

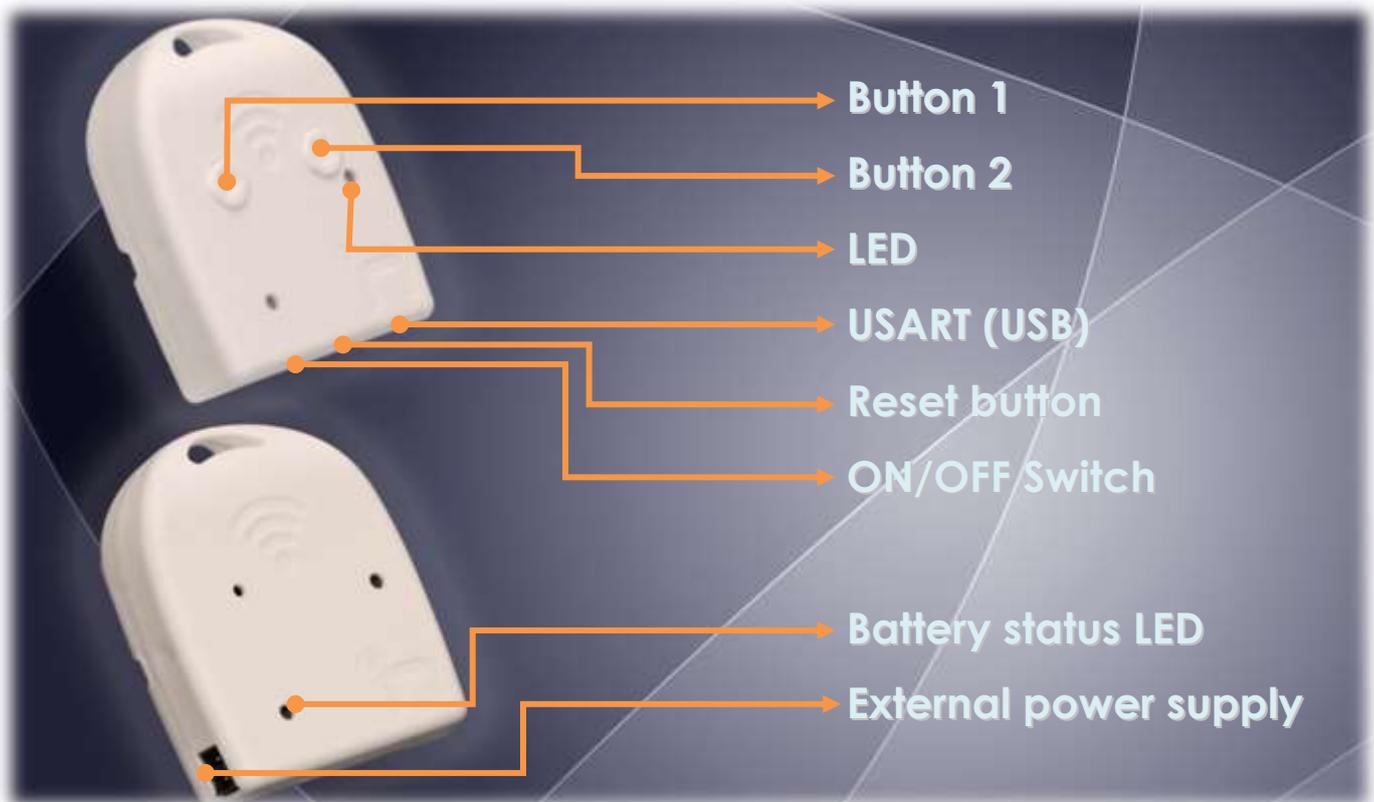
n-Core[®]

n-Core[®] Sirius B/D Device User Manual

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1. Introduction



Sirius B and *Sirius D* are radio-frequency devices that offer a total solution for deploying wireless networks based on the IEEE 802.15.4/ZigBee international standard in a fast and easy way.

Their slim design provides an extraordinary versatility to suit a wide range of applications. They offer several communication ports and I/O interfaces that allow integrating a great number of external devices, such as sensors, actuators or even computers, among many others.

