



***Under Development***

# **K-Band Doppler Sensor Module for Contactless Application**

RF Frequency: 24.05 to 24.25 GHz

## **Model No. NJR4266A3 series**

Frequency Line-up: J: 24.05 to 24.25 GHz  
F2: 24.15 to 24.25 GHz  
Antenna Type: A: TX/RX 1x1  
(Angle - 80°/80°, Distance - 20 to 80 cm)  
Interface Type: 3: Digital Output / Analog Range Setting  
for Contactless Application

**Specifications**  
**Rev.00-01e February 12, 2021**

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## 24GHz Microwave Intelligent Motion Sensor for Short Distance, Low Speed Applications with Low-profile and Low-power-consumption for Contactless Application

NJR4266 is intelligent human motion sensor module that can detect objects moving at low speed like a hand waving in a short distance range (approx. 80 cm as maximum distance) by itself and it incorporates a 24 GHz band microwave circuit, antenna, signal processing circuit, and also MCU in a 17.2 x 27.3 x 5.2 mm low profile package.

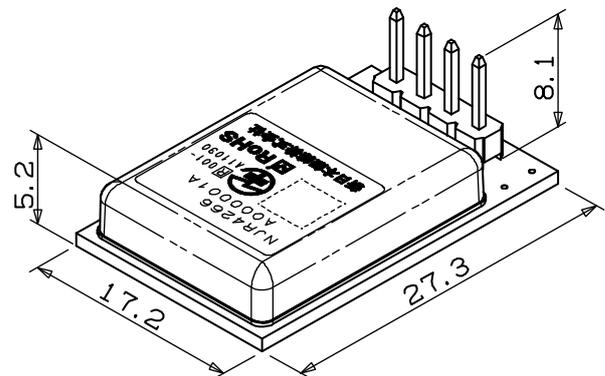
Signal processing of original technology greatly reduces false detection due to environmental noise, achieves stable detection results, and identifies directions of approach and separation. And also it has a function to reduce power consumption by sensitivity setting.

### Features:

- Motion sensor using the 24GHz Microwave Doppler
- Antenna, Microwave RF circuit, IF amp, MCU and voltage regulator are integrated in a low-profile package (17.2 x 27.3 x 5.2 mm)
- Low-power-consumption 1.9 mA @ 3.3 V
- Sleep mode for reducing power when unnecessary
- Signal processing software for the steady sensing
  - Enhancing the signal from movement object and decreasing random noises
  - Decreasing the mutual interference between sensors
  - Detection algorithms for hand waving

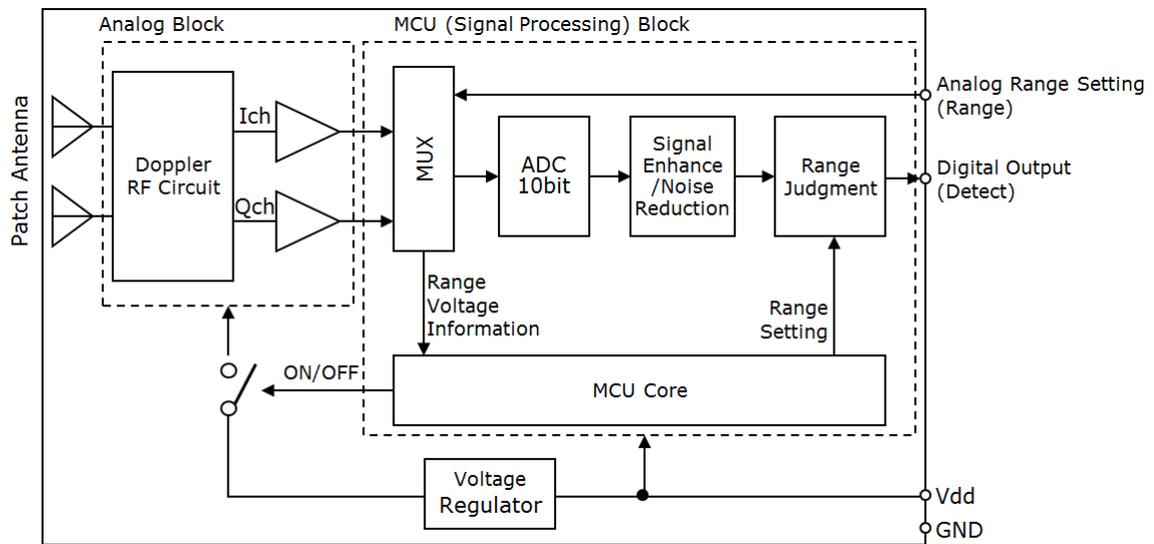
### Applications:

