Sub-GHz RF Modules

SP1ML and SPSGRF

www.st.com/subghzmodules

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Why an RF Module?

- **Plug & play solution** does not require in-depth RF know-how
- **Certified solution**: FCC or CE (ETSI) certified
- **Flexible solutions** for easier software and hardware integration in an existing system

Applications for RF Sub-GHz Modules

- Gas / Water smart metering
- Remote control
  - Garage doors
  - Window blinds
  - Industrial remote systems
- Wireless alarm systems
- Heat cost allocators

ST Sub-GHz RF Modules
and evaluation boards

RF module	Based on	Features
SP1ML-868	STM32L1+SPIRIT1+Balun	868 MHz ETSI-certified module
SP1ML-915	STM32L1+SPIRIT1+Balun	915 MHz FCC-certified module
SPSGRF-868	SPIRIT1+Balun	868 MHz ETSI-certified module
SPSGRF-915	SPIRIT1+Balun	915 MHz FCC-certified module

Evaluation board	Features
STEVAL-SP1ML-868	SP1ML-868 USB Dongle (863 to 870 MHz)
STEVAL-SP1ML-915	SP1ML-915 USB Dongle (902 to 928 MHz)
X-NUCLEO-IDS001A4	SPSGRF-868 STM32 Nucleo expansion board
STEVAL-IDS001V4M	SPSGRF-868 USB dongle
X-NUCLEO-IDS001A5	SPSGRF-915 STM32 Nucleo expansion board
STEVAL-IDS001V5M	SPSGRF-915 USB dongle

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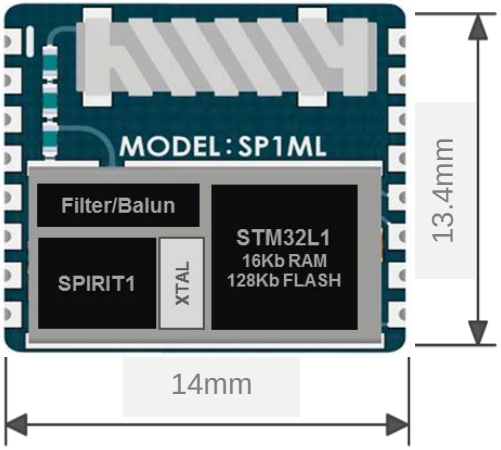
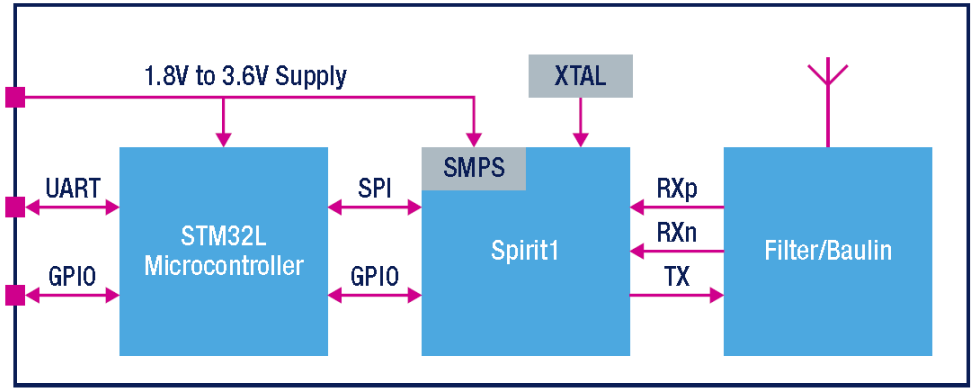
SP1ML – 868/915 Structure

SP1ML-868 and SP1ML-915 are low-power RF modules based on the SPIRIT1 low-power transceiver and integrate an STM32L151 ultra-low-power MCU





