Please design the circuit after evaluating by the customer.

If you want to use both USIM card adapter and eSIM, please use switch circuit.

**Table12 List of UART1 pins**

No.	Pin Name	I/O	Description
L4	VSIM	O	SIM VCC 1.8V
K3	SIMRST	O	SIM Reset 1.8V
L3	SIMCLK	I	SIM Clock 1.8V
K2	SIMIO	I/O	SIM Data 1.8V It is pulled up with 4.7kΩ by VSIM inside the module.



**Figure4 USIM Interface signal connection**

## 3.6. RF Antenna Interface

### 3.6.1. RF Connector location

This module does not include any antennas. External antennas need to be used for the final products using this module.

#### NOTE

- You should prepare an external antenna which was certified based on the Radio Type Approval of the module.
- Please optimize impedance matching between RF input/output line and antenna by using a matching circuit.

The RF input/output line of characteristic impedance in the module is 50Ω.

## 4. RF Specifications

### 4.1. Operating Frequencies

Table13 shows the RF bands supported by the module

Operating Band	Tx	Rx	Bandwidth	Carrier
Band1	1940MHz - 1960MHz	2130MHz - 2150MHz	5MHz /10MHz /15MHz	docomo
Band19	830MHz - 845MHz	875MHz - 890MHz	5MHz /10MHz /15MHz	docomo
Band26	814MHz - 849MHz	859MHz - 894MHz	5MHz /10MHz /15MHz	KDDI

\* For use in Japan only.

### 4.2. Test Standards

The module meets 3GPP TS 36.521-1 test standards. The module passes strict tests at the factory and thus the quality of the module is guaranteed.

### 4.3. RF Specifications

- "Test Value" in the table is the average value of the sample.
- The test values are offset in evaluation board pattern loss.  
Therefore, they are treated as the value of the electrode pad.
- conducted condition

Table14 RF Specifications (Band1)

Parameter	Condition	Min.	Max.	Unit
Maximum Output Power		20.3	25.7	dBm
Rx Sensitivity	Throughput > 95%	-103	-	dBm

Table15 RF Specifications (Band19)

Parameter	Condition	Min.	Max.	Unit
Maximum Output Power		20.3	25.7	dBm
Rx Sensitivity	Throughput > 95%	-103	-	dBm

Table16 RF Specifications (Band26)

Parameter	Condition	Min.	Max.	Unit
Maximum Output Power		20.3	25.7	dBm
Rx Sensitivity	Throughput > 95%	-101	-	dBm

## 5. Electrical Specifications

### 5.1. Absolute Maximum Ratings

#### WARNING

Table17 lists the absolute ratings for the module. Using the module beyond these conditions may result in permanent damage to the module.

**Table17 Absolute maximum ratings for the module**

Symbol	Parameter	Min.	Max.	Unit
VBAT	VBAT supply pin	-0.3	4.5	V
VBAT_FEM	RF supply pin	-0.3	4.5	V

### 5.2. Operating Conditions

**Table18 Operating conditions**

Parameter	Min.	Typ.	Max.	Unit	Condition
Operating temperatures	-30		+70	°C	*1-
Storage temperatures	-40	-	+80	°C	-
Module Vin (VBAT)	2.3	-	4.35	V	*2
Module Vin (VBAT_FEM)	2.3	-	4.35	V	-
VBAT_FEM Rise Time	-	-	1	ms	from power on to 2.2V

\*1: 3GPP release 13 compliant

\*2: VBAT slew rate should be less than 25mV/us

**Table19 DC Characteristics of pins**

Parameter	Min.	Max.	Unit
V <sub>IH</sub>	0.7 * V <sub>IO</sub>	-	V
V <sub>IL</sub>	-	0.3 * V <sub>IO</sub>	V
V <sub>OH</sub>	0.8 * V <sub>IO</sub>	-	V
V <sub>OL</sub>	-	0.2 * V <sub>IO</sub>	V
V <sub>IO</sub>	1.7	1.9	V

