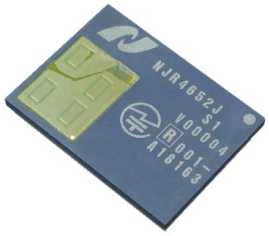
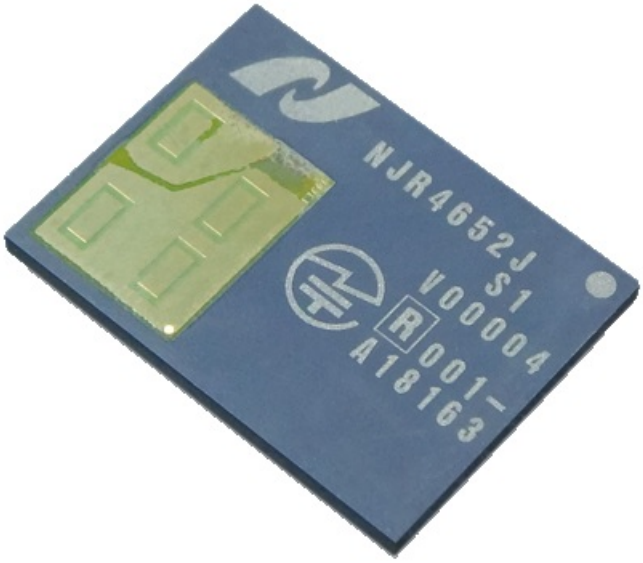


NISSHINBO NJR4652 F2S1 60 GHz Smart Sensor Micro Module User Manual

NJR4652 F2S1 60 GHz Smart Sensor Micro Module User Manual



– Specifications / User Manual –
60GHz Smart Sensor
Micro Module
Model No. NJR4652 F2S1/S2
Function Presence Detection(S1)
Smart Entrance Counter(S2)
Region: United States of America
Rev.00-10S1e / October 24, 2022

Contents

NJR4652 F2S1 60 GHz Smart Sensor Micro Module

Scope

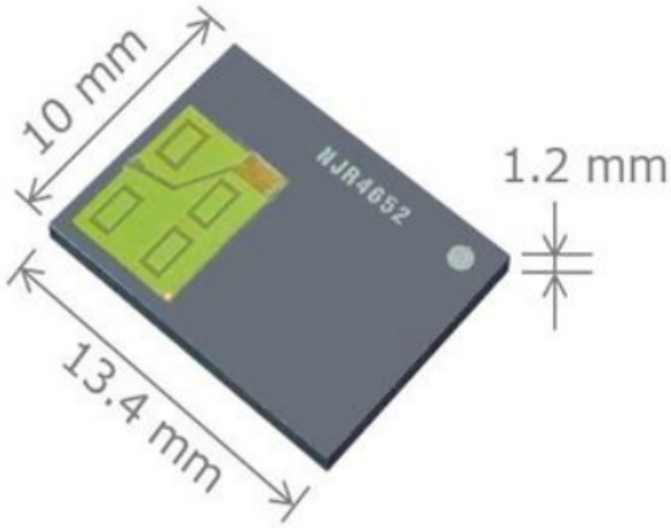
1.1 Features

- This microwave sensor is classified as Field Disturbance Sensor (FDS).
  This sensor has been certified by FCC with the FCC ID:2ACUJR4652.
- Presence detection sensor/Smart Entrance Counter by millimeter wave of 60GHz
- All-in-one from antenna to signal processing
- IC-like package compatible with SMT
- Low power consumption for intermittent operation 30mA @3.6V
- Application software included (turnkey solution) Presence Detection
- Supports UART/USB/GPIO interfaces
- Field of View, or Fovea: ±45° in V plane / ±45° in H plane
- Maximum detection range
  At Presence detection sensor
  ●Macro motion: 10m
  ●Micro motion: 5m
  At Smart Entrance Counter
  ●Detection Range: 0 to 1.6m
  ●Ceiling-mounted: Maximum Height: up to 3m
  ●Side-mounted: Maximum Aisle Width: up to 3m