- Contactless/touchless switch for Various equipment control



## Functional Block diagram:

- Digital Output / Analog Range Setting



## Model List:

| Model No.          | RF Frequency                 | Antenna Type  | Interface Type  | Region                 |
|--------------------|------------------------------|---|---|------------------------|
| <b>NJR4266JA3</b>  | 24.05 to 24.25 GHz (J type)  | 1x1 type<br>Angle: 80°/80°<br>Distance: 20 to 80 cm | Digital Output / Analog Range Setting for Contactless Application | JAPAN                  |
| <b>NJR4266F2A3</b> | 24.15 to 24.25 GHz (F2 type) |   |   | All of EU regions / US |

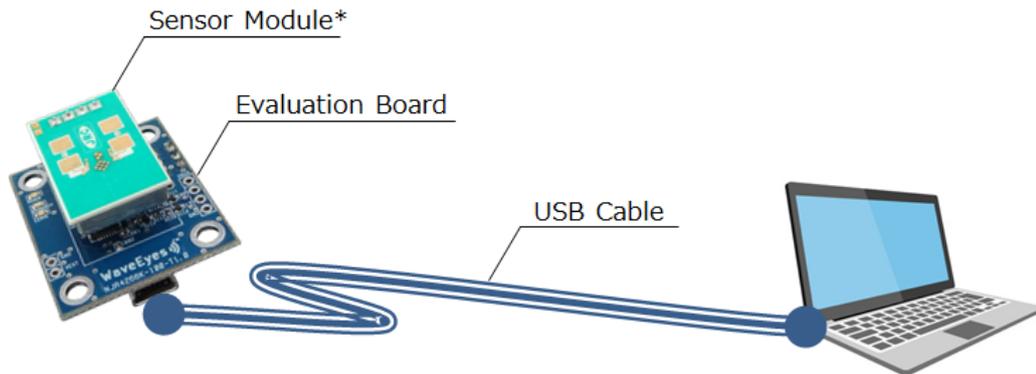
## Evaluation Kit:

The evaluation kit is available for NJR4266 series. The contents of the evaluation kit are as follows.

➤ **Evaluation Kit P/N.: NJR4266K**

➤ **Contents**

1. Evaluation Board (Functions are UART-to-USB convertor and analog threshold setting)
2. GUI Software
3. USB Cable



(\* ) The sensor module itself needs to be prepared separately.

## 1. Absolute Maximum Rating

| ITEM                          | MIN. | TYP. | MAX.     | UNITS | REMARKS  |
|-------------------------------|------|------|----------|-------|--|
| Supply Voltage                | 0    | —    | 6.5      | V     | Vdd  |
| Source Current of Detect Port | —    | —    | 100      | mA    |  |
| Sink Current of Detect Port   | —    | —    | 100      | mA    |  |
| Voltage of Range Port         | -0.3 | —    | Vdd +0.3 | V     |  |
| Operating Temperature         | -40  | —    | +85      | °C    | No Damage Condition. Refer to Section 9 as functional operating temperature. |
| Storage Temperature           | -40  | —    | +85      | °C    |  |