V<sub>IO</sub> is generated by the module's internal LDO

## 5.3. Power Supply

### 5.3.1. Input Power Supply

**Table20 Requirements for input power of the module**

Parameter	Min.	Max.	Ripple Max.	Unit
VBAT	2.3	4.35	50mVpp	V
VBAT_FEM	2.3	4.35	50mVpp	V

**Table21 Maximum Current Ratings**

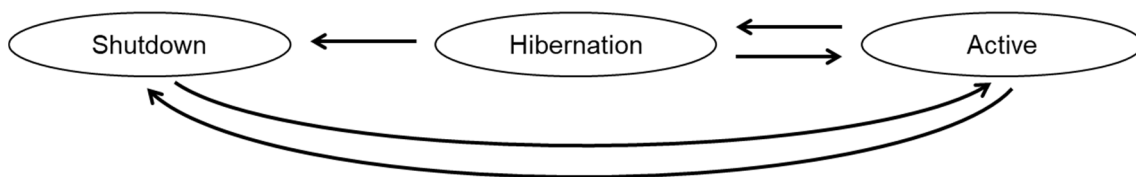
Supply Name	Description	Max	Unit
VBAT	Maximum current rating for the VBAT domain	0.6	A
VBAT_FEM	Maximum current rating for the FEM domain	1	A

### 5.3.2. Power State

Module is optimized to achieve ultra-low power consumption addressing IoT market needs. Power state is supported. (See the following Table29)

**Table22 Power state**

Power state	Description	Required supplies
Shutdown	Module powered off.	-
Hibernation	System is halted.	-
Active	All system is wake up.	All required power supplies are available.



**Figure5 power state transition diagram**

### 5.3.3. Power Consumption

[conditions]

- measured on our evaluation board at 25°C indoor
- Band: 1, Band Width: 5MHz
- DRX cycle = 1.28 s
- eDRX cycle = 81.92s, PTW = 1.28 s
- power supply of the module is 3.0V

**Table23 Averaged power consumption of the evaluation board**

Mode	Typical values (Avg)	Condition
Tx Power @23dBm	500mA	-
DRX	1.4mA	SIM power on
eDRX	50uA	Average power consumption for 1 hour after shift to eDRX.

