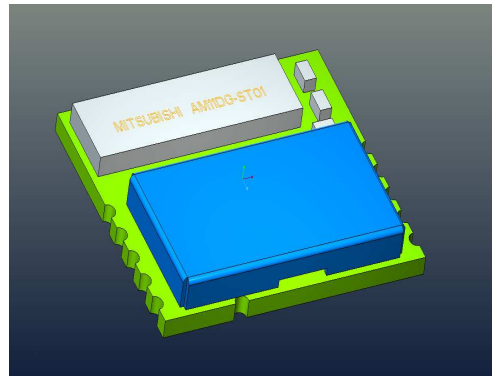
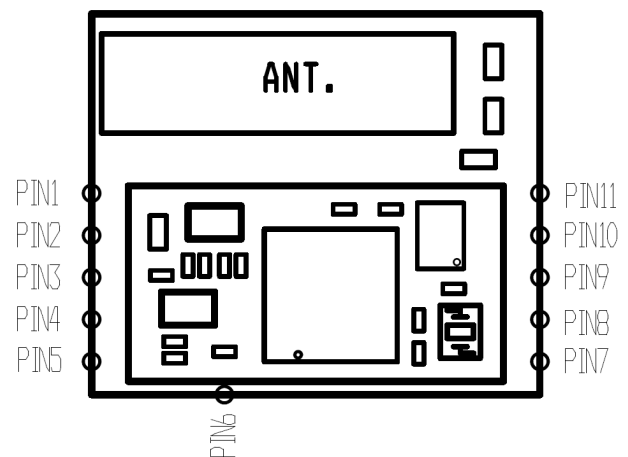


Features

- **Programmable Radio features**
 - Modulation schemes: 2-FSK, GFSK, MSK, GMSK, OOK, ASK
 - Air data rate from 1 to 500 kbps
 - On board antenna
- **RF features**
 - Receiver sensitivity: -118 dBm
 - Programmable RF output power
- **Host Interface**
 - SPI
- **General I/O**
 - Up to 32 programmable I/O functions on 4 GPIO programmable module pins
- **Two Carrier Frequency versions**
 - **868 MHz tuned antenna (Europe)**
 - **915 MHz tuned antenna (USA)**



Preliminary module picture
11.5 mm x 13.5 mm x 2.0 mm



1 Description

The SPSGRF is an easy to use sub-gigahertz transceiver module, with many programmable features. The module provides a complete RF platform in a tiny form factor.

The SPSGRF enables electronic devices with wireless connectivity, not requiring any RF experience or expertise for integration into the final product. The SPSGRF, being a certified solution, optimizes the time to market of the final applications.

The module is designed for maximum performance in a minimal space including 4 programmable I/O pin and SPI serial interface.

2 Applications

- M2M industrial control
- Service diagnostic
- Data acquisition equipment
- Machine control
- Sensor monitoring
- Security system
- Mobile health

5 Hardware Specifications

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

Absolute Maximum Ratings

Rating	Min	Typical	Max	Unit
Storage temperature range	-40	-	+85	$^{\circ}C$
Supply voltage, V_{IN}	-0.3	-	+ 3.9	Volts
I/O pin Voltage	-0.3	-	+ 3.9	Volts
RF saturation input power	-	10	-	dBm

