Sub-GHz (868 or 915 MHz) low power programmable RF transceiver modules

Datasheet - production data

Features

- Programmable radio features
  - Based on Sub-1GHz SPIRIT1 transceiver and integrated Balun (BALF-SPI-01D3)
  - Modulation schemes: 2-FSK, GFSK, MSK, GMSK, OOk, ASK
  - Air data rate from 1 to 500 kbps
  - On-board antenna
  - Operating temperature range from -40 °C to 85 °C
- RF features
  - Receiver sensitivity: -118 dBm
  - Programmable RF output power up to +11.6 dBm
- Host interface
  - SPI
- General I/O
  - Up to 32 programmable I/O functions on 4 GPIO programmable module pins
- Two typical carrier frequency versions:
  - SPSGRF-868 with 868 MHz tuned antenna
  - SPSGRF-915 with 915 MHz tuned antenna

Certification:
- CE (SPSGRF-868)
- FCC (SPSGRF-915)
- IC (SPSGRF-915)

Applications

- AMR (automatic meter reading)
- Home and building automation
- WSN (wireless sensor network)
- Industrial monitoring and control
- Wireless fire and security alarm systems
- Point-to-point wireless link

Description

The SPSGRF-868 and SPSGRF-915 are easy-to-use, low power sub-GHz modules based on the SPIRIT1 RF transceiver, operating respectively in the 868 MHz SRD and 915 MHz ISM bands.

The modules provide a complete RF platform in a tiny form factor.

The SPSGRF series enables wireless connectivity in electronic devices, requiring no RF experience or expertise for integration into the final product. As an FCC, IC, and CE certified solution, the SPSGRF series optimizes the time-to-market of end applications. The SPSGRF-915 is an FCC certified module (FCC ID: S9NSPSGRF) and IC certified (IC 8976C-SPSGRF), while the SPSGRF-868 is certified CE.

The modules are designed for maximum performance in minimal space and include 4 programmable I/O pins and SPI serial interfaces.
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1 Block diagram

Figure 1. SPSGRF block diagram

Battery or External Supply

SPI/RT1_RF - 2014 Module

868 MHz or 915 MHz INTERNALLY TUNED RF antenna

SUPPLY FILTER Bead Ferrite

SPI/LINE

RF TUNING NETWORK RF BALUN + Filter

SPI/RT1 DEVICE

SPI/LINE

I/O

M.C.U. clock

50 MHz Crystal
2 SPSGRF module functional behavior

The SPIRIT1 device in the SPSGRF module is equipped with a built-in main controller which controls the switching between the two main operating modes: transmit (TX) and receive (RX).

In shutdown condition, the SPSGRF module can be switched on/off with the external SDN pin; all other functions/registers/commands are available through the SPI interface and GPIOs. No internal supply is generated (in order to minimize battery leakage), and therefore all stored data and configurations are lost.

The GPIO and SPI ports of the module during shutdown are in HiZ. From the SHUTDOWN state, the SPSGRF module can be switched on from the SDN pin and goes into a READY state, which is the default, where the reference signal from XO is available.

From the READY state, the SPSGRF module can be moved to a LOCK state to generate the high precision LO signal and/or TX or RX modes. Switching from RX to TX and vice-versa can occur only by passing through the LOCK state. This operation is normally managed by radio control with a single user command (TX or RX).

At the end of the events above, the SPSGRF module can return to its default state (READY) and can then be put into a sleep condition (SLEEP state), characterized by very low power consumption.

If no timeout is required, the SPSGRF module can be moved from READY to STANDBY state, which has the lowest possible current consumption while retaining FIFO, status and configuration registers. To manage the transitions towards and between these operating modes, the controller works as a state machine, the state switching of which is driven by SPI commands.