## 2. Electrical Characteristics

Common measure condition Ta= +25 °C

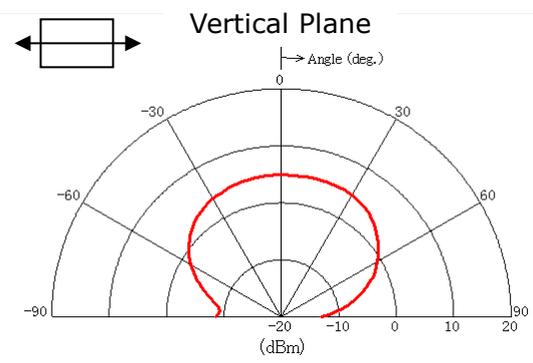
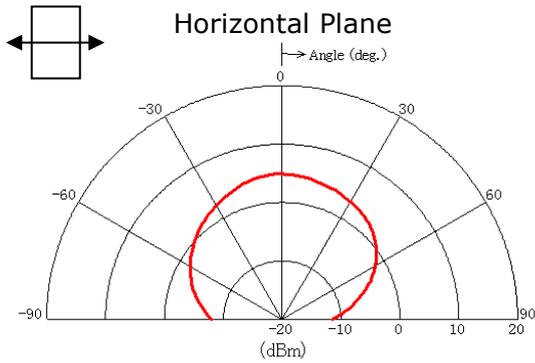
| ITEM   | MIN.   | TYP.         | MAX.           | UNITS       | REMARKS  |
|--|--|--------------|----------------|-------------|--|
| <b>2.1. Power Supply</b>                             |  |              |                |             |  |
| 2.1.1. Operating Voltage                             | 3.0  | 3.3/5.0      | 5.25           | V           | Vdd  |
| <b>2.1.2. Operating Current</b>                      |  |              |                |             |  |
| 1) Type of Digital Output / Analog Range Setting     |  |              |                |             |  |
| ● Peak Current                                       | —  | 50           | 60             | mA          |  |
| ● Average Current                                    | —  | 1.9          | 2.3            | mA          | Vdd = 3.3V                                     |
|  | —  | 2.9          | 3.4            | mA          | Vdd = 5.0 V                                    |
| <b>2.2. Characteristic of Input and Output Ports</b> |  |              |                |             |  |
| Input Voltage of Range Port                          |  |              |                |             |  |
| Range of Input Voltage                               | 0  | —            | Vdd            | V           | Refer to item 4.3 as Analog Range Setting      |
| Output Voltage of Detection Port                     |  |              |                |             |  |
| Range of High Level                                  | Vdd<br>-0.6  | —            | Vdd            | V           | In case of<br>3.0 ≤ Vdd ≤ 4.0V                 |
|  | Vdd<br>-1.5  | —            | Vdd            | V           | In case of<br>4.0 < Vdd ≤ 5.25V                |
| Range of Low Level                                   | 0  | —            | 0.6            | V           | In case of<br>3.0 ≤ Vdd ≤ 4.0V                 |
|  | 0  | —            | 1.3            | V           | In case of<br>4.0 < Vdd ≤ 5.25V                |
| Source Current of Detect port                        | —  | —            | 10             | mA          | Condition to connect<br>1.0kΩ pull-up resistor |
| Sink Current of Detect port                          | —  | —            | 10             | mA          | Condition to connect<br>1.0kΩ pull-up resistor |
| <b>2.3. Sensor RF</b>                                |  |              |                |             |  |
| Conformity Standard                                  | <ul style="list-style-type: none"> <li>● MIC Technical Conformity (Japan): ARIB STD-T73</li> <li>● EU Regulation: Radio Equipment Directive 2014/53/EU</li> <li>● FCC Regulation: Section 15.249 *Note1</li> </ul> |              |                |             |  |
| Operating Frequency                                  |  |              |                |             |  |
| J1 type  | 24.05  | —            | 24.25          | GHz         |  |
| F2 type  | 24.15  | —            | 24.25          | GHz         |  |
| Frequency Stability (Temp.)                          | —  | +/-0.2       | —              | MHz/°C      | Ta = -20 to +60 °C                             |
| Output Power   | 1.55   | 3.10         | 4.65           | mW          |  |
| E.I.R.P. (Reference)                                 | 4.8<br>(6.9)   | 9.6<br>(9.8) | 14.3<br>(11.5) | mW<br>(dBm) |  |
| 2 <sup>nd</sup> Harmonics (E.I.R.P.)                 | —  | —            | -30            | dBm         |  |
| <b>2.4. Antenna</b>                                  |  |              |                |             |  |
| 1 x 1 antenna type                                   |  |              |                |             |  |
| -3dB beam width / Horizontal                         | —  | 80           | —              | deg.        |  |
| -3dB beam width / Vertical                           | —  | 80           | —              | deg.        |  |
| Side-lobe suppression / Horizontal                   | —  | —            | —              | dB          | No Side lobe                                   |
| Side-lobe suppression / Vertical                     | —  | —            | —              | dB          | No Side lobe                                   |

\*Note1) Contact NJR for FCC compliance status.