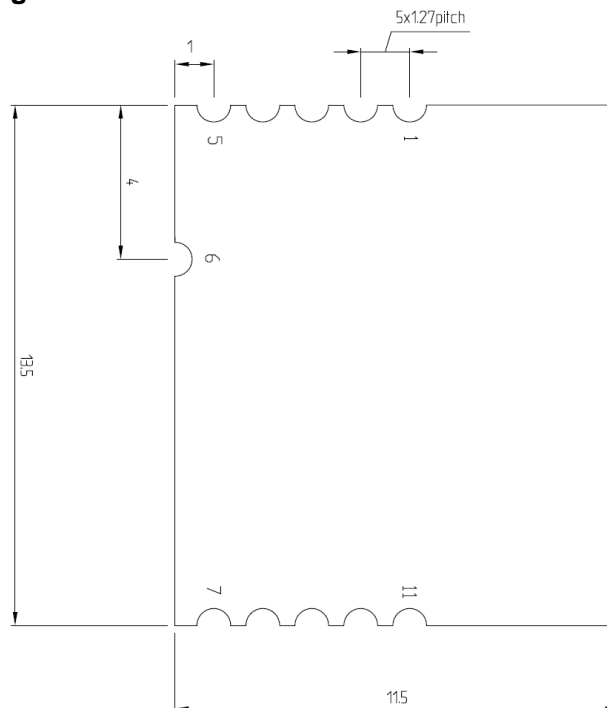
Recommended Operating Conditions

Rating	Min	Typical	Max	Unit
Operating Temperature Range	-40	-	85	$^{\circ}C$
Supply Voltage V_{IN}	1.8	3.3	3.6	Volts
Signals & I/O Pin Voltage (according Supply Voltage)	1.8	-	3.6	Volts
RF Frequency Bandwidth (SPSGRF-868)	863		870	MHz
RF Frequency Bandwidth (SPSGRF-915)	902		928	MHz

Power-On reset (POR) module internally generated signal

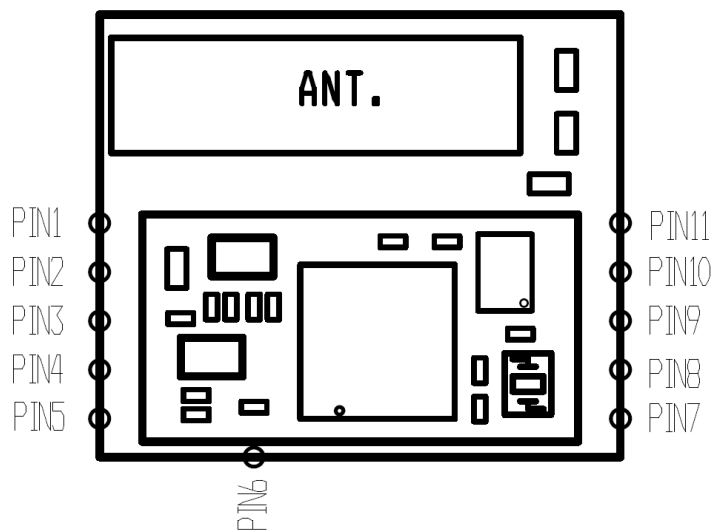
The power-on-reset circuit generates a reset pulse upon power-up which is used to initialize the entire internal module digital logic. Power-on-reset senses module V_{in} voltage.

Pin connection diagram



Pin Assignment

Name	Type	Pin #	Description	ALT Function	V max. Tolerant	Initial State
SPI Interface						
SPI_CLK	I	7	SPI CLOCK (Max. 8 MHz)		V_{in}	
SPI_MOSI	I	9	SPI MOSI (MASTER out SLAVE in)		V_{in}	
SPI_MISO	O	8	SPI MISO (MASTER in / SLAVE out)		V_{in}	
SPI_CS	I	10	SPI "Chip Select" (SPI slave select)		V_{in}	
Power and Ground						
V_{in}		5	V_{in}		(1.8V + 3.6V max.)	
GND		6	GND			
Module SHUTDOWN						
SDN	I	11	SHUTDOWN input (active high.)		(1.8V + V_{in} max.)	
GPIO – General Purpose Input/Output						
GPIO [0]	I/O	4	Programmable Input / Output & Analog Temperature output		(1.8V + V_{in} max.)	Digital Output. Low Power
GPIO [1]	I/O	3	Programmable Input / Output		(1.8V + V_{in} max.)	Digital Output. Low Power
GPIO [2]	I/O	2	Programmable Input / Output		(1.8V + V_{in} max.)	Digital Output. Low Power
GPIO [3]	I/O	1	Programmable Input / Output		(1.8V + V_{in} max.)	Digital Output. Low Power



