

MK71351

Bluetooth® Low Energy wireless module

■ Overview

MK71351 is a wireless module which is integrating Bluetooth® Specification v4.2 compliant LSI(TC3567CFSG),26MHz/32.768kHz crystal oscillator, 2.4GHz PCB pattern antenna and passive components.
 MK71351 is suitable for applications such as Healthcare, fitness device, Remote Controller or PC peripherals.

■ Features

- Wireless module which is integrated 2.4GHz PCB pattern antenna and passive components
- Bluetooth® Specification v4.2 low energy compliant
- Radio certification
 - MIC JAPAN (certification no: 006-000680)
 - FCC(FCC ID: 2ACIJ71351)
 - ISED(IC: 20971-71351)
 - CE (RED) EN300 328 V2.1.1
- Bluetooth® Qualification (End Product, QDID:xxxxx)
- Integrated-Bluetooth® Specification v4.2 low energy compliant LSI (TC3567CFSG)
- Integrated 26MHz /32.768kHz crystal oscillator
- Integrated NOR Flash Memory (128 KB、10⁵ times of erase and program)
- Integrated bypass capacitor and external component of switching regulator
- RSSI accuracy: ±1 dB (Typ, -85~-10dBm @input,25°C)
- General Purpose Input/Output(13ports)
- General Purpose Serial Interfaces
 - SPI Interface (1 ch assigned to a General Purpose IO)
 - I2C Interface (1 ch assigned to a General Purpose IO)
- Host Interface
 - UART Interface (9600bps~921.6kbps、1ch - shared with GPIOs)
 - SPI Interface
- PWM Interface (3ch、assigned to General Purpose IOs)
- AD Converter
 - 10bit resolution
 - External analog inputs assigned to GPIOs (3ch)
 - Internal VDD monitoring (1 ch - connected inside)
- Single power supply 2.0V to 3.6V (Typ.3.0V)
- Operating Temperature -40 deg.C to 85 deg.C
- Current Consumptions

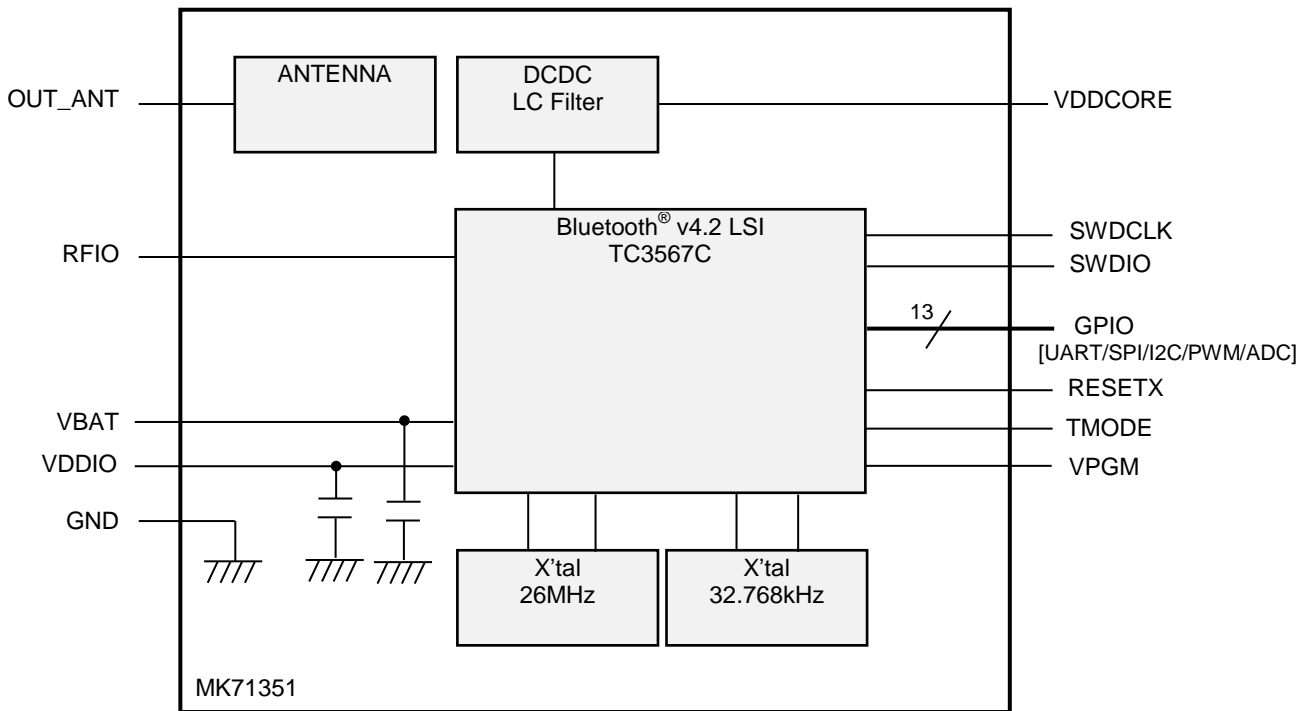
Deep Sleep State	0.05 uA (Typ.)
Sleep State	2.5 uA (Typ.)
Back up State	2.4 uA (Typ.)
Idle State	0.8 mA (Typ.)
Active RX	3.0 mA (Typ.)
Active TX	2.9 mA(Typ.)
Flash Writing	15.6mA (Typ.)
- Product name :MK71351-NNNYEZ05B
- PKG :M-FLGA33-9.7X11.95-0.75-9Y
- Dimension : 9.7mm (W) x 11.95mm (L) x 2.1mm (H)
- Pb Free, RoHS compliant



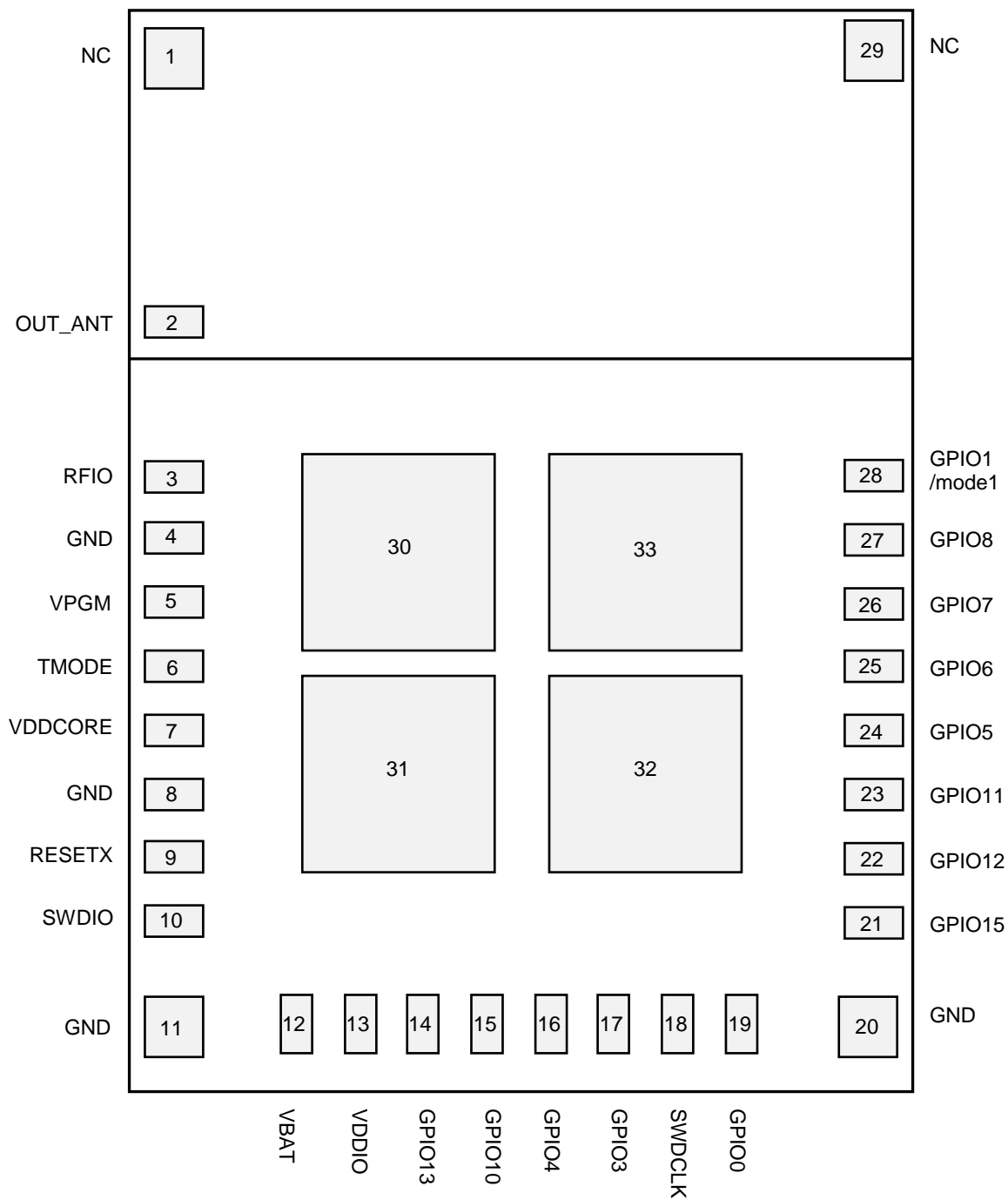
•Bluetooth® is a registered trademark of Bluetooth SIG, Inc.