When using NJR4266 series under FCC regulation, please be sure to read and observe FCC Statement in appendix.

## Antenna Pattern

1 x 1 Antenna Type



## 3. Sensing Specifications

### 3.1. Sensing Performance \*note1

Common measure condition  $T_a = +25\text{ }^\circ\text{C}$

| ITEM               | PERFORMANCE | UNITS | REMARKS   |
|--------------------|-------------|-------|---|
| Detection Distance | 20 to 80    | cm    | <ul style="list-style-type: none"> <li>◇ Front direction of the patch antenna plane.</li> <li>◇ Design value</li> <li>◇ Sensing Image is referred to figure 1.</li> </ul> |

### 3.2. Analog Voltage for Range Setting \*note1

The range setting against  $V_{dd}$  and  $V_{Range}$  is shown in figure 2.

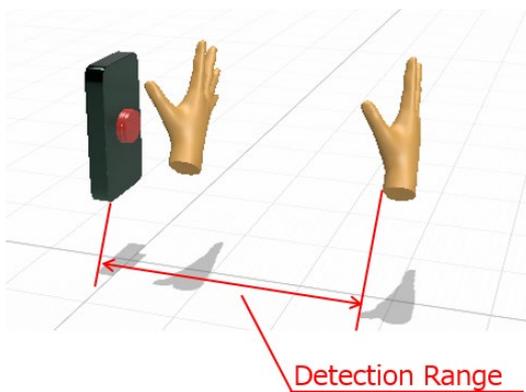


Fig. 1 Sensing Image

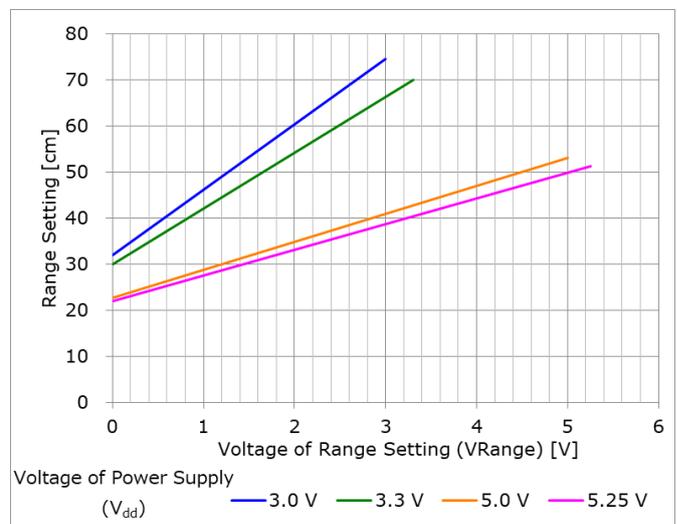


Fig. 2 Range Setting against Voltage

\*Note1) This is not the specification to guarantee the performance of this product. As for the specification of the product, the electric characteristic standard is applied. Sensing performance shown here is an example of the result of being to obtain it when this product is evaluated on the reference unit at the product development.

Actual sensing performance would be greatly different in each environment used. Please do enough confirmation in the environment actually used.

## 4. Signal Processing of Environmental Noise Reduction

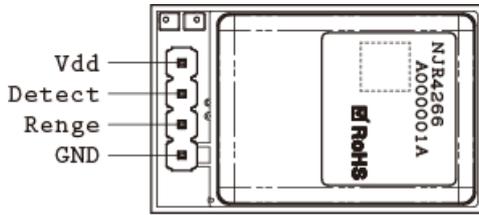
This product is embedding software for the steady sensing of moving object. It is enhance the signal from movement object of pedestrian etc. and is reduce random noise and sudden signal which caused an incorrect detection by using the signal from IQ mixer, namely **Environmental Noise Reduction**.