Pin1 = GPIO_3 (TBD)

Pin2 = GPIO_2 (TBD)

Pin3 = GPIO_1 (TBD)

Pin4 = GPIO_0 (TBD)

Pin5 = V_{in}

Pin11 = SDN

Pin10 = SPI_CS

Pin9 = SPI_MOSI

Pin8 = SPI_MISO

Pin7 = SPI_CLK

Pin6 = GND

Module Current Consumption

SPSGRF-868 module

Symbol	Parameter	Test Conditions	Typ.	Unit
I _{dd}	Supply current	Operating mode Tx , +11.6 dBm , 2-FSK , 868 MHz	22	mA
		Operating mode Tx , - 7 dBm , 2-FSK , 868 MHz	9	mA
		Operating mode Rx , 868.5 MHz	10	mA
		Command mode	0.6	mA
		Shutdown High Level -V _{dd} (with other I/O in High impedance)	0.1	μA

SPSGRF-915 module

Symbol	Parameter	Test Conditions	Typ.	Unit
I _{dd}	Supply current	Operating mode Tx , +11.6 dBm , 2-FSK , 915 MHz	22	mA
		Operating mode Tx , - 7 dBm , 2-FSK , 915 MHz	9	mA
		Operating mode Rx , 915 MHz	10	mA
		Command mode	0.6	mA
		Shutdown High Level -V _{dd} (with other I/O in High impedance)	0.1	μA

Module RF compliance limits

The RF compliance limits are those tested for FCC 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 and CE certification.

RF compliance limits table

Modulation	Standards	Parameter	Max.	Unit
2-FSK GFSK MSK	FCC Part 15.207 ⁽¹⁾ FCC Part 15.247 ⁽¹⁾	Data rate	500	kbps
	EN 300 220-2 V2.4.1 ⁽²⁾ EN 301 489-01 V1.9.2 ⁽²⁾ EN 301 489-03 V1.4.1 ⁽²⁾	Conducted Output power	+11.6	dBm
	FCC Part 15.207 ⁽¹⁾ FCC Part 15.249 ⁽¹⁾	Data rate	250	kbps
OOK ASK	EN 300 220-2 V2.4.1 ⁽²⁾ EN 301 489-01 V1.9.2 ⁽²⁾ EN 301 489-03 V1.4.1 ⁽²⁾	Conducted Output power	6	dBm

1. FCC standards are only applicable to the SPSGRF-915 module.
2. EN standards are only applicable to the SPSGRF-868 module.

Module RF typical performances

The RF performances of the SPSGRF-868 and SPSGRF-915 modules are depending from many factors, related to the Customer hardware application board where the module is connected and also to the Customer application firmware. To give some basic information to the Customer which will be the module integrator, may be useful to furnish the RF measures taken in an anechoic chamber using a dongle with inside connected the SPSGRF-868 or the SPSGRF-915 module.

SPSGRF-868 or 915 modules radiated typical performances

Symbol	Parameter	Test Conditions	Typ.	Unit
Tx RF power	RF radiated power	Operating mode Tx , +11.6 dBm , 2-FSK , 868,0-868,6 MHz	5.3	dBm
		Operating mode Tx , +11.6 dBm , 2-FSK , 902-928 MHz	2.2	dBm

SPSGRF-868 or 915 modules conducted typical performances before the RF antennas circuits (positive RF power signal values measured)