1.2 Abstract

The NJR4652 is one of the world's smallest sensor modules, incorporating an Infineon's 60GHz radar sensor IC and MCU for control and signal processing in an ultra- compact IC- like package measuring 10×13.4×1.2mm. This product, which has RX multiple antennas, can simultaneously get both distance and position (angle) information to an object with high resolution. In addition, Infineon's Presence Detection (NJR4652F2S1) and Smart Entrance

Counter (NJR4652F2S2) are available as turnkey solutions to shorten customers' product development time.



1.3 Applications

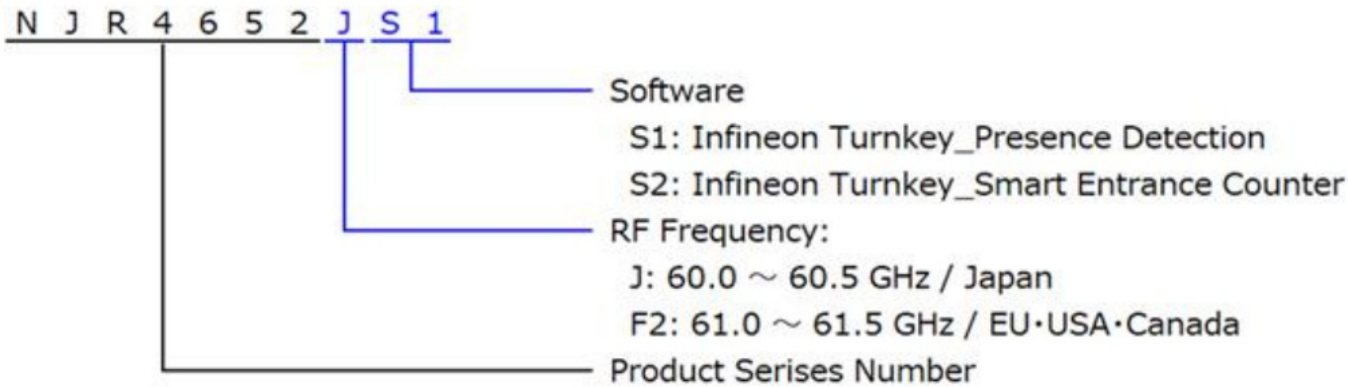
Presence detection sensor (NJR4652F2S1)

■ Lighting
■ Security
■ Housing
■ Robot, Hobby and other applications which need motion sensors

Smart Entrance Counter (NJR4652F2S2)

■ Passerby count at entrances and exits
■ Entry/exit status of meeting rooms, etc.
■ Admission control at events
■ Monitoring the flow of people at various gates, etc.
■ Other human flow sensors for embedded devices

1.4 List of Product Models



1.5 Main Structure

- NJR4652 is an IC-type module that packages an RF-IC with an integrated antenna (patch antenna), a controlling MCU, and a power supply IC (LDO) into one package.
- All of electric parts are covered with the resin.The RF-IC consists of a semiconductor chip and a dielectric substrate, and the RF circuit is completed within the semiconductor chip. The dielectric board is configured as part of the antenna and feeders. (Fig.1) The RF-IC's GND terminals (solder balls) are located at a distance shorter than the wavelength of 60 GHz and is connected to the solid GND of the printed circuit board. (Fig.2)

Therefore, the RF circuit has a metal shield structure formed by the RF-IC, GND terminal, and solid GND on the board.

- The RF signal is in the form of enclosing the feeder line with GND and feeding the antenna with a slot, and has a structure that is completely Metal Shielded.