The following effects are expectable. \*note1

- Reduction of false detection by random movement such as the shakes of plant by wind or the noise of rain etc.
- Reduction of the false detection by sudden movement such as the insect etc. which cross just before a sensor
- Steady detection of movement objects such as hand waving under the environment where the above-mentioned noise exists.
- Reduction of the mutual interference of sensors

## 5. Interface

### 5.1. Pin Assignment



**Pin diagram (Bottom View)**

| # | NAME   | I/O | DESCRIPTION  |
|---|--------|-----|--|
| 1 | Vdd    | I   | Power Supply: 3.0 to 5.25 V  |
| 2 | Detect | O   | Digital output of CMOS level for detecting hand waving.<br>Output is changed to H level when the movements of approaching or leaving is detected.<br>H: Detect / L: No detect<br>Output current < 14 mA max. |
| 3 | Range  | I   | Analog range setting<br>Refer to Item 4.3.   |
| 4 | GND    | —   | GND Pin  |

Refer to item 2.2 as voltage and current of Detect/Range port  
Connector: Pin-header of 2.54mm pitch

## 6. Operational mode

| MODE                       | DESCRIPTION  |
|----------------------------|--|
| Power ON / Reset<br>*note1 | CPU Reset.   |
| Initialization Mode        | Initialize and wait until sensor is stabilized. (approx. 1 second )  |
| Detection Mode             | Based on the analog range setting, when the following changes occur, the voltage of the digital detect output is controlled.<br>1. Detect hand waving (Voltage: H)<br>3. State change from detection to no-detection (Voltage: L)<br>The analog voltage of range setting is monitored in initialization mode and about every 1 second. |