## 6. Function and Features

### 6.1. Power on/off

#### 6.1.1. Power on

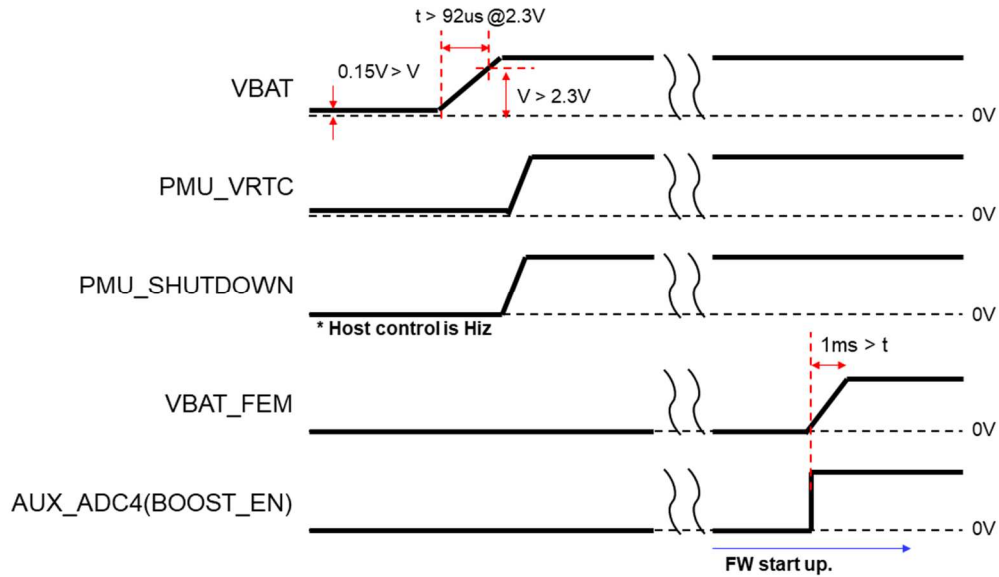


Figure6 power on sequence

#### 6.1.2. Power off

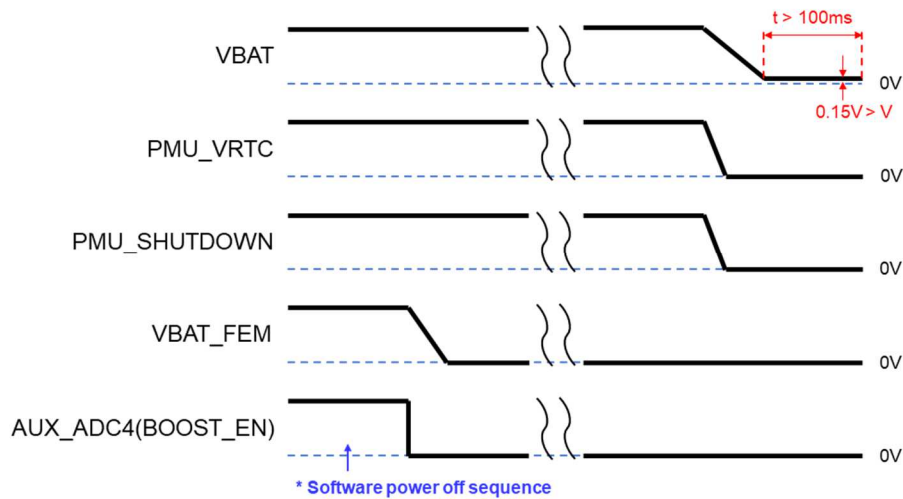
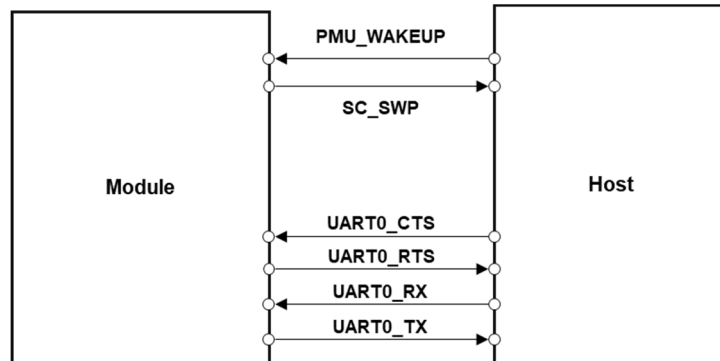


Figure7 power off sequence



## 6.2. Host-Module Mutual Wakeup Interface



**Figure8 Host-Module mutual wakeup**

The state of PMU\_WAKEUP and SC\_SWP

(1) PMU\_WAKEUP (Host: Output, Module: Input)

High : When host need to open the data interface and to wake up to module.

Low : When host need to close the data interface.

(2) SC\_SWP (Host: Input, Module: Output)

High : Module need to open the data interface.

Therefore, interrupt to wakeup host.

Low : Module do not need to open the data interface.

**Table24 the requirements for the external host interface IO**

No.	Pin Name	Description
G4	PMU_WAKEUP	host wakes up module
E3	SC_SWP	module wakes up host
D8	UART0_TX	UART0 transmitting data
C8	UART0_RX	UART0 receiving data
E8	UART0_RTS	UART0 ready to send
D9	UART0_CTS	UART0 clear to send
G2	PMU_SHUTDOWN	hardware reset

\*: Connect these pins to pins header etc.