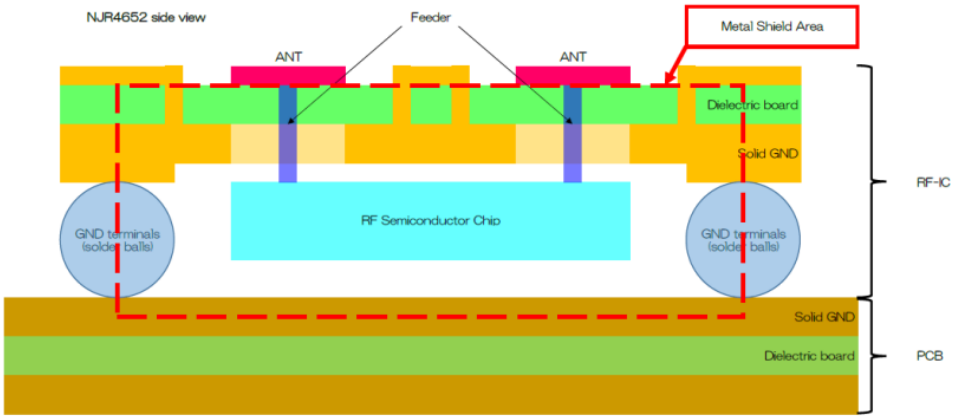


Fig. 1:Side View

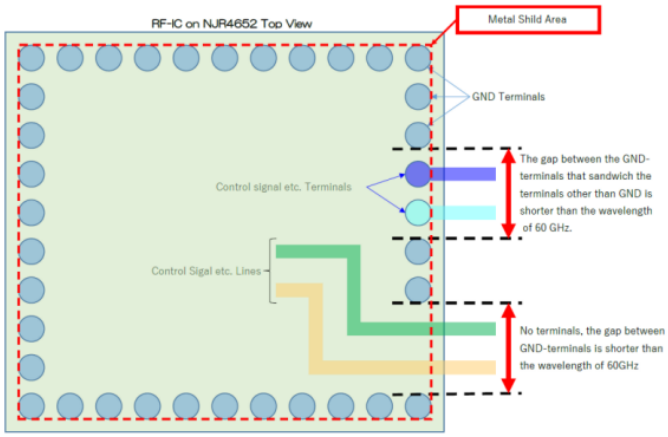
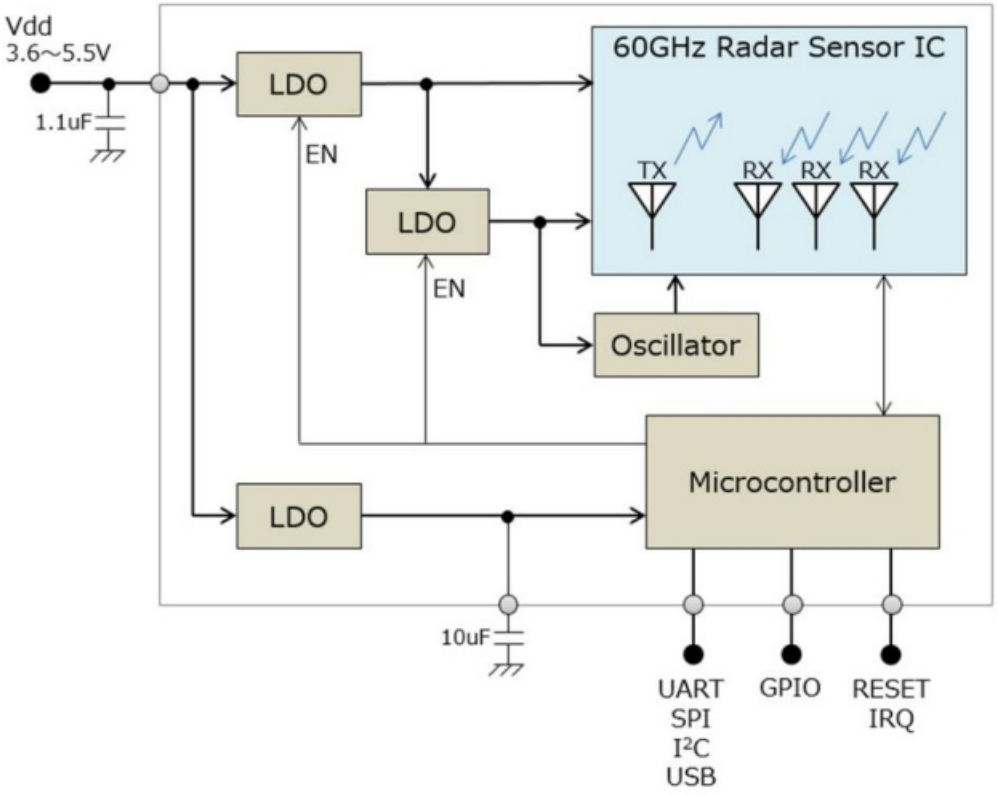