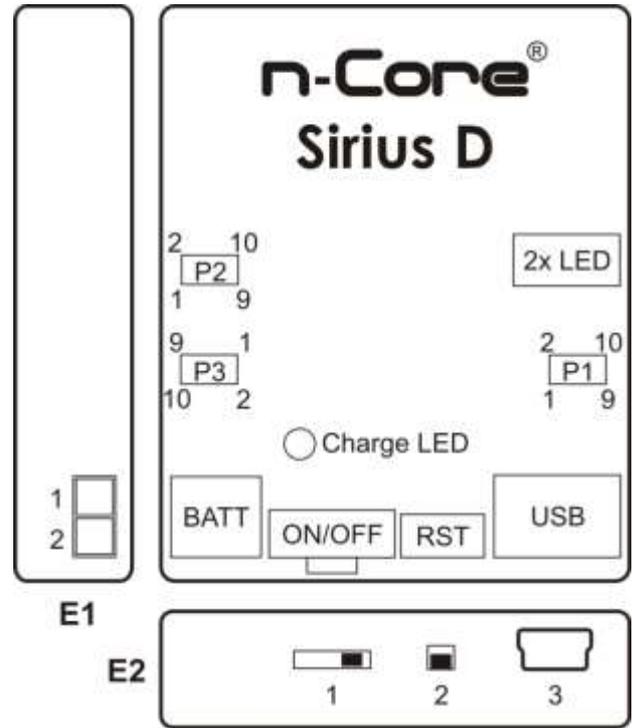
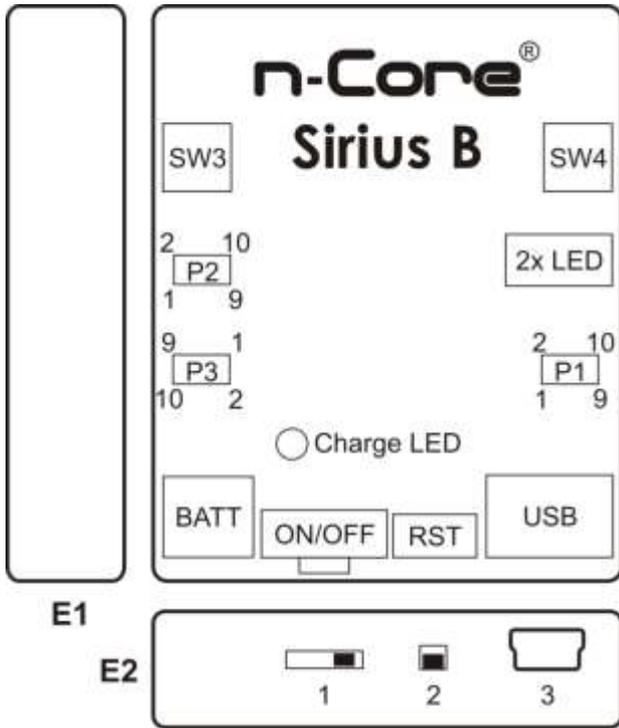
Sirius B and *Sirius D* devices are part of the n-Core® platform, developed by Nebusens. n-Core® offers a complete set of hardware and software tools that can fit all your necessities when developing and deploying wireless networks based on the IEEE 802.15.4/ZigBee international standard.

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

2. General Characteristics

Electrical characteristics	
Batteries power supply	3.7V
External power supply (<i>Sirius D</i> only)	3.7V
Mini-USB power supply	5V
Power switch	ON/OFF
Physical characteristics	
Dimensions	65 x 53 x 23 mm
Micro-controller	
Model	ATMEGA1281V
Frequency	8MHz
Flash	128KB
RAM	8KB
EEPROM	4KB
External EEPROM	256KB (AT25F2048)
Radio	
900MHz	
Transceiver	AT86RF212
Frequency bands	868 to 868.6MHz (Europe) 902 to 928MHz (USA)
Number of channels	1 (Europe), 10 (USA)
Channel spacing (USA)	2 MHz
Maximum power transmission (software-controlled)	Up to +5dBm
Sensitivity	-110dBm
Data transmission rate	20 – 100Kbps (Europe) 40 – 250Kbps (USA)
2.4GHz	
Transceiver	AT86RF231
Frequency band	2405 to 2480MHz
Number of channels	16
Channel spacing	5MHz
Maximum power transmission (software-controlled)	+15dBm
Sensitivity	-101dBm
Data transmission rate	250Kbps
Connectivity	
UART through USB	Virtual Com Port
SPI	10-pin connector
I ² C Master (pull-up)	
Programming port	Mini-JTAG
General purpose I/O (x8)	TTL compatible; 0 – 3.5V, 50mA
Buttons (x2) (<i>Sirius B</i> only)	Connected to IRQs
LEDs (x2)	Red/Green