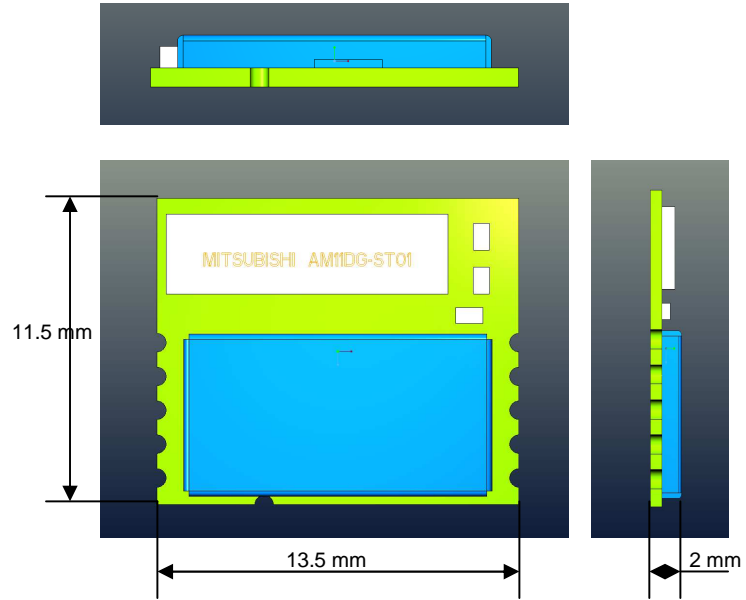
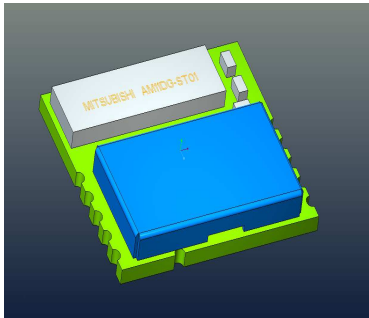
Parameter	Test Condition	Conducted Programmable Value	Measured conducted value Typ.	Unit
Tx RF Conducted Power (before the Antennas circuits)	Operating mode Tx , +11.6 dBm , 2-FSK , 868 MHz Tx , +11.6 dBm , 2-FSK , 915 MHz	11.6	11.2	dBm
	Operating mode Tx , +11 dBm , 2-FSK , 868 MHz Tx , +11 dBm , 2-FSK , 915 MHz	11.0	10.8	dBm
	Operating mode Tx , +10 dBm , 2-FSK , 868 MHz Tx , +10 dBm , 2-FSK , 915 MHz	10.0	9.7	dBm
	Operating mode Tx , +9 dBm , 2-FSK , 868 MHz Tx , +9 dBm , 2-FSK , 915 MHz	9.0	8.5	dBm
	Operating mode Tx , +8 dBm , 2-FSK , 868 MHz Tx , +8 dBm , 2-FSK , 915 MHz	8.0	7.6	dBm
	Operating mode Tx , +7 dBm , 2-FSK , 868 MHz Tx , +7 dBm , 2-FSK , 915 MHz	7.0	7.2	dBm
	Operating mode Tx , +6 dBm , 2-FSK , 868 MHz Tx , +6 dBm , 2-FSK , 915 MHz	6.0	6.2	dBm
	Operating mode Tx , +5 dBm , 2-FSK , 868 MHz Tx , +5 dBm , 2-FSK , 915 MHz	5.0	5.4	dBm
	Operating mode Tx , +4 dBm , 2-FSK , 868 MHz Tx , +4 dBm , 2-FSK , 915 MHz	4.0	4.0	dBm
	Operating mode Tx , +3 dBm , 2-FSK , 868 MHz Tx , +3 dBm , 2-FSK , 915 MHz	3.0	3.1	dBm
	Operating mode Tx , +2 dBm , 2-FSK , 868 MHz Tx , +2 dBm , 2-FSK , 915 MHz	2.0	2.1	dBm
	Operating mode Tx , +1 dBm , 2-FSK , 868 MHz Tx , +1 dBm , 2-FSK , 915 MHz	1.0	1.2	dBm
	Operating mode Tx , +0 dBm , 2-FSK , 868 MHz Tx , +0 dBm , 2-FSK , 915 MHz	0.0	0.6	dBm