## 7. Mechanical Specifications

### 7.1. Dimensions of the module

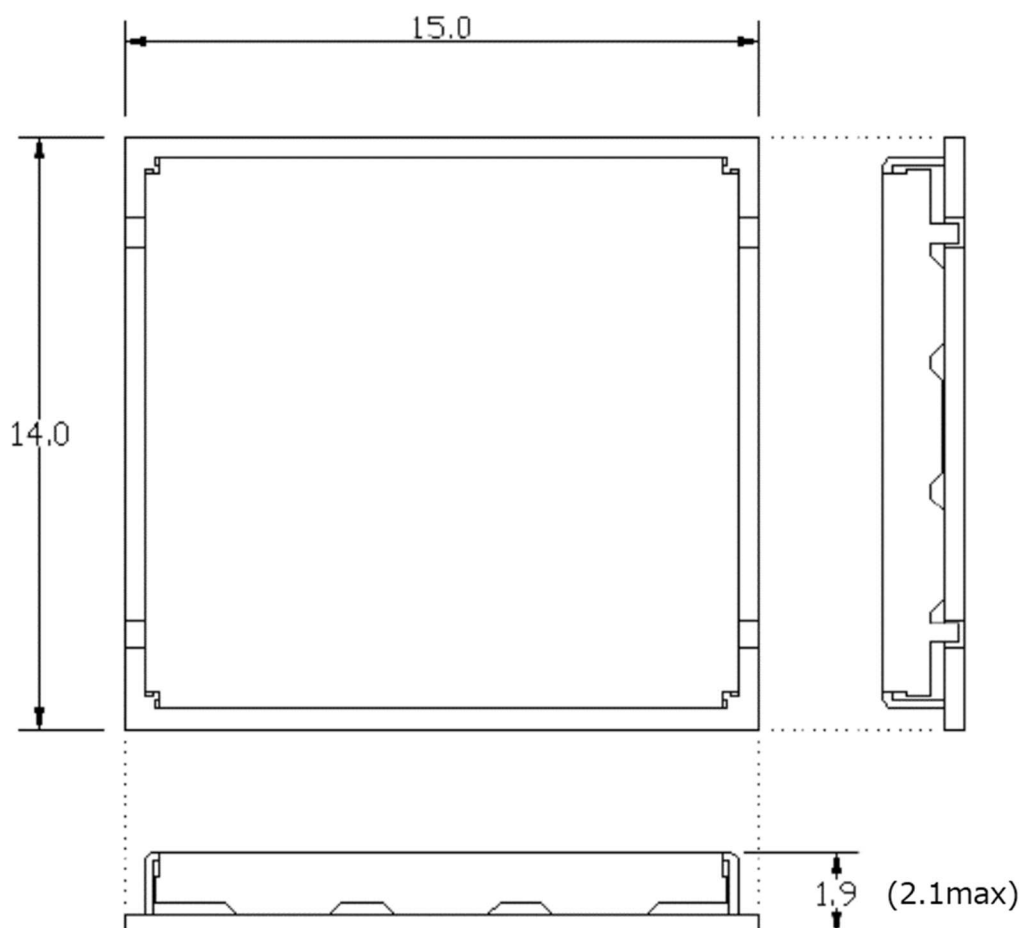


Figure9 dimensions of the module (TOP VIEW) (unit: mm)

\*Tolerances unless otherwise specified:  $\pm 0.2$ mm

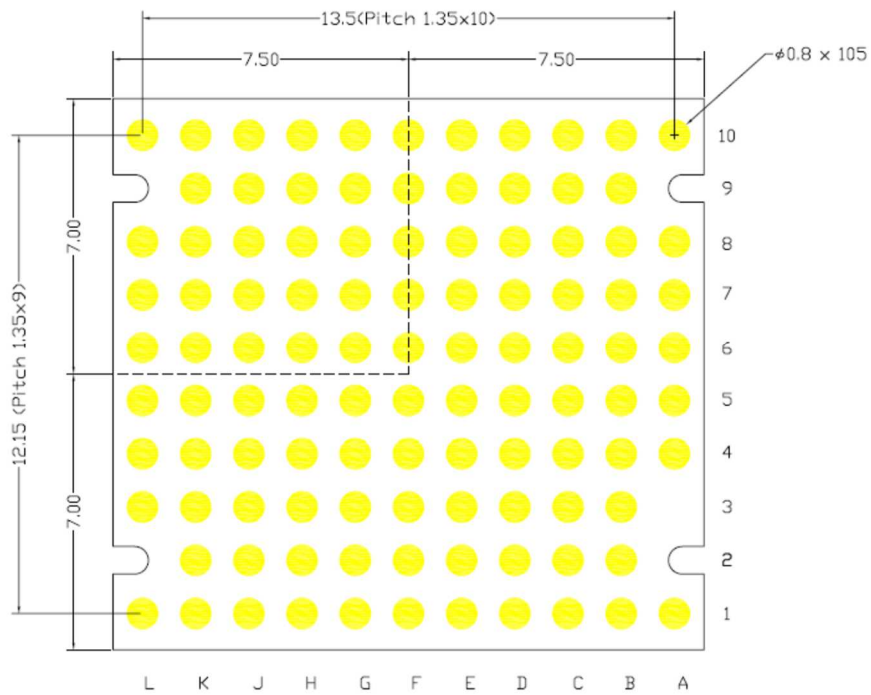
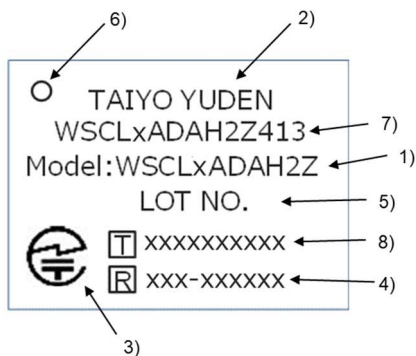