Fig. 2:Top View

1.6 Operation Overview

- +3.6~+5.5 V input operation, LDO integrated.
- All RF controls (Frequency, RF output ON / OFF etc.) in this module are controlled via the built-in microcontroller. The RF-IC cannot be controlled directly from an external device.
- User commands from external devices are processed by the microcontroller.
- The microcontroller controls the RF-IC to modulate at a predetermined frequency according to the command.

1.7 Functional Block Diagram



Electrical Specifications

2.1 Absolute Maximum Rating

Item	Specs			Unit	Remarks
	Min	Type	Max		
Vdd_IN input voltage	-0.3	—	6.0	V	Vdd_IN pin
MCU_3V3 output voltage	-0.3	—	4.0	V	MCU_3V3 pin
Digital pin input	-0.5	—	3.8	V	
Digital pin current	-25	—	25	mA	
Injection current	-0.5	—	0.5	mA	
Electrostatic-Discharge (human body model)	2000	—	—	V	
Operating temperature	-20	—	+70	℃	Guaranteed performance temperature range
Storage temperature	-40	—	+85	℃	

2.2 Electrical Characteristics
Common measurement conditions Ta= +25 °C

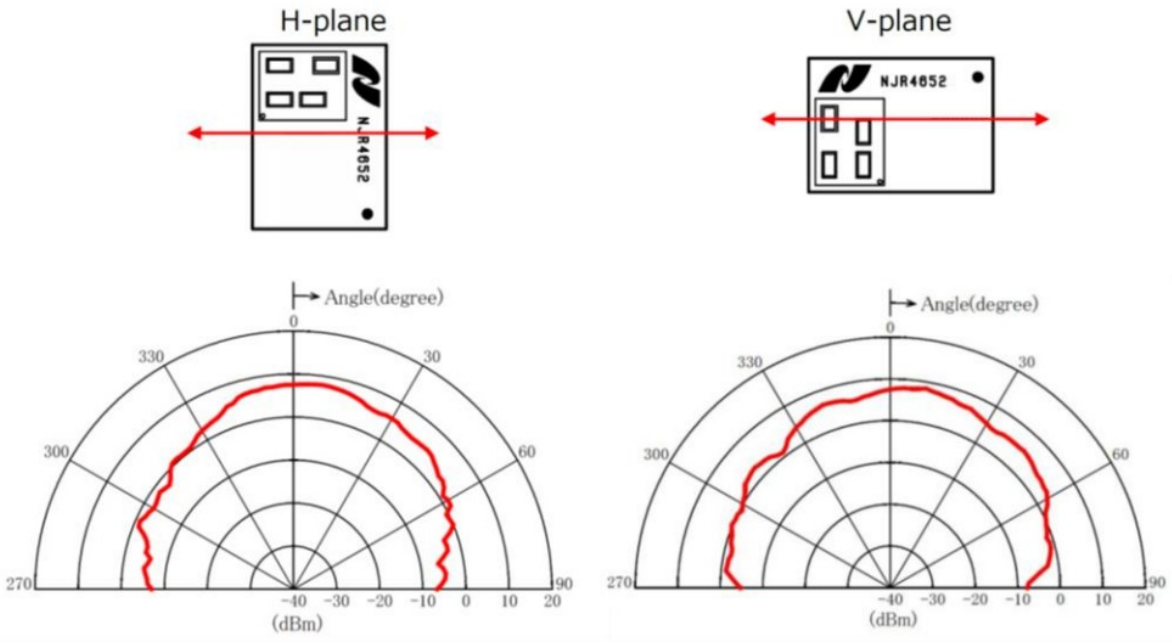
Items	Min 1	Specs Type	Max	Unit	Remarks
Power Supply Specifications					
Supply Voltage	3.6	5.0	5.5	V	DVDs IN
Current					
1) In case presence detect ON					
Average current Number of •1 time (Min. of times)	chirps per	frame 13	—	mA	___
•6 times	—	24	—	mA	
•11 times	—	35	—	mA	
•16 times Max. of times) Peak current	— —	46 155	— 185	mA mA	
2)In case presence detect OFF					
	—	5	—	mA	
3)RFCW(fixed frequency) *Note 1					
	–	1160	I 190	1 mA	I
4)Sleep mode					
	—	TBD	—	mA	