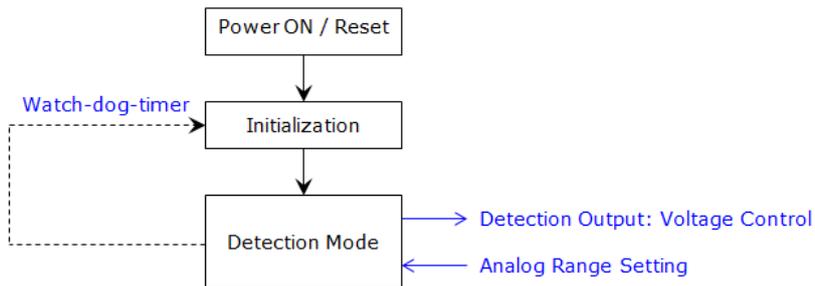
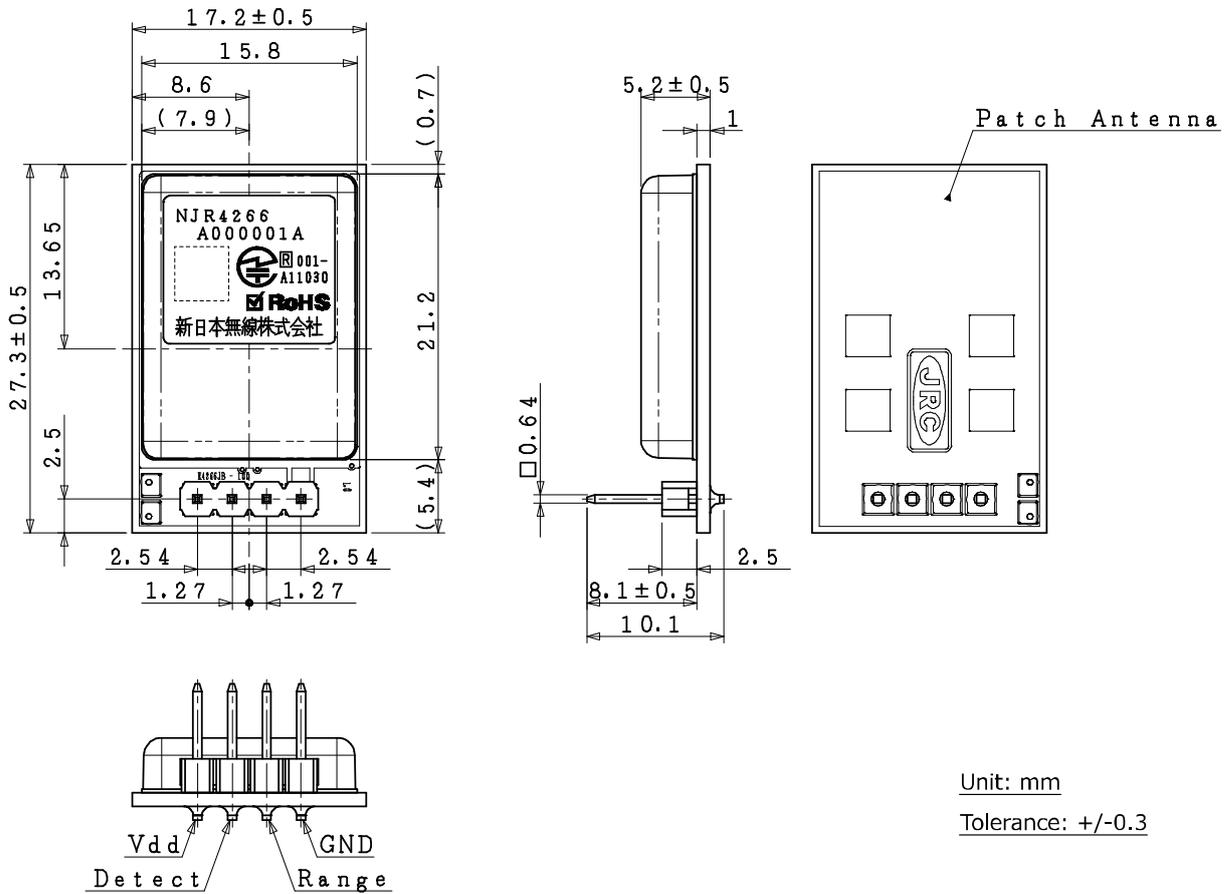


Fig.6 State Transition Diagram

\*Note1) When the watch dog timer overflows, it is reset from any mode.

## 7. Drawing

### 7.1. Outline



### 7.2. Label

Example)

| NJR4266JB1  | NJR4266F2A1  |
|---|--|
| <p>NJR4266 JB1<br/>A000001A</p>   <p>001-A11030<br/>RoHS</p> <p>新日本無線株式会社</p> | <p>NJR4266F2A1<br/>A000001A</p>   <p>New Japan Radio Co., Ltd.</p> |