Figure 2. Module functional state transitions diagram
3 Hardware specifications

3.1 Absolute maximum ratings

General conditions ($V_{IN}=3.3\, \text{V}$ and $25\, ^\circ\text{C}$)

<table>
<thead>
<tr>
<th>Table 1. Absolute maximum ratings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating</td>
</tr>
<tr>
<td>Storage temperature range</td>
</tr>
<tr>
<td>Supply voltage, $V_{IN}$</td>
</tr>
<tr>
<td>I/O pin voltage</td>
</tr>
<tr>
<td>RF saturation input power</td>
</tr>
</tbody>
</table>

3.2 Recommended operating conditions

<table>
<thead>
<tr>
<th>Table 2. Recommended operating conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rating</td>
</tr>
<tr>
<td>Operating temperature range</td>
</tr>
<tr>
<td>Supply voltage, $V_{IN}$</td>
</tr>
<tr>
<td>Signals &amp; I/O pin voltage</td>
</tr>
<tr>
<td>RF frequency bandwidth (SPSGRF-868)</td>
</tr>
<tr>
<td>RF frequency bandwidth (SPSGRF-915)</td>
</tr>
</tbody>
</table>

3.3 Module current consumption

<table>
<thead>
<tr>
<th>Table 3. SPSGRF-868 module</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symbol</td>
</tr>
<tr>
<td>$I_{DD}$</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>
3.4 Module RF compliance limits

The RF compliance limits are those tested for FCC, IC and CE certification using the dedicated dongle (PC92A.V01). These limits are enforced by the dongle firmware. Care must be taken with custom application firmware to ensure these limits are not exceeded, voiding the FCC, IC and CE certification.

Table 4. SPSGRF-915 module

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test conditions</th>
<th>Typ.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>$I_{DD}$</td>
<td>Supply current</td>
<td>Operating mode</td>
<td>22</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tx, +11.6 dBm, 2-FSK, 915 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operating mode</td>
<td>9</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tx, -7 dBm, 2-FSK, 915 MHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operating mode Rx, 915 MHz</td>
<td>10</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Command mode</td>
<td>0.6</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shutdown high level -$V_{DD}$ (with other I/O in high impedance)</td>
<td>0.1</td>
<td>μA</td>
</tr>
</tbody>
</table>

Table 5. RF compliance limits table

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Standards</th>
<th>Parameter</th>
<th>Max.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-FSK</td>
<td>FCC Part 15.207 (1)</td>
<td>Data rate</td>
<td>500</td>
<td>kbps</td>
</tr>
<tr>
<td></td>
<td>FCC Part 15.247 (1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GFSK</td>
<td>IC RSS-210</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MSK</td>
<td>EN 300 220-2 V2.4.1 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 301 489-01 V1.9.2 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 301 489-03 V1.4.1 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OOK</td>
<td>FCC Part 15.207 (1)</td>
<td>Data rate</td>
<td>250</td>
<td>kbps</td>
</tr>
<tr>
<td>ASK</td>
<td>FCC Part 15.247 (1)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>IC RSS-210</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 300 220-2 V2.4.1 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 301 489-01 V1.9.2 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EN 301 489-03 V1.4.1 (2)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. FCC and IC standards are applicable only to the SPSGRF-915 module.
2. EN standards are applicable only to the SPSGRF-868 module.
3.5 SPSGRF module RF typical performance