SP1ML-868/915 Key Features

SPIRIT1 RF modules for 868 MHz and 915 MHz applications

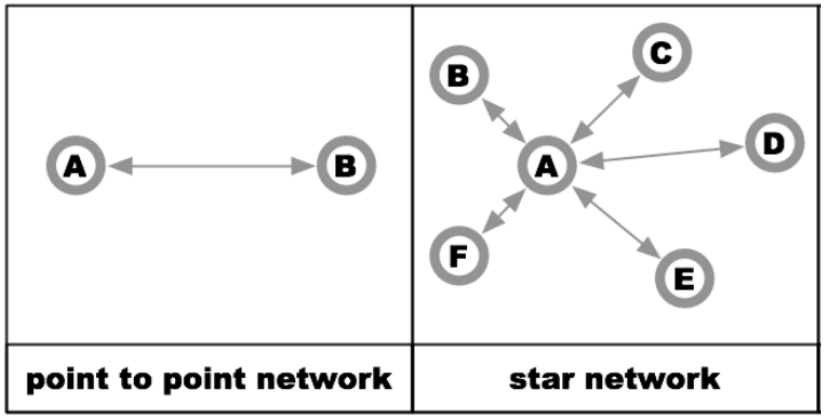
- Module based on:
  - **SPIRIT1** low-power sub-GHz transceiver
  - **STM32L151RBH6** ultra-low-power ARM Cortex-M3 MCU - 16 Kbytes of RAM – 128 Kbytes of Flash memory
  - **BALF-SPI-01D3** 868/915 MHz IPD balun and filter
- Supports **868 MHz** SRD and **915 MHz** ISM bands
- Surface mount antenna
- 1.8 V to 3.6 V supply - **Low power consumption**
- **Output power** up to +11.6 dBm
- Air data rates up to **500 kbit/s**
- Modulation schemes: 2-FSK, GFSK, MSK, GMSK, OOK, ASK
- Operating temperature: **-40 °C to 85 °C**
- **CE compliant**
- SP1ML-915 is **FCC certified** (FCC ID S9NSP1ML)
- Standard firmware with **AT Command** set interface **via UART** for configuration and cable replacement model

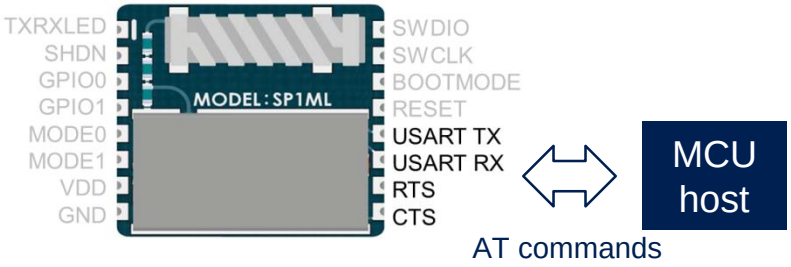
SP1ML-868/915 Support

- **AT commands**
- **Network configurations supported**
- **Evaluation tools**

SP1ML - AT Commands

	Command reference
ATO	Enter operating mode
AT/V	Read module version information
ATIn	Read an information register
ATSnn?	Read a configuration register(*)
ATSnn=x	Write a configuration register(*)
AT/S	Read all configuration registers
AT/C	Store the current configuration
ATZ	Restart the module
AT/SRnn?	Read a SPIRIT1 radio register
AT/SRnn=xx	Write a SPIRIT1 radio register
AT/Tn	Set RF test mode



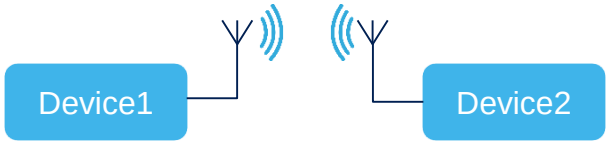


(*) **Configuration registers**

- S00 BAUD_RATE
- S01 FREQUENCY
- S02 DATA_RATE
- S03 MODULATION
- S04 OUTPUT_POWER
- S05 FREQ_DEVIATION
- S06 RX_FILTER
- S07 CS_MODE
- S08 RSSI_THRESHOLD
- S09 PREAMBLE_LEN
- S10 SYNC_LENGTH
- S11 SYNC_VALUE
- S12 CRC_MODE
- S13 WHITENING
- S14 FEC
- S15 SOURCE_ADDR
- S16 DESTINATION_ADDR
- S17 MULTICAST_ADDR
- S18 BROADCAST_ADDR
- S19 FILTER_xxx
- TXRX_LED
- HW_FLOW_CTRL
- ESCAPE_SEQ