Figure10 Dimensions of the module (TOP THRU VIEW) (unit: mm)

## 7.2. Label



- 1) Model : WSCLxADAH2Z
- 2) Manufacture : TAIYO YUDEN
- 3) Japan logo mark: Specified logo mark
- 4) Japan ID : Specified ID Number
- 5) Lot number : Four digits
- 6) 1Pin mark : φ1.0mm circle mark on the shield case
- 7) Type : WSCL2ADAH2Z413 / WSCL3ADAH2Z413
- 8) JATE ID : Specified ID Number
- 9) QR Code : Process control code
- 10) MSN : Manufacturing Serial Number  
EX) 2N410 12345

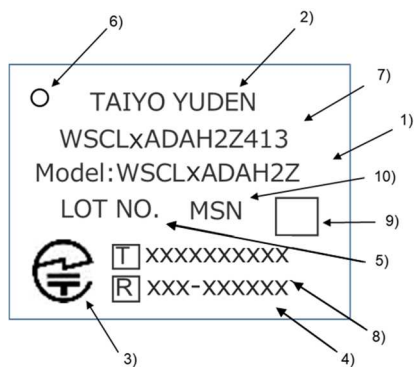


Figure11 description of label

### 7.3. Packing System

The module package includes the tray, tray(cover), antistatic band, desiccant, and humidity indicator card.

This module is stored in the tray.

- Packaging method: Tray
  - \* It might be providing as tray at sample stage.