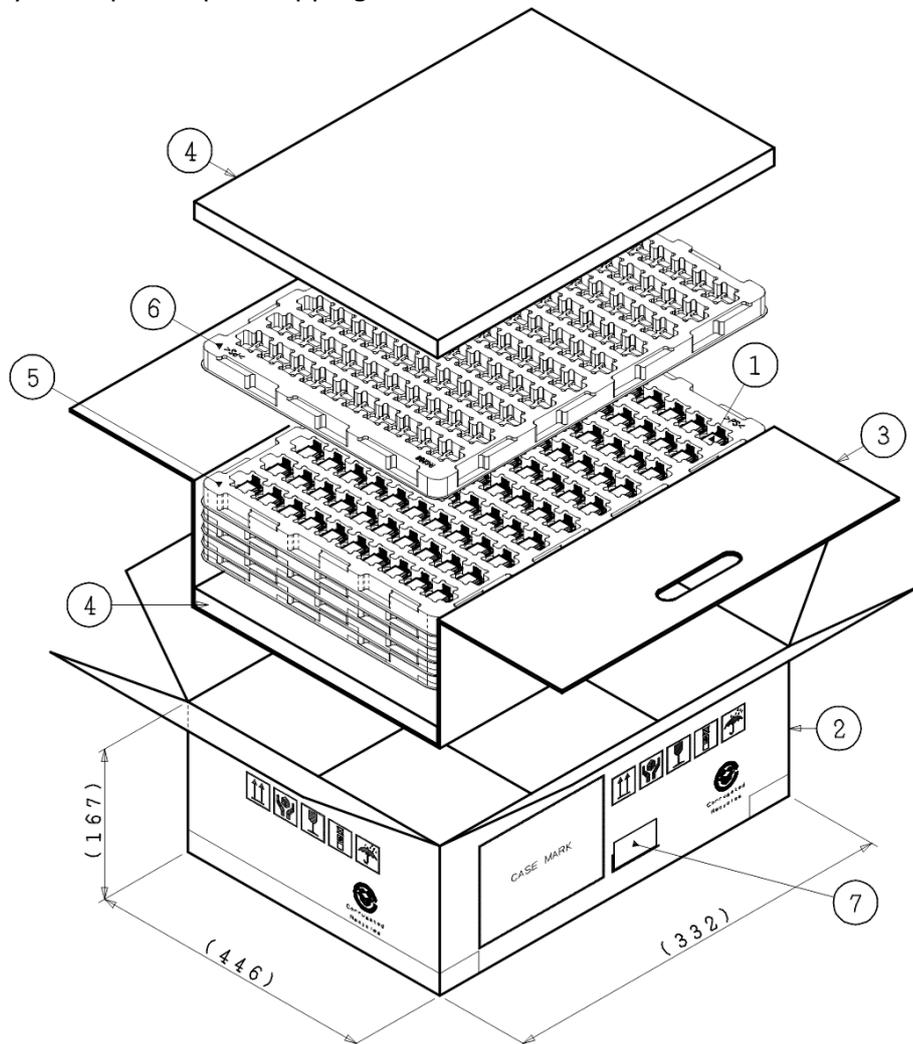
## 8. Environmental Characteristics

| ITEM                  | SPECIFICATION  |
|-----------------------|--|
| Operation Temperature | -20 to +60 °C  |
| Storage Temperature   | -40 to +85 °C  |
| Humidity              | 0 to 95 % @+30 °C  |
| Vibration             | 49.03 m/s <sup>2</sup> (5 G), 30 to 50 Hz, 10 minutes, XYZ direction       |
| Shock                 | 196.13 m/s <sup>2</sup> (20 G), Half sine, 11 msec, XYZ direction, 3 times |

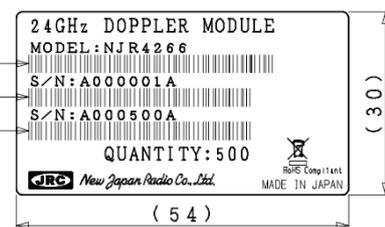
## 9. Package

### Standard Package

Packing Quantity: 500 pieces per shipping box



Code39 for Part number  
 Code39 for first S/N in carton  
 Code39 for end S/N in carton

