

n-Core[®]

n-Core[®] Sirius Quantum/RadlOn User Manual

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1. Introduction

The all-new Sirius Quantum and Sirius RadIOn devices are radio-frequency devices that offer a complete solution for deploying wireless sensor networks and real-time locating systems based on the IEEE 802.15.4/ZigBee™ international standard in a simple and fast way.



Their tiny design provides an extraordinary versatility to suit a wide range of applications, especially those where mobility, connectivity and miniaturization are key factors. They offer several communication ports and I/O interfaces, via the n-Core Sirius IOn, that allow integrating a great number of external devices, such as sensors, actuators or even computers, among many others.

The Sirius Quantum and Sirius RadIOn devices are part of the n-Core platform, developed by Nebusens. The n-Core platform offers a complete set of hardware and software tools to fit all your necessities when developing and deploying wireless networks based on the international standard IEEE 802.15.4/ZigBee™.

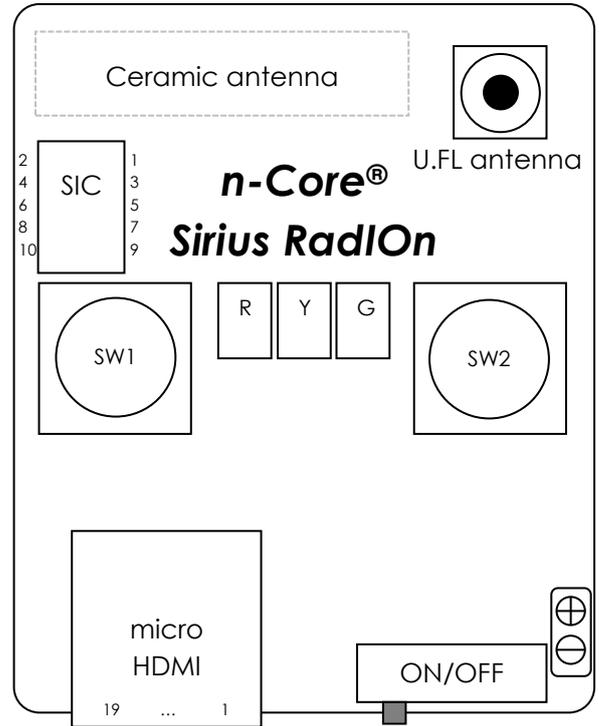
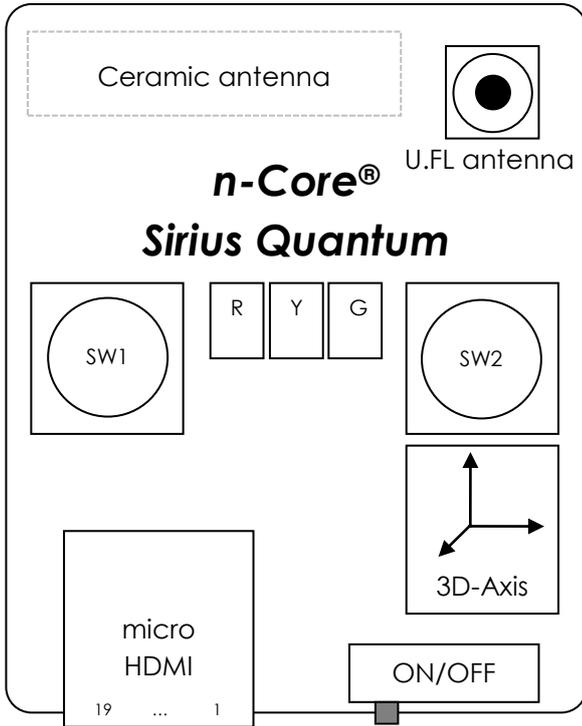
For more information about n-Core, please visit www.nebusens.com

2. General characteristics

Sirius Quantum	
Electrical features	
Batteries Power Supply	3.7V
External Power Supply	3.2V - 5V
Power Switch	ON/OFF
Physical characteristics	
Dimensions (mm)	22 x 32.72 x 5
Micro-controller	
Model	ATMEGA128RFA1
Frequency	16MHz
Flash	128KBytes
RAM	16KBytes
EEPROM	4KBytes
Radio	
Transceiver	Integrated AT86RF231
Frequency Band	2405 to 2480MHz
Number of Channels	16
Channel Spacing	5MHz
Power Transmission (Software-controlled)	+11 to +22dBm
Sensitivity	-100dBm
Data Transmission Rate	250Kbps
Connectivity	
<ul style="list-style-type: none"> • I²C Master (Pull-Up) • ADC • JTAG • SPI • GPIO (x2) TTL 0 - 3.5V • UART • Power Supply 	Via HDMI type D connector
Programming Port	JTAG (via HDMI type D connector)
Buttons (x2)	Connected to IRQs (WS1 and SW2)
LEDs (x3)	Red/Yellow/Green