•All other company and product names are the trademarks or registered trademarks of the respective companies.

■ Block Diagram



■ Pin Layout



TOP VIEW

■ List of Pins

Symbols	I_{RF}	:	RF I/O pin.
	ISHPUD	:	Schmitt Trigger input pin with Pull-up, and Pull-down.
	Ish	:	Schmitt Trigger input pin
	IO _{SHPUD}	:	Schmitt Trigger Digital I/O pin with Pull-up, and Pull-down.
	IO _{ASHPUD}	:	Schmitt Trigger Digital I/O with Pull-up, and Pull-down. and analog input pin

Pin	Symbol	Attribute/value at reset	I/O	Active level	Description
1	NC	---	---	---	NC Pin
2	OUT_ANT	---	I_{RF}	---	PCB antenna input (to be connected to RFIO by user's PCB)
3	RFIO	---	I_{RF}	---	RF Input/Output from Module (to be connected to OUT_ANT by user's PCB)
4	GND	---	---	---	GND
5	VPGM	---	---	---	Test pin
6	TMODE	Input	Ish	---	TEST MODE input (Low = Normal operation)
7	VDDCORE	1.35 V output	---	---	CORE voltage monitor pin
8	GND	---	---	---	GND
9	RESETX	Input	Ish	Low	Reset input (Low = Reset)
10	SWDIO	Input	IO _{SHPUD}	---	Serial wire debugger data pin and operation mode switching pin
11	GND	---	---	---	GND
12	VBAT	---	---	---	Power supply 2.0 to 3.6 V
13	VDDIO	---	---	---	Power supply 2.0 to 3.6 V
14	GPIO13	Pull-up	IO _{SHPUD}	---	General-purpose IO pin
15	GPIO10	Hi-Z	IO _{ASHPUD}	---	ADC input, general-purpose IO pin
16	GPIO4	Hi-Z	IO _{ASHPUD}	---	ADC input, general-purpose IO pin
17	GPIO3	Hi-Z	IO _{ASHPUD}	---	ADC input, general-purpose IO pin
18	SWDCLK	Input	ISHPUD	---	Serial wire debugger clock pin
19	GPIO0	Hi-Z	IO _{SHPUD}	---	General-purpose IO pin and WakeUp0 input pin
20	GND	---	---	---	GND
21	GPIO15	Hi-Z	IO _{SHPUD}	---	General-purpose IO pin and WakeUp1 input pin
22	GPIO12	Pull-up	IO _{SHPUD}	---	General-purpose IO pin
23	GPIO11	Pull-up	IO _{SHPUD}	---	General-purpose IO pin
24	GPIO5	Pull-up	IO _{SHPUD}	---	General-purpose IO pin
25	GPIO6	Pull-up	IO _{SHPUD}	---	General-purpose IO pin
26	GPIO7	Pull-up	IO _{SHPUD}	---	General-purpose IO pin
27	GPIO8	Pull-up	IO _{SHPUD}	---	General-purpose IO pin
28	GPIO1	Pull-up	IO _{SHPUD}	---	General-purpose IO pin
29	NC	---	---	---	NC pin
30	GND	---	---	---	GND
31	GND	---	---	---	GND
32	GND	---	---	---	GND
33	GND	---	---	---	GND

Note: Pull-up/Pull-down register's range is 20k~100k Ω .

■ Pin Description

Symbols	I_{RF}	:	RF I/O pin.
	ISHPUD	:	Schmitt Trigger input pin with Pull-up, and Pull-down.
	Ish	:	Schmitt Trigger input pin
	IO _{SHPUD}	:	Schmitt Trigger Digital I/O pin with Pull-up, and Pull-down..
	IO _{ASHPUD}	:	Schmitt Trigger Digital I/O with Pull-up, and Pull-down. and analog input pin.

● RF, Analog Related Pins

Pin	Symbol	Attribute/value at reset	I/O	Active level	Description
2	OUT_ANT	---	I_{RF}	---	PCB antenna input (to be connected to RFIO by user's PCB)
3	RFIO	---	I_{RF}	---	RF Input/Output from Module (to be connected to OUT_ANT by user's PCB)

● General-Purpose IO Pins

Pin	Symbol	Attribute/value at reset	I/O	Active level	Description
19	GPIO0	Hi-Z	IO _{SHPUD}	---	General-purpose I/O pin During reset, internal Pull-up/Pull-down resistor turns OFF and is put into the Disable state. After the pin configuration by software processing, this pin can function as a function pin or a GPIO pin of I/O. See Table 2-2.
21	GPIO15	Hi-Z	IO _{SHPUD}	---	
28	GPIO1	Pull-up	IO _{SHPUD}	---	General-purpose I/O pin During reset, internal Pull-up resistor turns ON and is put into the Disable state. After the pin configuration by software processing, this pin can function as a function pin or a GPIO pin of I/O. GPIO1 is used as a condition for switching the operation mode. See List of GPIO Pin Functions section.
24	GPIO5	Pull-up	IO _{SHPUD}	---	
25	GPIO6	Pull-up	IO _{SHPUD}	---	
26	GPIO7	Pull-up	IO _{SHPUD}	---	
27	GPIO8	Pull-up	IO _{SHPUD}	---	
23	GPIO11	Pull-up	IO _{SHPUD}	---	
22	GPIO12	Pull-up	IO _{SHPUD}	---	
17	GPIO3	Hi-Z	IO _{ASHPUD}	---	ADC input, general-purpose I/O pin During reset, internal Pull-up/Pull-down resistor turns OFF and is put into the Disable state. After the pin configuration by software processing, this pin can function as a function pin, a general-purpose ADC channel pin, or a GPIO pin of I/O, by selecting either of these. See List of GPIO Pin Functions section.
16	GPIO4	Hi-Z	IO _{ASHPUD}	---	
15	GPIO10	Hi-Z	IO _{ASHPUD}	---	
14	GPIO13	Pull-up	IO _{SHPUD}	---	General-purpose I/O pin During reset, internal Pull-up resistor turns ON and is put into the input Disable state. After the pin configuration by software processing, this pin can function as a function pin or a GPIO pin of I/O. See List of GPIO Pin Functions section.

