LoRaWAN 915 MHz BAND TRX MODULE

Product Code: 32001409

PRODUCT SUMMARY:
The 32001409 is a transceiver operating in the 902-928 MHz SRD Band optimized for very long range, low consumption applications, suitable for LPWA networks. Based on LoRa™ RF Technology and LoRaWAN protocol it provides ultra-long range spread spectrum communication and high interference immunity.

Thanks to its small LCC form factor (15.5 x 26 mm only) and its low current consumption, this module allows the implementation of highly integrated low power (battery operated) solutions for Internet of Things (IoT) applications, security systems, sensor networks, metering, smart buildings, agriculture, supply chain.

This pre-certified solution allows easy integration into final application reducing development time, costs and time-to-market.

The embedded stack is compliant with LoRaWAN Class A and C specification by Lora Alliance.

Module can be configured via UART interface.

The module meets all the requirements in the industrial temperature range -40/+85°C.

The module is compliant according to FCC Part 15.212 Modular Transmitter Statement about FCC.

Compliant with ReACH and ROHS directives.

1. MECHANICAL CHARACTERISTICS

ALL DIMENSIONS ARE IN MILLIMETERS

2. PIN DESCRIPTION

<table>
<thead>
<tr>
<th>Pin</th>
<th>Name</th>
<th>Pin type</th>
<th>Description</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>GND</td>
<td>Supply</td>
<td>Ground (0V)</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>RF I/O</td>
<td>A IN/OUT</td>
<td>Tx: output RF</td>
<td>Note 3</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Rx: input RF</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>GND</td>
<td>Supply</td>
<td>Ground (0V)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>NU</td>
<td>NC</td>
<td>Not Used Pin – do not connect</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>NDATA_INDICATE</td>
<td>D OUT</td>
<td>Data Indicate Pin</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>NWAKE</td>
<td>D IN</td>
<td>Wake-up Pin</td>
<td></td>
</tr>
</tbody>
</table>

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| 8   | NU     | NC     | Not Used Pin – do not connect |
| 9   | NU     | NC     | Not Used Pin – do not connect |
| 10  | NU     | NC     | Not Used Pin – do not connect |
| 11  | UART TX | D OUT  | UART TX Pin |
| 12  | UART RX | D IN   | UART RX Pin |
| 13  | NU     | NC     | Not Used Pin – do not connect |
| 14  | NU     | NC     | Not Used Pin – do not connect |
| 15  | GND    | Supply | Ground (0V)   |
| 16  | GND    | Supply | Ground (0V)   |
| 17  | Vcc    | Supply | Power supply |
| 18  | SWDAT  | NC     | Reserved for programming – do not connect |
| 19  | SWCLK  | NC     | Reserved for programming – do not connect |
| 20  | SWV    | NC     | Reserved for programming – do not connect |
| 21  | NRST   | D IN   | Reset, Input Pull-Up |
| 22  | NU     | NC     | Not Used Pin – do not connect |
| 23  | NU     | NC     | Not Used Pin – do not connect |
| 24  | NU     | NC     | Not Used Pin – do not connect |
| 25  | NU     | NC     | Not Used Pin – do not connect |
| 26  | NU     | NC     | Not Used Pin – do not connect |
| 27  | NU     | NC     | Not Used Pin – do not connect |
| 28  | NU     | NC     | Not Used Pin – do not connect |
| 29  | NU     | NC     | Not Used Pin – do not connect |
| 30  | GND    | Supply | Ground (0V)   |

### 3. ABS. MAX. RATINGS

- **Transceiver Power Supply +Vcc (pin 15)**: $0 \div +3.8V$
- **Max. Voltage allowed on input pins**: $+Vcc+0.3V$
- **Storage Temperature (excl. package)**: $-40 \div +85^\circ C$
- **Storage Temperature (incl. package)**: $-10 \div +65^\circ C$
- **Operating Temperature**: $-40 \div +85^\circ C$
- **Radio Frequency Input, pin 2**: $+10 \text{ dBm}$