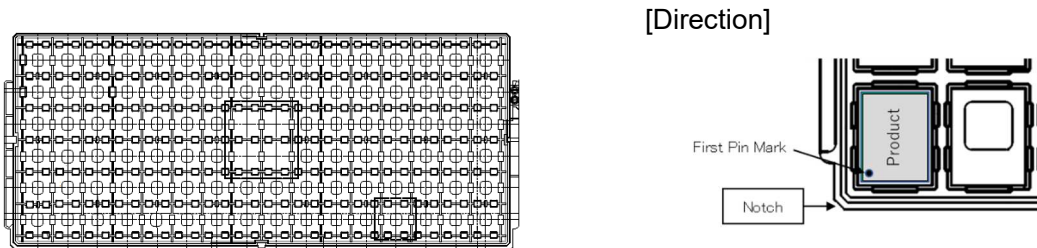


Figure12 packaging Figure

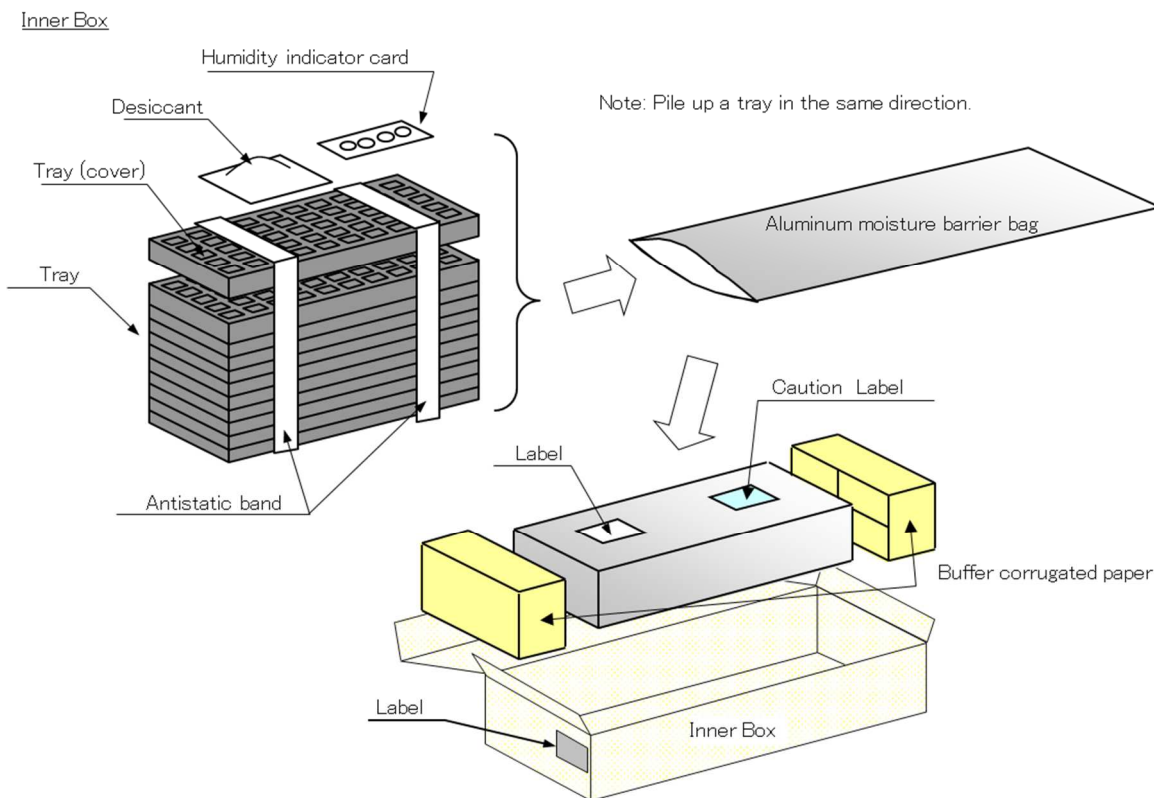


Figure13 package assembly

## 8. Handling Precautions

### 8.1. Thermal Management

WSCLxADAH2Z have high power consumption and due to their very small size, need to be designed properly for heat dissipation.

### 8.2. Desire and Conditions

This specification describes desire and conditions especially for mounting.

#### 8.2.1. Environment conditions for use and storage

1. Store the components in an environment of  $< 40^{\circ}\text{C} / 90\% \text{RH}$  if they are in a moisture barrier bag packed by TAIYO YUDEN.
2. Keep the factory ambient conditions at  $< 30^{\circ}\text{C} / 60\% \text{RH}$ .
3. Store the components in an environment of  $< 25 \pm 5^{\circ}\text{C} / 10\% \text{RH}$  after the bag is opened.  
(The condition is also applied to a stay in the manufacture process).

#### 8.2.2. Conditions for handling of products

Make sure all of the moisture barrier bags have no holes, cracks or damages at receiving. If an abnormality is found on the bag, its moisture level must be checked in accordance with 2 of 8.2.2. Refer to the label on the bag.