● Other Pins

Pin	Symbol	Attribute/value at reset	I/O	Active level	Description
6	TMODE	Input	Ish	---	TEST MODE input (Low = Normal operation)
9	RESETX	Input	Ish	Low	Reset input (Low = Reset)

● CORE Voltage Related Pins

Pin	Symbol	Attribute/value at reset	I/O	Active level	Description
7	VDDCORE	1.35 V output	---	---	CORE voltage monitor pin Normally, use this pin in the OPEN.

● Debugger Related Pins

Pin	Symbol	Attribute/value at reset	I/O	Active level	Description
10	SWDIO	Input Pull-up	IOSHPUD	---	Serial wire debugger data pin and operation mode switching pin. During reset, internal Pull-down resistor turns ON and is put into the input state. After the reset is released, this pin turns into the I/O of the serial wire debugger data. If this function is not used, the pin should be OPEN.
18	SWDCLK	Input Pull-Down	ISHPUD	---	Serial wire debugger clock pin During reset, internal Pull-down resistor turns ON and is put into the input state. After the reset is released, this pin turns into the input of the serial wire debugger clock. If this function is not used, the pin should be OPEN.

● Power Supply Pin

Pin	Symbol	Attribute/value at reset	I/O	Active level	Description
5	VPGM	---	---	---	Power supply pin for test Connect this pin to GND.
12	VBAT	---	---	---	Power supply 2.0 to 3.6 V
13	VDDIO	---	---	---	Power supply 2.0 to 3.6 V
4	GND	---	---	---	GND
8	GND	---	---	---	GND
11	GND	---	---	---	GND
20	GND	---	---	---	GND
30	GND	---	---	---	GND
31	GND	---	---	---	GND
32	GND	---	---	---	GND
33	GND	---	---	---	GND

● N.C. Pins

Pin	Symbol	Attribute/value at reset	I/O	Active level	Description
1	NC	---	---	---	NC pin, always use in the OPEN.
29	NC	---	---	---	NC pin, always use in the OPEN.

●List of GPIO Pin Functions

The functions of GPIO pins are allocated to the UART interface and serial memory interface, among others, depending on the firmware implemented to ROM and commands from the external host. This list indicates the hardware state during reset, the software control setting immediately after the reset is released, and the functions which can be set for each GPIO pin. When the same function name is allocated to several pins, it is not possible to select several pins to allocate the function at the same time.

Pin name	State during reset	State immediately after the reset is released	Function 1	Function 2	Function 3	Function 4	Analog input
GPIO0	Disable/ Hi-Z	Disable/ Pull-up, Pull-down: off	WakeUp0 input	-	-	-	-
GPIO1	Disable/ Pull-up	Input/Pull-up (*1)	PWM0 output	-	-	-	-
GPIO3	Disable/ Hi-Z	Disable/ Pull-up, Pull-down: off	PWM2 output	SPI-DOUT output	-	-	ADC1 input
GPIO4	Disable/ Hi-Z	Disable/ Pull-up, Pull-down: off	PWM3 output	SPI-DIN input	-	-	ADC2 input
GPIO5	Disable/ Pull-up	Input/Pull-up (*2)	UART1-TX output	SPI-DOUT output	-	-	-
GPIO6	Disable/ Pull-up	Input/Pull-up (*2)	UART1-RX input	SPI-DIN input	-	-	-
GPIO7	Disable/ Pull-up	Input/Pull-up	I2C-SCL output	-	SPI-SCS output	UART1-RTSX output	-
GPIO8	Disable/ Pull-up	Input/Pull-up	I2C-SDA I/O	-	SPI-SCLK output	UART1-CTS input	-
GPIO10	Disable/ Hi-Z	Disable/ Pull-up, Pull-down: off	-	-	-	-	ADC4 input
GPIO11	Disable/ Pull-up	Input/Pull-up	I2C-SCL output	SPI-DOUT output	-	-	-
GPIO12	Disable/ Pull-up	Input/Pull-up	I2C-SDA I/O	SPI-DIN input	-	-	-
GPIO13	Disable/ Pull-up	Input/Pull-up		-	-	-	-
GPIO15	Disable/ Hi-Z	Disable/ Pull-up, Pull-down: off	WakeUp1 input	-	-	-	-

(*1) In any mode except for the User-App mode, this will be Pull-down.

(*2) In the HCI mode, the Pull-up/Pull-down resistance will be OFF.

(*) The state of GPIO pin indicates the state when it is used in the User App mode. When the module is started in the HCI mode, some pins may have a different state. As to the detailed state of each pin and how to set it, refer to the Software Application Notes.

●Termination of Unused Pins

See below for the handling of unused pins.

Pin termination which can impair the basic operation of the MK71351 is not included.

Pin	Symbol	Description
1,29	NC	Open
7	VDDCORE	Open
10	SWDIO	Open
14	GPIO13	Open
15	GPIO10	Open
16	GPIO4	Open
17	GPIO3	Open
18	SWDCLK	Open
19	GPIO0	Open
21	GPIO15	Open
22	GPIO12	Open
23	GPIO11	Open
24	GPIO5	Open
25	GPIO6	Open
26	GPIO7	Open
27	GPIO8	Open
28	GPIO1	Open (*1)

(*1) Care should be taken because this pin is used as the operation mode switching pin.

■ Electrical Characteristics

The values listed in the section indicated as typical. below represent typical median values. They are not guaranteed values, as no consideration is given to a variety.

● Absolute Maximum Ratings

Item	Symbol	Condition	Rating	Unit
Power supply voltage	VBAT, VDDIO (*1)	Ta = -40 to +85 °C	-0.3 to +3.9	V
Input voltage	VIN		-0.3 to VDDIO+0.3 (*2)	V
Output voltage	VOOUT		-0.3 to VDDIO+0.3 (*2)	V
Input current	IIN		-10 to +10	mA
Input power	RFIO		+6	dBm
Storage temperature	Tstg		-	-40 to +85

(*1) When voltage is applied to the VDDIO power supply, do not connect VBAT to GND.

Otherwise, current flows from VDDIO to VBAT through the circuit inside IC and may cause breaking, damage, or deterioration.

(*2) VDDIO+0.3 V should not exceed 3.9 V when using.

● Recommended Operating Conditions

Item		Symbol	Min.	Standard	Max.	Unit
Power supply voltage	VBAT operating voltage	VBAT	2.00	3.00	3.60	V
	VDDIO operating voltage	VDDIO	2.00	3.00	3.60	V
RF channel frequency		FC	2400	-	2483.5	MHz
ADC	Analog reference voltage	VREFH	2.00	3.00	3.60	V
	Analog input voltage	VAIN	GND	-	VREFH	V
Operating temperature		Ta	-40	+25	+85	°C

●Current consumption

(Ta=25°C)

Item	Symbol	Condition	Min.	Standard	Max.	Unit
Current consumption of digital section	IDDDIG (Active1)	Operating state	-	0.8	-	mA
	IDDRD (FlashRead)	Flash read	-	2.4	-	mA
	IDDWR (FlashWrite)	Flash write	-	15.6	-	mA
Current consumption of power supply	IDDRX (Active2)	RF receiving state	-	3.0	-	mA
	IDDTX (Active3)	RF transmitting state (0 dBm)	-	2.9	-	mA
Current consumption at low power With connection	IDDS1 (Sleep)	26 MHz crystal oscillation has stopped 32 kHz crystal oscillation	-	2.5	-	uA
Current consumption at low power Without connection	IDDS2 (Backup)	26 MHz crystal oscillation has stopped 32 kHz crystal oscillation	-	2.4	-	uA
Current consumption at low power Without connection	IDDS (Deep Sleep)	26 MHz crystal oscillation has stopped 32 kHz crystal oscillation has stopped	-	0.05	-	uA

(*) Condition: VBAT=VDDIO=3.0V, GND=0V

(*) The operating current of I/O section during active operation varies depending on the buffer setting.