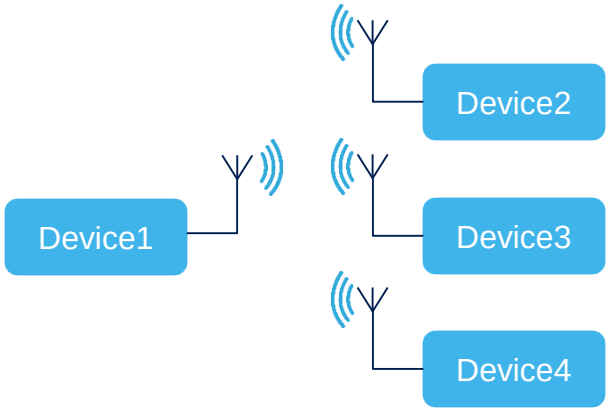
SP1ML – Network Configurations

Point-to-point



- Same RF and packet configuration for device 1 & 2
- Filtering conditions defined so that device 1 will only receive packet from device 2 (and reciprocally)

Star network: Point-to-point, multicast or broadcast

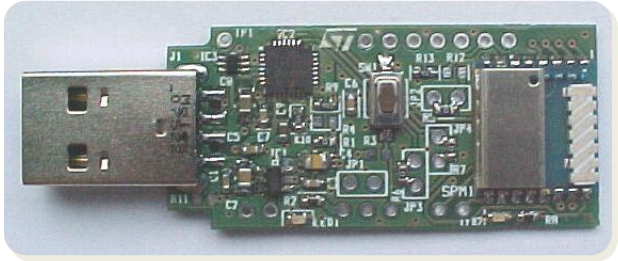


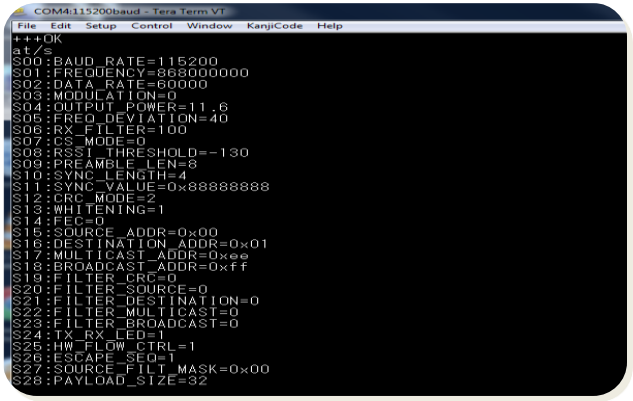
- Same RF and packet configuration for devices 1, 2, 3 and 4
- Filtering conditions for data to be sent
  - Point-to-point: e.g. Device 1 sends data to Device 2 only
  - Multicast: e.g. Device 1 sends data to Device 2 and 3 only
  - Broadcast: e.g. Device 1 sends data to Devices 2, 3 and 4

SP1ML – Evaluation Tools

STEVAL-SP1ML868 and STEVAL-SP1ML915 USB dongles

- STEVAL-SP1ML868 and 915 demonstration board allows to evaluate SP1ML-868 and 915 modules in a quick and simple way.