SPSGRF-868 or 915 modules conducted typical performances before the RF antennas circuits (negative RF power signal values measured)

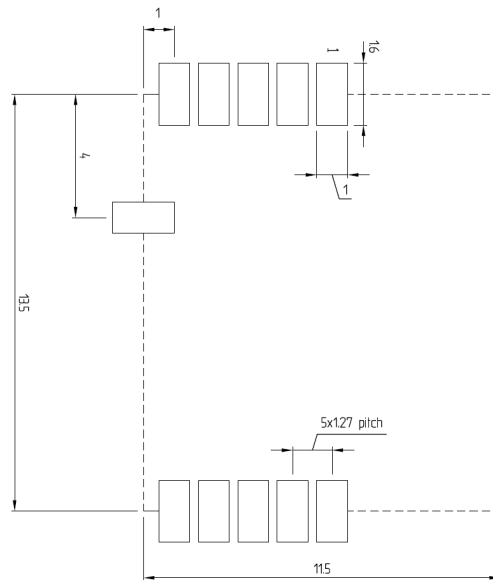
Parameter	Test Condition	Conducted Programmable Value	Measured conducted value Typ.	Unit
Tx RF Conducted Power (before the Antennas circuits)	Operating mode Tx, -1 dBm, 2-FSK, 868 MHz Tx, -1 dBm, 2-FSK, 915 MHz	-1.0	-1.1	dBm
	Operating mode Tx, -2 dBm, 2-FSK, 868 MHz Tx, -2 dBm, 2-FSK, 915 MHz	-2.0	-2.3	dBm
	Operating mode Tx, -3 dBm, 2-FSK, 868 MHz Tx, -3 dBm, 2-FSK, 915 MHz	-3.0	-3.4	dBm
	Operating mode Tx, -4 dBm, 2-FSK, 868 MHz Tx, -4 dBm, 2-FSK, 915 MHz	-4.0	-4.9	dBm
	Operating mode Tx, -5 dBm, 2-FSK, 868 MHz Tx, -5 dBm, 2-FSK, 915 MHz	-5.0	-5.8	dBm
	Operating mode Tx, -6 dBm, 2-FSK, 868 MHz Tx, -6 dBm, 2-FSK, 915 MHz	-6.0	-6.9	dBm
	Operating mode Tx, -7 dBm, 2-FSK, 868 MHz Tx, -7 dBm, 2-FSK, 915 MHz	-7.0	-6.5	dBm
	Operating mode Tx, -8 dBm, 2-FSK, 868 MHz Tx, -8 dBm, 2-FSK, 915 MHz	-8.0	-7.3	dBm
	Operating mode Tx, -9 dBm, 2-FSK, 868 MHz Tx, -9 dBm, 2-FSK, 915 MHz	-9.0	-8.2	dBm
	Operating mode Tx, -10 dBm, 2-FSK, 868 MHz Tx, -10 dBm, 2-FSK, 915 MHz	-10.0	-9.7	dBm
	Operating mode Tx, -15 dBm, 2-FSK, 868 MHz Tx, -15 dBm, 2-FSK, 915 MHz	-15.0	-14,6	dBm
	Operating mode Tx, -20 dBm, 2-FSK, 868 MHz Tx, -20 dBm, 2-FSK, 915 MHz	-20.0	-19.2	dBm
	Operating mode Tx, -25 dBm, 2-FSK, 868 MHz Tx, -25 dBm, 2-FSK, 915 MHz	-25.0	-23.3	dBm
	Operating mode Tx, -30 dBm, 2-FSK, 868 MHz Tx, -30 dBm, 2-FSK, 915 MHz	-30.0	-26.2	dBm
	Operating mode Tx, -35 dBm, 2-FSK, 868 MHz Tx, -35 dBm, 2-FSK, 915 MHz	-35.0	-27.8	dBm

Mechanical dimensions

PRELIMINARY



Recommend land pattern



Recommended land pattern top view

6 Hardware design notes

SPSGRF-868 and SPSGRF-915 modules support SPI hardware interfaces.