* **Note** 1: Fixed frequency (no frequency sweep) is available for evaluation purposes. However, the presence detection result will not be output when using this mode. Also, we do not recommend using this mode for any purpose other than evaluation, as it will significantly reduce the product life time.

Item	Specs			Units	Remarks
	Min	**Type**	**Max**		
Input / Output Pin Characteristics					
MCU_3V3 pin					
Output Voltage	-2%	3.	2%	V	
Digital pin (GPIO, UART)					
High level output voltage range	MCU_3V3-0 .5	—	—	V	Output current=8mA
Low level output voltage range	—	—	0.4	V	Output current=-8mA
High level input voltage range	2.0	—	—	V	UART_RX pin
Low level input voltage range	—	—	0.8	V	
Reset pin					
High level input voltage range	0.7xMCU_3v 3	—	—	V	4.7k Q pull-up resistor built-in
Low level input voltage range	–	–	0.3xMCU_3V 3	V	4.7k Q pull-up resistor built-in

Item	Specs			Unit	Remarks
	Min	Type	Max		
RF Circuit Specifications					
Conforming standards	l Japan / Radio Law: Construction Design Certification l EU / Radio Equipment Directive (RED) *Note 1 l United States / FCC , Canada / ISED *Note 1				
Transmission frequency					
J type Japan	60.0	—	60.5	GHz	Construction Design Certification
F2 type Europe US Canada)	61.0	—	61.5	GHz	RED *Note 1 FCC *Note 1 ISED *Note 1
Transmission bandwidth	—	480	500	MHz	
Output power	0.54	1.78	2.67	mW	
E.I.R.P. (reference value)	1.6	5.6	8.3	mW	
	2.2	7.5	9.2	dBm	
2nd Harmonic level (E.I.R.P.)	—	—	-30	dBm	
Antenna Characteristics					
Half width H-plane	—	65	—	deg.	
Half width V-plane	—	60	—	deg.	

2.3 Antenna Pattern



Environmental Specifications

3.1 Environmental Performance

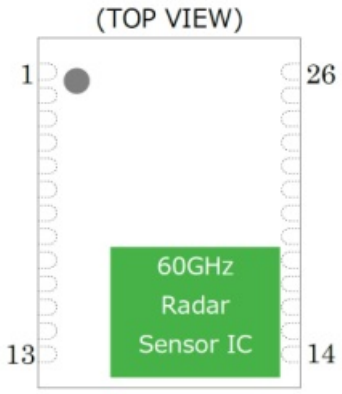
Item	Spec
Operating Temperature	-20 +70°C
Storage Temperature	-40 +85°C
Humidity	0 95%RH @+30°C
Moisture Sensitivity Level	T.B.D.
Vibration	49.03m/s^2 (5G) Condition: 30 50Hz, 10 minutes, XYZ axes
Shock	196.13m/s^2 (20G) Condition: Half sine, 11msec, XYZ axes, 3 times

3.2 Soldering Reflow

T.B.D.