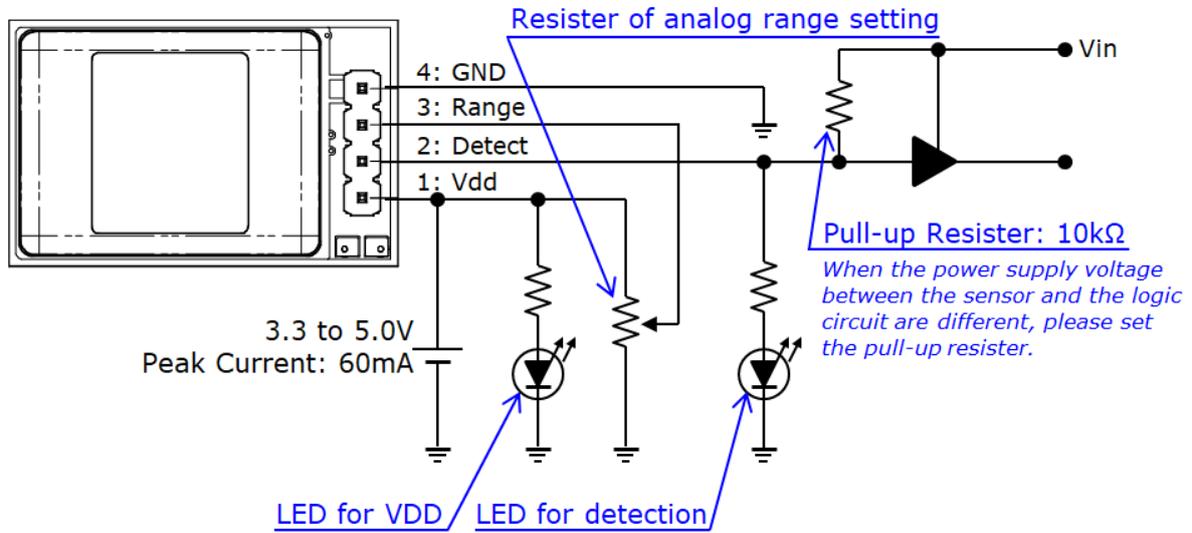


⑦: Package label

- ①NJR4266 24GHz Doppler module
- ②Outer packaging: double wall corrugated fiberboard
- ③Inner packaging: single wall corrugated fiberboard
- ④Package cushioning: polyethylene foam
- ⑤Tray for modules (100 pcs×5 trays): conductive polystyrene
- ⑥Dummy tray: conductive polystyrene
- ⑦Package label

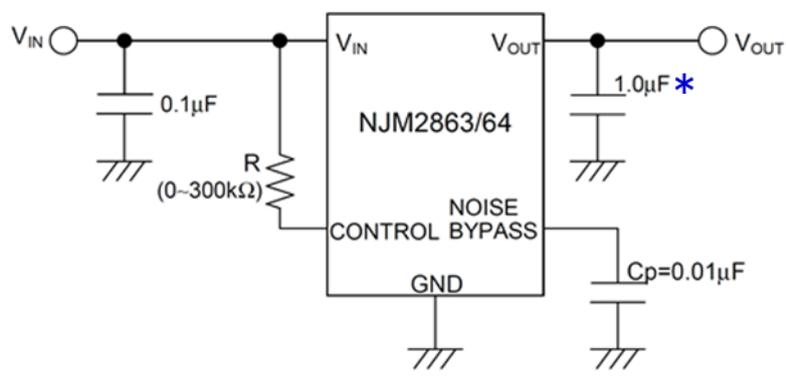
## 10. Reference Circuit

### 10.1. Example



## 10.2. Recommendation Power Supply Circuit

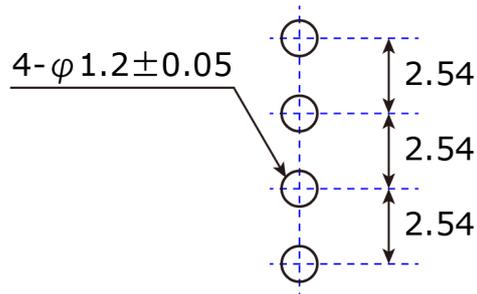
Recommendation linear regulator: NJM2863F33 or NJM2864F33



- \* To manufacture, distribute and sell unit products using this product in the EU (European Union) accession, in order to comply with Conductive Emission (EN 55022 Class B),  $22\mu\text{F}$  and more of capacitors is connected to this product's power input terminal (Pin 1: Vdd port).

## 11. Recommendation Mounting Conditions

### 11.1. Footprint dimensions



Unit: mm

\*Note) In actual design, please optimize in accordance with the situation of your board design and soldering condition.

### 11.2. Soldering conditions

- Soldering way: Solder iron \*Note
- Solder iron temperature: 350 °C or less
- Soldering time: in below

| # | NAME                | Soldering time   |
|---|---------------------|------------------|
| 1 | Vdd                 | 3 second or less |
| 2 | UART TX<br>/ Detect | 3 second or less |
| 3 | UART RX<br>/ Range  | 3 second or less |
| 4 | GND                 | 6 second or less |

\*Note) The soldering iron to be used must be grounded via a resistance of about 1 MΩ.



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