Notes

- 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.

7 Reflow soldering

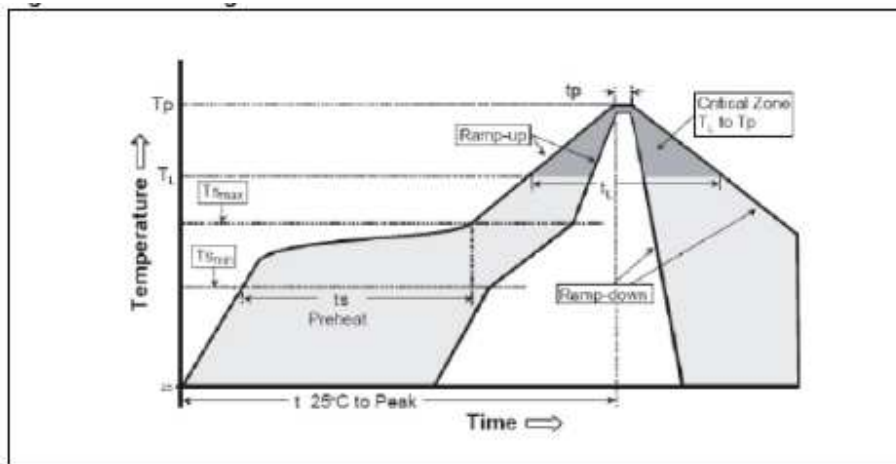
The SPSGRF is a surface mount SubGiga Transceiver module supplied on a 11 pin, 4-layer PCB. The final assembly recommended reflow profiles are indicated here below.

Soldering phase has to be executed with care: In order to avoid undesired melting phenomenon, particular attention has to be taken on the set up of the peak temperature. Here following some suggestions for the temperature profile based on IPC/JEDEC J-STD-020C, July 2004 recommendations.

Soldering

Profile feature	PB-free assembly
Average ramp up rate ($T_{S\text{MAX}}$ to T_P)	3°C / sec max
Preheat	
Temperature min (T_S min)	150 °C
Temperature max (T_S max)	200 °C
Time (t_S min to t_S max) (t_S)	60-100 sec
Time maintained above:	
Temperature T_L	217 °C
Time t_L	60-70 sec
Peak temperature (T_P)	240 + 0 °C
Time within 5 °C of actual peak temperature (t_p)	10-20 sec
Ramp down rate	6 °C / sec
Time from 25 °C to peak temperature	8 minutes max

Soldering profiles



8 RoHS compliance

ST Bluetooth modules comply with the ECOPACK2 level of RoHS compliance grade.

9 Ordering Information

Order code	Description	Packing	MOQ
SPSGRF-868	868 MHz Spirit1 transceiver module (Region 1, Europe)	Jedec tray	2448 pcs
SPSGRF-915	915 MHz Spirit1 transceiver module (Region 2, The Americas)	Jedec tray	2448 pcs

10 Regulatory compliance

FCC certification

This module has been tested and found to comply 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 colocation and RF exposure requirements in accordance with FCC multi-transmitter product procedures. Collocated transmitters operating in portable RF Exposure conditions (e.g. <20cm from persons including but not limited to body worn and hand held devices) may require separate approval.

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 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, and (2) this device

must accept any interference received, including any interference that may cause undesired operation.

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.

CE certification for SPSGRF-868 module

The SPSGRF-868 module has been certified according to the following standards:

EN 300 220-2 V2.4.1

EN 301 489-01 V1.9.2

EN 301 489-03 V1.4.1

EN60950-1:2006 + A11:2009 + A1:2010 + A12:2011

The module is CE certified:

CE0051

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