●DC Characteristics

(Ta=-40~85°C)

Item	Symbol	Condition		Min.	Standard	Max.	Unit
		I/F voltage	Other conditions				
High-level input voltage	VIH	3.0 V	LVC MOS	VBAT X0.8	-	-	V
Low-level input voltage	VIL	3.0 V	LVC MOS	-	-	VBAT X0.2	V
High-level output voltage	VOH	3.0 V	IOH=1 mA	VBAT - 0.6	-	-	V
Low-level output voltage	VOL	3.0 V	IOL=1 mA	-	-	0.4	V

(*) Condition: VBAT=VDDIO=3.0V, GND=0V

(*)The target pin is a digital input / digital output pin.

●RF Characteristics

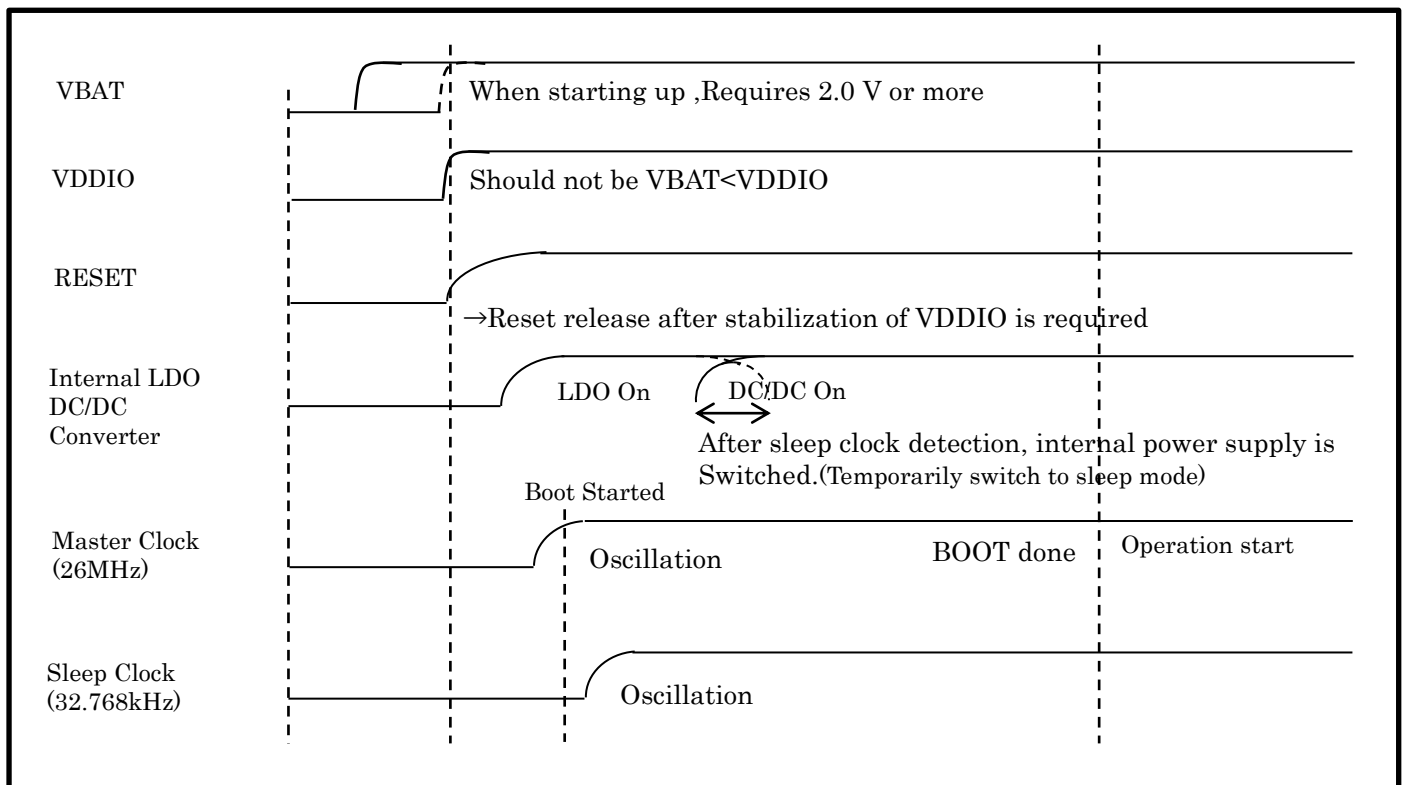
(Ta=25°C)

Item	Symbol	Condition	Min.	Standard	Max.	Unit
Transmitter						
Maximum transmitter power	POUT	0 dBm setting value	-	0	-	dBm
Center frequency tolerance	FCERR	Master Clock tolerance < 40 ppm	-40	0	40	ppm
Modulation data rate	DRATE	-	-	1	-	Mbps
Modulation index	FIDX	-	0.45	0.50	0.55	-
Bandwidth Time	BT	GFSK	-	0.5	-	-
Receiver						
Receiver sensitivity	PSENS	PER = 30.8 % (*1)	-	-93.5	-	dBm
Maximum receiving Power	PRXMAX	PER = 30.8 % (*1)	-	-	-10	dBm

(*) Condition: VBAT=VDDIO=3.0V, GND=0V

(*1) PER=30.8 % corresponds to BER=0.1 %.

●Power Supply Sequence



■ Operation Mode

MK71351 has the following operation modes.

Operation mode	General description
HCI mode	The standard operation mode of Bluetooth®. HCI mode conducts communication between MK71351 and the host MCU through the UART interface.
User-App mode	This is the Application mode which downloads the program code to the built-in SRAM. It is possible to operate this mode alone without the external host MCU.

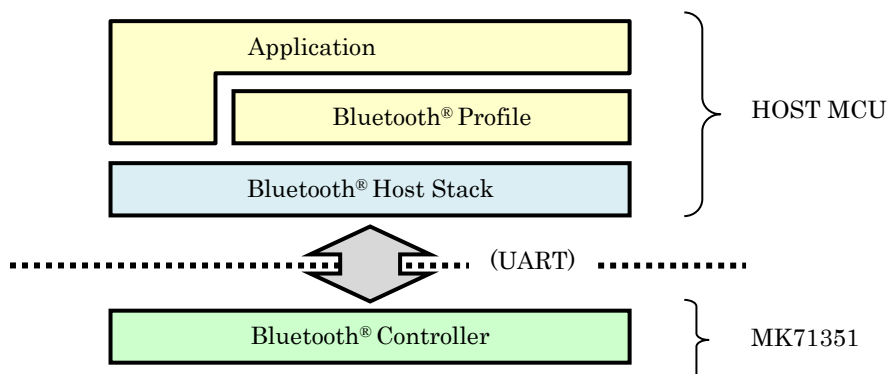
MK71351 chooses the operation mode during the Boot process at the start. Refer to the state of pins indicated below when choosing the operation mode.

Operation mode	Pin status	Note
	GPIO1	
HCI mode	Low input	
User-App mode	OPEN	

●HCI Mode

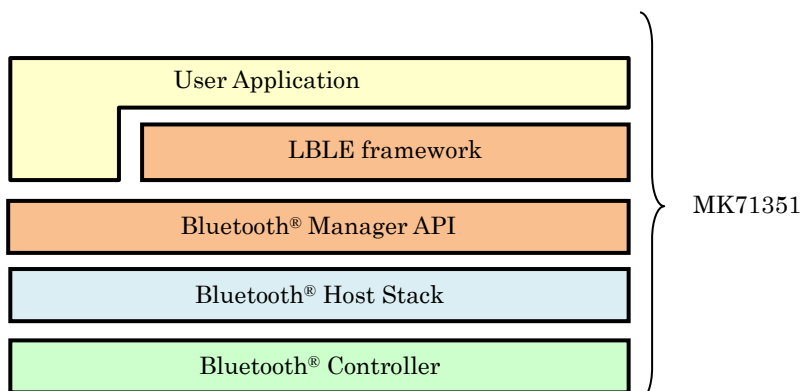
The following figure shows the protocol stack configuration when MK71351 is set to the HCI mode.