The RF performance of the SPSGRF-868 and SPSGRF-915 modules are dependent on many factors, related to the customer hardware application board where the module is connected and also to the customer application firmware. In order to provide some basic information to the customer integrating the module, it may be useful to provide the RF measurements taken in an anechoic chamber using a dongle containing a connected SPSGRF-868 or SPSGRF-915 module.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Parameter</th>
<th>Test conditions</th>
<th>Typ.</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tx RF power</td>
<td>RF radiated power</td>
<td>Operating mode Tx, +11.6 dBm, 2-FSK, 868-868.6 MHz</td>
<td>+5.3</td>
<td>dBm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Operating mode Tx, +11.6 dBm, 2-FSK, 902-928 MHz</td>
<td>+2.2</td>
<td>dBm</td>
</tr>
<tr>
<td>Parameter</td>
<td>Test conditions(^{(1)})</td>
<td>Conducted programmable value</td>
<td>Measured conducted value Typ.</td>
<td>Unit</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------------------</td>
<td>-------------------------------</td>
<td>-------------------------------</td>
<td>------</td>
</tr>
</tbody>
</table>
| **Tx RF conducted power (before the antenna circuits)** | Tx, +11.6 dBm, 2-FSK, 868 MHz  
Tx, +11.6 dBm, 2-FSK, 915 MHz | +11.6 | +11.2 | dBm |
| | Tx, +11 dBm, 2-FSK, 868 MHz  
Tx, +11 dBm, 2-FSK, 915 MHz | +11.0 | +10.8 | dBm |
| | Tx, +10 dBm, 2-FSK, 868 MHz  
Tx, +10 dBm, 2-FSK, 915 MHz | +10.0 | +9.7 | dBm |
| | Tx, +9 dBm, 2-FSK, 868 MHz  
Tx, +9 dBm, 2-FSK, 915 MHz | +9.0 | +8.5 | dBm |
| | Tx, +8 dBm, 2-FSK, 868 MHz  
Tx, +8 dBm, 2-FSK, 915 MHz | +8.0 | +7.6 | dBm |
| | Tx, +7 dBm, 2-FSK, 868 MHz  
Tx, +7 dBm, 2-FSK, 915 MHz | +7.0 | +7.2 | dBm |
| | Tx, +6 dBm, 2-FSK, 868 MHz  
Tx, +6 dBm, 2-FSK, 915 MHz | +6.0 | +6.2 | dBm |
| | Tx, +5 dBm, 2-FSK, 868 MHz  
Tx, +5 dBm, 2-FSK, 915 MHz | +5.0 | +5.4 | dBm |
| | Tx, +4 dBm, 2-FSK, 868 MHz  
Tx, +4 dBm, 2-FSK, 915 MHz | +4.0 | +4.0 | dBm |
| | Tx, +3 dBm, 2-FSK, 868 MHz  
Tx, +3 dBm, 2-FSK, 915 MHz | +3.0 | +3.1 | dBm |
| | Tx, +2 dBm, 2-FSK, 868 MHz  
Tx, +2 dBm, 2-FSK, 915 MHz | +2.0 | +2.1 | dBm |
| | Tx, +1 dBm, 2-FSK, 868 MHz  
Tx, +1 dBm, 2-FSK, 915 MHz | +1.0 | +1.2 | dBm |
| | Tx, +0 dBm, 2-FSK, 868 MHz  
Tx, +0 dBm, 2-FSK, 915 MHz | +0.0 | +0.6 | dBm |