### 4. ELECTRICAL CHARACTERISTICS AT $+25^\circ C$ TEMPERATURE

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage (Vcc)</td>
<td>2.4</td>
<td>3.3</td>
<td>3.7</td>
<td>Volt</td>
</tr>
<tr>
<td>Current consumption</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tx mode</td>
<td>-</td>
<td>118</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Rx mode</td>
<td>-</td>
<td>14</td>
<td>-</td>
<td>mA</td>
</tr>
<tr>
<td>Sleep</td>
<td>-</td>
<td>1.3</td>
<td>-</td>
<td>µA</td>
</tr>
<tr>
<td>Operating frequency range</td>
<td>902</td>
<td>-</td>
<td>928</td>
<td>MHz</td>
</tr>
<tr>
<td>Tx frequency accuracy</td>
<td>-</td>
<td>±25</td>
<td>-</td>
<td>kHz</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>-</td>
<td>-137</td>
<td>dBm</td>
<td>No.2</td>
</tr>
<tr>
<td>Output Power (on 50 Ohm load)</td>
<td>-</td>
<td>+18</td>
<td>-</td>
<td>dBm</td>
</tr>
<tr>
<td>Modulation</td>
<td></td>
<td></td>
<td></td>
<td>LoRa</td>
</tr>
<tr>
<td>UART Interface Datarate</td>
<td></td>
<td></td>
<td></td>
<td>kbps</td>
</tr>
</tbody>
</table>
NOTES:
NRST pin connection is optional but recommended.
NDATA_INDICATE pin connection is optional but it's mandatory for low power designs where host microcontroller is in sleep state and module 32001409 activates NDATA_INDICATE pin to wake host microcontroller.
6. TYPICAL CHARACTERISTICS

Output power vs. temperature

Current consumption in TX vs. temperature (CW mode)

Transmit Frequency vs. temperature (CW mode)
Note 1: Current consumption measured at power supply level of +3.3V.
Note 2: Sensitivity measured with GFSK modulated signal, PRBS code, 38.4 kbaud, result at BER equal or less than 10^{-2}.
Note 3: All RF parameters are measured with Input/output (pin 2) connected to 50 Ohm impedance signal source or load.
7. PROCESS INFORMATION

7.1. Delivery
32001409 modules are delivered in tape/reel packaging including 250 units.

Dimensions are:
- \( W = 44 \text{ mm} \)
- \( P = 20 \text{ mm} \)
- \( T = 0.35 \text{ mm} \)
- \( A_0 = 16 \text{ mm} \)
- \( B_0 = 26.5 \text{ mm} \)
- \( K_0 = 3.6 \text{ mm} \)
- \( D_0 = 1.5 \text{ mm} \)
- \( D_1 = 1.5 \text{ mm} \)

7.2. STORAGE AND HANDLING

7.2.1. Moisture Sensitivity Level (MSL)

The Moisture Sensitivity Level (MSL) relates to the packaging and handling precautions for devices that are sensitive to moisture-induced stress. The MSL standard is IPC/JEDEC J-STD-020 and can be downloaded from www.jedec.org.

Following table summarizes the dry pack requirements for different MSL levels in the IPC/JEDEC specification.

<table>
<thead>
<tr>
<th>MSL LEVEL</th>
<th>Dry Pack Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>2</td>
<td>Required</td>
</tr>
<tr>
<td>3</td>
<td>Required</td>
</tr>
<tr>
<td>4</td>
<td>Required</td>
</tr>
</tbody>
</table>

According to IPC/JEDEC specification J-STD-020, if a device passes MSL level 1, it is classified as not moisture sensitive and does not require dry pack. If a device fails level 1 but passes a higher level, it is classified as moisture sensitive and must be dry packed in accordance with J-STD-033.

The **32001409 is qualified for MSL level = 3**.

7.2.2. Dry Bag

Products with an MSL level of 2 or above are shipped dry packed in a Moisture Barrier Bag (MBB). Carrier materials such as trays, tubes, reels, etc., that are placed in the MBB can affect the moisture level within the dry bag. The effect of these materials is compensated by adding additional desiccant in the MBB to ensure the shelf life of the SMT packages.