3. Pinout



Block P1 (JTAG)	
1	TCK
2	GND
3	TDO
4	VCC_OUT
5	TMS
6	RESET
7	N/C
8	N/C
9	TDI
10	GND

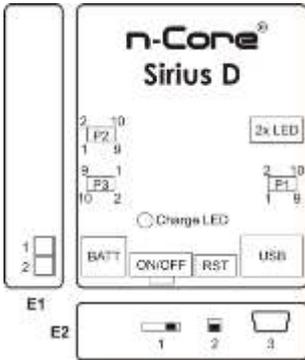
Block P2	
1	I2C_SCL
2	SPI_SCLK
3	I2C_SDA
4	SPI_MOSI
5	USART0_EXTCLK
6	SPI_MISO
7	USART0_TXD
8	USART0_RXD
9	N/C
10	GND

Block P3	
1	GPIO_6
2	GPIO_2
3	GPIO_7
4	GPIO_13
5	IRQ_6 (SW3)
6	GPIO_14
7	IRQ_7 (SW4)
8	GPIO_15
9	GND
10	GND

Block E1 (Sirius D)	
1	GND
2	VCC_IN

Block E2	
1	ON/OFF
2	RESET
3	USB

4. Power supply



Sirius B and Sirius D devices have the following power supply alternatives:

- Internal Li-Po battery 3.7V 1300mAh.
- Type B-Mini USB connector. Block E2, pin 3: 5V DC.
- 2-pin connector (Sirius D only). Block E1 (pins 1 and 2: 5V DC).

These options can work together as described next.

4.1. Battery

Sirius B and Sirius D devices have an internal Li-Po 1300mAh battery (only on devices purchased after Jan. 1, 2013) which can be recharged through the USB port (Block E2). The battery has an internal controller that protects its performance and therefore the device can be powered continuously.

There is a *Charge LED* that indicates the charge status of battery:

- On: Battery Charging
- Off: Battery Charged

Power supply through the USB port must meet the following characteristics:

	USB Port	Connector E1
Input Voltage	5V	3.7V a 4.2V
Input Current	500mA	500mA

IMPORTANT NOTE: External connector placed on Block E1 is connected directly to the battery, so no current will pass through the load control circuit. The user is responsible for controlling the battery charging from the outside.

4.2. External power supply

Sirius B and Sirius D devices have a USB port (Block E2) which can power the device while establishing data communication with the devices.

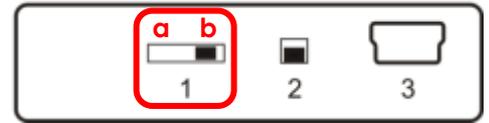
The Sirius D device has an external connector (Block E1) which allows powering the device without using the USB port. It is not recommended to power the device via the E1 connector when also using an internal battery.

	USB Port	E1 Connector
Input Voltage	5V	3.7V a 4.2V
Input Current	500mA	500mA

4.3. Switch On/Off

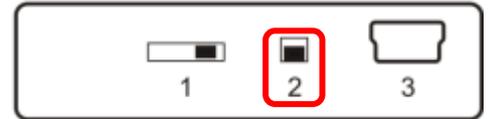
The On/Off switch (Block E2) allows eliminating completely the power supply of the device.

- a) Device On
- b) Device Off



4.4. Reset

The reset button (Block E2) reinitiates the routines programmed in the device, without affecting the data stored in EEPROM.



5. Input and output interfaces

Sirius B and Sirius D devices have the following input and output interfaces:

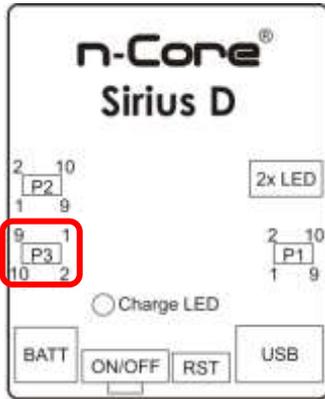
- 8 digital input/outputs (GPIO)
 - 2 GPI configurable by software as IRQs and accessible through external buttons (Sirius B only).
- 1 Analog-to-Digital Converter (ADC) as battery monitor.
- 2 LED (green and red)
- 1 I²C bus (internal pull-up)
- 1 SPI bus
- 2 USART
 - USART0 accessible internally
 - USART1 accessible through the USB port (Virtual Com Port)