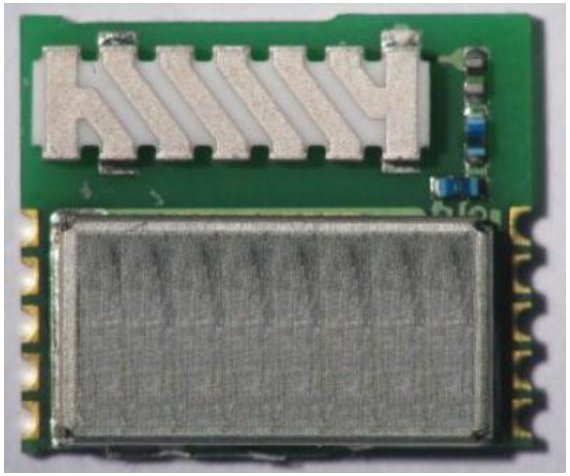


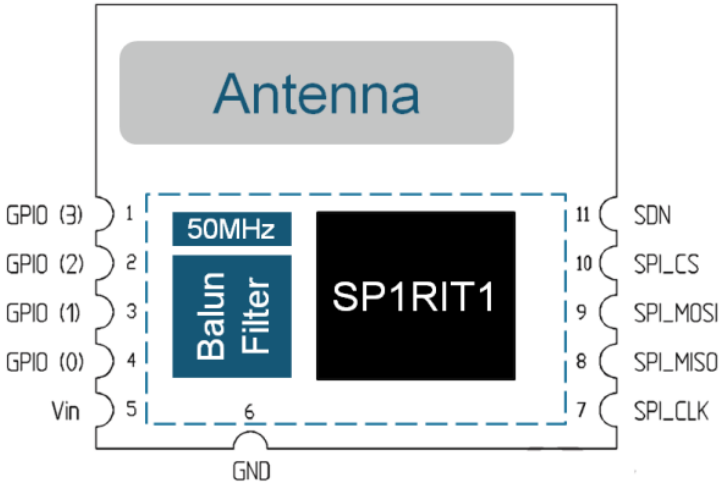


- USB connector is used to connect the dongle with a PC, to access the sub-GHz RF module and to supply the dongle
- User manual UM1889 - SP1ML modules getting started guide with firmware upgrade and simple communication setup

SPSGRF Structure

SPSGRF-868 and SPSGRF-915 are low-power RF modules based on the SPIRIT1 low-power transceiver





SPSGRF Key Features

SPSGRF-868 and SPSGRF-915 low-power programmable RF transceiver modules for 868 MHz and 915 MHz applications

- Module based on:
  - **SPIRIT1** low-power sub-GHz transceiver
  - **BALF-SPI-01D3** balun and filter
  - Surface mount antenna
- Tiny size: **13.5 x 11.5 mm**
- 500 Kbits/s data rate
- Temp. range from –40 to 85 °C
- Receiver sensitivity: **–118 dBm**
- Output power up to **+11.6 dBm**
- **RX: 9 mA, Tx: 21 mA** @ +11 dBm
- **Shutdown: 2.5 nA**
- **SPI** host interface
- **CE compliant**
- SPSGRF-915 is an **FCC certified** module (FCC ID: S9NSPSGRF)