Sirius RadIOn	
Electrical features	
External Power Supply	3.2V - 5V
Power Switch	ON/OFF
Physical characteristics	
Dimensions (mm)	22 x 32.72 x 5
Micro-controller	
Model	ATMEGA128RFA1
Frequency	16MHz
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Programming Port	JTAG (via HDMI type D connector)
Buttons (x2)	Connected to IRQs
LEDs (x3)	Red/Yellow/Green
<ul style="list-style-type: none"> • I²C • SPI • UART • Power Supply • Power supply 	Serial Interfaces Connector (SIC)
	Side connector (+ -)

3. Pinout



micro HDMI	
1	RESET
2	UART TXD
3	JTAG TDI
4	UART RXD
5	JTAG TDO
6	SPI MISO
7	JTAG TMS
8	SPI MOSI
9	JTAG TCK
10	SPI CLK
11	ADC 1
12	UART CTS
13	VCC IN
14	UART RTS
15	GND
16	GPIO2
17	I2C SCL
18	GPIO1
19	I2C SDA

SIC	
1	I2C SCL
2	SPI SCLK
3	I2C SDA
4	SPI MOSI
5	VCC IN
6	SPI MISO
7	USART0 TXD
8	USART0 RXD
9	ADC 1
10	GND

4. Power supply

Sirius Quantum and Sirius RadlOn devices have the following power supply alternatives:

- Internal Li-Po battery 3.7V 300mAh (Sirius Quantum only).
- micro HDMI connector¹.
- Serial Interface Connector – SIC – (Sirius RadlOn only).
- 2-pin connector (Sirius RadlOn only).

These options can work together as described next.

4.1. Battery

Sirius Quantum devices have an internal 300mAh Li-Po battery which can be recharged through the micro HDMI connector (via Sirius IOn-D only). The battery has an internal controller that protects its performance and therefore the device can be powered continuously.

4.2. External power supply

Sirius RadlOn has an external connector which allows powering the device directly. It has also an HDMI connector and a SIC port which can power the device only via the n-Core Sirius IOn-D device.

	HDMI (via Sirius IOn-D)	SIC (via Sirius IOn-D)	2-pin connector
Input Voltage	3.7V - 4.2V	3.2V - 3.7V	3.7V - 4.2V
Input Current	500mA	< 200mA	< 200mA

4.3. Switch On/Off

The On/Off switch (POWER Block) allows eliminating completely the power supply of the device.

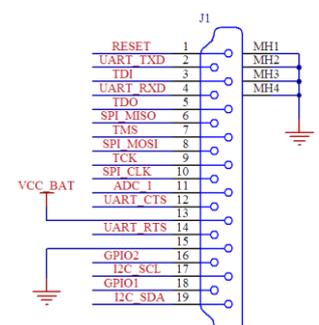
5. Input and output interfaces

Sirius Quantum and Sirius RadlOn devices have the following input and output interfaces:

- 2x buttons connected to the microcontroller interrupts.
- 1x Analog-to-Digital Converter (ADC) as battery monitor.
- 3x LED (red, green and yellow).
- 1x 3D-Axis accelerometer with 2 interrupts connected to the microcontroller (Sirius Quantum only).
- On/Off switch.

The following input and output interfaces are accessible via the micro HDMI. **It is mandatory to use a n-Core Sirius IOn-D device.**

- Sirius Quantum/RadlOn Reset.
- JTAG programming interface.
- 1x Analog-to-Digital Converter (ADC).
- 2x GPIO.
- 1x I²C bus (internal pull-up).
- 1x SPI bus.
- 1x USART.

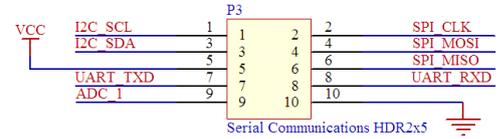


¹ Sirius IOn-D needed.

- Power supply (with battery charging capabilities via Sirius IOn-D device).

Sirius RadIOn devices have also the following input and output interfaces via the Serial Interface Connector (SIC). **It is mandatory to use a n-Core Sirius IOn (D, E, M) device.**

- 1x Analog-to-Digital Converter (ADC). It can be also used as GPI (address 0x19)
- 1x I²C bus (internal pull-up).
- 1x SPI bus.
- 1x USART.
- Power supply.