It can transmit/receive HCI commands/events compliant with **Bluetooth®** v4.2 to/from HOST-CPU through the UART interface.

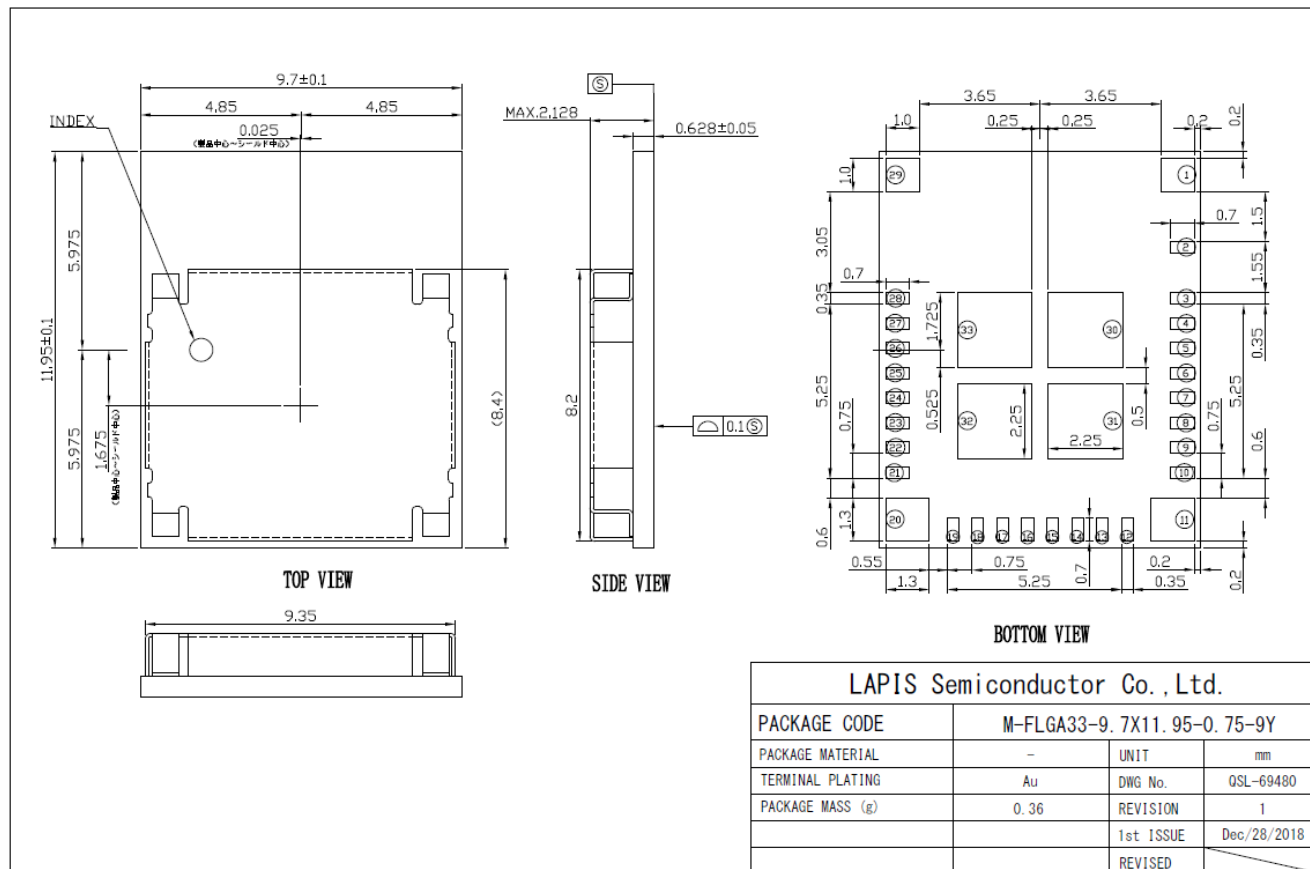
**●User-App Mode**

In this mode, the firmware which is stored in the Flash ROM is downloaded and executed after the Boot operation.

In the User-App mode, the operation is possible without host MCU. This operation assumes a Use Case, in which the data collected from the sensor device is transferred to another device by using Bluetooth® wireless technology. The following figure shows the protocol stack configuration when MK71351 is set to the User-App mode.



■ Module Dimension



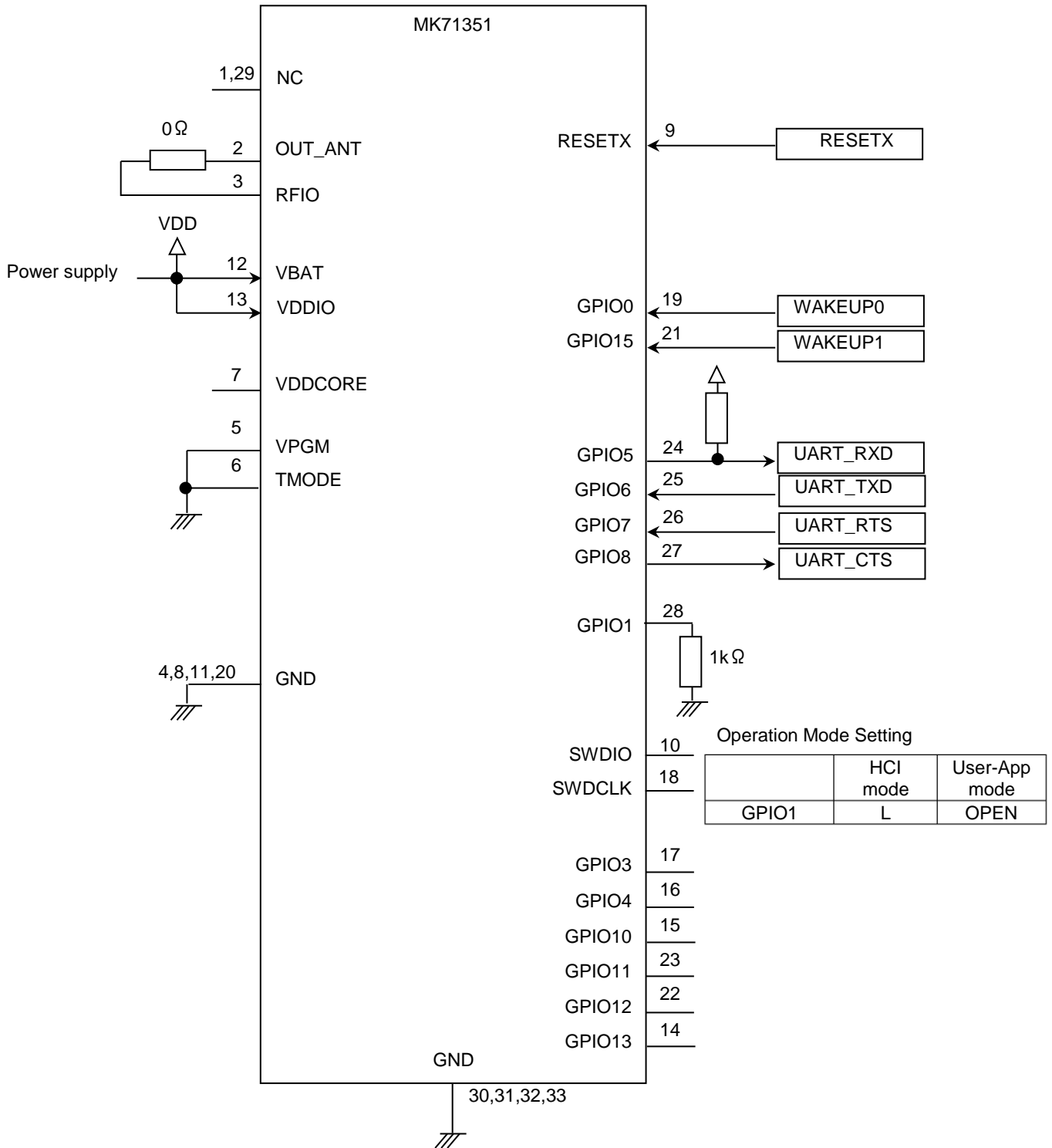
Remarks for Mounting the Surface Mount Type Package