1. All of the surface mounting process (reflow process) must be completed in 12 months from the bag sea date.
2. Make sure humidity in the bag is less than 10%RH immediately after open, using a humidity indicator card sealed with the components.
3. All of the surface mounting process (reflow process including rework process) must be completed in 168 hours after the bag is opened (inclusive of any other processes).
4. If any conditions in 8.2.1. or condition 2 and 3 of 8.2.2. are not met, bake the components in accordance with the conditions at  $125^{\circ}\text{C}$  24h.
5. As a rule, baking the components in accordance with conditions 4 of 8.2.2. shall be once.
6. Since semi-conductors are inside of the components, they must be free from static electricity while handled. ( $< 100\text{V}$ ) Use ESD protective floor mats, wrist straps, ESD protective footwear, air ionizers etc., if necessary.
7. Please make sure that there are lessen mechanical vibration and shock for this module, and do not drop it.
8. Please recognize pads of back side at surface mount.
9. This module should not be cleaned.
10. Please perform temperature conditions of module at reflow within the limits of the following.  
Please give the number of times of reflow as a maximum of 2 times.

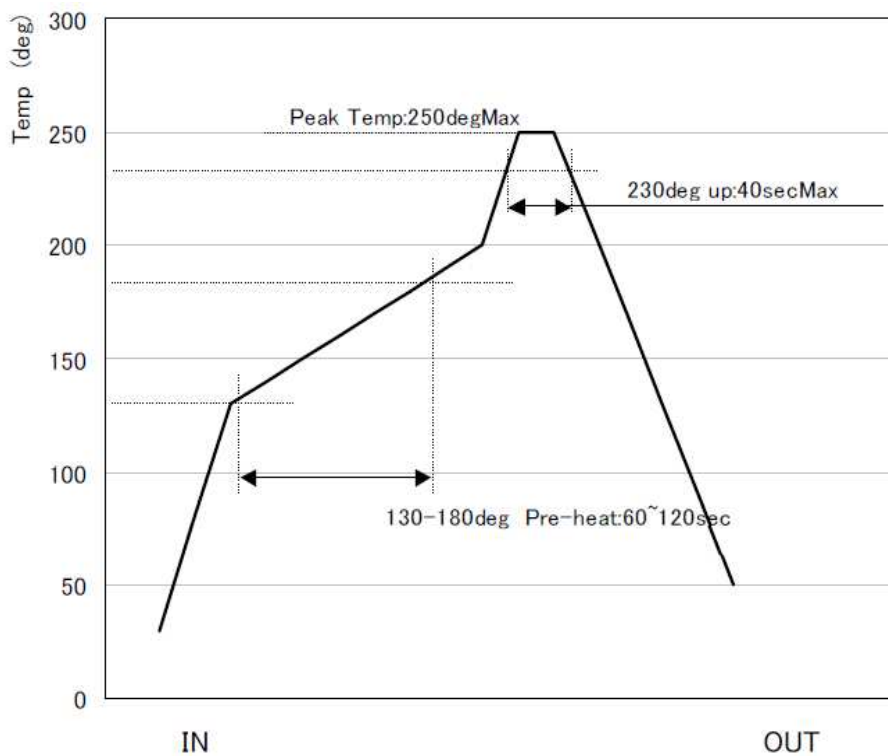


Figure14 temperature conditions of module at reflow

## 9. Certifications

### 9.1. Certifications

Table25 shows the certificate obtained by the module.

**Table25 Product certifications**

Certification	Model Name	
	WSCL2ADAH2Z	WSCL3ADAH2Z
technical regulations conformity certification of the Radio law	✓	✓
Japan Approvals institute for Telecommunications Equipment	✓	✓
Carrier IOT (docomo)	-	✓
Carrier IOT (kddi)	✓	-

## 10. Safety Information

Read the safety information carefully to ensure the correct and safe use of module. Applicable safety information must be observed.

### 10.1. Interference

Communication between this product and other might not be established nor maintained depending upon radio environment or operating condition of this product and other products with wireless technology.

This product operates in the licensed band at 2GHz/800MHz. In case this product is used around the other wireless devices which operate in same frequency band of this product, there is a possibility that interference occurs between this product and such other devices. If such interference occurs, please stop the operation of other devices or relocate this product before using this product or do not use this product around the other wireless devices.

Power off module if using the device is prohibited. Do not use the module when it causes danger or interference with electric devices.