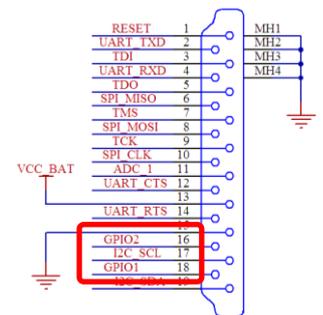


Electrical characteristics for all inputs and outputs are: TA = -40°C to 85°C, VCC = 1.8V to 3.7V (unless other values are specified).

Symbol	Parameter	Conditions	Min.	Max.	Units
VIL	Input Low Voltage	VCC = 2.4V - 5V		0.4	V
VIH	Input High Voltage	VCC = 2.4V - 5V	VCC - 0.4		V
VOL	Output Low Voltage	IOL = 10 mA, VCC = 3V		0.4	V
VOH	Output High Voltage	IOH = -10 mA, VCC = 3V	VCC - 0.4		V

5.1. GPIO

There are 2 digital inputs and outputs (GPIO) connected directly to the ATMEGA128RFA1 microcontroller. **It is mandatory to use a n-Core Sirius IOn-D device.**



IRQ_3 and IRQ_2 pins are connected to the SW1 and SW2 external switches, respectively. The n-Core API automatically activates the pull-up on each IRQ. Pushing each button generates a low level/falling edge.

5.2. Serial communications

All serial communication interfaces are directly connected to their respective pins of the ATMEGA128RFA1 microcontroller, unless otherwise indicated. **It is mandatory to use a n-Core Sirius IOn device.**

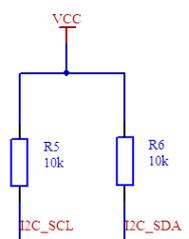
5.2.1. I²C

- micro HDMI: pins 17 and 19.
- SIC: pins 1 and 3.

The electrical and protocol characteristics of the I²C bus are determined by the specifications of the ATMEGA128RFA1 microcontroller.

I2C_SDA (micro HDMI pin 19 or SIC pin 3) and I2C_SCL (micro HDMI pin 17 or SIC pin 1) lines have an internal pull-up.

IMPORTANT NOTE: In order to use the I²C bus, it is necessary that the reference pins (GND) of the Sirius device (micro HDMI pin 15 or SIC pin 10) and the input device (for example, a sensor) are connected to each other.



5.2.2. SPI

- Micro HDMI (pins 6, 8 and 10).
- SIC (pins 2, 4 and 6).

The electrical and protocol characteristics of the SPI bus are associated to the specifications of the ATMEGA128RFA1 microcontroller.

	Micro HDMI	SIC
SPI MISO	6	6
SPI MOSI	8	4
SPI CLK	10	2

5.2.3. USART

The USART is accessible from the micro HDMI and SIC connectors. The available communication lines are:

	Micro HDMI	SIC
USART TXD	2	7
USART RXD	4	8
USART CTS	12	-
USART RTS	14	-

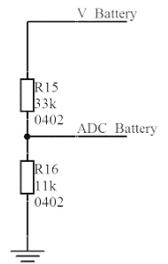
IMPORTANT NOTE: In order to use the USART0, it is mandatory that the reference pins (GND) of the Sirius device (micro HDMI pin 15 or SIC pin 10) and the input device (for example, a sensor) are connected to each other.

5.3. ADC – Battery

Sirius Quantum devices have an ADC that monitors the internal battery voltage. The reference voltage for the microcontroller is 1.5V. The input voltage range is from 0V to 3.75V.

The voltage of the battery is adapted through a voltage divider (see schema) before being read by the ADC_Battery analog-to-digital converter.

The relationship between the battery voltage (V_Battery) and the voltage read by the ADC (ADC_Battery) is given by the following expression: $ADC_{battery} = \frac{V_{Battery}}{4}$



5.4. ADC

Sirius Quantum and Sirius RadlOn devices have an external ADC accessible through micro HDMI and SIC connectors. The reference voltage for the microcontroller is 1.5V. The input voltage range is from 0V to reference voltage.

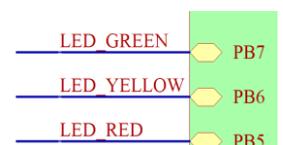
	Micro HDMI	SIC
ADC_1	11	9

ADC_1 can also be used as GPI (address 0x19).

5.5. LED

Sirius Quantum and Sirius RadlOn have 3 LEDs:

- Red LED: connected to the Port B5 of the microcontroller.
- Yellow LED: connected to the Port B6 of the microcontroller.
- Green LED: connected to the Port B7 of the microcontroller.