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IPC/JEDEC specifications require that MSD sensitive devices be packaged together with a Humidity Indicator Card (HIC) and desiccant to absorb humidity. If no moisture has been absorbed, the three fields in the HIC indicate blue color.

### 7.2.3. Storage and floor life

The calculated shelf life for dry packed SMT packages is a minimum of 12 months from the bag seal date, when stored in a non-condensing atmospheric environment of <40°C/90% RH. Following table lists floor life for different MSL levels in the IPC/JDEC specification.

<table>
<thead>
<tr>
<th>MSL level</th>
<th>Floor life (out of bag) at factory ambient ≤30°C/60% RH or as stated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Unlimited at ≤30°C/85% RH</td>
</tr>
<tr>
<td>2</td>
<td>1 year</td>
</tr>
<tr>
<td>2a</td>
<td>4 weeks</td>
</tr>
<tr>
<td>3</td>
<td>168 hours</td>
</tr>
<tr>
<td>4</td>
<td>72 hours</td>
</tr>
</tbody>
</table>

The parts must be processed and soldered within the time specified for the MSL level. If this time is exceeded, or the humidity indicator card in the sealed package indicates that they have been exposed to moisture, the devices need to be pre-baked before the reflow solder process.

### 7.2.4. Drying

Both encapsulate and substrate materials absorb moisture. IPC/JEDEC specification J-STD-020 must be observed to prevent cracking and delamination associated with the "popcorn" effect during reflow soldering. The popcorn effect can be described as miniature explosions of evaporating moisture. Baking before processing is required in the following cases:

- Humidity indicator card: At least one circular indicator is no longer blue
- Floor life or environmental requirements after opening the seal have been exceeded, e.g. exposure to excessive seasonal humidity.

Refer to Section 4 of IPC/JEDEC J-STD-033 for recommended baking procedures. Table 4-1 of the specification lists the required bake times and conditions for drying.

Following table provides a summary of specified recommendations:

<table>
<thead>
<tr>
<th>Bake Time</th>
<th>Bake @ 125°C</th>
<th>Bake @ 90°C ≤5% RH</th>
<th>Bake @ 40°C ≤5% RH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Package Body</td>
<td>MSL Level</td>
<td>Exceeding Floor Life by &gt; 72 h</td>
<td>Exceeding Floor Life by ≤72 h</td>
</tr>
<tr>
<td>Thicknes ≤1.4 mm</td>
<td>2</td>
<td>5 hours</td>
<td>3 hours</td>
</tr>
<tr>
<td></td>
<td>2a</td>
<td>7 hours</td>
<td>5 hours</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>9 hours</td>
<td>7 hours</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>11 hours</td>
<td>7 hours</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>12 hours</td>
<td>7 hours</td>
</tr>
<tr>
<td></td>
<td>5a</td>
<td>16 hours</td>
<td>10 hours</td>
</tr>
<tr>
<td>Thicknes &gt;1.4 mm ≤2.0 mm</td>
<td>2</td>
<td>18 hours</td>
<td>15 hours</td>
</tr>
<tr>
<td></td>
<td>2a</td>
<td>21 hours</td>
<td>16 hours</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>27 hours</td>
<td>17 hours</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>34 hours</td>
<td>20 hours</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>40 hours</td>
<td>25 hours</td>
</tr>
</tbody>
</table>
**7.3. SOLDERING INFORMATION**

**7.3.1. Soldering pad pattern**

The finished surface on the printed circuit board pads should be made of Nickel/Gold. The recommended soldering pad layout on the host board for the 32001409 is shown in the diagram below (purple lines):

![Soldering Pad Pattern Diagram](image)

Neither via-holes nor wires are allowed on the PCB upper layer in area occupied by the module.

**7.3.2. Solder Paste**

The 32001409 module is designed for surface mounting using half-moon solder joints (see diagram below). For proper module assembly, solder paste must be printed on the target surface of the host board. The suggested solder paste height should be within 150 µm and 180 µm.