\(^{(1)}\) Operating mode
Table 8. SPSGRF-868 or 915 module conducted typical performance before the RF antenna circuits (negative RF power signal values measured)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Test conditions (1)</th>
<th>Conducted programmable value</th>
<th>Measured conducted value Typ.</th>
</tr>
</thead>
</table>
| Tx RF conducted power (before the antennas circuits) | Tx, -1 dBm, 2-FSK, 868 MHz  
Tx, -1 dBm, 2-FSK, 915 MHz | -1.0 | -1.1 dBm |
| | Tx, -2 dBm, 2-FSK, 868 MHz  
Tx, -2 dBm, 2-FSK, 915 MHz | -2.0 | -2.3 dBm |
| | Tx, -3 dBm, 2-FSK, 868 MHz  
Tx, -3 dBm, 2-FSK, 915 MHz | -3.0 | -3.4 dBm |
| | Tx, -4 dBm, 2-FSK, 868 MHz  
Tx, -4 dBm, 2-FSK, 915 MHz | -4.0 | -4.9 dBm |
| | Tx, -5 dBm, 2-FSK, 868 MHz  
Tx, -5 dBm, 2-FSK, 915 MHz | -5.0 | -5.8 dBm |
| | Tx, -6 dBm, 2-FSK, 868 MHz  
Tx, -6 dBm, 2-FSK, 915 MHz | -6.0 | -6.9 dBm |
| | Tx, -7 dBm, 2-FSK, 868 MHz  
Tx, -7 dBm, 2-FSK, 915 MHz | -7.0 | -6.5 dBm |
| | Tx, -8 dBm, 2-FSK, 868 MHz  
Tx, -8 dBm, 2-FSK, 915 MHz | -8.0 | -7.3 dBm |
| | Tx, -9 dBm, 2-FSK, 868 MHz  
Tx, -9 dBm, 2-FSK, 915 MHz | -9.0 | -8.2 dBm |
| | Tx, -10 dBm, 2-FSK, 868 MHz  
Tx, -10 dBm, 2-FSK, 915 MHz | -10.0 | -9.7 dBm |
| | Tx, -15 dBm, 2-FSK, 868 MHz  
Tx, -15 dBm, 2-FSK, 915 MHz | -15.0 | -14.6 dBm |
| | Tx, -20 dBm, 2-FSK, 868 MHz  
Tx, -20 dBm, 2-FSK, 915 MHz | -20.0 | -19.2 dBm |
| | Tx, -25 dBm, 2-FSK, 868 MHz  
Tx, -25 dBm, 2-FSK, 915 MHz | -25.0 | -23.3 dBm |
| | Tx, -30 dBm, 2-FSK, 868 MHz  
Tx, -30 dBm, 2-FSK, 915 MHz | -30.0 | -26.2 dBm |
| | Tx, -35 dBm, 2-FSK, 868 MHz  
Tx, -35 dBm, 2-FSK, 915 MHz | -35.0 | -27.8 dBm |

1. Operating mode
### 3.6 Pin connections

**Table 9. Pin assignment**

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Pin#</th>
<th>Description</th>
<th>Alt function</th>
<th>V max. tolerance</th>
<th>Initial state</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPI_CLK</td>
<td>I</td>
<td>7</td>
<td>SPI CLOCK (Max. 8 MHz)</td>
<td>V&lt;sub&gt;in&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPI_MISO</td>
<td>O</td>
<td>8</td>
<td>SPI MISO (MASTER in / SLAVE out)</td>
<td>V&lt;sub&gt;in&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPI_MOSI</td>
<td>I</td>
<td>9</td>
<td>SPI MOSI (MASTER out SLAVE in)</td>
<td>V&lt;sub&gt;in&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPI_CS</td>
<td>I</td>
<td>10</td>
<td>SPI “Chip Select” (SPI slave select)</td>
<td>V&lt;sub&gt;in&lt;/sub&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Power and ground</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>V&lt;sub&gt;in&lt;/sub&gt;</td>
<td></td>
<td>5</td>
<td>V&lt;sub&gt;in&lt;/sub&gt;</td>
<td>(1.8V - 3.6V max.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GND</td>
<td></td>
<td>6</td>
<td>GND</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>Module shutdown</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SDN</td>
<td>I</td>
<td>11</td>
<td>Shutdown input (active high)</td>
<td>(1.8V - 3.6V max.)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td><strong>GPIO - general purpose input/output</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPIO [0]</td>
<td>I/O</td>
<td>4</td>
<td>Programmable input / output &amp; analog temperature output</td>
<td>(1.8V - V&lt;sub&gt;in&lt;/sub&gt; max.)</td>
<td>Digital output. Low power</td>
<td></td>
</tr>
<tr>
<td>GPIO [1]</td>
<td>I/O</td>
<td>3</td>
<td>Programmable input / output</td>
<td>(1.8V - V&lt;sub&gt;in&lt;/sub&gt; max.)</td>
<td>Digital output. Low power</td>
<td></td>
</tr>
<tr>
<td>GPIO [2]</td>
<td>I/O</td>
<td>2</td>
<td>Programmable input / output</td>
<td>(1.8V - V&lt;sub&gt;in&lt;/sub&gt; max.)</td>
<td>Digital output. Low power</td>
<td></td>
</tr>
<tr>
<td>GPIO [3]</td>
<td>I/O</td>
<td>1</td>
<td>Programmable input / output</td>
<td>(1.8V - V&lt;sub&gt;in&lt;/sub&gt; max.)</td>
<td>Digital output. Low power</td>
<td></td>
</tr>
</tbody>
</table>
4 Mechanical dimensions