Surface mount type package is very sensitive affected by heating from reflow process, humidity during storage. Therefore, before you perform reflow mounting, contact sales office for the product name, package name, pin number, package code and desired mounting conditions (reflow method, temperature and times) and storage environment.

Examples of Application Circuit

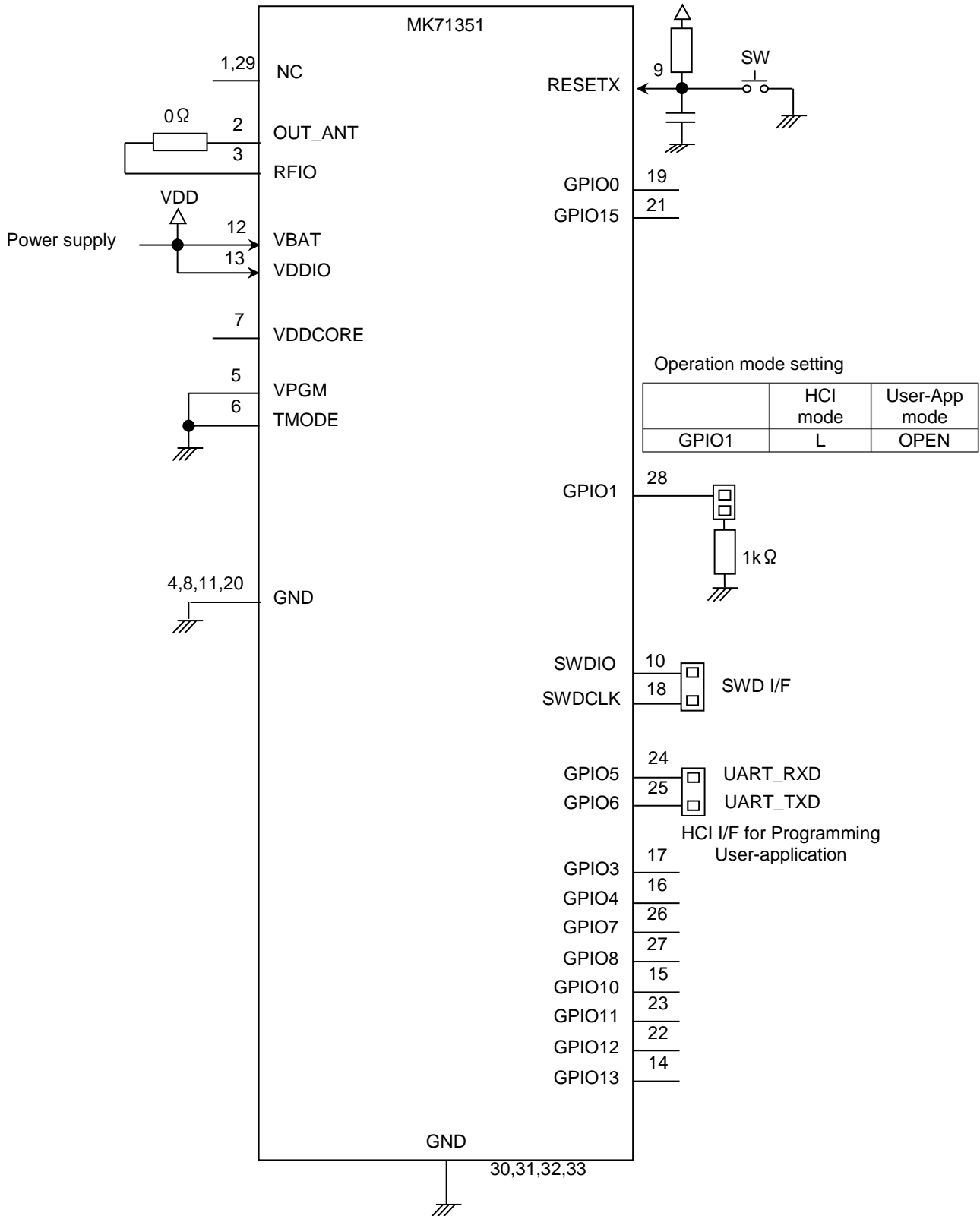
● Connection Example in HCI mode

In this example, GPIO pins except for HOST I/F(UART) are unused.



- Application data is written from HCI interface or SWD interface.
- Over the Air (OTA) function can be used to rewrite the application data.

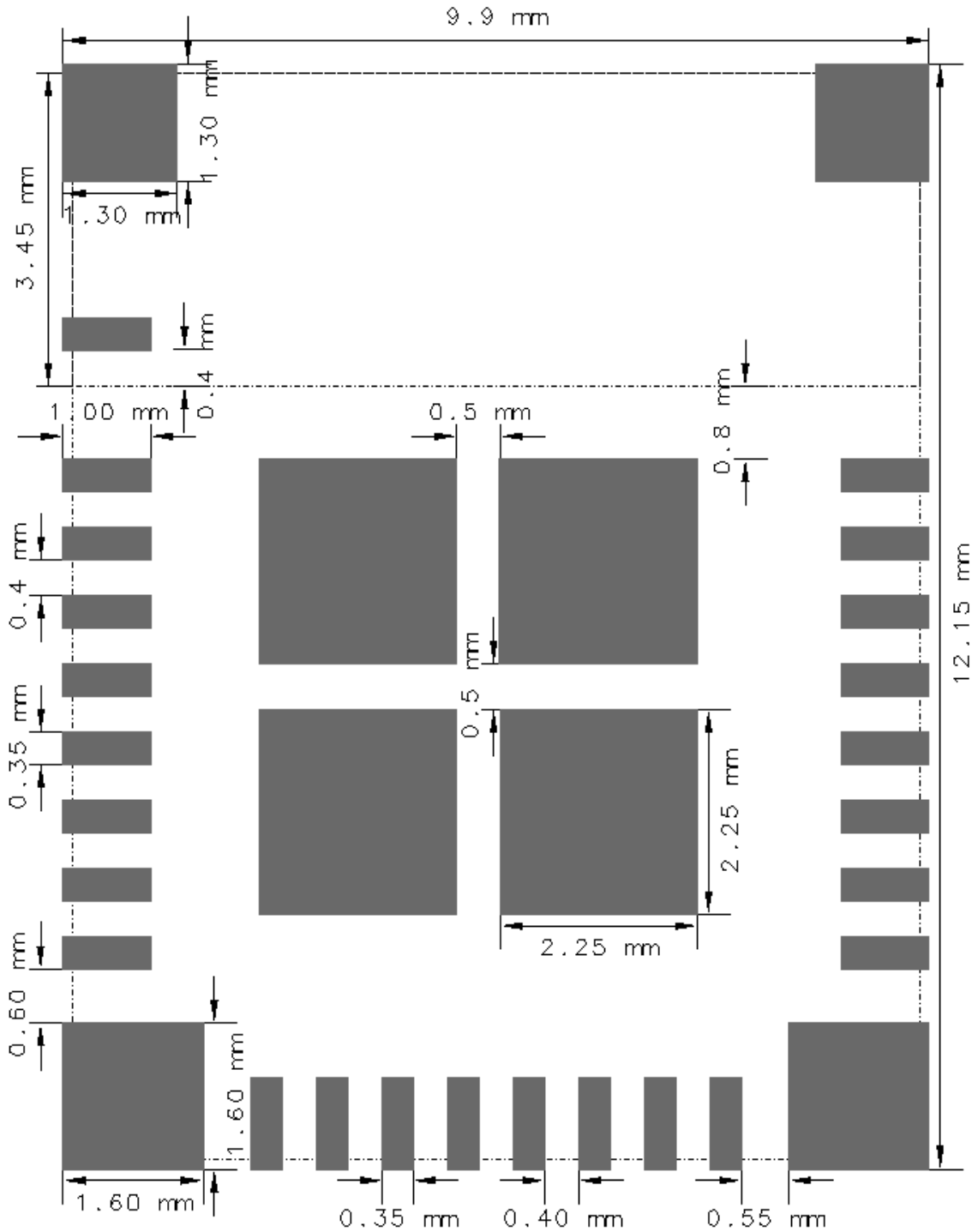
●Connection Example in User-App mode
 In this example, GPIO pins and SWD pins are unused.