Interface

4.1 Pin assignment



#	Pin Name	I/O	Function
1	MCU_3V3	O	3.3V pin for pass-controlled placement for noise rejection purposes Recommended 10uF
2	USBDP_MCU	I/O	USB2.0 standard
3	USBDM_MCU	I/O	USB2.0 standard
4	SPI_CLK_CTRL	—	Not supported Open
5	SPI_MOSI_CTRL	—	Not supported Open
6	SPI_MISO_CTRL	—	Not supported Open
7	SPI_CSN_CTRL	—	Not supported Open
8	IRQ_CTRL	—	Not supported Open
9	Reset	I	Soft reset by switch, etc. Normal High, Low reset
10	UART_TX	O	UART TX
11	UART_RX	I	UART RX
12	I2C_SCL	—	Not supported Open
13	I2C_SDA	—	Not supported Open
14	GPIO_7		Not supported Open
15	GPIO_8		Not supported Open
16	GND	—	GND
17	NC		Not supported Open
18	NC		Not supported Open
19	GPIO_0	O	Default Low, when presence is detected, High
20	GPIO_1	O	Default Low, when presence is not detected, High
21	GPIO_2		Not supported Open
22	GPIO_3		Not supported Open
23	GPIO_4		Not supported Open
24	GPIO_5		Not supported Open
25	GPIO_9		Not supported Open
26	Vdd_IN	I	Supply voltage 3.6 5.5 V

4.2 UART Communication Interface Specifications

This product has a built-in microcontroller and can acquire various settings and detection information from an external microcontroller via UART.

Item	Specs	unit	Remarks
UART input level	TTL		
UART output level	CMOS		
UART communication parameter			
Baud rate	115200	bps	
Data bit length	8	bit	
Stop bit	1	bit	
Parity	None	—	
Flow control	None	—	
Bit order	LSB first	—	

4.3 USB communication interface specifications

- USB2.0 compliant
- Full-speed (12 Mbps) device interface
- Built-in transceiver

4.4 GPIO communication interface specifications

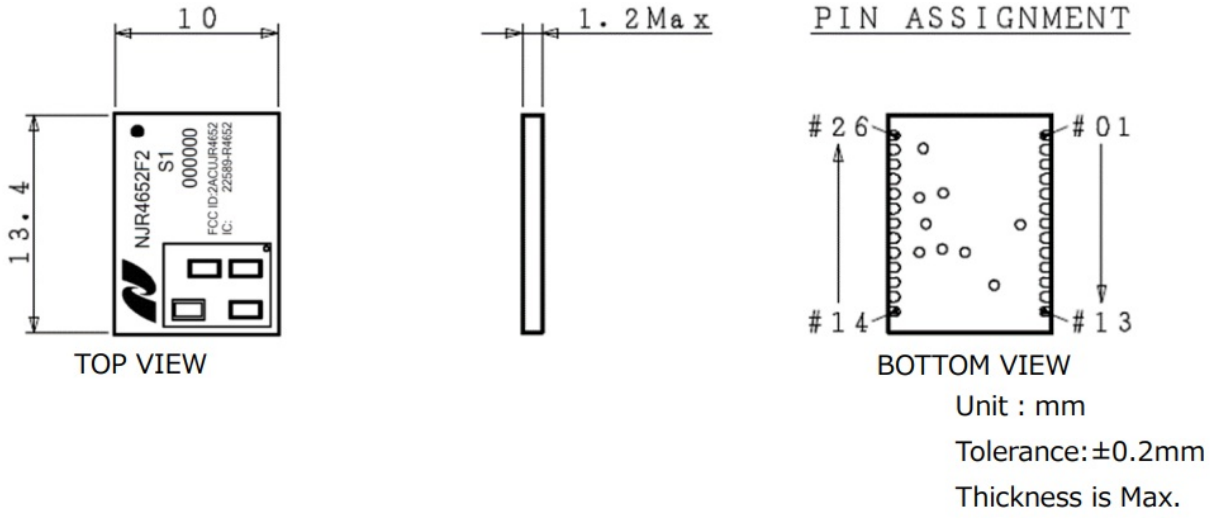
- Pins 19 and 20 output High or Low depending on detection status.
- Other pins are not used.