Electrical characteristics: TA = -40°C to 85°C, VCC = 1.8V to 3.7V (unless other values have been specified)

Symbol	Parameter	Conditions	Min.	Max.	Units
VIL	Input Low Voltage	VCC = 2.4V - 5.5V	-0.5	0.3VCC	V
VIH	Input High Voltage	VCC = 2.4V - 5.5V	0.6VCC	VCC + 0.5	V
VOL	Output Low Voltage	IOL = 10 mA, VCC = 3V		0.6	V
VOH	Output High Voltage	IOH = -10 mA, VCC = 3V	2.3		V
IIL	Input Leakage Current I/O Pin	VCC = 5.5V, pin low (absolute value)		1	µA
IIH	Input Leakage Current I/O Pin	Input Leakage Current I/O Pin		1	µA
RPU	I/O Pin Pull-up Resistor		20	50	kΩ

Next it is described each input/output interface of Sirius B and Sirius D devices.

5.1. GPIO



There are 8 digital inputs and outputs (Block P3) connected directly to the ATmega1281V[®] microcontroller.

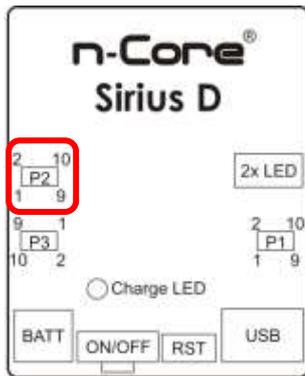
IRQ_7 and IRQ_6 can be configured as external interruptions (IRQs).

In the *Sirius B* device, the IRQ_6 and IRQ_7 pins are connected to the SW3 and SW4 external switches, respectively. The n-Core[®] API automatically activates the pull-up on each IRQ.

It is possible to enable independently the microcontroller internal *pull-up* on each port configured as an input (GPI) using the n-Core[®] API. Enabling the internal *pull-up* allows you to connect directly switching devices, for example, micro switch, magnetic switch, etc...

Bloque P3			
1	GPIO_6	6	GPIO_14
2	GPIO_2	7	IRQ_7 (SW4)
3	GPIO_7	8	GPIO_15
4	GPIO_13	9	GND
5	IRQ_6 (SW3)	10	GND

5.2. Serial communications



Serial communications (Block P2) are accessible from inside the device and distributed as shown in the following table:

All serial communication ports described next are directly connected to their respective pins of the ATmega1281V[®] microcontroller, unless otherwise indicated.

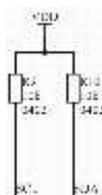
For detailed information about the electrical characteristics, please refer to the technical data sheet¹ of the ATmega1281V[®] microcontroller.

Block P2			
1	I2C_SCL	6	SPI_MISO
2	SPI_SCLK	7	USART0_TXD
3	I2C_SDA	8	USART0_RXD
4	SPI_MOSI	9	N/C
5	USART0_EXTCLK	10	GND

5.2.1. I2C

The I²C bus is accessible from the P2 block (pins 1 and 3). The electrical and protocol characteristics of I²C bus are determined by the specifications of the ATmega1281V^{®2} microcontroller.

I2C_SDA (block P2 pin 3) and I2C_SCL (block P2 pin 1) lines have an internal *pull-up* as is shown below:



IMPORTANT NOTE: In order to use the I²C bus is necessary that reference pins (GND), of both the Sirius device (block P2, pin 10) and the input device (for example, a sensor) are connected to each other.

5.2.2. SPI

The SPI bus is accessible from the block P2 (pins 2, 4 and 6). The electrical and protocol characteristics of SPI bus are associated to the specifications of the ATmega1281V^{®3} microcontroller.

2	SPI_SCLK
4	SPI_MOSI
6	SPI_MISO

¹ http://www.atmel.com/dyn/resources/prod_documents/doc2549.pdf

² http://www.atmel.com/dyn/resources/prod_documents/doc2549.pdf (Section 12.3.4 Alternate Functions of Port D, p. 83; section 30. Electrical Characteristics, p. 367).

³ http://www.atmel.com/dyn/resources/prod_documents/doc2549.pdf (Section 13.3.2 Alternate Functions of Port B, p. 79).