SPGRF Support

- **STM32 Nucleo expansion board**

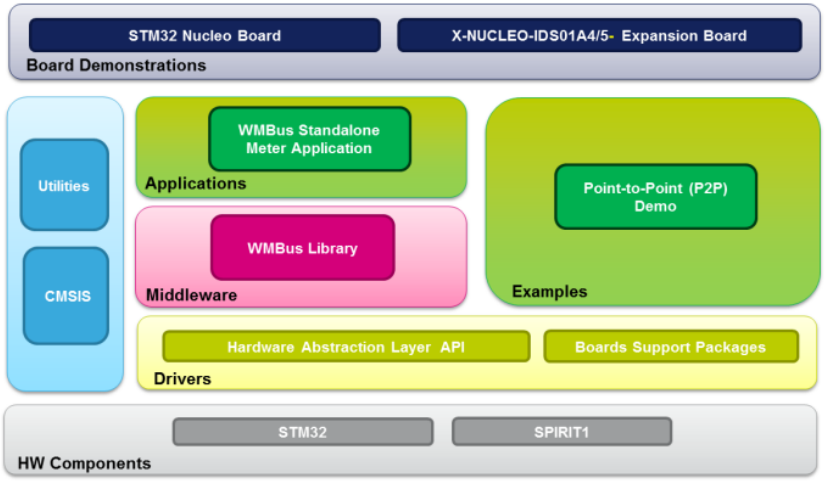
- **USB dongle**

SPSGRF

STM32 Nucleo expansion board

Sub-GHz expansion board based on SPIRIT1 SPSGRF module

- Expansion board for STM32 Nucleo development boards
- Scalable solution, can cascade multiple boards for larger systems
- Equipped with Arduino UNO R3 connectors
- RoHS compliant
- X-CUBE-SUBG1 example firmware:
- Point-to-point simple communication demo
- WMBus standalone application for automatic meter reading system

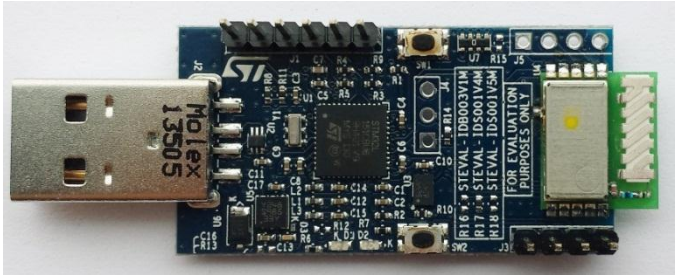


X-NUCLEO-IDS01A4 based on SPSGRF-868 (868 MHz ETSI-certified module)

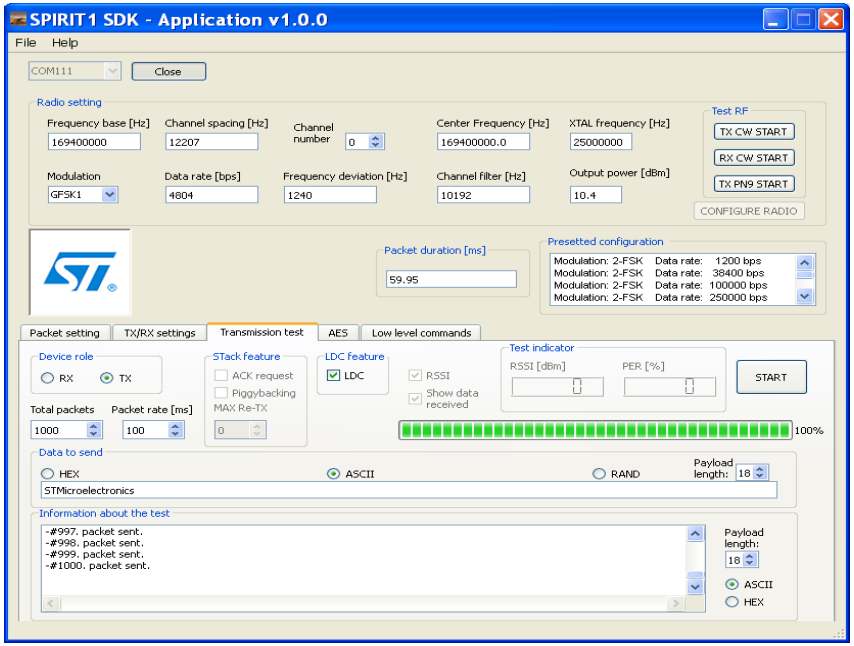
X-NUCLEO-IDS01A5 based on SPSGRF-915 (915 MHz FCC-certified module)

Sub-GHz RF USB Dongle

- USB dongle with on-board SPSGRF
  - Modulation: 2-FSK, GFSK, MSK, GMSK, OOK and ASK
  - Air data rate: from 1 to 500 kbits/s



- Full compliance in terms of firmware and GUI with the SPIRIT1 development kits: STSW-CONNECT009



- On-board:
  - STM23L low-power MCU
  - Debug connector
  - USB interface

- RoHS compliant

STEVAL-IDS001V4M based on SPSGRF-868 (868 MHz ETSI-certified module)

STEVAL-IDS001V5M based on SPSGRF-915 (915 MHz FCC-certified module)