- Application data is written from HCI interface or SWD interface.
- Over the Air (OTA) function can be used to rewrite the application data.
- Please refer to the related manual (MK71351 AT Command Application User's Manual), when using the AT Command Application.

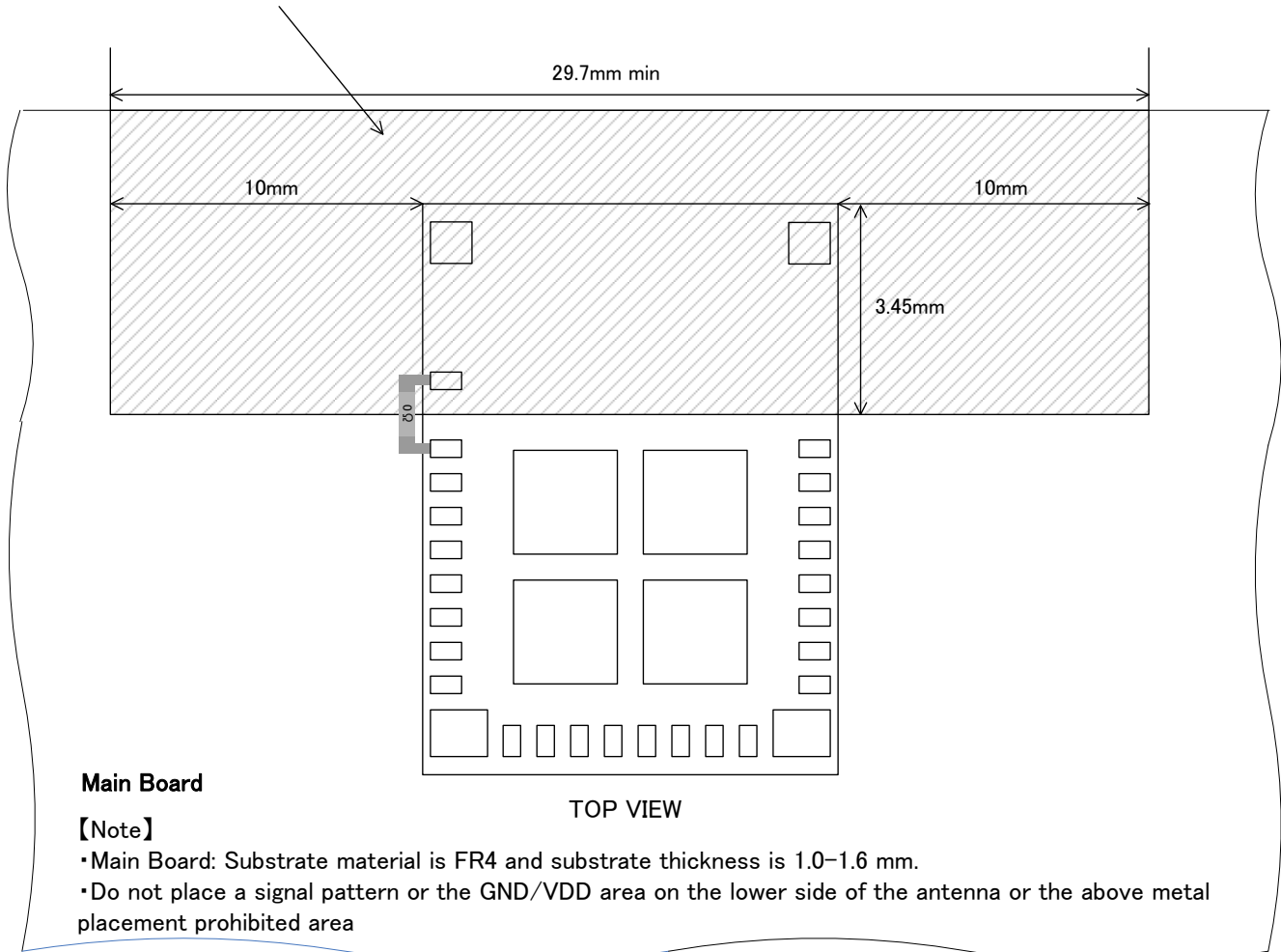
■ Appendix

● Reference Land Pattern



●Metal Keep-Out Area (Recommended Layout)

Metal exclusion zone to edge of board
(no metal on any layer except mechanical LGA pads and RF trace line.)



Main Board

TOP VIEW

【Note】

- Main Board: Substrate material is FR4 and substrate thickness is 1.0-1.6 mm.
- Do not place a signal pattern or the GND/VDD area on the lower side of the antenna or the above metal placement prohibited area

●Radio Certification**MIC JAPAN(certification no 006-000680)**

MK71351 complies with MIC JAPAN radio certification.(certification no:006-000680)

FCC (FCC ID: 2ACIJ71351)

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.

The regulatory label on the final system must include the statement: "Contains FCC ID: 2ACIJ71351" or using electronic labeling method as documented in KDB 784748.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

The antenna used for this transmitter must not be collocated or operating in conjunction with any other antenna or transmitter within a host device, except in accordance with FCC multi-transmitter product procedures.

The final system integrator must ensure there is no instruction provided in the user manual or customer documentation indicating how to install or remove the transmitter module except such device has implemented two-ways authentication between module and the host system.

OEM Responsibilities to comply with FCC Regulations

This module has been certified for integration into products only by OEM integrators under the following condition:

- The transmitter module must not be colocated or operating in conjunction with any other antenna or transmitter.

As long as the 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 any of these conditions can not be met (for example the reference trace specified in this manual, or use of a different antenna), then the FCC authorization is no longer considered valid and the FCC ID can not 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 authorization.

Changes or modification not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

IC (IC: 20971-71351)

This device complies with Industry Canada's licence-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;

(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

The regulatory label on the final system must include the statement: "Contains IC: 20971-71351".

Due to the model size the IC identifier is displayed in this manual only and can not be displayed on the modules label due to the limited size.

CE (RED)

MK71351 complies with the radio test requirements (EN 300 328 V2.1.1), which is based on the RE Directive. EMC and Safety test that is required for the CE marking should be done in the final end-product.