5.2.3. USART0

The USART0 is accessible from the block P2. The available communication lines are:

5	USART0_EXTCLK
7	USART0_TXD
8	USART0_RXD

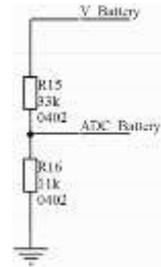
IMPORTANT NOTE: In order to use the USART0 is mandatory that the reference pins (GND) of both the Sirius device (block P2, pin 10) and the input device (for example, a sensor) are connected to each other.

5.3. ADC – Battery

Sirius B and Sirius D devices have an ADC that monitors the internal battery voltage. The reference voltage for the microcontroller is 1.1V. The input voltage range is from 0V to 3.75V.

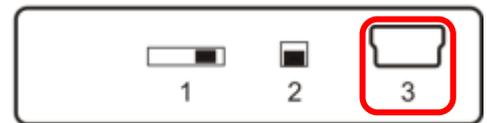
The voltage of the battery is adapted through a voltage divider (see the schema) before being read by the ADC_Battery analog-to-digital converter.

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. USB

Sirius B and Sirius D devices have a USART port (Block E2), which can be used to communicate the Sirius device with other devices with serial communication capabilities, such as a PC.



In addition, the USART can be used to update the firmware of the Sirius device, as described in Section 7 - Firmware Updates of this manual.

The USART1 of the ATmega1281V® microcontroller is connected to the USB port through the Silabs CP21034 USB-to-UART Bridge Controller.

This port is recognized by the Operating System (e.g., Windows®) as a Virtual Com Port⁵ and allows powering the Sirius device and establishing the communication with it at the same time.

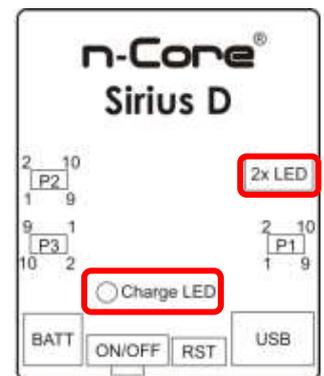
5.5. LED

Sirius B and Sirius D have 3 LEDs.

- Green LED: connected to the GPIO_8 of the microcontroller.
- Red LED: connected to the GPIO_1 of the microcontroller.
- Orange LED (Charge LED): Indicates the charging status of the battery.

By default, LEDs are configured as detailed below:

- Red LED fast blinking: the device is looking for a ZigBee™ network to join.
- Red LED sporadic blinking: the device is sending a Node Alive⁶ and indicates that the device is joined to a ZigBee™ network.
- Green LED fixed on⁷: the device is connected to a ZigBee™ network.
- If locating functions of n-Core® are used both LED are turned off and their behavior will be different according to the type of device:
 - Router: both LED blink at the same time when the table of Tags⁶ is sent by the device.
 - Tag: green LED blinks when a broadcast frame is sent by the device.



⁴ <http://www.silabs.com/support/pages/support.aspx?ProductFamily=USB%20to%20UART>

⁵ <http://www.silabs.com/products/mcu/Pages/USBtoUARTBridgeVCPDrivers.aspx>

⁶ For further information, please, consult the n-Core® development API reference at www.nebusens.com

⁷ It is possible that both LED are turned off and the device is still connected to the ZigBee™ network. This could happen because of some routines loaded into the device.

6. Radio

Sirius 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:

- Models SB2400 and SD2400: Internal ceramic antenna.
- Models SB900-1 and SD900-1: Internal ceramic antenna.

Transceiver:

- Model SB2400 and SD2400: AT86RF231 + amplifier (up to +15dbm).
- Models SB900-1 and SD900-1: AT86RF212.

7. Firmware updates

Sirius B/D firmware's updates optimize device performance, fix bugs and, in some cases, add new functionalities.

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 in the <http://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 3 of this manual.

8. Accessories

The following accessories can be used along with Sirius B/D devices.

- **2-pole connector:**
 - Terminal block Weidmüller 3.81 pitch / Camden Electronics 3.81pitch (CTB92HE).
- **External power supplies:**
 - Power supply through DC-IN:
 - 5 VCC@300mA + 2-pole connector
 - Power supply through USB:
 - Compatible with USB (>300mA).
- **USB data cable:**
 - USB-A – Mini USB-B Cable.



9. Recommendations of use and security

Please, follow the next indications in order to obtain the maximum performance and to use *Sirius B/D* device 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.
- 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.

10. 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.

Nebusens warrants performance of its products to the specifications applicable at the time of sale in accordance with the sale and use conditions of n-Core®. You can check these conditions at the Nebusens website (www.nebusens.com).

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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 at 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