### 10.2. Medical Device

- Power off module and follow the rules and regulations set forth by the hospitals and health care facilities.
- Some module may affect the performance of the hearing aids. For any such problems, consult your service provider.
- Pacemaker manufacturers recommend that a minimum distance of 15 cm be maintained between the module and a pacemaker to prevent potential interference with the pacemaker. If you are using an electronic medical device, consult the doctor or device manufacturer to confirm whether the radio wave affects the operation of this module.

### 10.3. Area with Inflammables and Explosives

To prevent explosions and fires in areas that are stored with inflammable and explosive devices, power off module and observe the rules. Areas stored with inflammables and explosives include but are not limited to the following:

- Gas station
- Fuel depot (such as the bunk below the deck of a ship)
- Container/Vehicle for storing or transporting fuels or chemical products
- Area where the air contains chemical substances and particles (such as granule, dust, or metal powder)
- Area indicated with the "Explosives" sign
- Area indicated with the "Power off bi-direction wireless equipment" sign
- Area where you are generally suggested to stop the engine of a vehicle



#### **10.4. Airline Security**

Observe the rules and regulations of airline companies. When boarding or approaching a plane, power off module. Otherwise, the radio signal of the module may interfere with the plane control signals.

#### **10.5. Safety of Children**

Do not allow children to use the module without guidance. Small and sharp components of the module may cause danger to children or cause suffocation if children swallow the components.

#### **10.6. Environment Protection**

Observe the local regulations regarding the disposal of your packaging materials, used module, and promote their recycling.

#### **10.7. RoHS Approval**

The module is in compliance with the restriction of the use of certain hazardous substances in electrical and electronic equipment Directive 2011/65/EU (RoHS Directive).

#### **10.8. Laws and Regulations Observance**

Observe laws and regulations when using module. Respect the privacy and legal rights of the others.

#### **10.9. Care and Maintenance**

It is normal that module gets hot when you use or charge it. Before you clean or maintain the module, stop all applications and power off the module.

- Use module with care and in clean environment. Keep the module from a fire or a lit cigarette.
- Protect module from water and vapor and keep it dry.
- Do not drop, throw or bend module.
- Clean module with a piece of damp and soft antistatic cloth. Do not use any chemical agents (such as alcohol and benzene), chemical detergent, or powder to clean it.
- Do not leave module in a place with a considerably low or high temperature.
- Do not dismantle the module. Otherwise, the module is not covered by the warranty.

#### **10.10. Emergency Call**

This module functions through receiving and transmitting radio signals.

Therefore, the connection cannot be guaranteed in all conditions. In an emergency, module cannot be used.

## 11. Appendix Acronyms and Abbreviations

Term	Definition
ADC	Analog-to-Digital Converter
AUX	auxiliary
DC	Direct Current
DRX	Discontinuous Reception
eDRX	Extended DRX
ESD	Electro-Static Discharge
EU	European Union
EUTRA	Evolved Universal Terrestrial Radio Access
FDD	Frequency Division Duplex
I2C	Inter-Integrated Circuit
LGA	Land Grid Array
LPDDR	Low Power DDR
LPF	Low-pass filter
LTE	Long Term Evolution
LwM2M	Lightweight machine-to-machine
MCP	Multi-chip Package
MISO	Master In Slave Out
MOSI	Master Out Slave In
NC	Not Connected
OFDMA	Orthogonal Frequency Division Multiple Access
PCB	Printed Circuit Board
PMU	Power Management Unit
PTW	Paging Transmission Window
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RoHS	Restriction of the Use of Certain Hazardous Substances
RRC	Radio Resource Control
RTC	Real Time Clock
Rx	Receive
SC-FDMA	Single-Carrier Frequency Division Multiple Access
SMS	Short Message Service
SPI	Serial Peripheral Interface
TCP	Transmission Control Protocol

TCXO	Temperature Compensated Crystal Oscillator
Tx	Transmit
UART	Universal Asynchronous Receiver Transmitter
UDP	User Datagram protocol
UICC	Universal Integrated Circuit Card
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
UTRA	Universal Terrestrial Radio Access
XO	Crystal Oscillator. Typically used to indicate a Crystal connection to the IC (utilizing internal Oscillator)