4.5 I2C/SPI communication interface specifications

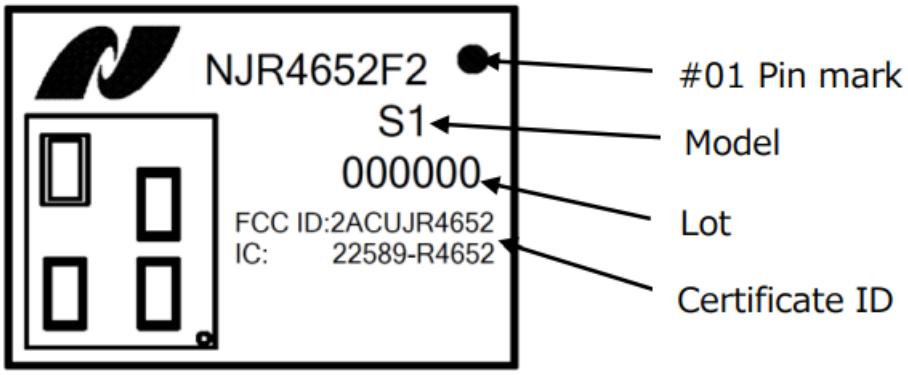
- Not supported.

Drawing

5.1 Outline



5.2 Marking Drawing



Caution

6.1 General Statement

1. Although we strive to improve the quality and reliability of our products, there is a certain probability that millimeter wave products will fail. To avoid any injury, disaster, or social damage resulting from a malfunction of our millimeter wave products, customers are requested to take sufficient care to ensure the safety of their equipment by implementing safety designs such as fail-safe design, redundancy design, fire spread prevention design, and malfunction prevention design on their own responsibility.
2. If this product is to use in the following equipment, which requires particularly high reliability, please contact our sales office in advance.
   • Aerospace equipment
   • Submarine equipment
   • Power generation control equipment (nuclear, thermal, hydro, etc.)
   • Medical equipment for life support
   • Disaster prevention/crime prevention equipment
   • Control equipment for movable objects (Automobiles, Airplanes, Trains, Ships, etc.)
   • Various safety devices
3. The following acts are different from the conditions at the time of application for this product and are violations of radio laws and regulations, and are subject to severe penalties (fines, imprisonment, etc.) and must be absolutely avoided.
   1) Opening and modifying the housing of the product.
   2) Removing the labeling on the product.
   3) Use the product in a mode other than the power supply standard range and unmodulated mode of the product.
   4) To make any other modifications to the product in accordance with the Radio Law and related laws.
   If you intend to use this product under conditions different from those of our application, please obtain a technical standards conformity certificate or construction design certification for your system separately. In the event of such an act, the marking on the product must be erased in accordance with the provisions of the Radio Law.
4. When handling this product, please be sure to take anti-static measures such as grounding the measurement system and human body. Also, when placing the product in a reflow oven, please handle it in compliance with

the MSL level.

5. Please note that the local oscillation frequency will be affected if strong stresses are applied to the external form of the product. Also, do not apply shocks exceeding the rated value.
6. When using multiple modules in the same area, please consider the prevention of interference.
7. Do not use the product under conditions that deviate from the product specifications listed in this specification sheet, as this may cause deterioration or destruction of the product. We shall not be liable for any injury, accident, or social damage resulting from use of the product under conditions that deviate from the specifications.
8. The contents of this specification are subject to change without notice. The delivery specifications must be exchanged before use.