The following diagram shows mounting characteristics for Module integration on host PCB:

![Solder Paste Diagram](image)

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7.3.3. Placement
The 32001409 module can be automatically placed on host boards by pick&place machines like any integrated circuit.

7.3.4. Soldering Profile (RoHS Process)
It must be noted that 32001409 module should not be allowed to be hanging upside down during the reflow operation. This means that the module has to be assembled on the side of the printed circuit board that is soldered last.
The recommendation for lead-free solder reflow in IPC/JEDEC J-STD-020D Standard should be followed.

<table>
<thead>
<tr>
<th>Profile Feature</th>
<th>Sn-Pb Assembly</th>
<th>Pb-Free Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Ramp-UP Rate (Ts max to Tp)</td>
<td>3°C/second max</td>
<td>3°C/second max</td>
</tr>
<tr>
<td>Preheat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Temperature Min (Ts min)</td>
<td>100°C</td>
<td>130°C</td>
</tr>
<tr>
<td>- Temperature Max (Ts max)</td>
<td>179°C</td>
<td>217°C</td>
</tr>
<tr>
<td>- Time (Ts min to Ts max)</td>
<td>80-135 seconds</td>
<td>80-135 seconds</td>
</tr>
<tr>
<td>Time maintained above:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Temperature (TL)</td>
<td>183°C</td>
<td>220°C</td>
</tr>
<tr>
<td>- Time (TL)</td>
<td>30-90 seconds</td>
<td>30-90 seconds</td>
</tr>
<tr>
<td>Peak/Classification Temperature (Tp)</td>
<td>max. Peak Temp. 220°C</td>
<td>max. Peak Temp. 250°C</td>
</tr>
<tr>
<td>Time within 5°C of actual Peak</td>
<td>10-15 seconds</td>
<td>10-15 seconds</td>
</tr>
<tr>
<td>Temperature (tp)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ramp-Down Rate</td>
<td>4°C/second max</td>
<td>4°C/second max</td>
</tr>
<tr>
<td>Time 25°C to Peak Temperature</td>
<td>6 minutes max</td>
<td>8 minutes max</td>
</tr>
</tbody>
</table>

Note: All temperatures refer to topside of the package, measured on the package body surface

CAUTION – Please note that if the host board is submitted to a wave soldering after the reflow operation, a solder mask must be used in order to protect the 32001409 module’s metal shield from being in contact with the solder wave.
8. REGULATORY APPROVAL

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

8.1. Class B device notice

Note: 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.

8.2. RF exposure safety

This product is a radio transmitter and receiver. It is designed not to exceed the emission limits for exposure to radio frequency (RF) energy set by the Federal Communications Commission. The antenna must be installed and operated with minimum distance of XX cm between the radiator and your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

8.3. Permitted Antenna

This radio transmitter has been approved by FCC to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

<table>
<thead>
<tr>
<th>Type</th>
<th>Max Gain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quarter-wave monopole, GSM 900/1800</td>
<td>&lt; 2 dBi</td>
</tr>
</tbody>
</table>

8.4. Labelling Requirements for the Host Device

The host device shall be properly labelled to identify the modules within the host device. The certification label of the module shall be clearly visible at all times when installed in the host device, otherwise the host device must be labelled to display the IC of the module, preceded by the words "Contains transmitter module", or the word "Contains", or similar wording expressing the same meaning, as follows:

Contains FCC ID: 2AQJP-32001409
9. GLOSSARY

ABP = Activation by personalization  
OTAA = Over The Air Activation  
SN = Serial Number  
FW = Firmware  
EUI = Extended Unique Identifier  
LSB = Least significant byte  
MSB = Most significant byte  
Cks = Checksum

10. REFERENCES

[1] LoRaWAN Specification V1.0.2  
[2] Sx1272 Datasheet

11. REVISION HISTORY

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>30-04-2018</td>
<td>Preliminary</td>
</tr>
<tr>
<td>0.2</td>
<td>31-07-2018</td>
<td>Added Regulatory section</td>
</tr>
<tr>
<td>1.0</td>
<td>10-10-2018</td>
<td>Change on FCC statement compliance</td>
</tr>
</tbody>
</table>

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