By default, LEDs are configured as detailed below:

- Red LED fast blinking: the device is looking for a ZigBee™ network to join.

- When the device is connected to the ZigBee™ network all LED are turned off and they will behave the next way:
 - Yellow LED on: the device starts to send data over the air.
 - Yellow LED off: the device has sent the data correctly over the air.
 - Red LED on: the device has received data over the air.
 - Red LED off: the received data has been analyzed.

5.6. Accelerometer

Sirius Quantum devices have a 3D-Axis accelerometer based on the Freescale MMA8452Q². The accelerometer is directly connected to the microcontroller using the I²C interface.

The MMA8452Q has two external programmable interrupts for detecting motion events:

- Accelerometer Interruption 1 ⇒ IRQ4
- Accelerometer Interruption 2 ⇒ IRQ5

6. Radio

Sirius Quantum and Sirius RadlOn devices have a transceiver that implements the IEEE 802.15.4/ZigBee™ standard. The transmission power can be configured by software through the n-Core API.

Types of antenna:

- Integrated ceramic antenna.
- U.FL antenna.

Transceiver:

- AT86RF231 + amplifier (up to +22dBm).

7. Firmware updates

In order to update the device's firmware in a safe way, please, download the n-Core update package and follow instructions of use carefully. The update package can be downloaded from the support section on the www.n-core.info Web page.

IMPORTANT NOTE: During the firmware update, it is necessary to ensure the power supply in order to prevent any damage or data loss. See section 4 of this manual.

² http://www.freescale.com/files/sensors/doc/data_sheet/MMA8452Q.pdf

8. Recommendations of use and security

Please, follow the next indications in order to obtain the maximum performance and to use *Sirius Quantum* and *Sirius RadIOn* devices in a safe way:

- Avoid placing metallic objects near the device as far as possible.
- Architectonic elements, such as metallic walls, doors, railings, pipes, concrete walls, among many others, can affect signal quality and, therefore, the maximum distance of communication between devices.
- Do not wet the device.
- Do not store or make use of the device in atmospheres with a high humidity rate (70% as maximum).
- Do not expose the device to heat sources or directly to the sun.
- Avoid short-circuiting connections.
- Do not use cables longer than 3 meters.
- Pay special attention to relay output connections, because it could cause a short circuit in the device to be controlled.
- Do not apply to the device voltages and currents out of maximum and minimum rates recommended in this manual (both in power supply and input/output ports, as well as communication buses).
- Use an appropriate external power supply. The product must only work with the type of power supply indicated in this manual. If you are not sure about the type of the required power supply, please consult the manufacturer.
- Avoid manipulating any element of the device not described in this manual, because the warranty could be invalidated and the equipment could be damaged permanently.
- Do not use this product in gas stations, fuel tanks, chemical plants or places where demolition operations are being carried out or near potentially explosive atmospheres, such as re-fuelling areas, fuel tanks, under boat decks, chemical plants, facilities of transference or storage of fuel or chemical agents and areas where the air contains chemistries or particles, such as grain, metallic dust or dust. Please, consult the pertinent preventive measures before using this device in these kinds of zones.
- The use of accessories unapproved by the manufacturer could damage the equipment, break local laws and invalidate the warranty.
- This product works in approved bands for the use in presence of medical, industrial and scientific equipment (ISM band), however, in case of doubt avoid the use of the device until being completely sure of the absence of risk derived from its use in the presence of this type of equipment.
- Use only the antenna that is delivered with the device. The use of modified or unauthorized antennas can reduce the quality of the communication and damage the equipment, besides break local regulations of your country.

9. Further information

Disclaimer

Nebusens believes that all information is correct and accurate at the time of issue. Nebusens reserves the right to make changes to this product without prior notice. Please visit the Nebusens website (www.nebusens.com) for the latest available version.

Nebusens does not assume any responsibility for the use of the described product or convey any license under its patent rights.

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Technical Support

Technical support is provided by Nebusens, S.L. on demand and in accordance to sale and use conditions agreed. You can check these conditions on the Nebusens website (www.nebusens.com).

We provide you with a support forum (support.nebusens.com) for any question related to the n-Core platform.

Waste and recycling

When the device reaches the end of its life cycle, it will have to be deposited in a point of recycling for electronic equipment. The equipment will not have to be deposited in the points of urban garbage collection. Please, go to a specialized point. Your distributor will indicate the most appropriate way to proceed with the recycle of the device.





www.n-core.info