Figure 4. Mechanical dimensions

Figure 5. Recommended land pattern
5 Hardware design

The SPSGRF module supports SPI hardware interfaces.

Note: 
- All unused pins should be left floating; do not ground.
- All GND pins must be well grounded.
- The area around the module should be free of any ground planes, power planes, trace routings, or metal for 6 mm from the module antenna position, in all directions.
- Traces should not be routed underneath the module

5.1 Reflow soldering

The SPSGRF is a surface mount sub-1 GHz transceiver module supplied on an 11 pin, 4-layer PCB. The final assembly recommended reflow profiles are indicated below.

The soldering phase must be executed with care. In order to avoid an undesired melting phenomenon, particular attention should be given to the setup of the peak temperature.

Table 10 provides suggestions for the temperature profile based on IPC/JEDEC J-STD-020C, July 2004 recommendations.

<table>
<thead>
<tr>
<th>Profile feature</th>
<th>PB-free assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average ramp up rate ( T_{\text{S MAX}} ) to ( T_p )</td>
<td>3°C/sec max</td>
</tr>
<tr>
<td>Preheat</td>
<td></td>
</tr>
<tr>
<td>Temperature min ( T_{S \text{ min}} )</td>
<td>150 °C</td>
</tr>
<tr>
<td>Temperature max ( T_{S \text{ max}} )</td>
<td>200 °C</td>
</tr>
<tr>
<td>Time ( t_{S \text{ min}} ) to ( t_{S \text{ max}} ) ( t_S )</td>
<td>60-100 sec</td>
</tr>
<tr>
<td>Time maintained above:</td>
<td></td>
</tr>
<tr>
<td>Temperature ( T_L )</td>
<td>217 °C</td>
</tr>
<tr>
<td>Time ( t_L )</td>
<td>60-70 sec</td>
</tr>
<tr>
<td>Peak temperature ( T_P )</td>
<td>240 + 0 °C</td>
</tr>
<tr>
<td>Time within 5 °C of actual peak temp ( t_p )</td>
<td>10-20 sec</td>
</tr>
<tr>
<td>Ramp down rate</td>
<td>6 °C/sec</td>
</tr>
<tr>
<td>Time from 25 °C to peak temperature</td>
<td>8 minutes max</td>
</tr>
</tbody>
</table>
Figure 6. Soldering profile
6 Regulatory compliance

6.1 FCC certification

The SPSGRF-915 module has been tested and found compliant with the FCC part 15 rules. These limits are designed to provide reasonable protection against harmful interference in approved installations. 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 may not occur in a particular installation.

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.

Modifications or changes to this equipment not expressly approved by STMicroelectronics may render void the user's authority to operate this equipment.

Modular approval

FCC ID: S9NSPSGRF

In accordance with FCC part 15, the SPSGRF-915 is listed as a modular transmitter device.

This module is evaluated for stand-alone use only. Finished products incorporating multiple transmitters must comply with collocation and RF exposure requirements in accordance with FCC multi-transmitter product procedures. Collocated transmitters operating in portable RF exposure conditions (e.g. <20 cm from persons including but not limited to body worn and hand-held devices) may require separate approval.