●Bluetooth SIG Qualification(End Product)

MK71351 is listed on the Bluetooth SIG website as qualified End Products. (QDID:XXXXXX)

■ Note

- When mounting this product on the double-sided board, do not mount it on the initial mounting side. (Reflow on the other side from the module mounting side is prohibited.)
- Due to its material characteristic, the sealed case may change color. However, this does not affect the product performance and its quality.

■ Related Documents

The following related documents are available and should be referenced as needed.

-MK71351 SDK related documents:

Download "MK71351 SDK" and related documents from the location related to Bluetooth Low Energy at the LAPIS Support Site below.

<https://www.lapis-semi.com/cgi-bin/MyLAPIS/regi/login.cgi> (English)

-TC3567CFSG-002 related documents

Download the below documents from the location related to the technical documentation download website of Bluetooth® ICs at the below site.

<https://toshiba.semicon-storage.com/ap-en/product/wireless-communication/bluetooth/documents.html>

- Hardware datasheet
- Software application manual
- Software reference manual
- Sample software manual

■ Revision History

Document No.	Date	Page		Description
		Previous Edition	Current Edition	
PEDK71351-03	Feb 8,2019	—	—	Preliminary edition

Notes

Precautions for the Specification

- 1) Contents of the Specification are the information at the time of their issuance. The information contained herein is subject to change without notice.
- 2) LAPIS Semiconductor has used reasonable care in preparing the information included in the Specification, but LAPIS Semiconductor does not warrant that such information is error free. LAPIS Semiconductor assumes no liability whatsoever for any damages incurred by you resulting from errors in or omissions from the information included herein.
- 3) The technical information specified herein is intended only to show the typical functions of the Products and examples of application circuits for the Products. No license, expressly or implied, is granted hereby under any intellectual property rights or other rights of LAPIS Semiconductor or any third party with respect to the information contained in this document; therefore LAPIS Semiconductor shall have no responsibility whatsoever for any dispute, concerning such rights owned by third parties, arising out of the use of such technical information.
- 4) The Specification contains information related to the LAPIS Semiconductor's copyright and technical know-how. Any use of them other than pertaining to the usage of appropriate products is not permitted. Further, the Specification, in part or in whole, may not be reprinted or reproduced and disclosed to third parties without prior consent of LAPIS Semiconductor.

Precautions for the Products

●Precautions for Safety

- 1) The Products are designed and produced for application in ordinary electronic equipment (AV equipment, OA equipment, telecommunication equipment, home appliances, amusement equipment, etc.).
- 2) For use of our Products in applications requiring a high degree of reliability (as exemplified below), please contact and consult with a LAPIS Semiconductor representative: transportation equipment (i.e. cars, ships, trains), primary communication equipment, traffic lights, fire/crime prevention, safety equipment, medical systems, servers, solar cells, and power transmission systems.
- 3) Do not use our Products in applications requiring extremely high reliability, such as aerospace equipment, nuclear power control systems, and submarine repeaters.
- 4) The Products are designed for use in a standard environment and not in any special environments. Application of the Products in a special environment can deteriorate product performance. Accordingly, verification and confirmation of product performance, prior to use, is recommended if used under the following conditions:
 - [a] Use in various types of liquid, including water, oils, chemicals, and organic solvents
 - [b] Use outdoors where the Products are exposed to direct sunlight, or in dusty places
 - [c] Use in places where the Products are exposed to sea winds or corrosive gases, including Cl₂, H₂S, NH₃, SO₂, and NO₂
 - [d] Use in places where the Products are exposed to static electricity or electromagnetic waves
 - [e] Use in environment subject to strong vibration and impact.
 - [f] Use in proximity to heat-producing components, plastic cords, or other flammable items
 - [g] Use involving sealing or coating the Products with resin or other coating materials
 - [h] Use of the Products in places subject to dew condensation
 - [i] Use in an environment where the temperature is always low, such as in a freezer
- 5) The Products might receive the radio wave interference from electronic devices such as Wireless LAN devices, Bluetooth devices, digital cordless telephone, and microwave oven and so on that radiate electromagnetic wave.
- 6) The Products are not radiation resistant.
- 7) Verification and confirmation of performance characteristics of Products, after on-board mounting, is advised.
- 8) Confirm that operation temperature is within the specified range described in the Specification.

- 9) Although LAPIS Semiconductor is continuously working to improve product reliability and quality, semiconductors can break down and malfunction due to various factors. Therefore, if product malfunctions may result in serious damage, including that to human life, sufficient fail-safe measures must be taken, including the following:
- [a] Installation of protection circuits or other protective devices to improve system safety
 - [b] Installation of redundant circuits in the case of single-circuit failure
- 10) Failure induced under deviant condition from what defined in the Specification cannot be guaranteed.
- 11) This product is a specification to radiate the radio wave. It is necessary to acquire the attestation of decided Radio Law of each region used to use the equipment that radiates the radio wave.
Please inquire about the attestation of Radio Law that this product acquires.
- 12) When product safety related problems arises, please immediately inform to LAPIS Semiconductor, and consider technical counter measure.

● Precautions for Reference Circuits

- 1) If change is made to the constant of an external circuit, allow a sufficient margin due to variations of the characteristics of the Products and external components, including transient characteristics, as well as static characteristics.
- 2) The reference circuit examples, their constants, and other types of information contained herein are applicable only when the Products are used in accordance with standard methods. Therefore, if mass production is intended, sufficient consideration to external conditions must be made.

● Precaution for Electrostatic

This product is Electrostatic sensitive product, which may be damaged due to Electrostatic discharge. Please take proper caution during manufacturing and storing so that voltage exceeding Product maximum rating won't be applied to the Products. Please take special care under dry condition (Grounding of human body / equipment / solder iron, isolation from charged objects, setting of Ionizer, friction prevention and temperature / humidity control etc.)

● Precautions for Storage / Transportation

- 1) Product performance and connector mating may deteriorate if the Products are stored in the following places:
 - [a] Where the Products are exposed to sea winds or corrosive gases, including Cl₂, H₂S, NH₃, SO₂ and NO₂
 - [b] Where the temperature or humidity exceeds those recommended by LAPIS Semiconductor
Temperature: 5°C to 40°C, Humidity 40% to 60%
 - [c] Storage in direct sunshine or condensation.
 - [d] Storage in high Electrostatic.
- 2) Even under LAPIS Semiconductor recommended storage condition, connector mating, mountability, and heat resistance of products over 1 year old may be degraded.
- 3) Store / transport cartons in the correct direction, which is indicated on a carton as a symbol, otherwise bent leads may occur due to excessive stress applied when dropping of a carton.

● Precaution for Product Label

QR code printed on LAPIS Semiconductor product label is only for internal use, and please do not use at customer site. It might contain internal products information that is inconsistent with product information.

● Precaution for Disposition

When disposing products, please dispose them properly with an industry waste company.

● Prohibition Regarding Intellectual Property

LAPIS Semiconductor prohibits the purchaser of the Products to exercise or use the intellectual property rights, industrial property rights, or any other rights that either belong to or are controlled by LAPIS Semiconductor, other than the right to use, sell, or dispose of the Products.

• The other precautions

- 1) Please use the Products in accordance with any applicable environmental laws and regulations, such as the RoHS Directive. For more details, including RoHS compatibility, please contact a ROHM sales office. LAPIS Semiconductor shall have no responsibility for any damages or losses resulting non-compliance with any applicable laws or regulations.
- 2) When providing our Products and technologies contained in the Specification to other countries, you must abide by the procedures and provisions stipulated in all applicable export laws and regulations, including without limitation the US Export Administration Regulations and the Foreign Exchange and Foreign Trade Act.

Copyright 2019 LAPIS Semiconductor Co., Ltd.

LAPIS Semiconductor Co.,Ltd.

2-4-8 Shinyokohama, Kouhoku-ku,
Yokohama 222-8575, Japan
<http://www.lapis-semi.com/en/>