6.2 FCC Statement

- **Appendix)**
  FCC Statement of FCC ID: 2ACUJR4652
- **Responsible party:**
  Nisshinbo Micro Devices Americas Inc.
  2107 North First Street, Suite 520, San Jose, CA 95131, U.S.A.
  Tel: +1-408-320-2873(Main), Fax: +1-408-320-2874
  Bossiness Micro Devices Inc.
  Microwave Business Headquarters
  1-1, Fukuoka 2-Chome Fuji Mino-City
  Saitama Prefecture 356-8510 Japan
  Tel: +81-49-278-1271, Fax: +81-49-278-1234

This device complies with Part 15 of the FCC rules. Operation is a subject to the following two conditions:
(1) This device may not cause harmful interference.
(2) This device must accept any interference received, including interference that may cause undesired operation.
RF Exposure Statement for FCC
This equipment complies with radio frequency exposure limits set forth by the FCC for an uncontrolled environment.
This equipment should be installed and operated with a minimum distance of 2.0 cm between the device and the user or bystanders. This device must not be co-located or operating in conjunction with any other antenna or transmitter.

FCC Caution
DC power supply for each module should be conformed to the electrical specifications as described in this section. A host in which a module is integrated should provide stable DC power through suitable regulator circuit to the module.
As per the FCC rule § 15.255, restrictions are existing for use in a host product.
As per the § 15.255 (a), Operation is NOT permitted for the following products:
(1) Equipment used on satellites.
(2) Field disturbance sensors (FDS), unless the field disturbance sensors are employed for fixed operation.
Note: Fixed FDS is only permitted, Vehicular radar application is NOT permitted under the current FCC rule.
As per the§ 15.255 (b), Operation on aircraft is restricted with specific conditions.
This 60GHz Smart Sensor Micro Module is NOT intended to be used in aircraft.
See the section 6.1 in this manual.

FCC Note:

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

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.
- The equipment complies with radio frequency exposure limits set forth by the FCC for an uncontrolled environment.
- The device must not be co-located or operating in conjunction with any other antenna or transmitter.
- **WARNING:**

  The FCC regulations provide that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
- **Limitation for use of the modules:**

  When the module is installed in a host product, the module shall be connected directly to a PCB of the host product. It shall NOT be extended by any cable. DC power supply for each module must strictly be conformed to each electrical specification as described in the section 1 of this document.
- **Additional testing, Part 15 Subpart B disclaimer**

  This modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and each host product manufacturer is responsible for compliance to any other FCC rules that apply to their host device that is not covered by the modular transmitter grant of certification. Therefore, this final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.
- Manual and Product Labeling information to the End User:

  End user manual must include all required regulatory information and/or warning as show in this manual.

  OEM Integrator must indicate "Contain FCC ID: 2ACUJR4652" at the outside of a host product such as label when the module is installed in the host product.
- The following statement from FCC §15.19(a)(3) is required on the label of the host equipment.

  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.

  OEM Integrator may be sure that the End user manual may not contain any information about the way to install or remove the modules from the host product.
- **APPLICABLE MODEL:**

  This FCC Statement is valid only for the following model number:

  (1) NJR4652F2S1

  (2) NJR4652F2S2

Rev.00-10S1e Oct 24, 2022
IM-R4652F2S1EV

Documents / Resources

	NISSHINBO NJR4652 F2S1 60 GHz Smart Sensor Micro Module [pdf] User Manual NJR4652 F2S1 60 GHz Smart Sensor Micro Module, NJR4652 F2S1, 60 GHz Smart Sensor Micro Module, Smart Sensor Micro Module, Sensor Micro Module, Micro Module, Module