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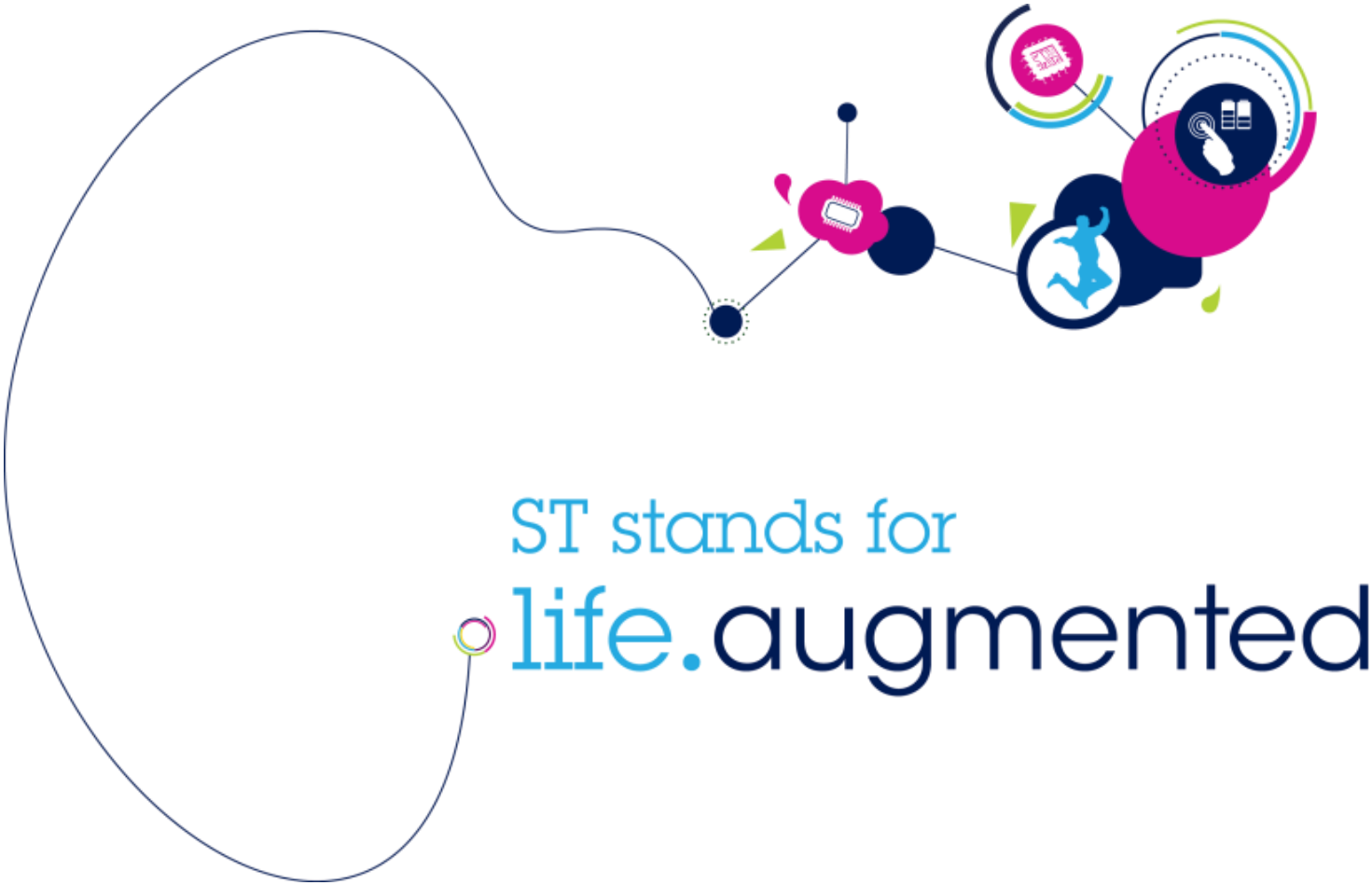
Thank You



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