6.1.1 Labeling instructions

When integrating the SPSGRF-915 into the final product, the OEM must ensure that the FCC labeling requirements are satisfied. A statement must be included on the exterior of the final product which indicates that the product includes a certified module. The label should state the following (or similar wording that conveys the same meaning):

Contains FCC ID: S9NSPSGRF

OR 

This product contains FCC ID: S9NSPSGRF

The OEM must include the following statements on the exterior of the final product unless the product is too small (e.g. less than 4 x 4 inches):

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
2. this device must accept any interference received, including any interference that may cause undesired operation.
6.1.2 Product manual instructions

This section applies to OEM final products containing the SPSGRF-915 module, subject to FCC compliance. The final product manual must contain the following statement (or a similar statement that conveys the same meaning):

“Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. (Part. 15.21)”

In the case where an OEM seeks Class B (residential) limits for the final product, the following statement must be included in the final product manual:

“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.”

In the case where an OEM seeks the lesser category of a Class A digital device for the final product, the following statement must be included in the final product manual:

“Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his expense.”

6.2 IC certification

The SPSGRF-915 module has been tested and found compliant with the IC RSS-210 rules. These limits are designed to provide reasonable protection against harmful interference in approved installations. 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 may not occur in a particular installation.

This device complies with RSS-210 of the IC 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.
Modifications or changes to this equipment not expressly approved by STMicroelectronics may render void the user's authority to operate this equipment.

**Modular approval**

IC: 8976C-SPSGRF

In accordance with IC RSS-210, the SPSGRF-915 is listed as a modular transmitter device. This module is evaluated for stand-alone use only. Finished products incorporating multiple transmitters must comply with collocation and RF exposure requirements in accordance with IC multi-transmitter product procedures. Collocated transmitters operating in portable RF exposure conditions (e.g. <20 cm from persons including but not limited to body worn and hand-held devices) may require separate approval.

### 6.2.1 Labeling instructions

When integrating the SPSGRF-915 into the final product, the OEM must ensure that the IC labeling requirements are satisfied. A statement must be included on the exterior of the final product which indicates that the product includes a certified module. The label should state the following (or similar wording that conveys the same meaning):

Contains IC ID: 8976C-SPSGRF

OR

This product contains IC ID: 8976C-SPSGRF

The OEM must include the following statements on the exterior of the final product unless the product is too small (e.g. less than 4 x 4 inches):

“This device complies with RSS-210 of the IC Rules. Operation is subject to the following two conditions:

1. this device may not cause harmful interference
2. this device must accept any interference received, including any interference that may cause undesired operation."

### 6.2.2 Product manual instructions

This section applies to OEM final products containing the SPSGRF-915 module, subject to IC compliance. The final product manual must contain the following statement (or a similar statement that conveys the same meaning):

“Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. (RSS-210)"

In the case where an OEM seeks Class B (residential) limits for the final product, the following statement must be included in the final product manual:

“Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to RSS-210 of the IC 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.”

In the case where an OEM seeks the lesser category of a Class A digital device for the final product, the following statement must be included in the final product manual:

“Note: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to RSS-210 of the IC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his expense.”
6.3 CE certification

The module has been certified according to the following certification rules:

- EN 300 328 V 2.1.1 (2016-11)\textsuperscript{(a)}
- ETSI EN 301 489-17 V3.1.1 (2017-02)\textsuperscript{(b)}
- ETSI EN 301 489-1 V2.1.1 (2017-02)\textsuperscript{(c)}
- EN 62479:2010

The module is provided by CE marking:

The SPSGRF-868 module has obtained the RED certificate: No. 0051-RED-0024 REV. 0

The certified module test platform is based on STSW-SP1ML868AT production firmware release: 1.X

For additional information please refer to:

STMicroelectronics Via C. Olivetti 2, Agrate Brianza 20864 (ITALY)

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\textsuperscript{a} EN 300 328 V 2.1.1 (2016 11): “electromagnetic compatibility and radio spectrum Matters (ERM); Wideband transmission systems; data transmission equipment operating in the 2.4 GHZ ISM band and using wideband modulation techniques; harmonized EN covering essential requirements under article 3.2 of the R&TTE directive”.

\textsuperscript{b} EN 301 489-17 V 3.1.1 (2017 02): “electromagnetic compatibility and radio spectrum Matters (ERM); electromagnetic compatibility (EMC) standard for radio equipment and services; part 17: specific condition for 2.4 GHz wideband transmission systems and 5 GHz high performance RLAN equipment”.

\textsuperscript{c} ETSI EN 301 489-1 V2.1.1 (2017 02): “electromagnetic compatibility and radio spectrum Matters (ERM); electromagnetic compatibility (EMC) standard for radio equipment and services; part 1: Common technical requirements”.

7 Module traceability and marking

The SPSGRF bottom-side label contains the following information:

- Model: “MODEL: SPSGRF-915” indicating the SPSGRF RF module family
- FCC USA Certification Identification number: “FCCID:S9NSPSGRF”. This code is valid only for 915 MHz frequency band
- IC Canada certification number: “IC: 8976C-SPSGRF”. This code is used only for the Canadian market
- 2D laser data matrix

![Figure 7. SPSGRF bottom side](image)

Each module is univocally identified by serial number stored in a 2D laser data matrix marked on the bottom of the module.

The figure below shows the standard bottom-side QR-code laser marking.

![Figure 8. SPSGRF QR-code laser marking](image)
The serial number has the following format: WW YY K PP NNN
where:
- WW - Week
- YY - Year
- K - Product ID (refer to Table 11 below)
- PP - internal ST use only
- NNN - internal ST use only

<table>
<thead>
<tr>
<th>K</th>
<th>Product family identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>W</td>
<td>SPSGRF-868</td>
</tr>
<tr>
<td>X</td>
<td>SPSGRF-915</td>
</tr>
</tbody>
</table>

Each module bulk package is identified by a bulk ID.
The Bulk ID and module 2D data matrix are linked by a reciprocal traceability link.
The module 2D data matrix traces the lot number of any raw material used.
8 Ordering information

Table 12. Ordering information

<table>
<thead>
<tr>
<th>Order code</th>
<th>Description</th>
<th>Packing</th>
<th>MOQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPSGRF-868</td>
<td>868 MHz SPIRIT1 transceiver module (Region 1, Europe)</td>
<td>JEDEC tray</td>
<td>2448 pcs</td>
</tr>
<tr>
<td>SPSGRF-915</td>
<td>915 MHz SPIRIT1 transceiver module (Region 2, The Americas)</td>
<td>JEDEC tray</td>
<td>2448 pcs</td>
</tr>
</tbody>
</table>
In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.
10 Revision history

Table 13. Document revision history

<table>
<thead>
<tr>
<th>Date</th>
<th>Revision</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>31-Mar-2015</td>
<td>1</td>
<td>Initial release.</td>
</tr>
<tr>
<td>14-Apr-2015</td>
<td>2</td>
<td>Updated Features and Description in cover page.</td>
</tr>
<tr>
<td>22-May-2015</td>
<td>3</td>
<td>Updated Description in cover page.</td>
</tr>
<tr>
<td>29-Jun-2016</td>
<td>4</td>
<td>– Added marking and module identification details in Section 7: Module traceability and marking.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Updated Figure 5: Recommended land pattern</td>
</tr>
<tr>
<td>17-Oct-2016</td>
<td>5</td>
<td>Corrected typographical error in part number SPSGRF-915 in the Features and Description sections of the coverpage.</td>
</tr>
<tr>
<td>04-Oct-2017</td>
<td>6</td>
<td>Updated Section 6.3: CE certification</td>
</tr>
</tbody>
</table>
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